GE Energy Services
Digital Energy

Hydran* M2 (DNP) Host With Models

Software Manual

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SAFETY WARNINGS IN SIX LANGUAGES

[EN] (in English) WARNINGS:

- All procedures in this manual must be strictly adhered to.
- Any deviation from these could cause irreversible damages to the transformer being monitored and/or the Hydran M2, and could lead to property damage, personal injury and/or death.
- Installation and maintenance of the Hydran M2 must be carried out by qualified personnel only. Please advise station operator prior to maintenance. Working inside the Hydran M2 may trigger unwanted alarms due to parameter changes, power shutdown, system rebooting or electrostatic discharge.
- For a maximum distance of 15 m (50 ft) from the power source, use a 14-AWG (2.08 mm^2) cable and an overcurrent protection.
- The Hydran M2 is intended for industrial use and shall not be connected to the public low-voltage supply system.

[FR] (in French) ATTENTION :

- Toutes les procédures dans ce manuel doivent être observées rigoureusement.
- Tout écart par rapport à celles-ci pourrait causer des dommages irréversibles au transformateur surveillé et/ou au Hydran M2, et pourrait entraîner des dommages à la propriété, des blessures corporelles et/ou la mort.
- L'installation et l'entretien du Hydran M2 doivent être effectués par du personnel qualifié seulement. Veuillez aviser l'opérateur du poste avant l'entretien. Travailler à l'intérieur du Hydran M2 peut déclencher des alarmes non voulues en raison de changements à des paramètres, d'arrêt de l'alimentation, de remise en marche du système ou de décharge électrostatique.
- Pour une distance maximale de 15 m (50 pi) de la source d'alimentation, utiliser un câble de 14 AWG (2,08 mm^2) et une protection contre les surintensités.
- Le Hydran M2 est destiné à un usage industriel et ne doit pas être branché au système public d'alimentation à basse tension.

[ES] (in Spanish) ADVERTENCIA:

- Se debe cumplir estrictamente con todos los procedimientos señalados en este manual.
- Cualquier desviación al respecto puede causar daños irreparables al transformador que está bajo monitoreo y/o al Hydran M2, asimismo puede ser causa de daños materiales, lesiones corporales y/o muerte.
- La instalación y mantenimiento del equipo Hydran M2 se reserva únicamente al personal perfectamente cualificado. Aconseje por favor a operador de la estación antes del mantenimiento. El trabajo dentro del Hydran M2 puede accionar alarmas indeseadas debido a los cambios del parámetro, parada de la energía, sistema que reanuda o descarga electrostática.
- Para una distancia máxima de 15 m (50 pies) de la fuente de alimentación, utilice un cable de 14-AWG (2,08 mm^2) y una protección contra las sobrecargas de corriente.
- El Hydran M2 se piensa para el uso industrial y no será conectado con el sistema de fuente de baja tensión público.

[DE] (in German) WARNUNG:

- Alle Abläufe in diesem Handbuch müssen strengstens befolgt werden.
- Jede Abweichung davon könnte dem zu überwachenden Transformator und/oder dem Hydran M2 unwiderrufliche Schäden zufügen, und könnte zu Sachschaden, Personenverletzung und/oder Tod führen.
- Installation und Wartung des Hydran M2 dürfen daher nur von qualifiziertem Personal durchgeführt werden. Verständigen Sie bitte den Bediener der Schaltanlage vor der Wartung. Das Arbeiten innerhalb des Hydran M2 kann aufgrund von Parameteränderungen, Spannungsabschaltung, Neubooten des Systems oder elektrostatischer Entladung unerwartete Alarme auslösen.
- Für eine maximale Entfernung von 15 m von der Spannungsquelle, verwenden Sie ein 14 AWG Kabel (2,08 mm^2) und ein Überstromschutz.
- Der Hydran M2 ist für industriellen Einsatz vorgesehen und soll nicht an das öffentliche Niederspannungs-Versorgungssystem angeschlossen werden.

[IT] (in Italian) ATTENZIONE:

- Tutte le procedure del presente manuale dovranno essere eseguite in totale conformità.
- Qualsiasi deviazione dallo stesso manuale potrebbe causare danni irreversibili al trasformatore sotto monitoraggio e/o all' Hydran M2, e potrebbe causare danni alla proprietà, lesioni personali e/o alla morte.
- L'installazione e la manutenzione del Hydran M2 devono essere eseguite solo ed esclusivamente da personale qualificato. Avissare l'operatore della stazione prima di manutenzione. Funzionando all'interno del Hydran M2 può fare scattare degli alarmi indesiderabili e cambiamenti dei parametri, arresto dell'alimentazione, un "reboot" del sistema o scarico elettrostatico.
- A una distanza massima di 15 m dalla fonte di energia usare un cavo 14-AWG (2.08 mm^2) e una protezione di sovracorrente.
- L'intenzione del Hydran M2 è per uso industriale e a non collegare al sistema di bassa tensione pubblico.

[SV] (in Swedish) VARNING:

- Alla procedurer i manualen måste följas noggrant.
- Varje avvikelse från dessa procedurer kan orsaka oåterkalleliga skador på den övervakade transformatorn och/eller på Hydran M2 samt leda till egendomsförlust, personskada och/eller livsfara.
- Installation och underhåll av Hydran M2 måste utföras av behörig personal. Råd var god posterar operatören före underhåll. Funktionsduglig insida Hydran M2 kan starta oönskade parameterändringar för larm tack vare, driver avstängning, systemomstart eller elektrostatisk urladdning.
- För ett maximalt avstånd på 15 m från kraftuttaget, använd 2,08 mm^2 kabel (14-AWG) och ett överströmsskydd.
- Hydran M2 ämnas för industriellt bruk och förbinds inte till det offentliga tillförselsystemet för låg spänning.

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PREFACE

This manual provides installation and operation instructions for the Hydran M2 Host (DNP) software included in the Hydran M2, which is a unique, continuous, on-line monitor of combustible gases and moisture in dielectric oils. See the *Hydran M2 Instruction Manual* for additional information.

The information in this manual may be used by:

- A purchaser/specifier
- An installer
- A maintenance technician
- An engineer/designer
- An operator

WARNING

All procedures in this manual must be strictly adhered to. Any deviation from these could cause irreversible damages to the Hydran M2 and/or the transformer being monitored, and could lead to property damage, personal injury and/or death. Installation and maintenance of the Hydran M2 must be carried out by qualified personnel only.

This manual is not a tutorial on combustible gases or water in dielectric oil. It is assumed that the reader is already familiar with these subjects.

This manual is written for the 0–2,000 ppm operating range only. This range is the one used by most Hydran M2's. Should your Hydran M2('s) use a different operating range, please convert the values (in doubt, contact the General Electric Canada Customer Service; the coordinates can be found at the bottom of page ii).

To help the reader, a Table of Contents and a List of Figures are present at the beginning of the manual, along with a Glossary in Appendix C.

The name of menus, options, parameters, etc. shown on the screen of the Hydran M2 Host (DNP) software are displayed in bold characters; for example: the **Network Survey** window.

The Hydran M2 Host (DNP)'s menus and options can be embedded; to indicate the path to a submenu, an option or a parameter, the symbol ">" is used to separate each step towards this item.

The *Hydran M2 (DNP) Host Software Manual* (this manual), the *Instruction Manual for the Hydran M2 With Models* and the *Hydran M2 Installation Guide* are located in PDF format in the **English/Manuals** folder of the Hydran M2 installation CD. Hard copies of each manual can be purchased from General Electric Canada.

DATES OF REVISIONS

All pages in this manual are labeled “Rev. 6, December 2010” since they all have been modified during this general revision.

Issue dates of this manual are:

Original (Rev. 1) . . . . . August 2006

Revision 2 . . . . . May 2007

Revision 3 . . . . . January 2009

Revision 4 . . . . . August 2009

Revision 5 . . . . . May 2010

Revision 6 . . . . . December 2010

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The preceding paragraphs set forth the exclusive remedies for all claims based on failure of or defect in Products covered by this manual, whether the failure or defect arises before or during the applicable Warranty Period and whether a claim, however instituted, is based on contract, indemnity, warranty, tort (including negligence) or civil liability, strict liability or otherwise. The foregoing warranties are exclusive and are in lieu of all other warranties and guarantees whether written, oral, implied or statutory. NO IMPLIED STATUTORY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY.

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Chapter 1

Software Installation

This Chapter explains how to install the Hydran M2 Host (DNP) software on a stand-alone computer. Network installation is not supported.

*Note: In Microsoft Windows 2000 settings (**Control Panel > Display > Appearance** menu), select the **Windows Standard** under the **Scheme** list in order to get full window's title. Do not load the Hydran M2 Host (DNP) software in the DOS environment. You may install the Hydran M2 Host (DNP) software as many times as needed.*

1.1 SYSTEM REQUIREMENTS

- PC running Microsoft Windows, recommended Pentium* III, 1 GHz, 256 MB of available RAM memory
- Hard disk with 2 GB of free space plus 0.4 MB per Hydran M2 per month
- Display mode resolution (pixels): XGA (1024 x 768), SXGA (1280 x 1024), or UXGA (1600 x 1200)
- Microsoft Windows-compatible printer (optional)
- Microsoft Windows 2000, XP, Vista or Windows 7
- Null-modem serial cable

Note: The Hydran M2 Host (DNP) software has only been tested with the English version of Microsoft Windows.

1.2 SHIPPING LIST

The Hydran M2 Host (DNP) package contains:

- Installation CD that includes the following items:
  - The Hydran M2 Host (DNP) software
  - The latest version of the embedded programs (firmware)
  - The *Hydran M2 (DNP) Host Software Manual* (this manual), the *Instruction Manual for the Hydran M2 With Models* and the *Hydran M2 Installation Guide* in PDF format
- One six-foot RS-232 standard communication cable with DB-9 female connectors at both ends

- One printed *Hydran M2 Installation Guide*

1.3 INSTALLING THE DNP SERVER

This Section explains how to install the DNP Server on a PC running a Microsoft Windows operating system.

The DNP Server is a software component that controls the communication between the Host application and the Hydran M2 network. The DNP Server supports true client server architecture, thus enabling many PC's running the Hydran M2 Host (DNP) application to connect to the PC running the DNP Server application. Therefore, the DNP Server can be installed on a separate PC being a server or on the same PC as the Hydran M2 Host (DNP) application.

Note: You may install the software as many times as needed.

WARNING **Before installing the Hydran M2 Host (DNP) software, please read the License Agreement in Appendix A.**

To install the DNP Server on a Microsoft Windows PC, follow these steps:

1. Close all running applications.

2. Insert the installation CD into the CD-ROM drive.

3. The installation begins automatically and the **Software CD-ROM** box shown in Figure 1-1 on page 1-3 is displayed.

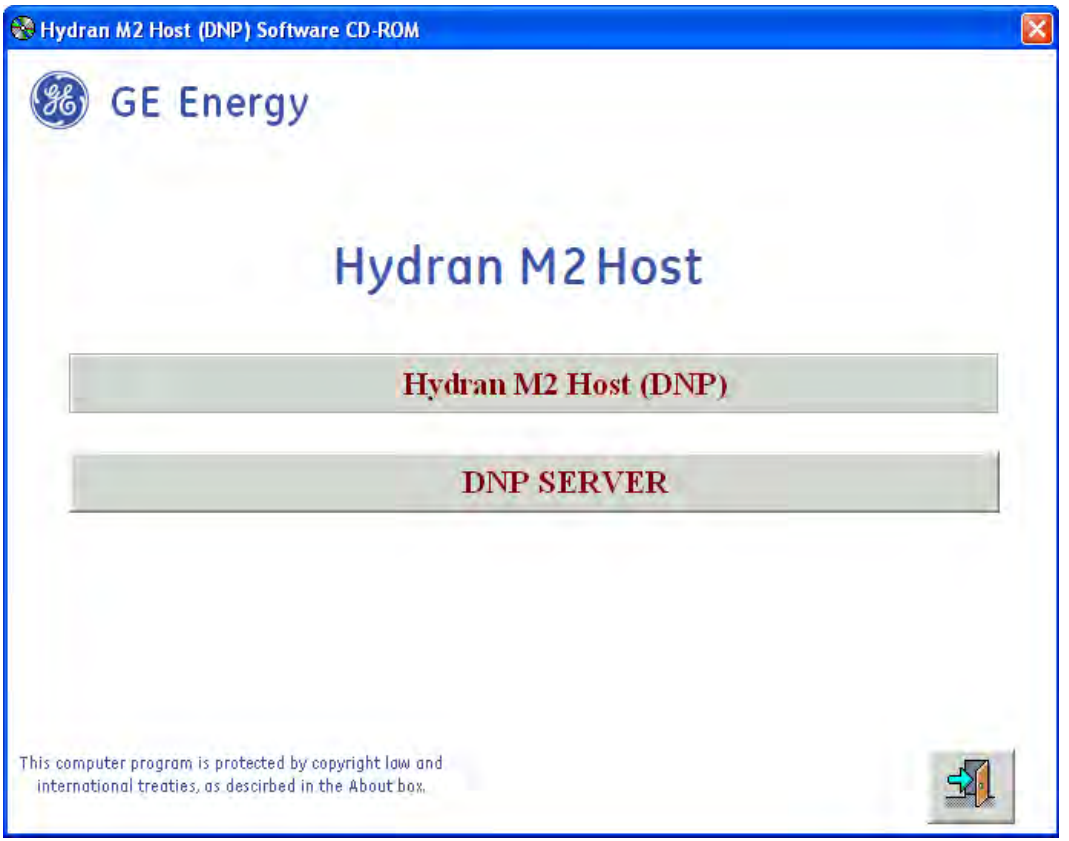

*Figure 1-1 - **Software CD-ROM** Box*

*Note: If this box does not appear, click **Start** and select **Run**. Type **X:\setup.exe** (where **X** is the drive letter associated with the CD-ROM drive) into the text box, and then click **OK**.*

- To quit the installation procedure, click the button shown on the right or the **X** in the top right corner.

4. Click **DNP SERVER**. The DNP Server **InstallShield Wizard** box shown in Figure 1-2 on page 1-4 appears.

*Note: If a check mark [✓] is present to the left of **DNP SERVER V x.x** in Figure 1-1 on page 1-3, it means that the DNP Server is already installed. Proceed directly to Section 1.4 on page 1-10 to install the Hydran M2 Host (DNP) application.*

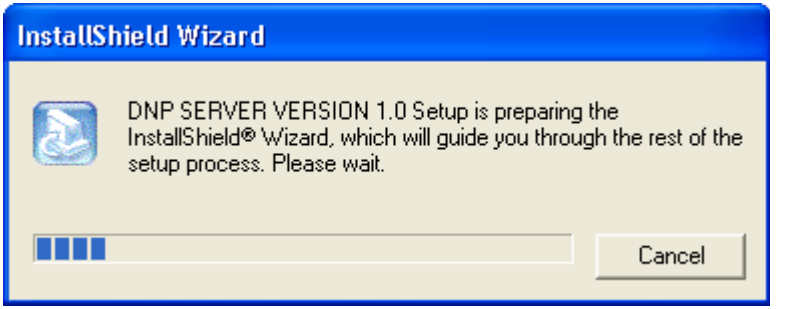

*Figure 1-2 - DNP Server **InstallShield Wizard** Box*

- To quit the installation procedure, click **Cancel**. The **Exit Setup** box shown in Figure 1-3 on page 1-4 is displayed.

*Figure 1-3 - **Exit Setup** Box*

  - To exit the installation procedure, click **Yes**.
  - To continue, click **No**.

5. The DNP Server **Welcome** box shown in Figure 1-4 on page 1-5 appears.

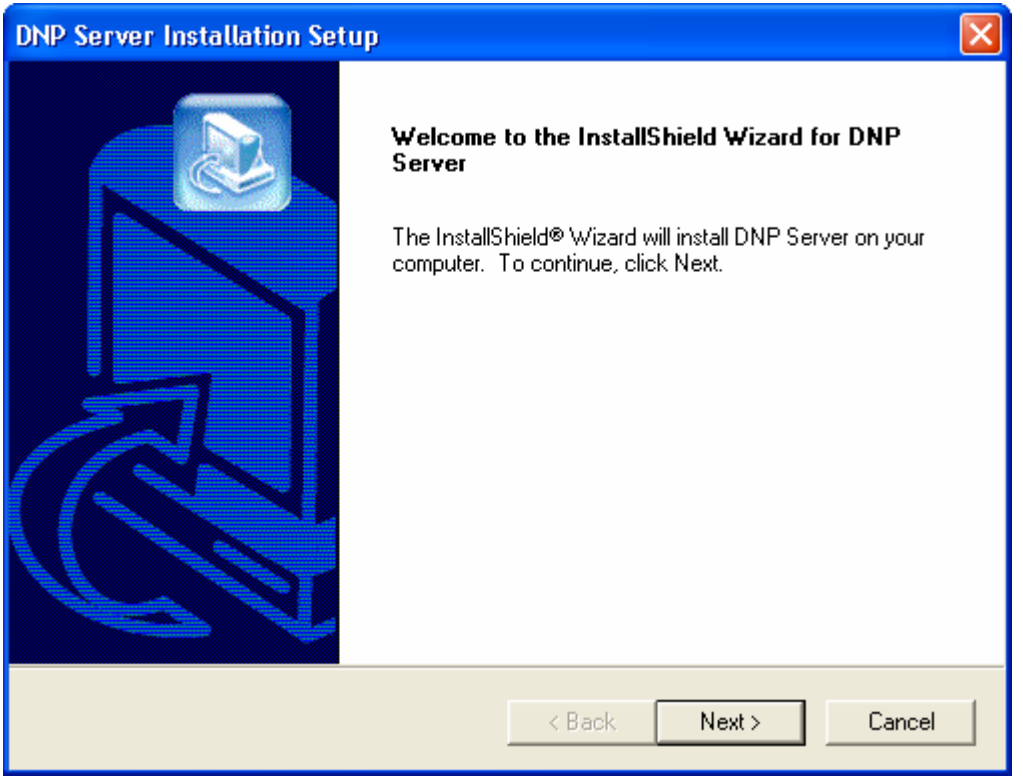

*Figure 1-4 - DNP Server **Welcome** Box*

- To quit the installation procedure, click **Cancel** or the **X** in the top right corner.
- To continue, read the statement and click **Next >**.

6. The DNP Server **Choose Destination Location** box shown in Figure 1-5 on page 1-6 is used to select the destination folder for the DNP Server software files.

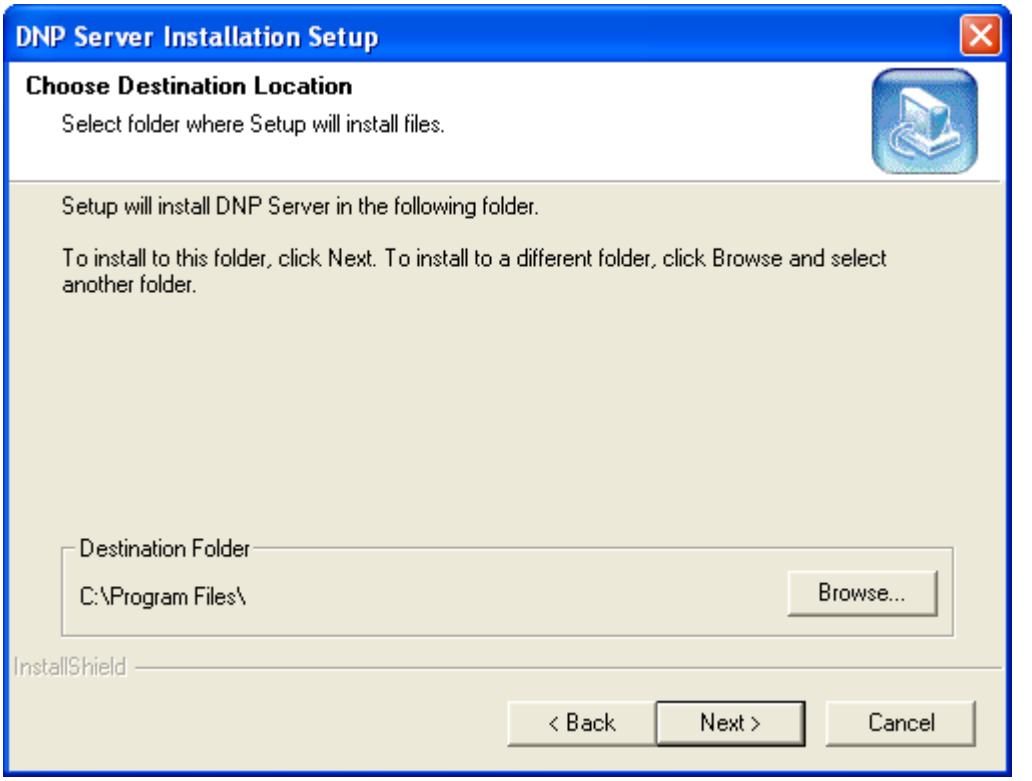

*Figure 1-5 - DNP Server **Choose Destination Location** Box*

- To return to Figure 1-4 on page 1-5, click **< Back**.
- To quit the installation procedure, click **Cancel** or the **X** in the top right corner in Figure 1-5 on page 1-6.
- The default destination folder is **C:\Program Files**.
- To select another folder, click **Browse...**.
- When the desired folder is indicated in the **Destination Folder** area, click **Next >**. The default or selected folder is created if it does not exist.

Note: It is strongly recommended to accept the default directory that you are asked to confirm.

7. The installation program has now collected enough information to start copying the DNP Server software files into the destination folder. The DNP Server **Start Copying Files** box shown in Figure 1-6 on page 1-7 presents the current settings.

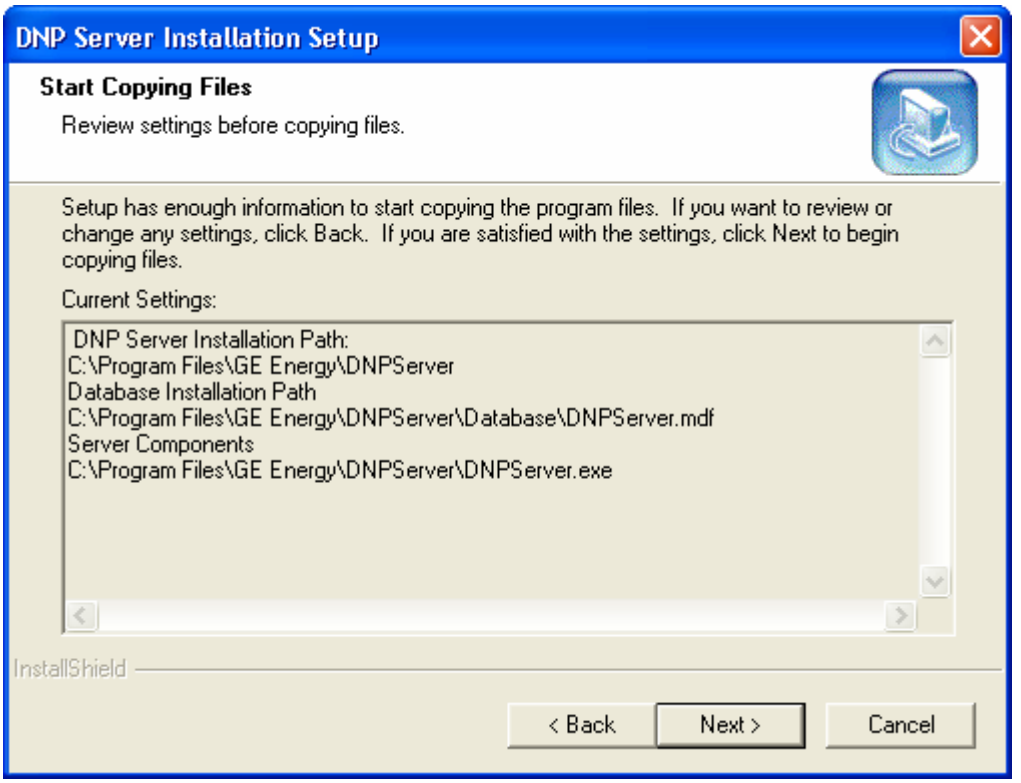

*Figure 1-6 - DNP Server **Start Copying Files** Box*

- To quit the installation procedure, click **Cancel** or the **X** in the top right corner.
- To modify any setting, click **< Back**.
- If you are satisfied with the settings, click **Next >** to begin copying the files into the destination folder.

8. The DNP Server **Setup Status** progress box shown in Figure 1-7 on page 1-8 is displayed.

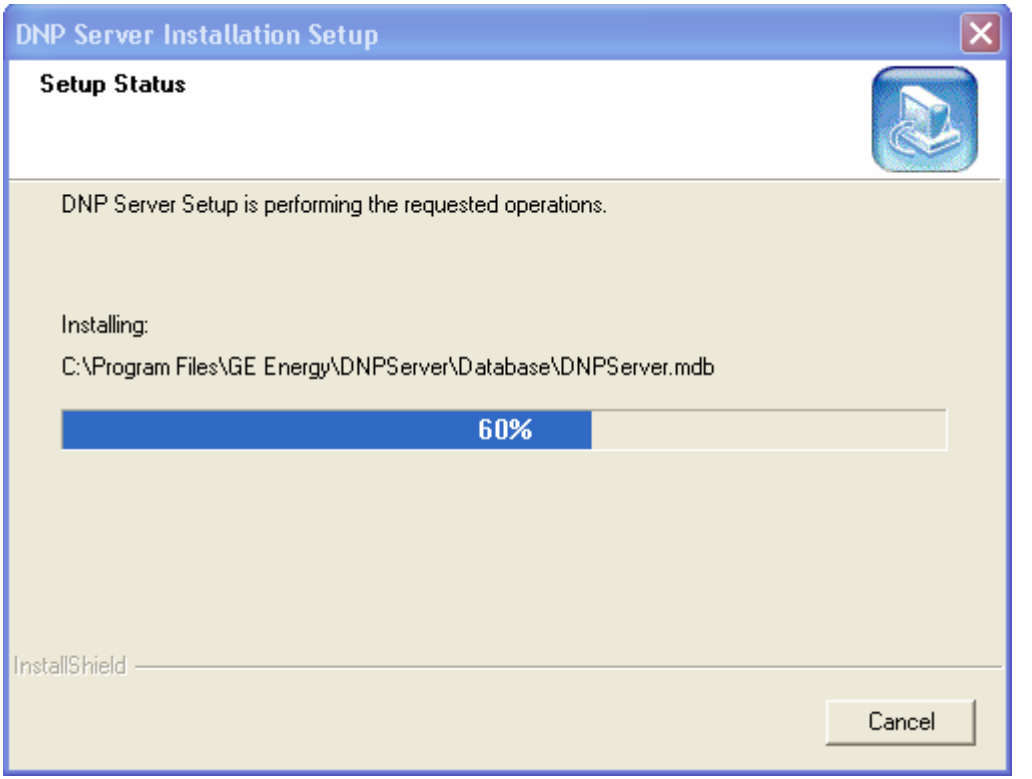

*Figure 1-7 - DNP Server **Setup Status** Progress Box*

- To quit the installation procedure, click **Cancel** or the **X** in the top right corner.

9. After all DNP Server software files have been successfully copied into your computer, the DNP Server **InstallShield Wizard Complete** box shown in Figure 1-8 on page 1-9 appears.

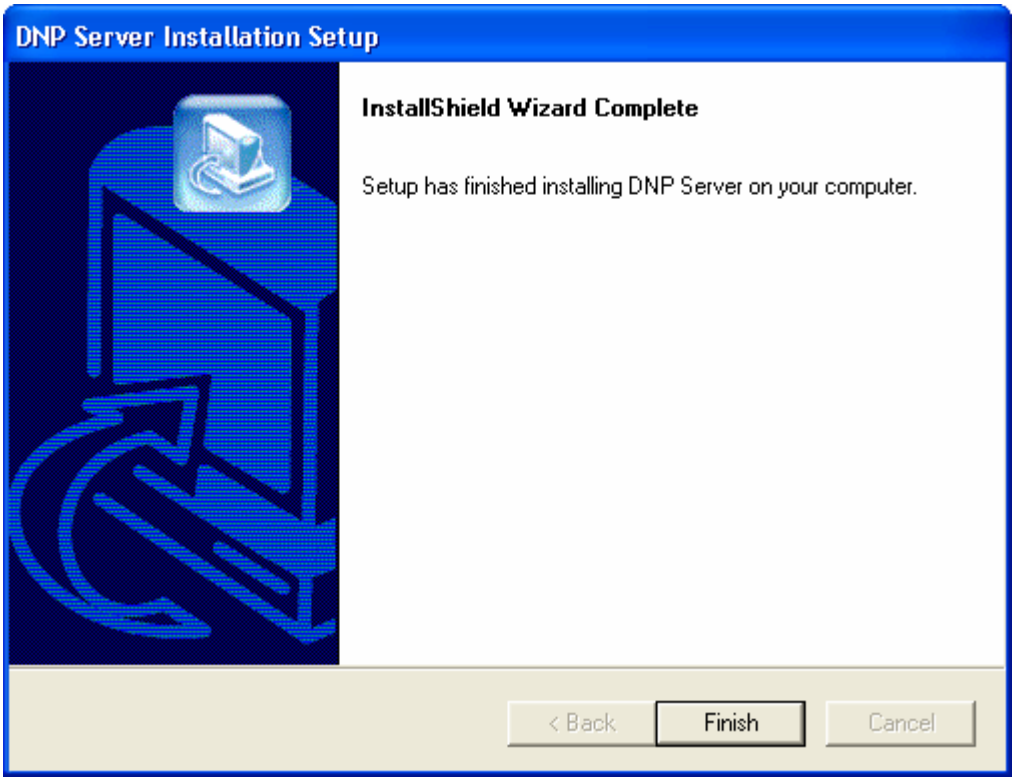

*Figure 1-8 - DNP Server **InstallShield Wizard Complete** Box*

- Click **Finish** >.

1.4 INSTALLING THE HYDRAN M2 HOST (DNP) APPLICATION

Once the DNP Server is installed, the next step consists in installing the Hydran M2 Host (DNP) application.

1. The **Software CD-ROM** box shown in Figure 1-1 on page 1-3 is displayed once more, and a check mark [✓] is present to the left of **DNP SERVER**.

2. Click **Hydran M2 Host (DNP)**. The Hydran M2 Host (DNP) **InstallShield Wizard** box shown in Figure 1-9 on page 1-10 appears.

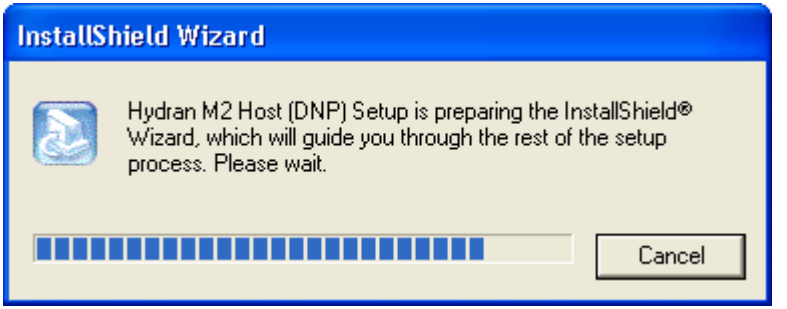

*Figure 1-9 - Hydran M2 Host (DNP) **InstallShield Wizard** Box*

- To quit the installation procedure, click **Cancel**. The **Exit Setup** box shown in Figure 1-3 on page 1-4 is displayed.
  - To exit the installation procedure, click **Yes**.
  - To continue, click **No**.

3. The Hydran M2 Host (DNP) **Welcome** box shown in Figure 1-10 on page 1-11 appears.

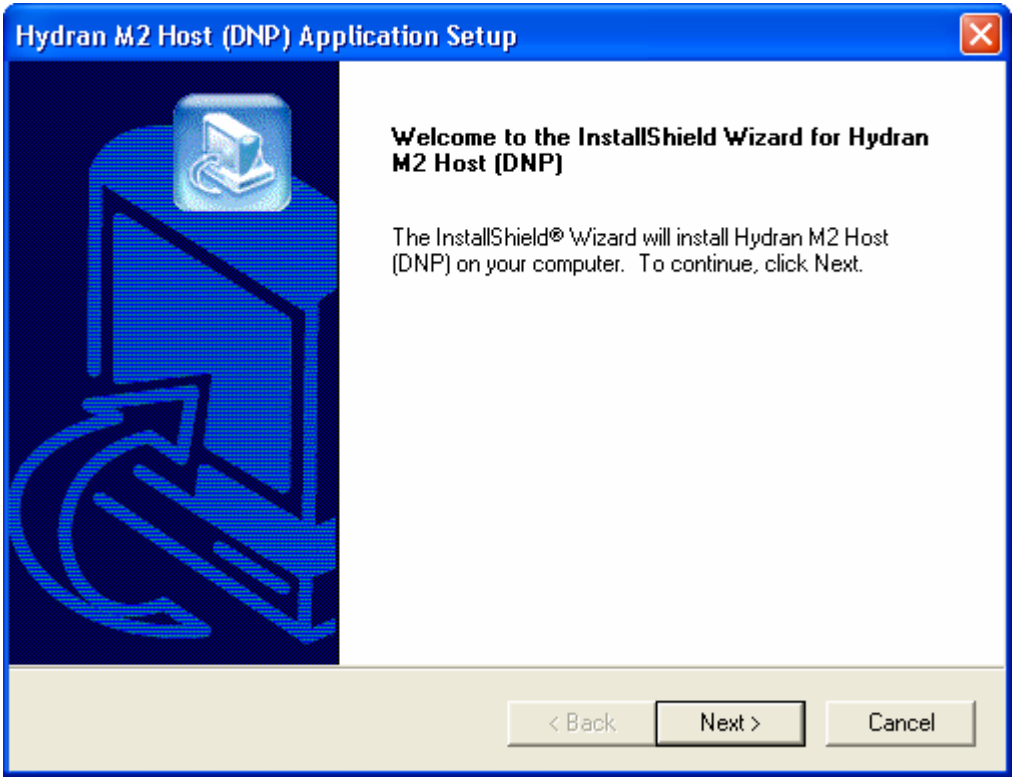

*Figure 1-10 - Hydran M2 Host (DNP) **Welcome** Box*

- To quit the installation procedure, click **Cancel** or the **X** in the top right corner.
- To continue, read the statement and click **Next >**.

4. The Hydran M2 Host (DNP) **Choose Destination Location** box shown in Figure 1-11 on page 1-12 is used to select the destination folder for the Hydran M2 Host (DNP) software files.

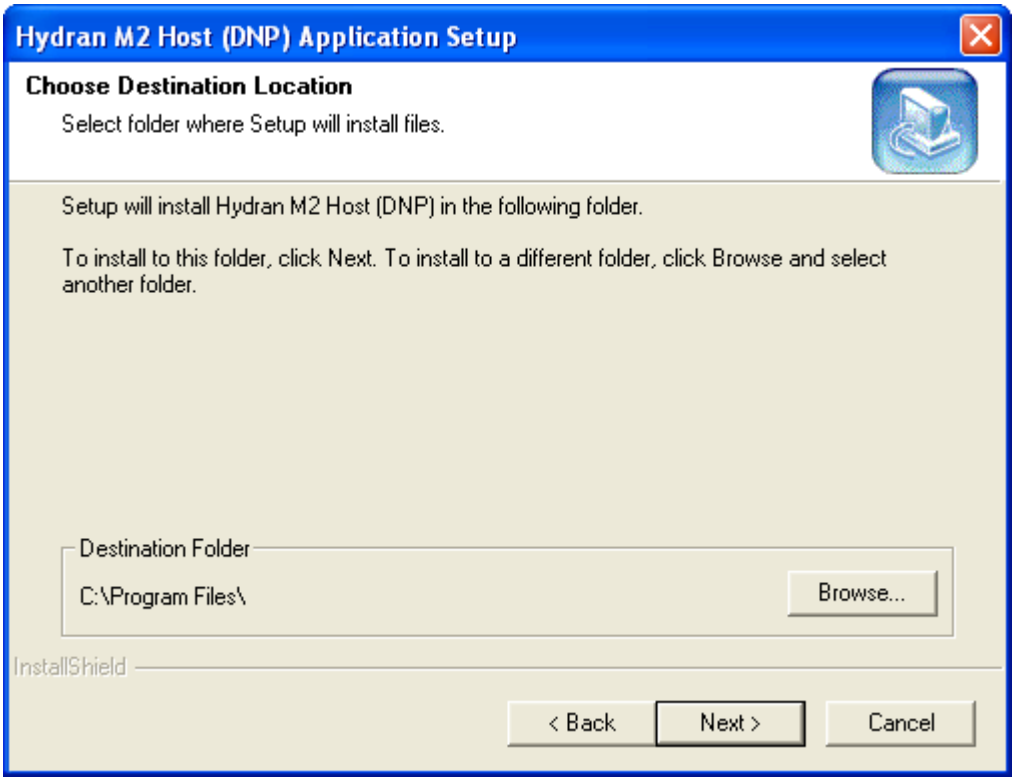

*Figure 1-11 - Hydran M2 Host (DNP) **Choose Destination Location** Box*

- To return to Figure 1-10 on page 1-11, click **< Back**.
- To quit the installation procedure, click **Cancel** in Figure 1-11 on page 1-12.
- The default destination folder is **C:\Program Files**.
- To select another folder, click **Browse...**.
- When the desired folder is indicated in the **Destination Folder** area, click **Next >**. The default or selected folder is created if it does not exist.

Note: It is strongly recommended to accept the default directory that you are asked to confirm.

5. The installation program has now collected enough information to start copying the Hydran M2 Host (DNP) software files into the destination folder. The Hydran M2 Host (DNP) **Start Copying Files** box shown in Figure 1-12 on page 1-13 presents the current settings.

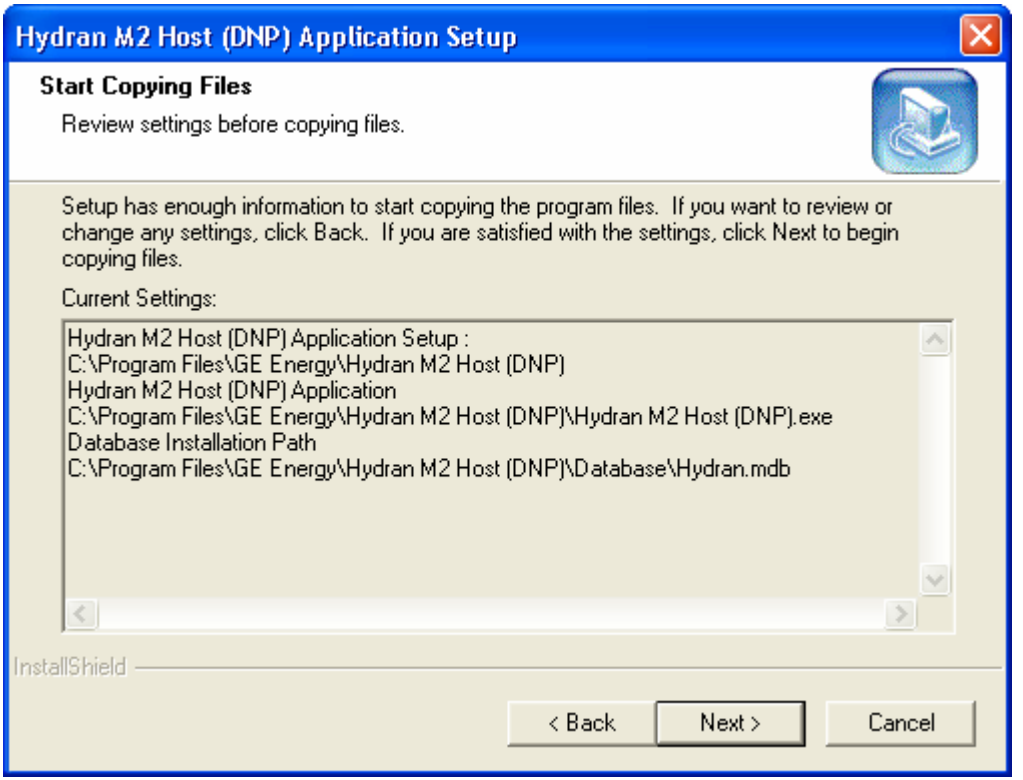

*Figure 1-12 - Hydran M2 Host (DNP) **Start Copying Files** Box*

- To quit the installation procedure, click **Cancel** or the **X** in the top right corner.
- To modify any setting, click **< Back**.
- If you are satisfied with the settings, click **Next >** to begin copying the files into the destination folder.

6. The Hydran M2 Host (DNP) **Setup Status** progress box shown in Figure 1-13 on page 1-14 is displayed.

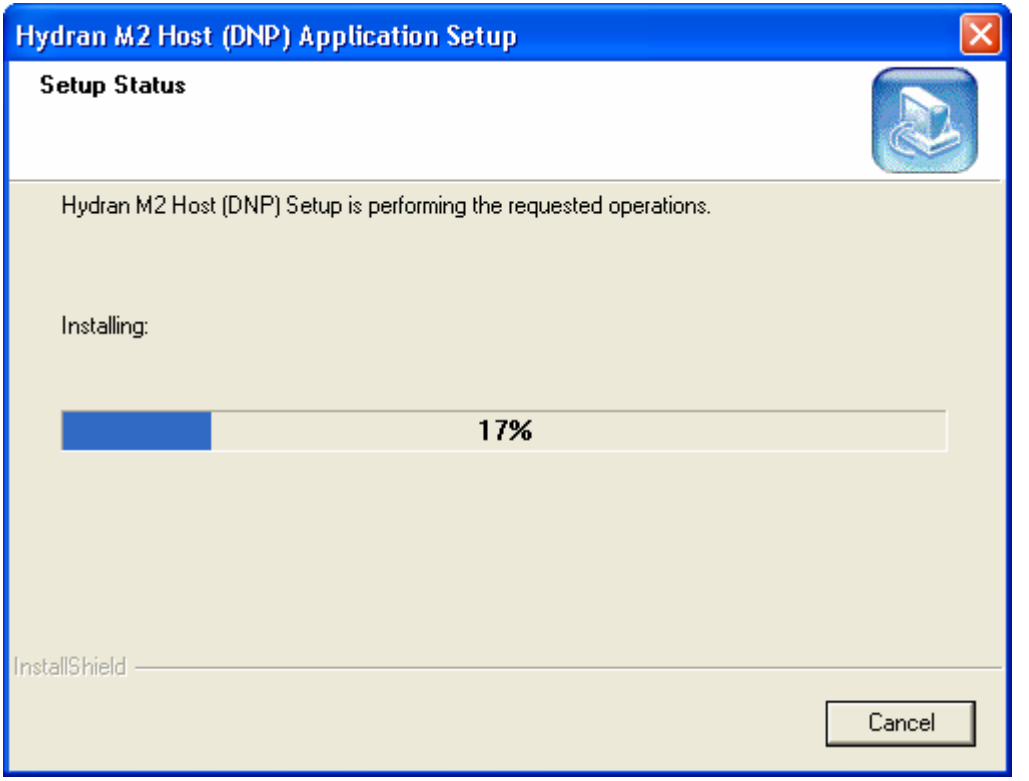

*Figure 1-13 - Hydran M2 Host (DNP) **Setup Status** Progress Box*

- To quit the installation procedure, click **Cancel** or the **X** in the top right corner.

7. After all Hydran M2 Host (DNP) software files have been successfully copied into your computer, the Hydran M2 Host (DNP) **InstallShield Wizard Complete** box shown in Figure 1-14 on page 1-15 appears.

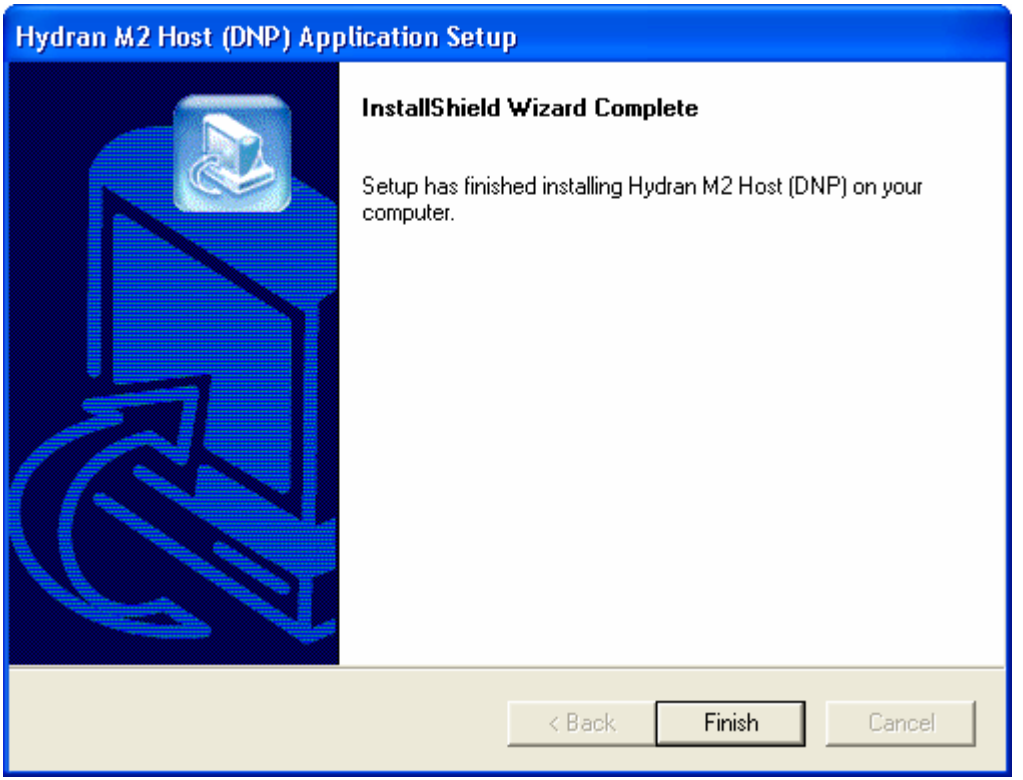

*Figure 1-14 - Hydran M2 Host (DNP) **InstallShield Wizard Complete** Box*

- Click **Finish** >.

The software installation is now completed. Chapter 2 explains how to start up the Hydran M2 Host (DNP) software, how to configure a network of Hydran M2 devices, and then how to select the mode of operation.

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Chapter 2

Managing Device Connections

This Chapter explains how to start up the Hydran M2 Host (DNP) software, how to configure a network of Hydran M2 devices, and then how to select the mode of operation.

2.1 STARTING UP THE HYDRAN M2 HOST (DNP) SOFTWARE

1. To start up the software, click **Start**, bring the cursor on **All Programs** and on **GE Energy** (or the destination folder selected in Figure 1-11 on page 1-12), and then click **Hydran M2 Host (DNP)**. The **Database Upgrade Utility** box shown in Figure 2-1 on page 2-1 is displayed.

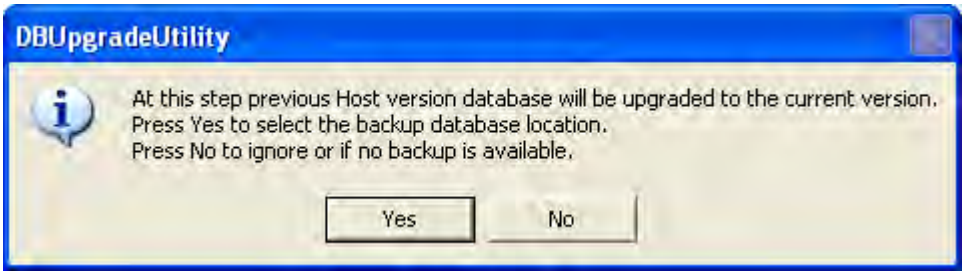


*Figure 2-1 - **Database Upgrade Utility** Box*

- To upgrade the current database with a previously-saved database from another Host version, click **Yes**.
- To continue without upgrading the database, click **No**.

2. If **Yes** has been selected in Figure 2-1 on page 2-1, the box shown in Figure 2-2 on page 2-2 appears.

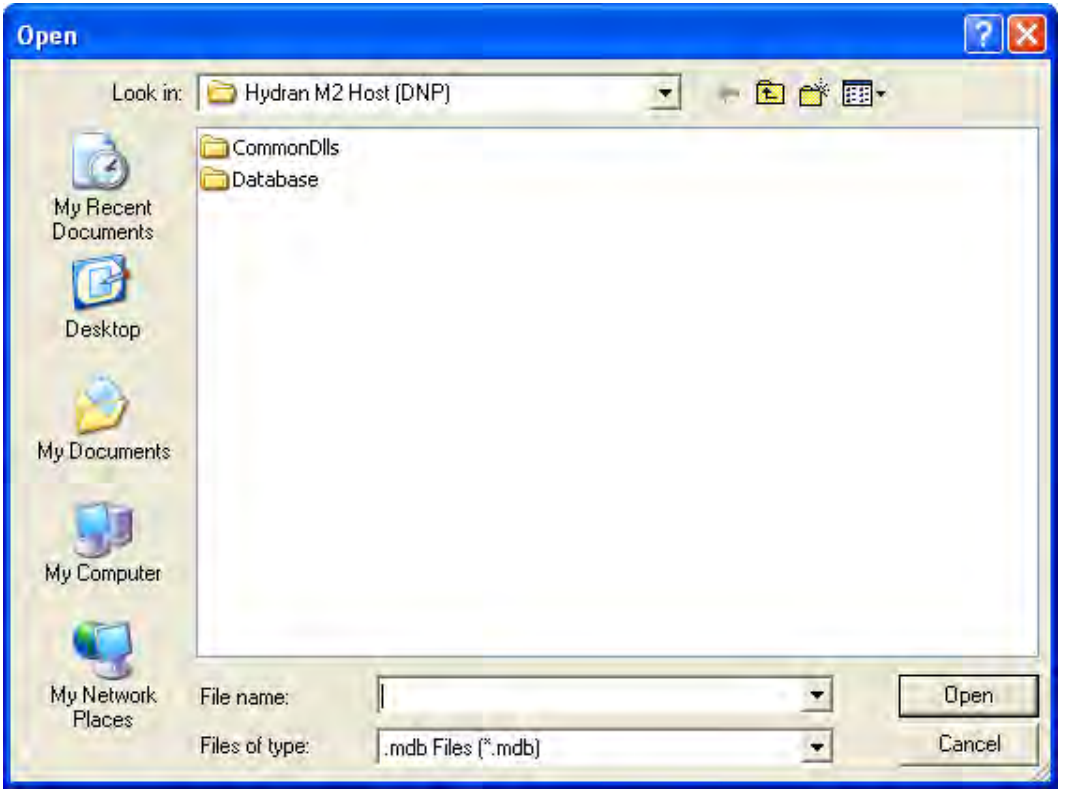


Figure 2-2 - Database Selection Box

- To cancel the operation and continue to start up the Hydran M2 Host (DNP) software, click **Cancel** or the **X** in the top right corner.
- Select a previously-saved version of the database, which must be named **Hydran.mdb**.
- Click **Open**.

3. The **Database Upgrade Utility** progress box shown in Figure 2-3 on page 2-3 appears in the middle of the screen while the database is being upgraded.

