Hydrokos 15 Pump Control System

User's Manual

Second Edition, Nov 2017

Contents

1 Introduction

The *Hydrokos 15* (hereinafter "system") is designed as a pump controller, packaged with a set of pumps. The system controls the operation of the pumps, depending on the input values from the main analog sensor and additional sensors installed as requested during the product configuration. The system is designed to function with Schneider Electric variable speed drives (Altivar 12, Altivar 312, Altivar 31, Altivar 61, etc.) and communicates via the Modbus (RS485) RTU protocol. The main display module is a 5.7" Schneider Electric Proface. It is the main user interface into the system and will display all relevant information on system status and alarms. The screens are navigated by pressing the relevant button on the face of the touch screen.

2   Quick Start

The following configuration procedures are the minimum required to start and operate the HYDROKOS 15.

Before changing the settings, make sure that the system is in the OFF state and rotation direction of the pumps is correct. Sequence of operation does not matter at this stage.

1. Select one of three groups of VFD types:
    - ATV12
    - ATV212
    - ATV312 (ATV31, ATV61 compatible)
    - To undertake this step, it is necessary to click on the 'Set' button on the applicable pump to bring up the below screen:
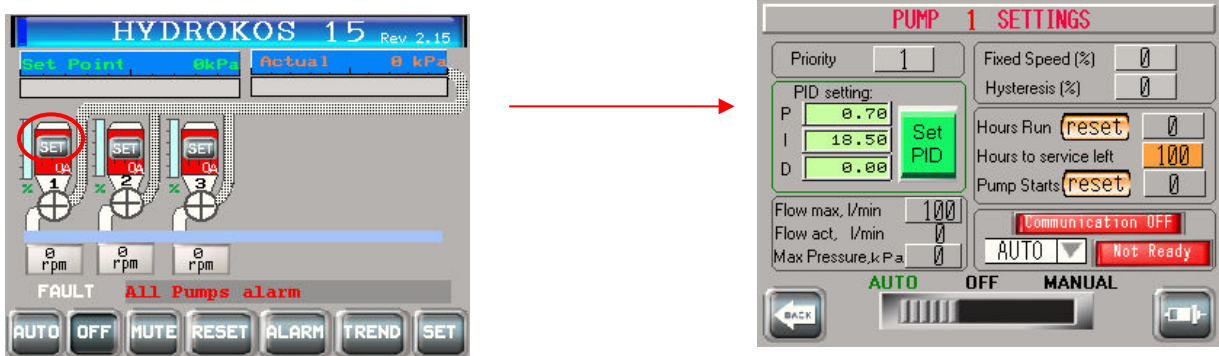
> Upon entering the pump settings screen, click onto the selection shown as 'AUTO' and select the correct pump type.

2. The next step is for hardware configuration; - set the VFDs parameters. Refer to the applicable VSD type manual for what configuration must be changed to achieve the settings below:
    - Address = 1 to 6 (increment to suit the applicable drive)
    - Baud Rate = 19,200bps
    - Modbus format = 8bits Even parity 1 or 2 stop bits (drive depending)

3. System parameters configure
    - number of pumps configured in accordance with the installed configuration.
    - number of duty pumps configured in accordance with the target flow
    - upper limit from sensor shield
    - measure from sensor shield
    - upper system limit
    - set point value
    - pumps speed control parameters (PID or fixed)

3   System Screen Map
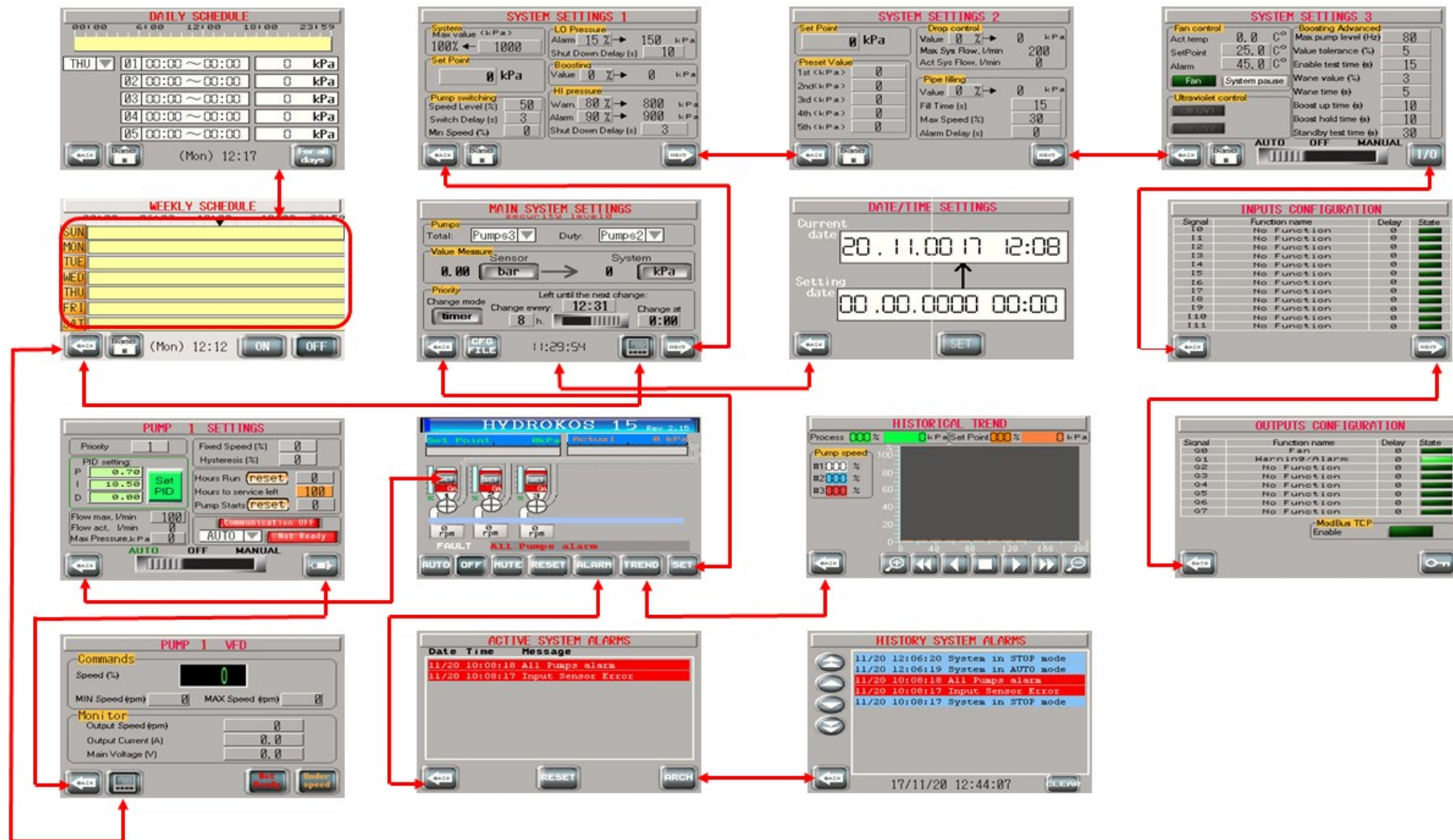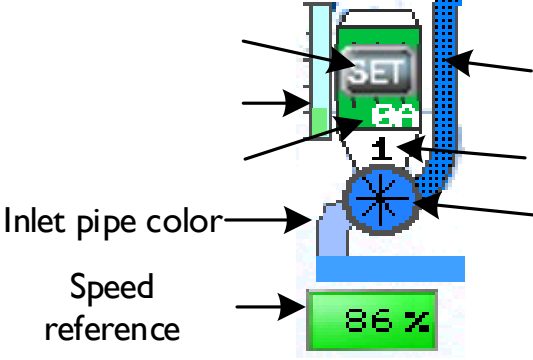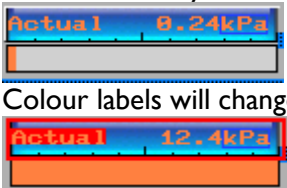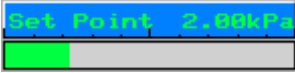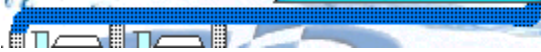
4   Main Screen

