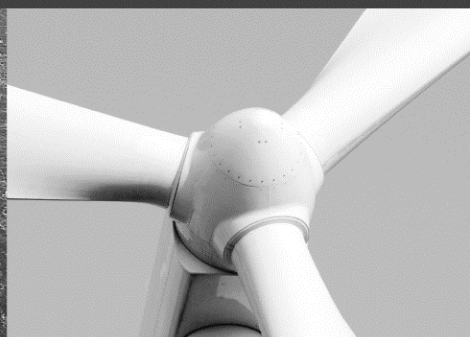




-power in control



Delomatic 400 HYDRO controller OPERATOR'S MANUAL



DELOMATIC 400, DM-400 HYDRO

- Functional description
- User interface
- Log books
- Alarm handling



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1. About this document

General purpose

This document is the Operator's Manual for DEIF's Delomatic 400, DM-400 Hydro turbine generator controller. The document mainly includes general product information, display readings, Operator interface, alarm handling descriptions and presentation of the log list.

The general purpose is to give the user important information on how to carry out the daily operation of the unit.



Please make sure to read this handbook before working with the DM-400 Hydro controller and the turbine/generator to be controlled. Failure to do this could result in damage to the equipment or human injury.

Intended users

This operator's manual is mainly intended for the daily user. On the basis of this document, the operator will be able to carry out simple procedures such as start/stop and control of the generator set.

Contents/overall structure

The document is divided into chapters, and in order to make the structure simple and easy to use, each chapter will begin from the top of a new page.

2. Warnings and legal information

Legal information and responsibility

DEIF takes no responsibility for installation or operation of the turbine generator. If there is any doubt about how to install or operate the turbine generator controlled by the unit, the company responsible for the installation or the operation of the turbine generator must be contacted.

In order to obtain safe and trouble-free use of the DM-400 Hydro, it is important that transport, storage, mounting and commissioning is done according to standards. The units are not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

Electrostatic discharge awareness

Sufficient care must be taken to protect the terminals against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

Safety issues

Installing the unit implies work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.



Be aware of the hazardous live currents and voltages. Do not touch any AC measurement inputs as this could lead to injury or death.

Extra care must be taken that components are not replaced with power on the system.

Definitions

Throughout this document, a number of notes and warnings will be presented. To ensure that these are noticed, they will be highlighted in order to separate them from the general text.

Notes



The notes provide general information which will be helpful for the reader to bear in mind.

Warnings



The warnings indicate a potentially dangerous situation which could result in death, personal injury or damaged equipment, if certain guidelines are not followed.

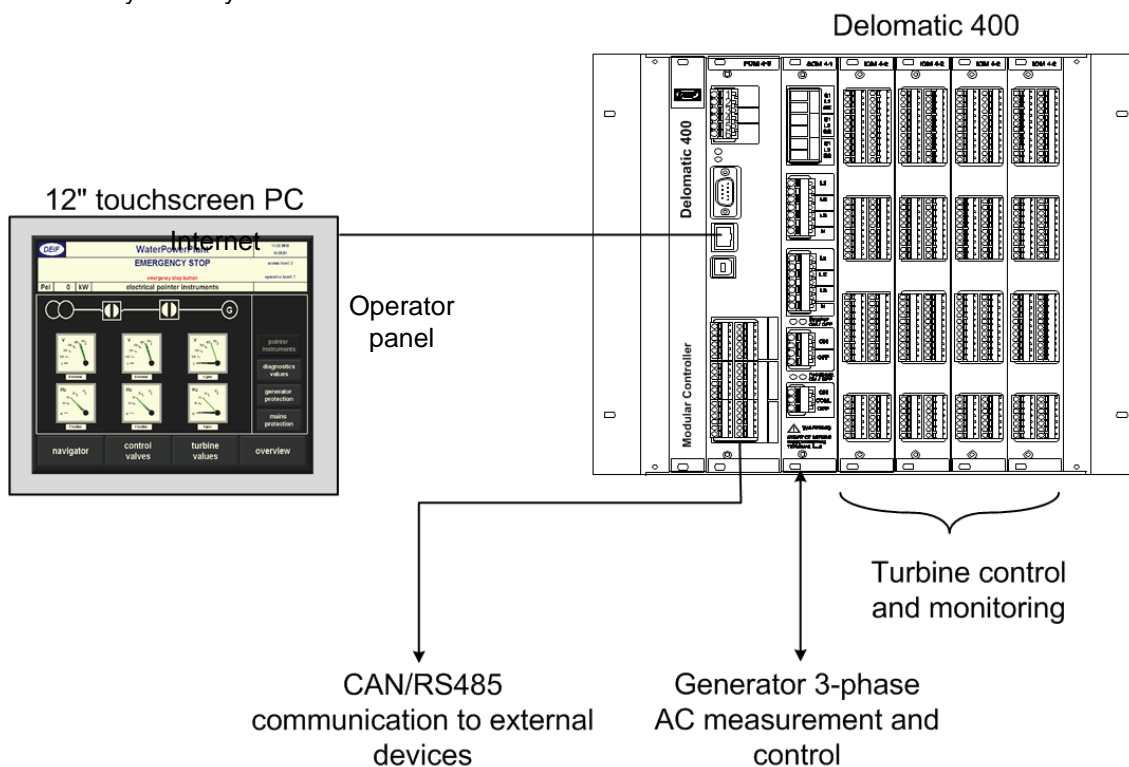
3. General overview

As a minimum, the DM-400 Hydro system consists of a double-height (6 HE, 266 mm height) 19" rack mounted with the necessary I/O modules and a 12" colour graphic touch screen operator interface.

The DM-400 Hydro has a TCP/IP interface with a built-in webserver. This means that the graphic screens are stored here and can be accessed from any computer locally or on the internet, using a free of charge DEIF HMI Client software and thereby enabling remote control and monitoring from anywhere in the world.

Connecting an RS232 GSM modem enables SMS clear text alarm messages.

General system layout:



4. Functional description

The Delomatic 400 Hydro control system is laid out for control of a Hydro turbine driven generator. The following functions are carried out:

- Turbine start/stop sequences
- Control of main valve, drain valve and fill valve (selectable)
- Control of brake
- Control of pre-lubrication
- Control of hydraulic power pack
- Synchronising
- Power control
- Automatic power reduction
- CosPhi control
- Mains failure protection
- Generator protection

The integrated visualisation software allows for uncomplicated operation using a panel touch PC placed in a console or on the wall. For remote control, it is possible to use an RS485 Modbus or an Ethernet TCP/IP.

- Graphic visualisation of functions and values
- Trend curves
- Log books
- Running hours dependent service timers

All the above are available as strong help tools for the operator, to give a quick overview, to make service easy and to handle problems in a quick way.

Parameters can be changed. They are password-protected.