*Figure 2-3 - **Database Upgrade Utility** Progress Box*

4. The Splash Screen shown in Figure 2-4 on page 2-3 appears in the middle of the screen while the software is loading.

Figure 2-4 - Splash Screen

2.2 PASSWORDS

Access to the Hydran M2 Host (DNP) software is protected by two passwords:

- Level-1 password: **1253**
- Level-2 password: **1231**

Note: There is also a level-3 password that is restricted to General Electric Canada employees.

Each higher-level password encompasses the functionalities of lower-level passwords. The level-1 password provides access to some windows and commands and is also needed to modify the Hydran M2 configuration. The level-2 password is required for most of the setup commands, such as:

- Clearing and setting history files
- Modifying sensor cell parameters
- Installing a new sensor
- Upgrading a Hydran M2's embedded program
- Changing the station identification number

The **Password** box shown in Figure 2-5 on page 2-4 is displayed when an online connection is established.

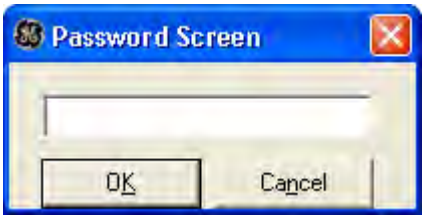


*Figure 2-5 - **Password** Box*

- To cancel the operation and return to the previous window, click **Cancel** or the **X** in the top right corner. In this case, level-0 (read-only) access is granted.
- Enter the level-1 (**1253**) or level-2 (**1231**) password, and click **OK**.

Once a password has been correctly entered, it remains in effect for 30 minutes. During this period, if the Hydran M2 Host (DNP) software is not closed, the password does not need to be entered again when required. After this period, the password is reset to level-0.

If there are settings that appear as read-only, this is because a higher-level password is required. To enter it, select **Security** in the **Options** menu, enter the password in Figure 2-5 on page 2-4, and click **OK**.

2.3 CONFIGURING THE DNP SERVER, THE POWER STATIONS AND THE DEVICES

2.3.1 Hierarchical Structure

The first time the Hydran M2 Host (DNP) software is started, the DNP Server, the Power Stations and the Devices must be configured. The hierarchichal structure of these components is as follows:

- *DNP Server* (Section 2.3.2 on page 2-6): A computer on which the DNP Server software is installed. Every DNP Server contains one or many Power Stations.
- *Power Station* (Section 2.3.3 on page 2-8): A group of Devices connected in a daisy chain. The connections to a Power Station can be either RS-232, Ethernet (via copper wires or fiber optic), or modem.
- *Device* (Section 2.3.4 on page 2-9): A Hydran M2. Every Device has an ID number to identify it when it is in a daisy chain.

The **System Manager** box shown in Figure 2-6 on page 2-6 is used to configure the Hydran M2 networks. It opens automatically when the Hydran M2 Host (DNP) software is started, or when **Change Work Mode** is selected in the **Options** menu.

- The left side displays the Power Stations and Devices in a tree structure.
- To show the Devices contained in a Power Station, click the + on its left.
- To hide the Devices contained in a Power Station, click the - on its left.
- To see (on the right side) the parameters of a Power Station or a Device, select its name on the left side.
- To save the modifications brought to parameters, click **Save**.
- To exit this box, click **Exit** or the **X** in the top right corner.

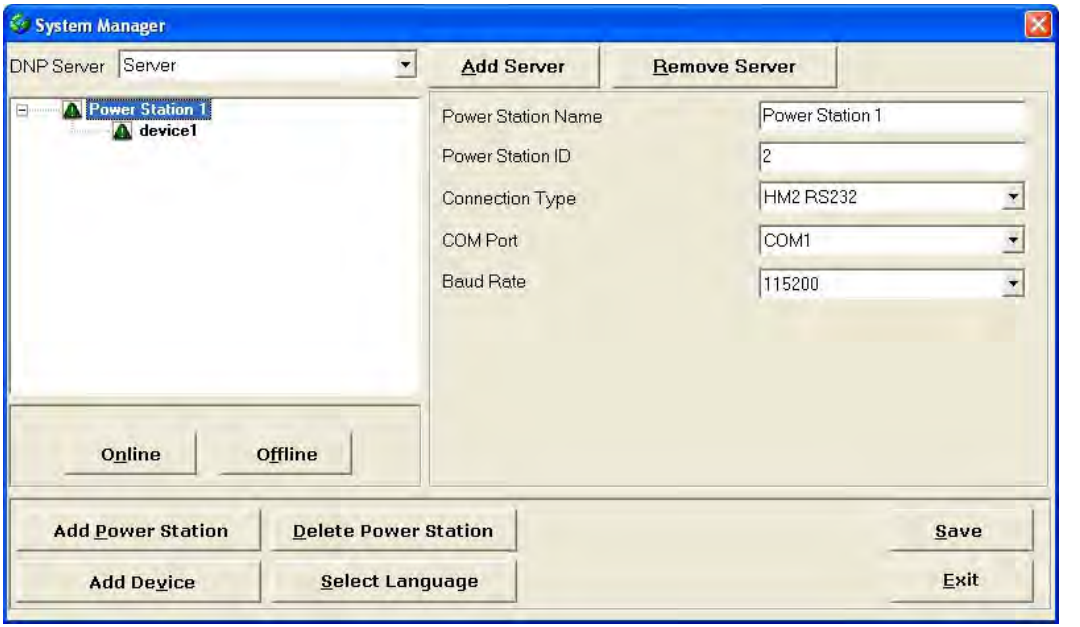


*Figure 2-6 - **System Manager** Box*

2.3.2 Adding a DNP Server

The first time the Hydran M2 Host (DNP) software is started, the **Add DNP Server** box shown in Figure 2-7 on page 2-6 opens automatically. If this is not the first time, then click **Add Server** in Figure 2-6 on page 2-6.

Note: Only one DNP Server can be installed on a single PC.

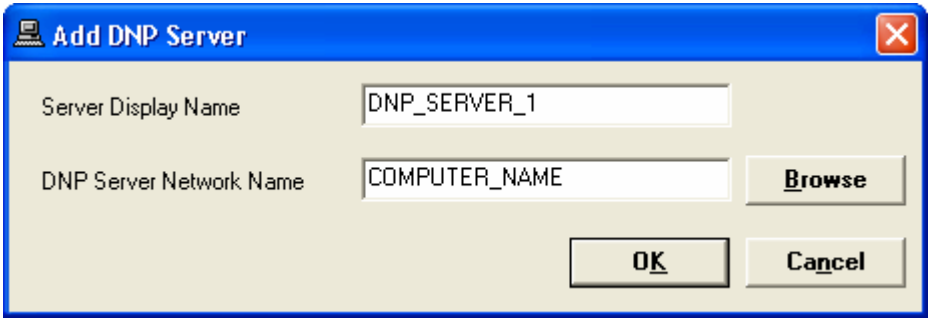


*Figure 2-7 - **Add DNP Server** Box*

- **Cancel**: To cancel the operation.
- **Server Display Name**: The name of the DNP Server.
- **DNP Server Network Name**: The network name of the computer on which the DNP Server is being created.
- **Browse**: To display a list of the computers currently found on the network. The box shown in Figure 2-8 on page 2-7 appears.

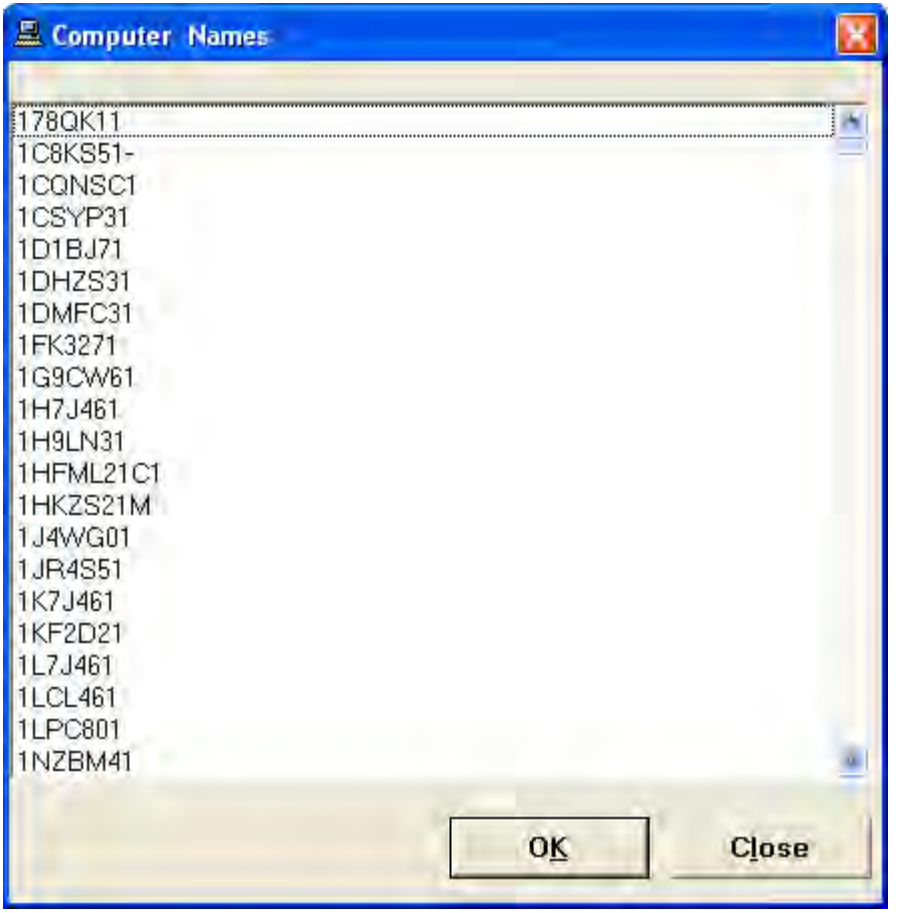


*Figure 2-8 - **Computer Names** Box*

  - **Close**: To cancel the operation.
  - Click the name of the computer on which the DNP Server is installed.
  - Click **OK**.
- **OK** (in Figure 2-7 on page 2-6): To create the DNP Server with the parameters entered.

2.3.3 Adding a Power Station

In Figure 2-6 on page 2-6, click **Add Power Station**. The right side of the **System Manager** box can then be used to configure the Power Station parameters (see Figure 2-9 on page 2-8).

*Figure 2-9 - Adding a Power Station in the **System Manager** Box*

- **Power Station Name**: The name of the Power Station.
- **Power Station ID**: The identification number of the Power Station.
- **Connection Type**: The way the Power Station can be connected. Select between:
  - **HM2 RS-232**
  - **Hydran controller**: A Hydran 201C*i*-C or Hydran 201C*i*-4 Controller
  - **TCP/IP**
  - **MODEM**
- **COM Port**:
  - For RS-232 and Hydran 201C*i* Controller connections: The port to which a Hydran M2 is connected.
  - For modem connections: The port to which the internal or external modem is connected.

- **Baud Rate**: The speed of the connection
  - For RS-232 connections: The same speed must be configured in the Hydran M2.
  - For Hydran 201C*i* Controller connections: The speed must be 19,200 bps or lower.
  - For modem connections: The speed must be 19,200 bps or lower.
  - For Ethernet (via copper wires or fiber optic): The Ethernet card should be configured.
- **TCP/IP Port** (for TCP/IP only): The port used by the Hydran M2's Ethernet card.
- **TCP/IP Address** (for TCP/IP only): The IP address of the Hydran M2's Ethernet card.
- **Modem String** (for modem only): The string sent to the computer's modem in order to initialize the connection. The default settings are **&FX3&M0&D2**, which is valid for most modems.
- **Phone Number**: The number (without hyphens) to dial in order to reach the Device.
- **Save**: To create the Power Station with the parameters entered. The newly created Power Station appears in the tree structure on the left side.
- **Exit**: To exit this box.

2.3.4 Adding a Device

In Figure 2-6 on page 2-6, select on the left side the Power Station to which you want to add a Device, and click **Add Device**. The right side of the **System Manager** box can then be used to configure the Device parameters (see Figure 2-10 on page 2-10).

- **Device Name**: The desired name for the Device.
- **Monitor ID**: The identification number of the Device.
- **Power Station Name**: The name of the Power Station to which the Device is being added.
- **Source DNP3 Address**: The DNP address of the Server. It must be different from the DNP addresses of all the Devices in the Power Station.
- **Device DNP3 Address**: The address of the Device. The same address must be configured in the Hydran M2.
- **Connection Timeout**: The maximum period of time (in seconds) during which the Hydran M2 Host (DNP) software will search for the connection, when connecting to a Device.
- **Request Timeout**: The maximum period of time (in seconds) during which the Hydran M2 Host (DNP) software will wait for a response, if the connection to a Device is lost.
- **Connect On Startup**: If enabled [✓], the Hydran M2 Host (DNP) software attempts to connect to this Device when clicking **Online**.
- **Save**: To create the Device with the parameters entered. The newly created Device appears in the tree structure on the left side.

- **Exit**: To exit this box.

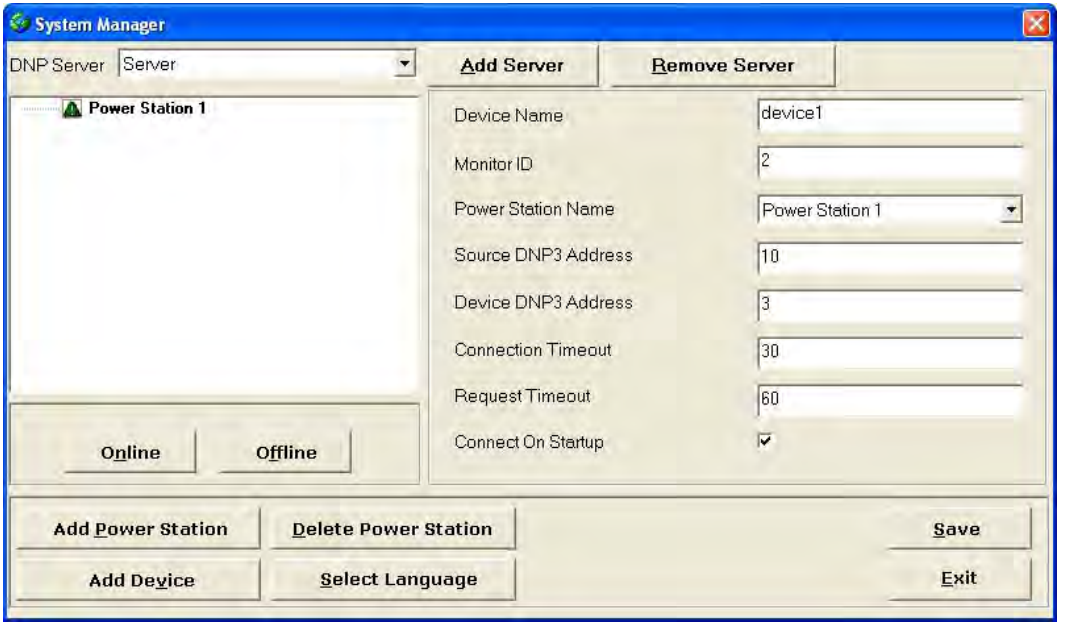


*Figure 2-10 - Adding a Device in the **System Manager** Box*

2.3.5 Deleting a DNP Server, a Power Station or a Device

Proceed as follows in Figure 2-6 on page 2-6:

- *DNP Server*: Select the DNP Server in the drop-down list at the top, and click **Remove Server**.
- *Power Station*: Select the Power Station in the tree structure on the left side, and click **Delete Power Station**.
- *Device*: Select the Device in the tree structure on the left side, and click **Delete Device**.

A confirmation message similar to the one shown in Figure 2-11 on page 2-11 is displayed.

- **No**: To cancel the deletion.
- **Yes**: To delete the DNP Server, Power Station or Device.

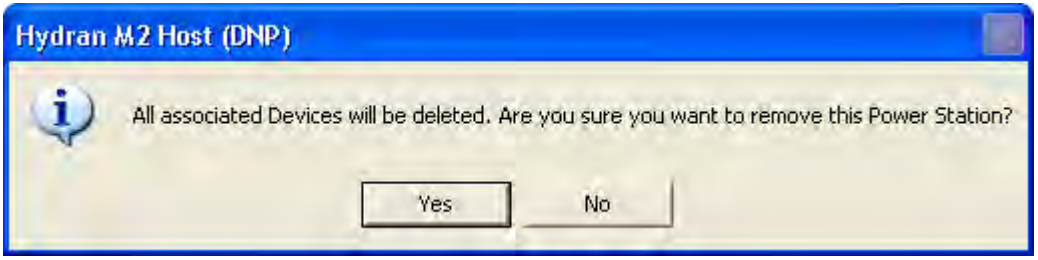


*Figure 2-11 - **Remove Power Station?** Confirmation Box*

2.3.6 Changing the Software Language

The Hydran M2 Host (DNP) software supports two languages: English and Russian. To select the desired language, click **Select Language** in the **System Manager** box (Figure 2-6 on page 2-6). The box shown in Figure 2-12 on page 2-11 appears.

*Figure 2-12 - **Select Language** Box*

- To cancel the operation, click **Cancel**.
- From the drop-down menu, select **English** or **Russian**.
- Click **Ok**.

2.4 CONNECTING TO POWER STATIONS AND DEVICES

2.4.1 Updating the DNP Server

The DNP Server supports true client server architecture, thus enabling many PC's running the Hydran M2 Host (DNP) application to connect to the PC running the DNP Server application.

The **DNP Server Configuration Changed** confirmation box shown in Figure 2-13 on page 2-12 appears if all of the following conditions are met:

- The DNP Server is accessed by a Hydran M2 Host (DNP) software on one PC.
- Changes are made in the **System Manager** box (Figure 2-6 on page 2-6), such as adding or deleting Power Stations or Devices.
- The **System Manager** box (Figure 2-6 on page 2-6) is accessed while connecting to the DNP Server on another PC.

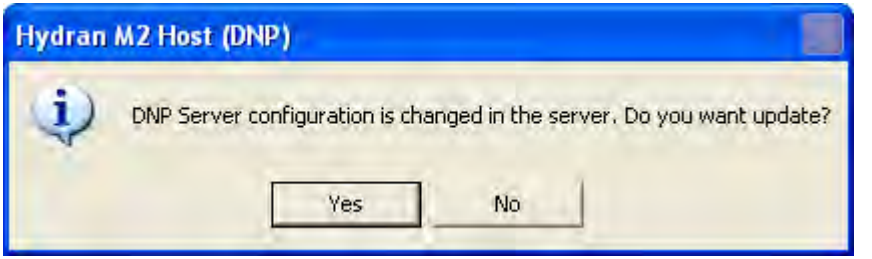


*Figure 2-13 - **DNP Server Configuration Changed** Confirmation Box*

The **DNP Server Configuration Changed** confirmation box informs the user that changes were made to the DNP Server configuration. Updating will allow seeing the changes done by other Hydran M2 Host (DNP) applications connected to the Server.

- **Yes**: To update the DNP Server configuration.
- **No**: To leave the DNP Server as is. This might cause problems if major changes were brought to the DNP Server configuration, since these changes will not be visible.

Note: It is strongly recommended to update the DNP Server configuration every time Figure 2-13 on page 2-12 appears, in order to avoid working with outdated settings.

2.4.2 Changing the Work Mode and Device Connections

Once the Power Stations and Devices have been configured, two modes of operation are available:

- Online (Section 2.4.3 on page 2-14)
- Offline (Section 2.4.4 on page 2-16)

Switching from one online or offline Power Station to another is possible without closing the Hydran M2 Host (DNP) software. In the **Options** menu select **Change Working Mode**, or click the button shown on the right. The **Exit Current Working Mode?** confirmation box shown in Figure 2-14 on page 2-13 is displayed.

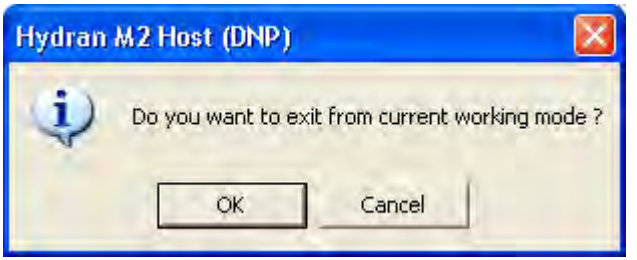


*Figure 2-14 - **Exit Current Working Mode?** Box*

- **Cancel**: To cancel the operation.
- **OK**: To exit the current working mode. The **System Manager** box (Figure 2-6 on page 2-6) then opens.
  - Select a Server in the **DNP Server** drop-down list.
  - Select a Power Station on the left side.
  - Click **Online**.

It is also possible to modify the connection status of individual Devices within the current Power Station. In the **Options** menu, select **Connection**, and the **Device Connect/ Disconnect** box shown in Figure 2-15 on page 2-14 appears.

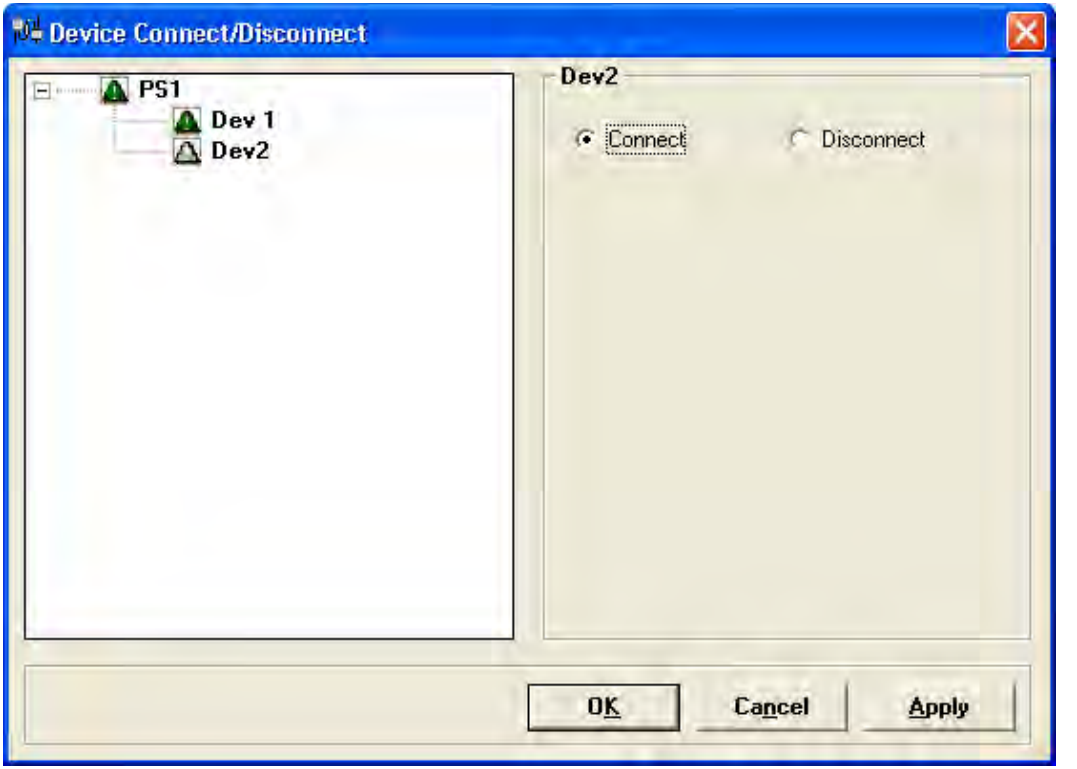


*Figure 2-15 - **Device Connect/Disconnect** Box*

- **Cancel**: To cancel the operation.
- Select a Device on the left side.
- Select either **Connect** or **Disconnect** on the right side.
- **Apply**: To apply the connection status to the selected Device without exiting the box.
- **OK**: To apply the connection status to the selected Device and exit this box.

2.4.3 Online

In each monitoring model, the **Online** mode of operation provides full access to the settings in the Hydran M2 Host (DNP) software. It is used to modify the Hydran M2 configuration. This mode is protected by a password to restrict access (see Section 2.2 on page 2-3).

In the **Online** mode, the Hydran M2 Host (DNP) software can perform all the operations that could be done directly on the Hydran M2's LCD screen, as well as many other functions such as graphing and exporting data.

In this mode, each model reads data directly from the Hydran M2's local Microsoft Access database, using a direct communication link (modem or LAN) between the on-site Hydran M2 and the system operator or supervisor computer running the Client application software. The database is managed by Microsoft Access and data can be saved or altered.

To enter into the **Online** mode, follow the procedure in Section 2.4.2 on page 2-13.

Upon entering in **Online** mode from the **System Manager** box (Figure 2-6 on page 2-6), the message box shown in Figure 2-16 on page 2-15 appears to confirm which Power Station will be connected.

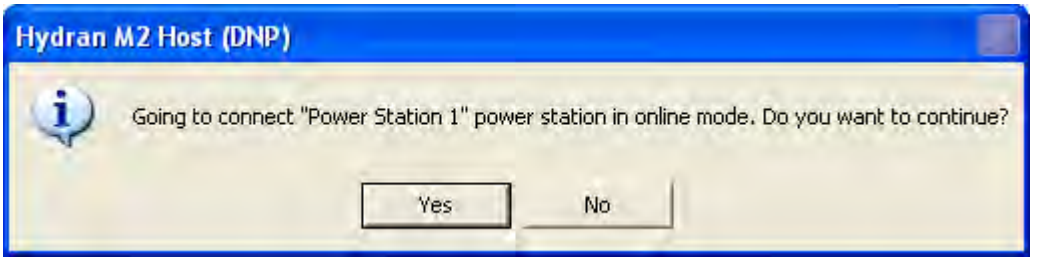


*Figure 2-16 - **Connect Power Station in Online Mode** Box*

- To cancel the connection with the Power Station in the **Online** mode and return to the **System Manager** box (Figure 2-6 on page 2-6), click **No**.
- To continue the operation, click **Yes**.

If the Power Station ID and the Device ID do not correspond with the values in the database, the message box shown in Figure 2-17 on page 2-15 is displayed in order to inform the user of a discrepancy.

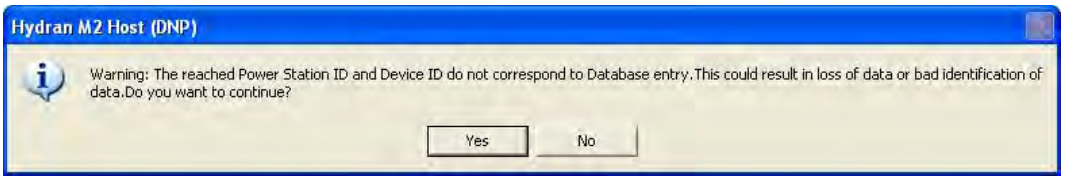


*Figure 2-17 - **Power Station ID and Device ID Not Corresponding** Message Box*

- To cancel the connection with the Power Station in the **Online** mode and return to the **System Manager** box (Figure 2-6 on page 2-6), click **No**.
- To continue the operation, click **Yes**.

2.4.4 Offline

In each monitoring model, the **Offline** mode of operation is used to consult the various model windows and to select the displayed outputs. This mode provides limited functionalities compared to the **Online** mode, and many settings cannot be modified; however a connection to the device is not required.

The following options are available in the **Offline** mode:

- Network View
- Setup
- Service
- Display Settings
- History
- Models

Note: The values found in the Setup and Service windows for an offline Device are limited to the values stored the last time the Device was online. If the Device has never been online, the default values are displayed.

This mode is not protected by any password and is intended for the local utility manager who wants access to the operating data from the Hydran M2 and the transformer.

In the **Offline** mode, each model reads data from the database located on the Client application software computer, where the data must have been previously downloaded from the Hydran M2's local Microsoft Access database. In this mode, no direct communication link is used to review the data, and only the data previously imported can be consulted or accessed.

To enter into the **Offline** mode, follow the procedure in Section 2.4.2 on page 2-13.

Chapter 3

Buttons and Menus

After the start-up of the Hydran M2 Host (DNP) software, the main window shown in Figure 3-1 on page 3-1 is displayed.

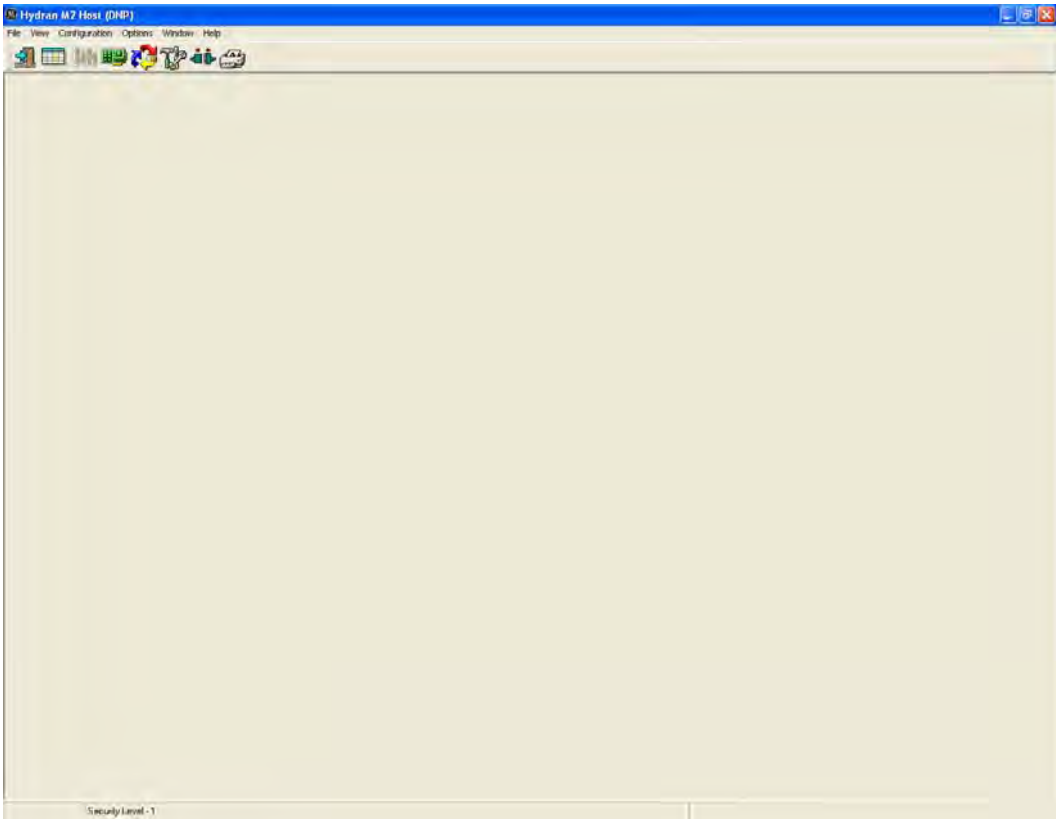


Figure 3-1 - Main Window

This Chapter explains the buttons and menus that are common to all windows of the software. The buttons are described in Section 3.1 on page 3-2, and the menus are presented in the following Sections:

- File Menu (Section 3.2 on page 3-3)
- View Menu (Section 3.3 on page 3-5)
- Configuration Menu (Section 3.4 on page 3-37)
- Options Menu (Section 3.5 on page 3-82)
- Window Menu: To select the active window
- Help (Section 3.6 on page 3-82)

3.1 BUTTONS

The set of buttons shown in Figure 3-2 on page 3-2 can be commonly used through the various Hydran M2 Host (DNP) software windows. They are described below.

Figure 3-2 - Buttons

(or **Exit** in the **File** menu): To close the Hydran M2 Host (DNP) software. The confirmation box shown in Figure 3-3 on page 3-2 appears.

- **Yes**: To exit the software application.
- **No**: To cancel the operation and return to the previous window.

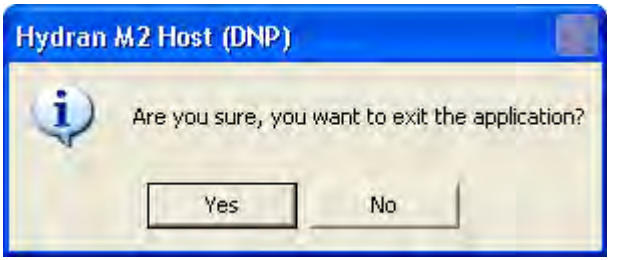


*Figure 3-3 - **Exit the Application?** Box*

(or **Network View** in the **View** menu): To display real-time measurements, model values and input readings from the Hydran M2 units connected to the Hydran M2 Host (DNP) software. See Section 3.3.1 on page 3-5.

(or **Models** in the **View** menu): To select a model and display graphically real-time or historic model values for a certain period of time. See Section 3.3.3 on page 3-18.

(or **Setup** in the **Configuration** menu): To configure the Input/Output modules, alarms, models and history in the Hydran M2 Host (DNP) software. See Section 3.4.2 on page 3-39.

(or **Test** in the **Configuration** menu): To test the relays, alarms and Hydran sensor of the Hydran M2. See Section 3.4.3 on page 3-68.

(or **Service** in the **Configuration** menu): To set the sensor parameters, to activate models, and to view service data. See Section 3.4.4 on page 3-71.

(or **Change Working Mode** in the **Options** menu): To switch from one online or offline Power Station to another. See Section 2.4.2 on page 2-13.

(or **Print Screen** in the **File** menu): To send the contents of the active window to the Microsoft Windows default printer.

3.2 FILE MENU

The **File** menu includes three items:

- **All History Download** (Section 3.2.1 on page 3-3)
- **Print Screen** (Section 3.2.2 on page 3-4)
- **Exit** (Section 3.2.3 on page 3-4)

3.2.1 All History Download

This function is used to download all the history records contained in a Device:

- Short term records
- Long term records
- Events
- Alarms
- Service records
- Digital events
- DGA records

Proceed as follows:

- Select the desired Device in the **Network View** window (Figure 3-8 on page 3-7). The **All History Download** item becomes enabled in the **File** menu.
- In the **File** menu, select **All History Download**. The **All History Download** progress box shown in Figure 3-4 on page 3-4 is displayed.

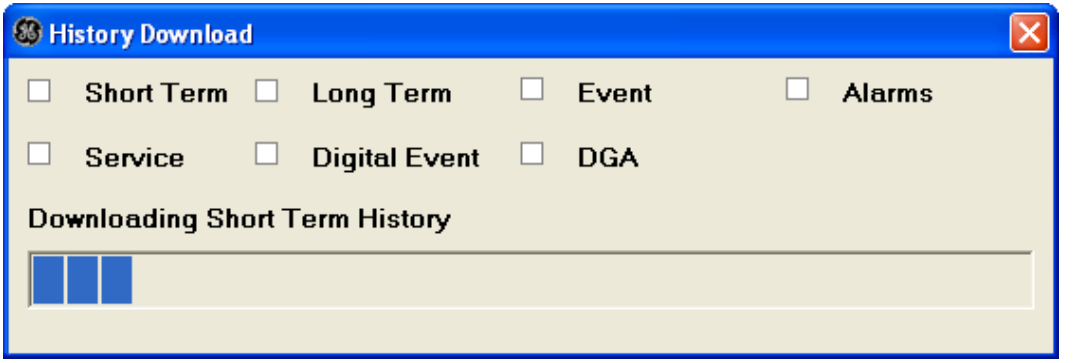


*Figure 3-4 - **All History Download** Progress Box*

- After each type of history records has been downloaded, a checkmark [✓] appears to the left of its name.
- When all history records have been downloaded, the progress box closes automatically.

3.2.2 Print Screen

In the **File** menu select **Print Screen**, or click the button shown on the right. The contents of the active window is sent to the Microsoft Windows default printer.

3.2.3 Exit

In the **File** menu select **Exit**, or click the button shown on the right. The confirmation box shown in Figure 3-3 on page 3-2 appears.

- **Yes**: To exit the software application.
- **No**: To cancel the operation and return to the previous window.

3.3 VIEW MENU

The **View** menu is used to display information, and it includes six items:

- **Network View** (Section 3.3.1 on page 3-5)
- **Real Time** (Section 3.3.2 on page 3-9)
- **Models** (Section 3.3.3 on page 3-18)
- **History** (Section 3.3.4 on page 3-24)
- **View & Update Last DGA** (Section 3.3.5 on page 3-32)
- **Test and Service** (Section 3.3.6 on page 3-34)

3.3.1 Network View

The Network View is used to display real-time measurements, model values and input readings from the Hydran M2 units connected to the Hydran M2 Host (DNP) software.

In the **View** menu select **Network View**, or click the button shown on the right.

The first time the Hydran M2 Host (DNP) software application is opened, the **Network View Parameters Not Configured** box shown in Figure 3-5 on page 3-5 is displayed since the Network View Parameters are not assigned yet for the selected Power Station.

*Figure 3-5 - **Network View Parameters Not Configured** Box*

- Click **OK**.
- To select which parameters are displayed in the Network View, proceed as described in Section 3.4.1 on page 3-37.

When the parameters have been selected, the **Network View** window shown in Figure 3-6 on page 3-6 is displayed.

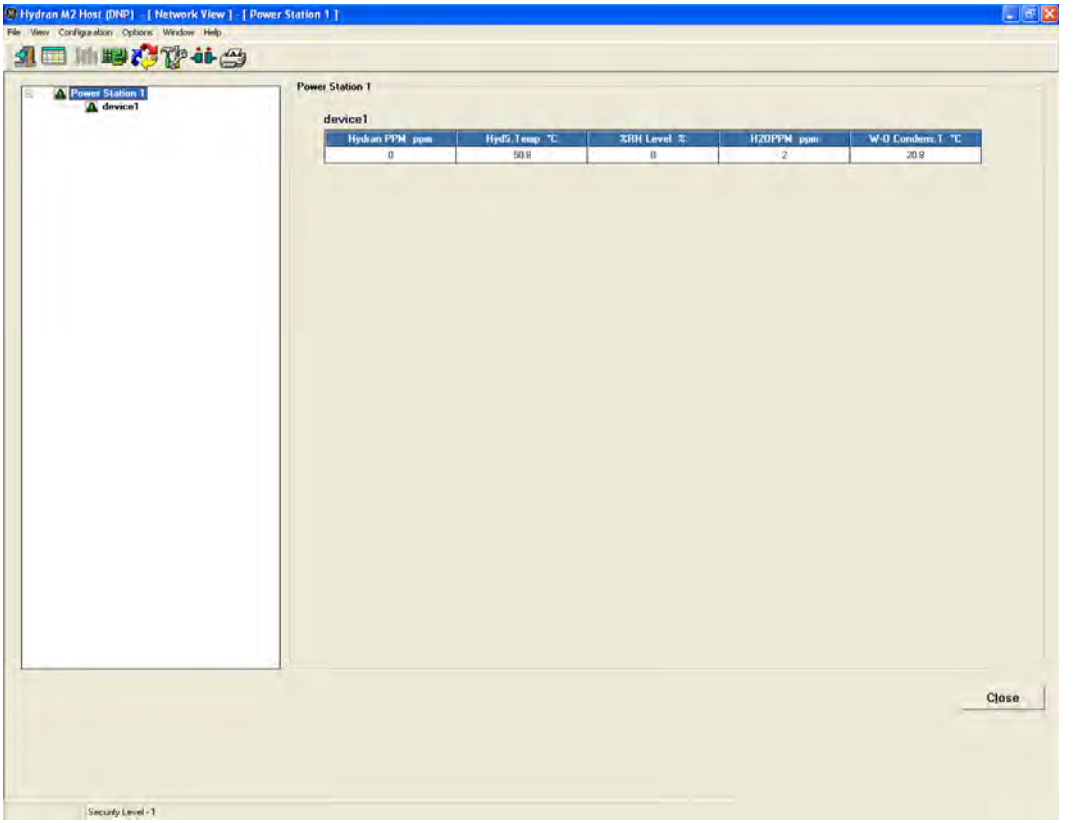


*Figure 3-6 - **Network View** Window for Power Station*

- The left side of the window illustrates the tree structure of the network. It can be used to rapidly switch between Devices.
- The parameters (up to five) on the right side are the ones selected in Section 3.4.1 on page 3-37, with the actual values.
- There is a group of up to five parameters and their actual values on the right side for each Device in the Power Station.
- To visualize the real-time measurements, model values and input readings for a Device, click its name in the tree structure on the left side.
- To close the window, click **Close** or the **X** in the top right corner.

When clicking a Device's name in the tree structure on the left side, the **Reading Values** progress box shown in Figure 3-7 on page 3-7 appears in the middle of the screen.

*Figure 3-7 - **Reading Values** Progress Box*

After a few seconds, the **Network View** window shown in Figure 3-8 on page 3-7 is displayed for the selected Device.

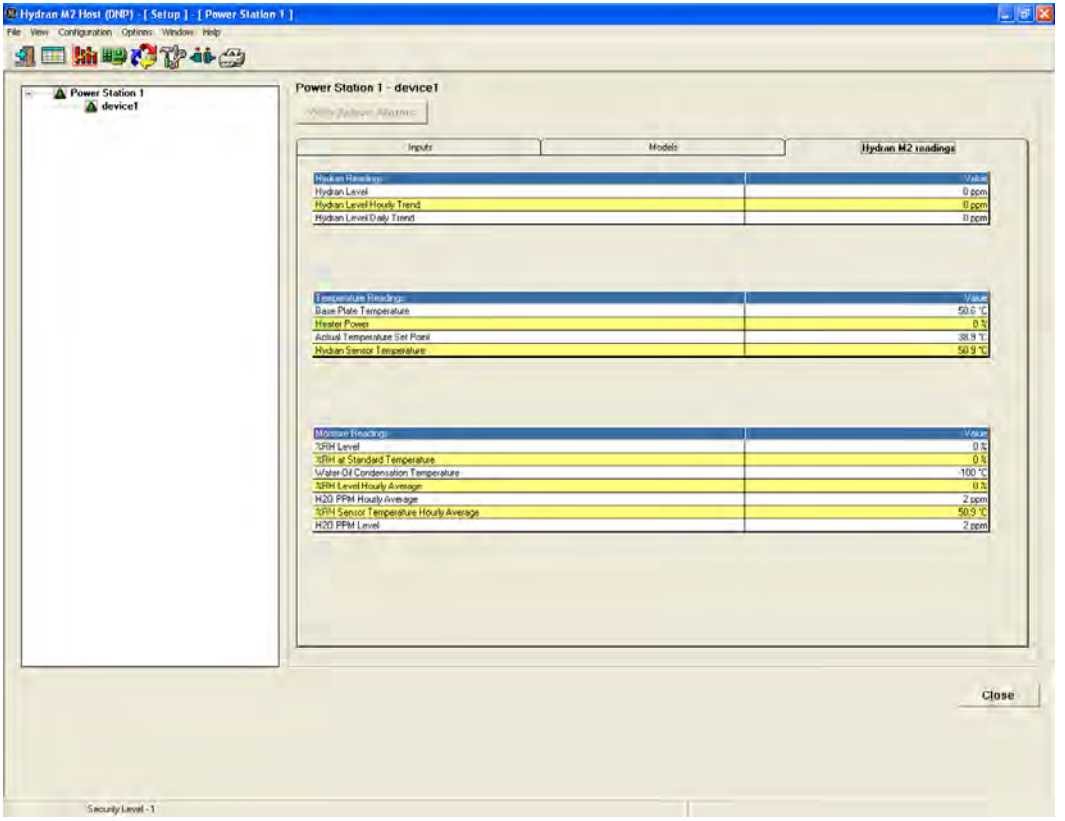


*Figure 3-8 - **Network View** Window for Device*

- The left side of the window illustrates the tree structure of the network. It can be used to rapidly switch between Devices.
- The **Inputs** tab is shown first for the selected Device.
- To see the **Models** or **Hydran M2 readings** tabs, click their name.
- To visualize the real-time measurements, model values and input readings for another Device, click its name in the tree structure on the left side.
- To close the window, click **Close** or the **X** in the top right corner.

At the start-up of the Hydran M2 Host (DNP) software, when a Power Station is put online, the software displays the **Network View** window for the Power Station with the selected parameters of all the Devices.

The tree structure on the left side also quickly shows whether any of the Power Stations or Devices detected any problems and displays active alarms:

- A green icon to the left of the Power Station's or Device's name indicates it is online with no active alarms.
- A red icon indicates it is online with an active alarm.
- A grey icon indicates it is offline.
- If no alarms are present, the **View Active Alarms** button is disabled (grey).
- If there are active alarms, click **View Active Alarms** to view them. The **Active Alarms** box shown in Figure 3-9 on page 3-8 appears.
  - Select the alarm to acknowledge by clicking it.
  - Click **Acknowledge**.
  - Click **Close**.

*Figure 3-9 - **Active Alarms** Box*

To enable the other options in the **View** menu, the **Network View** window (Figure 3-8 on page 3-7) must be opened for a specific Device. If the options are disabled (grey), open the **Network View** window first.

3.3.2 Real Time

The **Real Time** menu includes three items:

- **Actual Values** (Section 3.3.2.1 on page 3-9)
- **Maximum Values** (Section 3.3.2.2 on page 3-14)
- **Enabled Alarms** (Section 3.3.2.3 on page 3-16)

3.3.2.1 Actual Values

In the **View** menu, select **Real Time** and then **Actual Values**. The **Reading Actual Values** progress box shown in Figure 3-10 on page 3-9 appears in the middle of the screen.

*Figure 3-10 - **Reading Actual Values** Progress Box*

3.3.2.1.1 Inputs Tab

A few seconds later, the **Inputs** tab of the **Actual Values** window is displayed. In Figure 3-11 on page 3-10, no digital inputs are connected.

Because the Hydran M2 is fully dynamic, the Hydran M2 Host (DNP) software displays only the inputs, both analog and digital, that are connected to the Hydran M2 and configured.

Analog inputs can be configured to display any of the following:

- Top oil temperature
- OLTC tank temperature
- Ambient temperature
- Tap position
- Winding H current
- Winding X current
- Winding Y current
- Any other input configured by the user

For information on how to configure the inputs, see Section 3.4.2.1 on page 3-41.

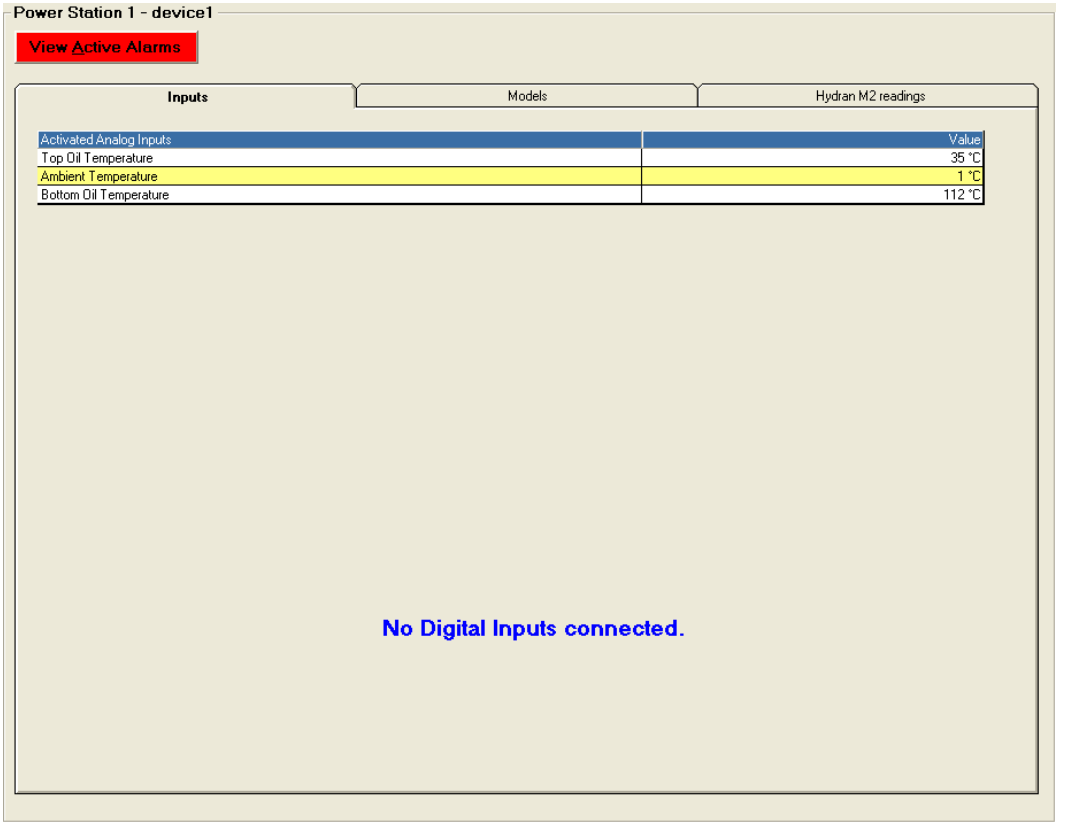


*Figure 3-11 - **Inputs** Tab of the **Actual Values** Window Without Digital Inputs*

Since no digital inputs are connected to that particular Device, **No Digital Inputs Connected.** is indicated in Figure 3-11 on page 3-10. If there are any digital inputs connected, the **Inputs** tab of the **Actual Values** window is similar to Figure 3-12 on page 3-11.

Digital inputs can be configured to display any of the following:

- Cooling Bank Status
- Transformer Energized Status
- Any other input configured by the user

For information on how to configure the digital inputs and their associated models, see Section 3.4.2.1 on page 3-41.