The system configuration can support up to a maximum of 6 pumps, as shown in the below picture.
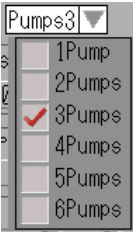
No.	Object	Description
1	System State Indication	The current system state is shown in three colours, coded to the following; • Orange – Warning; • Green – Normal; and • Red – Fault. WARNING NORMAL FAULT The word "FAULT" appearing without a background colour indicates that system is in Fault and OFF state.
2	System Mode	Pressing the "AUTO" button will set the system to operate. If system is in AUTO mode, the buttons are displayed on the main screen as follows: AUTO OFF To shut down system "OFF" button must be pressed. When in OFF mode the buttons are displayed on the main screen as follows: AUTO OFF
3	Active Alarms Pushbutton	Pressing this pushbutton will display the active alarms screen
4	Trend Screen Pushbutton	Pressing this pushbutton will display the trends screen
5	Alarm Reset Pushbutton	Pressing this pushbutton will clear the information about an alarm if it is not active. Warnings and Messages acknowledge automatically after some time.
6	Alarm Mute Pushbutton	Pressing this pushbutton will mute the alarm buzzer and any buzzer wired to Q1 digital output
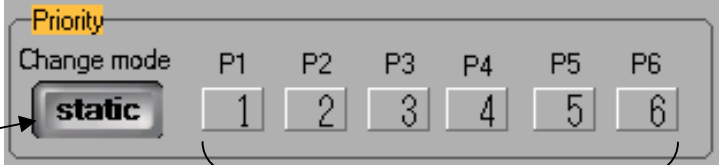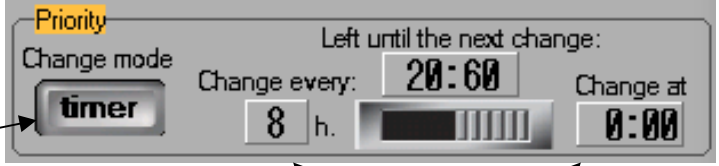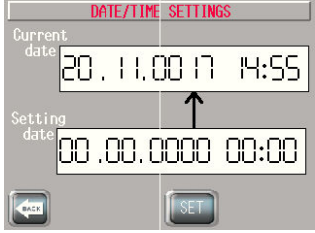
7	Main Settings Pushbutton	Pressing this pushbutton will display the main settings screen
8	Pump State Indication	The status of each pump is shown in the picture below: Inlet pipe color → Speed reference → The pump Icon fill colour displays the individual pump's current state. These are the following options: • White – passive. • Grey – pump ready. • Green – pump running. • Orange – manual mode. • Red – pump fault. • Speed bar displays the current speed command sent to the VFD (in %). • Current shows the electrical load of the pumps engine (in Amps). • Speed reference displays the output speed of the pump (in rpm or Hz as noted). • Out pipe colour changed from white to blue if pump is running • Pump priority is the sequence in which the pumps will be started, if a digit is not displayed it indicates that the pump is in OFF mode (Pump Force input activated or the selector switch on pump settings screen is set to OFF position). • Impeller colour changes from white to blue and animated when pump is running • Inlet pipe colour changes from blue to white if LO level signal is activated.
9	Process Value Monitoring	On the main screen, the actual system pressure is displayed in the form of a bar graph with a numerical display. Value metric units are configured on the Main System Settings screen (ref Page 12). The orange graph bar displays Actual Value in percentage from the 0 to MAX System Level Actual 0.24kPa Colour labels will change to red when the HI Pressure alarm is active. Actual 12.4kPa

10	Setpoint Value Monitoring	Setpoint Value is displayed in the form of a bar graph with a numerical display. Value metric units are configured on the Main System Settings screen (ref page 12). The green graph bar displays the current value in percentage from 0 to MAX System Level The varying source where the Set Point Value is taken from is displayed in the text field to the left of the numerical value. These are the following types of labels: • For user control (available change Set Point Value manually) Set Point 2.00kPa • For weekly Schedule control (Set Point Value moved from weekly timer settings) the following text will be displayed Schedule Set Point 0.00kPa • For Boost function period worked, the following text will be displayed Boost Set Point 2.00kPa • For External Set Point Value from digital input signals (preset values if appropriated input is activated) Extern.1 Set Point 2.58kPa
11	Pipe State Monitoring	Pipes colours and labels displayed on it are dependent on the current operating mode. • Inlet pipes are shown white in colour with a red border if Low Level sensor is active • Otherwise light blue in colour if low level sensor is not active: • Outlet pipes colour indicates that pipes are in filling stage. While Process value is less than or equal than Pipe filling value, the colour of the outlet pipe is white • Otherwise it is blue indicated that the pipes are filled • If the Pipe filling process is activated it will be shown on the outlet pipe and display elapsed time from pipe filling start PIPE FILLING 9s • If the Boost function is activated it will be shown on the outlet pipe and display the remaining time for the boost to be active. BOOST 19s
12	Message Field	The last system message with time of creation (warning, alarm, state changes) is shown on the main screen in the System Message line. 15/08/12 Boost func. is ON For a complete list of System Messages see on Appendix B.

5   Main System Settings

No.	Object	Description
1	Pump configuration	This is a drop-down list that allows configuration of the number of pumps used in the system. This should only be modified during system commissioning to reflect the number of pumps installed. A Security Level of at least 4 is needed to modify this setting. The maximum number of pumps possible is six pumps. The picture above is an example of a system consisting of three pumps.
2	Duty Pump selection	This is a drop-down list that allows configuration of the number of Duty pumps used in system. A Security Level of at least 4 is needed to modify this setting. The drop-down list looks identical to the previous one. The number of duty pumps must be less than or equal total number of system pumps. If it is not, it will be corrected automatically.
3	Pressure Metric Unit Selection	Pressing the button allows the user to change the System measured pressure metric unit (Pa -> kPa -> MPa -> bar -> psi).
4	CFG File Pushbutton	Pressing this pushbutton will display system settings by file screen
5	Next Page Pushbutton	Pressing this pushbutton will navigate to system settings screen
6	Weekly Schedule Pushbutton	Pressing this pushbutton will display the weekly schedule settings screen
7	Main Screen Navigation Button	Pressing this pushbutton will navigate back to main screen

8	Analog Sensor Configuration	A Security Level of at least 4 is needed to modify these settings. This screen allows the user to configure the system for use of a sensor with an analogue output 4-to-20mA. The minimum settings required to be set is the Maximum value corresponding to an input current of 20 mA Pressing the button allows the user to change the Sensor measured pressure metric unit (Pa -> kPa -> MPa -> bar -> psi). All data should be entered from the specific analogue sensor's data sheet, and should only be changed during commissioning or sensor replacement
9	Pump Priority Selection	The Priority Box allows the user to set Priority Mode and Priority Value for each pump. A Security Level of at least 2 is needed to modify this setting. There are two modes of priority control: • Static-Priorities are set by the user and do not change. In this mode, the pumps are working in a permanent manner as specified by the user. • Timer-Priorities are changed by the user configured time cycle. Automatic change of priority run pumps provides even wear across the system.
10	Time/Date Settings Screen	Pressing this field will display time/date configuration screen, press on the set pushbutton within the date/time settings screen to login and set time and date

5.1   System Settings Screen 1
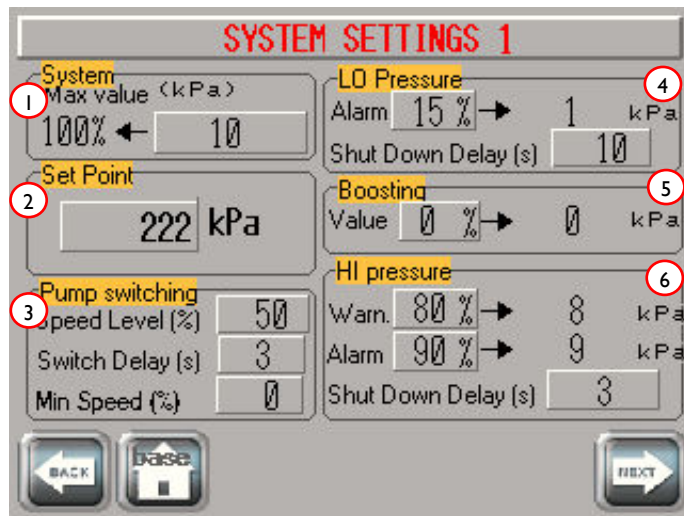
No.	Object	Description
1	Maximum System Value	Maximum System Value – value limited by system physical characteristics. Cannot be set more than the analogue sensor maximum value.
2	Set Point Value	Set Point Value – the target value that the system must achieve, Metric Unit is set on Main Settings Screen, Object 3
3	Pump Switching	Pump Switching Box contains values to determine the switching speed of subsequent pumps relative to each other
4	Low Pressure Configuration	LO Pressure parameters group for the LO Level function configuration
5	Boosting	Boost Value Parameters group box for the BOOST function configuration
6	High Pressure Configuration	HI Pressure parameters group for the HI Level function configuration

5.2   System Settings Screen 2
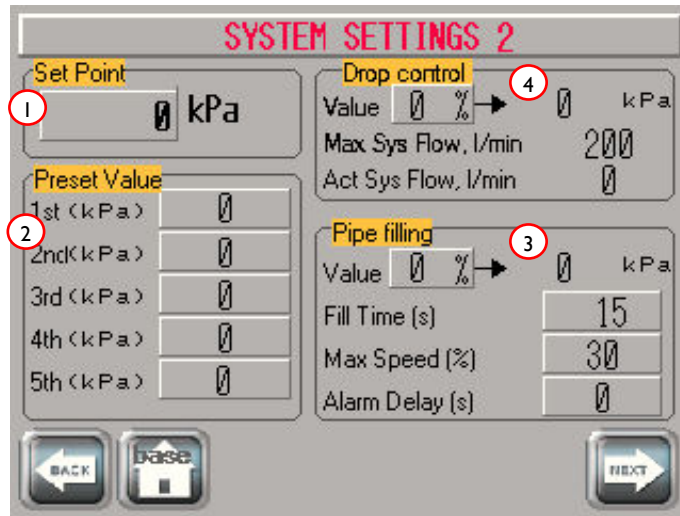
No.	Object	Description
1	Set Point Value	Set Point Value field. The system set point as above.
2	Preset Value	Preset Values field for the Preset Values function configuration
3	Pump Filling Parameters	Pipe Fill Parameters group box for the pipe fill function configuration
4	Droop Control	Drop Control group box for the configuration of the system drop control
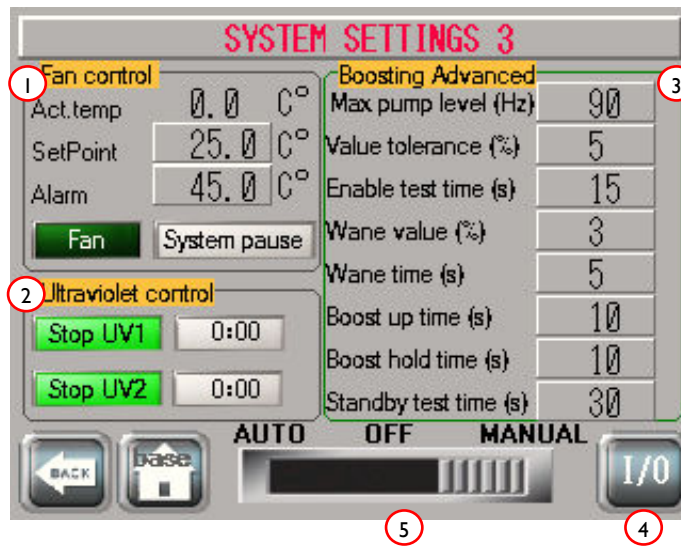
No.	Object	Description
1	Fan Control	Enclosure internal temperature control parameters
2	UV Lamps	Ultraviolet Lamps Control box for the configuration of the UV lamp operation
3	Boosting Control	Boosting method Configuration, ref page 33