Measurements

- Generator and busbar/mains 3-phase AC voltages
- Generator 3-phase AC currents
- Power per phase/total
- Reactive power per phase/total
- 4-quadrant counter for power consumed/produced and reactive power consumed/produced
- Running hours
- Breaker operation counter
- Turbine temperatures
- Lubrication circuit pressures and temperatures
- Water circuit temperatures
- Room temperature
- Misc. plant measurements

Protections

- Mains failure
- Generator protections
 - o Over-/undervoltage
 - o Over-/underfrequency
 - o Current asymmetry
 - o Overload
 - o Reverse power
 - o Minimum load
 - o Overcurrent
 - o Thermal curve overcurrent
 - o Reactive power high
 - o Reactive power low (loss of AVR)
 - o Vector jump
 - o Df/dt
- Overspeed
- Wire fail safe monitoring of breaker position(s)
- Lube oil pressure
- Cooling water temperature
- Bearing temperatures
- Emergency stop
- Water level or water flow monitoring
- Digital error messages by monitoring switches and safety devices
- Error messages with configurable texts and fail classes
- Monitoring of regulators with regard to deviation from setpoint
- Control functions
- Automatic start/stop
- RPM with controlled ramp-up by start and stop
- Synchronising with voltage matching and time monitoring
- Power ramp function (ramp up/ramp down)
- Sliding setpoint acc. to water level or mains power consumption
- Pre- and post-running of auxiliaries
- Power reduction by oil temperature and cooling water temperature
- 2-pump hydraulic power pack control
- Activation of main valve, drain valve, fill valve (selectable)
- Control of deflector/bypass (selectable)

5. Operator interface

At the graphical operator interface, a number of pre-defined pages offer easy access to all data. The pages are arranged according to functions and can be accessed via the menus or via a central navigator page. In the status field, which is equal in all pages, a single look gives access to the condition of the plant and – if active – the most important error messages.

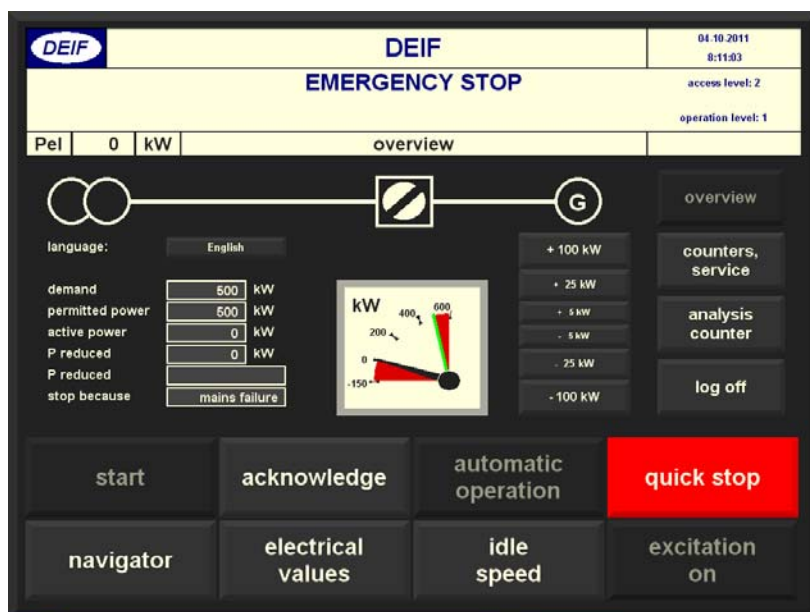
Graphic elements like e.g. breaker position, bar graphs and pointer instruments for electrical measuring values (kW, A, V, CosPhi) gives a good overview of the condition of the turbine, generator, mains and plant.

The protective functions can be seen on special diagnostic pages with the present status; measured values limit values and running timers.

In the following, a number of examples are shown.

Overview

The overview page gives a fast view of the present status of the plant. Using the eight selection buttons at the bottom of the screen, the most important pages can be accessed directly.



Counters, service

Display of energy counters (active, reactive) and plant hour counters. Besides these, the service timers are important. By accessing the parameter page for service timers, a run out timer can be reset.

DEIF		04.10.2011 8:13:32
EMERGENCY STOP		access level: 2
		operation level: 1
PeI	0 kW	overview: counters, service
active energy, generated	0 kWh	overview counters, service analysis counter log off
active energy, consumed	0 kWh	
reactive energy, generated	0 kvarh	
reactive energy, consumed	0 kvarh	
operating time	0 h	
start counter	0	
breaker operations GCB	0	
service 1 in	1000 h	start acknowledge automatic operation quick stop
service 2 in	1000 h	
service 3 in	2000 h	
		navigator electrical values idle speed excitation on

Analysis Counter

This page shows the counters for kWh and the configurable counters. Names, pulses per count and unit are all configurable values.

Besides the actual counter value, data for day, month and year are also indicated.

DEIF		04.10.2011 8:19:00
EMERGENCY STOP		access level: 2
		operation level: 1
PeI	0 kW	overview: analysis counter
counter name	counter value	day month year unit
active energy, generated	0	0 0 0 kWh
counter 01	0.0	0 0 0
counter 02	0.0	0 0 0
counter 03	0.0	0 0 0
counter 04	0.0	0 0 0
		overview counters, service analysis counter log off
		start acknowledge automatic operation quick stop
		navigator electrical values idle speed excitation on

Log on/log off

On the overview pages, you can log on/log off the system. If you are logged off the button "log off" changes name to "log on". It is always recommended to log off before you leave the system unattended.

Log off will happen automatically after a certain time without operation.

Start

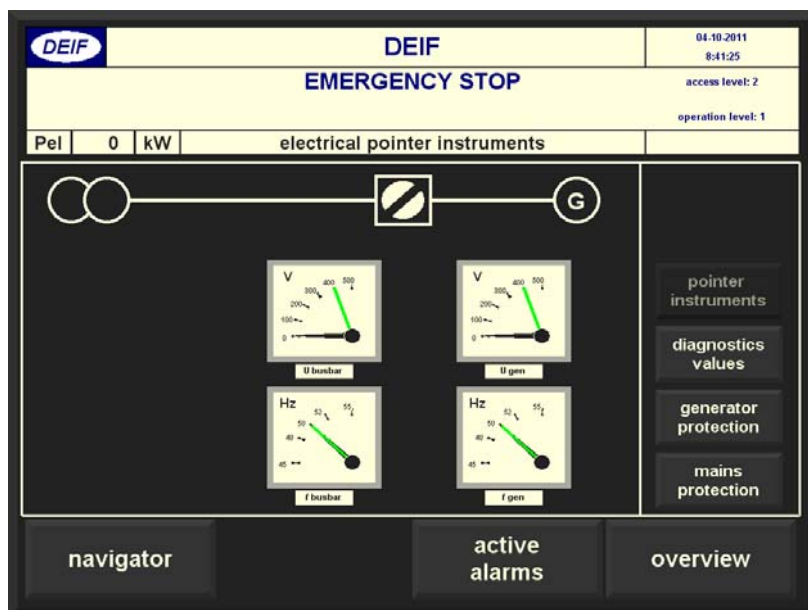
Auto start of turbine/generator with auto closing of the breaker. If you press "Idle speed", the synchronisation will not take place until you press "nominal speed" (name change on the same button). When in "idle speed" the excitation can be turned ON or OFF. When going back to nominal speed the excitation is automatically turned ON, provide the speed exceeds the excitation speed value.