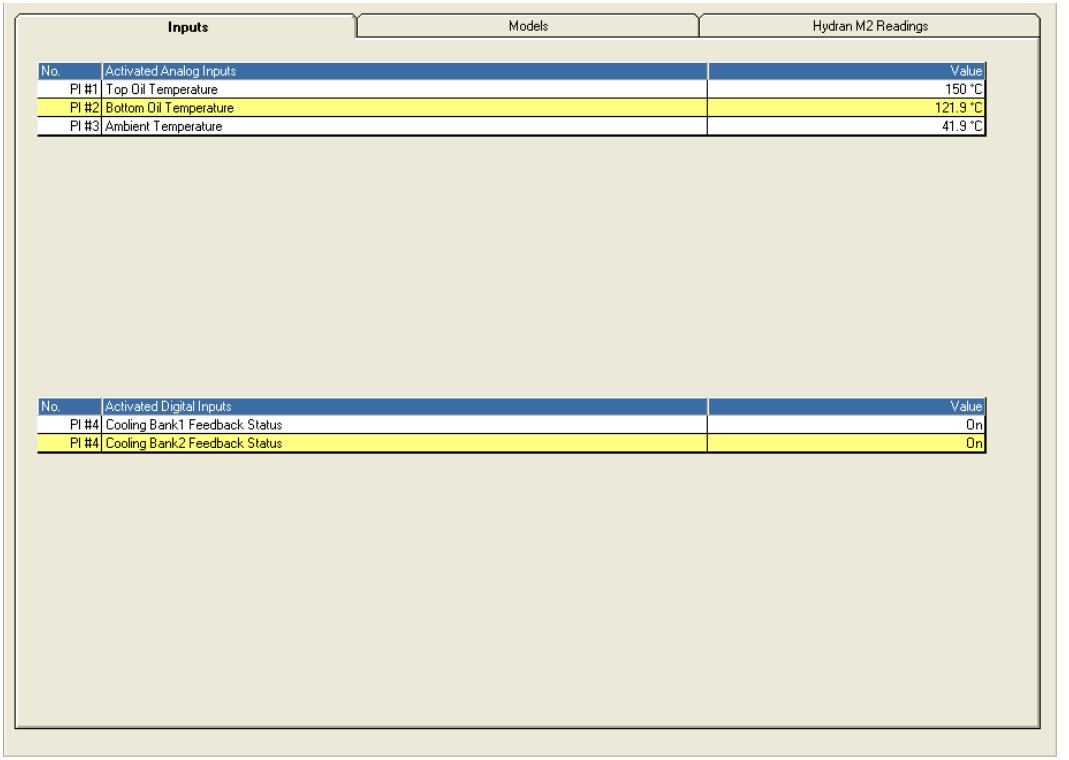
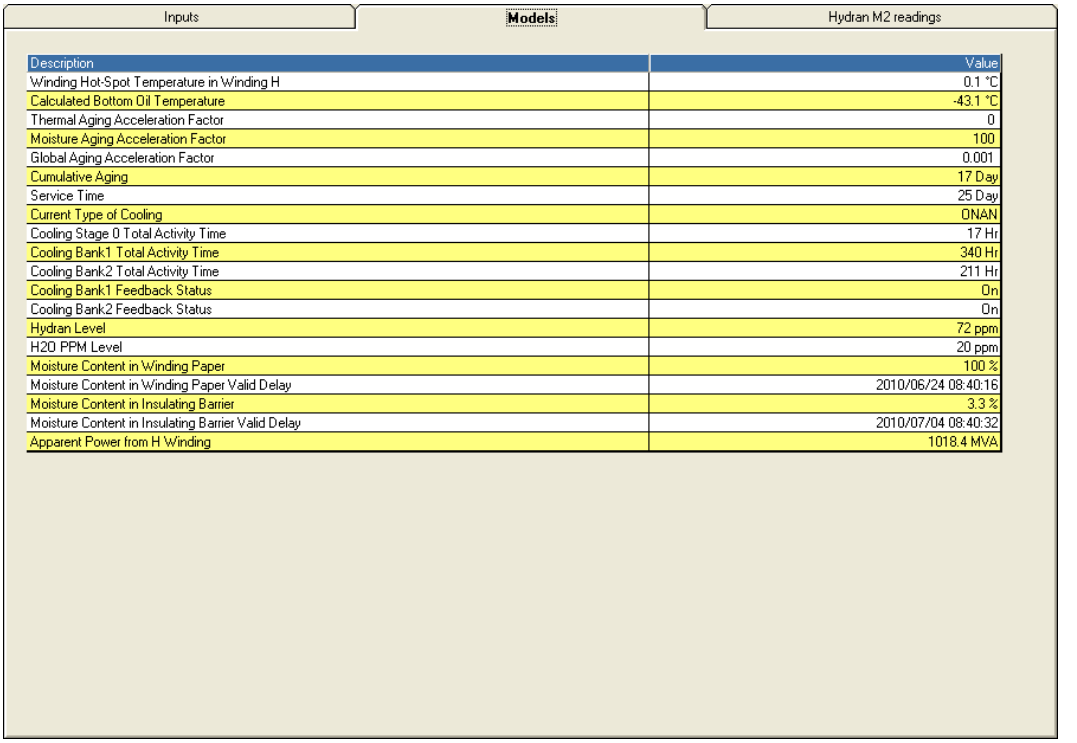


*Figure 3-12 - **Inputs** Tab of the **Actual Values** Window With Digital Inputs*

3.3.2.1.2 Models Tab

To view the values calculated by the models, click the **Models** tab. A window similar to Figure 3-13 on page 3-12 appears.



Description	Value
Winding Hot-Spot Temperature in Winding H	0.1 °C
Calculated Bottom Oil Temperature	-43.1 °C
Thermal Aging Acceleration Factor	0
Moisture Aging Acceleration Factor	100
Global Aging Acceleration Factor	0.001
Cumulative Aging	17 Day
Service Time	25 Day
Current Type of Cooling	ONAN
Cooling Stage 0 Total Activity Time	17 Hr
Cooling Bank1 Total Activity Time	340 Hr
Cooling Bank2 Total Activity Time	211 Hr
Cooling Bank1 Feedback Status	On
Cooling Bank2 Feedback Status	On
Hydran Level	72 ppm
H2O PPM Level	20 ppm
Moisture Content in Winding Paper	100 %
Moisture Content in Winding Paper Valid Delay	2010/06/24 08:40:16
Moisture Content in Insulating Barrier	3.3 %
Moisture Content in Insulating Barrier Valid Delay	2010/07/04 08:40:32
Apparent Power from H Winding	1018.4 MVA

*Figure 3-13 - **Models** Tab of the **Actual Values** Window*

The models displayed depend on the inputs connected to the Hydran M2 and will be displayed automatically once the necessary inputs are connected. The models are discussed in further detail in Chapter 6 to Chapter 14.

3.3.2.1.3 Hydran M2 Readings Tab

To view the actual values read by the Hydran M2, click the **Hydran M2 Readings** tab. A window similar to Figure 3-14 on page 3-13 is displayed.

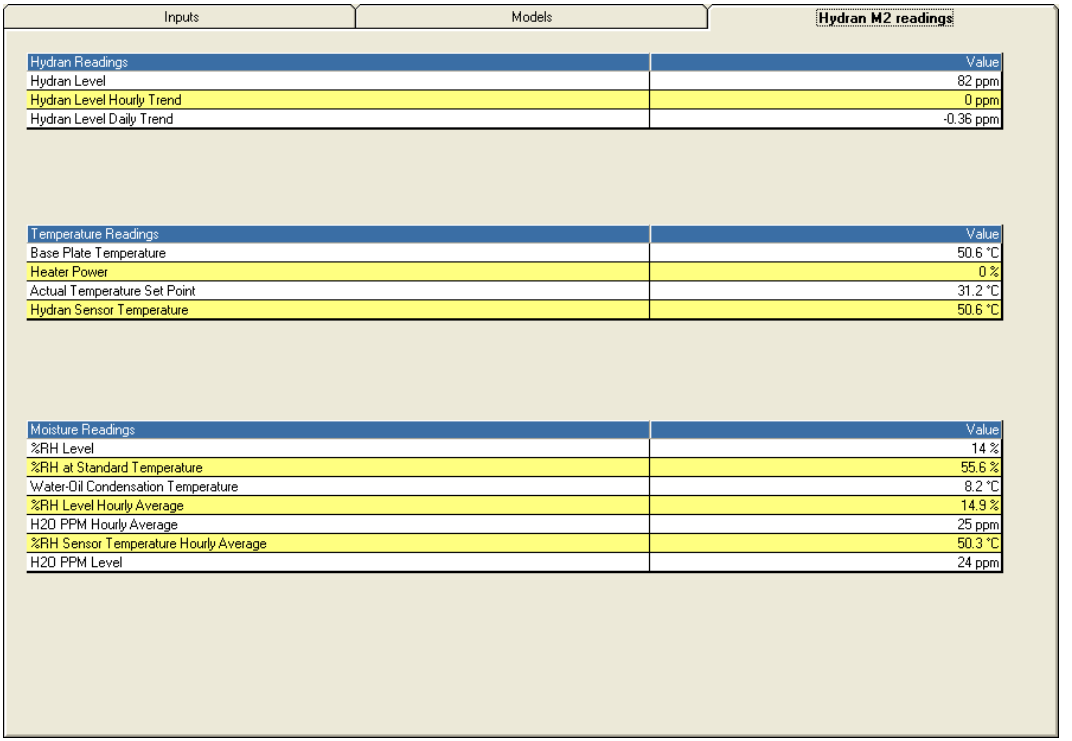


*Figure 3-14 - **Hydran M2 Readings** Tab of the **Actual Values** Window*

The following readings can be measured by the Hydran M2 sensor:

- **Hydran Readings**:
  - **Hydran Level**: The level of Hydran gas, in ppm
  - **Hydran Level Hourly Trend**: The daily trend of Hydran gas in ppm/x hours, where x is the Hourly Trend Period
  - **Hydran Level Daily Trend**: The daily trend of Hydran gas in ppm/x days, where x is the Daily Trend Period

- **Temperature Readings**:
  - **Base Plate Temperature**: The temperature (in °C) of the base plate that holds the Hydran sensor
  - **Heater Power**: The amount of power used by the base plate heater, in %
  - **Actual Temperature Set Point**: The computed value of the temperature set point (in °C) based on the modulation temperature settings
  - **Hydran Sensor Temperature**: The temperature of the Hydran sensor, in °C
- **Moisture Readings**:
  - **%RH Level**: The relative humidity, in %
  - **%RH at Standard Temperature**: The relative humidity (in %) at the user-defined standard temperature, used to compare RH% values from different transformers even if the sensors are at different temperatures
  - **%RH Level Hourly Average**: The average relative humidity (in %), computed over the %RH Average Period
  - **H2O PPM Hourly Average**: The average moisture level (in %), computed over the %RH Average Period
  - **%RH Sensor Temperature Hourly Average**: The average temperature of the relative humidity sensor, in °C
  - **H2O PPM Level**: The water content, in parts per million

3.3.2.2 Maximum Values

In the **View** menu, select **Real Time** and then **Maximum Values**. The **Reading Maximum Values** progress box shown in Figure 3-15 on page 3-14 appears in the middle of the screen.

*Figure 3-15 - **Reading Maximum Values** Progress Box*

A few seconds later, the **Temperature Values** tab of the **Maximum Values** window is displayed; see Figure 3-16 on page 3-15.

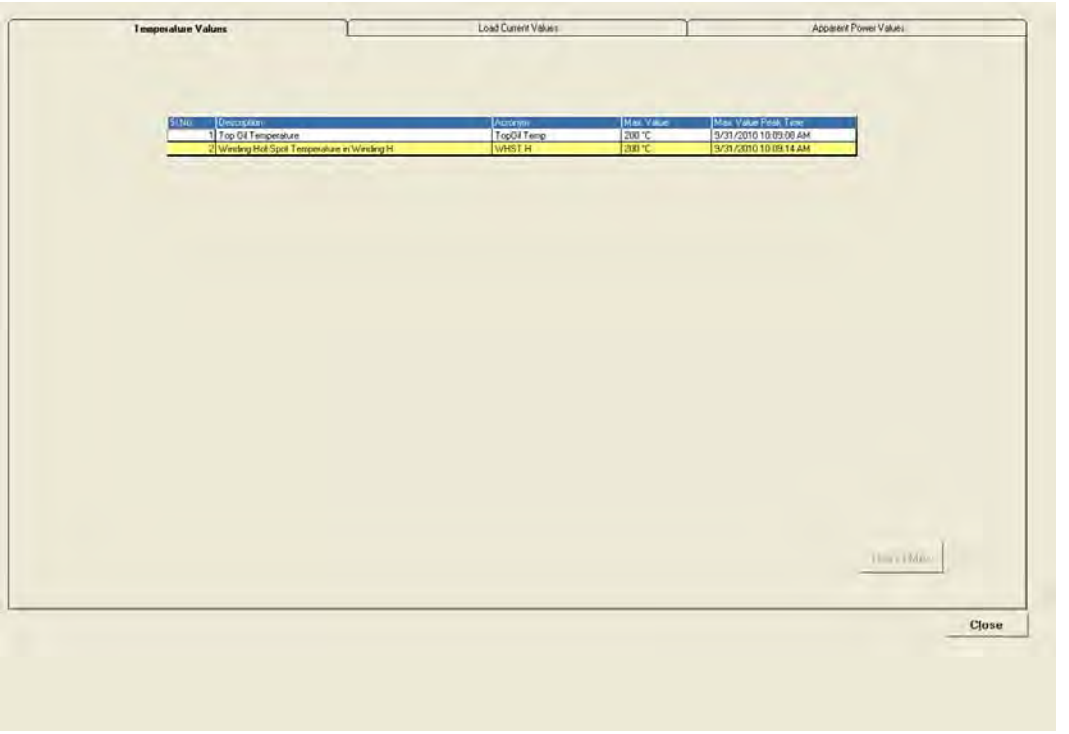


*Figure 3-16 - **Maximum Values** Window*

This window displays the maximum values set for the selected and configured inputs.

- To view the maximum load current values, click the **Load Current Values** tab.
- To view the maximum apparent power values, click the **Apparent Power Values** tab.
- To close the window, click **Close** or the **X** in the top right corner.

The following maximum values, along with their date and time, can be displayed:

- **Temperature Values** tab:
  - **Top Oil Temperature**, in °C
  - **Bottom Oil Temperature**, in °C
  - **Winding Hot-spot Temperature**, in °C

  - **OLTC Tank Temperature**: The temperature of the tap changer tank, in °C
  - **Ambient Temperature**, in °C
- **Load Current Values** tab:
  - **Current Winding H**
  - **Current Winding X**
  - **Current Winding Y**
- **Apparent Power Values** tab:
  - **Historic Max for MVA winding H**
  - **Historic Max for MVA winding X**
  - **Historic Max for MVA winding Y**

Note: Some inputs do not have any associated maximum values.

3.3.2.3 Enabled Alarms

In the **View** menu, select **Real Time** and then **Enabled Alarms**. The **Enabled Alarms** window shown in Figure 3-17 on page 3-17 displays a complete list of the *enabled* alarms along with their acknowledgement status.

Note: Some model-related alarms can only be generated if two specific models are enabled. Appendix B presents the list of all alarm messages that can appear on the Hydran M2 Host (DNP) software.

Some alarms could be off but not acknowledged; this occurs when an alarm condition is present and then returns to normal. To ensure that the presence of this alarm is noticed, the **Acknowledgement Status** remains as **Pending**.

The following properties are listed for each alarm:

- **No.**: The number of the alarm.
- **Name**: The name of the alarm.
- **Alarm Level**: The level of the alarm. **1st Level** indicates a High or Low alarm, **2nd Level** indicates a High-High or Low-Low alarm, and **Input Fault** indicates an alarm due to a system fault condition.
- **Alarm Set Point**: The maximum or minimum acceptable value before the alarm is triggered.
- **Present Value**: The value measured currently.
- **Alarm Status**: Indicates if the alarm is **ON** or **OFF**. If an alarm is **ON**, the entire line is highlighted in red.

- **Acknowledge Status**: Can be blank (no active alarm), **Pending** (an alarm that is or has been active but has not been acknowledged), or **Acknowledged**.

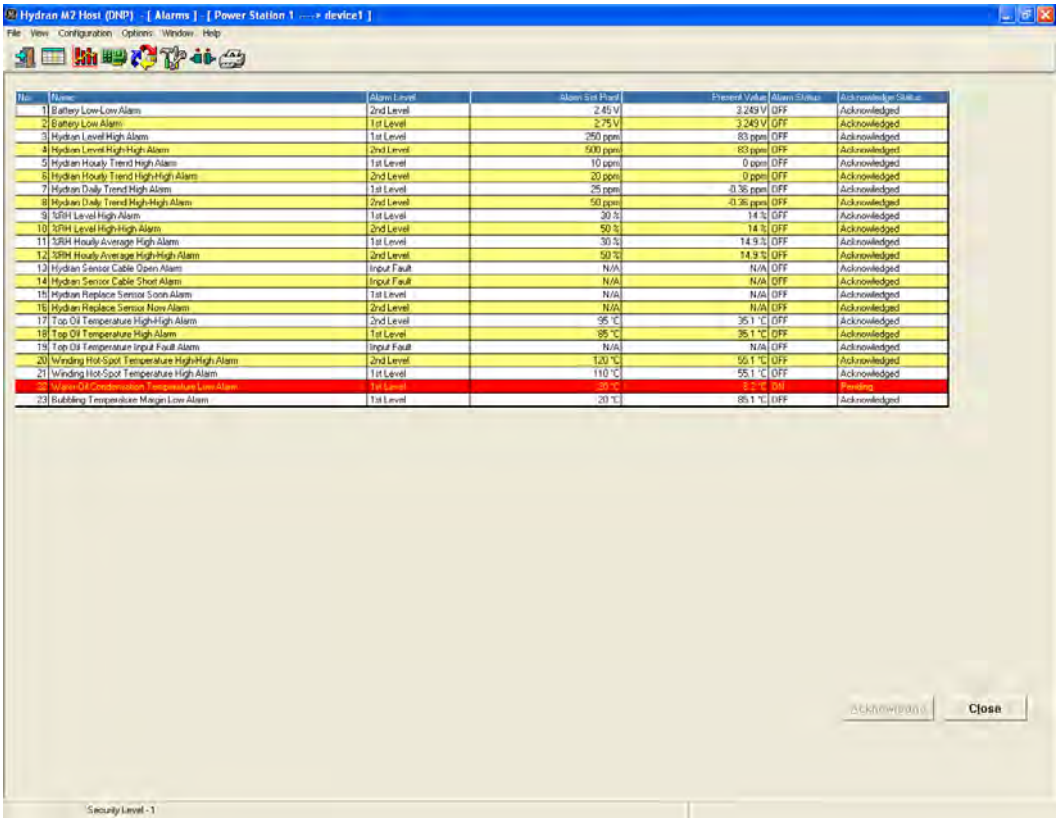


*Figure 3-17 - **Enabled Alarms** Window*

The following actions can be carried out:

- To acknowledge an alarm, select it and click **Acknowledge**.
- To close the window, click **Close** or the **X** in the top right corner.

3.3.3 Models

In the **View** menu select **Models**, or click the button shown on the right. The **View Models** window shown in Figure 3-18 on page 3-18 appears.

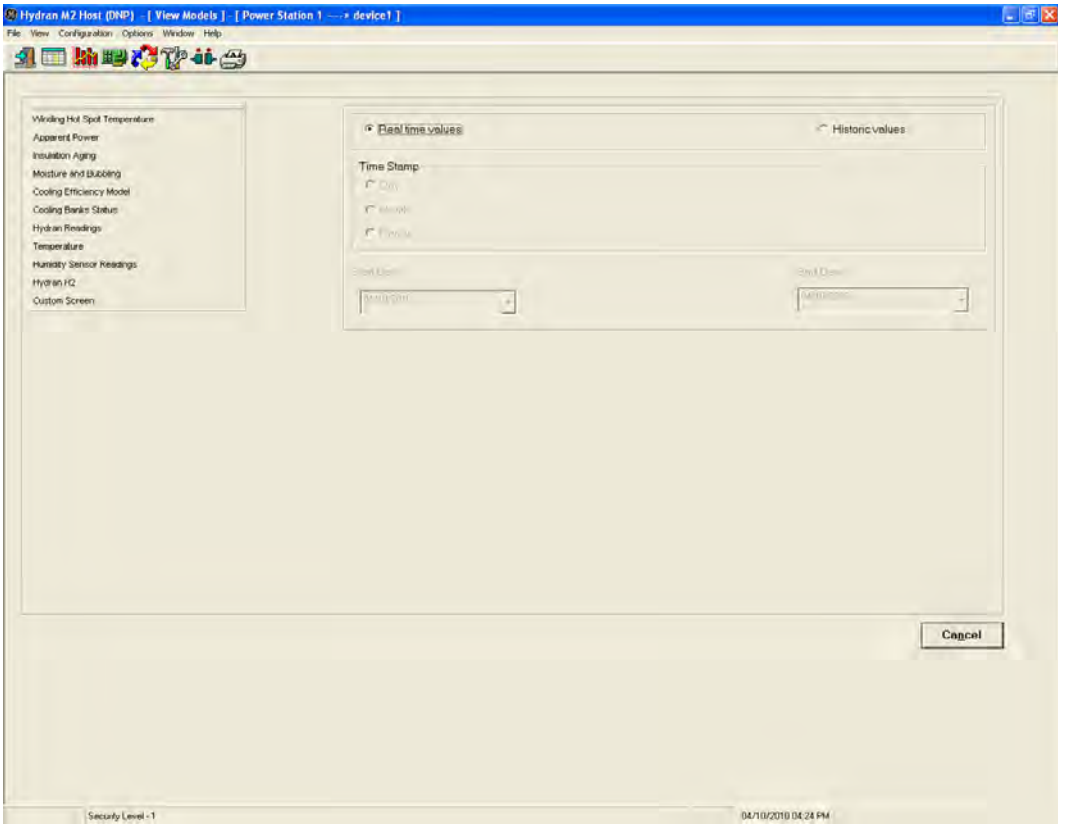


*Figure 3-18 - **View Models** Window With Real-Time Values*

The available models are listed on the left side. For detailed explanation of the models, the required inputs, the models outputs and the associated alarms, see Chapter 6 to Chapter 14.

3.3.3.1 Real Time Values

By default, **Real Time Values** is selected in Figure 3-18 on page 3-18. To display a model's real-time graph that is updated every 15 seconds, proceed as follows:

- Ensure **Real Time Values** is selected.
- Click the name of the desired real-time model on the left side.
- If **Custom Screen** is selected, see Section 3.3.3.1.1 on page 3-19.
- To close the window without generating a real-time graph, click **Cancel** or the **X** in the top right corner.

Note: The commands available for all graphs are described in Chapter 5.

3.3.3.1.1 Custom Screen

The curves of up to ten analog inputs, digital inputs and/or calculated values from different models can be graphed simultaneously. In Figure 3-18 on page 3-18, click **Custom Screen**, and the **Select Inputs** box shown in Figure 3-19 on page 3-20 appears.

- The inputs enumerated in the **Connected analog inputs** and **Connected digital inputs** areas depend on the inputs connected to the Hydran M2.
- The values listed in the **Calculated values** depend on the models enabled.
- Select [✓] up to ten analog inputs, digital inputs and/or calculated values by clicking their name or on the checkbox to the left of each name.
- If the user tries to add an eleventh curve, a message box similar to Figure 3-39 on page 3-39 appears. Click **OK** and remove [ ] at least one curve.
- To save the selections for future use, click **Save** and enter a name in the textbox that appears.
- To reuse a custom configuration, select it in the **Select custom configuration** list.
- To delete a custom configuration, select it in the list and then click **Delete**.
- To clear the selected curves, click **Clear**.
- To close the box without generating a **Custom Screen** graph, click **Cancel** or the **X** in the top right corner.
- To produce the desired **Custom Screen** graph, click **OK**.

A typical **Custom Screen** graph is shown in Figure 3-20 on page 3-21. Initially, there are no curves, and real-time data appears as time passes.

Note: The commands available for all graphs are described in Chapter 5.

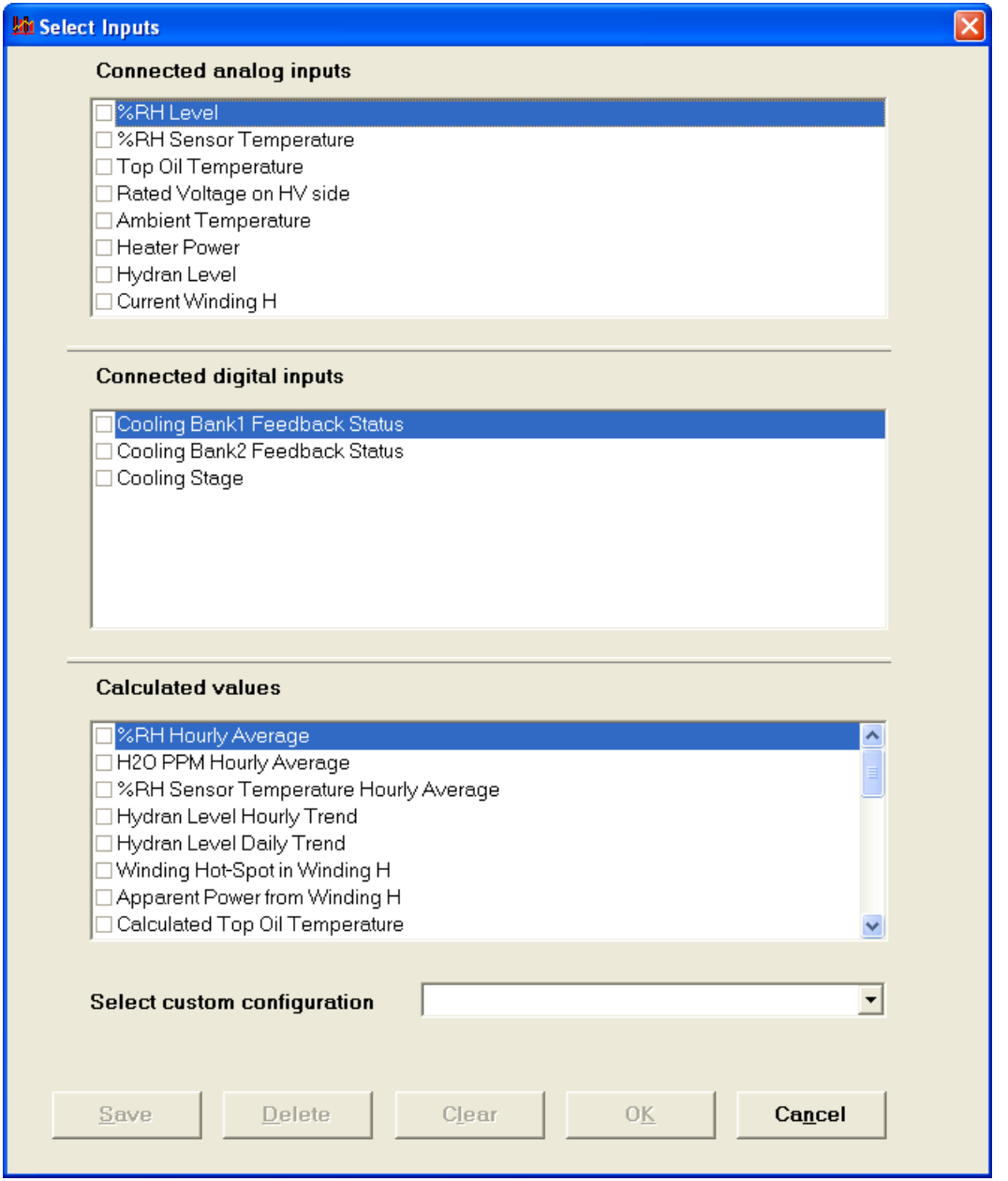


*Figure 3-19 - **Select Inputs** Box*

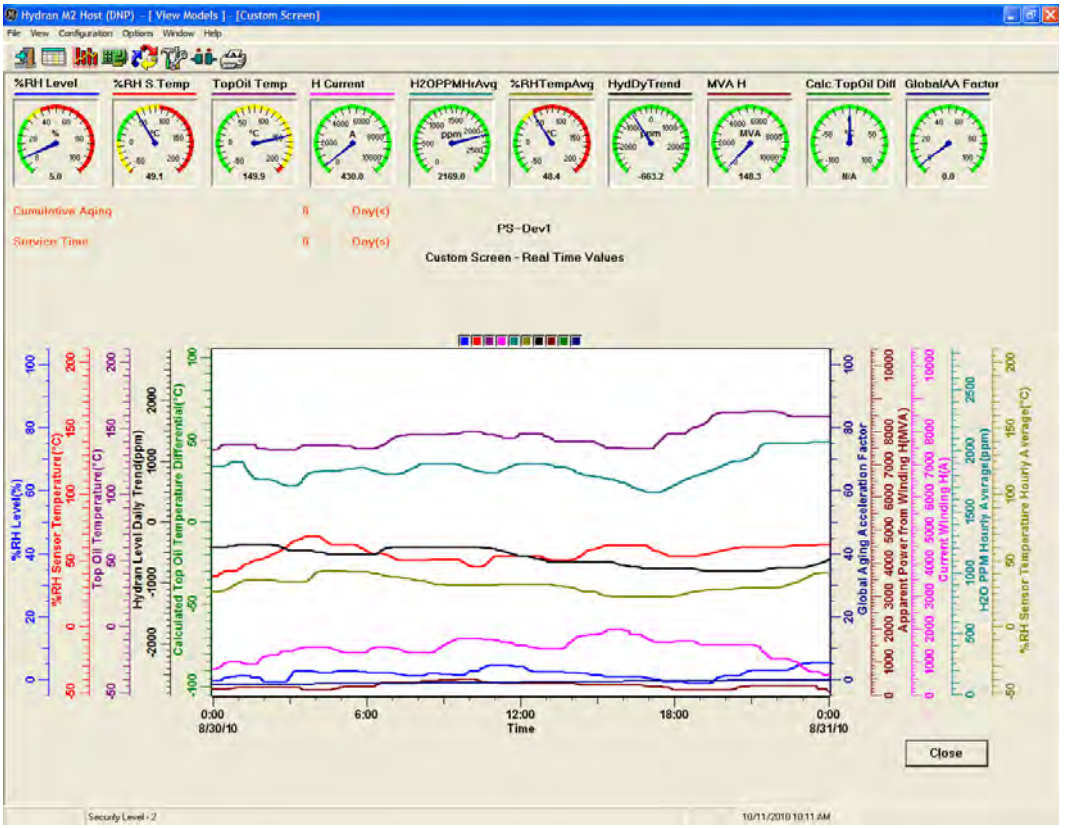


Figure 3-20 - Typical Graph

3.3.3.2 Historic Values

In the **View Models** window (Figure 3-18 on page 3-18), click **Historic Values**, and this window becomes as shown in Figure 3-21 on page 3-22.

Note: Before trying to graph Historic Values, it is recommended to download all the History of the Device to have it available. To do so, refer to Section 3.3.4 on page 3-24.

The **Time Stamp** and the **Start Date** are now enabled. Also, all the models now appear on the left side, to allow graphing historic values if they exist.

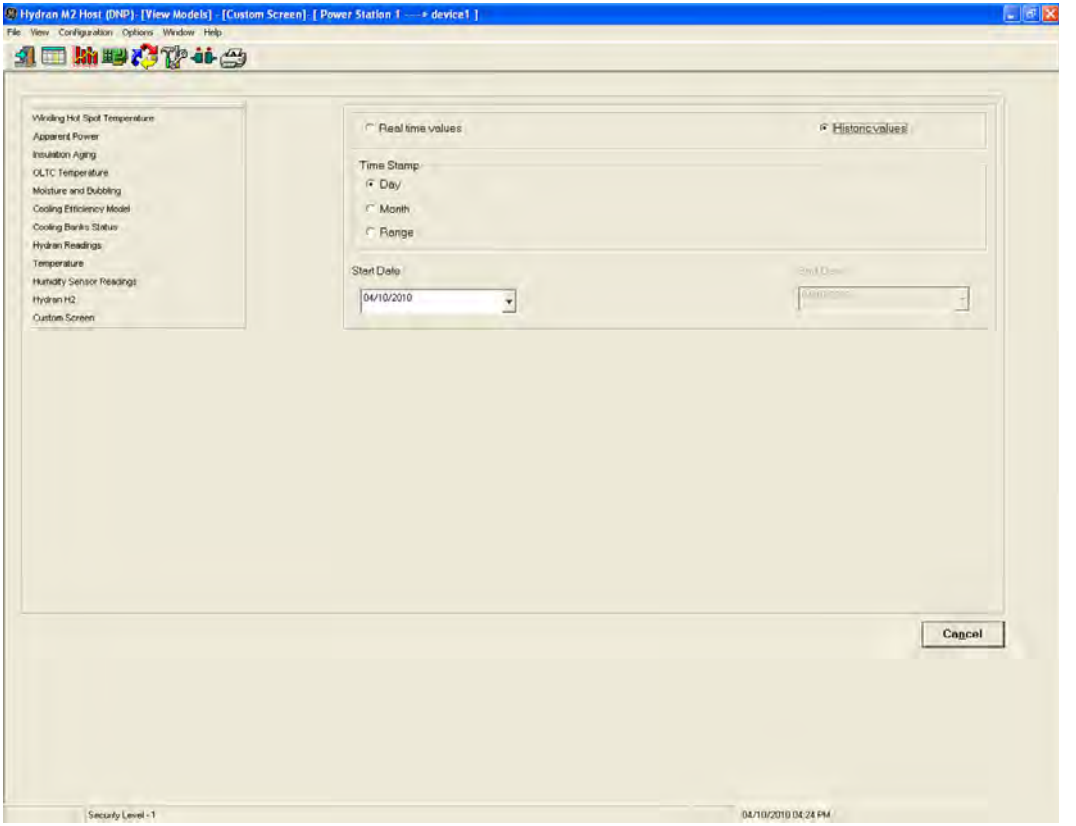


*Figure 3-21 - **View Models** Window With Historic Values*

- Ensure **Historic Values** is selected.
- To display the historic values since a certain day, click **Day** and select the **Start Date**. This will graph the selected model's values from that day to the last available entry.
- To display the historic values since the beginning of a certain month, click **Month** and select the **Start Date**. This will graph the selected model's values from the beginning of that month to the last available entry.
- To display the historic values during a certain period, click **Range** and select the **Start Date** and then the **End Date**. This will graph the selected model's values between the two dates.
- Click the name of the desired model on the left side.

- Depending on the date range selected, some history records could have to be downloaded. A confirmation box similar to Figure 3-22 on page 3-23 would appear. Click **Yes**.

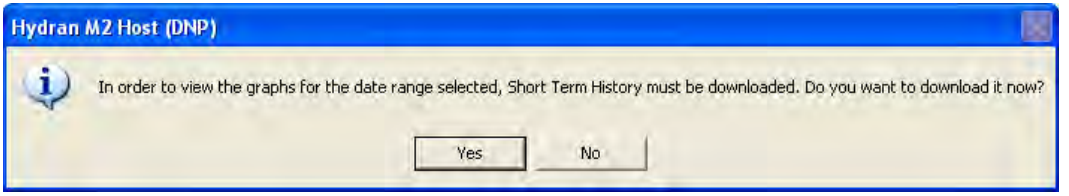


*Figure 3-22 - **Download History?** Confirmation Box*

- During the download operation, a progress box similar to Figure 3-23 on page 3-23 is displayed and then disappears automatically.

*Figure 3-23 - **History Download** Progress Box*

- If **Custom Screen** is selected, see Section 3.3.3.1.1 on page 3-19.
- To close the window without generating a real-time graph, click **Cancel** or the **X** in the top right corner.

Note: The commands available for all graphs are described in Chapter 5.

If no History is available for the desired period of time, the **History not available** message box shown in Figure 3-24 on page 3-24 appears.

*Figure 3-24 - **History Not Available** Box*

- Click **OK**.
- Modify the **Time Stamp**, the **Start Date** and/or the **End Date** in Figure 3-21 on page 3-22.

3.3.4 History

The Hydran M2 keeps History logs of measured values, alarms and other events. These logs can be downloaded to a PC using the Hydran M2 Host (DNP) software. Once downloaded, the History can be viewed in a grid or as a graph, or exported to a Microsoft Excel or text file to be compatible with other office tools.

In the **View Menu**, select **History**. The **History Options** box shown in Figure 3-25 on page 3-24 is displayed.

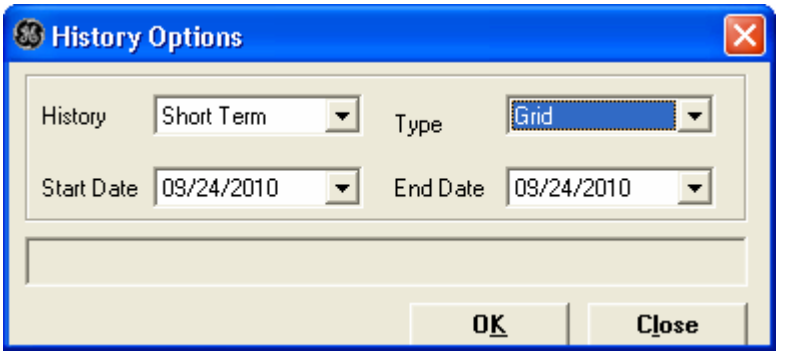


*Figure 3-25 - **History Options** Box*

The following types of History can be selected in the **History** drop-down list:

- **Short Term**: Contains the Hydran M2 measurements, recorded continuously every periodic interval set by the user (default is 15 minutes).
- **Long Term**: Contains all the Hydran M2 measurements, recorded over a longer periodic interval (up to four times a day).
- **Event**: Keeps track of changes made to settings such as alarm set points and user-defined models. It also records down the date and time when the device was powered up and powered down.
- **Alarms**: Keeps track of all alarms that were triggered and acknowledged, as well as all the measured values at the time that the alarm occurred.
- **Service**: Stores the results of sensor tests.
- **Digital Event**: Keeps track of the status of alarm relays and other digital inputs, such as cooling bank status and user-defined inputs.
- **DGA History**: Stores the values set for the digital gaz analyzer.

3.3.4.1 Viewing History in Grid Format

Each type of History log can be viewed in a grid. Proceed as follows:

- In the **View Menu**, select **History**.
- In Figure 3-25 on page 3-24, select the desired type in the **History** drop-down list.
- In the **Type** drop-down list, select **Grid**.
- Select the **Start Date** and the **End Date** for the data to be downloaded.
- To close the box without generating a grid, click **Close** or the **X** in the top right corner.
- To generate a grid, click **OK**.

If the desired type of History is unavailable during the selected period of time, the **Proceeding to Download History** message box shown in Figure 3-26 on page 3-26 appears.

- Click **OK**.
- Wait for the History data to transfer from the Hydran M2 to the PC.

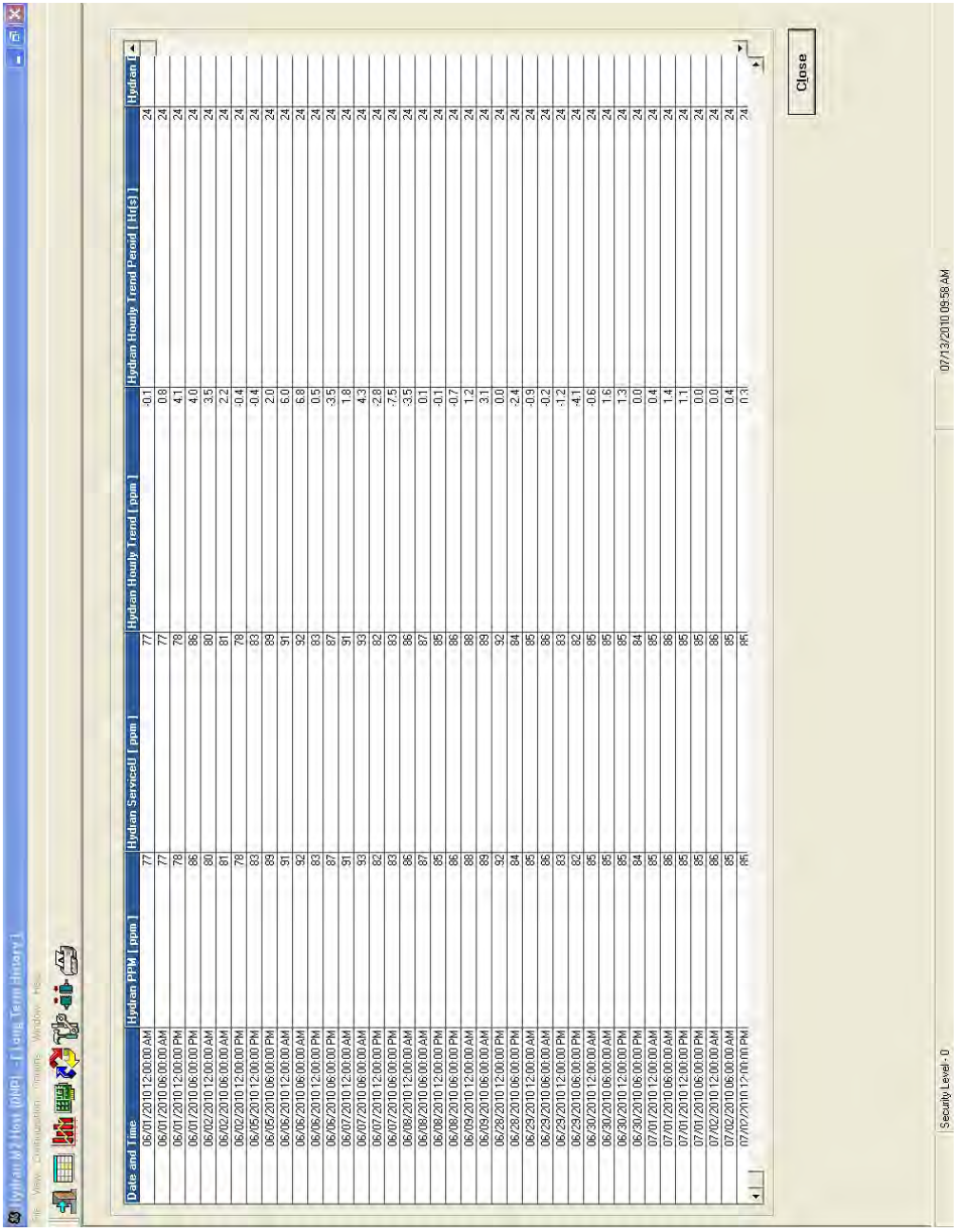
*Note: The History download time is not proportional to the date range selected, but rather on how much time has passed since the last History download. When **OK** is clicked, all records of the selected type of History not currently in the PC's database are downloaded to ensure that the PC is completely up to date.*

*Figure 3-26 - **Proceeding to Download History** Box*

Once the History has finished downloading, it is displayed in a grid. There are two types of grid:

- The **Short Term**, **Long Term** and **Service** histories are displayed in a spreadsheet-type format (see Figure 3-27 on page 3-27).
- For all the other types of history, there are two separate grids (see Figure 3-28 on page 3-28):
  - The grid on the left contains the **Date and Time** as well as the **Event Description**.
  - Click an event in the grid on the left.
  - The grid on the right presents the **Value** of each **Variable** at the time of the event occurrence.

To close the grid, click **Close** or the **X** in the top right corner.



Date and Time	Hydran PPM [ppm]	Hydran ServiceU [ppm]	Hydran Hourly Trend [ppm]	Hydran Hourly Trend Period [Hr(s)]	Hydran [
06/01/2010 12:00:00 AM	77	77	-0.1	24	
06/01/2010 06:00:00 AM	77	77	0.8	24	
06/01/2010 12:00:00 PM	78	78	4.1	24	
06/01/2010 06:00:00 PM	86	86	4.0	24	
06/02/2010 12:00:00 AM	80	80	3.5	24	
06/02/2010 06:00:00 AM	81	81	2.2	24	
06/02/2010 12:00:00 PM	78	78	-0.4	24	
06/05/2010 12:00:00 PM	83	83	-0.4	24	
06/05/2010 06:00:00 PM	89	89	2.0	24	
06/06/2010 12:00:00 AM	91	91	6.0	24	
06/06/2010 06:00:00 AM	92	92	6.8	24	
06/06/2010 12:00:00 PM	83	83	0.5	24	
06/06/2010 06:00:00 PM	87	87	-3.5	24	
06/07/2010 12:00:00 AM	91	91	1.8	24	
06/07/2010 06:00:00 AM	93	93	4.3	24	
06/07/2010 12:00:00 PM	82	82	-2.8	24	
06/07/2010 06:00:00 PM	83	83	-7.5	24	
06/08/2010 12:00:00 AM	86	86	-3.5	24	
06/08/2010 06:00:00 AM	87	87	0.1	24	
06/08/2010 12:00:00 PM	85	85	-0.1	24	
06/08/2010 06:00:00 PM	86	86	-0.7	24	
06/09/2010 12:00:00 AM	88	88	1.2	24	
06/09/2010 06:00:00 AM	89	89	3.1	24	
06/28/2010 12:00:00 PM	92	92	0.0	24	
06/28/2010 06:00:00 PM	84	84	-2.4	24	
06/29/2010 12:00:00 AM	85	85	-0.9	24	
06/29/2010 06:00:00 AM	86	86	-0.2	24	
06/29/2010 12:00:00 PM	83	83	-1.2	24	
06/29/2010 06:00:00 PM	82	82	-4.1	24	
06/30/2010 12:00:00 AM	85	85	-0.6	24	
06/30/2010 06:00:00 AM	85	85	1.6	24	
06/30/2010 12:00:00 PM	85	85	1.3	24	
06/30/2010 06:00:00 PM	84	84	0.0	24	
07/01/2010 12:00:00 AM	85	85	0.4	24	
07/01/2010 06:00:00 AM	86	86	1.4	24	
07/01/2010 12:00:00 PM	85	85	1.1	24	
07/01/2010 06:00:00 PM	85	85	0.0	24	
07/02/2010 12:00:00 AM	86	86	0.0	24	
07/02/2010 06:00:00 AM	85	85	0.4	24	
07/02/2010 12:00:00 PM	85	85	0.3	24	

*Figure 3-27 - **Short Term**, **Long Term** or **Service** History Grid*

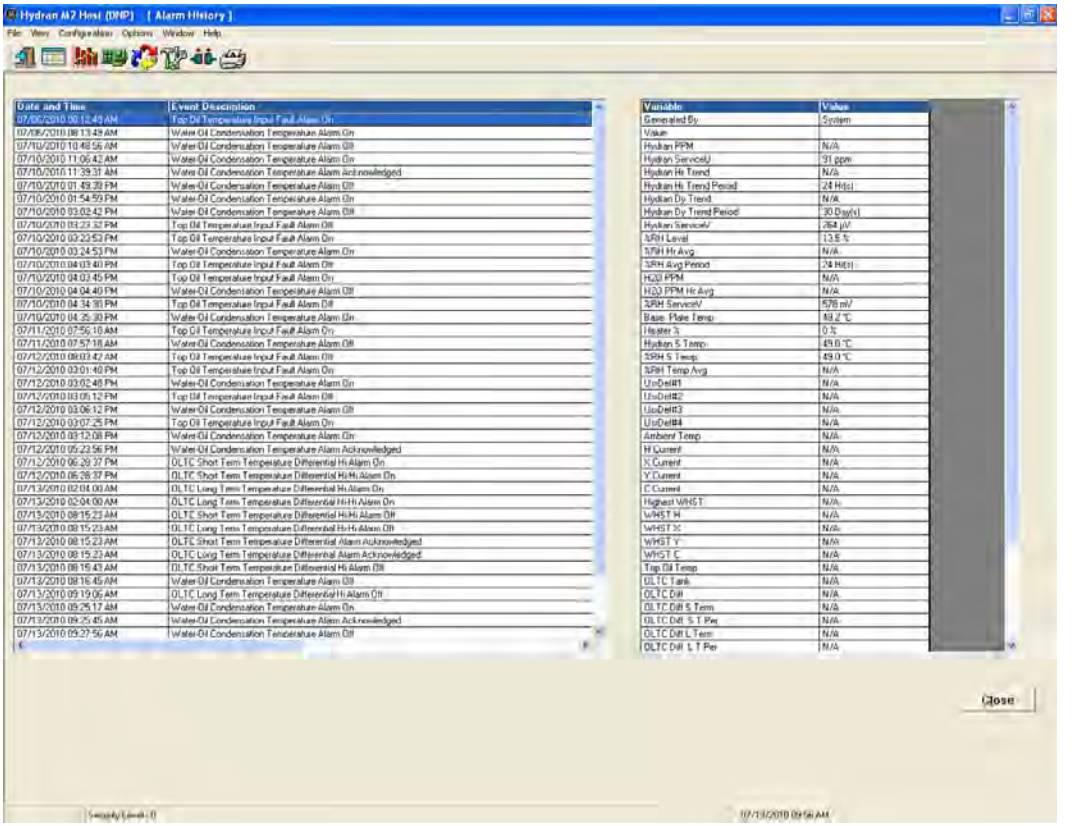


Figure 3-28 - Other History Types

3.3.4.2 Viewing Short Term, Long Term or Service History in Graphical Format

Only the **Short Term**, **Long Term** and **Service** histories can be viewed in a graph. Proceed as follows:

- In the **View Menu**, select **History**.
- In Figure 3-25 on page 3-24, select **Short Term**, **Long Term** or **Service** in the **History** drop-down list.
- In the **Type** drop-down list, select **Graphical**, and this box becomes as shown in Figure 3-29 on page 3-29.
- Select the **Start Date** and the **End Date** for the data to be downloaded.
- Select [✓] up to ten parameters by clicking their name or the checkbox to the left of each name.

- If the user tries to add an eleventh parameter, a message box similar to Figure 3-39 on page 3-39 appears. Click **OK** and remove [ ] at least one parameter.
- To close the box without generating a graph, click **Close** or the **X** in the top right corner.
- To generate a graph, click **OK**.

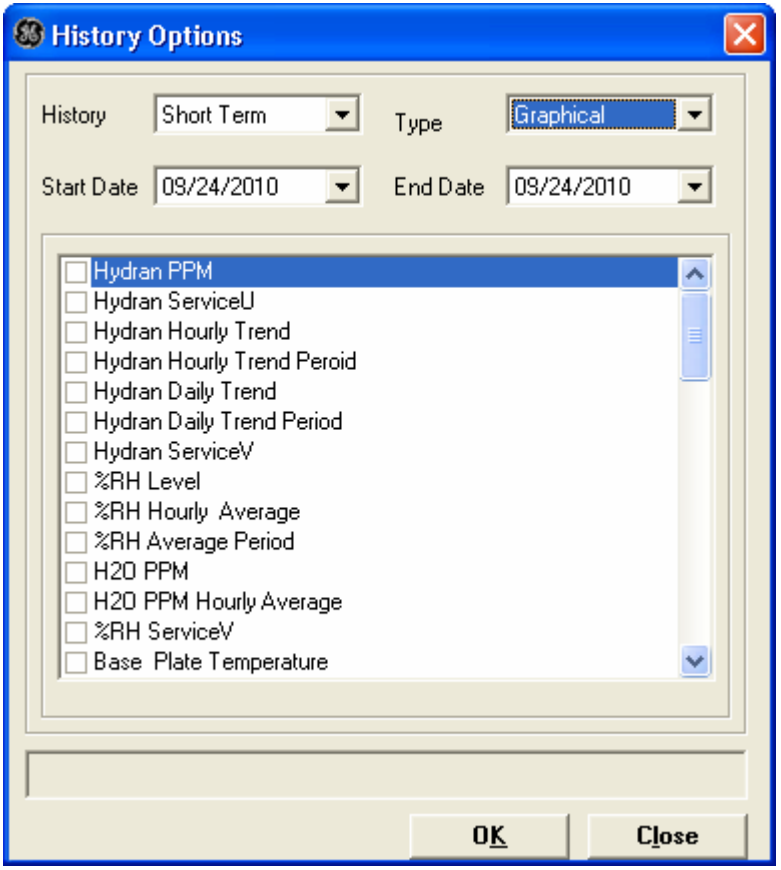


*Figure 3-29 - **History Options** Box in Graphical Format*

If the desired type of History is unavailable during the selected period of time, the **Proceeding to Download History** message box shown in Figure 3-26 on page 3-26 appears.

- Click **OK**.
- Wait for the History data to transfer from the Hydran M2 to the PC.

*Note: The History download time is not proportional to the date range selected, but rather on how much time has passed since the last History download. When **OK** is clicked, all records of the selected type of History not currently in the PC's database are downloaded to ensure that the PC is completely up to date.*

Once the History has finished downloading, it is displayed in a graph similar to Figure 3-20 on page 3-21.

Note: The settings available for all graphs are described in Chapter 5.