4	Input Configuration	Press this Pushbutton to navigate to input configuration screen
5	UV Filters Mode Selector Switch	This Selector switch is used to change the mode of the Ultraviolet filters Auto: PLC will control starting of UV filters Off: UV filters will be shut down and will not start Manual: UV filters will be started manually.

7 Active Alarms

The System Alarm screens allows the user to view system messages (alarms, warning, state changes).

Active System Alarms Screen displays only active and unacknowledged alarms. Each alarm will be date and time stamped
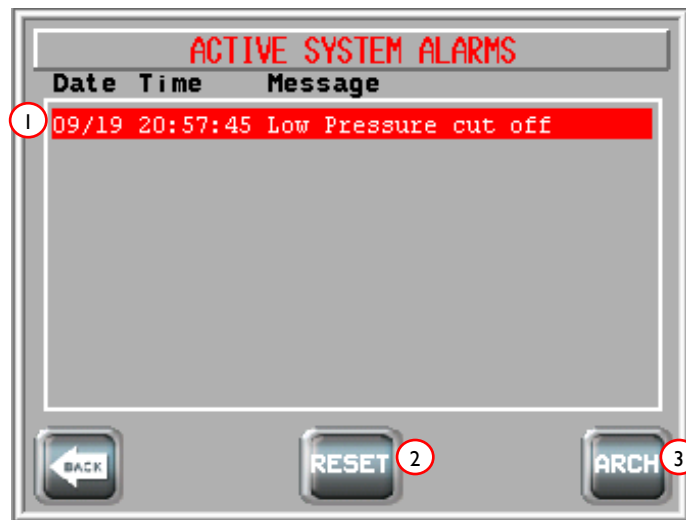
No.	Object	Description
1	Active Alarms	Active and acknowledged alarms will appear on this screen Each alarm will be time and date stamped.
2	Alarm Reset Bush button	Press this button to reset active alarms. When an alarm is reset, it will no longer be displayed on this screen. It will re-appear when that same alarm is triggered again
3	Archived Alarms Push button	Pressing the Arch Pushbutton will display the Alarm History screen.

8 Active Alarms

The System Alarm screens allows the user to view system messages (alarms, warning, state changes).

History System Alarms Screen displays all alarms. Each alarm will be date and time stamped

No.	Object	Description
1	Page Up Button	Press this button to move up a page.
2	Cursor Up Button	Press this button to move the cursor up.
3	Cursor Down Button	Press this button to move the cursor down.
4	Page Down Button	Press this button to move down a page.
5	Alarm Clear Button	Pressing the Clear Pushbutton allows the user to clear the alarm messages on this screen
6	Alarm History	Active and historical messages are shown on the History System Alarms screen and marked by following colours (active are highlighted): • Red – alarms • Orange – warnings • Blue – state changes The arrow keys to navigate through the list. Please Refer to Appendix B for list of alarm messages.

9   Process Historical Trend Screen

The Historical Trend screen allows monitoring changes of pumps speed, and changes in actual and set values. The trend area shows value changes in real time mode for the current system configuration.
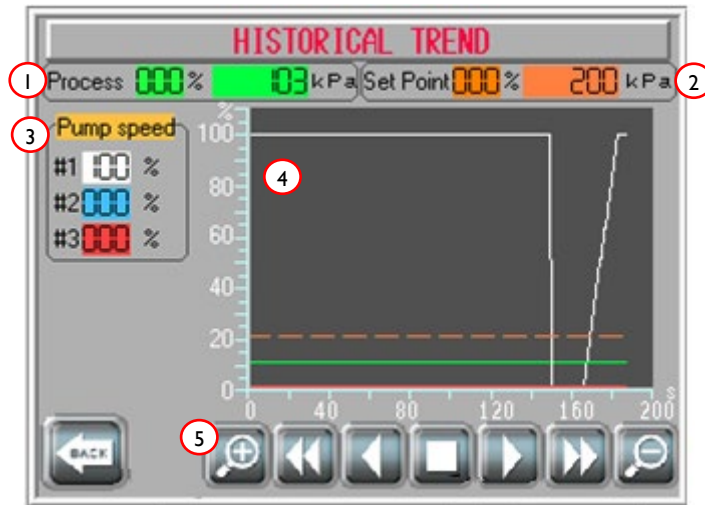
No.	Object	Description
1	Process	The value of Process being trended, also represented in percentage
2	Set Point	The value of Set point being trended, also represented in percentage
3	Pump Speed	This section indicates the pump speed in (%), the number of pumps selected will be shown as a list.
4	Trend Window	Trending for Pumps speed, Process and Petpoint will be displayed here, Y axis represents %, X axis represents time (s)
5	Navigation Buttons	For monitoring of historical trends, the navigation buttons can be used. For navigation through historical trends, the Stop Pushbutton must first be pressed.

10 Weekly Schedule

The Weekly Schedule controls the operation of the system from the set points for the various time intervals. A maximum of five set points can be set for every day of the week.
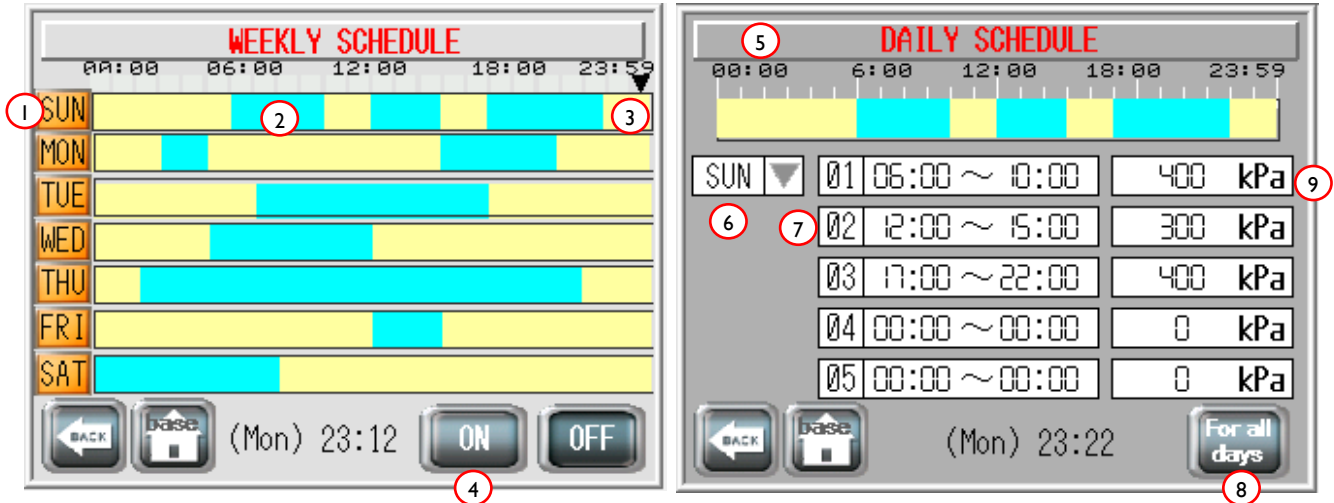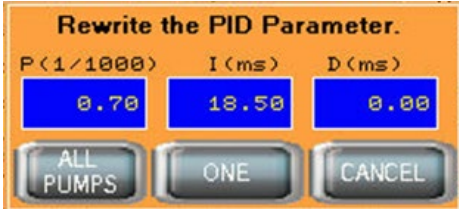
No.	Object	Description
1	Days of the week	The Weekly Schedule Screen shows the full scene of week schedules. For detailed configuration, the user can press on each day line to display the daily schedule screen.
2	Scheduled Operation	This blue section indicated scheduled pump operation time(s). The yellow section indicated the times when the pump isn't scheduled to operate.
3	Current time	A black triangle indicates the current system time.
4	On/Off Pushbuttons	These buttons enable/disable system schedule, buttons are visible to users with a Security level of 1 or higher.
5	Daily Schedule	After pressing one of the day's push button. [SUN] The Daily Schedule Screen will be displayed:
6	Day selection	Pressing on this arrow will display a drop-down list of the days, allowing the user to schedule each day individually.
7	Daily Set Points	A maximum of five Set points can be configured for every day.
8	All Day Pushbutton	The All Days button allows the user to copy settings for every day of the week. The All Days button is only visible for users with a Security Level of 1 or higher.
9	Target Set Point	Entry field for target system setpoint, System will work to maintain this set pressure. For metric unit selection (ref Main System Settings Screen, object 3)