Electrical values

These values are accessible via the overview page and the navigator.

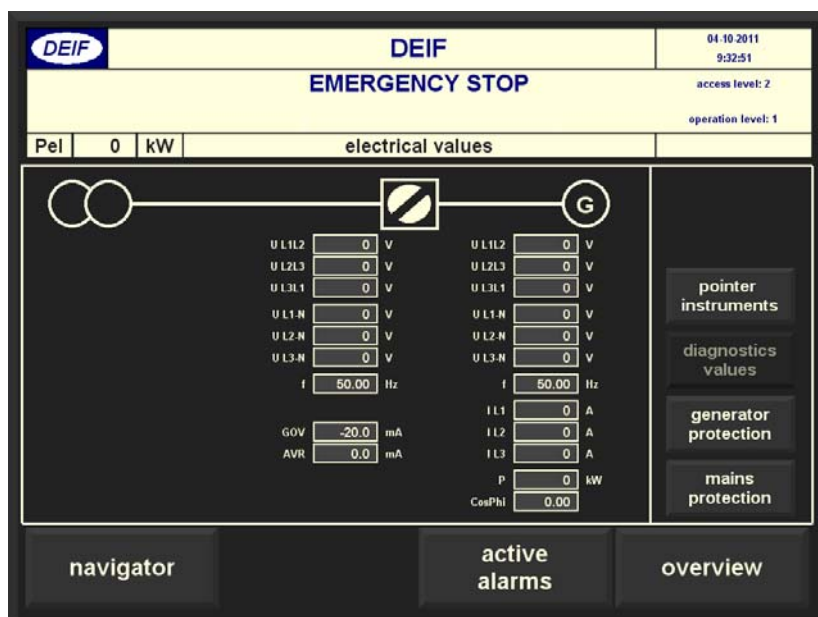
Pointer instruments

In parallel with mains the currents as well as the power and CosPhi will be shown. This is done by automatic change of meter indications on the generator side of the breaker.



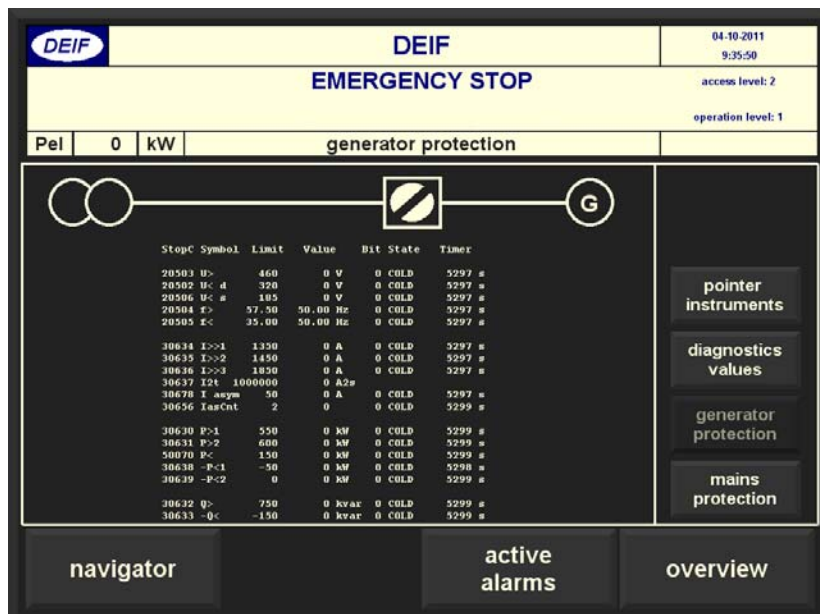
Diagnostic values

Electrical values as well as speed control and AVR control outputs are shown.



Generator protection

This page is an overview of the present status of the generator protections. Status “cold” means normal, “hot” means alarm has triggered.



Mains protection

This page is an overview of the present status of the mains grid protections. Status “cold” means normal, “hot” means alarm has triggered.

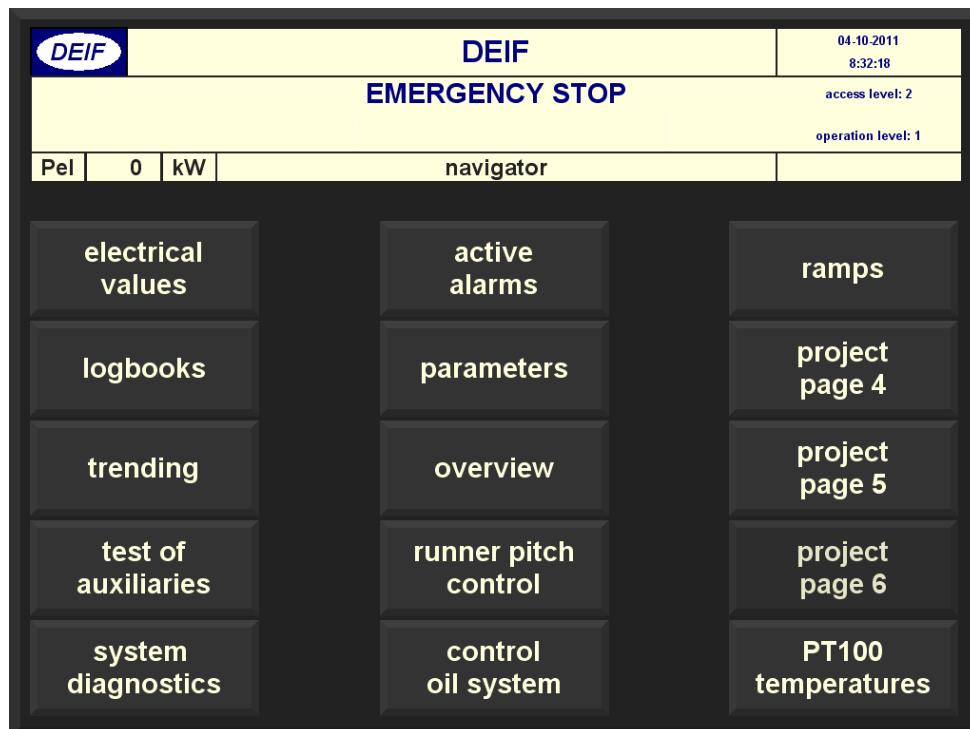


Navigator page

The navigator page is, as the name suggests, the navigation page to get into details around the turbine and generator.