3.3.4.3 Exporting History

The History logs can also be exported to a Microsoft Excel or text file to be compatible with other office tools. Proceed as follows:

- In the **View Menu**, select **History**.
- In Figure 3-25 on page 3-24, select the desired type in the **History** drop-down list.
- In the **Type** drop-down list, select **Export**, and this box becomes as shown in Figure 3-30 on page 3-31.
- Select the format **Excel**.
- Select the **Start Date** and the **End Date** for the data to be downloaded.
- Select [✓] the desired parameters by clicking their name or the checkbox to the left of each name, or click **Select All** if all are needed.
- To close the box without generating a file, click **Close** or the **X** in the top right corner.
- To generate a file, click **OK**.

If the desired type of History is unavailable during the selected period of time, the **Proceeding to Download History** message box shown in Figure 3-26 on page 3-26 appears.

- Click **OK**.
- Wait for the History data to transfer from the Hydran M2 to the PC.

*Note: The History download time is not proportional to the date range selected, but rather on how much time has passed since the last History download. When **OK** is clicked, all records of the selected type of History not currently in the PC's database are downloaded to ensure that the PC is completely up to date.*

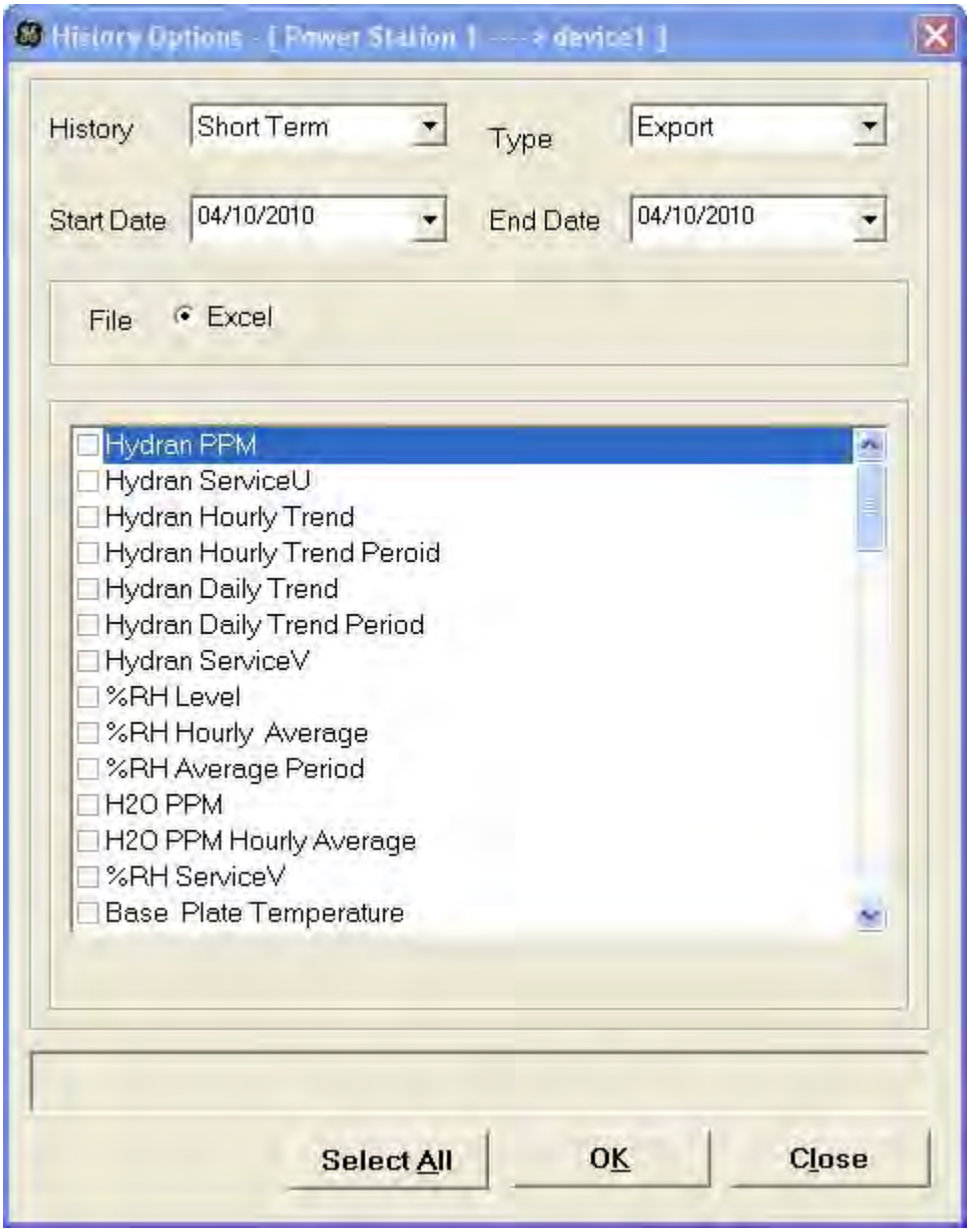


*Figure 3-30 - **History Options** Box in Export Format*

Once the History has finished downloading, an **Exported History** message box (see Figure 3-31 on page 3-32) appears to show the path and name of the file created. The files are saved in the **Export** subdirectory found in the Hydran M2 Host (DNP) installation directory; the default directory is **C:\Program Files\GE Energy\Hydran M2 Host (DNP)\Export**, which might have been modified in Figure 1-11 on page 1-12.

*Figure 3-31 - **Exported History** Message Box*

3.3.5 View & Update Last DGA

This function is used to enter DGA (Dissolved Gas Analysis) values obtained from oil sample tests so that the Hydran M2 can perform more accurate model computations.

In the **View Menu**, select **View & Update Last DGA**. The box shown in Figure 3-32 on page 3-33 is displayed. It presents the following data for the last DGA:

- The following gases, in ppm:
  - H_2: Hydrogen
  - CO: Carbon monoxide
  - CO_2: Carbon dioxide
  - CH_4: Methane
  - C_2H_6: Ethane
  - C_2H_4: Ethylene
  - C_2H_2: Acetylene
  - N_2: Nitrogen
  - O_2: Oxygen
  - H_2O: Water
- The computed value of the total gas content, in %
- The time stamp

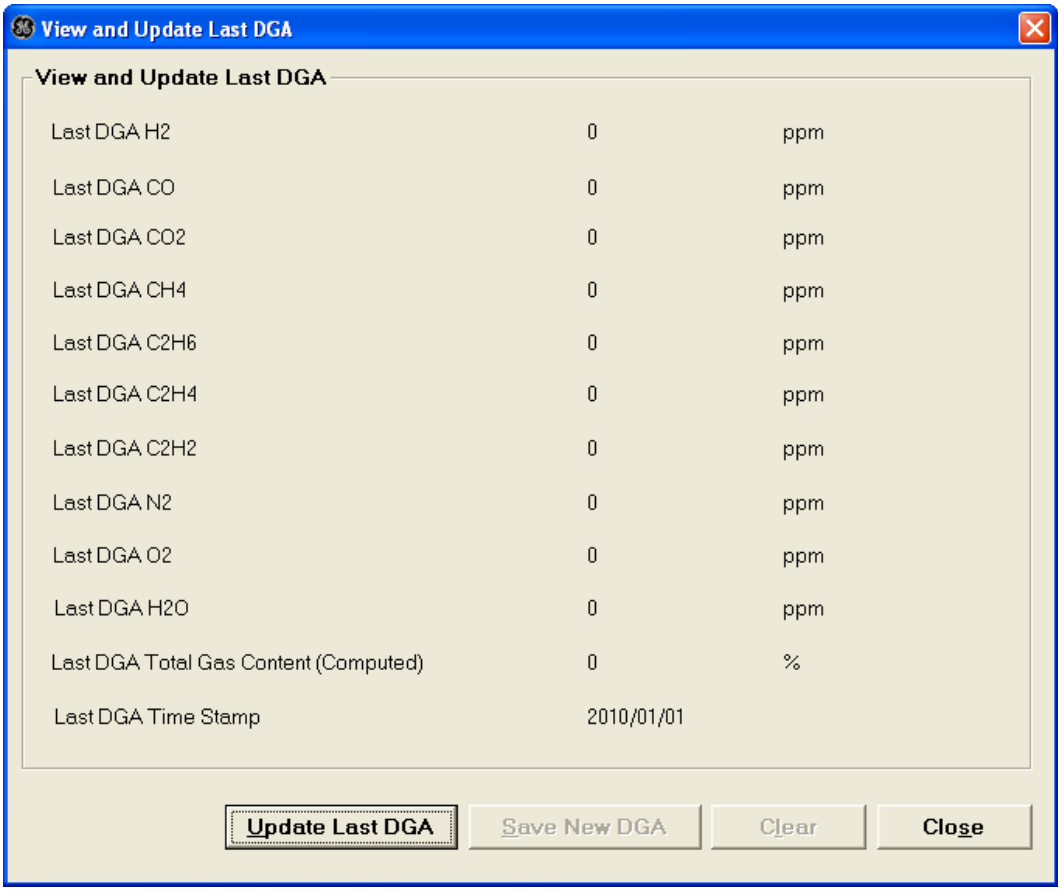


*Figure 3-32 - **View Last DGA** Box*

- To close this box, click **Close**.
- To update the last DGA or to enter a new one, click **Update Last DGA**. The fields can now be edited, as can be seen in Figure 3-33 on page 3-34.

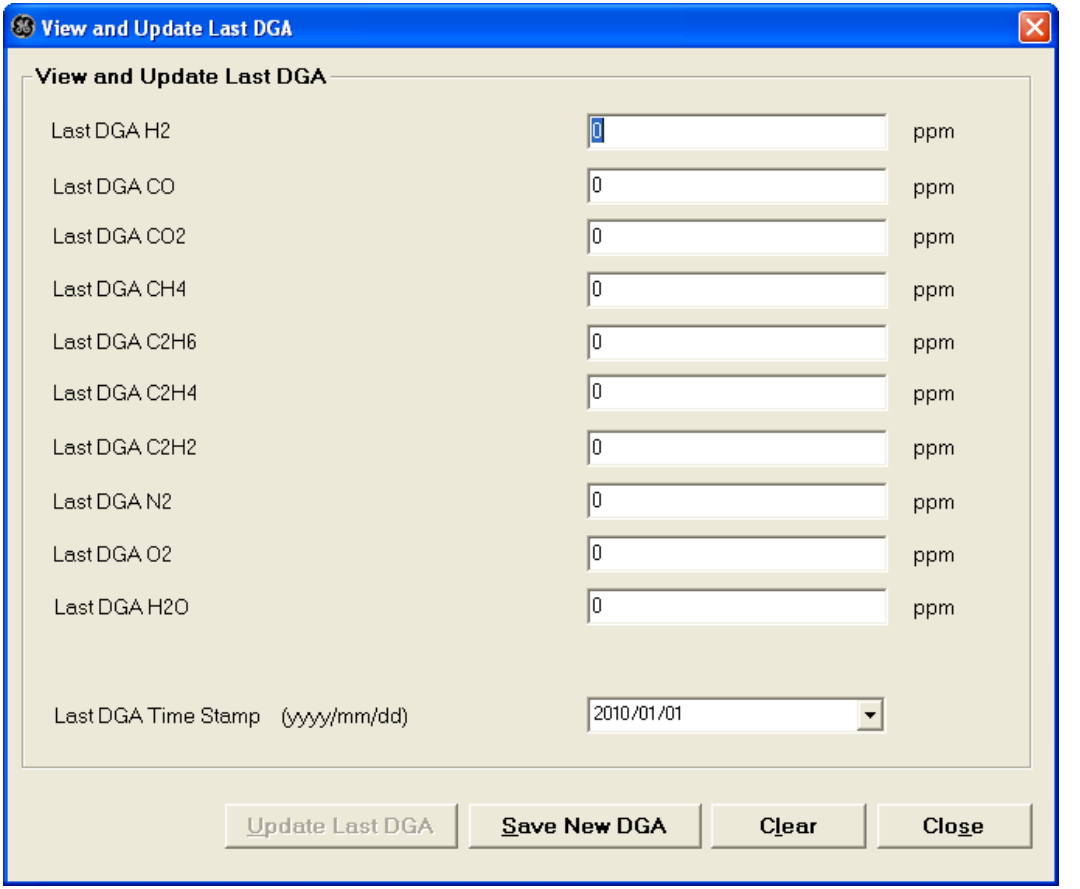


*Figure 3-33 - **Update Last DGA** Box*

- Update or enter the values for the various gases listed on page 3-32.
- Update or enter the time stamp.
- To clear the values displayed, click **Clear**.
- To save the new DGA, click **Save New DGA**.
- To close this box, click **Close**.

3.3.6 Test and Service

The **Test and Service** menu shows the status of the relays as well as the Hydran and moisture sensor parameters.

In the **View Menu**, select **Test and Service**. The **Reading Test and Service Values** progress box shown in Figure 3-34 on page 3-35 is displayed in the center of the screen.

*Figure 3-34 - **Reading Test and Service Values** Progress Box*

A few seconds later, the **Test** tab of the **Test and Service** window appears; see Figure 3-35 on page 3-35.

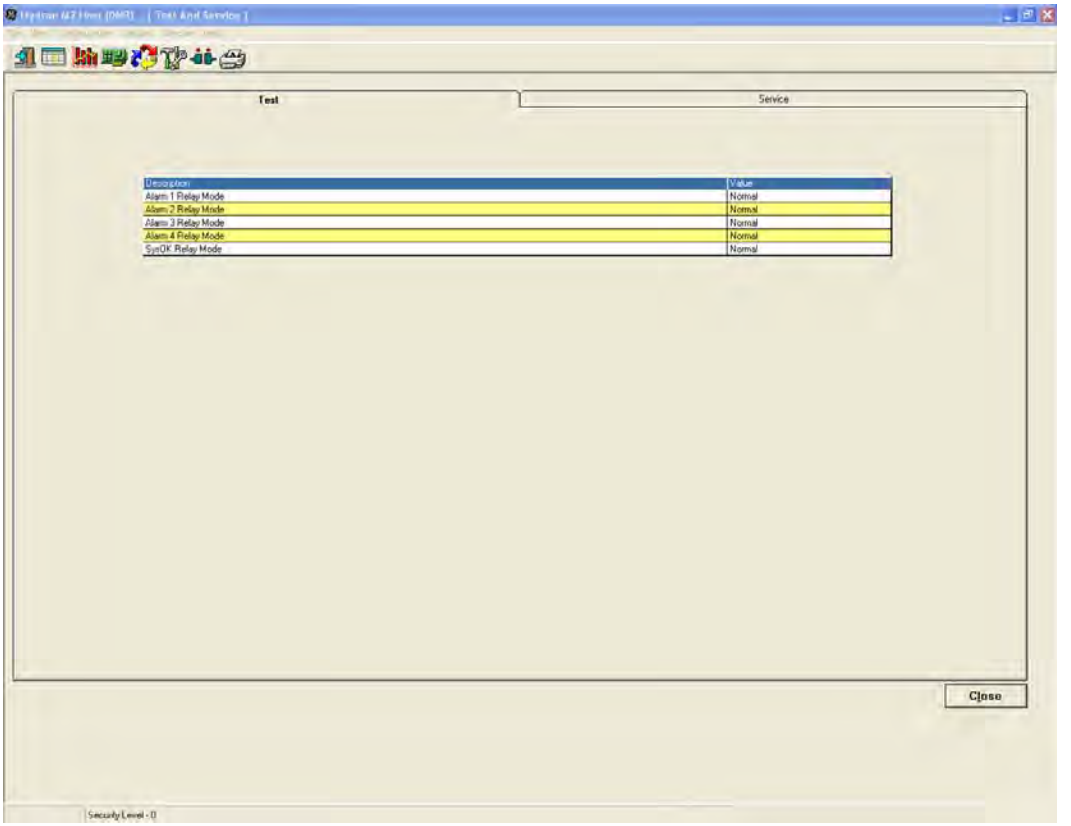


*Figure 3-35 - **Test** Tab of the **Test and Service** Window*

- The status of the relay modes **Alarm 1** to **Alarm 4** and **SysOK** is indicated.
- To close the window, click **Close** or the **X** in the top right corner.

To see the **Service** tab, click its name and it is displayed; see Figure 3-36 on page 3-36.

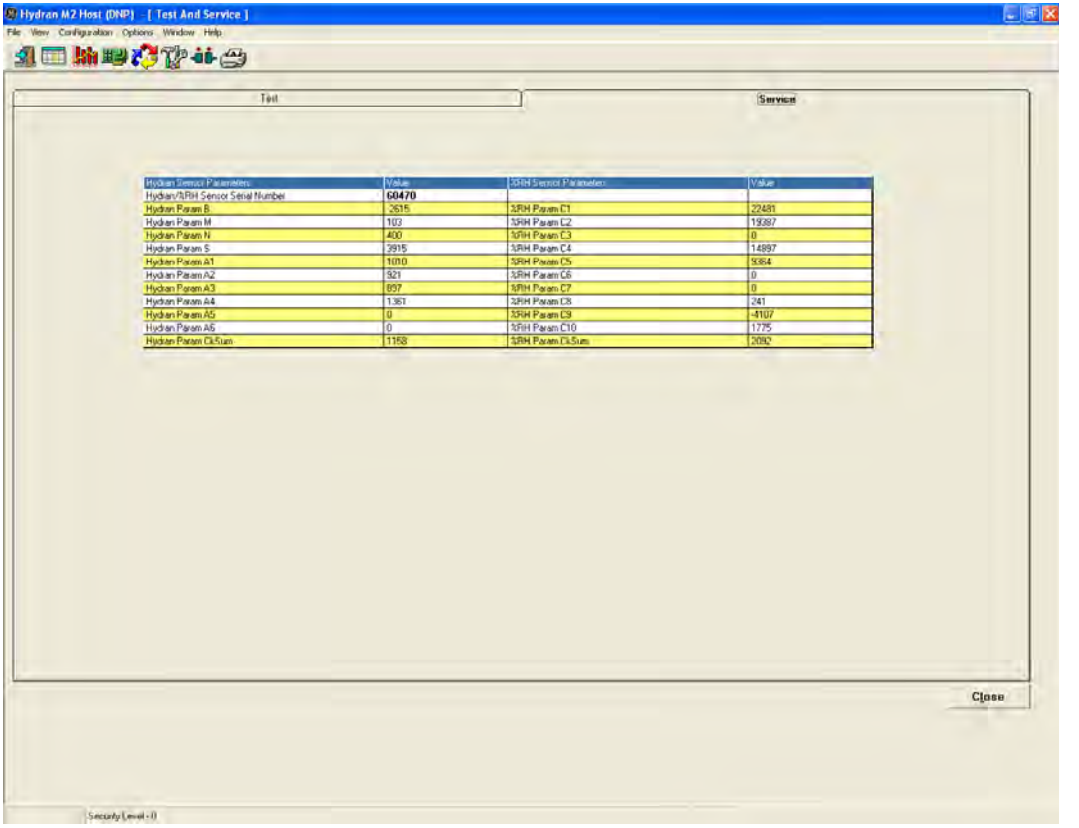


*Figure 3-36 - **Service** Tab of the **Test and Service** Window*

The following information is provided:

- Sensor serial number
- Hydran sensor:
  - Value of the parameters B, M, N, S and A1 to A6
  - Value of the parameters checksum
- Moisture sensor:
  - Value of the parameters C1 to C10
  - Value of the parameters checksum

To close the window, click **Close** or the **X** in the top right corner.

3.4 CONFIGURATION MENU

The **Configuration** menu is used to configure the different parameters, alarms, inputs, outputs and all other characteristics of the Hydran M2.

The **Configuration** menu includes five items:

- **Network View Parameter Selection** (Section 3.4.1 on page 3-37)
- **Setup** (Section 3.4.2 on page 3-39)
- **Test** (Section 3.4.3 on page 3-68)
- **Service** (Section 3.4.4 on page 3-71)
- **Display Settings** (Section 3.4.5 on page 3-81)

3.4.1 Network View Parameter Selection

This function is used to select which parameters are displayed in the **Network View** window (Figure 3-6 on page 3-6). Proceed as follows:

- In the **Network View** window (Figure 3-6 on page 3-6), select the desired Power Station.
- In the **Configuration** menu select **Network View Parameter Selection**, and the **Loading Network View Parameter Selection Values** progress box shown in Figure 3-37 on page 3-37 appears in the middle of the screen.

*Figure 3-37 - **Loading Network View Parameter Selection Values** Progress Box*

After a few seconds, the **Network View Parameter Selection** window shown in Figure 3-38 on page 3-38 is displayed. It is used to select up to five parameters that will be visible in the Power Station Network View.

- In the tree view in the left area, select the Device for which the real-time measurements, model values and input readings will be displayed.
- The center area lists all the parameters available for the selected Device.
- The right area shows all the parameters already assigned for the selected Device.
- To cancel the operation, click **Cancel** or the **X** in the top right corner.
- To add a parameter to the Device's Network View, highlight its name in the center area and click >. The selected parameter moves to the right area.

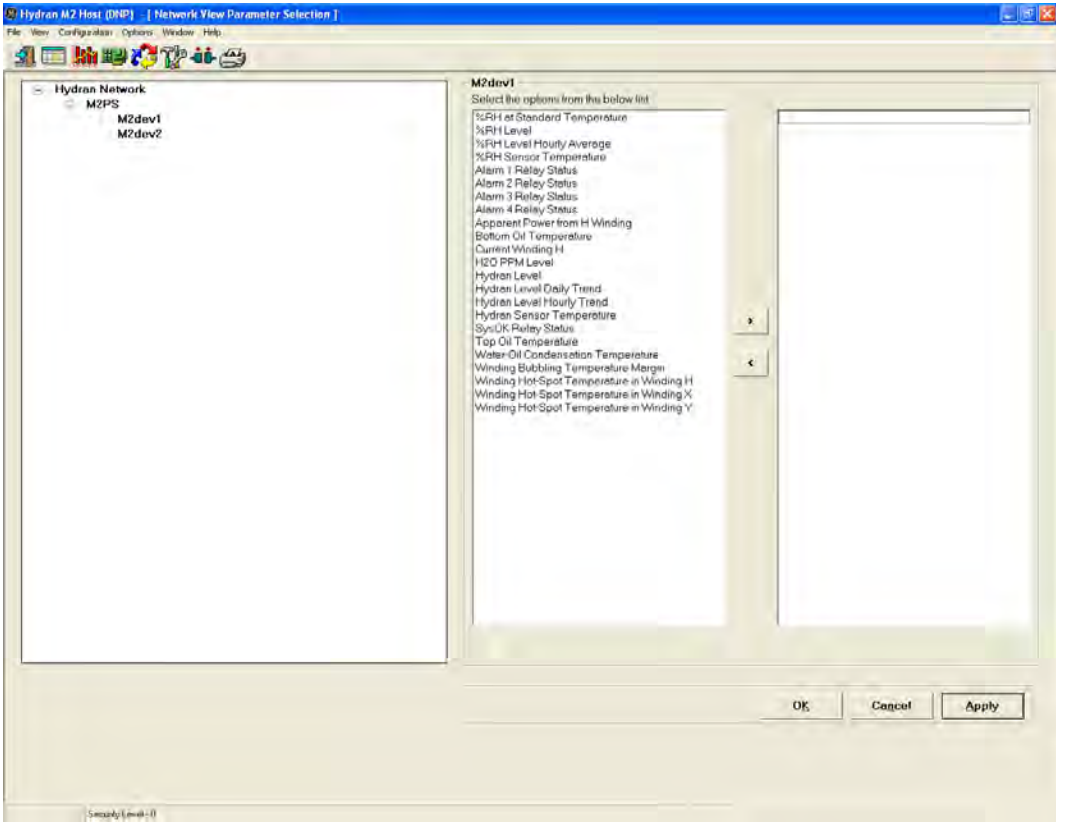


*Figure 3-38 - **Network View Parameter Selection** Window*

- To remove a parameter from the Device's Network View, highlight its name in the right area and click <. The selected parameter goes into the center area.
- As soon as the user adds a sixth parameter into the right area, the message box shown in Figure 3-39 on page 3-39 appears. Click **OK** and remove at least one parameter from the right area.
- When up to five parameters have been selected in Figure 3-38 on page 3-38, click **Apply** and then **OK**.

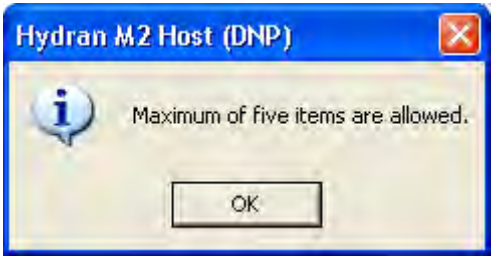


*Figure 3-39 - **Maximum Five Items Allowed** Box*

3.4.2 Setup

The **Setup** function is used to configure the Input/Output modules, alarms, models and history in the Hydran M2 Host (DNP) software. In the **Configuration** menu select **Setup**, or click the button shown on the right.

The **Loading Device Data** progress box shown in Figure 3-40 on page 3-39 is displayed in the center of the screen.

*Figure 3-40 - **Loading Device Data** Progress Box*

A few seconds later, the **Setup** window appears; see Figure 3-41 on page 3-40.

- The left side displays the **Setup** tree structure.
- To expand a node, click the **+** on its left.
- To collapse a node, click the **-** on its left.
- To see (on the right side) the parameters of an item, select its name on the left side.
- To apply the modifications brought to parameters, click **Apply**.
- To exit this box without applying the modifications, click **Cancel** or the **X** in the top right corner.

The expanded **Setup** tree structure is shown in Figure 3-42 on page 3-40.

*Note: If a value is changed and **Apply** or **OK** is not clicked before moving to another item, the **Values Modified** box shown in Figure 3-43 on page 3-41 appears to remind that the changes have not been saved. Click **Yes** to save the changes or **No** to refuse them.*

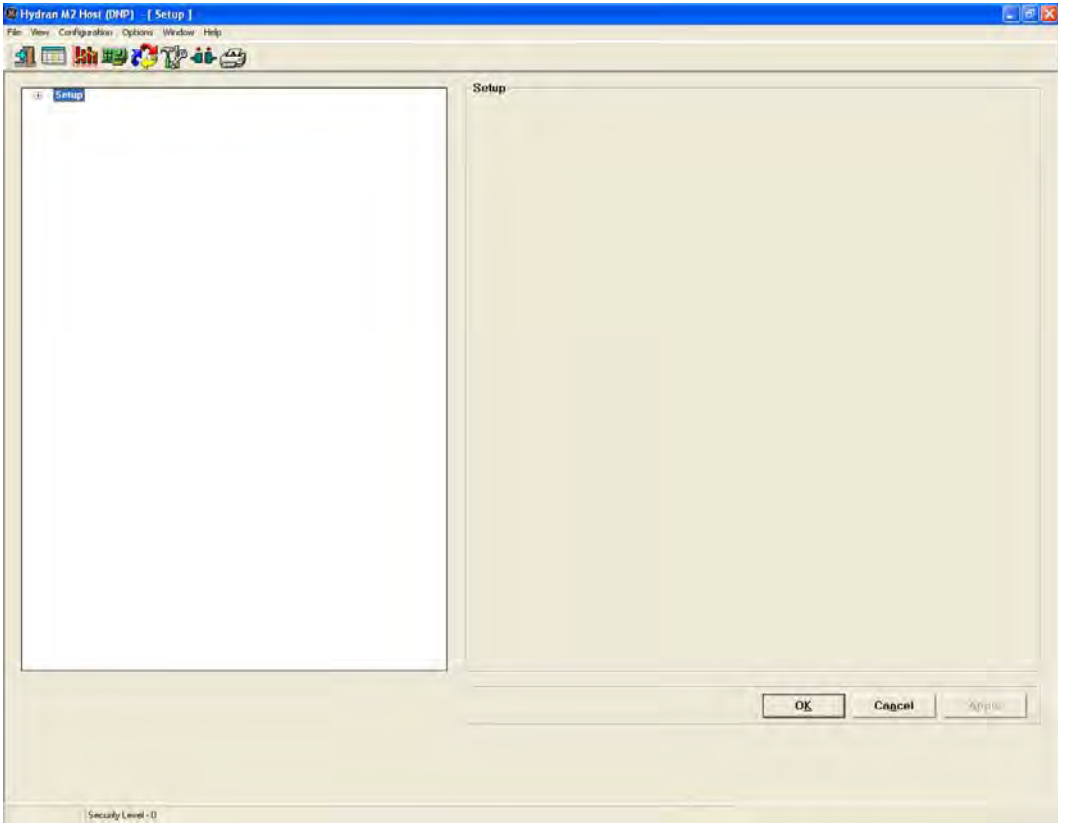


*Figure 3-41 - **Setup** Window*

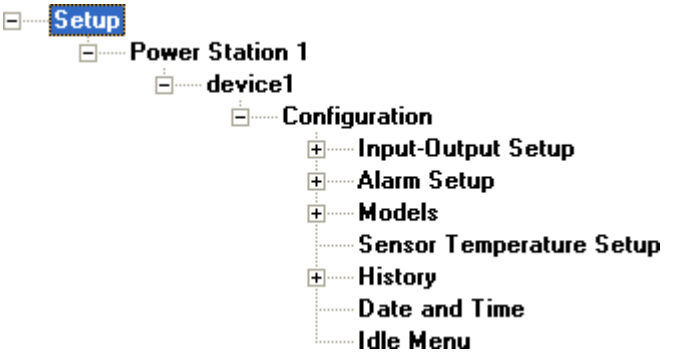


*Figure 3-42 - Expanded **Setup** Tree*

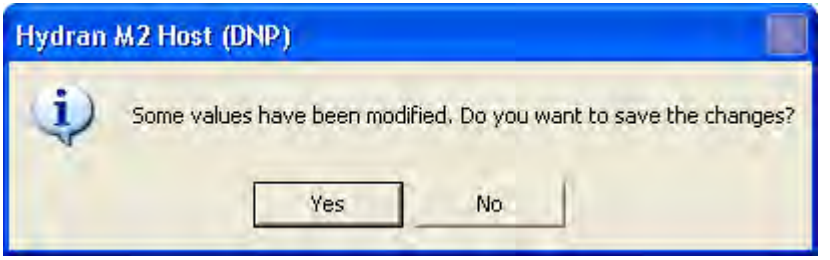


*Figure 3-43 - **Values Modified** Box*

3.4.2.1 Input-Output Setup

Input-Output Setup is used to configure the plugins and the communication port 2 used for RS-485 and TDM communication. Four plugin slots are available on the Hydran M2 to receive analog input, analog output and digital input cards.

Depending on the number and type of plugin cards, the Hydran M2 Host (DNP) software displays different data. Figure 3-44 on page 3-41 illustrates the expanded **Input-Output Setup** tree structure with four plugin slots full.

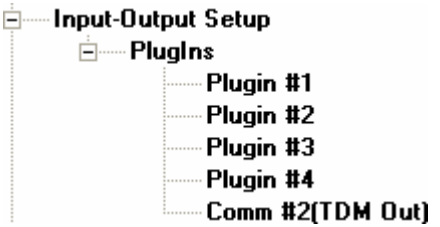


*Figure 3-44 - Expanded **Input-Output Setup** Tree*

3.4.2.1.1 Analog Input Plugin

When the plugin card is an analog input 4–20 mA card, the following information is displayed by clicking the plugin (see Figure 3-45 on page 3-42):

- Set the **Range** to **4-20 mA** if the input to the card is to be between 4 and 20 mA.
- Set the **Range** to **As Calibrated** if the input to the card is calibrated for different currents.
- **State**: the actual reading of the input card. **-25 %** means no input current is detected.
- **Value Selection**: the parameter that is represented by the input card. It can be set to:
  - **None**
  - **User defined**

– **Top Oil Temp**
– **OLTC Tank Temp**
– **Tap position**
– **Winding H Current**
– **Winding Y Current**
– **Winding X Current**
– **Ambient Temp**
– **Bottom Oil Temp**

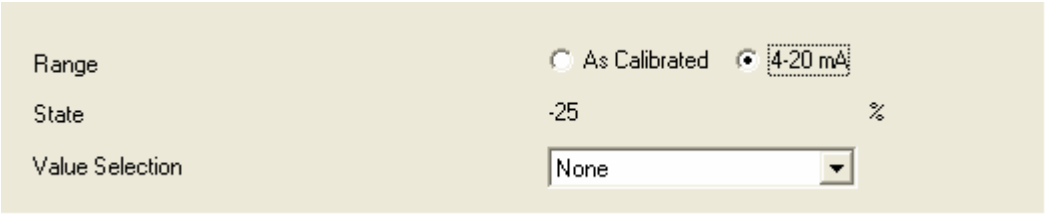


Figure 3-45 - Analog 4–20 mA Input Card

Proceed as follows:

- Select the desired settings.
- Click **Apply**.
- Click the + that appears to the left of the selected input (Plugin 1 in Figure 3-44 on page 3-41). The expanded plugin setup tree is displayed (see an example in Figure 3-46 on page 3-43, where the input has been set to **Top Oil Temperature**).
- Click the input parameter configuration (**Top Oil Temperature** in Figure 3-46 on page 3-43).

The properties to be changed differ depending on the parameter assigned to the input. If **Value Selection** has been set to **User defined** in Figure 3-45 on page 3-42, the entries shown in Figure 3-47 on page 3-43 appear.

- Enter the **Minimum Value** in %.
- Enter the **Maximum Value** in %.
- Enter the **Input Resolution** in %.
- To modify the input name, input units or reading precision, refer to Section 3.4.2.3 on page 3-61.
- When the input is set up as desired, click **Apply**.

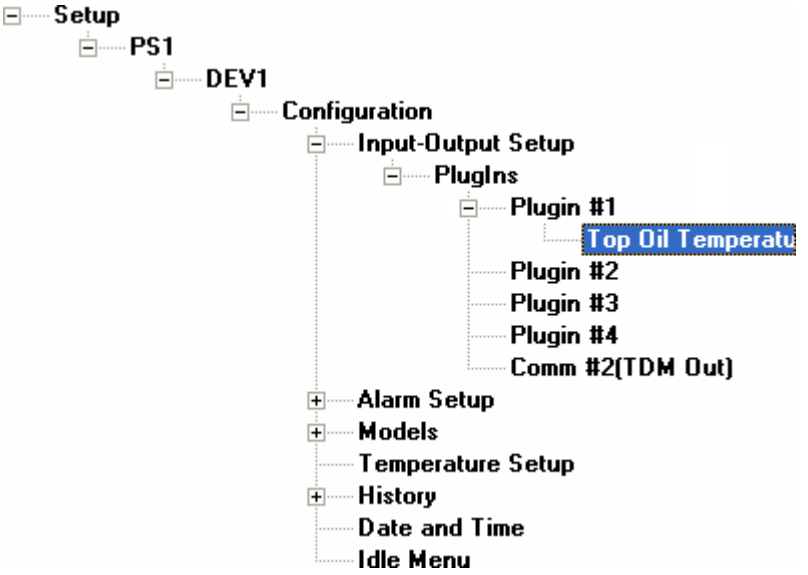


Figure 3-46 - Expanded Plugin Setup Tree

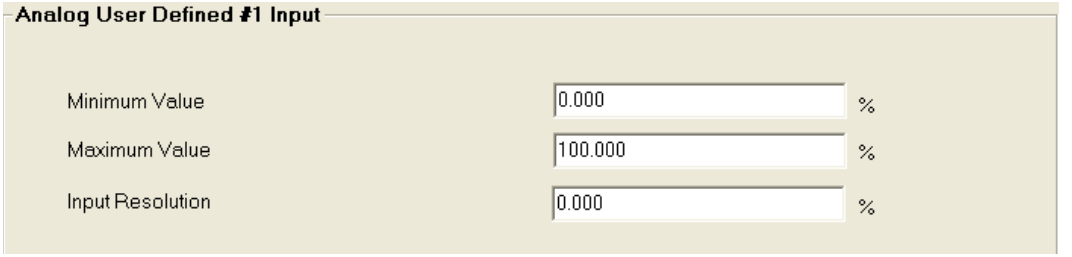


Figure 3-47 - Analog User Defined Input

3.4.2.1.2 Analog Output Plugin

When the plugin card is an analog output 4–20 mA card, the following information is displayed by clicking the plugin (see Figure 3-48 on page 3-44):

- Set the **Sample Rate** to the desired interval, in seconds.
- Set the **Minimum Value** that will correspond to an output of 4 mA.
- Set the **Maximum Value** that will correspond to an output of 20 mA.
- Set the **Mode** to **Normal** unless the output needs to be tested.

- **Reading To Output**: the parameter that is represented by the output card. It can be set to:
  - **None**
  - **%RH Level**
  - **H2O PPM Level**
  - **Hydran Level**
  - **Sensor Temp**
  - **%RH Temp**

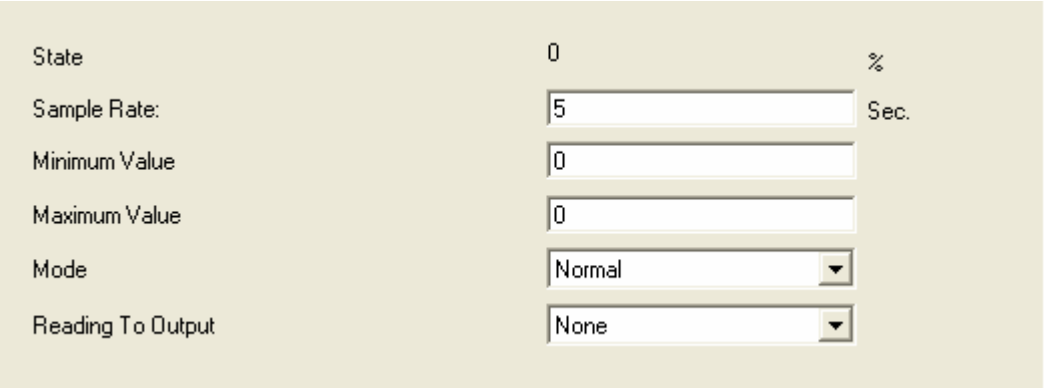


Figure 3-48 - Analog 4–20 mA Output Card

When the output is set up as desired, click **Apply**.

3.4.2.1.3 Digital Input Plugin

Each digital input card can be associated to two digital inputs. When the plugin card is a digital input card, click the plugin to obtain the information shown in Figure 3-49 on page 3-44.

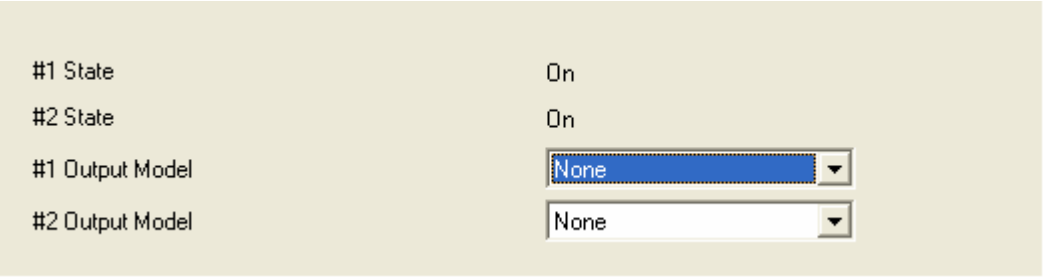


Figure 3-49 - Digital Input Card

- Assign to **#1 Output Model** one of the available parameters:
  - **None**
  - **Cooling Bank 1**
  - **Cooling Bank 2**
  - **Trans. Energized**
  - **User Defined**
- Repeat for **#2 Output Model**.
- Click **Apply**.
- Click the + that appears to the left of the selected input.
- Click the input parameter configuration.

3.4.2.1.4 Comm #2 Setup

The Comm #2 port is always plugged-in. It is used for RS-485 communication but can also be used as a TDM output. Click **Comm #2(TDM Out)** in Figure 3-44 on page 3-41, and the entries shown in Figure 3-50 on page 3-45 appear.

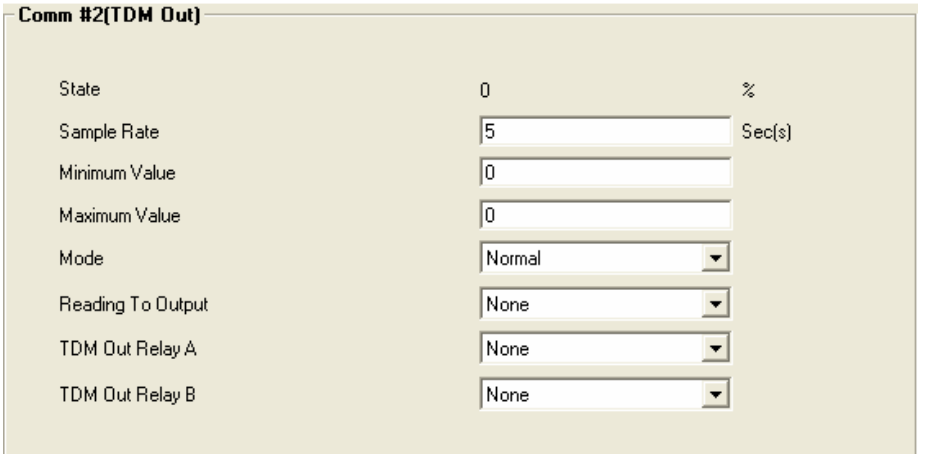


Figure 3-50 - Comm #2 Setup

- Set the **Sample Rate** to the desired interval, in seconds.
- Set the **Minimum Value** that will correspond to the TDM's minimum output.
- Set the **Maximum Value** that will correspond to the TDM's maximum output.
- Set the **Mode** to **Normal** unless the output needs to be tested.
- **Reading To Output**: the parameter that is represented by the output card. It can be set to:
  - **None**
  - **%RH Level**

  - **H2O PPM Level**
  - **Hydran Level**
  - **Sensor Temp**
  - **%RH Temp**
- Assign to **TDM Out Relay A** one of four relays (or **None**).
- Assign to **TDM Out Relay B** one of four relays (or **None**).
- Click **Apply**.

3.4.2.2 Alarm Setup

Appendix B presents the list of all alarm messages that can appear on the Hydran M2 Host (DNP) software. The **Alarm Setup** options are shown in the expanded tree view in Figure 3-51 on page 3-46.

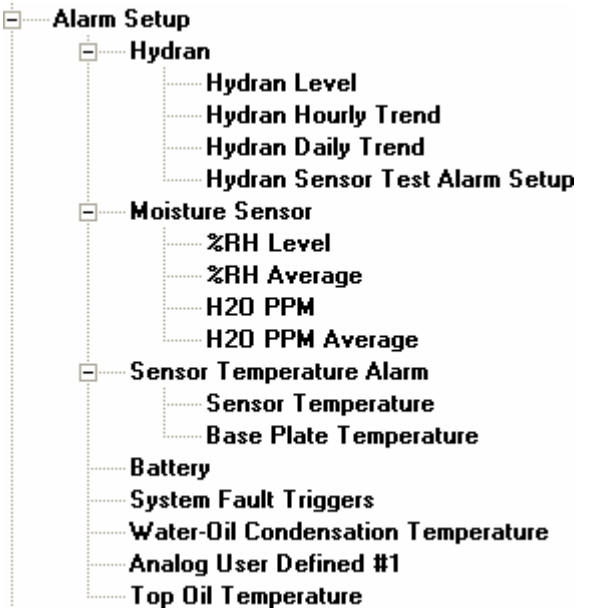


*Figure 3-51 - Expanded **Alarm** Tree*

There are several types of alarms associated with the Hydran M2 readings:

- Hydran alarms (Section 3.4.2.2.1 on page 3-47)
- Moisture alarms (Section 3.4.2.2.2 on page 3-51)
- Temperature alarms (Section 3.4.2.2.3 on page 3-54)

- Alarms due to system fault conditions
- Additional alarms that are available depending on the set inputs and models

For more details on which alarms are available with which model and associated inputs, see Chapter 6 to Chapter 14.

3.4.2.2.1 Hydran Alarms

In Figure 3-51 on page 3-46, click the + to the left of **Hydran**. There are four types of Hydran alarms that can be enabled or disabled:

- **Hydran Level**
- **Hydran Hourly Trend**
- **Hydran Daily Trend**
- **Hydran Sensor Test Alarm Setup**

In Figure 3-51 on page 3-46, click **Hydran Level**, and the menu shown in Figure 3-52 on page 3-47 is displayed on the right side.

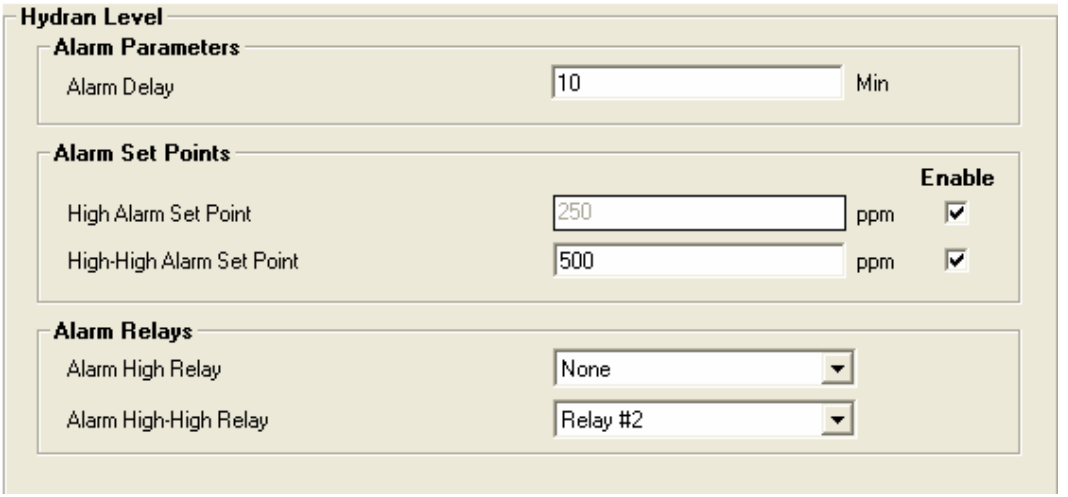


*Figure 3-52 - **Hydran Level** Alarm*

The following parameters can be adjusted:

- **Alarm Delay**, in minutes.

- Enable [✓] or disable [ ] the **High Alarm Set Point** and/or **High-High Alarm Set Point** by clicking the appropriate checkbox. Once an alarm is enabled, a check mark appears in the box and the Set Point becomes enabled.
- If the **High Alarm Set Point** and/or **High-High Alarm Set Point** is enabled, set their values in ppm.
- If required, assign an **Alarm High Relay** to the **High Alarm Set Point**.
- If required, assign an **Alarm High-High Relay** to the **High-High Alarm Set Point**.
- Click **Apply** to save the settings.

Note: There are only four relays available for all the alarms. Each relay can only accept one alarm. Ensure there is only a total of four alarms assigned to the relays.

In Figure 3-51 on page 3-46, click **Hydran Hourly Trend**, and the menu shown in Figure 3-53 on page 3-48 is displayed on the right side.

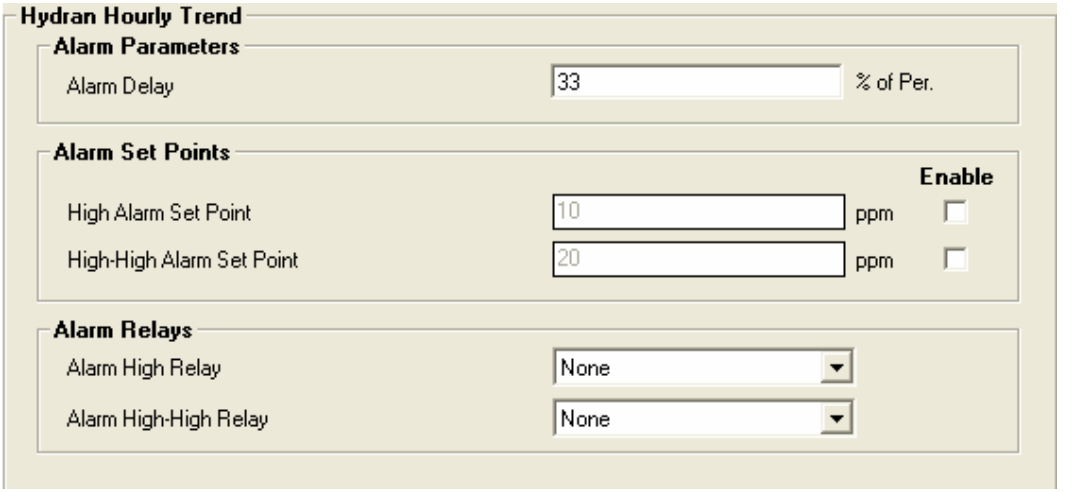


*Figure 3-53 - **Hydran Hourly Trend** Alarm*

The following parameters can be adjusted:

- **Alarm Delay**, in % of period.

Note: To set the period, refer to Section 3.4.2.3.1 on page 3-61.

- Enable [✓] or disable [ ] the **High Alarm Set Point** and/or **High-High Alarm Set Point** by clicking the appropriate checkbox. Once an alarm is enabled, a check mark appears in the box and the Set Point becomes enabled.
- If the **High Alarm Set Point** and/or **High-High Alarm Set Point** is enabled, set their values in ppm.
- If required, assign an **Alarm High Relay** to the **High Alarm Set Point**.
- If required, assign an **Alarm High-High Relay** to the **High-High Alarm Set Point**.
- Click **Apply** to save the settings.

In Figure 3-51 on page 3-46, click **Hydran Daily Trend**, and the menu shown in Figure 3-54 on page 3-49 is displayed on the right side.

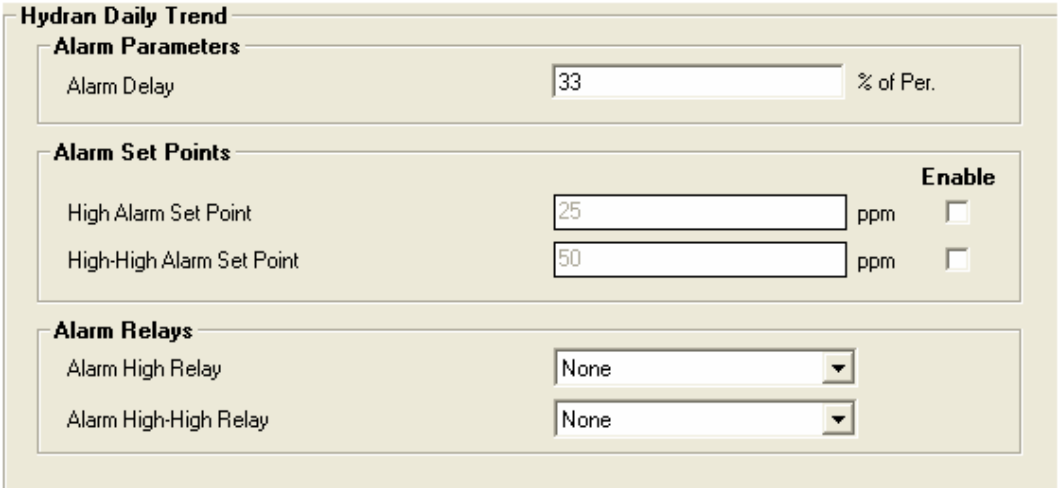


*Figure 3-54 - **Hydran Daily Trend** Alarm*

The following parameters can be adjusted:

- **Alarm Delay**, in % of period.