11 Pump Settings

The settings for each pump can be configured individually, an example of the Pump Settings Screen for pump 1 shown below:

No.	Object	Description
1	Priority Selection	This field allows the user to change the pump priority if Static Priority Mode is enabled. Enabling Static Priority Mode will cause the field to have an orange border colour.
2	Fixed Speed Configuration	This field contains parameters for configuration of Fixed speed mode.
3	Hours Run	This field displays how many hours the pump was in the run state. The number is calculated from zero following the last reset of the counter. Resetting of the counter is only available to users with a Security Level of 2 or higher.
4	Hours to Next Service	This field displays the set period for pump service. This field can only be modified by users with a Security Level of 2 or higher.
5	Pump Start Counter	This field displays the number of times the pump state is changed from STOP to START. This number is calculated from zero following the last reset of the counter. The reset button is only visible to users with a Security Level of 2 or higher.
6	Communication Status	This section displays system Modbus communication state
7	Pump mode Selector Switch	The current Pump state can be changed by the available three position switch to one of the following settings: • AUTO – Pump is controlled by the automatic program and pressure control. • OFF – Pump is disabled and prevented from running. Communication to the pump is maintained in the mode. • MANUAL – Pump is no longer controlled by the automatic program and is available for Manual control via user input. Pump will be controlled via the VFD screen, see Object 11, and Object12
8	VFD State	This field message will display the VFD state (ready/not ready)

9	VFD Selection	VFD type selection pop-up screen will be displayed
10	Pump Performance Data	This field includes pump performance parameters and allows the user to set available options for the system to calculate Actual System Flow. Max Pump Flow and Max Pump Pressure can be obtained from the pump's nameplate ratings. Actual pump flow is calculated using those values and comparing the pump's speed (%) against its maximum rated speed.
11	PID Settings	This field allows the user to configure the P, I and D parameters for the current pump: If either of the P or I coefficients are set to zero it will revert to default- P=1, I=2s. An option for copying current parameters to all pumps is available. P and I coefficients are specific to a system configuration and will need to be tuned for correct operation of a system when installed in its final location.
12	VFD Screen Pushbutton	Pressing this Pushbutton will display an additional screen for individual VFD control, it is framed by an orange border if the pump is set for Manual Mode Control.

12 Pump VFD Screen

The Pump VFD Screen shows the VFD state and main parameters. Please note, pump run/stop and speed selection can only be done via this screen when the pump is manual mode. Placing the pump in manual mode is done via the Pump Settings Screen.
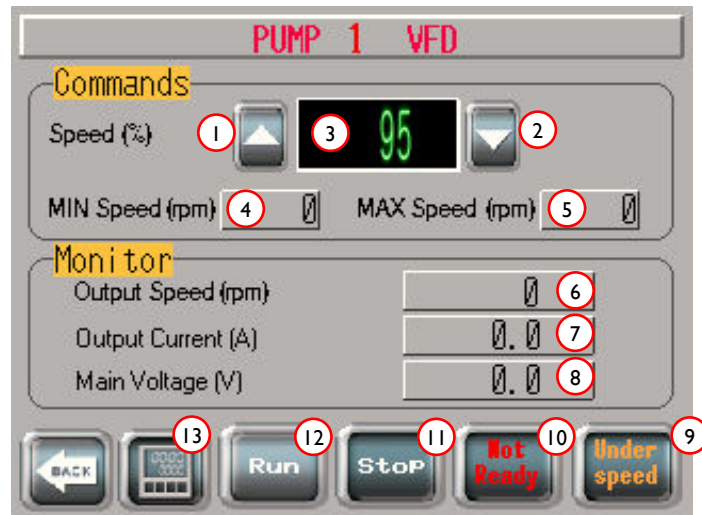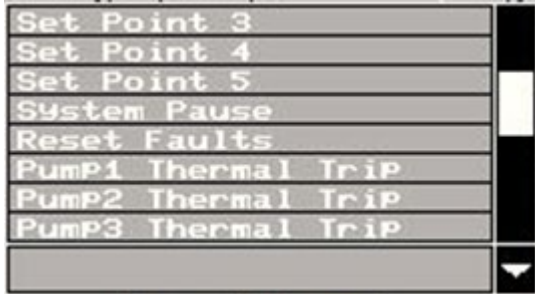
No.	Object	Description
1	Speed Increase Selection	Press this pushbutton to increase pump speed in (%), This pushbutton is only visible when pump is in manual mode, (ref Pump Settings Screen, object 7)
2	Speed Decrease Selection	Press this pushbutton to decrease pump speed in (%), This pushbutton is only visible when pump is in manual mode, (ref Pump Settings Screen, object 7)
3	Fixed Speed	This window displays the selected fixed pump speed
4	Min Pump Speed	Minimum pump speed selection is configured via the VFD, this is the display
5	Max Pump speed	Maximum pump speed selection is configured via the VFD, this is the display
6	Output Speed	This section displays Output Speed of the VFD in rpm.
7	Output Current	This section displays output Current of the VFD in Amps.
8	Main Voltage	This section displays output Voltage of the VFD in Volts.
9	Pump Speed/Under Speed	The At Speed/Under Speed lamp lights after the pump speed is stabilised, and the system registers that the pump is up to speed.
10	VFD Fault State	The Ready/Not Ready button shows the VFD fault state. This button can be pressed by the user for fault resetting
11	Manual Pump Stop	Press this pushbutton to manually stop the pump. This pushbutton is active when the pump is in manual mode. (ref Pump Settings Screen, object 7)
12	Manual Pump start	Press this pushbutton to manually run the pump. This pushbutton is active when the pump is in manual mode. (ref Pump Settings Screen, object 7)
13	Weekly schedule Pushbutton	Press this Pushbutton navigate to the weekly schedules screen where user can set view and set schedules pump run times

13 Input Configuration Screen

This screen allows the user to define the function for input signals. The active level of input signals is a HI signal (+24V). Time delay configuration and monitoring of input state is possible.
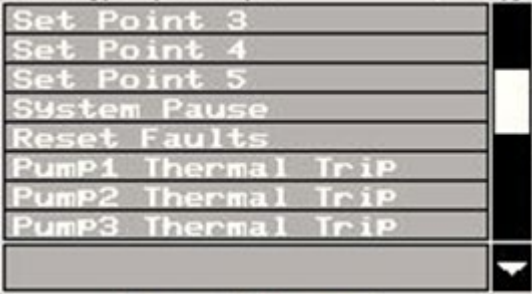
No.	Object	Description
1	Input Address	This is the physical input address within the PLC
2	Input Function Name	Only predefined function names can be selected via the drop-down list (See object 5)
3	Input Delay Timer	This is the delay timer used to delay the input being registering within the PLC, pressing on this field will display an input keypad which can be used change timer value (0-99) seconds
4	Input State	The Input State Area changes to light green colour when an input is registered by the PLC. It will display the lapse time of the delay timer
5	Function List	Press on the arrow to configure inputs, the function can be selected by the user. A drop-down list will appear displaying all available functions for selection. List will appear when signed on with a security level of 2 or above, ref to Outputs Configuration screen, object 6
6	Function Selection	Press this pushbutton to assign a function to an input

14 Outputs Configuration Screen

This screen allows the user to define the function for output signals. By pressing on the Output State Area, the user can manually force outputs with a Security Level of 4 or higher. The individual output will obtain an orange background on the output number to indicate that it is in a forced state. Time delay configuration and monitoring of individual output states is possible.

No.	Object	Description
1	Output Address	This is the physical output address within the PLC. The individual output will obtain an orange background to indicate that it is in a forced state.
2	Output Function Name	Only predefined function names can be selected via the drop-down list (See object 6)
3	Output Delay Timer	This is the delay timer used to delay the activation on an output by the PLC pressing on this field will display an input keypad which can be used change timer value (0-99) seconds
4	Output State	By pressing on the Output State Area, the user can manually force outputs with a Security Level of 4 or higher. The state indicator lamp will change colour to light green when output is forced on. Q0 and Q1 outputs are not available for configuration, as the functions of these outputs are constant as part of the factory system configuration.
5	Modbus TCP	Pressing this pushbutton will allow the communication of Modbus TCP protocol.
6	Login Pushbutton	Press this pushbutton to login to the system, a pop-up keypad will be displayed.
7	Function Selection	Press this pushbutton to assign a function to an output

8	Function List	Press on the arrow to configure outputs, the function can be selected by the user. A drop-down list will appear displaying all available functions for selection.
		Set Point 3 Set Point 4 Set Point 5 System Pause Reset Faults Pump1 Thermal Trip Pump2 Thermal Trip Pump3 Thermal Trip
		List will appear when signed on with a security level of 2 or above, ref to Object 6

15 System Functions

Tuning Function

The main function of the system is pulling up the Actual value read by the system to the Set point value by changing the output capacity of the installed pumps. The pump's output capacity depends on the rotation speeds and the number of running pumps. Pump speed can be from MIN (0%) to MAX (100%) as configured in the individual VFD.