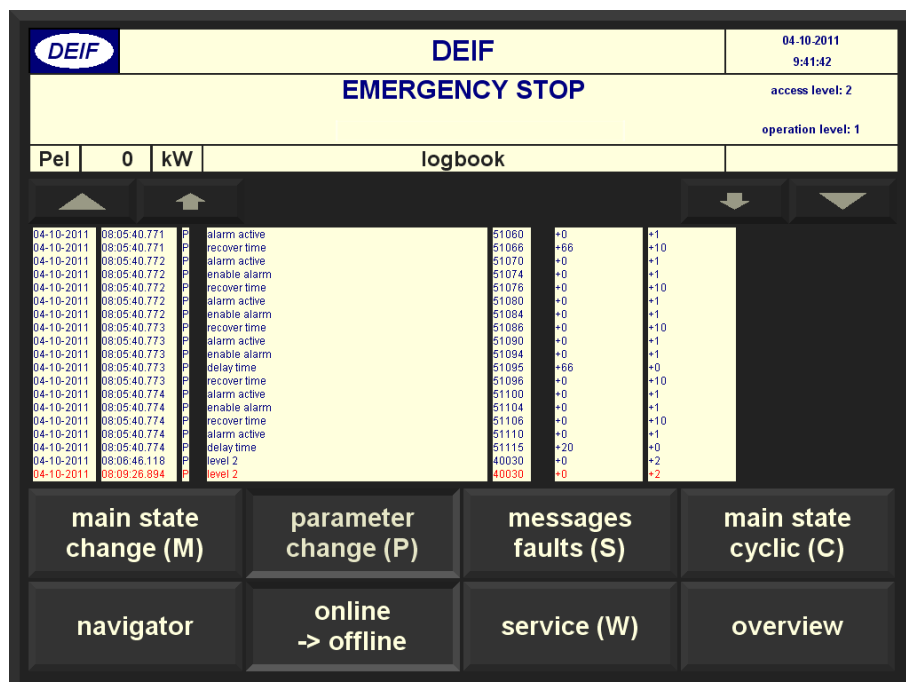
The pages named "Project page x" are empty pages prepared for any specific requirements there may be with regards to presenting data to the operator. These pages are programmed specifically upon need.

This example shows the navigator page for a Kaplan turbine with variable runner pitch. Other variants are Kaplan turbine without runner pitch control, Francis turbine or Pelton turbine with multiple nozzles.



Logbooks

The reading of logbooks can be combined so that a single log or a mix of logs is shown.



In the logs, the following abbreviations are used:

- M: Event log
- P: Parameter setting changed
- S: Alarm log
- C: Cyclic events
- W: Service log

By activating the corresponding buttons, the log in question will be shown in the list. The logs will be presented sorted by time.

If "Offline" is chosen, it is possible to see all historic logs.

In "Online", the log shows the actual logs, the newest logs are at the bottom of the list.

Offline mode: the triangular buttons are used to scroll up and down in the logs. The offline mode only shows the logs up to the time of selection of the offline mode. When scrolling, the view scrolls 18 indications, leaving the 19th from the previous view. If there are less than 19 logs, the upper line will be greyed out.

Main state change

The main state change selection makes it possible to follow the main states of the system. These are shown as: date, time, M, state and level.

Max no. of logs: 250.

Parameter change

Every parameter change is logged and can be seen when activating this button. The changes are shown as: date, time, P, parameter text, parameter number, old value, new value.

The parameter number equals the number shown in the parameter editor. The number is specific, which rules out mistakes.

Special loggings: login (user, service or master) is logged under parameter change.

The log holds 250 loggings.

Messages/faults

A column is added here indicated if the message/fault has been acknowledged (Q). The lines read:

date, time, S, [Q], text, message number, level.



The active alarms can be read and acknowledged on the page “active alarms”, which can be accessed via the navigator page

Main state cyclic

Every full hour, a log of the actual state of the system is made, including running hours and produced energy (kWh).

Each line shows: date, time, C, state, level, running hours, produced energy.

Number of logs: 250.

Service

The service log shows the coming up services as well as already carried out services (Q), indicated when the counter is reset.

Each line shows: date, time, W, [Q], text, running hours.

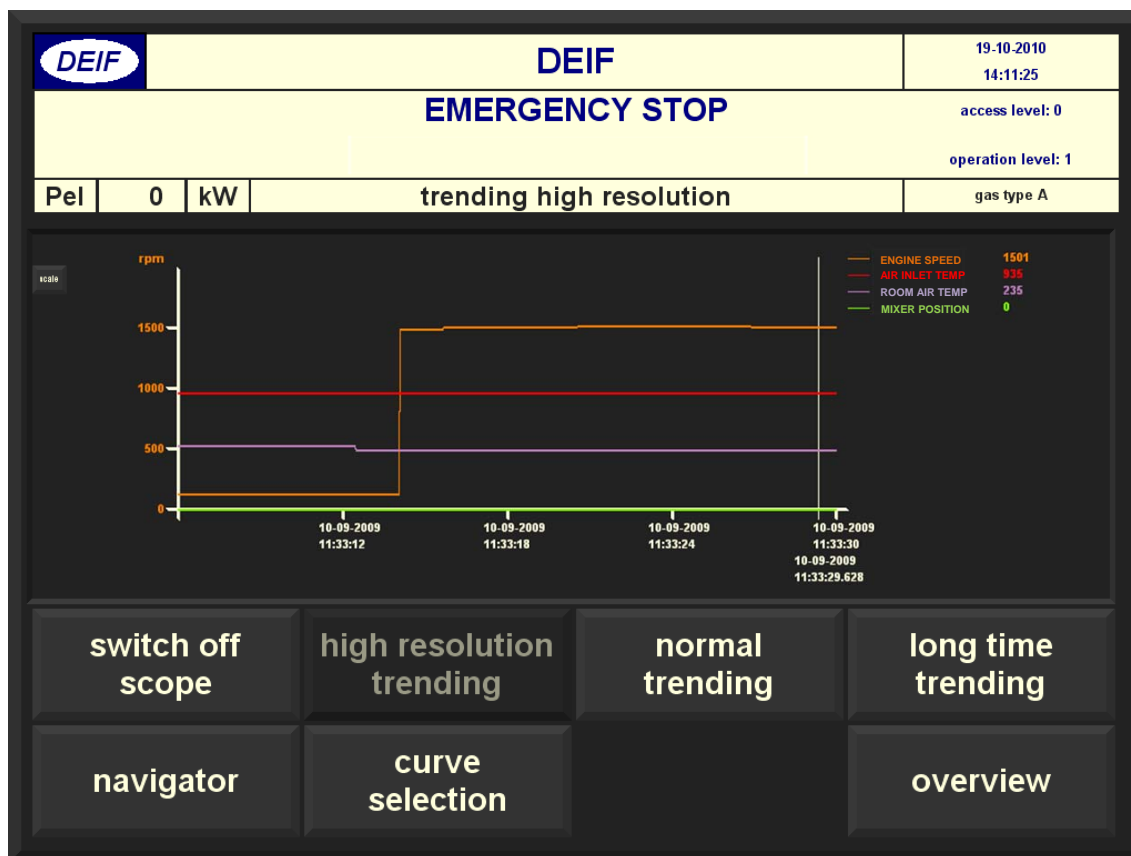
Number of logs: 200.

Trending

Trend curves can be accessed via the navigator. They are especially useful during commissioning. There is a choice of high resolution, normal resolution and long time trending. As soon as “switch scope on” is activated, the trending will start. For every available value, 600 points with time stamps can be saved.

Curve view

The view can handle up to 10 different values.




The small “scale” button in the top left corner by the side of the unit axis makes it possible to select the axis scaling to match the curves chosen.

When clicking “switch off scope”, the trending is stopped and the values stored can be analysed.

Curve selection

The available curves are shown when clicking on “curve selection”.