Note: To set the period, refer to Section 3.4.2.3.1 on page 3-61.

- Enable [✓] or disable [ ] the **High Alarm Set Point** and/or **High-High Alarm Set Point** by clicking the appropriate checkbox. Once an alarm is enabled, a check mark appears in the box and the Set Point becomes enabled.
- If the **High Alarm Set Point** and/or **High-High Alarm Set Point** is enabled, set their values in ppm.

- If required, assign an **Alarm High Relay** to the **High Alarm Set Point**.
- If required, assign an **Alarm High-High Relay** to the **High-High Alarm Set Point**.
- Click **Apply** to save the settings.

In Figure 3-51 on page 3-46, click **Hydran Sensor Test Alarm Setup**, and the menu shown in Figure 3-55 on page 3-50 is displayed on the right side.

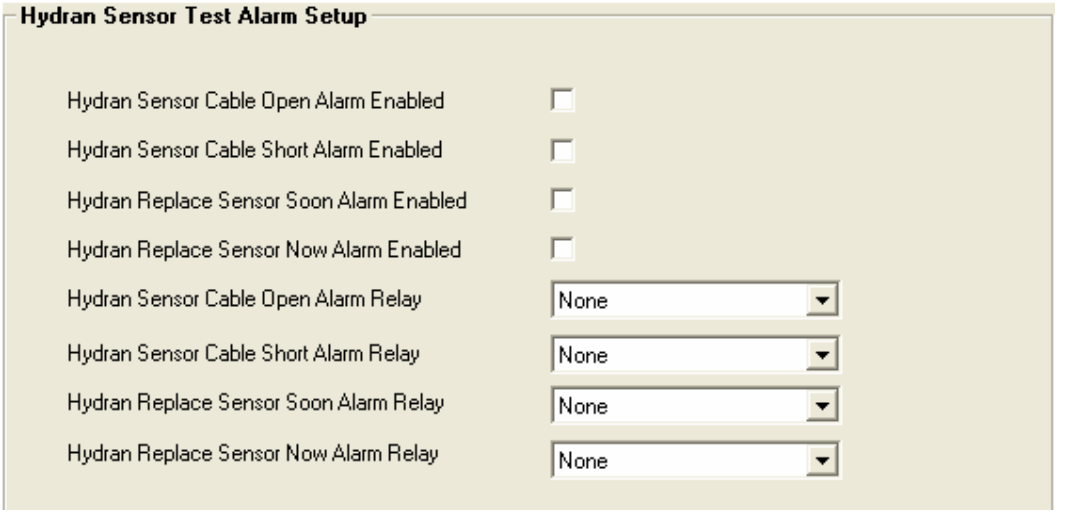


*Figure 3-55 - **Hydran Sensor Test** Alarm*

The following parameters can be adjusted:

- Enable [✓] or disable [ ] each of the following alarms by clicking the appropriate checkbox:
  - Sensor cable open
  - Sensor cable short
  - Replace sensor soon
  - Replace sensor now
- If required, assign a relay to the enabled alarms.
- Click **Apply** to save the settings.

3.4.2.2.2 Moisture Alarms

In Figure 3-51 on page 3-46, click the **+** to the left of **Moisture Sensor**. There are four types of moisture sensor alarms that can be enabled or disabled:

- **%RH Level**
- **%RH Average**
- **H2O PPM**
- **H2O PPM Average**

In Figure 3-51 on page 3-46, click **%RH Level**, and the menu shown in Figure 3-56 on page 3-51 is displayed on the right side.

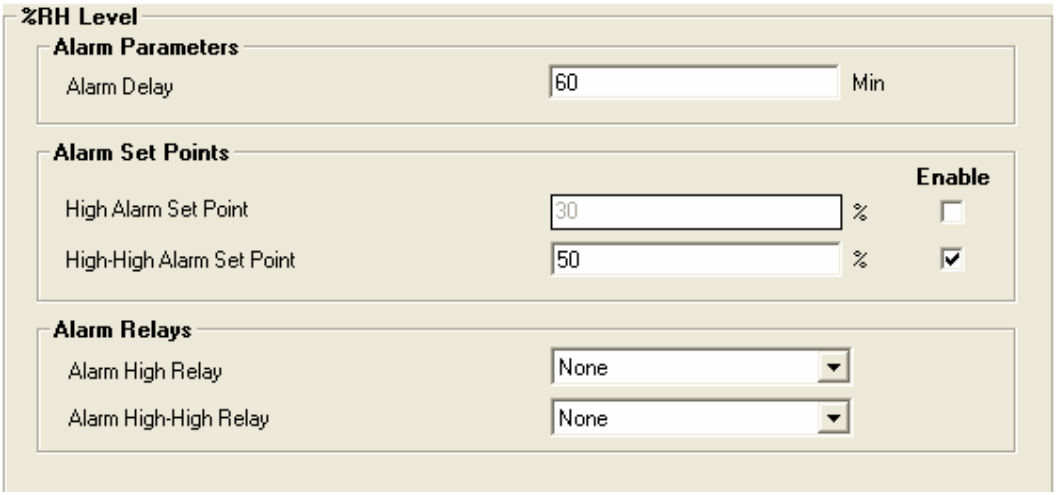


*Figure 3-56 - **%RH Level** Alarm*

The following parameters can be adjusted:

- **Alarm Delay**, in minutes.
- Enable [✓] or disable [ ] the **High Alarm Set Point** and/or **High-High Alarm Set Point** by clicking the appropriate checkbox. Once an alarm is enabled, a check mark appears in the box and the Set Point becomes enabled.
- If the **High Alarm Set Point** and/or **High-High Alarm Set Point** is enabled, set their values in %.
- If required, assign an **Alarm High Relay** to the **High Alarm Set Point**.

- If required, assign an **Alarm High-High Relay** to the **High-High Alarm Set Point**.
- Click **Apply** to save the settings.

In Figure 3-51 on page 3-46, click **%RH Average**, and the menu shown in Figure 3-57 on page 3-52 is displayed on the right side.

*Figure 3-57 - **%RH Average** Alarm*

The following parameters can be adjusted:

- **Alarm Delay**, in % of period.

Note: To set the period, refer to Section 3.4.2.3.2 on page 3-62.

- Enable [✓] or disable [ ] the **High Alarm Set Point** and/or **High-High Alarm Set Point** by clicking the appropriate checkbox. Once an alarm is enabled, a check mark appears in the box and the Set Point becomes enabled.
- If the **High Alarm Set Point** and/or **High-High Alarm Set Point** is enabled, set their values in %.
- If required, assign an **Alarm High Relay** to the **High Alarm Set Point**.
- If required, assign an **Alarm High-High Relay** to the **High-High Alarm Set Point**.
- Click **Apply** to save the settings.

In Figure 3-51 on page 3-46, click **H2O PPM**, and the menu shown in Figure 3-58 on page 3-53 is displayed on the right side.

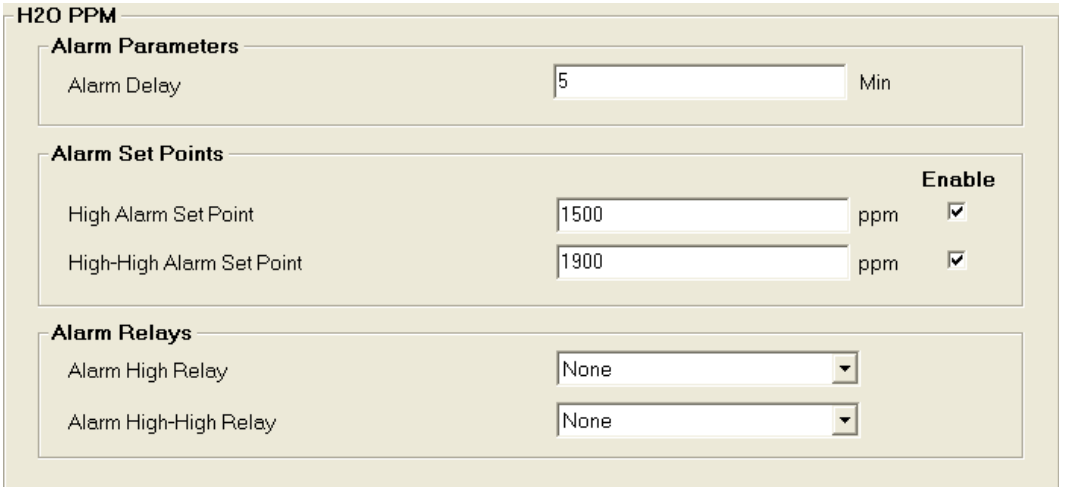


*Figure 3-58 - **H2O PPM** Alarm*

The following parameters can be adjusted:

- **Alarm Delay**, in minutes.
- Enable [✓] or disable [ ] the **High Alarm Set Point** and/or **High-High Alarm Set Point** by clicking the appropriate checkbox. Once an alarm is enabled, a check mark appears in the box and the Set Point becomes enabled.
- If the **High Alarm Set Point** and/or **High-High Alarm Set Point** is enabled, set their values in ppm.
- If required, assign an **Alarm High Relay** to the **High Alarm Set Point**.
- If required, assign an **Alarm High-High Relay** to the **High-High Alarm Set Point**.
- Click **Apply** to save the settings.

In Figure 3-51 on page 3-46, click **H2O PPM Average**, and the menu shown in Figure 3-59 on page 3-54 is displayed on the right side.

The following parameters can be adjusted:

- **Alarm Delay**, in % of period.

Note: To set the period, refer to Section 3.4.2.3.2 on page 3-62.

- Enable [✓] or disable [ ] the **High Alarm Set Point** and/or **High-High Alarm Set Point** by clicking the appropriate checkbox. Once an alarm is enabled, a check mark appears in the box and the Set Point becomes enabled.
- If the **High Alarm Set Point** and/or **High-High Alarm Set Point** is enabled, set their values in ppm.
- If required, assign an **Alarm High Relay** to the **High Alarm Set Point**.
- If required, assign an **Alarm High-High Relay** to the **High-High Alarm Set Point**.
- Click **Apply** to save the settings.

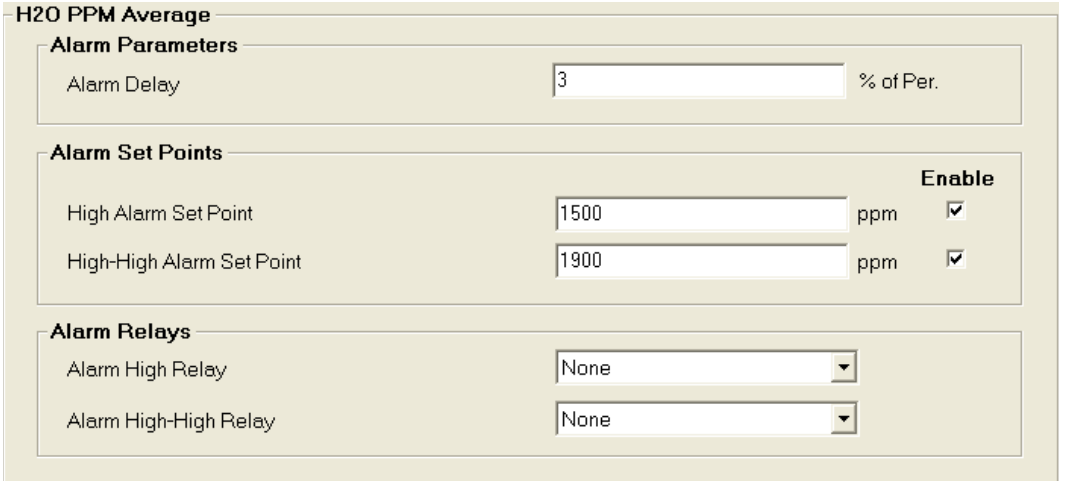


*Figure 3-59 - **H2O PPM Average** Alarm*

3.4.2.2.3 Sensor Temperature Alarm

In Figure 3-51 on page 3-46, click the + to the left of **Sensor Temperature Alarm**. There are two types of sensor temperature alarms that can be enabled or disabled:

- **Sensor Temperature**
- **Base Plate Temperature**

In Figure 3-51 on page 3-46, click **Sensor Temperature**, and the menu shown in Figure 3-60 on page 3-55 is displayed on the right side.

The following parameters can be adjusted:

- **Alarm Delay**, in minutes.

- Enable [✓] or disable [ ] the **Low-Low Alarm Set Point**, **Low Alarm Set Point**, **High Alarm Set Point** and/or **High-High Alarm Set Point** by clicking the appropriate checkbox. Once an alarm is enabled, a check mark appears in the box and the Set Point becomes enabled.
- If the **Low-Low Alarm Set Point**, **Low Alarm Set Point**, **High Alarm Set Point** and/or **High-High Alarm Set Point** is enabled, set their values in °C.
- Enable [✓] or disable [ ] the **Input Fault Alarm** by clicking the appropriate checkbox. Once this alarm is enabled, a check mark appears in the box.
- If required, assign an **Alarm Low-Low Relay** to the **Low-Low Alarm Set Point**.
- If required, assign an **Alarm Low Relay** to the **Low Alarm Set Point**.
- If required, assign an **Alarm High Relay** to the **High Alarm Set Point**.
- If required, assign an **Alarm High-High Relay** to the **High-High Alarm Set Point**.
- Click **Apply** to save the settings.

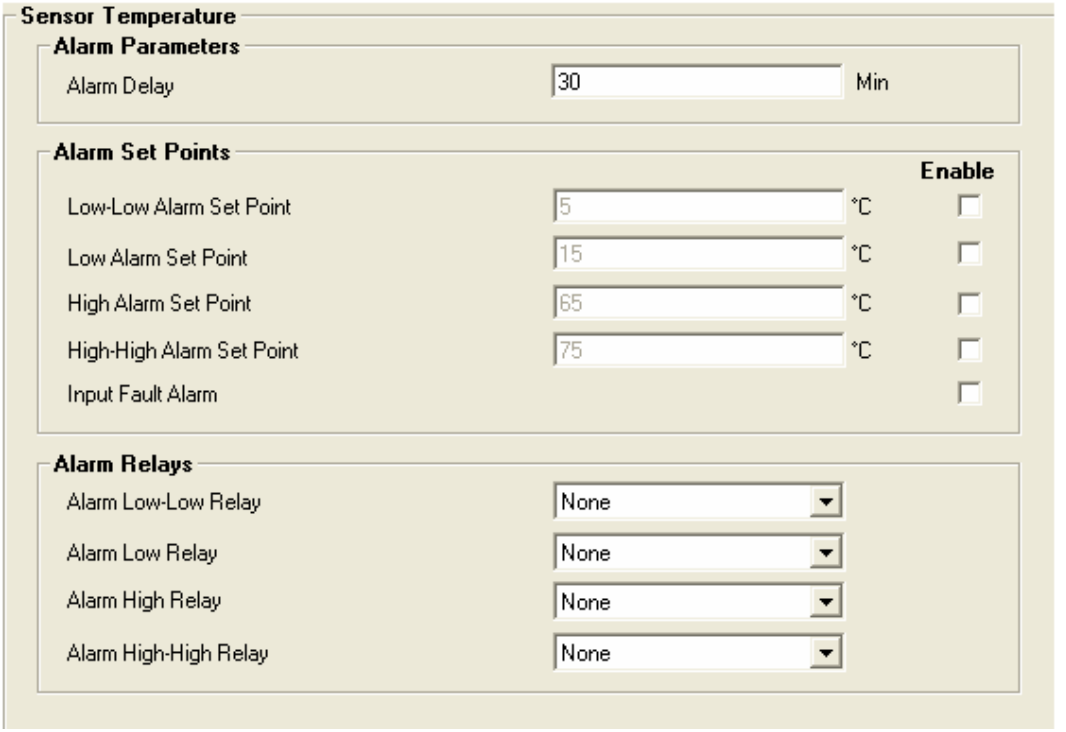


Figure 3-60 - ***Sensor Temperature*** *Alarm*

In Figure 3-51 on page 3-46, click **Base Plate Temperature**, and the menu shown in Figure 3-61 on page 3-56 is displayed on the right side.

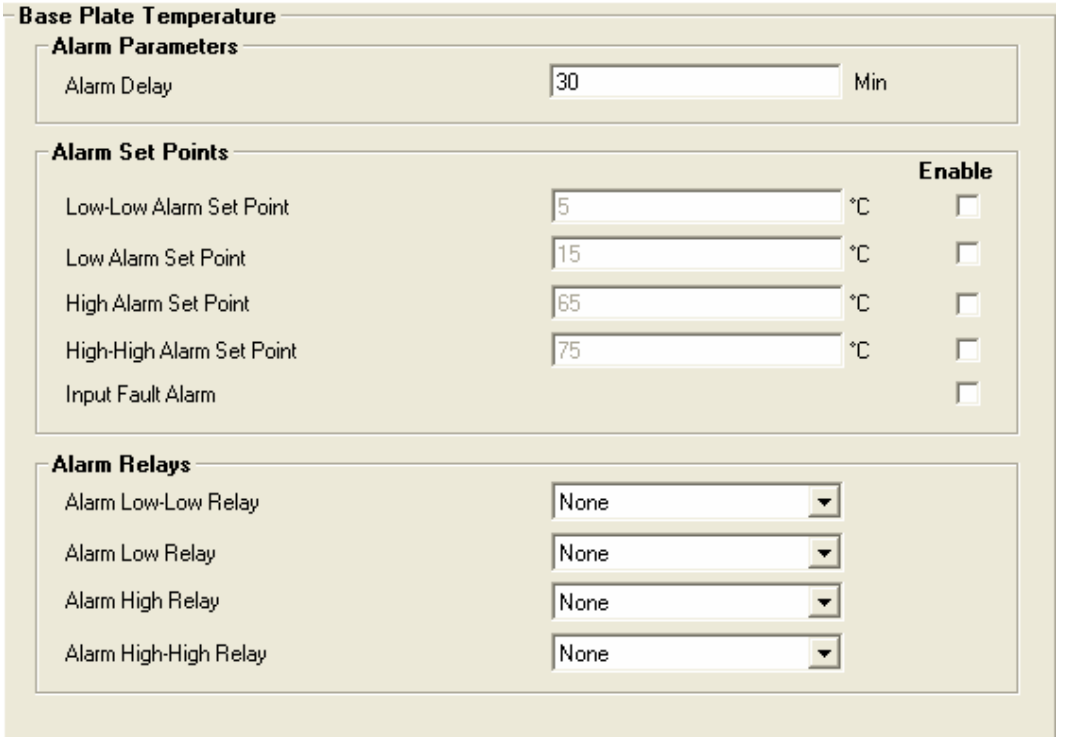


*Figure 3-61 - **Base Plate Temperature** Alarm*

The following parameters can be adjusted:

- **Alarm Delay**, in minutes.
- Enable [✓] or disable [ ] the **Low-Low Alarm Set Point**, **Low Alarm Set Point**, **High Alarm Set Point** and/or **High-High Alarm Set Point** by clicking the appropriate checkbox. Once an alarm is enabled, a check mark appears in the box and the Set Point becomes enabled.
- If the **Low-Low Alarm Set Point**, **Low Alarm Set Point**, **High Alarm Set Point** and/or **High-High Alarm Set Point** is enabled, set their values in °C.
- Enable [✓] or disable [ ] the **Input Fault Alarm** by clicking the appropriate checkbox. Once this alarm is enabled, a check mark appears in the box.
- If required, assign an **Alarm Low-Low Relay** to the **Low-Low Alarm Set Point**.

- If required, assign an **Alarm Low Relay** to the **Low Alarm Set Point**.
- If required, assign an **Alarm High Relay** to the **High Alarm Set Point**.
- If required, assign an **Alarm High-High Relay** to the **High-High Alarm Set Point**.
- Click **Apply** to save the settings.

3.4.2.2.4 Battery Alarm

The battery alarm is used to monitor the internal battery in the Hydran M2 that keeps the data in memory when the Hydran M2 is not powered.

In Figure 3-51 on page 3-46, click **Battery**, and the menu shown in Figure 3-62 on page 3-57 is displayed on the right side.

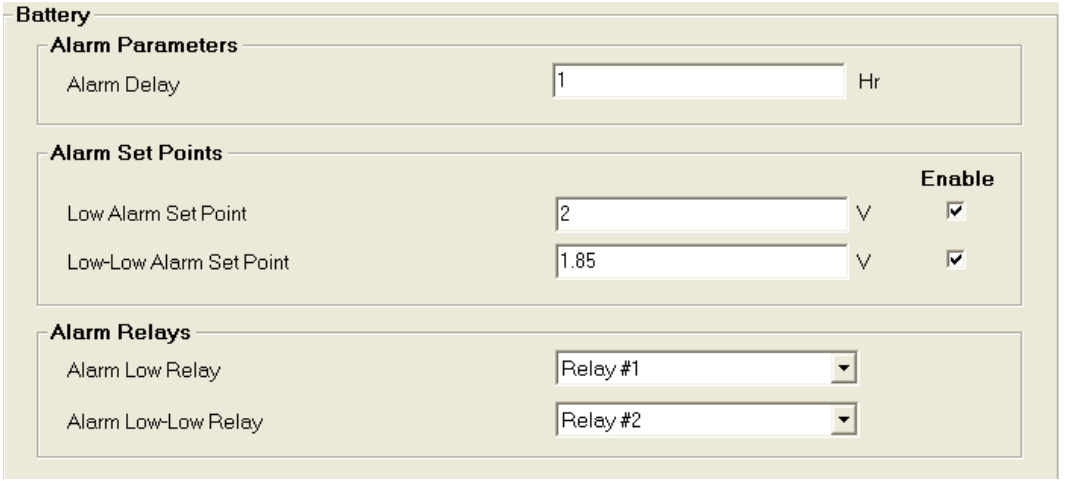


*Figure 3-62 - **Battery** Alarm*

The following parameters can be adjusted:

- **Alarm Delay**, in hours.
- Enable [✓] or disable [ ] the **Low Alarm Set Point** and/or **Low-Low Alarm Set Point** by clicking the appropriate checkbox. Once an alarm is enabled, a check mark appears in the box and the Set Point becomes enabled.
- If the **Low Alarm Set Point** and/or **Low-Low Alarm Set Point** is enabled, set their values in volts.
- If required, assign an **Alarm Low Relay** to the **Low Alarm Set Point**.
- If required, assign an **Alarm Low-Low Relay** to the **Low-Low Alarm Set Point**.

- Click **Apply** to save the settings.

3.4.2.2.5 System Fault Triggers

When enabled, the System Fault Trigger alarms will turn on the System OK relay. This serves to show that there might be a problem with the Hydran M2.

In Figure 3-51 on page 3-46, click **System Fault Triggers**, and the menu shown in Figure 3-63 on page 3-58 is displayed on the right side.

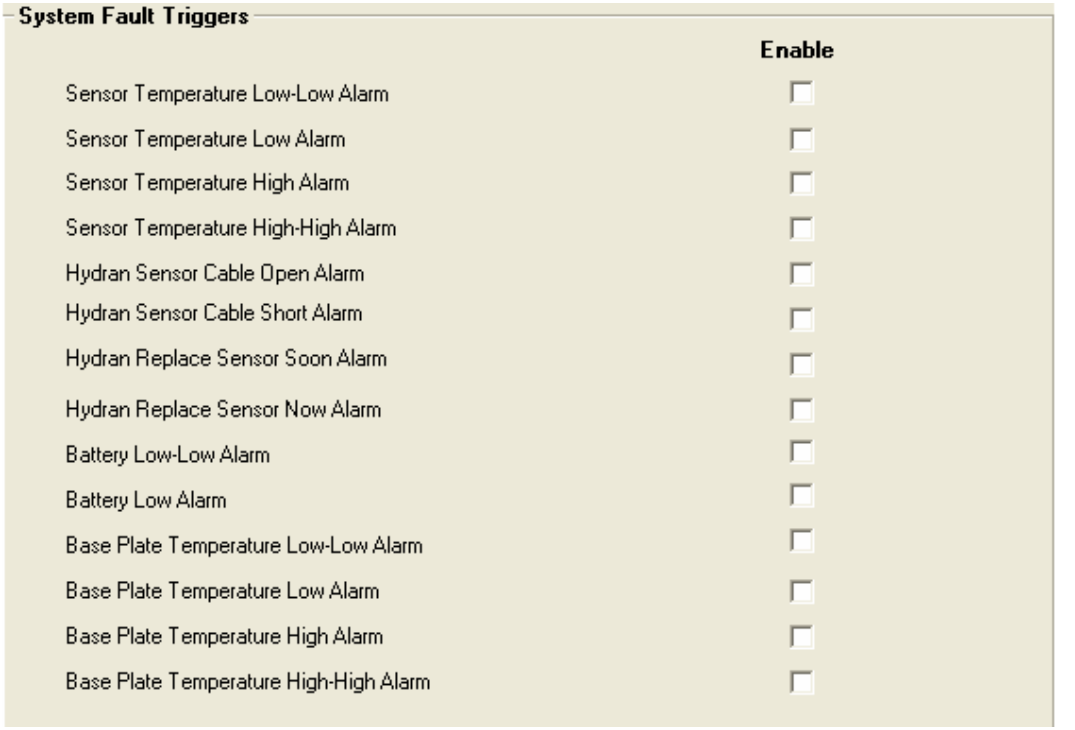


Figure 3-63 - System Fault Triggers

Enable [✓] or disable [ ] the following alarms:

- **Low-Low Alarm**, **Low Alarm**, **High Alarm** and/or **High-High Alarm** for the sensor temperature
- **Cable Open Alarm** and/or **Cable Short Alarm** for the Hydran sensor
- **Replace Sensor Soon Alarm** and/or **Replace Sensor Now Alarm** for the Hydran sensor

- **Low-Low Alarm** and/or **Low Alarm** for the battery
- **Low-Low Alarm**, **Low Alarm**, **High Alarm** and/or **High-High Alarm** for the base plate temperature

Click **Apply** to save the settings.

3.4.2.2.6 Water-Oil Condensation Temperature Alarm

In Figure 3-51 on page 3-46, click **Water-Oil Condensation Temperature**, and the menu shown in Figure 3-64 on page 3-59 is displayed on the right side.

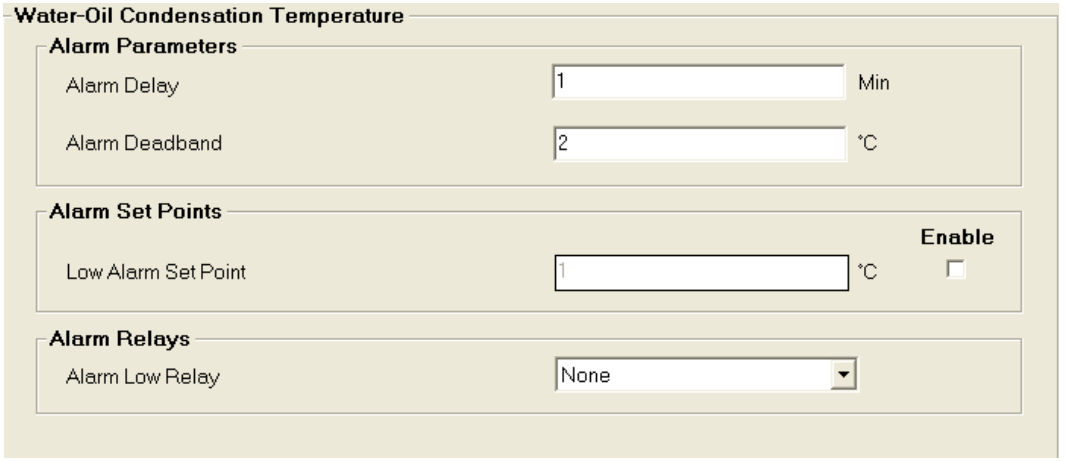


*Figure 3-64 - **Water-Oil Condensation Temperature** Alarm*

The following parameters can be adjusted:

- **Alarm Delay**, in minutes.
- **Alarm Deadband**, in °C.
- Enable [✓] or disable [ ] the **Low Alarm Set Point** by clicking the checkbox. Once an alarm is enabled, a check mark appears in the box and the Set Point becomes enabled.
- If the **Low Alarm Set Point** is enabled, set its values in °C.
- If required, assign an **Alarm Low Relay** to the **Low Alarm Set Point**.
- Click **Apply** to save the settings.

3.4.2.2.7 Analog User Defined Alarms

Note: These settings are only available when one or more inputs are set to Analog User Defined.

In Figure 3-51 on page 3-46, click **Analog User Defined #X**, and the menu shown in Figure 3-65 on page 3-60 is displayed on the right side.

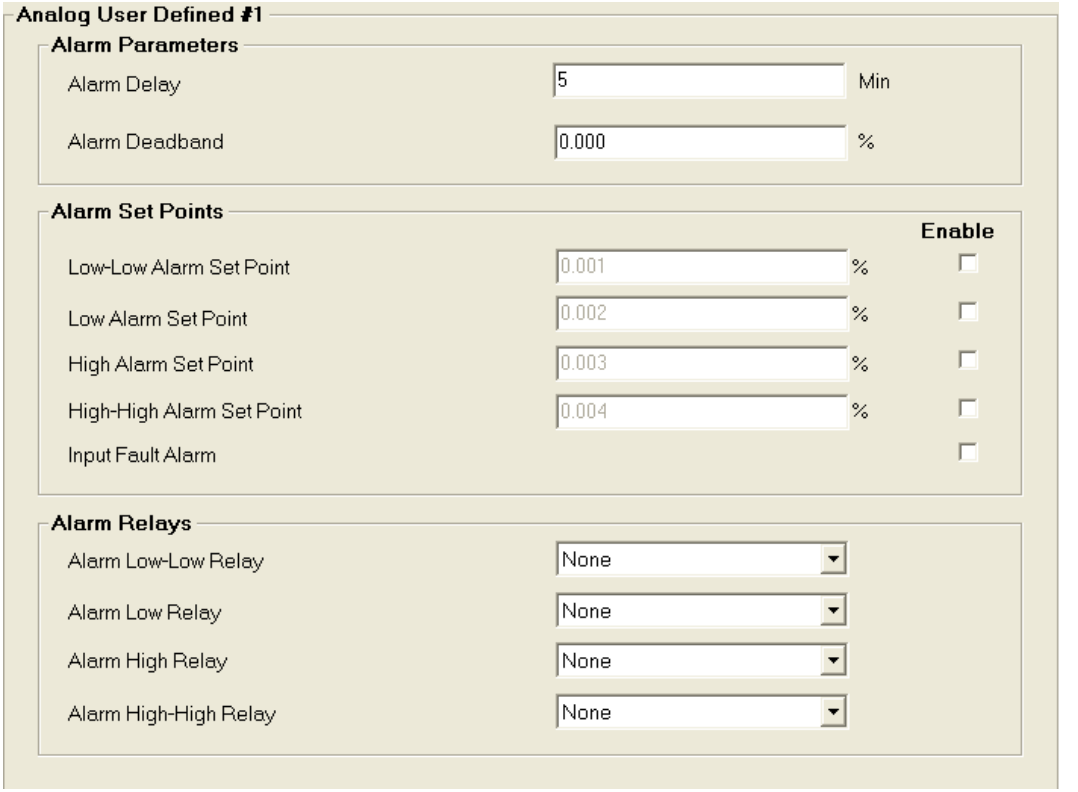


*Figure 3-65 - **Analog User Defined** Alarms*

The following parameters can be adjusted:

- **Alarm Delay**, in minutes.
- **Alarm Deadband**, in %.
- Enable [✓] or disable [ ] the **Low-Low Alarm Set Point**, **Low Alarm Set Point**, **High Alarm Set Point** and/or **High-High Alarm Set Point** by clicking the appropriate

checkbox. Once an alarm is enabled, a check mark appears in the box and the Set Point becomes enabled.
- If the **Low-Low Alarm Set Point**, **Low Alarm Set Point**, **High Alarm Set Point** or **High-High Alarm Set Point** is enabled, set their values in amperes.
- Enable [✓] or disable [ ] the **Input Fault Alarm** by clicking the appropriate checkbox. Once this alarm is enabled, a check mark appears in the box.
- If required, assign an **Alarm Low-Low Relay** to the **Low-Low Alarm Set Point**.
- If required, assign an **Alarm Low Relay** to the **Low Alarm Set Point**.
- If required, assign an **Alarm High Relay** to the **High Alarm Set Point**.
- If required, assign an **Alarm High-High Relay** to the **High-High Alarm Set Point**.
- Click **Apply** to save the settings.

3.4.2.3 Models

In the Hydran M2, the models are dynamic and are enabled depending on the Input Plugins connected to the Hydran M2. If no additional Input Plugins are connected, only the Hydran and moisture readings models are enabled. If Analog or Digital User Defined Inputs are set in **Input-Output Setup** (Figure 3-46 on page 3-43), these can be configured in the models also. For other standard models available in the Hydran M2, see Chapter 6 to Chapter 14.

3.4.2.3.1 Hydran Reading Setup

In Figure 3-42 on page 3-40, click the + to the left of **Models**, and then **Hydran Reading Setup**. The menu shown in Figure 3-66 on page 3-61 is displayed on the right side.

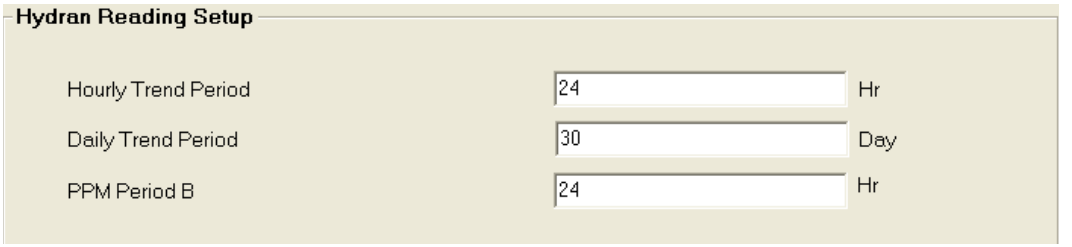


Figure 3-66 - Hydran Reading Setup

The following parameters can be adjusted:

- **Hourly Trend Period**, in hours (the default value is 24 hours).
- **Daily Trend Period**, in days (the default value is 30 days).
- **PPM Period B**, in hours (the default value is 24 hours).

- Click **Apply** to save the settings.

3.4.2.3.2 Moisture Reading Setup

In Figure 3-42 on page 3-40, click the + to the left of **Models**, and then **Moisture Reading Setup**. The menu shown in Figure 3-67 on page 3-62 is displayed on the right side.

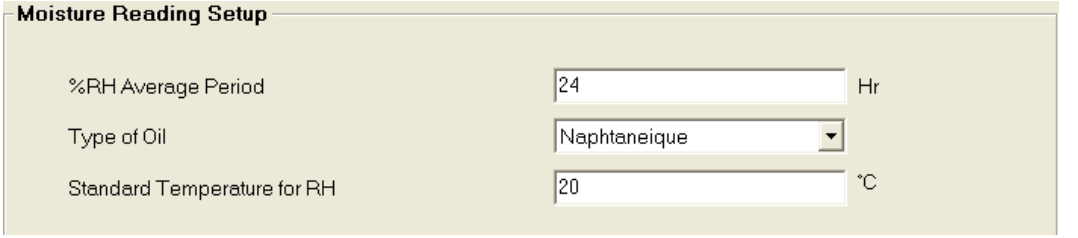


Figure 3-67 - Moisture Reading Setup

The following parameters can be adjusted:

- **%RH Average Period**, in hours (the default value is 24 hours).
- **Type of Oil**, selected using the drop-down list.
- **Standard Temperature for RH**, in °C: This value is used to convert the measured relative saturation (RH%) to a relative saturation at a reference temperature. This reference temperature can be configured from 0 to 40 °C with a default value of 20 °C.
- Click **Apply** to save the settings.

3.4.2.3.3 Analog User Defined Reading Setup

Note: These settings are only available when one or more inputs are set to Analog User Defined.

In Figure 3-42 on page 3-40, click the + to the left of **Models**, and then **Analog User Defined #X**. The menu shown in Figure 3-68 on page 3-63 is displayed on the right side.

The following parameters can be adjusted:

- Change the **Input Name** if desired.
- Change the **Input Short Name** if desired.
- Change the **Input Units** if required.

- Set the **Reading Precision** to the number of decimals desired, selected using the drop-down list.
- Click **Apply** to save the settings.

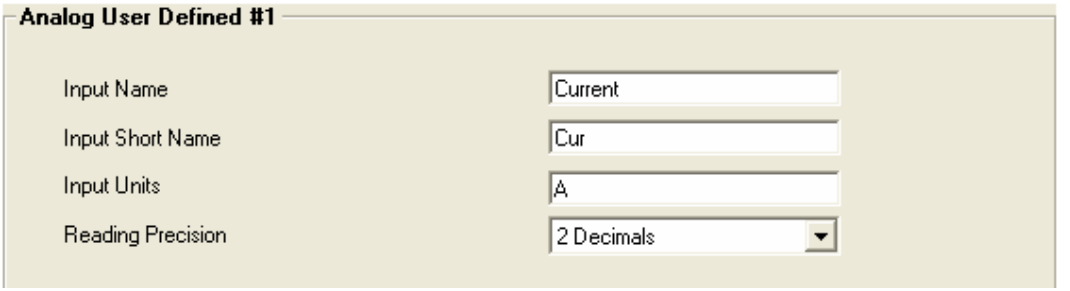


*Figure 3-68 - **Analog User Defined** Reading Setup*

3.4.2.3.4 Digital User Defined Reading Setup

Note: These settings are only available when there is a digital input set to Digital User Defined.

In Figure 3-42 on page 3-40, click the + to the left of **Models**, and then **Digital User Defined #X**. The menu shown in Figure 3-69 on page 3-63 is displayed on the right side.

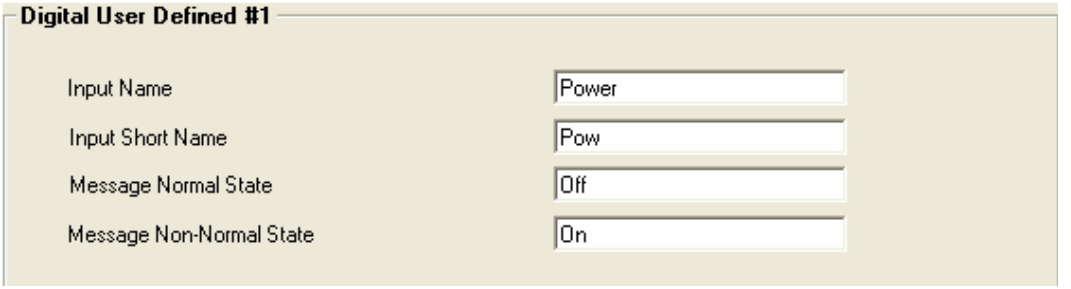


*Figure 3-69 - **Digital User Defined** Reading Setup*

The following parameters can be adjusted:

- Change the **Input Name** if desired.
- Change the **Input Short Name** if desired.
- Change the **Message Normal State** if desired.

- Change the **Message Non-Normal State** if desired.
- Click **Apply** to save the settings.

3.4.2.4 Sensor Temperature Setup

The Hydran sensor must be kept at a certain temperature in order to be accurate. The sensor temperature is set in the **Temperature Setup** menu.

In Figure 3-42 on page 3-40, click **Temperature Setup**, and the menu shown in Figure 3-70 on page 3-64 is displayed on the right side.

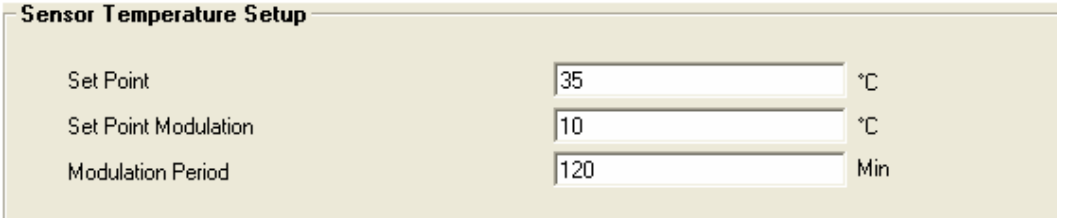


Figure 3-70 - Sensor Temperature Setup

The following parameters can be adjusted:

- **Set Point**, in °C (the default value is 35 °C).
- **Set Point Modulation**, in °C (the default value is 10 °C).
- **Modulation Period**, in minutes (the default value is 120 minutes).
- Click **Apply** to save the settings.

3.4.2.5 History

The Hydran M2 acquires data regularly and stores it in its memory. This data is called history and can be downloaded to a PC or simply deleted. The log rate can also be modified.

Note: The different history types are explained in more detail in Section 3.3.4 on page 3-24.

3.4.2.5.1 Clear History

In Figure 3-42 on page 3-40, click the + to the left of **History**, and then **Clear History**. The menu shown in Figure 3-71 on page 3-65 is displayed on the right side.

Figure 3-71 - Clear History

- Click the appropriate checkbox to enable [✓] or disable [ ] the clearing of the following history types:
  - **Alarm**
  - **Digital Event**
  - **Event**
  - **Short Term**
  - **Long Term**
- Click **Apply** to clear the selected history types.

Before deleting, the **Histories Not Downloaded** message box shown in Figure 3-72 on page 3-65 is displayed.

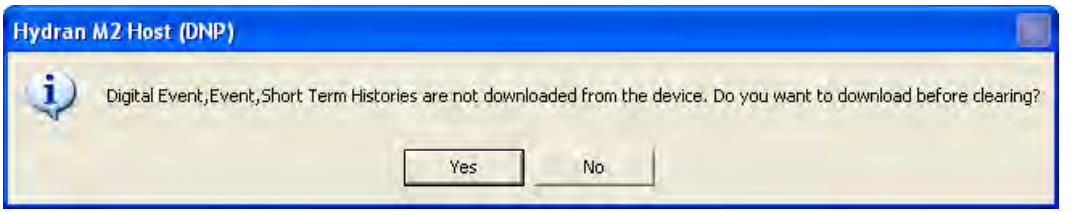


*Figure 3-72 - **Histories Not Downloaded** Message Box*

- **No**: To delete the selected history types without first downloading them on the PC.
- **Yes**: To download the selected history types before deleting them.

After the deletion operation, the **History Cleared** message box shown in Figure 3-73 on page 3-66 appears. Click **OK**.

*Figure 3-73 - **History Cleared** Message Box*

3.4.2.5.2 History Log Rate

The **History Log Rate** menu is used to set the sampling frequency of short-term and long-term data acquisition.

In Figure 3-42 on page 3-40, click the + to the left of **History**, and then **History Log Rate**. The menu shown in Figure 3-74 on page 3-66 is displayed on the right side.

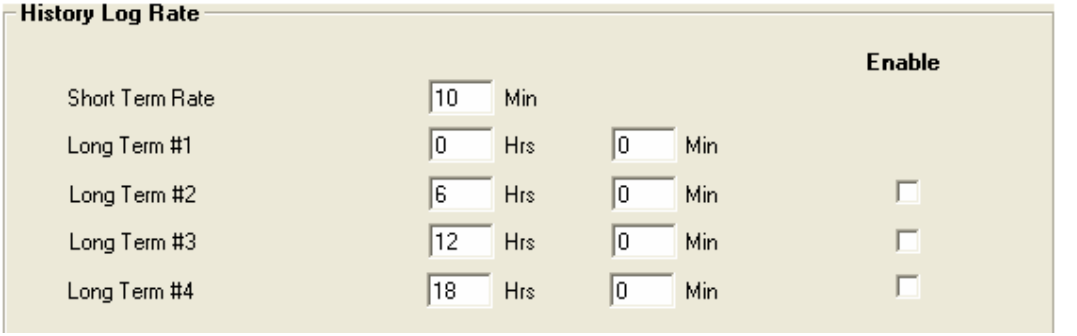


Figure 3-74 - History Log Rate

The following parameters can be adjusted:

- Set the **Short Term Rate**, in minutes.
- Set the time of the day for the **Long Term #1** data acquisition.
- Enable [✓] or disable [ ] the **Long Term #2**, **Long Term #3** and/or **Long Term #4** by clicking the appropriate checkbox. Once a rate is enabled, the Hydran M2 acquires data every day at this time.
- If the **Long Term #2**, **Long Term #3** and/or **Long Term #4** is enabled, set their time of the day.

- Click **Apply** to save the settings.

3.4.2.6 Date and Time

This option is used to set the date and time of the Hydran M2.

In Figure 3-42 on page 3-40, click **Date and Time**, and the menu shown in Figure 3-75 on page 3-67 is displayed on the right side.

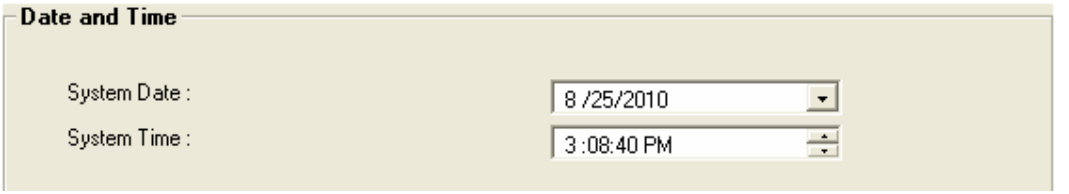


*Figure 3-75 - **Date and Time***

The following parameters can be adjusted:

- Set the **System Date** by typing it directly or using the arrow.
- Set the **System Time** by typing it directly or using the arrows.
- Click **Apply** to save the settings.

3.4.2.7 Idle Menu

The **Idle Menu** is used to choose which panels will appear on the Hydran M2 display when it is idle. If more than one is chosen, they will alternate every ten seconds. If none is selected, the Hydran M2 will display the **Main Menu**.

Two panels are always available to be enabled [✓] or disabled [ ]:

- Hydran
- Moisture/Bubbling

The 11 other panels are available to be enabled [✓] or disabled [ ] if the corresponding input(s) are configured:

- Winding Hot Spot H
- Winding Hot Spot X/C
- Winding Hot Spot Y

- Apparent Power H
- Apparent Power X
- Apparent Power Y
- Top Oil
- Aging
- Cooling Efficiency
- OLTC Temperature
- Tap Position

In Figure 3-42 on page 3-40, click **Idle Menu**, and a menu similar to the one shown in Figure 3-76 on page 3-68 is displayed on the right side.

Figure 3-76 - Typical Idle Menu

- Click the appropriate checkbox to enable [✓] or disable [ ] the display of each panel.
- Click **Apply** to save the settings.

3.4.3 Test

The **Test** function is used to verify the relays, alarms and Hydran sensor of the Hydran M2. In the **Configuration** menu select **Test**, or click the button shown on the right. The **Test** window shown in Figure 3-77 on page 3-69 appears.

- The left side displays the **Test** tree structure.
- To expand a node, click the + on its left.
- To collapse a node, click the - on its left.
- To see (on the right side) the parameters of an item, select its name on the left side.
- To apply the modifications brought to parameters, click **Apply**.
- To exit this box without applying the modifications, click **Cancel** or the **X** in the top right corner.

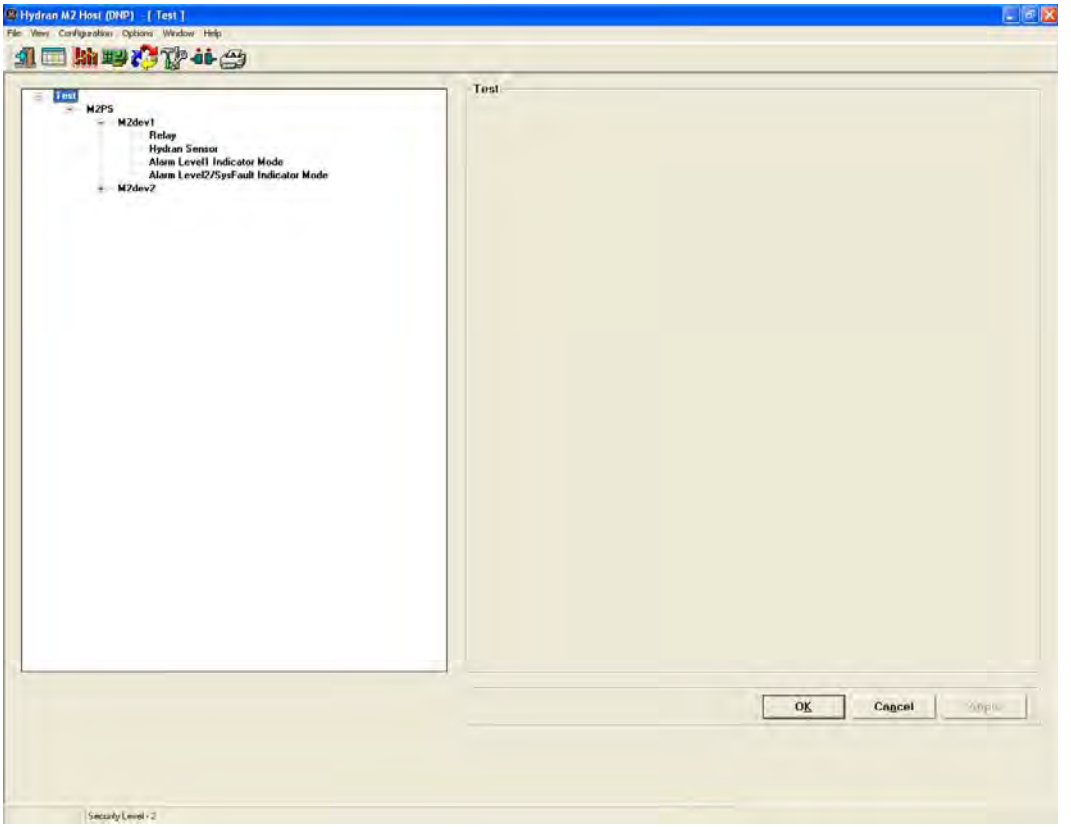


*Figure 3-77 - **Test** Window*

The expanded **Test** tree structure is shown in Figure 3-78 on page 3-69.

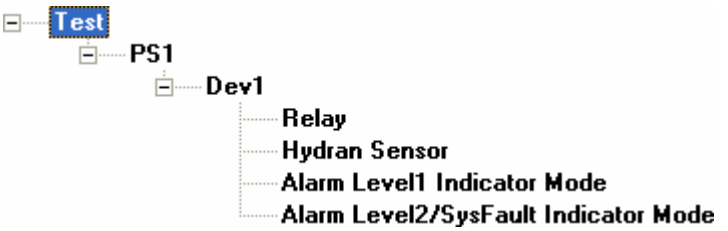


*Figure 3-78 - Expanded **Test** Tree*

*Note: To modify any parameters in the **Test** menu, a Level-2 password is required. Refer to Section 2.2 on page 2-3.*

3.4.3.1 Relay

The **Relay** menu is used to test the functionality of the Hydran M2 relays. There are five relays in the Hydran M2, one reserved for device maintenance, and four for other uses.

In Figure 3-78 on page 3-69, click **Relay**, and the menu shown in Figure 3-79 on page 3-70 is displayed on the right side.