There are two ways for pumps capacity change:
- Individual pump manual speed control, ref VFD settings Screen.
- Automatic speed control to vary the pump(s) output capacity, ref Pump Settings Screen – Object 11.

Stepless Speed Control

Speed is automatically tuned by the PID control with the actual value included into the feedback loop. P, I and D parameters can be set individually by the user for each pump. Whilst the system is in adjustment mode, pump speed is changed only for the active pump. The Active Pump is the running pump with the highest priority, ref Pump Settings Screen – Object 11.

Step Speed Control (Fixed Speed)

If the pump is configured to a Fixed speed mode (both parameters on Pump Screen must be greater than zero) and it is Active, the pump speed will be adjusted in steps. Pump speed can take only two values 0% and Fixed Speed %. If the current pump is not the Active Pump, it will continue running at Fixed Speed %. The user can only update these settings with a Security Level of 1 or higher.

| Fixed Speed (%) | 75 |
| Hysteresis (%) | 20 |
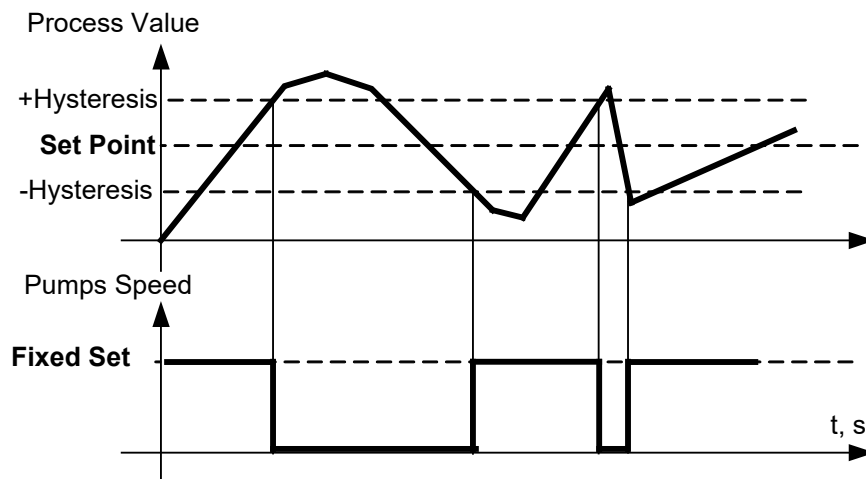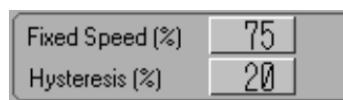
The above graph shows the operation of the system using the Step Speed Control method for the Active Pump.

Standby Pump Activation

If the Process Value is less than the Set Point Value and the Current Speed of the Active Pump is at MAX, the next priority Ready Pump is set to start in the pumping process. The next Ready Pump will start when the following operational conditions are met concerning the current Active Pump:

- Pump is at a speed higher than (Maximum Speed - Speed Level %)
- Switch delay time has elapsed

At this point, the Ready pump with next priority is started. When the pump has started, the system will recognise this pump as the Actual Pump, and the above process will continue as required until all duty pumps are running (if required) to achieve the Set Point Value.
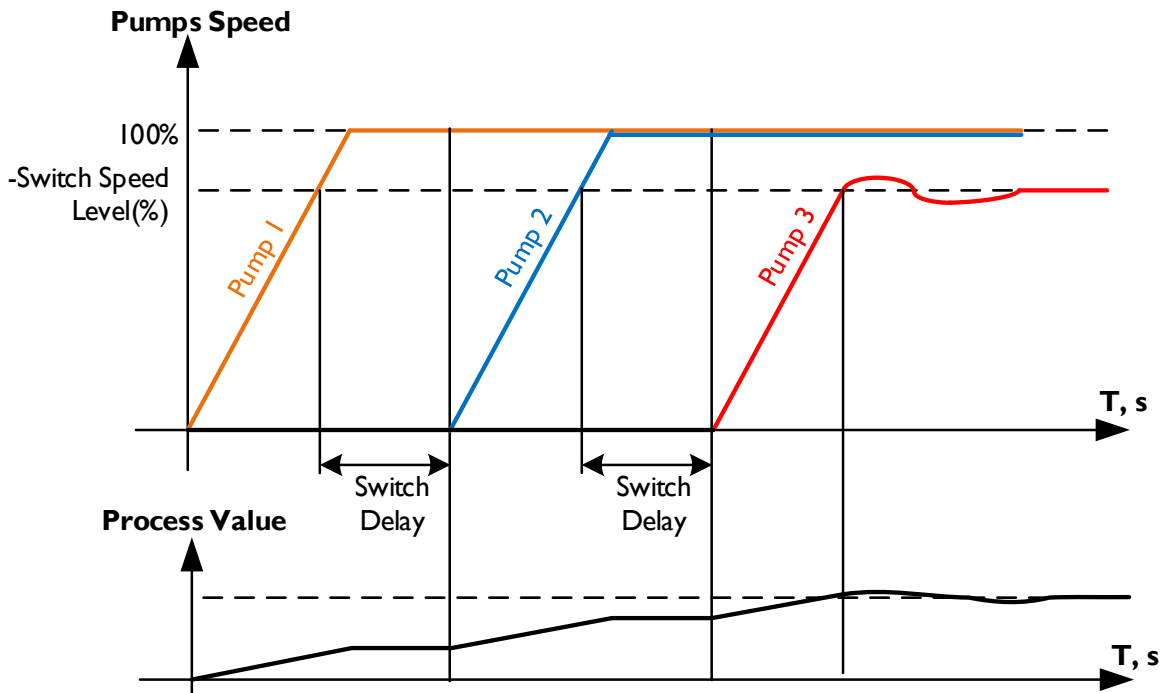
The Actual Pump stopping process is the reverse. Pumps will gradually scale down and turn off once the system has reached the required Set Point Value, such that the value is maintained. This process starts with the pump of lowest priority and continues until the Set Point Value is constant or all pumps are deactivated (as required).

Discrete Control

The Hydrokos system allows using not only VFDs, but also contactors and the soft starters for motor control. It is also possible to use a joint configuration of fixed speed and variable speed. To activate Discrete Pump Control mode, the system must be set in Fixed Speed (ref Pump Settings Screen Object 2). And outputs configured to Pump Direct Start (ref Outputs Configuration Screen, Objects 8). Optionally (if required), it is possible to configure input signals to recognise Pump Thermal Trip and Pump Operate functions. Ref Inputs Configuration Screen, Objects 5.

The below diagram shows the connection to the panel for utilising Discrete Pump Control:
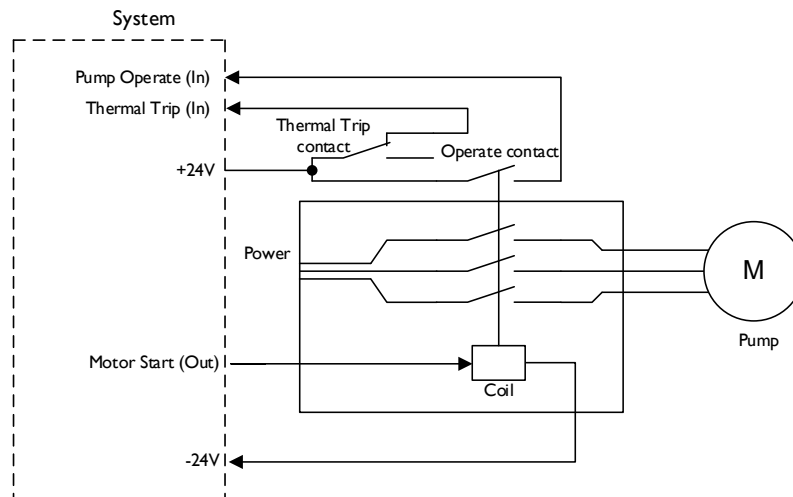
The Pump Thermal Trip signal is implemented as a normally closed contact, and if opened when the is pump running it will be stop immediately. The Hydrokos system will indicate that the pump is in alarm mode signed "Pump * Alarm.ThermalTrip".

The Pump Operate signal is implemented as a normally open contact, this is a delayed input signal to the PLC, the duration this delay timer can be configured by the user. If a start command is sent for the pump (Pump Start) and a pump running status (Pump Operate) hasn't been received after a time delay the Hydrokos system will indicate that the pump is in alarm mode signed "Pump * Alarm.Operate err".

Setting System Maximum Pressure

For protection of the pipeline and connected devices, the monitoring functions of the MIN and MAX pressure values can be configured by the user.

MAX and MIN values are set in percentage from MAX System Value (100%).
Maximum System Value – value limited by system physical characteristics. Cannot be set more than the analogue sensor maximum value.

For further explanation refer to (Main System Setting Screen, Object 8), (System Setting 1 Screen, Object 1), Also refer to Appendix A.

High Pressure Warning and Alarm

To enable protection against the system Process Value exceeding the system design limits, there are Warning and Alarm level limits that must be configured.

System pressure warning level (Object 2) can be configured to be at a percentage of the max value (Object 1) When the warning pressure level is reached the message *"HI Pressure warning"* will display on the unit screen. It is acknowledged automatically after the pressure value declines below the warning level. The system changes the state to Warning.