DEIF
26-10-2010
7:40:24

EMERGENCY STOP
access level: 2
operation level: 1

Pel	0	kW	curve selection high resolution trending		gas type A
-----	---	----	--	--	------------

U gen L1L2	P	T exhaust after engine A	p cooling water	cooling pump
U gen L2L3	Q	T exhaust after engine B	T cold junction	heating pump
U gen L3L1	P permitted	T exhaust after KAT	T room air	lambda
U gen L1N	GOV out	T exhaust after AWT	FU setpoint room vent.	phase angle
U gen L2N	AVR out		oil level engine	throttle position
U gen L3N	T engine in		T receiver	gas mixer position
U bus L1L2	T engine out		p receiver	CH4
U bus L2L3	heating water valve		p lube oil	gas valves
U bus L3L1	emerg-cooler valve		T lube oil	ignition
I gen L1	emerg-cooler stage		T intercooler water	exhaust bypass
I gen L2	T emerg-cooler		intercooler stage	T heating water flow
I gen L3	starter		intercooler valve	T heating water return
f gen	island stage	20msTask	gas level plant	T in eng-heat-exchanger
f bus	imported power	100msTask	phase angle MCB	T in exh-heat-exchanger
speed	generator demanded load	1000msTask	U battery	p crank case

navigator

back to trending

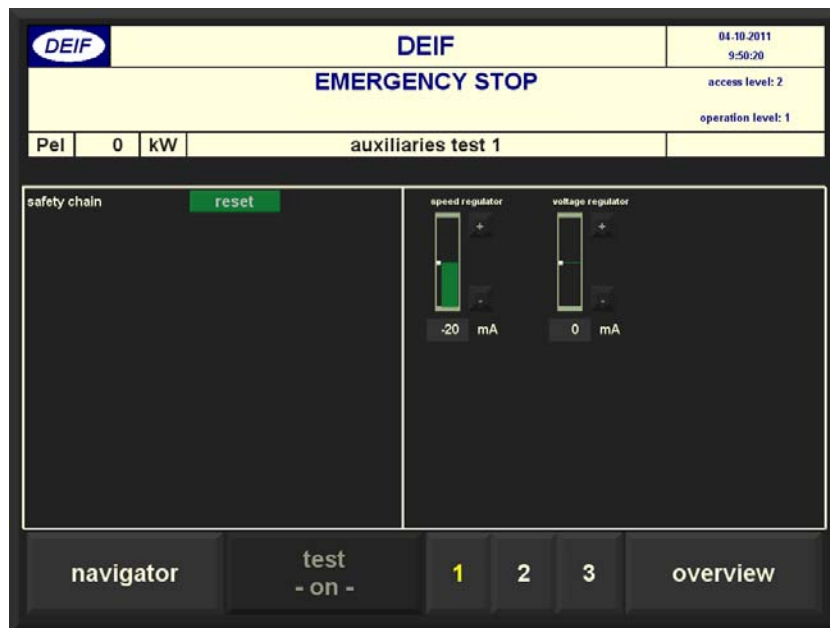
overview

The chosen values are highlighted (yellow).

The curve storing continues as long as the scope is ON.

Test of auxiliaries

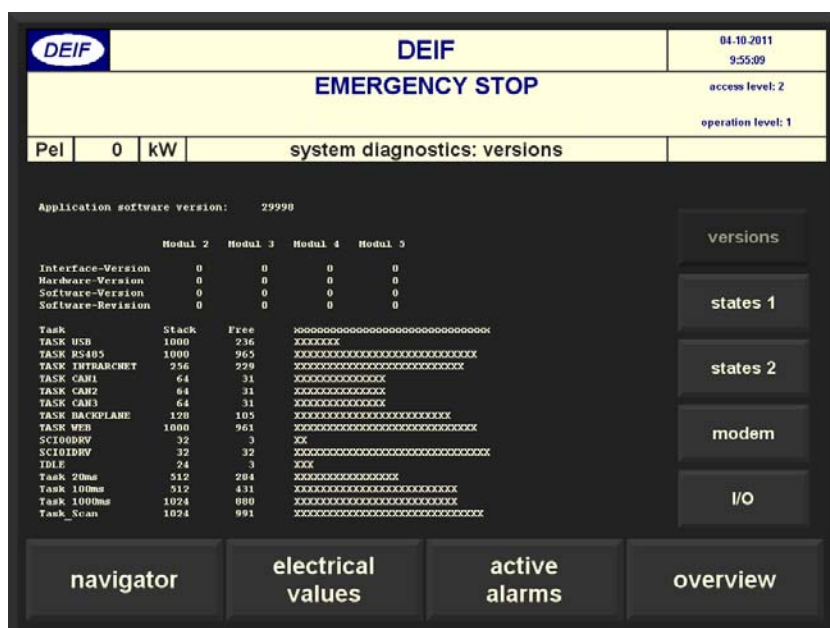
The test pages are intended for testing connections during commissioning.



The layout of the test pages is dependent on the actual system setup.

System diagnostics

System diagnostics are intended for the commissioning engineer and also as a diagnostics tool in case of malfunctions. The system diagnostics can indicate if an error is external or internal to the DM-4 Hydro.



Active alarms

The active alarm page is an overview of acknowledged and unacknowledged active alarms.

Date	Time	Message	Parameter no.	Running level	Action
04-10-2011	08:07:37.184	oil pump 2 disturbed	70044	7	
04-10-2011	08:07:37.184	oil pump 1 disturbed	70043	7	
04-10-2011	08:07:37.184	oil pump 1 and 2 disturbed	70042	7	
04-10-2011	08:07:37.884	oil pressure very low	70040	7	
04-10-2011	08:07:37.185	wire break turbine chamber pressure	70015	7	
04-10-2011	08:07:47.387	water level downstream low	70006	7	
04-10-2011	08:07:47.386	water level upstream low	70005	7	
04-10-2011	08:07:37.187	wire break water level downstream	70003	7	
04-10-2011	08:07:37.187	wire break water level upstream	70001	7	
04-10-2011	08:07:37.184	stop: wire break cooling water pressure	50160	5	
04-10-2011	08:07:54.893	mains star undervoltage 2: stopping	30852	3	
04-10-2011	08:07:54.892	mains delta undervoltage 2: stopping	30851	3	
04-10-2011	08:07:34.243	generator breaker position failure	30610	3	
04-10-2011	08:07:35.384	feedback brake 4 'on' does not appear	20073	2	
04-10-2011	08:07:35.384	feedback brake 3 'on' does not appear	20072	2	
04-10-2011	08:07:35.384	feedback brake 2 'on' does not appear	20071	2	
04-10-2011	08:07:35.384	feedback brake 1 'on' does not appear	20070	2	
04-10-2011	08:07:37.884	oil pressure emergency low	20040	2	
04-10-2011	08:07:33.259	operation stopped	80001	8	
04-10-2011	08:07:33.259	operation blocked on switchboard panel	80000	8	
04-10-2011	08:07:33.259	manual mode	30001	3	
04-10-2011	09:29:11.037	idle speed demanded	30000	3	
04-10-2011	08:07:33.254	emergency stop button	10201	1	
26-04-2011	10:04:37.177	DM4 IO card data exchange timeout	10103	1	