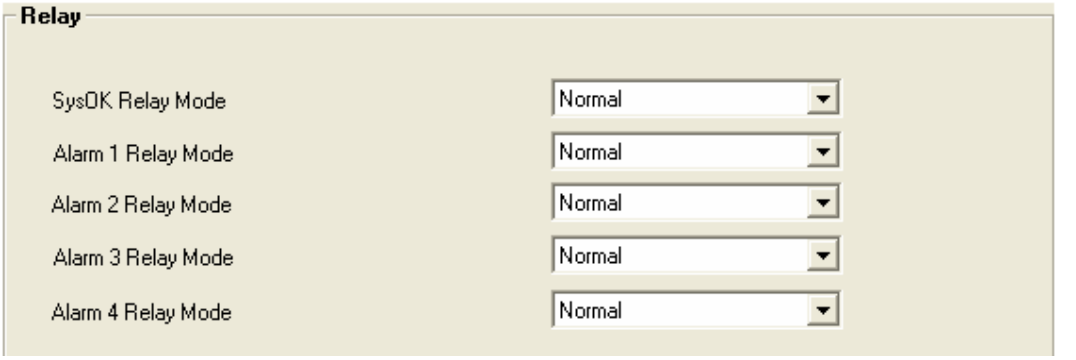


*Figure 3-79 - **Relay** Test Menu*

- Set each of the **SysOK** and **Alarm 1** to **Alarm 4** relays to one of the following modes:
  - **Force On**: To turn it on for test purposes.
  - **Force Off**: To turn it off for test purposes.
  - **Normal**: For normal operation.
- Click **Apply** to save the settings.

3.4.3.2 Hydran Sensor

To test the Hydran sensor, click **Hydran Sensor** in Figure 3-78 on page 3-69. The menu shown in Figure 3-80 on page 3-71 is displayed on the right side.

- Click **Test**.
- Wait until **Stabilisation Delay** becomes **0**.
- The **Sensor Test Result** is indicated.
- More detailed results can be viewed in the **Service** menu (see Section 3.4.4.4.1 on page 3-77).

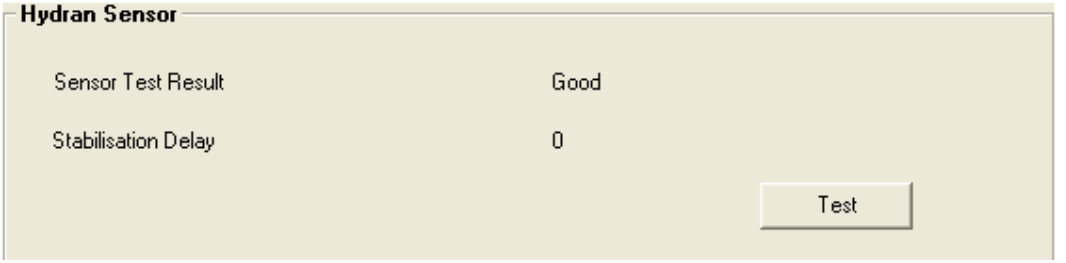


*Figure 3-80 - **Hydran Sensor** Test Menu*

3.4.4 Service

The **Service** function is used to set the sensor parameters, to activate models, and to view service data. In the **Configuration** menu select **Service**, or click the button shown on the right. The **Service** window shown in Figure 3-81 on page 3-72 appears.

- The left side displays the **Service** tree structure.
- To expand a node, click the **+** on its left.
- To collapse a node, click the **-** on its left.
- To see (on the right side) the parameters of an item, select its name on the left side.
- To apply the modifications brought to parameters, click **Apply**.
- To exit this box without applying the modifications, click **Cancel** or the **X** in the top right corner.

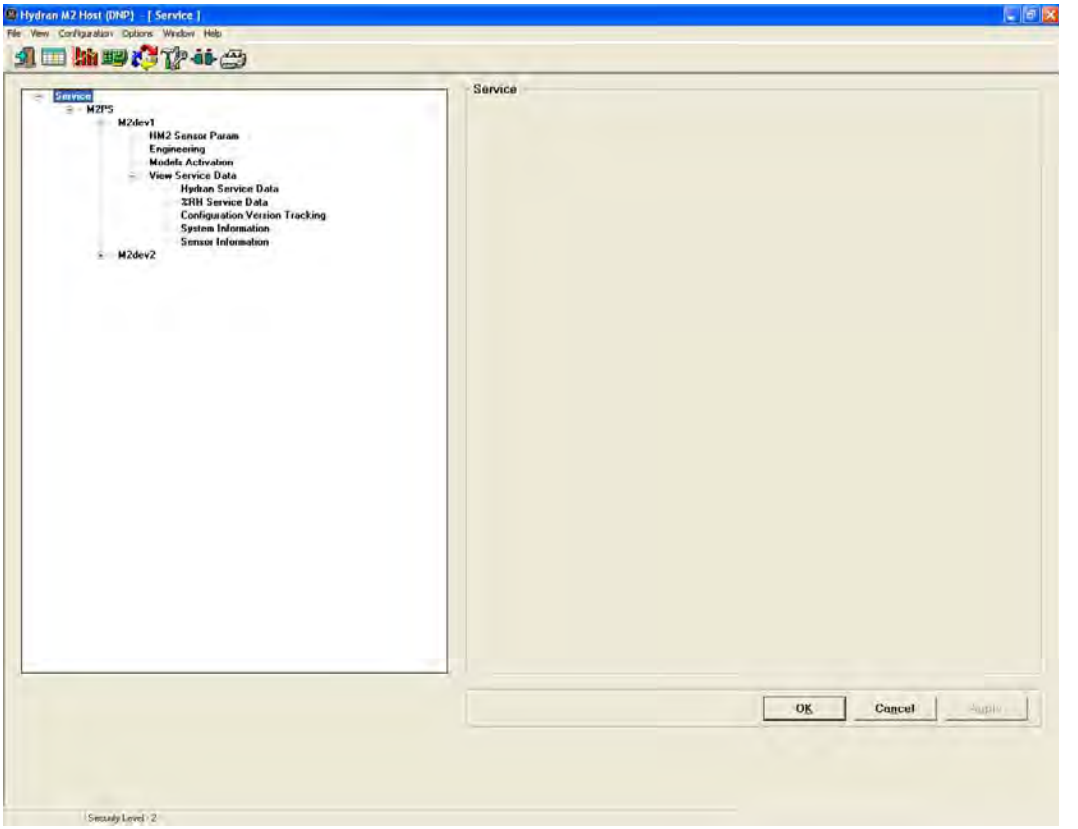


*Figure 3-81 - **Service** Window*

The expanded **Service** tree structure is shown in Figure 3-82 on page 3-73.

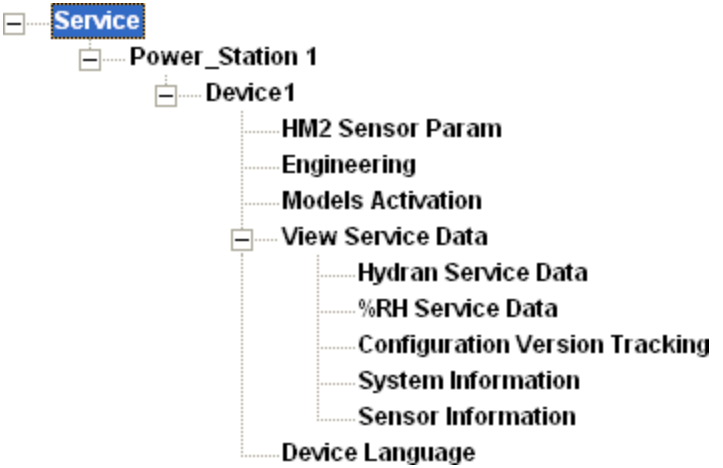


*Figure 3-82 - Expanded **Service** Tree*

3.4.4.1 HM2 Sensor Param

This option is used to set the parameters of the Hydran and moisture sensors.

In Figure 3-82 on page 3-73, click **HM2 Sensor Param**, and the menu shown in Figure 3-83 on page 3-74 is displayed on the right side.

- The following parameters can be adjusted:
  - Sensor serial number
  - Hydran sensor:
    - Value of the parameters B, M, N, S and A1 to A6
    - Value of the parameters checksum
  - Moisture sensor:
    - Value of the parameters C1 to C10
    - Value of the parameters checksum
- Click **Apply** to save the settings.

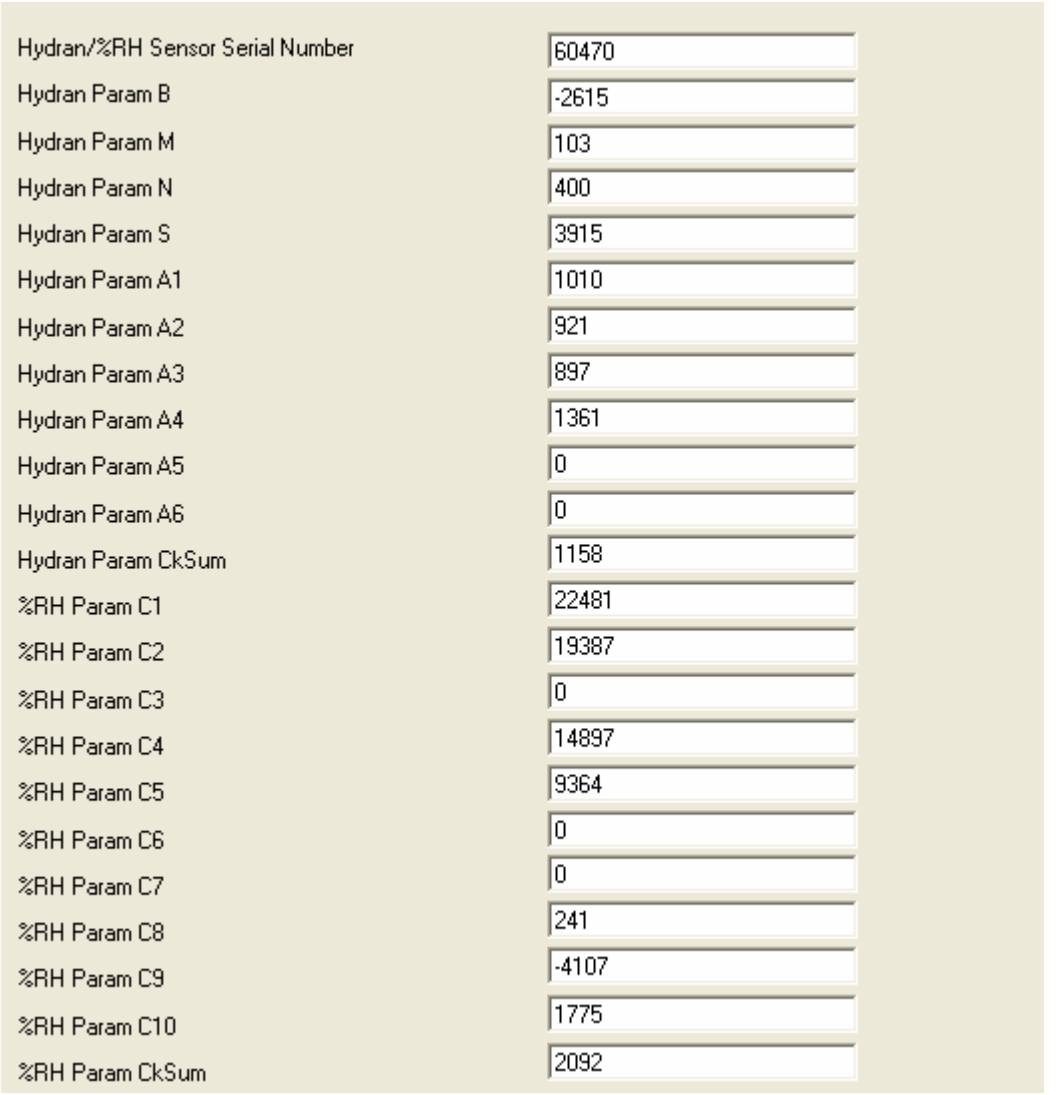


Figure 3-83 - HM2 Sensor Param

If an erroneous parameter is entered, the **Incorrect Parameters** message box shown in Figure 3-84 on page 3-75 appears.

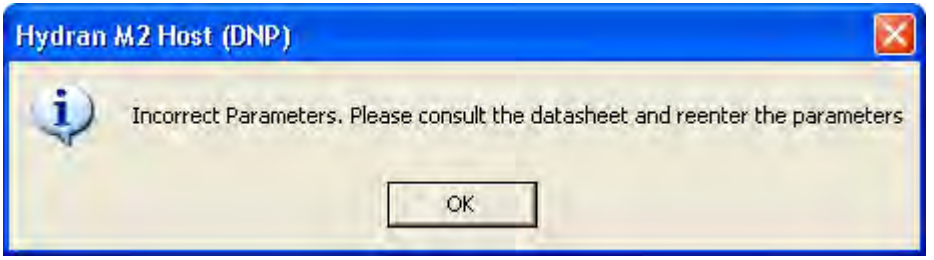


*Figure 3-84 - **Incorrect Parameters** Message Box*

- Click **OK**.
- Enter valid parameters.

Once valid parameters are entered, the **Sensor Successfully Installed** message box shown in Figure 3-85 on page 3-75 is displayed. Click **OK**.

*Figure 3-85 - **Sensor Successfully Installed** Message Box*

3.4.4.2 Engineering

In Figure 3-82 on page 3-73, click **Engineering**, and the menu shown in Figure 3-86 on page 3-76 is displayed on the right side.

- **Hydran Engineering Slope**: Slope for the Hydran sensor
- **Hydran Engineering Offset**: Offset for the Hydran sensor, in ppm
- **%RH Engineering Slope**: Slope for the moisture sensor
- **%RH Engineering Offset**: Offset for the moisture sensor, in %

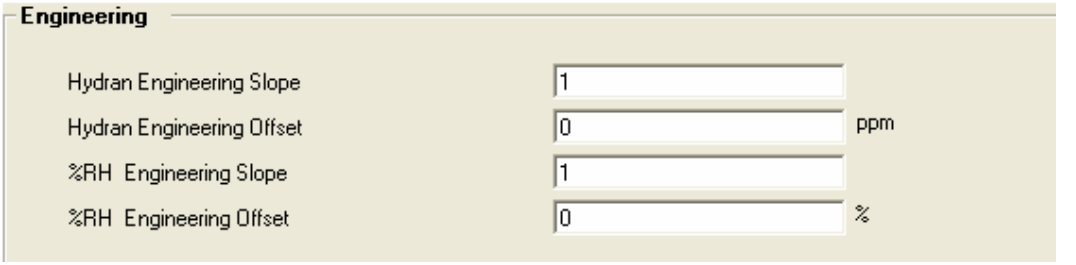


*Figure 3-86 - **Engineering** Menu*

- To verify the range of a value to enter, place the mouse cursor over the input window. A yellow box appears displaying the minimum and maximum of the input range (see Figure 3-87 on page 3-76).

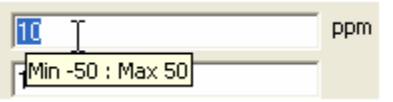


Figure 3-87 - Range Indicator

- If an entered value is outside the range limits, an error message box appears (see an example in Figure 3-88 on page 3-76).

Figure 3-88 - Typical Out-of-Range Error Message Box

- Click **Apply** to save the settings.

3.4.4.3 Models Activation

In Figure 3-82 on page 3-73, click **Models Activation**, and the menu shown in Figure 3-89 on page 3-77 is displayed on the right side.

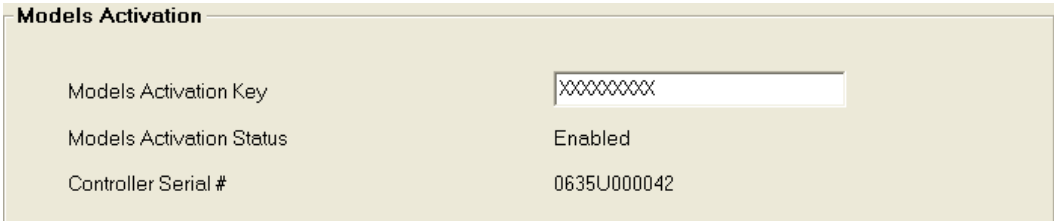


*Figure 3-89 - **Models Activation** Menu*

- To activate the models, type the **Models Activation Key**.
- Click **Apply** to save the settings.
- To check if the models were activated, close the **Models Activation** menu and open it again. The **Models Activation Status** should indicate **Enabled**.

3.4.4.4 View Service Data

The **View Service Data** menu presents:

- Information about the Hydran M2 which has been collected during the tests performed
- Other system information

3.4.4.4.1 Hydran Service Data

In Figure 3-82 on page 3-73, click the + to the left of **View Service Data**, and then **Hydran Service Data**. The data shown in Figure 3-90 on page 3-77 is displayed on the right side.

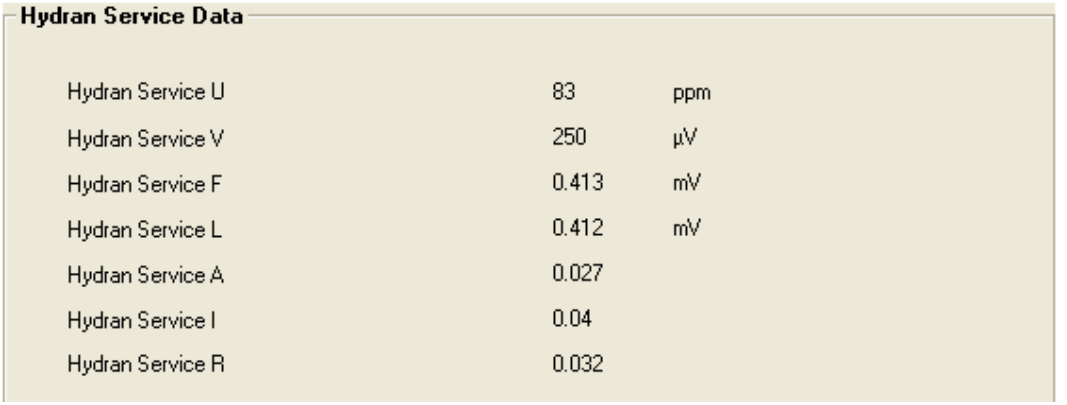


Figure 3-90 - Hydran Service Data

The following service data is displayed for the Hydran sensor:

- **Service U**, in ppm
- **Service V**, in microvolts
- **Service F** and **Service L**, in millivolts
- **Service A**, **Service I** and **Service R**

3.4.4.4.2 %RH Service Data

In Figure 3-82 on page 3-73, click the **+** to the left of **View Service Data**, and then **%RH Service Data**. The data shown in Figure 3-91 on page 3-78 is displayed on the right side.

Figure 3-91 - %RH Service Data

The value of **Service V** (in microvolts) is displayed for the moisture sensor.

3.4.4.4.3 Configuration Version Tracking

The **Configuration Version Tracking** records the number of setting changes done to the Hydran M2. Every time a setting is modified, the number increases by 0.001.

In Figure 3-82 on page 3-73, click the **+** to the left of **View Service Data**, and then **Configuration Version Tracking**. The menu shown in Figure 3-92 on page 3-78 is displayed on the right side.

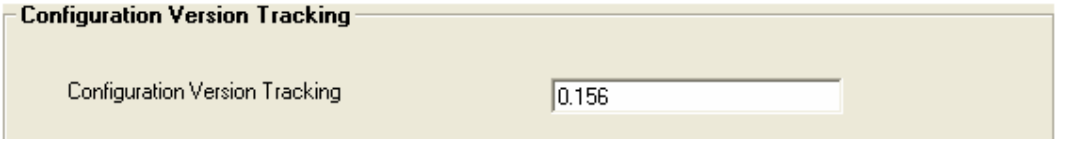


*Figure 3-92 - **Configuration Version Tracking** Menu*

- If required, reset the count by typing **0**.
- If required, input a number to set the integer part. For example, **2** will be interpreted as 2.000.
- Click **Apply** to save the settings.

3.4.4.4.4 System Information

The **System Information** menu displays the serial numbers of the system, the controller board and the plugin input-output cards.

In Figure 3-82 on page 3-73, click the **+** to the left of **View Service Data**, and then **System Information**. The menu shown in Figure 3-93 on page 3-79 is displayed on the right side.

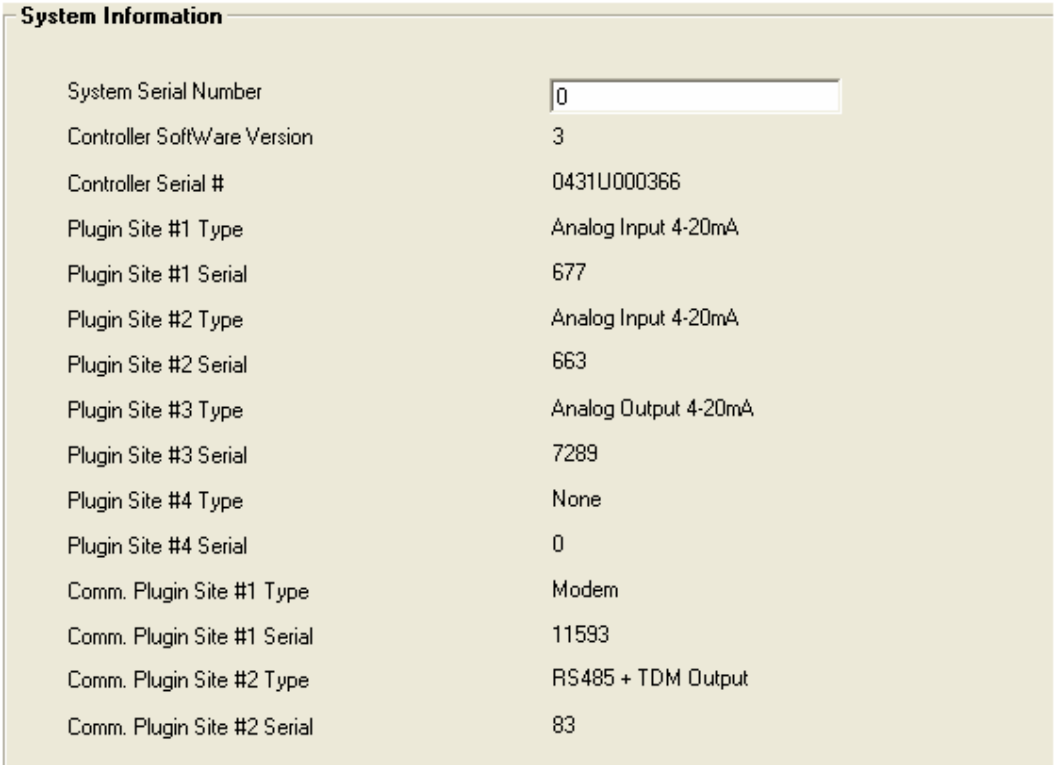


*Figure 3-93 - **System Information** Menu*

- A Level-3 password (see Section 2.2 on page 2-3) is required to modify the **System Serial Number**.
- The following information is displayed:
  - Software version and serial number of the controller
  - Type and serial number of the plugin sites No. 1 to No. 4
  - Type and serial number of the communication plugin sites No. 1 and No. 2
- Click **Apply** to save the settings.

3.4.4.4.5 Sensor Information

In Figure 3-82 on page 3-73, click the + to the left of **View Service Data**, and then **Sensor Information**. The menu shown in Figure 3-94 on page 3-80 appears on the right side.

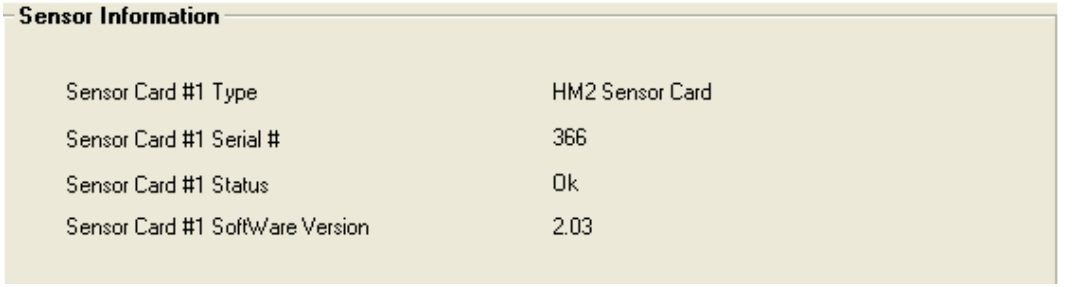


*Figure 3-94 - **Sensor Information** Menu*

The following information on the Hydran M2 sensor card is displayed:

- Type
- Serial number
- Status
- Software version

3.4.4.5 Device Language

This option is used to change the language of the Hydran M2's embedded software, as well as the date format, the date separator and the decimal separator as seen in the embedded software.

In Figure 3-82 on page 3-73, click **Device Language**, and the menu shown in Figure 3-95 on page 3-81 appears.

- The following parameters can be adjusted:
  - **Device Language**: choose between **Russian** and **English**.
  - **Date Format**: select between **YYYY-MM-DD** and **DD-MM-YYYY**.
  - **Date Separator**: select between **Slash (/)**, **Dash (-)**, **Point (.)** and **Space ( )**.
  - **Decimal Separator**: select between **Point (.)** and **Comma (,)**.
- Click **Apply** to save the settings.

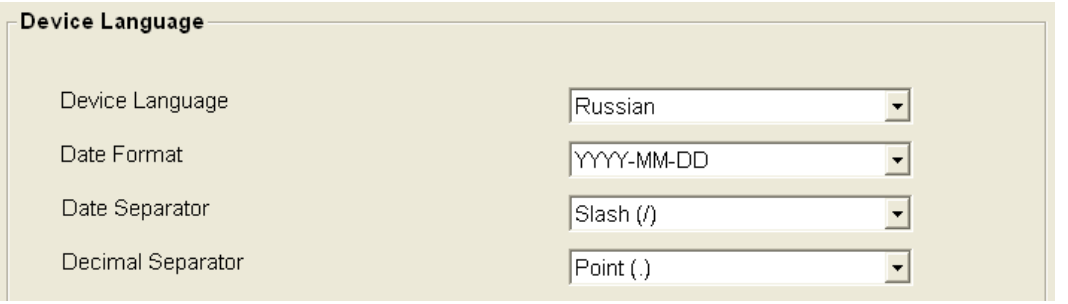


*Figure 3-95 - **Device Language** Menu*

3.4.5 Display Settings

The **Display Settings** box is used to customize the acronyms used throughout the Hydran M2 Host (DNP) software application as well as the upper and lower limits used in the graphical display.

In the **Configuration** menu select **Display Settings**, and the **Display Settings** box shown in Figure 3-96 on page 3-81 appears.

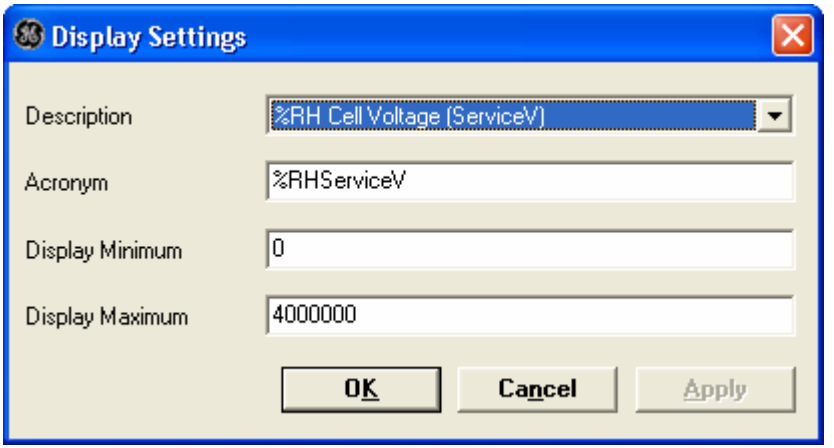


*Figure 3-96 - **Display Settings** Box*

- Click the Down arrow to select a parameter in the **Description** drop-down list.
- Modify the **Acronym**, **Display Minimum** and/or **Display Maximum** if desired.
- To apply the modifications brought, click **Apply**.

- To exit this box without applying the modifications, click **Cancel** or the **X** in the top right corner.

3.5 OPTIONS MENU

The **Options** menu includes four items:

- **Change Working Mode** (Section 2.4.2 on page 2-13)
- **Security** (Section 2.2 on page 2-3)
- **Connection** (Section 2.4.2 on page 2-13)
- **Embedded Version** (Section 3.5.1 on page 3-82)

3.5.1 Embedded Version

This function is used to know the number of the Hydran M2's embedded version.

In the **Options** menu select **Embedded Version**, and the **Embedded Version** box shown in Figure 3-97 on page 3-82 is displayed. Click **OK**.

*Figure 3-97 - **Embedded Version** Box*

3.6 HELP

The software version information as well as the General Electric Canada coordinates are available in the **About** box.

In the **Help** menu select **About**, and the **About** box shown in Figure 3-98 on page 3-83 is displayed.

*Figure 3-98 - **About** Box*

- The following information is presented:
  - The version number of the Hydran M2 Host (DNP) software, the controller and the sensor.
  - The coordinates of General Electric Canada.
- Click **System Info...** to view the local computer properties.
- Click **OK** to close the box.

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Chapter 4

Model Inputs and Selection

In order to obtain valuable information about the real-time operating conditions of the transformer, the Hydran M2 uses many different monitoring models, each one defined as a specific computation or algorithm, and following industry-recognized standards (such as the IEEE and IEC Loading Guides).

Each model uses the data received from the sensors connected to the transformer, and makes computations to produce useful transformer information. The model gives results that can be compared with user-configurable alarm levels.

This Chapter explains how to select one of the various models.

4.1 INPUTS REQUIRED FOR EACH MODEL

The Hydran M2 is limited to four plugin ports for 4–20 mA or digital inputs. Thus, at any given time, the total number of models that can run simultaneously on the Hydran M2 is limited, based on the four configured inputs. Since the digital input card is dual, two of the digital inputs can be configured on one card.

Table 4-1 on page 4-2 depicts the inputs required or optional to enable a model.

The first three inputs (Hydran Gas Level, Relative Humidity, and Sensor Temperature) are included as part of the functionality of the Hydran M2; therefore they do not need to be assigned to any of the four available plugin ports. Of the 11 remaining analog and digital inputs, up to four can be configured to enable models.

For example, assume the following inputs are selected:

- Top Oil Temperature using a 4–20 mA plugin card in input slot No. 1
- Load Current Winding H using a 4–20 mA plugin card in input slot No. 2
- Ambient Temperature using a 4–20 mA plugin card in input slot No. 3
- Status of Cooling Bank #1 and Status of Cooling Bank #2 using a digital input card in plugin slot No. 4

Table 4-1 - Inputs Required for Each Model

Required and **O**ptional Inputs	Analog											Digital		
	Hydran Gas Level (ppm)[a]	Relative Humidity (%RH)[a]	Sensor Temperature (°C)[a]	Top Oil Temperature (°C)	Load Current Winding H (A)	Load Current Winding X (A)	Load Current Winding Y (A)	OLTC Tap Position	OLTC Tank Temperature (°C)	Ambient Temperature (°C)	Bottom Oil Temperature (°C)	Status of Cooling Bank #1	Status of Cooling Bank #2	Transformer Energized
Transformer Insulation Models:														
Winding H Apparent Power					**R**									
Winding X Apparent Power						**R**								
Winding Y Apparent Power							**R**							
Winding H Hot-Spot Temperature				**R**	**R**									
Winding X Hot-Spot Temperature				**R**		**R**								
Winding Y Hot-Spot Temperature				**R**			**R**							
Insulation Aging		**R**	**R**	**R**	**R**									
Moisture and Bubbling		**R**	**R**	**R**	**R**									
Moisture Content in Insulating Barrier		**R**	**R**	**R**	**R**						**R**	**O**	**O**	
Cooling System Models:														
Cooling Efficiency				**R**	**R**					**R**		**R**	**R**	**O**
Cooling Banks Status												**R**	**R**	
Tap Changer Models:														
OLTC Position Tracking								**R**						
OLTC Temperature Differential				**R**					**R**					

a. The first three inputs (Hydran Gas Level, Relative Humidity, and Sensor Temperature) are included as part of the functionality of the Hydran M2. Therefore they do not need to be assigned to any of the four available plugin ports.

This input selection would enable the following models:

- Winding H Apparent Power
- Winding H Hot-Spot Temperature
- Insulation Aging
- Moisture and Bubbling
- Moisture Content in Insulating Barrier
- Cooling Efficiency
- Cooling Banks Status

4.1.1 Assigning Inputs

The models are dynamically enabled based on the inputs configured. For instance, in order for the Winding Hot-Spot Temperature model to be enabled, the user must navigate to the **Setup** tree (Figure 3-42 on page 3-40), click **Input-Output Setup**, and assign **Top Oil Temp** and a **Winding Current** to inputs. Once these are assigned, the Hydran M2 dynamically enables the Winding Hot-Spot Temperature model. The user may then click **Models** in the **Setup** tree to configure the model in question.

The inputs to activate the models can be selected from a predefined list during input configuration. The list of analog inputs includes:

- **Top Oil Temp**
- **OLTC Tank Temp**
- **Tap position**
- **Winding H Current**
- **Winding Y Current**
- **Winding X Current**
- **Ambient Temp**
- **Bottom Oil Temp**
- **User defined**

The list of digital inputs includes:

- **Cooling Bank 1**
- **Cooling Bank 2**
- **Trans. Energized**
- **User Defined**

4.1.2 Input Alarms

The inputs **Top Oil Temp**, **Bottom Oil Temp** and **Ambient Temp** all have input fault alarms that can be enabled or disabled. A lost input connection will produce **N/A** values for the inputs as well as the corresponding models, thus the input fault alarms will alert the user that the input signal is unavailable.

4.2 MODEL SELECTION

In the **View** menu select **Models**, or click the button shown on the right. The **View Models** window shown in Figure 4-1 on page 4-4 appears.

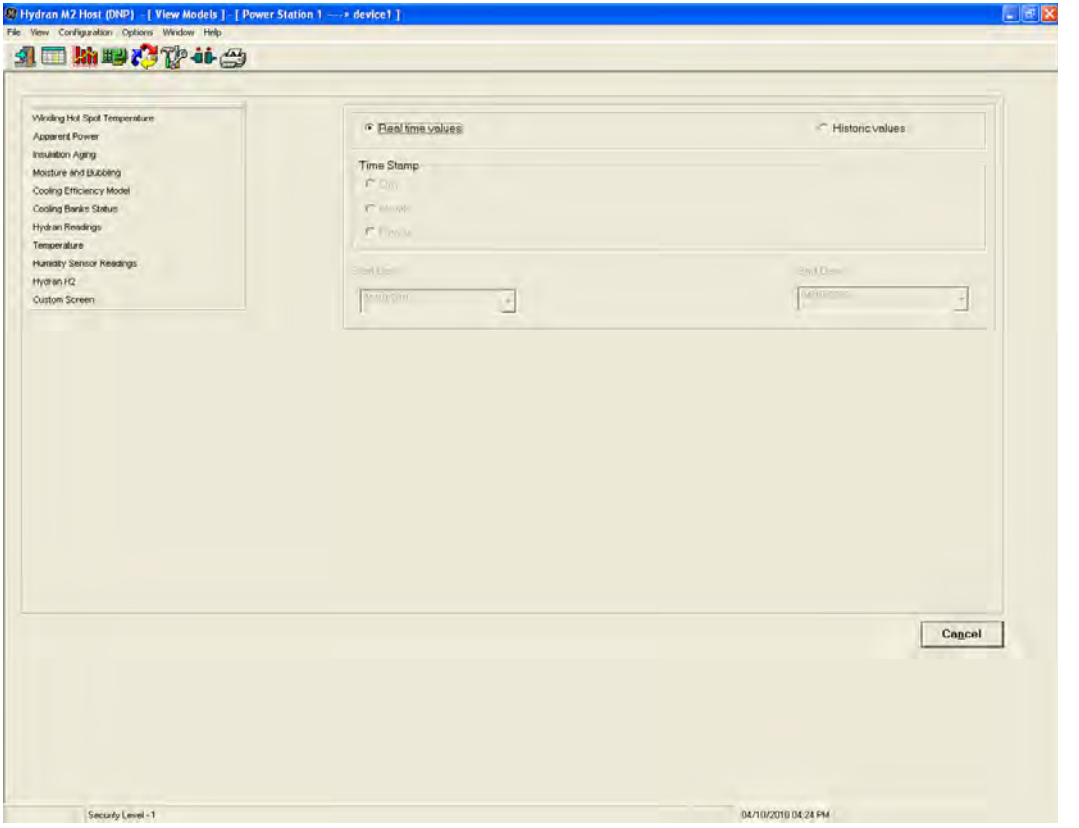

*Figure 4-1 - **View Models** Window With Real-Time Values*

4.2.1 Real Time Values

By default, **Real Time Values** is selected in Figure 4-1 on page 4-4. To display a model's real-time graph that is updated every 15 seconds, proceed as follows:

- Ensure **Real Time Values** is selected.
- Click the name of one of the available real-time models on the left side.
- If **Custom Screen** is selected, see Section 3.3.3.1.1 on page 3-19.
- To close the window without generating a real-time graph, click **Cancel** or the **X** in the top right corner.

Note: The commands available for all graphs are described in Chapter 5.

For detailed explanation of the models, the required inputs, the models outputs and the associated alarms, see Chapter 6 to Chapter 14.

4.2.2 Historic Values

When the Historic Values mode is selected, the displayed readings and models are different from the ones available in real time. This feature is used to see all related historic records, even if the selected inputs are no longer connected.

In the **View Models** window (Figure 4-1 on page 4-4), click **Historic Values**, and this window becomes as shown in Figure 4-2 on page 4-6.

The **Time Stamp** and the **Start Date** are now enabled. Also, all the models now appear on the left side, to allow graphing historic values if they exist.

- Ensure **Historic Values** is selected.
- To display the historic values since a certain day, click **Day** and select the **Start Date**. This will graph the selected model's values from that day to the last available entry.
- To display the historic values since the beginning of a certain month, click **Month** and select the **Start Date**. This will graph the selected model's values from the beginning of that month to the last available entry.
- To display the historic values during a certain period, click **Range** and select the **Start Date** and then the **End Date**. This will graph the selected model's values between the two dates.
- Click the name of the desired model on the left side.
- If **Custom Screen** is selected, see Section 3.3.3.1.1 on page 3-19.

- To close the window without generating a real-time graph, click **Cancel** or the **X** in the top right corner.

Note: The commands available for all graphs are described in Chapter 5.

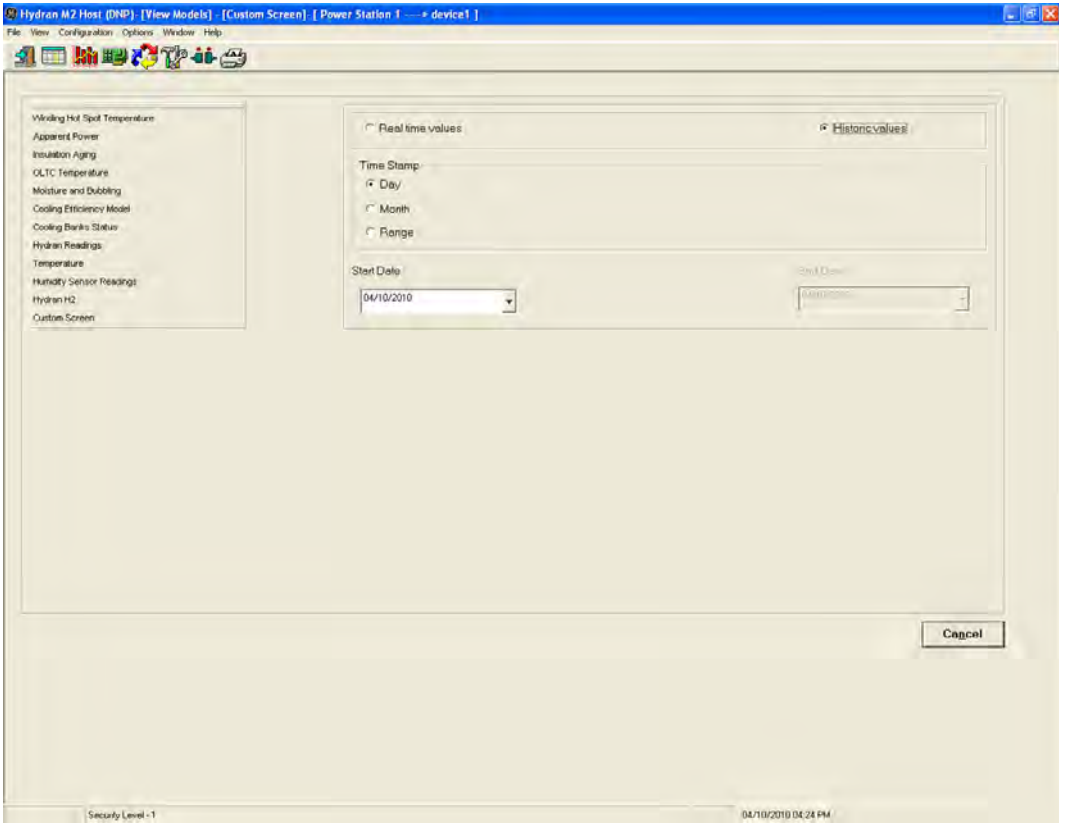

*Figure 4-2 - **View Models** Window With Historic Values*

If no History is available for the desired period of time, the **History not available** message box shown in Figure 3-24 on page 3-24 appears. Click **OK**, and modify the **Time Stamp**, the **Start Date** and/or the **End Date** in Figure 4-2 on page 4-6.

For detailed explanation of the models, the required inputs, the models outputs and the associated alarms, see Chapter 6 to Chapter 14.

Chapter 5

Commands Common to All Model Windows and Graphs

The commands described in this Chapter apply to most monitoring models (from Chapter 6 to Chapter 14), and to all the graphs generated by the Hydran M2 Host (DNP) software. The graph area of a typical model window is shown in Figure 5-1 on page 5-1.

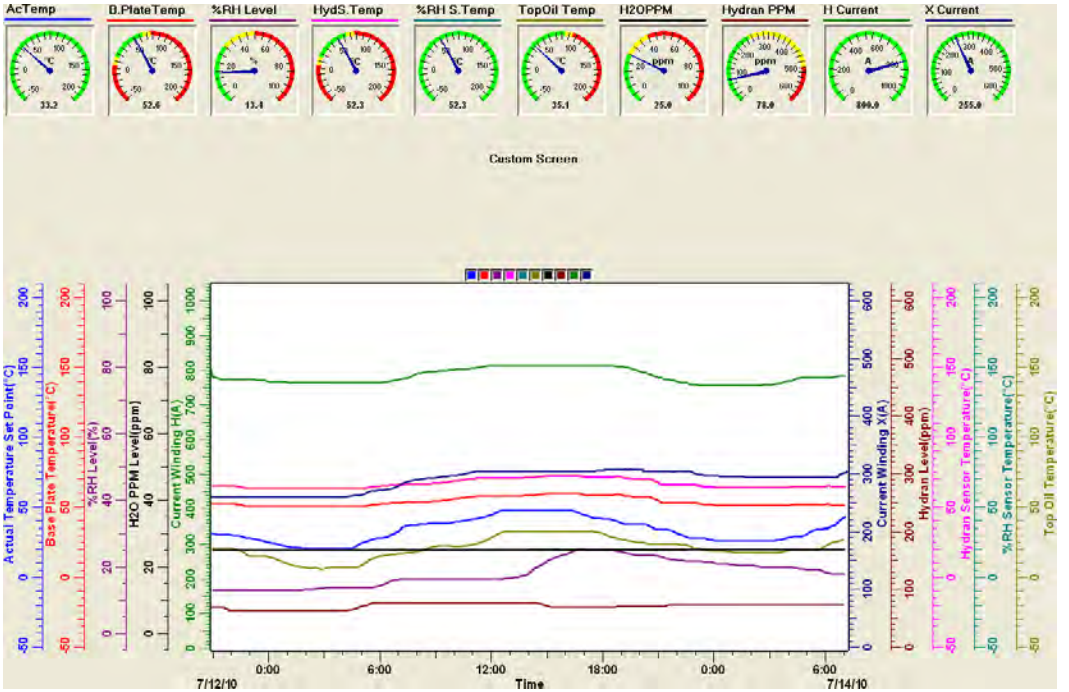

Figure 5-1 - Typical Graph Area

5.1 ANALOG SIGNAL DISPLAYS

In most windows and graphs, an analog signal display is represented as in Figure 5-2 on page 5-2.

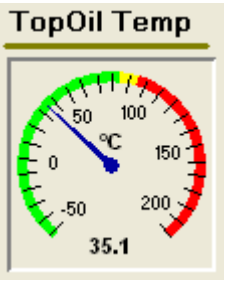

Figure 5-2 - Analog Signal Display

The following properties apply to all analog signal displays:

- The colored line under the name is given by the Hydran M2 Host (DNP) software and is the color of the curve for that signal (refer to Figure 5-1 on page 5-1).
- The value (**35.1** in Figure 5-2 on page 5-2) and the needle indicate the reading for that signal at the present moment.
- The limits for the scale (**-50** and **210 °C** in this case) are the maximum and minimum displayed values. To modify them, refer to Section 3.4.5 on page 3-81.
- The colors green, yellow and red are delineated by the alarm set-points (**85** and **95 °C** in this case).
- These three colors for the different alarm levels cannot be modified.

5.2 DIGITAL SIGNAL DISPLAYS

In most windows and graphs, a digital signal display is represented as in Figure 5-3 on page 5-2.

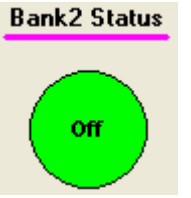

Figure 5-3 - Digital Signal Display

The following properties apply to all digital signal displays:

- The colored line under the name is given by the Hydran M2 Host (DNP) software and is the color of the graph for that signal.
- The value (**Off** in this case) indicates the status of that signal at the present moment.
- The sensor is always shown with a green circle, no matter if it is **On** or **Off**.

5.3 VERTICAL SCALES FOR ANALOG SIGNALS

A window or a graph can possess a maximum of ten vertical scales, including digital inputs (refer to Figure 5-1 on page 5-1). The following properties apply to the vertical scales for analog model values:

- The number of vertical scales is equivalent to the number of signals displayed (one scale per signal).
- The color of the vertical scale is given by the Hydran M2 Host (DNP) software, and it is the same as the corresponding curve.
- The limits for a vertical scale (**-50** and **210 °C** for the last scale on the right side in Figure 5-1 on page 5-1) are the same as in the corresponding display above the chart, and they are the maximum and minimum displayed values. To modify them, refer to Section 3.4.5 on page 3-81.
- There is a maximum of five vertical scales the left side of the chart and a maximum of five vertical scales on the right side.
- Above the chart (on top of Figure 5-1 on page 5-1), each of the small squares represents a curve. For each signal displayed, the corresponding square contains a button with the same color as the curve.
- Click one of the small squares to depress it and the corresponding curve and vertical scale disappear from the chart (however, the corresponding display above the chart remains visible). When doing so, the vertical scales for the other curves remain on their respective side. Click a small square to press it and the corresponding curve and vertical scale reappear.
- The vertical scale of any curve can be extended by clicking it and dragging it down, in order to improve the clarity of the corresponding curve. To return a vertical scale to its initial condition, click it and drag it up many times until there is no movement.

5.4 VERTICAL SCALES FOR DIGITAL SIGNALS

Digital inputs can have an **On** or **Off** state only. The following properties apply to the vertical scales for digital model values:

- All digital input curves use the same vertical scale labeled **Digital Inputs**. The even values on that scale represent the **Off** state and the odd values on the scale represent the **On** state.
- The color of the vertical scale is given by the Hydran M2 Host (DNP) software, and it is the same as the corresponding curve.
- The limits for the vertical digital scale are **0** and **14**.
- Above the chart, each of the small squares represents a curve. For each signal displayed, the corresponding square contains a button with the same color as the curve.
- Click one of the small squares to depress it and the corresponding curve disappears from the chart (however, the corresponding display above the chart remains visible). When doing so, the vertical scales for the other curves remain on their respective side. Click a small square to press it and the corresponding curve reappears.

5.5 HORIZONTAL SCALE

There is one horizontal time scale per graph, whatever the number of signals displayed (see Figure 5-1 on page 5-1). The following properties apply to the horizontal scale in all graphs:

- If **Real Time Values** has been selected in Figure 3-18 on page 3-18, the horizontal scale extends from the time of the graph creation until now.
- If **Historic Values** has been selected in Figure 3-18 on page 3-18, the horizontal scale covers the period of time selected.
- In the main window for a particular monitoring model, the horizontal scale covers the period of time selected in Figure 4-2 on page 4-6.
- A horizontal scale can be extended by clicking it and dragging it to the left or to the right, in order to improve the clarity of all curves.
- When the horizontal scale is modified, all curves vary correspondingly. However, extending the scale beyond the initial start date does not allow to display older values.
- To return the horizontal scale to its initial condition, click it and drag it to the left or to the right many times until the curves touch the left axis of the chart. You can also regenerate the graph.

5.6 ZOOM

In addition to modifying the vertical and/or horizontal scales in a chart, the clarity of the various curves can also be improved by using the zoom function.

To do so, move the cursor into the graph and click the left button of the mouse. Drag the cursor to the opposite corner of a box with the desired dimensions, and let go the left button of the mouse. The selected zoom area expands to cover the entire graph, and all curves and scales are modified accordingly. However, the displays above the chart do not change. This process can be repeated until a certain section of the graph is shown as desired.

To zoom out, move the cursor into the graph and click the right button of the mouse, as many times as wanted. To return a graph to its initial condition, click the right button of the mouse until both ends of the curves can be seen, and then draw a zoom box around the curves to zoom in; you can also regenerate the graph.

Note: If you return a graph to its initial condition by zooming out, the range of the vertical and horizontal scales will probably vary slightly from those in the initial window.

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Chapter 6

Apparent Power Model

The primary function of this model is to continuously monitor the load carried by the transformer in MVA (Mega Volt-Amperes). The Apparent Power can be computed on the primary, secondary, and tertiary windings, depending on the input configuration. The historic maximum MVA value is retained with a time stamp and can be reset by the user.

The current signal is a mandatory input, whereas the voltage signal is configured as a fixed value. Since voltage variations occurring in service and tap changer operations are not taken into consideration, the MVA is an approximate reading, and used only for display purposes.

The sensors, rules and outputs of the Apparent Power model are illustrated in Figure 6-1 on page 6-1.