The system pressure alarm level (Object 3) can also be configured to be at a percentage of the max pressure value. When this level is reached the message *"HI Pressure Alarm"* will display on the unit screen.
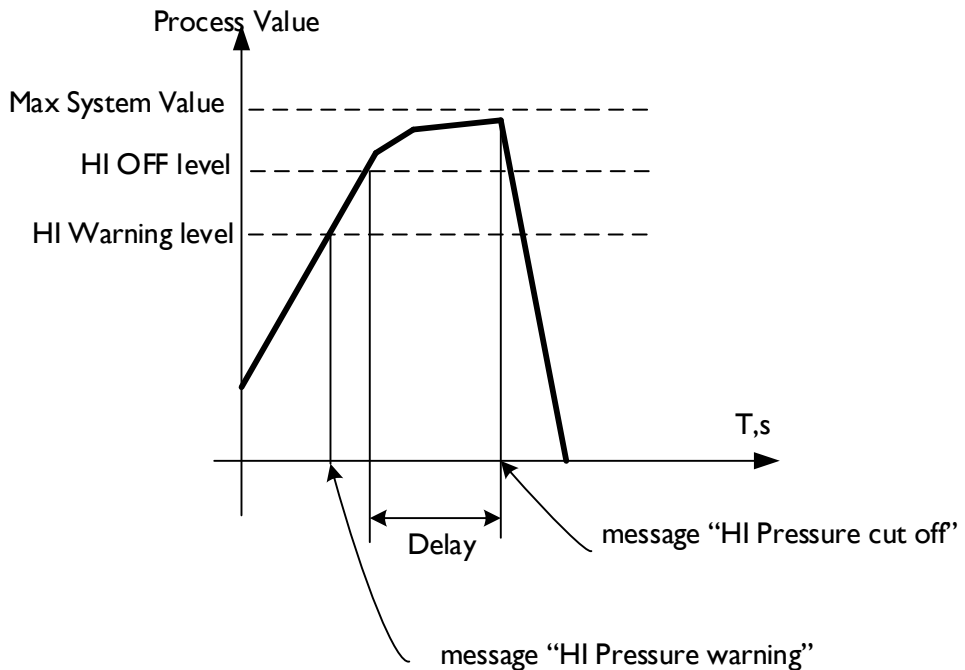
After the Actual Value reaches HI Pressure Alarm value (percentage) and HI Pressure Shut Down delay time (Object 4) has elapsed, the Hydrokos system will be set in "ALARM" mode.

If the "HI Pressure cut off" message is displayed on the main screen, the Actual Value will be marked red.

Low Pressure Alarm

For Low Level control enable LO Pressure Alarm and Shut Down Delay must be configured.

The system pressure low level (Object 2) can also be configured to be at a percentage of the max pressure value (Object 1). When this level is reached the message *"LO Pressure Alarm"* will display on the unit screen. After the Actual Value reaches LO Pressure Alarm value (percentage) and LO Pressure Shut Down delay (Object 3) has elapsed, the Hydrokos system will set in "ALARM" mode, "LO Pressure cut off" message display and system set to ALARM mode. The LO alarm will not be active if the system is in Pipe Filling mode.
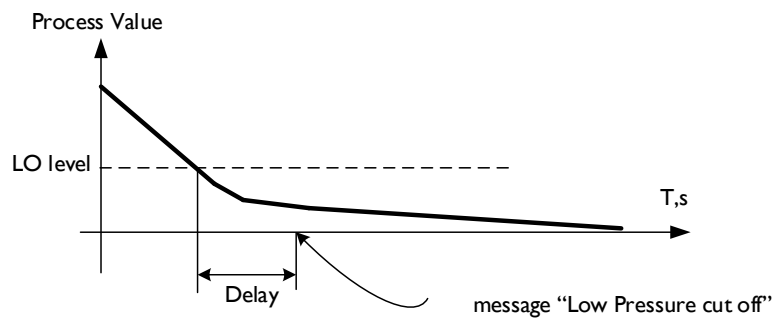
Pump Operating Time Equalising Control

The pump with the highest priority will always start first, this could cause uneven wear to the pumps. To equalise pump running times, user can configure pumps to change duty status at a defined time. This can be done by setting the priority change mode to timer (Object 1),
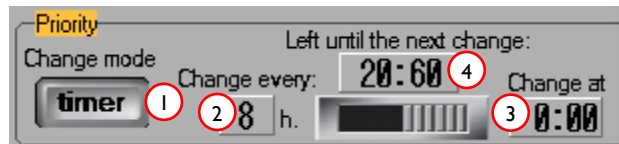
The pump duty status changeover can be configured to change every 'x' hours (Object 2), or change at a specific time of the day (Object 3). When the time left until next change (Object 4) is zero, the Hydrokos system will be paused momentarily and start again with new values of priorities.

Pump Priority values determines the order of pump starting. If the Pump Priority is changed at any stage when the system is active (pumps running), changes will take effect after the next start of the pump.

The user can configure to set up each pump with a static priority value that does not change, this can be done by setting the priority change mode to static (Object 1). And then each pump can be given a priority number (Object 2). If the set priority is duplicated, the system automatically corrects it.
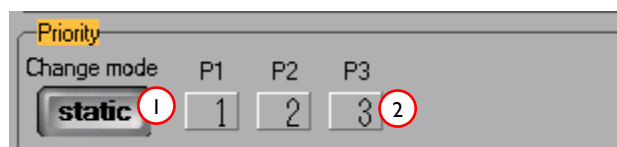
The maximum number available for priority settings is the number of used pumps. This function only has effect for a system with more than one pump.

Service Time Control

For each pump individually, the time remaining until a pump requires a service can be set.

The timer will count down during all times that the individual pump is running, and when it reaches zero the impeller will be shown as orange on the main screen indicating that a service is required.

Schedule Work

The Scheduled Work function allows the user to program different system pressure settings at the set times of the day / week. For the entire week the Hydrokos system can accept up to five set points per day.

The Week Schedule Screen (Page 19) shows an overall picture of the system work time periods for the week. The Day Schedule Screen (Page 19) shows a detailed diagram of the schedule for the selected day. If the Scheduled Work function is activated by pressing the ON button (ref to Weekly Schedule Screen, Object 4) the Main Screen will show information as below:

If scheduled Set Points overlap in time but are different in value, the value that is higher in the list will have priority.

For example:
- SetPoint 1:   8:00-12:30 – 245 kPa
- SetPoint 2:   10:00-15:00 – 400 kPa
- SetPoint 3:   11:00-20:00 – 0 kPa
- Process will be: 8:00-12:30 – 245kPa, 12:30-15:00 – 400kPa, 15:00-20:00 – 0kPa.

Dry Run Protection

This function is implemented to prevent pumps running with empty inlet pipes. The function is enabled by a "Low Level Alarm" being assigned to one of the system inputs. Low Level sensors or Pressure relays (among others), can be connected to this input. If the input is activated and time delay has elapsed – the Hydrokos system will change mode to "ALARM". On the main screen it will be marked as follows:

Low Level Lamp

Low Level Message

Pipe Filling

The Pipe Filling function starts the system in a soft mode at low speed. The purpose of this function is to protect the pipes from damage and water hammering effect when filling with water.

The function is enabled if Pipe Filling Value is set to greater than zero. Pipe Filling Value is set as a percentage of the Set Point Value (%).
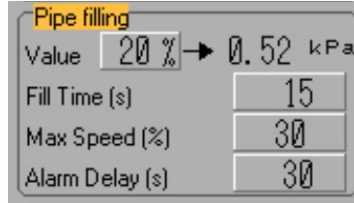
When the system is started and if the Actual Value is less than Pipe Filling Value, the function is activated. The function has the below effect on system operation:
- All available pumps run at a Pipe Filling Speed
- The Alarm Delay countdown is started (if configured >0)
- The Fill Time count is started after Actual Value reaches the Pipe Filling Value.
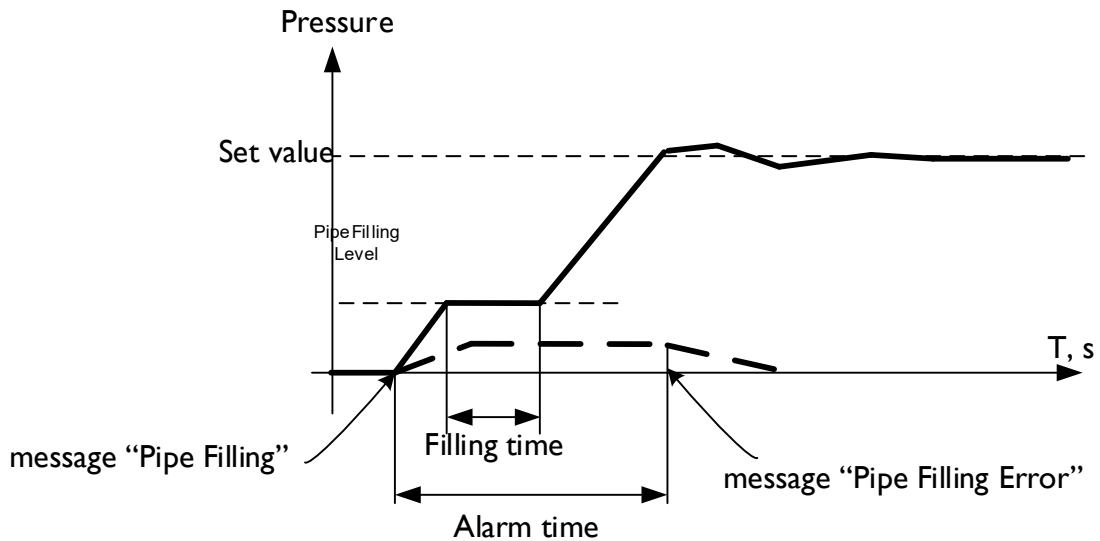
After the Fill Time is over and the Actual Value is more than the Pipe Fill Value, the Hydrokos system switches to normal tuning mode. If the Alarm Delay Timer elapses prior to the Pipe Fill Value being reached, the Pipe Fill Alarm message will be displayed, as below:

The Hydrokos system then switches to ALARM mode:

Boost Function (Standby Detection)

The Hydrokos system has two methods to determine if is in a "No flow" system state:

One of inputs cab be configured to "No Flow" function via the inputs screen. If this input is HI and the time delay has elapsed, the system will switch to "Pause" mode. After the input has returned to LO state the system returns to active mode immediately.