The messages are to be read as follows:

04-10-2011	08:07:37.184	oil pump 2 disturbed	70044	7	
04-10-2011	08:07:37.184	oil pump 1 disturbed	70043	7	
04-10-2011	08:07:37.184	oil pump 1 and 2 disturbed	70042	7	R
04-10-2011	08:07:37.884	oil pressure very low	70040	7	R

Date Time Message

Parameter no. _____

Running level _____

Action _____

The levels are:

Level	Level name
0	System Boot, System Start
1	Emergency stop
2	Fast stop
3	GCB trip, sync block
4	Synchronise but do not close GCB
5	Normal run (may cause soft stop, dependent on the alarm in question).
6	Power reduction (reserved, not used)
7	Warning

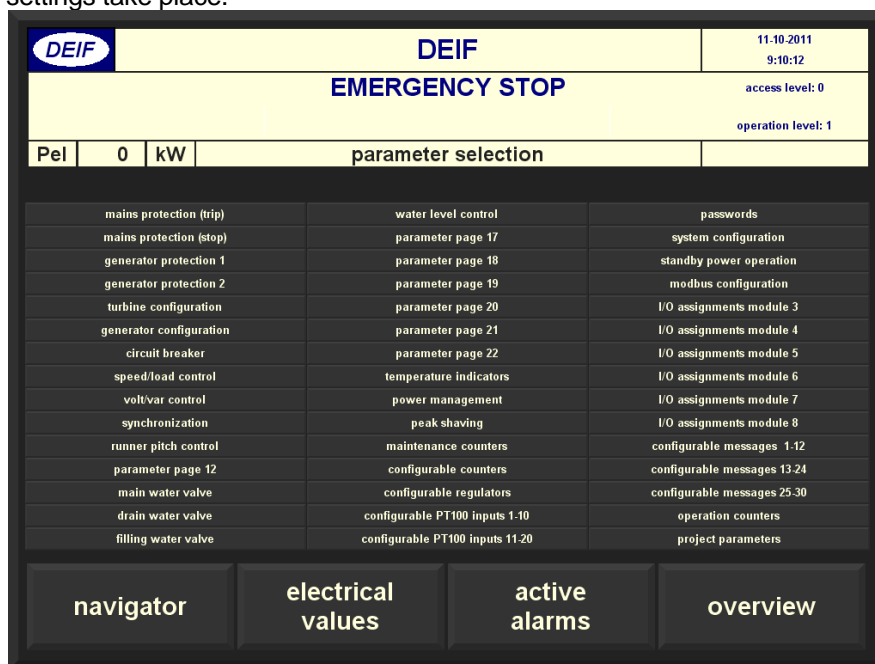
The first number in the error indication is the level which is accepted by the error in question. In the status field, the most important error messages are shown.

Some error messages initiate the following actions:

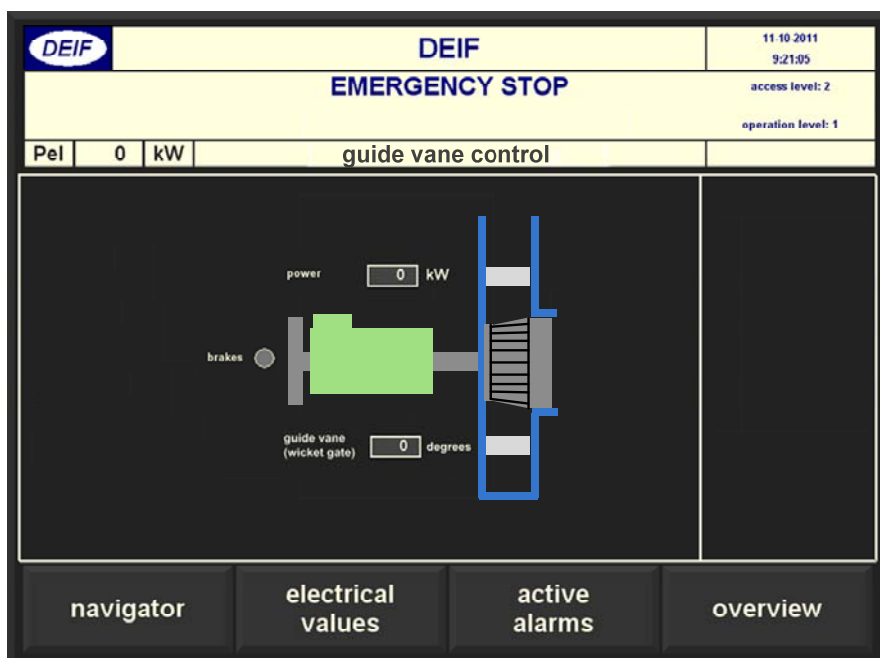
- A – Open generator breaker
- R – Regulator stop
- N – Emergency stop

Parameters

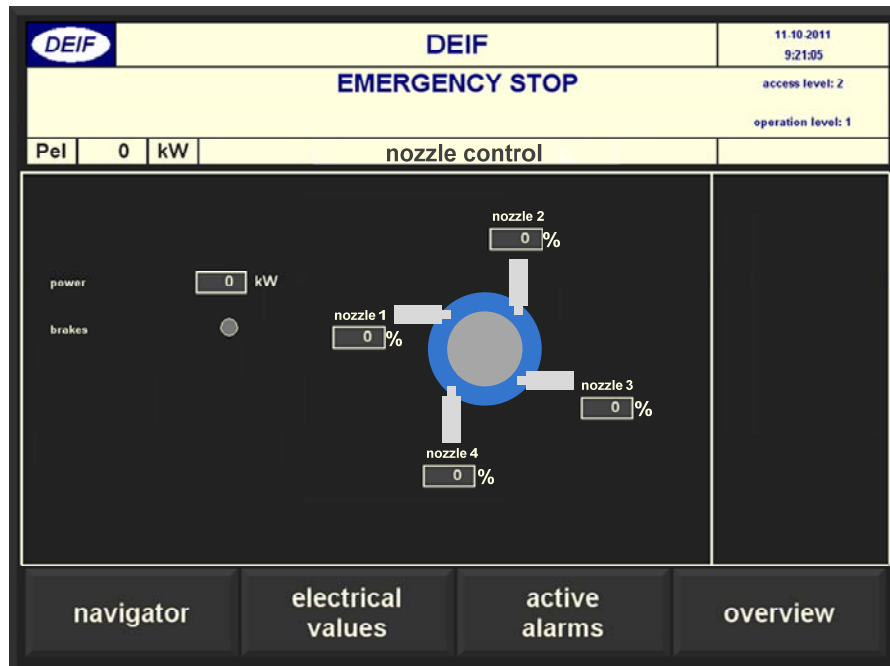
The parameter page is normally not intended for the operator. This is the place where all parameter settings take place.