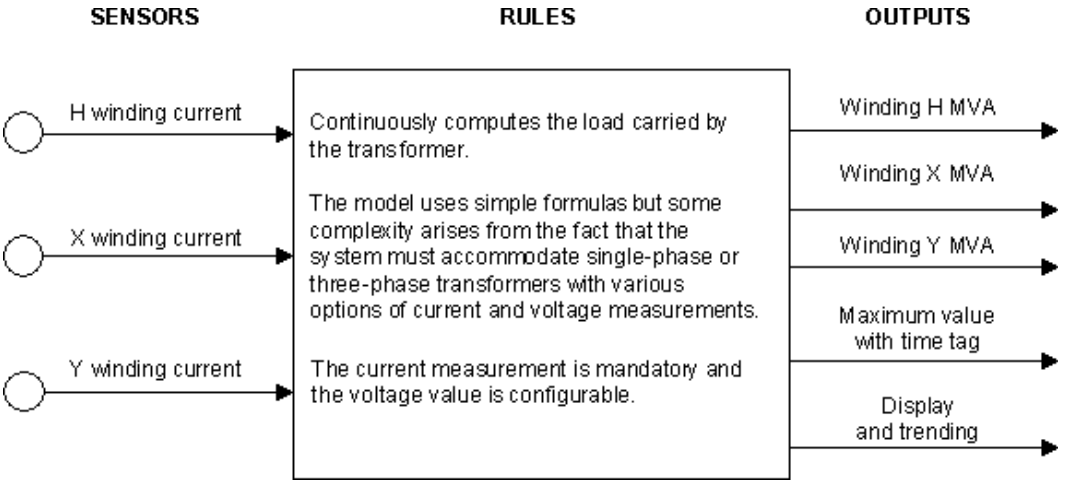

Figure 6-1 - Summary of the Apparent Power Model

6.1 MODEL INPUTS

- H winding current (required)
- X winding current (optional)

- Y winding current (optional)

6.2 PARAMETERS TO CONFIGURE

Number of Phases:

- Enter **1 phase** for single-phase transformers.
- Enter **3 phases** for three-phase transformers.

Rated Current on Windings H, X, Y and C: The rated load current for each winding is expressed in amperes (A) and is configurable from 1 to 5,000 A for the H winding, and from 1 to 50,000 A for the X and Y windings. The C winding is applicable only for autotransformers; it is configurable from 1 to 50,000 A. Before configuration, a default value of 250 A is shown for all current values.

Rated Voltage on High Voltage Side, *Rated Voltage on Low Voltage Side* (optional) and *Rated Voltage on Tertiary Side* (optional): The rated voltage for each winding can be derived from the transformer nameplate. For three-phase transformers, the value written for the line-to-line voltage is required. For single-phase transformers, the value written for line-to-ground voltage is required for star windings, and the value written for line-to-line voltage is required for delta windings. These voltages are expressed in kilovolts (kV). The rated voltage is configurable from 10 to 1,500 kV for the H and X windings, and from 3 to 1,500 kV for the Y winding. Before configuration, a default value of 100 kV is shown.

6.3 MODEL OUTPUTS

Winding H MVA: The historic maximum load value on the H winding with a time stamp. The load is expressed in Per Unit (p.u.) of rated current. This value is resettable by the user.

Winding X MVA and *Winding Y MVA* (if the X winding current and the Y winding current are configured as inputs): The historic maximum load values on the X and Y windings with time stamps. The loads are expressed in Per Unit (p.u.) of rated current. These values are resettable by the user.

6.4 MAIN WINDOW

The main window for the Apparent Power model is shown in Figure 6-2 on page 6-3. The commands applying to all monitoring models are explained in Chapter 5.

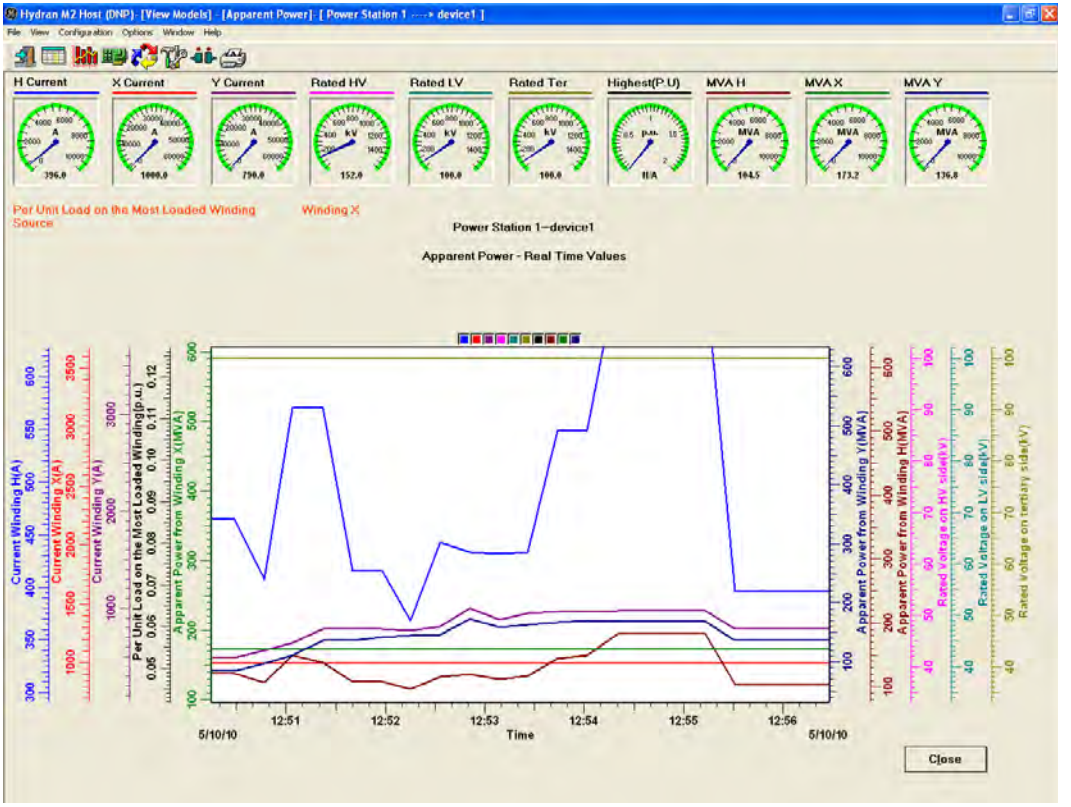

Figure 6-2 - Main Window for the Apparent Power Model

By default, the following ten analog signals are displayed:

- Current winding H (minute-averaged value of the load current for phase H)
- Current winding X (minute-averaged value of the load current for phase X)
- Current winding Y (minute-averaged value of the load current for phase Y)
- Rated Voltage on HV side
- Rated Voltage on LV side
- Rated Voltage on Tertiary side
- Apparent Power from H winding
- Apparent Power from X winding
- Apparent Power from Y winding
- Per Unit load on most loaded winding

Note: If only one winding current is set as input, the Apparent Power model is still enabled, but only computes the parameters related to that winding as well as the Per Unit load on the most loaded winding.

Chapter 7

Winding Hot-Spot Temperature Model

The rating of a transformer is closely linked to the winding temperature as it governs the insulation aging rate and bubbling release threshold. This winding temperature can also raise an alarm if excessively high values occur. In the industry standards, the winding temperature limit is defined as a temperature rise above the ambient air temperature. The cooling system is designed to ensure that at full load, the average winding temperature rise does not exceed the industry-accepted value (usually 65 °C).

However it is not the average winding temperature that is of most interest but rather the temperature in the hottest area (so called “hot-spot temperature”). This temperature cannot be measured directly as it is not possible to insert thermocouples in a winding that is to be put in service. It is possible to use fiber optic temperature sensors that do not interfere with dielectric strength but this procedure is costly and is usually limited to the validation of the manufacturer calculation methods. Therefore the traditional method was to use a Winding Temperature Indicator to fulfill that function.

A more accurate and reliable evaluation of the hot-spot temperature can be provided, using the equations provided in IEEE and IEC Loading Guides:

- IEEE C57.91 - 1995, IEEE Guide for Loading Mineral-Oil-Immersed Transformers
- IEC 60076-7 - 2005, Power Transformers - Part 7: Loading Guide for Oil-Immersed Power Transformers

In the computation methods described in these Loading Guides, a key value is the temperature difference between the winding hot-spot and the top oil at rated conditions. This value is normally provided by the transformer manufacturer after suitable validation of their computation method. In the Winding Hot-Spot Temperature model, this rated value is corrected to account for actual load current and winding thermal time constant. The computed hot-spot temperature rise is then added to the measured top oil temperature to provide the actual winding hottest-spot temperature.

The winding hot-spot temperature is computed separately for each winding. The highest value of winding hot-spot temperature is identified and used to raise an alarm signal on the

transformer. The hottest winding might not always be the same, depending on the load on the tertiary winding and on the position of the tap changer.

For autotransformers, the winding hot-spot temperature is calculated for the series winding (H), the common winding (C) and the tertiary winding (Y). The current in the common winding is calculated by subtracting the secondary load current minus the primary load current.

The sensors, rules and outputs of the Winding Hot-Spot Temperature model are illustrated in Figure 7-1 on page 7-2.

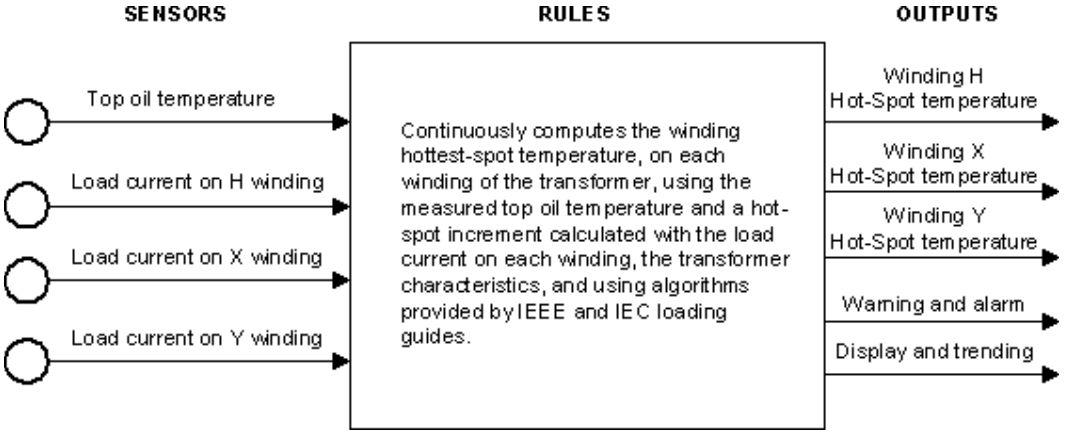

Figure 7-1 - Summary of the Winding Hot-Spot Temperature Model

7.1 MODEL INPUTS

- Top oil temperature
- H winding current (required)
- X winding current (optional)
- Y winding current (optional)

7.2 PARAMETERS TO CONFIGURE

Transformer Type: Select between Standard Transformer and Autotransformer, in order to calculate correctly the load current in the common winding of autotransformers.

Rated Current on Winding H, Rated Current on Winding X (optional) and *Rated Current on Winding Y* (optional): For each winding, the rated current on the top cooling mode is to

be used. These values are available from the transformer nameplate. The rated load current is expressed in amperes (A) and is configurable from 1 to 5,000 A for the H winding, and from 1 to 50,000 A for the X and Y windings. Before configuration, a default value of 250 A is used.

Winding Exponent: The winding exponent "m" relates the hot-spot rise above top oil to the load level. It is normally calculated only for the top cooling mode. It can be derived from the temperature rise tests under several load levels. If no information is available, a default value of 0.8 can be used for the ONAN, ONAF and OFAF cooling types, and a default value of 1.0 can be used for the ODAF cooling type. This value is configurable between 0.5 and 1.0, and the system default value is 0.9.

Winding Time Constant: The winding has its own thermal capacity that will delay somewhat the temperature change caused by load variations. This delay is significant only during sudden overloads of high magnitude. Specific values can be obtained from the manufacturer or by analysis of results from temperature rise tests. A default value of 6 minutes is conservative and acceptable in most cases. This value is configurable from 0.1 to 20 minutes and the system default value is 6 minutes.

Rated Hot-Spot Rise Above Top Oil in Winding H, Rated Hot-Spot Rise Above Top Oil in Winding X (optional) and *Rated Hot-Spot Rise Above Top Oil in Winding Y* (optional): The winding hottest-spot temperature rise above top oil is needed on the top cooling mode, at rated load, for each winding to be monitored. On recent units, these values should appear on the reports for temperature rise tests (heat run test). Otherwise they have to be obtained from the manufacturer. These values are critical for winding hot-spot calculation and an effort should be made to get the proper values. As a last resort, an approximate value can be obtained from calculations as recommended in the IEC and IEEE Loading Guides. This value is configurable from 1 to 50 °C and the system default value is 30 °C.

Rated Hot-Spot Rise Above Top Oil in Winding C (optional): Winding C is applicable only for autotransformers. For this type of unit, the H winding is considered as the series winding and the current in the common winding is calculated by subtracting the LV current minus the HV current. The winding hot-spot rise is similar as for a regular transformer.

7.3 MODEL OUTPUTS

Winding Hot-Spot Temperature in Winding H

Winding Hot-Spot Temperature in Winding X and *Winding Hot-Spot Temperature in Winding Y* (if load current X and load current Y are configured as inputs).

Winding Hot-Spot Temperature in Winding C (if load current C is configured as an input and Transformer type is Autotransformer).

Highest Winding Hot-Spot Temperature

Historic Maximum Value of Winding H Hot-Spot Temperature, *Historic Maximum Value of Winding X Hot-Spot Temperature*, *Historic Maximum Value of Winding Y Hot-Spot Temperature* and *Historic Maximum Value of Winding C Hot-Spot Temperature* with time stamps: These values are resettable by the user.

7.4 ASSOCIATED ALARMS

Top Oil Temperature Hi and Hi-Hi Alarms: These values are configurable from 50 to 200 °C. The system default values are 85 °C for the Hi alarm and 95 °C for the Hi-Hi alarm. These alarms come with a deadband configurable from 0 to 15 °C (default: 2 °C) to avoid oscillation of the alarm signal. A time delay, configurable from 0 to 30 minutes (default: 1 minute), is also provided for the same purpose.

Winding Hot Spot Hi and Hi-Hi Alarms: These alarms are sensitive to all windings being monitored and react to the hottest winding temperature. These values are configurable from 70 to 170 °C. The system default values are 110 °C for the Hi alarm (this is the rated temperature for thermally-upgraded paper) and 120 °C for the Hi-Hi alarm. These alarms come with a deadband configurable from 0 to 15 °C (default: 2 °C) to avoid oscillation of the alarm signal. A time delay, configurable from 0 to 30 minutes (default: 1 minute), is also provided for the same purpose.

Note: Appendix B presents the list of all alarm messages that can appear on the Hydran M2 Host (DNP) software.

7.5 MAIN WINDOW

The main window for the Winding Hot-Spot Temperature model is shown in Figure 7-2 on page 7-5. The commands applying to all monitoring models are explained in Chapter 5.

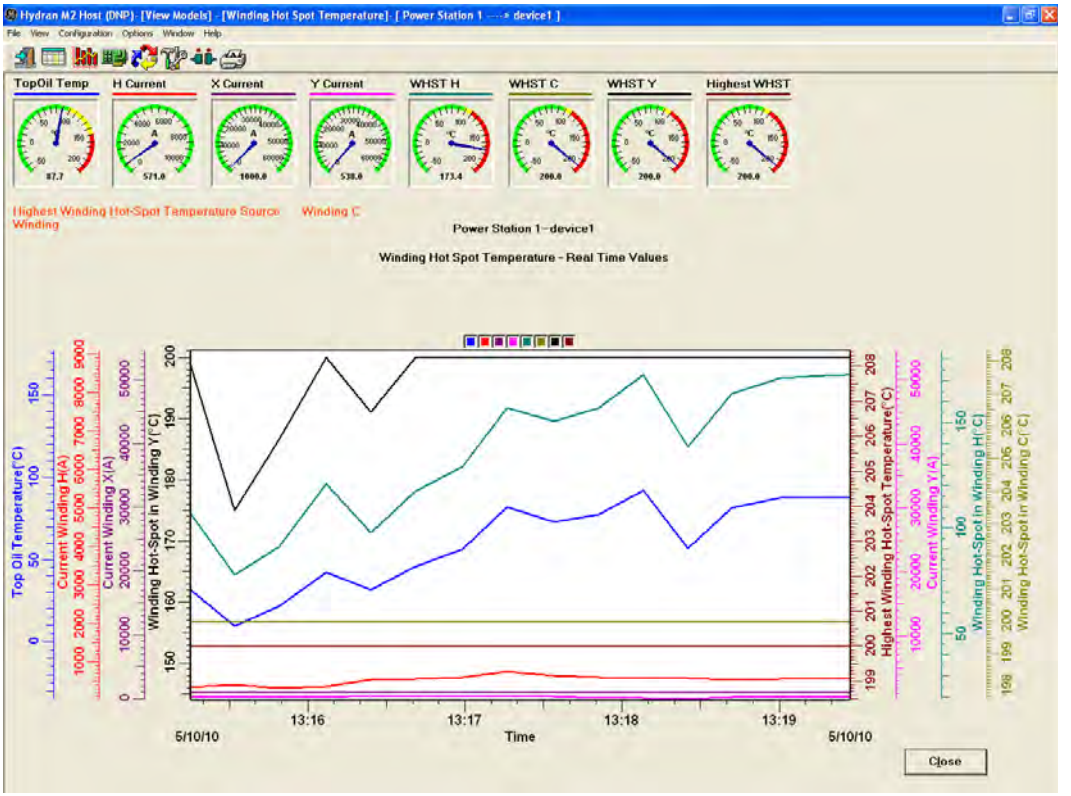

Figure 7-2 - Main Window for the Winding Hot-Spot Temperature Model

By default, the following eight analog signals are displayed:

- Top Oil Temperature
- Current Winding H
- Current Winding X
- Current Winding Y
- Winding Hot-Spot Temperature in winding H
- Winding Hot-Spot Temperature in winding X
- Winding Hot-Spot Temperature in winding Y
- Highest Winding Hot-Spot Temperature

Note: If only one winding current is set as input, the Winding Hot-Spot Temperature model is still enabled but only computes the parameters related to that winding as well as the Per Unit load on the most loaded winding.

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Chapter 8

Insulation Aging Model

Winding insulation is made of oil-impregnated cellulose material. In order to properly fulfill its function, this material needs to have a certain mechanical strength and flexibility. These properties depend on the length of the cellulose chain constituent of the paper and pressboard. With time and temperature, these long polymer chains break down into shorter segments, a process called depolymerization. The practical effect is that the paper loses its flexibility and tensile strength to become a brittle material. The winding is continuously submitted to clamping forces and vibrations. Moreover, during short-circuit on the system, these forces are increased tremendously and if the insulating paper is too brittle, it may rupture under the pressure and create a weak point in the insulation that will later allow flashover between adjacent turns when a voltage surge occurs on the transformer.

This insulation aging process is irreversible. It is also the main factor determining the transformer's end of life. The rate of aging of cellulose insulation material is a function of the following factors:

- Insulation temperature at the hot spot
- Water content in the winding insulation paper
- Oxygen content of the insulating oil

The effect of temperature is the most important, as described in the IEEE and IEC Loading Guides. The effect of temperature on aging is a function of the type of paper. It is therefore important to state in the configuration page the type of paper used for winding insulation.

A second factor affecting insulation aging is the moisture content. It is assumed that the aging acceleration factor is directly proportional to the water content with 0.5 % as reference value for dry paper. The water content in winding insulation is computed in the Moisture Content in Insulating Barrier model (Chapter 10). The effect is more severe on the normal Kraft paper than on thermally-upgraded paper and it can be practically neglected on Aramid paper.

The third factor is the oxygen content of the insulating oil. This oxygen content can be inferred from the type of oil preservation system. The IEEE Loading Guide recommends using an aging acceleration factor of 2.5 for free-breathing conservators while the sealed-

type transformers and those with a membrane in the conservator are practically oxygen-free.

The sensors, rules and outputs of the Insulation Aging model are illustrated in Figure 8-1 on page 8-2.

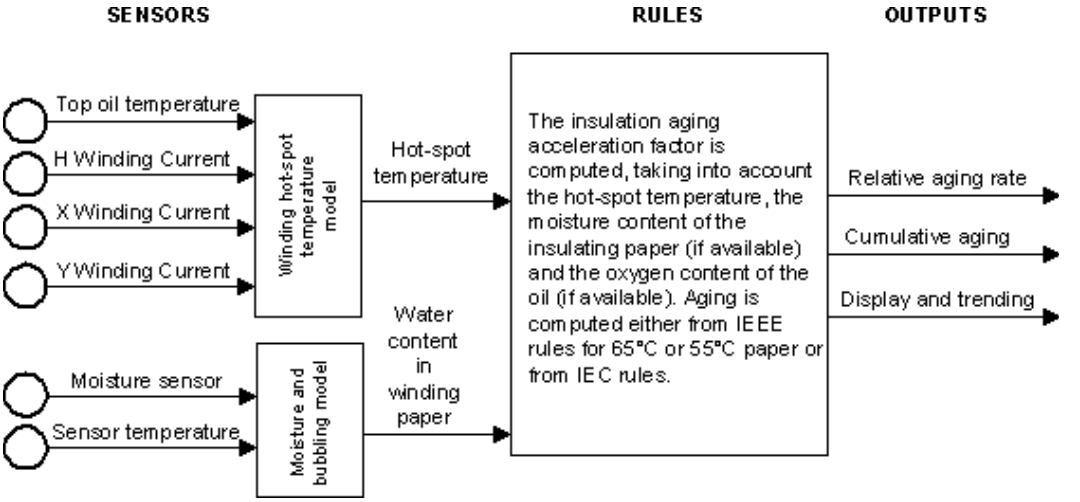

Figure 8-1 - Summary of the Insulation Aging Model

8.1 MODEL INPUTS

- Top oil temperature
- H winding current (required)
- X winding current (optional)
- Y winding current (optional)

8.2 PARAMETERS TO CONFIGURE

Aging Calculation Method and Type of Paper: The selection of the paper type is tied directly to the selection of the aging calculation method:

- Select **IEC 65 °C rise** for units built according to IEC rules with a 65 °C average winding rise and a maximum rated winding hot-spot temperature of 98 °C.
- Select **IEEE 55 °C rise** for older units built according to IEEE rules with a 55 °C average winding rise and a maximum rated winding hot-spot temperature of 95 °C.

- Select **IEEE 65 °C rise** as defined in the IEEE Loading Guide for transformers with a 65 °C average winding rise and a maximum rated winding hot-spot temperature of 110 °C.
- Select **Nomex aging** for winding insulation made of Aramid paper with a maximum rated winding hot-spot temperature of 188 °C.

Some newly-built transformers are specified with a 55 °C average winding rise although they use thermally-upgraded insulating paper that would allow the transformer to operate at 65 °C for normal life duration. Selecting a lower-rated temperature rise provides longer life duration in those applications where the ambient temperature is expected to be very high. In such case, the type of paper should be configured as **IEEE 65 °C rise**.

Some transformers are specified according to IEC standard with the addition of thermally-upgraded paper. In this case, the rated hot-spot temperature is 110 °C and the **IEEE 65 °C rise** formula should be used for aging calculation.

Previous Aging: The previous aging can be configured when a monitoring system is retrofitted on an existing transformer. When a monitoring system is installed on a transformer that has been in service for some time, the user may wish to enter in the cumulative aging counter the thermal aging incurred before commissioning of the monitoring system. This aging must be estimated by the user from the loading history, the ambient temperature, the estimated water content in the winding insulation, and the oxygen content in the oil. When only subsequent aging is to be reported, a value of 0 hour in used for this configuration field. The Previous Aging value is configurable from 0 to 400,000 days and the default value is 0 day.

Oil Preservation System: The type of oil preservation system has a direct influence on the amount of oxygen dissolved in the transformer oil, thus determining the aging acceleration factor used in the calculation of the Global Aging Acceleration factor. The aging acceleration factor used by the Hydran M2 is as follows:

- 1 for a sealed tank or a conservator with membrane
- 2.5 for a free-breathing conservator

Previous Service Time: The Service Time represents the number of days the transformer has been in service regardless of the load level, prior to the commissioning of the monitoring system. When only subsequent aging is to be reported, a value of 0 hour should be used for this configuration. This value is configurable from 0 to 40,000 days with a default value of 0 day.

8.3 MODEL OUTPUTS

Thermal Aging Acceleration Factor considering only the hot-spot current temperature.

Moisture Aging Acceleration Factor considering only the effect of moisture in paper.

Global Aging Acceleration Factor: This is the actual aging rate or aging acceleration factor, considering the cumulated effect of temperature, moisture and oxygen in oil.

Cumulative Aging: This field indicates the aging cumulated since the commissioning of the system, adding the "Previous Aging" if this value was configured on the Insulation Aging Model configuration page. The value is expressed in days of operation at rated temperature; for instance, a transformer with thermally-upgraded paper operating 24 hours at 117 °C will undergo 2 days of "normal aging at rated temperature."

Service Time: This field indicates the number of days the transformer has been in service since the commissioning of the system, adding the "Previous Service Time" if this value has been configured.

8.4 MAIN WINDOW

The main window for the Insulation Aging model is shown in Figure 8-2 on page 8-5. The commands applying to all monitoring models are explained in Chapter 5.

By default, the following three analog signals are displayed:

- Highest winding hot-spot temperature
- Global aging accumulation factor
- Moisture content in winding paper

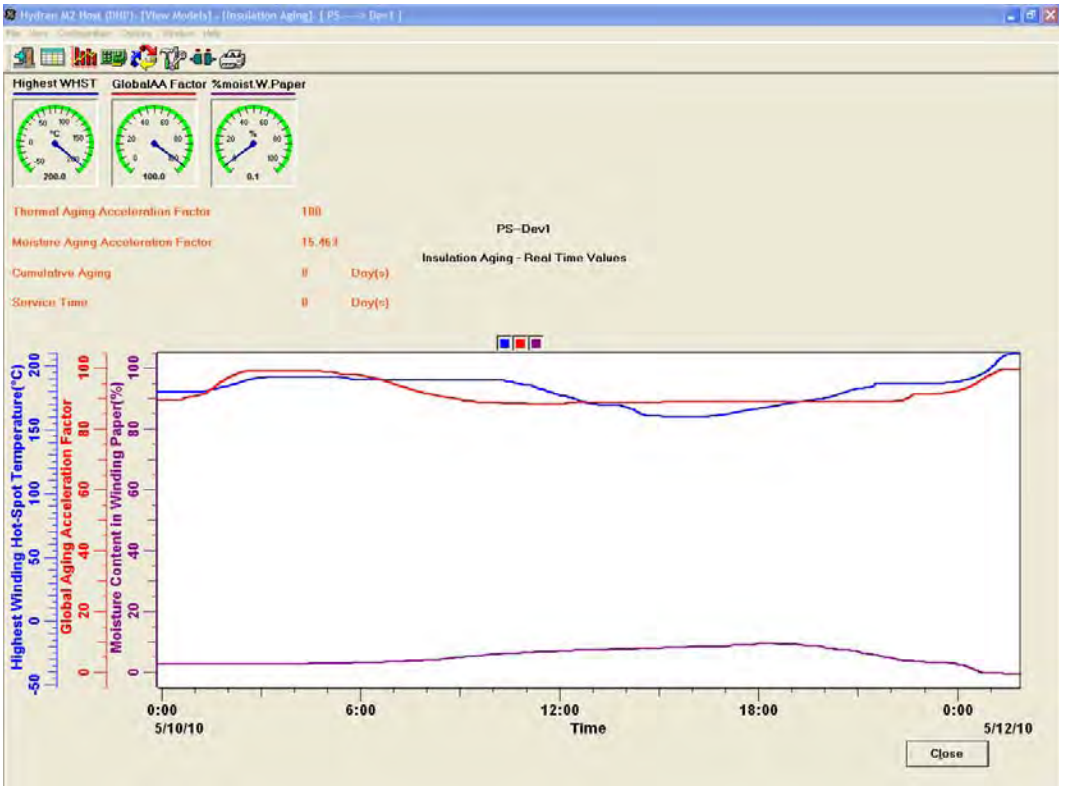

Figure 8-2 - Main Window for the Insulation Aging Model

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Chapter 9

Moisture and Bubbling

The moisture content of the oil and the solid insulation is a serious concern for power transformers, especially for aging units. Extensive drying procedures are applied at the manufacturing stage and sustained efforts are deployed in service to maintain a high level of dryness. However, with time, water can penetrate through various paths such as the air breather and leaky gaskets. Aging of cellulose also releases some water. Moisture tends to accumulate in the solid insulation and leads to several detrimental consequences, namely:

- Acceleration of insulation aging
- Risk of water vapor bubbles being released from the winding insulation
- Reductions of dielectric strength of insulating barriers
- Risk of water condensation in transformer oil at low temperatures

Moisture content assessment is too often derived from a single oil sample submitted to a Karl Fischer test in laboratory. This is a valid approach for oil evaluation but it does not allow evaluation of the moisture content in the solid insulation as the rate of water exchange between the oil and the paper has to be taken into account. On-line monitoring of moisture in oil allows integration of temperature variations and the computation of a dependable value for moisture content in the various components of the solid insulation system, even if they are at different temperatures and characterized by different diffusion rates.

The most critical part of the winding insulation is the top of the winding that operates at the hot-spot temperature. This is the area where the aging is most severe, and the effect of the water content can be computed. The determination of the critical temperature for bubble evolution takes into account the atmospheric pressure, the oil pressure above the hot-spot area, and the amount of gas dissolved in the oil.

The moisture sensor continuously monitors the oil's temperature and relative moisture saturation at the sensor location. A filtering is applied to remove the effect of cyclic heating created by the sensor to ensure oil circulation. This filtered value is used to calculate the absolute value of the water content in the oil, the temperature of water condensation, and the relative saturation at the reference temperature.

Since the oil and winding temperature varies continuously, this moving target is used with an integrating algorithm taking into account the diffusion time constant and the temperature.

The calculated value of the water content in the winding insulation allows prediction of the bubbling temperature. It is also used in the Insulation Aging model (Chapter 8).

The sensors, rules and outputs of the Moisture and Bubbling model are illustrated in Figure 9-1 on page 9-2.

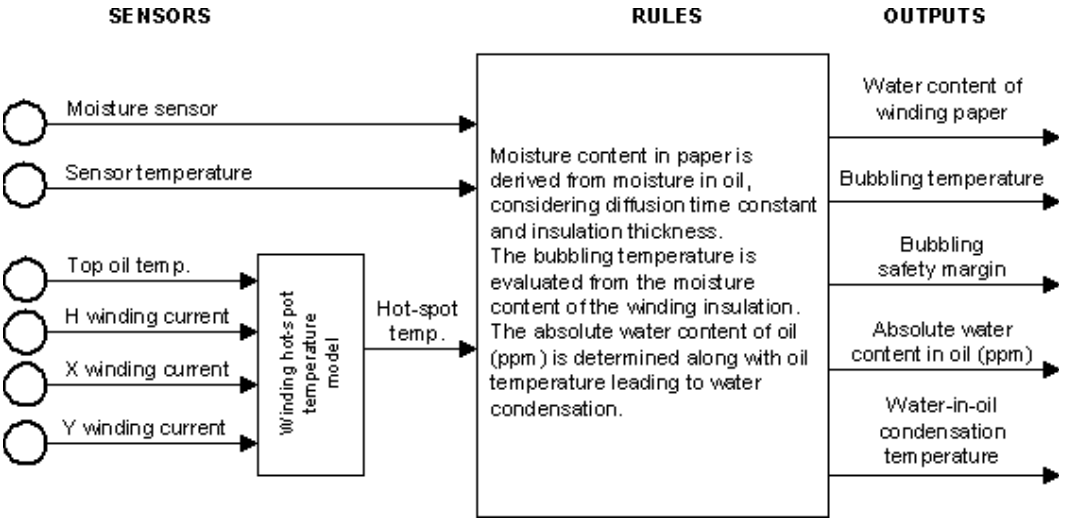

Figure 9-1 - Summary of the Moisture and Bubbling Model

9.1 MODEL INPUTS

- Top oil temperature
- Winding current

9.2 PARAMETERS TO CONFIGURE

Height of Oil Above the Hot Spot Area: This value is used in the calculation of the bubbling threshold temperature. The oil column above the winding creates a pressure that prevents the release of free gas bubbles. This value is configurable from 0 to 5 meters and the default value is 2 meters.

Type of Oil: In order to convert the relative oil saturation (RH%) into the absolute water content in oil (ppm), it is necessary to know the water saturation curve of the oil. This curve varies with the type of oil (naphtaneic, aromatic, vegetable or silicon) that has been selected in the general transformer configuration page.

If the user wishes to define his water solubility curve, it can be done by providing specific values for the factors A, B and C in the water solubility function:

$$ppm = RH\% * EXP(B-A/(273.16 + \text{hot-spot temperature})) + C$$

These parameters can be configured using the limits shown in Table 9-1 on page 9-3. The default values correspond to naphtaneic oil.

Table 9-1 - Factors in the Water Solubility Function

	Minimum Value	Maximum Value	Default Value
A	1,000	10,000	4,107.18
B	10	25	17.749
C	0	10	2.41

Standard Temperature for RH: This value is used to convert the measured relative saturation (RH%) to a relative saturation at a reference temperature. This reference temperature can be configured from 0 to 40 °C with a default value of 20 °C.

Altitude of the Transformer

Type of Oil Preservation System

9.3 MODEL OUTPUTS

Absolute Water Content in Oil in ppm

Water-Oil Condensation Temperature: This is the critical temperature (in °C) for the formation of free water in the insulating oil when a wet transformer is allowed to cool down rapidly. If the water dissolved in the oil does not have sufficient time to migrate back to the cellulose insulation, droplets of free water may precipitate in the oil. This would create a hazard for dielectric failure should the transformer be reenergized in this condition.

Moisture Content in Winding Paper: This value is expressed in percentage weight by weight.

Moisture Content in Winding Paper Validation Delay: The migration of moisture between the oil and the paper is a slow process governed by the moisture content and the diffusion time constant. At system commissioning, it is not possible to provide and immediate value of moisture content in the paper. Data may need to be integrated over several days or weeks before a reliable value can be displayed. This delay is calculated considering the current temperature conditions and the time elapsed since the system was commissioned.

Winding Bubbling Temperature: Residual moisture in the winding insulation can release free gas bubbles if the hot-spot temperature is too high or increasing rapidly. The bubble inception temperature is function of the moisture content in the paper and also the oil pressure and partial vapor pressure in the area of the winding hot-spot.

Winding Bubbling Temperature Margin: This is the difference between the bubbling inception temperature and the actual winding hot-spot temperature.

9.4 ASSOCIATED ALARMS

Water-in-Oil Condensation Temperature Alarm: This alarm is normally set to alert the operator when the condensation temperature exceeds the minimum temperature that can be observed on the transformer, should it be suddenly removed from service. This value can be configured from -40 to +20 °C with a default value of -20 °C.

Bubbling Temperature Margin Alarm: A significant margin should be maintained at all time to avoid the occurrence of free bubbles circulation in the cooling oil. This margin can be configured from 0 to 50 °C with a default value of 20 °C.

Note: Appendix B presents the list of all alarm messages that can appear on the Hydran M2 Host (DNP) software.

9.5 MAIN WINDOW

The main window for the Moisture and Bubbling model is shown in Figure 9-2 on page 9-5. The commands applying to all monitoring models are explained in Chapter 5.

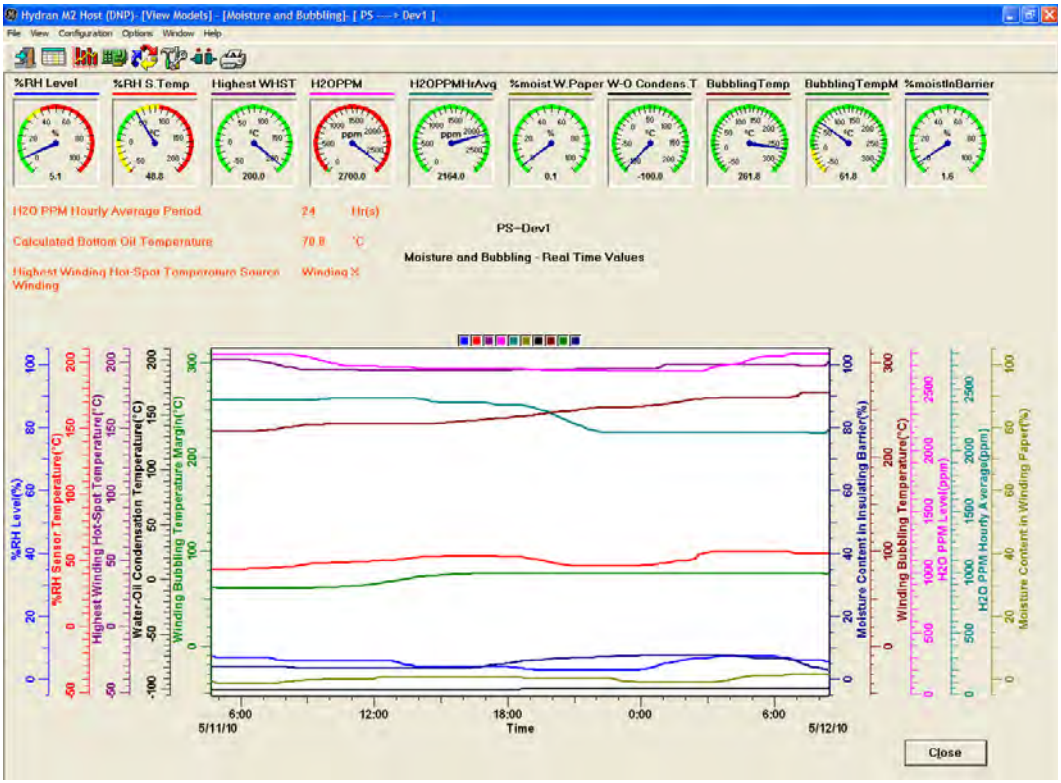

Figure 9-2 - Main Window for the Moisture and Bubbling Model

By default, the following five outputs are displayed:

- Moisture Content in Winding Paper
- Winding Bubbling Temperature
- Winding Bubbling Temperature Margin
- Water-Oil Condensation Temperature
- H_2O PPM Level

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Chapter 10

Moisture Content in Insulating Barrier Model

The moisture content in the solid insulation can significantly reduce the dielectric strength of the components submitted to high electric fields. This effect is especially critical for partial discharges inception on barriers that provide insulation between the windings and that can be submitted to tangential electric fields.

The most critical pressboard barriers are at the bottom oil temperature because this is the coolest area and this is where the moisture content in solid insulation will be the highest. Ideally, a sensor providing a measured value of the bottom oil temperature should be connected as an input. If this is not available, the Hydran M2 will use a calculated value that takes into account the load, the cooling stage, the rated top oil rise and the rated bottom oil rise under each cooling mode, as well as the effect of the altitude on the cooling characteristics.

Knowing the bottom oil temperature, the relative oil saturation in this area can be calculated. The oil-to-paper equilibrium curves providing an ultimate value of the moisture in the paper at those conditions would be maintained continuously.

The value of the water content in pressboard barriers can be used to evaluate the reduction of dielectric strength of this component.

The sensors, rules and outputs of the Moisture Content in Insulating Barrier model are illustrated in Figure 10-1 on page 10-2.

10.1 MODEL INPUTS

- Top oil temperature
- Load current on Winding H
- Bottom Oil Temperature
- Fan feedback status of cooling bank #1 (optional)
- Fan feedback status of cooling bank #2 (optional)

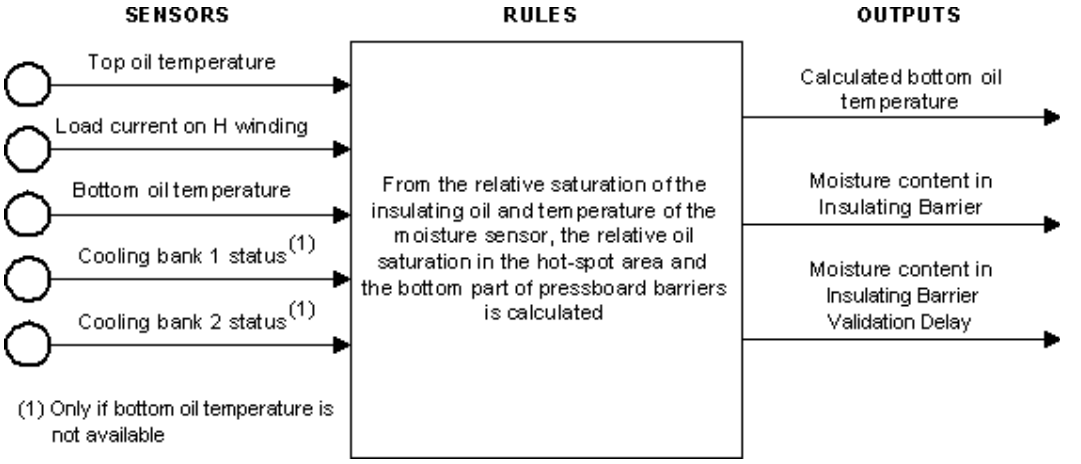

Figure 10-1 - Summary of the Moisture Content in Insulating Barrier Model

10.2 PARAMETERS TO CONFIGURE IF NO BOTTOM OIL MEASUREMENT IS AVAILABLE

Load Losses on Top Cooling Stage: This value is needed to calculate the temperature drop between the measured top oil temperature and the calculated bottom oil temperature. It can be configured from 10 to 10,000 kW with a default value of 500 kW.

No Load Losses at Rated Voltage: This value is needed to calculate the temperature drop between the measured top oil temperature and the calculated bottom oil temperature. It can be configured from 2 to 2,000 kW with a default value of 100 kW.

Rated Power at Cooling Stage 0: The cooling stage 0 is defined as the lowest cooling stage that can be used on a transformer. It can be the ONAN mode, or OFAN if there are some oil pumps. Stages 1 and 2 are under the control of the cooling system control but stage 0 is not under this control. Some transformers have only one cooling stage (typically GSU with OFWF cooling mode); in this case the rated power is to be configured as cooling stage 0. The rated power under cooling stage 0 can be found on the transformer's nameplate. It can be configured from 1 to 600 MVA with a default value of 100 MVA.

Rated Power at Cooling Stage 1: In general, cooling stage 1 can be initiated by activating either cooling bank 1 or 2. It is therefore necessary to distinguish between cooling bank and cooling stage. The rated power under cooling stage 1 is to be found on the transformer's nameplate. It can be configured from 1 to 800 MVA with a default value of 150 MVA.

Some transformers have only one cooling bank that can be controlled; in this case, the two rated values indicated on the nameplate are to be configured as cooling stages 0 and 1.

Rated Power at Cooling Stage 2: The cooling stage 2 is available when both cooling banks are in service. The rated power at cooling stage 2 can be found on the transformer's nameplate. It can be configured from 1 to 1,000 MVA with a default value of 200 MVA.

Oil Exponent at Cooling Stage 0, Oil Exponent at Cooling Stage 1 and *Oil Exponent at Cooling Stage 2*: The oil exponent is a parameter defining the relation between the load and the top oil temperature rise. This value is configurable from 0.5 to 1.0 with a default value of 0.8. The best method to establish this value is to run several temperature rise tests as described in IEEE C57.119 - Recommended Practices for Performing Temperature Rise Tests on Oil-Immersed Power Transformers at Loads Beyond Nameplate Rating. Otherwise, the following approximate oil exponent values related to the cooling mode of each cooling stage can be used:

- 0.8 for the ONAN cooling mode
- 0.9 for the ONAF, OFAN, OFAF and OFWF cooling modes
- 1.0 for the ODAN, ODAF and ODWF cooling modes

Rated Top Oil Rise at Cooling Stage 0, Rated Top Oil Rise at Cooling Stage 1 and *Rated Top Oil Rise at Cooling Stage 2*: These are the top oil temperature rises over the ambient temperature, when the transformer is loaded at the rated load applicable to cooling stages 0, 1 and 2. These values can be found on the transformer's temperature rise test report if such test has been done on cooling stages 0, 1 and 2. If not, the values can be obtained from the manufacturer or estimated from similar transformers. These values are configurable from 20 to 80 °C with a default value of 55 °C.

Altitude of the Transformer: As the altitude increases, the air density reduces and cooling is less efficient. The altitude value allows the Hydran M2 to calculate a reduced value of the rated current that will produce the same top oil temperature rise. The correction factor varies with the type of cooling, in line with IEEE C.57.91-1995. The altitude value is configurable from 0 to 5,000 meters with a default value of 500 meters.

Rated Bottom Oil Rise at Cooling Stage 0, Rated Bottom Oil Rise at Cooling Stage 1 and *Rated Bottom Oil Rise at Cooling Stage 2*: These are the differences between the oil temperature at the bottom of the transformer and the ambient temperature, when the transformer is loaded at the rated load, applicable to cooling stages 0, 1 and 2. These values can be found on the transformer's temperature rise test report if such test has been done on

cooling stages 0, 1 and 2. If not, the values can be obtained from the manufacturer or estimated from similar transformers. These values are configurable from 10 to 60 °C with a default value of 25 °C.

10.3 MODEL OUTPUTS

- Calculated Bottom Oil Temperature (if the bottom oil temperature is not available as an input)
- Moisture Content in Insulating Barrier
- Moisture Content in Insulating Barrier Valid Delay

10.4 MAIN WINDOW

The Moisture Content in Insulating Barrier model is displayed in the main window for the Moisture and Bubbling model, shown in Figure 9-2 on page 9-5. The commands applying to all monitoring models are explained in Chapter 5.

By default, the following two outputs are displayed:

- Moisture Content in Insulating Barrier
- Calculated Bottom Oil Temperature

Chapter 11

Cooling Efficiency Model

This model computes the top oil temperature that should be expected considering the load current, the ambient temperature, the cooling mode, the oil time constant and the altitude. The calculated value is then compared with the measured value and an alarm is raised if the transformer is found to be overheating. This calculation allows for the detection of obstructions, such as dirt on the coolers, which could be a limiting factor when the transformer is required to operate at full load or under overload conditions.

During the initial model computation, the measured values of top oil temperature and ambient temperature are used to provide a starting point for the calculated value of top oil temperature rise. From then on, the calculated temperature at the end of the time interval is used as the initial temperature for the next time interval. This calculation is run with load current in the H winding only. The rated current for each cooling stage is calculated from the rated power on each stage and the rated current on the top cooling stage.

The ultimate temperature rise and the current temperature rise are calculated considering the actual cooling stage and the actual oil time constant. This value is added to the ambient temperature to provide a calculated top oil temperature. This value is subtracted from the measured top oil temperature and the difference is averaged over a configurable period. An alarm is raised when the difference exceeds a configured value for a period of time that is also configurable.

The model can accommodate a transformer with one, two or three cooling stages.

Note: If the transformer is not energized, it is important to remove the core losses when calculating the top oil temperature. Otherwise a false alarm could be generated.

The sensors, rules and outputs of the Cooling Efficiency model are illustrated in Figure 11-1 on page 11-2.

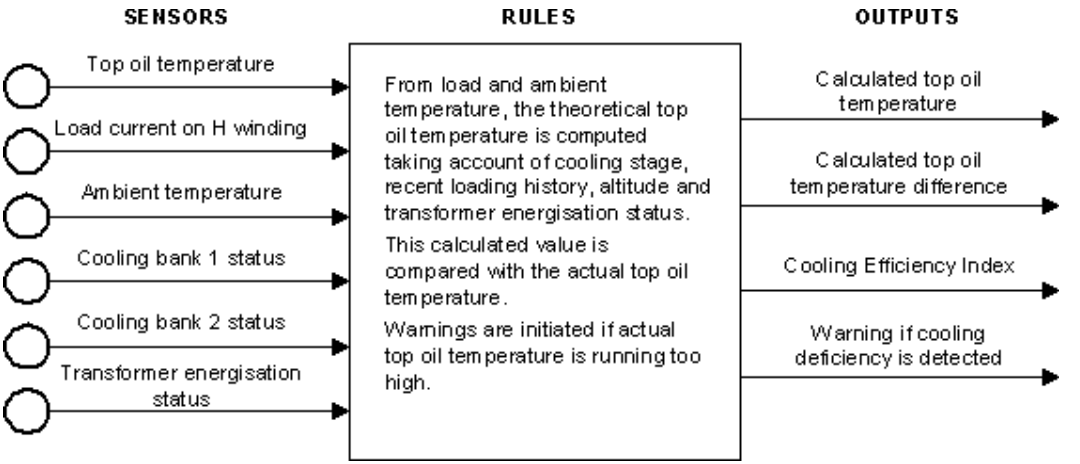

Figure 11-1 - Summary of the Cooling Efficiency Model

11.1 MODEL INPUTS

- Top oil temperature
- Load current on Winding H
- Ambient Temperature
- Fan feedback status of cooling bank #1
- Fan feedback status of cooling bank #2
- Transformer Energized status (optional)

11.2 PARAMETERS TO CONFIGURE

Rated Current in Winding H on Top Cooling Stage: This model considers only the current in the H winding to calculate the actual loading. The rated value of this current is compared to the measured value to derive a Per Unit (p.u.) value. The rated current on the top cooling mode can be found on the transformer's nameplate. This value is configurable from 1 to 5,000 A. Before configuration, a default value of 250 A is shown.

Load Losses on Top Cooling Stage: This value is needed to calculate the temperature drop between the measured top oil temperature and the calculated bottom oil temperature. It can be configured from 10 to 10,000 kW with a default value of 500 kW.

No Load Losses at Rated Voltage: This value is needed to calculate the temperature drop between the measured top oil temperature and the calculated bottom oil temperature. It can be configured from 2 to 2,000 kW with a default value of 100 kW.

Rated Power at Cooling Stage 0: The cooling stage 0 is defined as the lowest cooling stage that can be used on a transformer. It can be the ONAN mode, or OFAN if there are some oil pumps. Stages 1 and 2 are under the control of the cooling system control but stage 0 is not under this control. Some transformers have only one cooling stage (typically GSU with OFWF cooling mode); in this case the rated power is to be configured as cooling stage 0. The rated power under cooling stage 0 can be found on the transformer's nameplate. It can be configured from 1 to 600 MVA with a default value of 100 MVA.

Rated Power at Cooling Stage 1: In general, cooling stage 1 can be initiated by activating either cooling bank 1 or 2. It is therefore necessary to distinguish between cooling bank and cooling stage. The rated power under cooling stage 1 is to be found on the transformer's nameplate. It can be configured from 1 to 800 MVA with a default value of 150 MVA. Some transformers have only one cooling bank that can be controlled; in this case, the two rated values indicated on the nameplate are to be configured as cooling stages 0 and 1.

Rated Power at Cooling Stage 2: The cooling stage 2 is available when both cooling banks are in service. The rated power at cooling stage 2 can be found on the transformer's nameplate. It can be configured from 1 to 1,000 MVA with a default value of 200 MVA.

Type of Cooling for Stage 0, Type of Cooling for Stage 1 and *Type of Cooling for Stage 2*: Select in the menu the standard type of cooling that is applicable for cooling stages 0, 1 and 2.