Advanced Boosting Settings

This method is activated if:

- The system is in automatic mode;
- A single pump is running, and not at maximum speed;
- The Pipe Filling function is not active;
- The corresponding boost parameters are set greater than zero as below:

The system tests for "No Flow" by boosting the system pressure to a new temporary Set Point ("Boost Value") for a short period of time ("Boost Hold Time") and then checks the system pressure response over a period of time ("Standby Test Time"). The "Standby Boost" pressure sets the amount that the Set Point pressure is boosted by. The time that it takes to drop back to the Set Point is compared to the Standby Test Time.

NOTE - If the time to return to the "Set Point" is less than the "Standby Test Time" the system continues to operate. If the pressure does not drop to the "Set Point" over the test time, the system assumes there is "NO FLOW" and will switch to "Pause" mode until the cut in pressure point is reached to start up again.
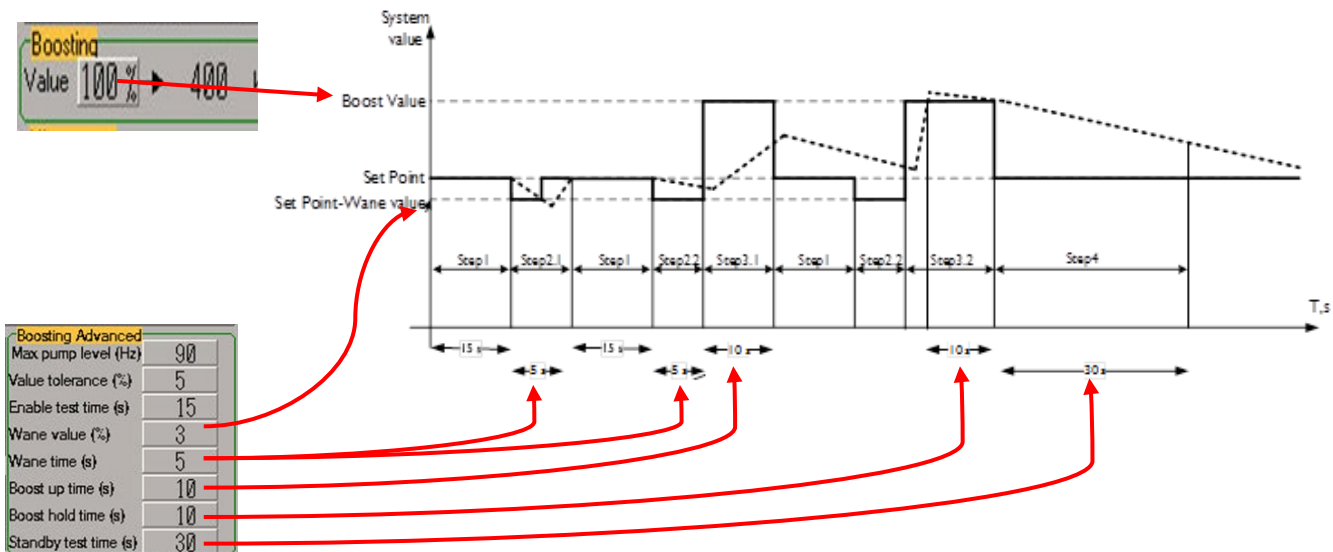
Step 1:

- Process Value more than Set Point Value tolerance (%)
- Pump speed less than 100%
- Timer counting down:
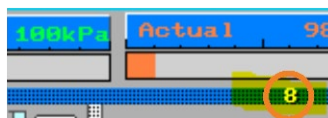
Step 2:

- Set Point changed to Set Point Wane Value (%)
- Pump's Speed is frozen
- Count down to check the pressure value after the Wane Time:
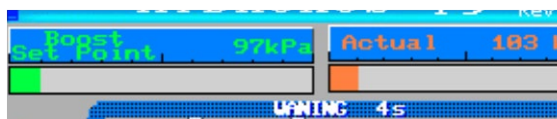
Step 2.1:
- If Process value dropped down below the current Set Point (Wane Value) return to Step 1;
Step 2.2:
- If Process value stays within the current Set Point range (> Wane Value) than go to Step 3;

Step3:

- The Set Point is changed to Set Point + Boost Value (%);
- The Pump Speed will increase as required to reach the new Set Point;
- The Boosting countdown timer is started;

Step3.1:
- If the Boost Up Time has elapsed and the Boost Set Point is not reached, the system reverts back to Step 1.

Step 3.2:

- If the Boost Set Point is reached, the system will start the Boost Time countdown:

- Once the Boost Timer has elapsed, the system proceeds to Step 4.

Step 4:

- The system changes the current Set Point back to its original value;
- The active pumps are slowed down and / or stopped if required.
- The system activates the Standby Test Timer:

Both methods for the system to define the "NO FLOW" condition may be used in combination (i.e. System Flow Switch and automatic software testing).

Digital Inputs/Outputs

The Input Configuration screen shows the Hydrokos system's 12 Digital Inputs configuration and current state. Each Digital Input can be programmed to activate one of following functions (the Input is registered as active after a HI signal is registered and any set time delay has elapsed):

OPTION	DESCRIPTION
System Pause	Switch system to pause mode
Low Level	Tanks Low Level sensor input
Emergency Stop	Emergency Stop Button
Pump N Force Stop	Force stop pump #N
Set Point N	External Set Point activate
No Flow	Flow detect sensor Input (flow relay, pressure relay etc.)
Reset Fault	External alarms acknowledge
Pump N Thermal Trip	Optional input for direct control
Pump N Operate	Optional input for direct control
UV1 Fault (Stop Pumps)	Ultra Violet Lamp fault input
UV2 Fault (Stop Pumps)	Ultra Violet Lamp fault input
UV1 Fault	Ultra Violet Lamp fault input
UV2 Fault	Ultra Violet Lamp fault input
UV1 ON	Ultra Violet Lamp operated input
UV2 ON	Ultra Violet Lamp operated input
Filter 1 Fault	Filter fault input
Filter 2 Fault	Filter fault input
High Level	High level input
High Level (System Pause)	High level input

The Output Configuration screen shows the Hydrokos system's 6 Digital Outputs configuration and current state. Each Digital Output can be programmed to be activated by one of following functions:

OPTION	DESCRIPTION
Alarm	System is in ALARM mode
Low Pressure Fault	Lo Level Function
High Pressure Fault	Hi Level Function
Pump N Run	Pump #N is running
Pump N Fault	Pump #N is in fault mode
System In Auto Mode	While system in AUTO mode
Any Pump Running	One of pumps is running

N – the actual Pump number

Each digital input or output signal can be delayed by between 0 and 999s. If the state of the input or output changes prior to the timer elapsing, the system does not register to input or output as active. The next time the state of the input or output is active, the timer resets and begins the count again.

System units of measurement

The Hydrokos system is able to use different metric units for sensors and system pressure values. It is changed by a cyclic button press (Pa->kPa->MPa->bar-psi) ref to Main Settings Screen , Object 3, 8. If the system is set to display a different measure for the sensor and the system, it calculates applicable reference values based on the following table:

SYSTEM	Pa	kPa	MPa	bar	psi
Pa	x1	x1000	n/a	n/a	n/a
kPa	x1000	x1	/1000	/100	/145
SENSOR MPa	n/a	/1000	x1	x10	x145
bar	n/a	x100	n/a	x1	x14.5
psi	x6895	x6,895	n/a	/0.06895	x1

n/a – not available (if the result value is too large or too small)