Guide vane (wicket gate) control (Francis turbine)



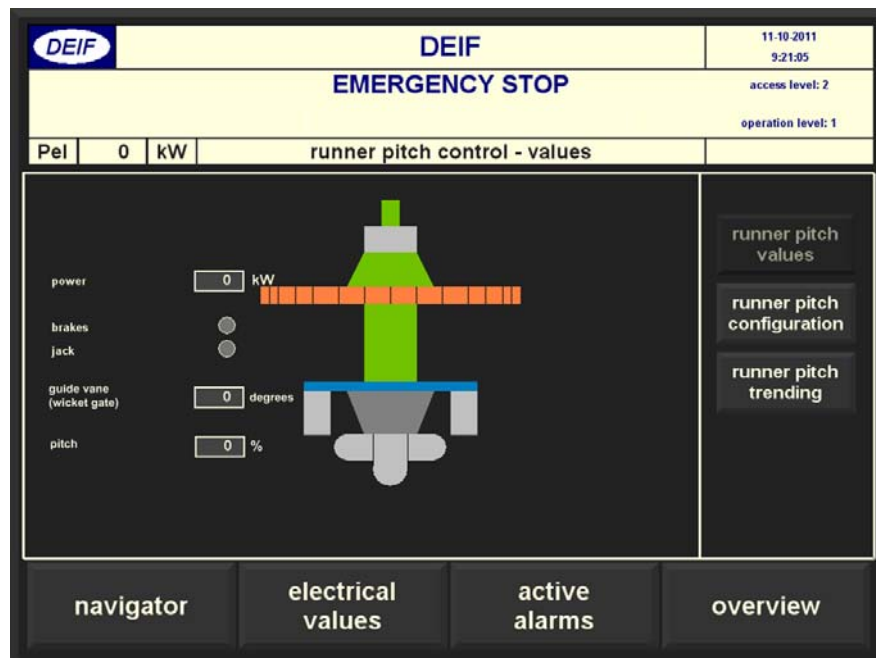
Nozzle control (Pelton turbine)



The number of nozzles shown are dependent on how many is selected (max. 6).

Runner pitch control (Kaplan turbine)

Runner pitch values



Runner pitch configuration

The configuration page is normally not intended for the operator. This is the place where initial adjustment of guide vane (wicket gate) and runner pitch is made.

DEIF		11-10-2011 10:04:53
EMERGENCY STOP		access level: 0
		operation level: 1
Pel	0 kW	runner pitch control - configuration

+	Pel (act)	0 kW	+	pos (act)	0.0 deg
-	Pel (set)	500 kW	-	pos (set)	0.0 deg

actual values:

configuration start

point 1 save point 2 save point 3 save point 4 save point 5 save point 6 save

parameter values:

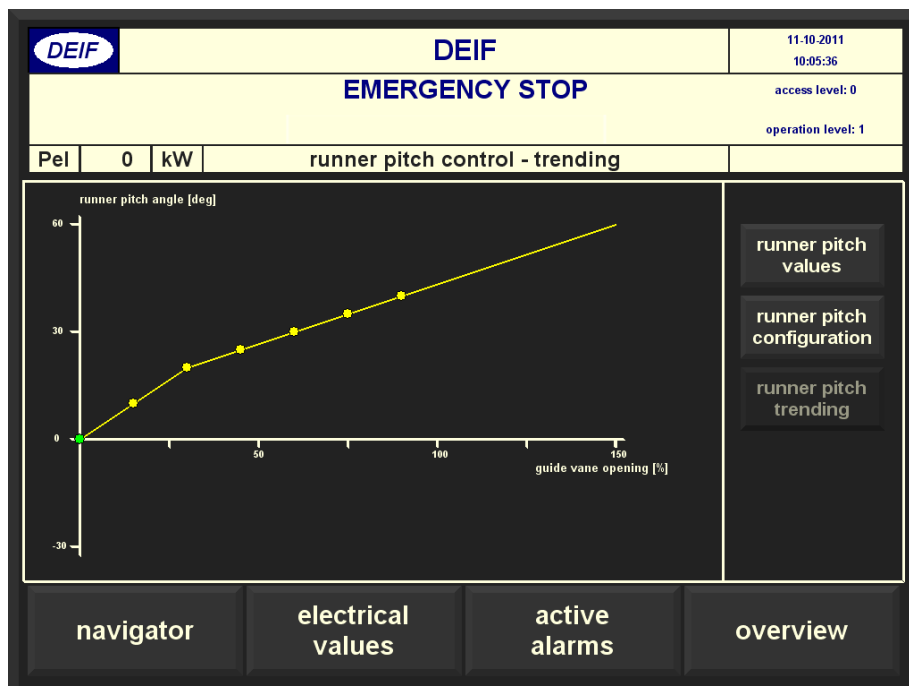
15.0	30.0	45.0	60.0	75.0	90.0
10.0	20.0	25.0	30.0	35.0	40.0

runner pitch values
runner pitch configuration
runner pitch trending

navigator electrical values active alarms overview

Runner pitch trending

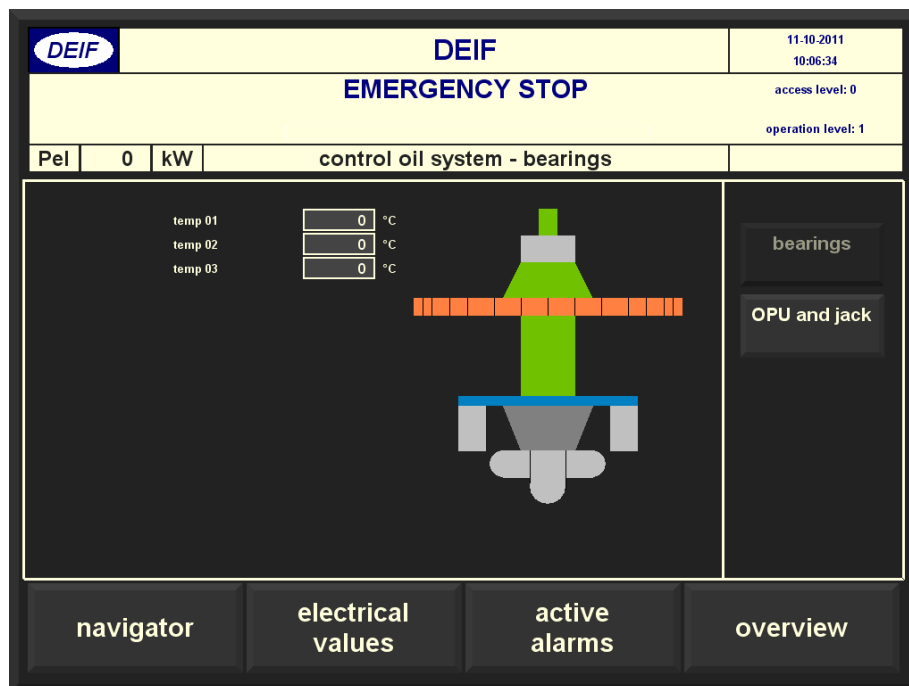
The trending page gives information about the present state of guide vane (wicket gate) opening and runner pitch. The green dot represents the actual values and must follow the yellow curve.