Oil Exponent at Cooling Stage 0, Oil Exponent at Cooling Stage 1 and *Oil Exponent at Cooling Stage 2*: The oil exponent is a parameter defining the relation between the load and the top oil temperature rise. This value is configurable from 0.5 to 1.0 with a default value of 0.8. The best method to establish this value is to run several temperature rise tests as described in IEEE C57.119 - Recommended Practices for Performing Temperature Rise Tests on Oil-Immersed Power Transformers at Loads Beyond Nameplate Rating. Otherwise, the following approximate oil exponent values related to the cooling mode of each cooling stage can be used:

- 0.8 for the ONAN cooling mode
- 0.9 for the ONAF, OFAN, OFAF and OFWF cooling modes
- 1.0 for the ODAN, ODAF and ODWF cooling modes

Rated Top Oil Rise at Cooling Stage 0, Rated Top Oil Rise at Cooling Stage 1 and *Rated Top Oil Rise at Cooling Stage 2*: These are the top oil temperature rises over the ambient temperature, when the transformer is loaded at the rated load applicable to cooling stages 0,

1 and 2. These values can be found on the transformer's temperature rise test report if such test has been done on cooling stages 0, 1 and 2. If not, the values can be obtained from the manufacturer or estimated from similar transformers. These values are configurable from 20 to 80 °C with a default value of 55 °C.

Rated Top Oil Time Constant: The thermal time constant of the top oil is needed to calculate the effect of a load change on the oil temperature change. This time constant can be derived from the temperature rise test report or it can be calculated from the weight of the core, windings and oil as recommended in IEEE C.57.91-1995. This value is configurable from 0.5 to 8 hours with a default value of 3 hours.

Cooling Efficiency Averaging Period: The cooling efficiency is computed from the difference between the calculated and measured top oil temperature values. To avoid false alarms due to sudden variations of ambient or load conditions, the difference is averaged over a period of time. This averaging period can be configured from 60 to 2,880 minutes with a default value of 1,440 minutes.

Altitude of the Transformer: As the altitude increases, the air density reduces and cooling is less efficient. The altitude value allows the Hydran M2 to calculate a reduced value of the rated current that will produce the same top oil temperature rise. The correction factor varies with the type of cooling, in line with IEEE C.57.91-1995. The altitude value is configurable from 0 to 5,000 meters with a default value of 500 meters.

11.3 MODEL OUTPUTS

- Calculated Top Oil Temperature
- Calculated Top Oil Difference
- Calculated Bottom Oil Temperature (if the bottom oil temperature is not available as an input)
- Cooling Efficiency Index

11.4 ASSOCIATED ALARMS

Cooling Efficiency Index Hi Alarm: This alarm indicates that the transformer is operating at a higher temperature than it should, considering the recent load and recent ambient conditions. Although it does not present an immediate threat for transformer life duration, it indicates that the cooling system is not performing as it should and could mean excessive temperature if the transformer is requested to operate at full load or under overload

conditions. The set point for this alarm is configurable from 0 to 50 °C with a default value of 10 °C.

Note: Appendix B presents the list of all alarm messages that can appear on the Hydran M2 Host (DNP) software.

11.5 MAIN WINDOW

The main window for the Cooling Efficiency model is shown in Figure 11-2 on page 11-5. The commands applying to all monitoring models are explained in Chapter 5.

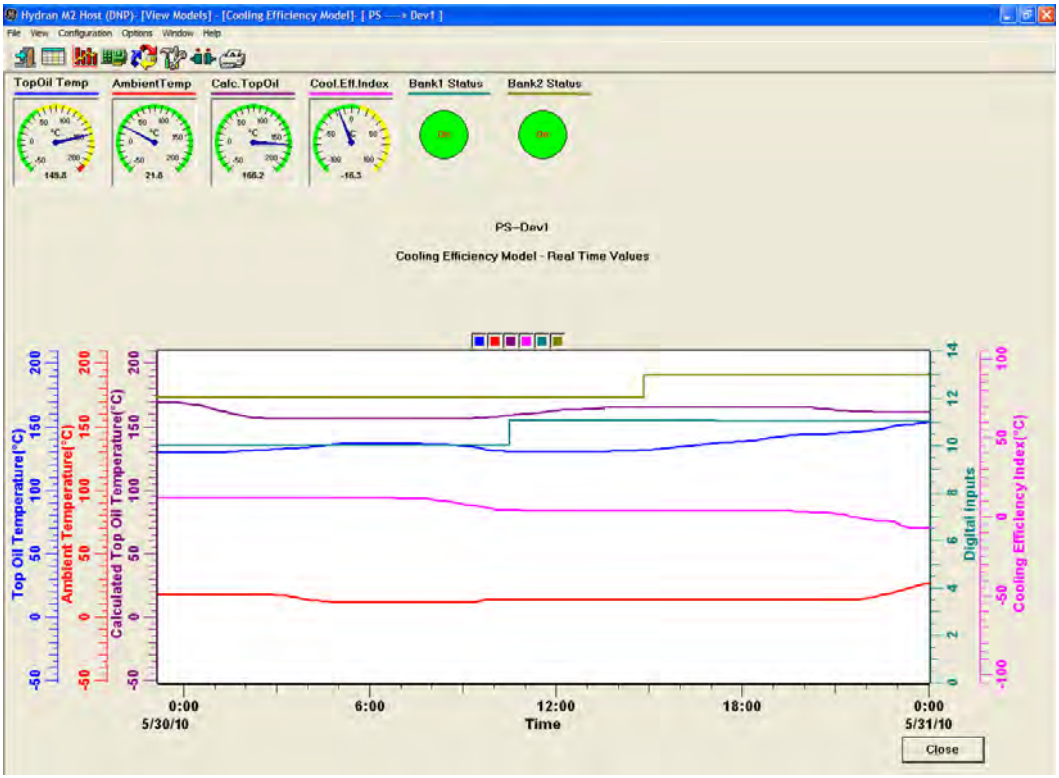

Figure 11-2 - Main Window for the Cooling Efficiency Model

By default, the following four analog and two digital signals are displayed:

- Top Oil Temperature

- Ambient Temperature
- Calculated Top Oil Temperature
- Cooling Efficiency Index
- Cooling Bank 1 Status
- Cooling Bank 2 Status

Chapter 12

Cooling Banks Status Model

The digital indication of cooling bank status can be used as a prime source of information. Transformers usually have two or three ratings related to the three different cooling stages. The lowest rating is defined as “cooling stage 0” and usually applies to the natural cooling of the transformer tank without any fan or pump. Similarly, cooling stages 1 and 2 imply the starting of fans or pumps that increase the cooling capacity.

Since permutation of fan operation is intended, activating either bank 1 or 2 enables cooling stage 1. The cooling stage 2 implies that both bank 1 and bank 2 fans are activated.

Some transformers (such as GSU indoor) have only one cooling stage; thus whenever the transformer is energized, the full cooling is automatically initiated. These units are treated as having only cooling stage 0.

The sensors, rules and outputs of the Cooling Banks Status model are illustrated in Figure 12-1 on page 12-1.

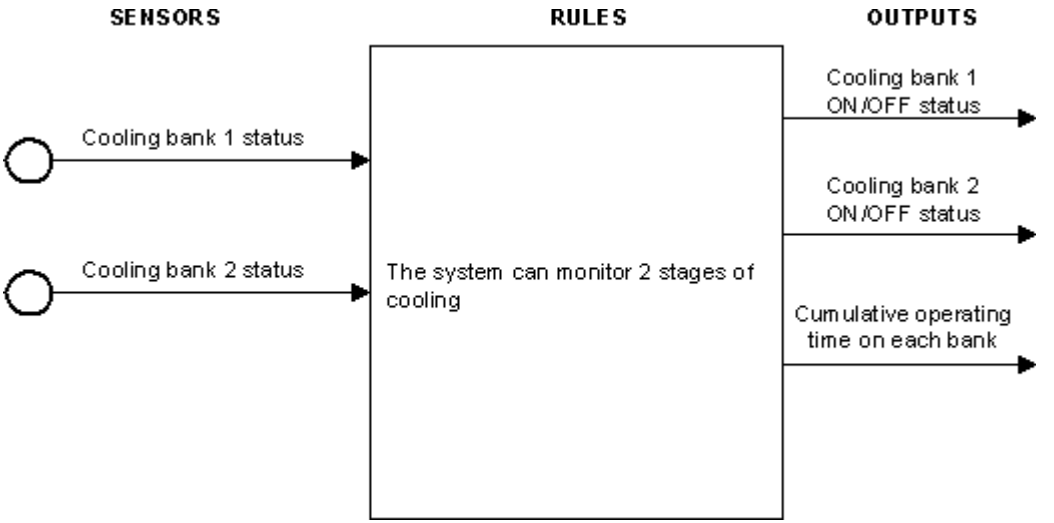

Figure 12-1 - Summary of the Cooling Banks Status Model

12.1 MODEL INPUTS

- Fan feedback status of cooling bank #1
- Fan feedback status of cooling bank #2

12.2 PARAMETERS TO CONFIGURE

Number of Cooling Banks: The number of cooling banks that can be activated from the cooling control unit. This number can be 0 (if the transformer has only one cooling stage), 1 or 2. Default value is 2.

Type of Cooling for Stage 0, *Type of Cooling for Stage 1* and *Type of Cooling for Stage 2*: Select in the menu the cooling modes that are applicable for cooling stages 0, 1 and 2.

12.3 MODEL OUTPUTS

Cooling Status on (Present Cooling Stage): Displays the cooling stage presently in service.

Cooling Bank 1 Feedback Status and *Cooling Bank 2 Feedback Status*: Current status of cooling banks 1 and 2.

Cooling Bank 1 Total Activity Time and *Cooling Bank 2 Total Activity Time*: The total cumulative time (since system commissioning) that the transformer has been operated without any cooling bank.

12.4 MAIN WINDOW

The main window for the Cooling Banks Status model is shown in Figure 12-2 on page 12-3. The commands applying to all monitoring models are explained in Chapter 5.

By default, the following three analog and two digital signals are displayed:

- Top Oil Temperature
- Current Winding H
- Current Winding X
- Cooling Bank 1 Status
- Cooling Bank 2 Status

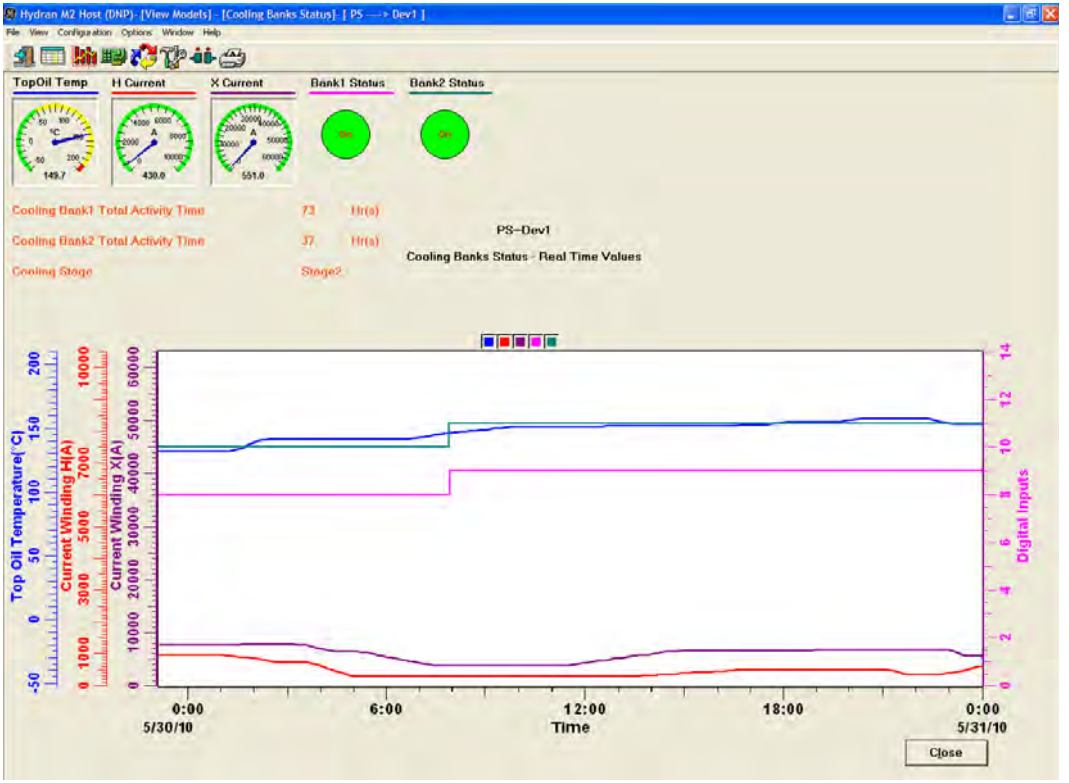

Figure 12-2 - Main Window for the Cooling Banks Status Model

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Chapter 13

OLTC Position Tracking Model

Tap changer driving mechanisms are always provided with a visual tap position indicator and a counter indicating the total number of operations. This model provides additional information that is useful to monitor the proper operation of this critical device, such as:

- The cumulative number of operations at each tap since commissioning
- Resettable variables for operation and maintenance counts
- Warnings for excessive number of operations over a certain period
- The time spent since the last operation of the reversing switch and a warning to avoid contact cooking because of insufficient operation

A position transducer, driven by the visual indicator shaft (also called Geneva shaft), provides a 4–20 mA signal that is proportional to the tap changer mechanical position. The multi-position switch can be equipped with jumpers (instead of resistors) in the “through positions” where the tap position indicator will stay only momentarily during operation of the reversing switch. In this case, the potentiometer provides an indication of the electric position of the tap changer. When the tap changer operates, the signal should remain steady, until it changes to a new value without falling to zero.

It is assumed that the Geneva shaft rotates by a fixed value for each step on the transducer. The signal from the Geneva shaft position transducer is read at regular intervals and is analyzed to determine the actual position of the visual position indicator.

The position generated may refer to the mechanical position of the Geneva gear or the electrical position. In the first case, the mechanical position is converted into the electrical position considering the number of through positions specific to this tap changer when it moves to the neutral position.

The number of operations on each tap position is presented by histograms using the tap position denomination configured by the user. The system provides three separate registers to record the number of operations carried out by the tap changer:

- The *Permanent Tap Position Transition Count* is intended to be the summation of all operations since the commissioning of the system. However, if the monitoring system is

moved to a different transformer, the System Administrator can reset this value to zero. This counter provides the number of operations on each tap position, the total number of operations, and the date when the system was put is service. The total number of operations performed prior to the commissioning of the system can also be taken into account.

- The *Operator Tap Position Transition Count* can be reset by the Operator when there is need to check the number of operations in one or several days to demonstrate that the tap changer control unit is operating properly. This counter provides the number of operations on each tap position, the maximum and minimum position visited by the tap changer since the last reset, and the date of the last reset.
- The *Maintenance Tap Position Transition Count* is used by maintenance personnel to assess the need for maintenance and to plan maintenance schedules. It will be typically reset every three or four years when an inspection activity is preformed on the unit. This counter provides the number of operations on each tap position, the maximum and minimum position visited by the tap changer since the last reset, and the date of the last reset.

The sensors, rules and outputs of the OLTC Position Tracking model are illustrated in Figure 13-1 on page 13-2.

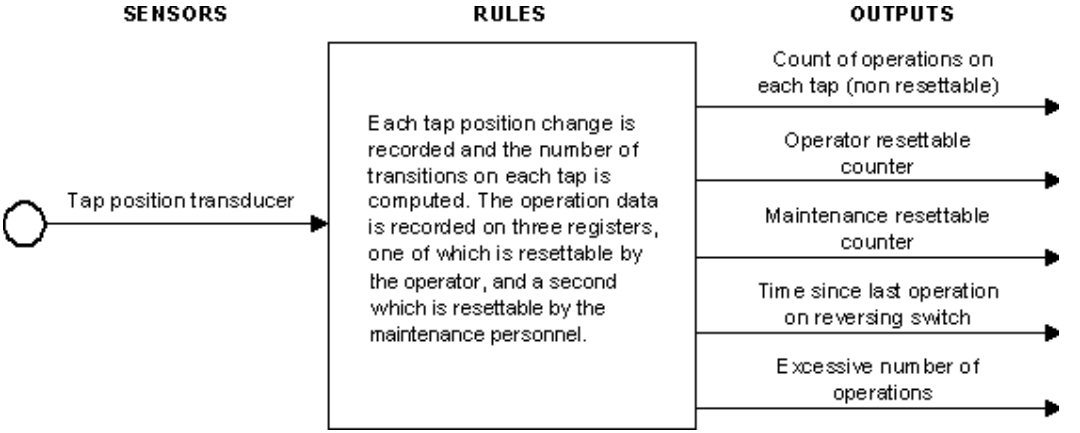

Figure 13-1 - Summary of the OLTC Position Tracking Model

13.1 MODEL INPUTS

- Tap Position

13.2 PARAMETERS TO CONFIGURE

Total Number of Positions on the Tap Changer: The total number of mechanical positions that are used by the tap changer. This value comprises the total number of electrical tap positions plus the through positions. This value is configurable from 1 to 35 with a default value of 19.

Middle Position: Indicates the tap position that provides the rated voltage at mid tap.

Through Positions: In order to convert the mechanical position of the driving mechanism to the electrical position of the tap changer, the number of through positions is needed. These are the intermediate positions that take place when the tap changer goes through the neutral position. Information is available in the tap changer operation manual. If the position transducer is equipped with jumpers (instead of resistors) in the through position, enter a zero value in this field.

Tap Position Polarity: This information will define the type of display used in the OLTC Position Tracking model window. This value is to be selected from Table 13-1 on page 13-3 illustrating a tap changer with 17 electrical positions.

Table 13-1 - Tap Positions

	Lowest Tap	Middle Tap	Maximum Tap
Absolute	1	9	17
Absolute Reverse	17	9	1
Bipolar	L8	0	R8
Bipolar Reverse	R8	0	L8

Tap Position Units (-/+): This value complements the preceding one by indicating whether the signs "-" and "+" or the symbols "L" and "R" are to be used. For "Bipolar" and "Bipolar Reverse," the units can be set to any character, the first character designating the left side, and the second character the second side.

Real Tap Position Count

Actual Tap Position: The number of positions that the tap changer can take. The value can be found on the tap changer nameplate. This value can be configured from 3 to 35 with a default value of 17.

Number of Operations Since Last Maintenance Setpoint: The number of operations that is deemed acceptable between two successive maintenance operations. This value can be configured from 10,000 to 200,000 operations with a default value of 30,000 operations.

Elapsed Time Since Last Maintenance Setpoint: The maximum time duration that is allowed between successive maintenance operations. This value can be configured from 1 to 10 years with a default value of 5 years.

Days Elapsed Since Last Reversing Switch Operation Setpoint: Tap changers should not be left on the same position of the reversing switch for an excessive length of time. Contacts that are not being operated tend to overheat and develop carbon that will collect around the contact. Manufacturers normally recommend that this contact be operated at least once a year. This value is configurable from 100 to 1,000 days with a default value of 365 days.

Maximum Number of Tap Operations per Hour Setpoint: An abnormal network condition or an unsuitable setting of the tap changer control system can lead to an excessive number of operations that will wear unduly the tap changer. The value for the maximum number of operations per hour can be configured from 5 to 100 operations with a default value of 10.

Maximum Number of Tap Operations per Day Setpoint: An abnormal network condition or an unsuitable setting of the tap changer control system can lead to an excessive number of operations that will wear unduly the tap changer. The value for the maximum number of operation per day can be configured from 20 to 1,000 operations with a default value of 100.

13.3 MODEL OUTPUTS

- Actual Tap Position
- Elapsed Time Since Last Maintenance Reset
- Elapsed Days Since Last Reversing Switch Operation
- Last Hour Operation Count
- Last Day Operation Count
- Last Permanent Tap Position Reset Time Stamp
- Permanent Tap Position Transition Count
- Permanent Count for Positions 1-35

- Last Operator Tap Position Reset Time Stamp
- Operator Tap Position Transition Count
  - Historic Min for Tap Position
  - Historic Min Timestamp for Tap Position
  - Historic Max for Tap Position
  - Historic Max Timestamp for Tap Position
- Resettable Count for Positions 1-35
- Last Maintenance Tap Position Reset Time Stamp
- Maintenance Tap Position Transition Count
  - Historic Min for Maintenance Tap Position
  - Historic Min Timestamp for Maintenance Tap Position
  - Historic Max for Maintenance Tap Position
  - Historic Max Timestamp for Maintenance Tap Position
- Maintenance Count for Positions 1-35

Note: When viewed in historic mode, the OLTC Position Tracking model only displays the tap positions that had been viewed the last time in real time.

13.4 ASSOCIATED ALARMS

Number of Operations Since Last Maintenance: This alarm indicates that the number of operations since the last maintenance has exceeded the setpoint.

Elapsed Time Since Last Maintenance: This alarm indicates that the time elapsed since the last maintenance has exceeded the setpoint.

Days Elapsed Since Last Reversing Switch Operation: This alarm indicates that the time elapsed since the last operation of the reversing switch has exceeded the setpoint.

Maximum Number of Tap Operations per Hour and *Maximum Number of Tap Operations per Day*: These alarms indicate that the numbers of operations per hour or per day have exceeded the setpoints.

Note: Appendix B presents the list of all alarm messages that can appear on the Hydran M2 Host (DNP) software.

13.5 MAIN WINDOW

The main window for the OLTC Position Tracking model is shown in Figure 13-2 on page 13-6.

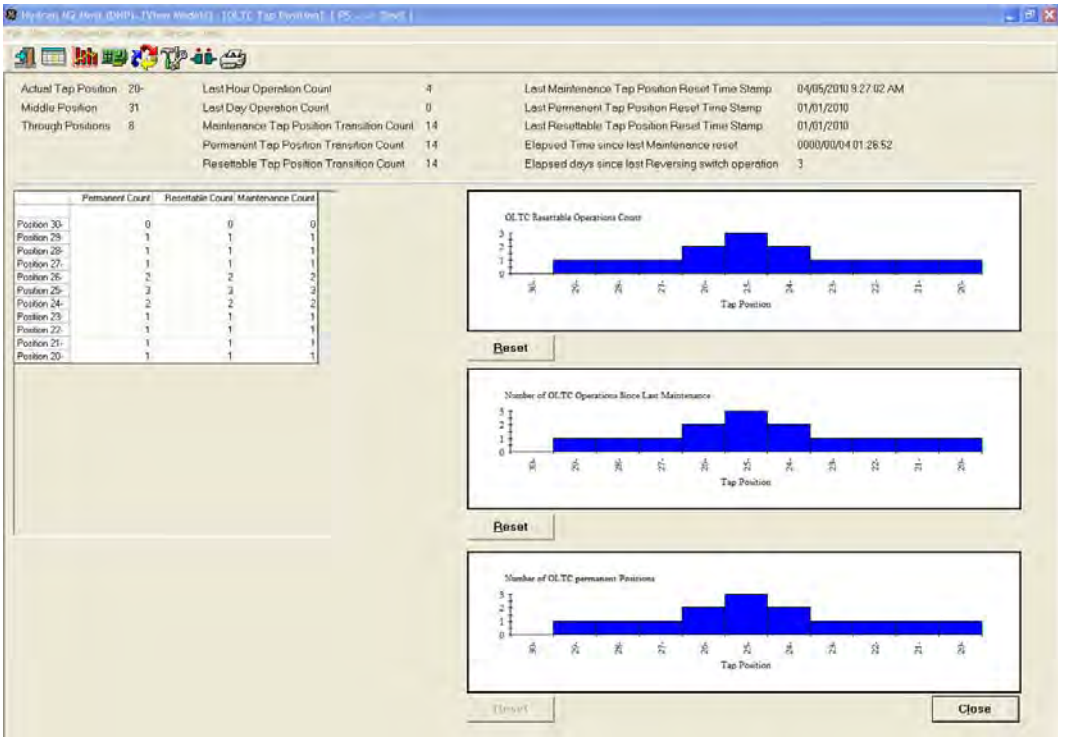

Figure 13-2 - Main Window for the OLTC Position Tracking Model

- On the left side, a table shows the count of permanent positions, resettable positions and maintenance positions.
- On the right side, the same data is displayed graphically.
- Each graph has a **Reset** button associated to it. However, the permanent position's **Reset** button, used to reset all the fields, is protected by the level-3 password (refer to Section 2.2 on page 2-3).
- On the top, other information relative to the OLTC tap position is displayed.

Chapter 14

OLTC Temperature Differential Model

The On-Load Tap Changer (OLTC) Temperature Differential model continuously compares the top oil temperature in the main tank with the tap changer compartment temperature. Monitoring of the tap changer temperature is a recognized method of detecting abnormal operating conditions in the tap changer. This monitoring method is intended for tap changers mounted on a separate compartment on the transformer tank. The tap changer temperature is normally lower than the main tank temperature because no heat source is expected in the tap changer. If the tap changer temperature rises above the main tank temperature, it is indicative of an overheating contact.

The temperature difference is calculated by subtracting the tap changer temperature minus the main tank temperature, thus yielding a negative value. This method allows to set the alarm on a positive threshold value rather than a negative value. This temperature difference is averaged with a low-pass filter to eliminate normal variations arising from sunshine and wind.

A short-term averaged value is generated with a configurable filtering factor typically set at 60 minutes. This short-term average is intended to detect severe heat sources such as resistor overheating when the mechanical links break while the switches are between two contacts.

A long-term averaged value is generated with a configurable filtering factor typically set at seven days. This long-term average is intended to detect slow-evolving thermal problems such as contact overheating. The measured temperature difference is averaged over a round number of days to filter out the daily temperature variations.

The sensors, rules and outputs of the OLTC Temperature Differential model are illustrated in Figure 14-1 on page 14-2.

14.1 MODEL INPUTS

- Top Oil Temperature
- OLTC Main Tank Temperature

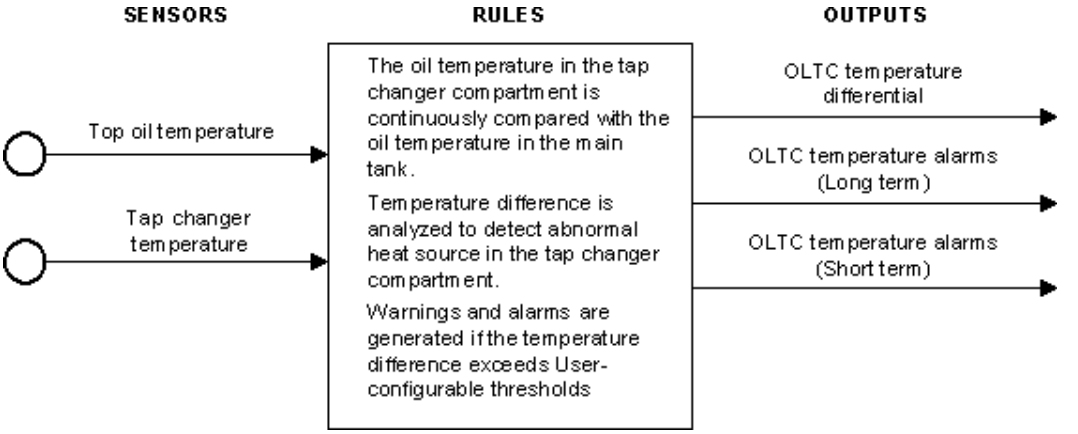

Figure 14-1 - Summary of the OLTC Temperature Differential Model

14.2 PARAMETERS TO CONFIGURE

Short-Term Filtering Value: The major problems in the tap changer, such as an incomplete operation of the selector switch, are better detected with a short-term filtering. The short-term filtering value can be configured from 5 to 1,380 minutes with a default value of 60 minutes.

Long-Term Filtering Value: The slow-evolving thermal problems such as contact overheating are better detected with a long-term filtering. The long-term filtering value can be configured from 12 to 168 hours with a default value of 24 hours.

14.3 MODEL OUTPUTS

- OLTC Differential Temperature
- Short-Term Average of Tap Changer Temperature Differential
- Long-Term Average of Tap Changer Temperature Differential

14.4 ASSOCIATED ALARMS

OLTC Short-Term Temperature Differential Hi Alarm: A tap changer running 5 °C above the main tank temperature should be closely monitored. This value is configurable from 0 to 30 °C.

OLTC Short-Term Temperature Differential Hi-Hi Alarm: A tap changer running 15 °C above the main tank temperature is a serious concern. This value is configurable from 0 to 40 °C.

OLTC Long-Term Temperature Differential Hi Alarm: A tap changer running continuously 3 °C above the main tank temperature should be closely monitored. This value is configurable from 0 to 20 °C.

OLTC Long-Term Temperature Differential Hi-Hi Alarm: A tap changer running continuously at 10 °C above the main tank temperature is a serious concern. This value is configurable from 0 to 30 °C.

Note: Appendix B presents the list of all alarm messages that can appear on the Hydran M2 Host (DNP) software.

14.5 MAIN WINDOW

The main window for the OLTC Temperature Differential model is shown in Figure 14-2 on page 14-4. The commands applying to all monitoring models are explained in Chapter 5.

By default, the following five analog signals are displayed:

- Top Oil Temperature
- OLTC Tank Temperature
- OLTC Temperature Differential
- Long-Term Average of Tap Changer Temperature
- Short-Term Average of Tap Changer Temperature

Figure 14-2 - Main Window for the OLTC Temperature Differential Model

Appendix A

Software License for the Hydran M2 Host (DNP) Software

In order to access the Hydran M2 Host (DNP) software, you must agree to be bound by the terms of this Software End User License Agreement:

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Appendix B

Alarm Messages

Table B-1 on page B-1 presents the list of all alarm messages that can be displayed by the Hydran M2 and that can appear on the Hydran M2 Host (DNP) software.

Note: Some model-related alarms can only be generated if two specific models are enabled.

Table B-1 - Alarm Messages on the Hydran M2 Display and on the Hydran M2 Host (DNP) Software

Alarm Name	Alarm Message on the Hydran M2 Display	Alarm Message on the Hydran M2 Host (DNP) Software
Hydran Level Hi Alarm	Hydran Level Hi Alarm	Hydran Level High Alarm
Hydran Level Hi-Hi Alarm	Hydran Level Hi-Hi Alr	Hydran Level High-High Alarm
Hydran Hourly Trend Hi Alarm	Hydran Hr.Tr. Hi Alarm	Hydran Hourly Trend High Alarm
Hydran Hourly Trend Hi-Hi Alarm	Hydran Hr.Tr. H-H Alr	Hydran Hourly Trend High-High Alarm
Hydran Daily Trend Hi Alarm	Hydran Dy.Tr. Hi Alr	Hydran Daily Trend High Alarm
Hydran Daily Trend Hi-Hi Alarm	Hydran Dy.Tr. H-H Alr	Hydran Daily Trend High-High Alarm
%RH Level Hi Alarm	%RH Hi Alarm	%RH Level High Alarm
%RH Level Hi-Hi Alarm	%RH Hi-Hi Alarm	%RH Level High-High Alarm
H_2O PPM Level Hi Alarm	H_2O PPM Hi Alarm	H2O PPM Level High Alarm
H_2O PPM Level Hi-Hi Alarm	H_2O PPM Hi-Hi Alarm	H2O PPM Level High-High Alarm
%RH Hourly Average Hi Alarm	%RH Avg.Hi Alarm	%RH Hourly Average High Alarm
%RH Hourly Average Hi-Hi Alarm	%RH Avg. Hi-Hi Alr	%RH Hourly Average High-High Alarm
H_2O PPM Hourly Average Hi Alarm	H_2O PPM Avg. Hi Alr	H2O PPM Hourly Average High Alarm
H_2O PPM Hourly Average Hi-Hi Alarm	H_2O PPM Av. H-H Alr	H2O PPM Hourly Average High-High Alarm

Alarm Name	Alarm Message on the Hydran M2 Display	Alarm Message on the Hydran M2 Host (DNP) Software
Hydran Sensor Temp Low-Low Alarm	S. Temp L-Low Alr	Hydran Sensor Temp Low-Low Alarm
Hydran Sensor Temp Low Alarm	S. Temp Low Alarm	Hydran Sensor Temp Low Alarm
Hydran Sensor Temp Hi Alarm	S. Temp Hi Alarm	Hydran Sensor Temp High Alarm
Hydran Sensor Temp Hi-Hi Alarm	S. Temp Hi-Hi Alarm	Hydran Sensor Temp High-High Alarm
Hydran Sensor Temp Input Fault	S. Temp Input Fault	Hydran Sensor Temp Input Fault
Base Plate Temperature Low-Low Alarm	B.P. Temp L-L Alr	Base Plate Temperature Low-Low Alarm
Base Plate Temperature Low Alarm	B.P.Temp Low Alarm	Base Plate Temperature Low Alarm
Base Plate Temperature Hi Alarm	B.P. Temp Hi Alarm	Base Plate Temperature High Alarm
Base Plate Temperature Hi-Hi Alarm	B.P. Temp Hi-Hi Alr	Base Plate Temperature High-High Alarm
Base Plate Temperature Input Fault	B.P. Temp Input Fault	Base Plate Temperature Input Fault
Battery Low-Low Alarm	Battery L-Low Alrm	Battery Low-Low Alarm
Battery Low Alarm	Battery Low Alarm	Battery Low Alarm
(An. User Defined #1) Low-Low Alarm	AnUsrDf#1 LL Alr	An. User Defined #1 Low-Low Alarm
(An. User Defined #1) Low Alarm	AnUsrDf#1 Low Alr	An. User Defined #1 Low Alarm
(An. User Defined #1) Hi Alarm	AnUsrDf#1 Hi Alr	An. User Defined #1 High Alarm
(An. User Defined #1) Hi-Hi Alarm	AnUsrDf#1 HH Alr	An. User Defined #1 High-High Alarm
(An. User Defined #1) Input Fault Alarm	AnUsrDf#1 Inp. Fault	Analog User Def #1 Input Fault Alarm
(An. User Defined #2) Low-Low Alarm	AnUsrDf#2 LL Alr	An. User Defined #2 Low-Low Alarm
(An. User Defined #2) Low Alarm	AnUsrDf#2 Low Alr	An. User Defined #2 Low Alarm
(An. User Defined #2) Hi Alarm	AnUsrDf#2 Hi Alr	An. User Defined #2 High Alarm

Alarm Name	Alarm Message on the Hydran M2 Display	Alarm Message on the Hydran M2 Host (DNP) Software
(An. User Defined #2) Hi-Hi Alarm	AnUsrDf#2 HH Alr	An. User Defined #2 High-High Alarm
(An. User Defined #2) Input Fault Alarm	AnUsrDf#2 Inp. Fault	Analog User Defined #2 Input Fault Alarm
(An. User Defined #3) Low-Low Alarm	AnUsrDf#3 LL Alr	An. User Defined #3 Low-Low Alarm
(An. User Defined #3) Low Alarm	AnUsrDf#3 Low Alr	An. User Defined #3 Low Alarm
(An. User Defined #3) Hi Alarm	AnUsrDf#3 Hi Alr	An. User Defined #3 High Alarm
(An. User Defined #3) Hi-Hi Alarm	AnUsrDf#3 HH Alr	An. User Defined #3 High-High Alarm
(An. User Defined #3) Input Fault Alarm	AnUsrDf#3 Inp. Fault	Analog User Defined #3 Input Fault Alarm
(An. User Defined #4) Low-Low Alarm	AnUsrDf#4 LL Alr	An. User Defined #4 Low-Low Alarm
(An. User Defined #4) Low Alarm	AnUsrDf#4 Low Alr	An. User Defined #4 Low Alarm
(An. User Defined #4) Hi Alarm	AnUsrDf#4 Hi Alr	An. User Defined #4 High Alarm
(An. User Defined #4) Hi-Hi Alarm	AnUsrDf#4 HH Alr	An. User Defined #4 High-High Alarm
(An. User Defined #4) Input Fault Alarm	AnUsrDf#4 Inp. Fault	Analog User Defined #4 Input Fault Alarm
Top Oil Temperature Input Fault Alarm	Top Oil Input Fault	Top Oil Temperature Input Fault Alarm
Top Oil Temperature Hi-Hi Alarm	Top Oil Hi-Hi Alarm	Top Oil Temperature High-High Alarm
Top Oil Temperature Hi Alarm	Top Oil Hi Alarm	Top Oil Temperature High Alarm
Winding Hot-Spot Temperature Hi-Hi Alarm	WHST Hi-Hi Alarm	Winding Hot-Spot Temperature High-High Alarm
Winding Hot-Spot Temperature Hi Alarm	WHST Hi Alarm	Winding Hot-Spot Temperature High Alarm
Hydran Sensor Cable Open Alarm	Hyd. C.Open Alarm	Hydran Sensor Cable Open Alarm
Hydran Sensor Cable Short Alarm	Hyd. C.Short Alarm	Hydran Sensor Cable Short Alarm

Alarm Name	Alarm Message on the Hydran M2 Display	Alarm Message on the Hydran M2 Host (DNP) Software
Hydran Replace Sensor Soon Alarm	Hyd. Rep.S.Soon Alr	Hydran Replace Sensor Soon Alarm
Hydran Replace Sensor Now Alarm	Hyd. Rep.S.Now Alr	Hydran Replace Sensor Now Alarm
Sensor Card #1 Comm. Error Alarm	Sens#1 Com Err.Alarm	Sensor Card #1 Comm. Error Alarm
OLTC Short Term Temperature Differential Hi-Hi Alarm	OLTC Diff. S.T. H-H Alr	OLTC Short Term Temperature Differential High-High Alarm
OLTC Short Term Temperature Differential Hi Alarm	OLTC Diff. S.T. Hi Alr	OLTC Short Term Temperature Differential High Alarm
OLTC Long Term Temperature Differential Hi-Hi Alarm	OLTC Diff. L.T. H-H Alr	OLTC Long Term Temperature Differential High-High Alarm
OLTC Long Term Temperature Differential Hi Alarm	OLTC Diff. L.T. Hi Alr	OLTC Long Term Temperature Differential High Alarm
Number of operations since last Maintenance Alarm	Op. Cnt. S. Maint. Alr	Number of operations since last Maintenance Alarm
Elapsed Time since last Maintenance Alarm	Time since Maint. Alr	Elapsed Time since last Maintenance Alarm
Days Elapsed since last Reversing Switch Operation Alarm	Day s. Rev. Sw. Op. Alr	Days Elapsed since last Reversing Switch Operation Alarm
Maximum Number of Tap Operations per Hour Alarm	Max Tap Op. per HrAlr	Maximum Number of Tap Operations per Hour Alarm
Maximum Number of Tap Operations per Day Alarm	Max Tap Op. per DyAlr	Maximum Number of Tap Operations per Day Alarm
Ambient Temperature Input Fault Alarm	Ambient Input Fault	Ambient Temperature Input Fault Alarm
Cooling Efficiency Index Alarm	Cool. Eff. Index Alr	Cooling Efficiency Index High Alarm
Bottom Oil Temperature Input Fault Alarm	Bottom Oil Input Fault	Bottom Oil Temperature Input Fault Alarm
Water-Oil Condensation Temperature Alarm	W-Oil Cond. Temp Alr	Water-Oil Condensation Temperature Low Alarm

Alarm Name	Alarm Message on the Hydran M2 Display	Alarm Message on the Hydran M2 Host (DNP) Software
Bubbling Temperature Margin Alarm	Bubbling Temp M. Alr	Bubbling Temperature Margin Low Alarm
(Dg. User Defined #1) Alarm	DgUsrDf#1 Alarm	No alarm message!
(Dg. User Defined #2) Alarm	DgUsrDf#2 Alarm	No alarm message!
(Dg. User Defined #3) Alarm	DgUsrDf#3 Alarm	No alarm message!
(Dg. User Defined #4) Alarm	DgUsrDf#4 Alarm	No alarm message!

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Appendix C

Glossary

A: Ampere

ac: Alternating Current

Adaptor (brass): Device used to mount a Hydran M2 With Models (specifically its sensor) onto a valve of the electrical equipment to monitor (typically a transformer)

Alarm: Operating condition occurring when a data point value exceeds the parameter's alarm set point

Alarm Contact: Terminal used as interface between the alarm relays of the Hydran M2 With Models and any SCADA system (alarm panel, etc.)

Analog Output: Analog signal that is proportional to the gas or moisture level reading performed by the Hydran M2 With Models

Analog Signal: Electronic signal that can represent an infinite range of numbers (as opposed to digital signal)

Analysis: Algorithm applied to data points for the purpose of calculating features that are then applied to rules

ANSI: American National Standards Institute, a non-governmental organization that develops and publishes standards for voluntary use in the United States

ASTM: American Society for Testing and Materials (United States)

AWG: American Wire Gauge (United States)

bps: Bit Per Second

CD-ROM: Compact Disc - Read-Only Memory

CE: European Conformity

CH_4: Methane

C_2H_2: Acetylene

C_2H_4: Ethylene

C_2H_6: Ethane

Channel: Path along which data passes in the form of electrical signals

CO: Carbon monOxide

CO_2: Carbon diOxide

COM: Serial COMmunication port on a PC

Combustible Gas: Fault gas in the dielectric oil of a transformer

CPU: Central Processing Unit

CSA: Canadian Standards Association

CT: Current Transmitter

Daily Trend: Variation of a gas or moisture level during an adjustable period of time calculated in days

Daisy Chain: Parallel connection from one Hydran M2 to another using an RS-485 link cable

dc: Direct Current

DGA: Dissolved Gas Analysis

Diagnostic: Identification of specific malfunctions of an electrical apparatus

Digital Output: Output that provides a digital signal derived from the digital information within the instrument

Digital Signal: Electronic signal that can only represent discrete numbers (as opposed to analog signal)

DIN: Deutsches Institut für Normung, a german standards institute

DNP: Distributed Network Protocol

Download: Transferring data stored in the memory of the Hydran M2's PLC to the Hydran M2 Host's long-term database

EC: Electronic Controller, the Intel Pentium PC responsible for data acquisition, transfer, storage, interpretation and communications

EEC: European Economic Community

Embedded Software: Small program that runs inside the Hydran M2 With Models. It manages the dynamic oil sampling system, monitors alarm conditions, triggers alarms, displays the gas and moisture level readings and other values, etc. It also allows the user to set and modify the value of every operational parameter.

EMI: ElectroMagnetic Interference

End User: Commercial client for General Electric Canada

Error: Deviation (difference or ratio) of a measurement from its true value

Esc: ESCape key on the Hydran M2's keypad

ESD: ElectroStatic Discharge

Extended Menu: Menu of the Hydran M2's embedded software that gives access to all operation parameters and commands (including those of the Main Menu)

Fault: Indication (other than diagnostics) issued by the hardware or software that an anomaly exits in the Hydran M2 With Models

FCC: Federal Communications Commission, the United States government agency responsible for ensuring that phone lines are being used correctly and that radio interference is at acceptable levels

Feedback: A means of providing indication of operation either by measured values or contact status (On/Off)

FIFO: First In, First Out. The first data into a memory buffer is the first data out of the buffer.

Gas Level: Composite value of four dissolved gases in transformer oil, measured by the Hydran M2 sensor

GE: General Electric

GND: GrouND (earth), a common reference point in an electric or electronic circuit

GUI: Graphical User Interface, the graphical layout designed to enable user interaction with the Hydran M2 With Models. It enables information to be passed between a user and hardware or software components of a computer system via graphical symbols (icons, buttons and menus) located on a screen, accessed using a mouse, keyboard, keypad, etc.

H or **Hi**: High alarm

H_2: Hydrogen

Hardware: The physical parts of a computer-controlled system, such as circuit boards, chassis, peripheral devices, cables, etc.

HH, **HiHi** or **Hi-Hi**: High-High alarm

History File: Either one of four distinct groups of data (Short Term, Long Term, Events and Service) that are recorded automatically and/or periodically and stored in the Hydran M2's memory

H_2O: Water

Host Computer: IBM PC (or compatible) connected remotely to a Hydran M2 With Models or a network of Hydran M2 With Models and running the Hydran M2 Host (DNP) software

Hourly Trend: Variation of a gas or moisture level during an adjustable period of time calculated in hours

Hydran 201C*i*: Any of the three controllers from the Hydran family of products: Hydran 201C*i*-1, Hydran 201C*i*-4 or Hydran 201C*i*-C. Abbreviated to H201C*i*.

Hydran 201C*i*-1: One-channel controller designed to supervise one Hydran 201T*i* and link it to a host computer running the Hydran Host software. This configuration is referred to as Hydran 201R Model *i*. Abbreviated to H201C*i*-1.

Hydran 201C*i*-4: Four-channel controller designed to supervise up to four Hydran 201T*i*'s and link them to a host computer running the Hydran Host software. Abbreviated to H201C*i*-4.

Hydran 201C*i*-C: Communications controller designed to supervise up to four Hydran 201T*i*'s. The Hydran 201C*i*-C does not have a numerical display, analog outputs or alarm contacts; it is meant only as an interface between the Hydran 201T*i*'s and a host computer running the Hydran Host software. Abbreviated to H201C*i*-C.

Hydran 201*i* System: Continuous, on-line, combustible gas-in-oil monitor, taking the form of either a Hydran 201T*i* used alone or the combination of at least one Hydran 201T*i* and a Hydran 201C*i* Controller

Hydran 201R Model *i*: Specific configuration of Hydran 201*i* System, which consists of one Hydran 201T*i* linked to a Hydran 201C*i*-1. This combination has been designed to replace or complete an existing installation of Hydran 201R (previous generation of transformer incipient fault monitor).

Hydran 201 Sensor: Electrochemical gas detector used in the Hydran M2 With Models to detect and measure a composite value of four dissolved gases in transformer oil

Hydran 201T*i*: Intelligent transmitter, an IED that uses an electrochemical gas sensor to detect and measure a composite value of four dissolved gases in transformer oil. Abbreviated to H201T*i*.

Hydran M2 Host (DNP): Microsoft Windows software that communicates, through an RS-232 serial communication link or a modem, with one or several Hydran M2 With Models using a host or laptop computer. It allows a user to set operational parameters, survey alarm status, etc.

Hydran M2 With Models: Intelligent transmitter, an IED that uses an electrochemical gas sensor to detect and measure moisture and a composite value of four dissolved gases in transformer oil

Hz: HertZ, a unit of frequency equal to a cycle per second

ID: IDentification

IEC: International Electrotechnical Commission

IED: Intelligent Electronic Device

IEEE: Institute of Electrical and Electronics Engineers

in: INch

I/O: Input/Output, two of the three activities (input, processing and output) characterizing a computer. Refers to the complementary tasks of gathering data for the microprocessor to work with and making the results available to the user through communication channels such as the display, disk drive or printer.

Isolated Output: Output signal where a common reference is not connected to either input terminal

L or **Lo**: Low alarm

Lab Data: Manually-entered gas sample data obtained from laboratory results

LAN: Local Area Network, a group of computers and other devices dispersed over a relatively-limited area and connected by a communications link enabling any device to interact and share with any other device or resource on the network. Usually, there is one computer that controls all peripherals (such as printers and a hard disk drive). The other computers are linked to the controlling computer, which lets the other computers take turns using the peripherals.

Laptop Computer: IBM PC (or compatible) connected locally to a Hydran M2 With Models or a network of Hydran M2 With Models and running the Hydran M2 Host (DNP) software

LCD: Liquid Crystal Display, a type of flat-panel display commonly used on laptops or PC's

LED: Light-Emitting Diode

LL, **LoLo** or **Lo-Lo**: Low-Low alarm

Local Network: Daisy chain of Hydran 201C*i* Controllers connected together using an RS-485 link in order to be monitored locally or remotely (via modem) using the Hydran M2 Host (DNP) software

Local Site: User location where the data of the remote site is being analyzed

mA: MilliAmpere

Main Menu: Menu of the Hydran M2's embedded software that gives access to the most frequently used operation parameters and commands

Mbps: MegaByte Per Second

Menu: Group of parameters and values accessed through a hierarchical, treelike structure

MHz: MegaHertZ, a unit of frequency equal to one million cycles per second

Modem: MOdulator/DEModulator, a communication device connecting data terminal equipment to an analog or digital line. A modem transforms digital signals into an analog signal suitable for transmission over telephone lines. This is the heart of computer telecommunications. The main factor that differentiates modems is their speed, measured in bps or bauds.

MOV: Metal Oxide Varistor

N_2: Nitrogen

NC: Normally Closed

Network: See Local Network

NO: Normally Open

Null Modem: A special connection between two computers that makes them think they are hooked up to a modem, so that the two computers can communicate with each other

O_2: Oxygen

Oil Sample: Small quantity of oil, representative of the oil contained in the transformer

PC: Personal Computer, a computer typically based on an Intel microprocessor and capable of receiving network cards, modems, data acquisition boards, etc.

PCB: Printed Circuit Board

PDF: Portable Document Format

PLC: Programmable Logic Controller

POT: POTentiometer

ppm: Part Per Million, representing the concentration of a gas in transformer oil

PVC: PolyVinyl Chloride, a plastic used for cable insulation

RAM: Random Access Memory, a semiconductor-based memory that can be read and written by the microprocessor or other digital hardware devices

Range: A continuous band of signal values that can be measured or sourced. In bipolar instruments, the range includes positive and negative values.

Real-Time: Pertaining to a system or operating mode under which computation is performed during the actual time when an external process occurs, instead of being accumulated and processed at a later time. The computation results can therefore be used to control, monitor, or respond in a timely manner to the external process.

Remote: A connection using modems between a Hydran M2 With Models and a host computer through a public or private telephone system

Remote Site: Location of the Hydran M2 With Models

Repeatability: The ability of an instrument to measure the same input to the same value over a short period of time and over a narrow temperature range

Response Time: For a measuring instrument, designates the time between the application of a step input signal and the indication of its magnitude within a rated accuracy. For a sourcing instrument, designates the time between a programmed change and the availability of the value at its output terminals.

RFI: Radio-Frequency Interference

%RH: Relative Humidity in %

RMS: Root Mean Square

RS-232: Specific type of port on the back of some computers, or peripherals such as modems. It has 9 or 25 pins.

RS-232 Serial Communication Link: Cable that connects a Hydran M2 With Models or a network of Hydran M2 With Models to a laptop computer

RS-485 Network Link: Cable that connects Hydran 201C*i* Controllers together to form a network

RTC: Real-Time Clock

SCADA: Supervisory Control And Data Acquisition. Identifies the numerous devices (control panel, alarm panel, retransmission unit, display, terminal, data recorder, external detection device, etc.) on which can be connected the components of the Hydran M2 With Models.

SH: SHield

SP: Set Point

SPDT: Single Pole Double Throw

Submenu: A branch of the treelike structure of a menu

Supervisory Link: Cable connecting a Hydran M2 With Models to a Hydran 201C*i* Controller

TB: Terminal Block

TB4: Terminal Block 4, a term inherited from the Hydran 201R (previous generation of transformer incipient fault monitor), in which there were also TB1, TB2 and TB3

Teflon: polyTEtraFLuOrethyleNe

TM: TradeMark

Transformer Oil: Highly-refined, mineral oil used as a dielectric and heat transfer fluid in transformers

User: Person operating the Hydran M2 With Models

User-Friendly: An interface designed to simplify the use of an application

User Interface: The means (display, keypad, push button, etc.) used to achieve communication between the user and a Hydran M2 With Models

µV: Microvolt

V: Volt

VA: Volt-Ampere

Vac: Volt Alternating Current

Vdc: Volt Direct Current

VDE: Verein Deutscher Elektrotechniker, a german standards institute

Vibration-Absorbing Rubber Pad: Device used to protect a Hydran 201C*i* Controller against vibrations

W: Watt

WAN: Wide Area Network, a communication network using telephone lines or other telecommunication devices to link computers in geographically-separated areas

Watchdog: Process used periodically to test if a computerized system is operating properly

% w/w: Percentage Weight by Weight

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