Control oil system

Bearings (Kaplan turbine shown)

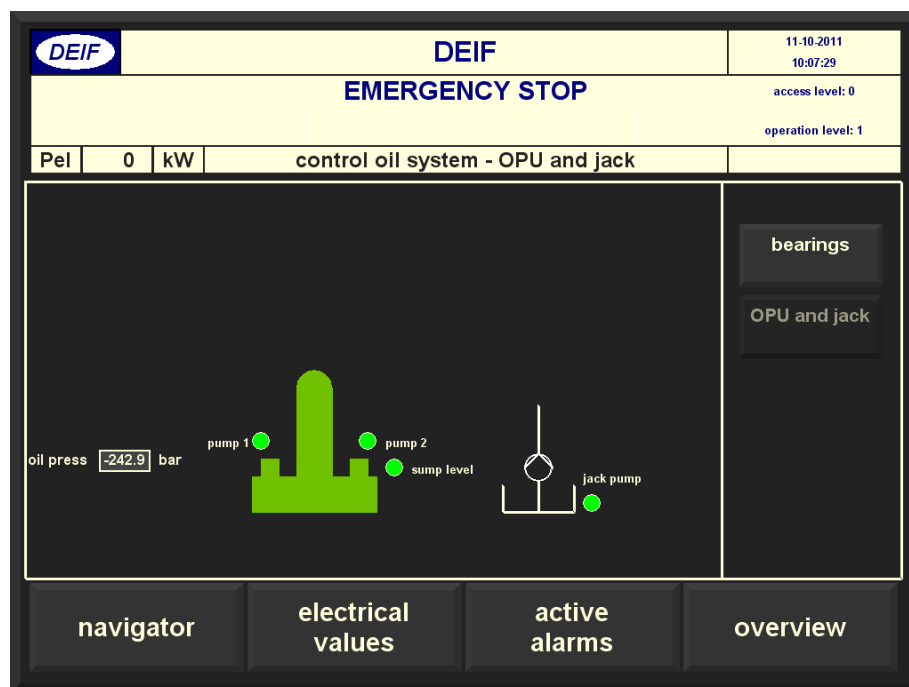
This page shows the present conditions of the turbine bearings.



There are up to 20 configurable temperature indicators available. For each, the text, input and alarms can be configured freely. Similar screens are available for Francis and Pelton turbines.

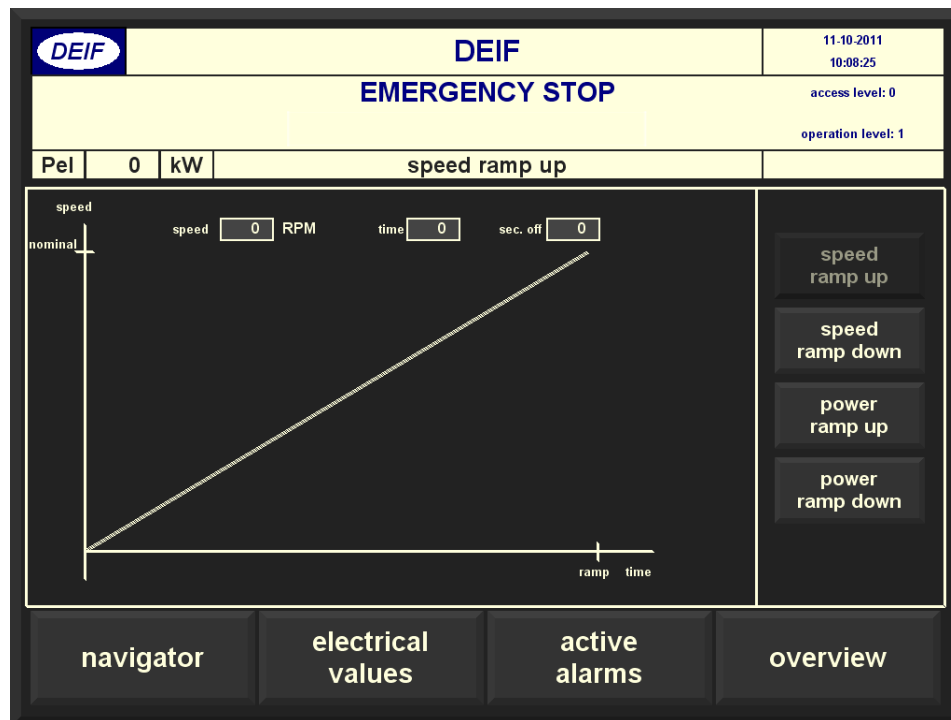
OPU and jack

Indication of conditions for oil pressure unit (OPU) and jacking of rotor.



Ramps

The ramps pages indicate the progress of ramping, when taking place.



Selectable ramps are:

- Speed ramp up
- Speed ramp down
- Power ramp up
- Power ramp down

Pt100 temperatures

The Pt 100 temperature pages are divided into 3 sub-pages, showing the configurable temperatures (1-20 shown on 2 pages) and generator winding temperatures (winding temperatures)

Example (only temperatures 1-3 are configured):

The screenshot shows the DEIF Pt100 temperatures control interface. At the top, the DEIF logo is on the left, and the text 'DEIF' is in the center. To the right of 'DEIF' is the date and time '11-10-2011 10:00:49'. Below this, the text 'EMERGENCY STOP' is displayed in large, bold letters. To the right of 'EMERGENCY STOP' are the labels 'access level: 2' and 'operation level: 1'. Below the emergency stop section, there is a status bar with 'Pel' and '0 kW' on the left, and 'PT100 - temperatures 1-10' in the center. The main display area is divided into two columns. The left column lists temperatures 01 through 10, with 'temp 01', 'temp 02', and 'temp 03' being the only ones with values. The right column shows the temperature values in degrees Celsius, all of which are '0'. To the right of the main display area, there are three buttons: 'temperatures 1-10', 'temperatures 11-20', and 'generator temperatures'. At the bottom of the interface, there are four navigation buttons: 'navigator', 'electrical values', 'active alarms', and 'overview'.

Pel	0	kW	PT100 - temperatures 1-10
01	temp 01	0	°C
02	temp 02	0	°C
03	temp 03	0	°C
04			
05		0	°C
06		0	°C
07		0	°C
08		0	°C
09		0	°C
10		0	°C

temperatures 1-10

temperatures 11-20

generator temperatures

navigator electrical values active alarms overview

6. Conditions

The present main condition of the system is at all times indicated on the user interface. Right below the main condition, the sub-conditions are indicated. Also a red text will indicate an active alarm. The alarm indication will, in case of more active alarms, indicate the most severe alarm condition.

Main conditions

The following main conditions are present:

SYSTEM BOOT
SYSTEM START
EMERGENCY STOP
SHUTDOWN
RESET SAFETY CHAIN
START BLOCKED
READY TO START
STOPPING
START PREPARE
STARTING
ACCELERATING
IDLE
POST RUN
BREAKER OPENING
PARALLEL TO GRID
TEST RUN

Sub-conditions

The following sub-conditions are present:

Main valve open
Turbine running
Excitation on
Voltage adjustment
Cos Phi adjustment
Frequency adjustment
Power adjustment
Power reduction
Ramp down
Hydraulic oil pump running

DEIF A/S reserves the right to change any of the above.