Droop Control

To compensate for friction loss in a long pipeline, Drop Value settings can be configured. It can be set within the Drop Control area on the System Settings Screen:

```
┌Drop control───────────────┐
│ Drop value, %     [   0 ]  │
│ Max Sys Flow, l/min  100   │
│ Act Sys Flow, l/min   0    │
└────────────────────────────┘
```
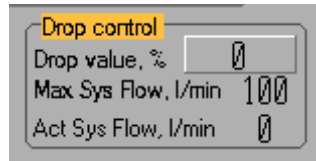
The setting increases the Set Point Pressure based on the calculated flow rate. The increase in Set Point is proportional to the calculated flow rate.
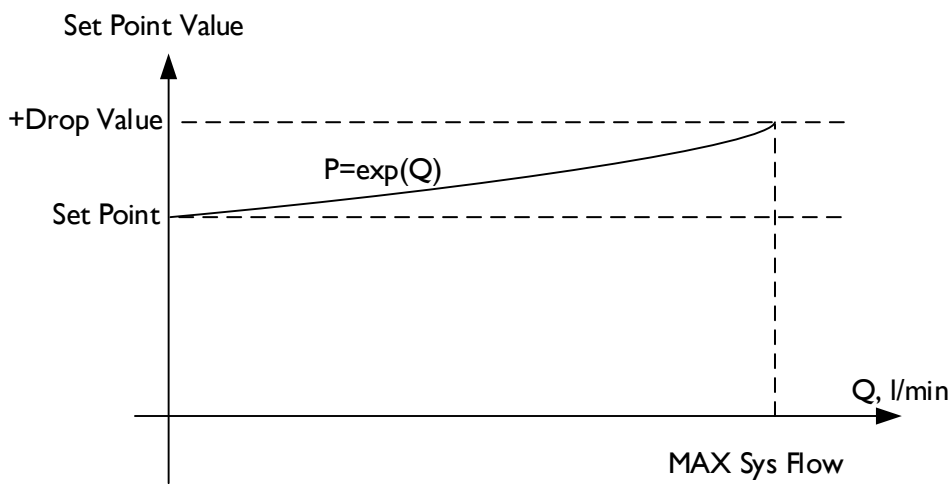
Within the Drop Control area, the following values can be monitored:

- Max Sys Flow is calculated as a SUM of MAX Pump Flows for configured duty pumps.
- Total Flow rate of the system as a SUM of the ACTUAL flows of running pumps.

NOTE For each pump

Enclosure Temperature Control

To monitor and manage temperature of enclosure Hydrokos system is equipped with a temperature sensor. Enclosure internal temperature setpoint and alarm can be configured via the System Settings Screen 3, Object 1.
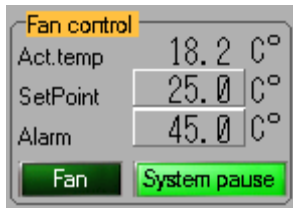
- Actual Temp is the temperature inside the enclosure as measured by the PT100 sensor;
- Set Point is the temperature at which the fan turns on;
- Alarm is the level to display the "Temperature Alarm" message and will instigate a System Pause if it configured.
- System Pause button is configured to stop the system while temperature is in the Alarm zone. The light changes to green if it is active.
- Fan lamp changes colour to light green when fan is running. The "Fan is on" message will display on the main screen.

The fan is controlled by the following logic:
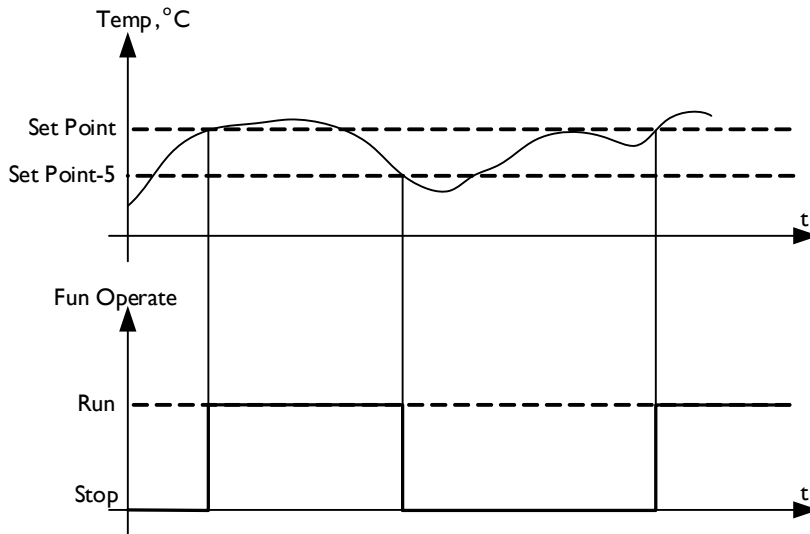
The Fan relay must be wired to the Q0 system output. This is fixed in functionality as set in the Factory and cannot be changed.

Duty Pump Configuration

The Hydrokos system can be configured to limit the number of pumps operating simultaneously. Duty pump(s) are selected as the pumps with the lowest priority setting. If the running pump is in a faulting state, the next available pump will start as duty.

The number of Duty Pumps can be configured on the Main System Settings screen Object 2.

Ultra Violet Lamps Control

The Hydrokos system can control up to two separate ultraviolet lamps. To use this functionality, the "UV Start/Stop" outputs need to be configured (ref Output Configuration screen, Object 4) . After configuration the output goes to HI immediately and the UV button changes colour to light green. The UV output state can be controlled manually by pressing on the Stop/start pushbutton for the UV. (ref System Settings Screen 3, Object 2)

For monitoring of the UV state, the below inputs can be configured:

- The UV Fault (Stop Pumps) input activates a message "UV Fault" and changes system state to "PAUSE". The associated UV lamp will change colour to red indicating the presence of a fault.
- The UV Fault input activates a message "UV Fault" only, but pump operation is not affected. The UV lamp will change colour to red indicating the presence of a fault.
- The UV ON input activates a message "UV ON" and changes the UV lamp colour to green.

Filter State Monitoring

- If the input is configured The Filter 1 Fault input activates a message "Filter 1 Fault" and "Filter Fault" output (if configured).
- Filter 2 Fault input activates a message "Filter 2 Fault" and "Filter Fault" output (if configured).

The Hydrokos system can monitor the state of two separate Filters. There are two inputs and one output that can be configured for filter state monitoring: The inputs of these filters can be configured via inputs configuration screen also the outputs that can be configured for these filter outputs configuration screen:

- If an input is configured for a filter, he Filter 1 Fault input activates a message "Filter 1 Fault" and "Filter Fault" output (if configured).
- Filter 2 Fault input activates a message "Filter 2 Fault" and "Filter Fault" output (if configured).

System Modes

- "OFF" (STOP) - all pumps are stopped and can be forced to start in MANUAL mode. Actual value monitoring is still available. External inputs and outputs can be operated and can change system mode to WARNING or FAULT depending on current settings. (ref to Main System Screen)

- "AUTO" (NORMAL) – Pump system tuning runs as normal. No faults and warnings have been registered in the system, the Process Value is within the operating range, and no external interlocks or signals have been received. (ref to Main System Screen)

- "PAUSE" (STANDBY) – all pumps are stopped until the system state returns to active. This mode can be activated by:
    - A configured "System Pause" input is activated; (ref page 23 - Input Configuration Screen)
    - A "Temperature Alarm" is activated; (ref System Settings Screen 3, Object 1)
    - The timer mode is changing Pump Priority (ref Main Settings Screen, Object 9)
    - The system determines a "No Flow" state (ref Boost Standby Function)
    - The system has registered a UV Fault requesting a system pause (ref Ultra Violet Lamps Control)

"WARNING" – Some of the pumps or connected external units are registering in a fault state. Actual value tuning continues in Warning Mode. One of the available warning messages is displayed on the main screen. The Warning Mode is cancelled after the initiator signal has been resolved. This mode can be activated by:
    - A Fault State present on one of the pumps; (MPCB stripped Status, Failed to Start)
    - The Process Value reaching the HI Pressure Warning level (ref System Settings Screen, Object 6)
    - "FAULT" – All pumps immediately stop and a Fault message is displayed on the main screen. The Fault mode is cancelled after the initiator signal has been resolved and acknowledged by pressing the reset pushbutton. This mode can be activated by:

    - An Emergency Stop input activating (if configured via the inputs screen;
    - A Low-Level process value
    - All pumps in Fault or Off states
    - A Pipe Filling Error
    - The Set Point Value of the system is out of system limits;
    - A High-Level process value
    - A UV Fault state (if configured to stop);
    - A "Low Level" input activating (if configured);

Pump Modes

Pump states are colour coded by an icon on the Main Screen, as below:

- Passive - the pump is not running or the pump is not used (if no priority digit is visible);
- Ready - the pump is ready to run. The pump will start next (pumps priority is the lowest of the ready pumps);
- Run - the pump is running and the system is in Auto Mode;
- Manual - the pump is in manual mode. (pump can be forced to run manually);
- Fault – the pump is in an alarm state (VFD fault, communications error, or speed error). The Fault Mode is acknowledged with command from the system.

System Security Levels

In order to gain access to specific controls the Security Login Screen needs to be correctly completed.

The Login Screen below is displayed when trying to access controls that require a higher Security Level:
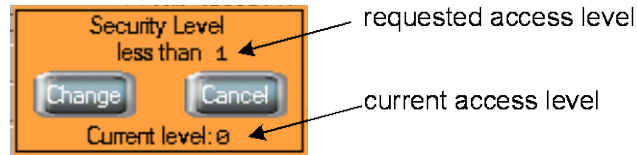
After completion of a successful login the below window will be shown:

The Security Level may also be changed on the Output Configuration screen. The current level is displayed on Main System Settings screen.

There are 4 levels of security available:

NUM.	NAME	OPERATION CAPABILITY	Password
0	Read Only	Navigating the menu without changing the settings. Start/Stop of the system is available.	001
1	Operator	All Read Only level privileges, plus Set Point and Weekly Timer configuration added.	002
2	Manager	All Operator level privileges, plus All Access except for hardware configuration (number of pumps, sensor settings, input/output function, system measure)	003
4	Supervisor	All Access	100

Appendix A - Set Point Description Chart
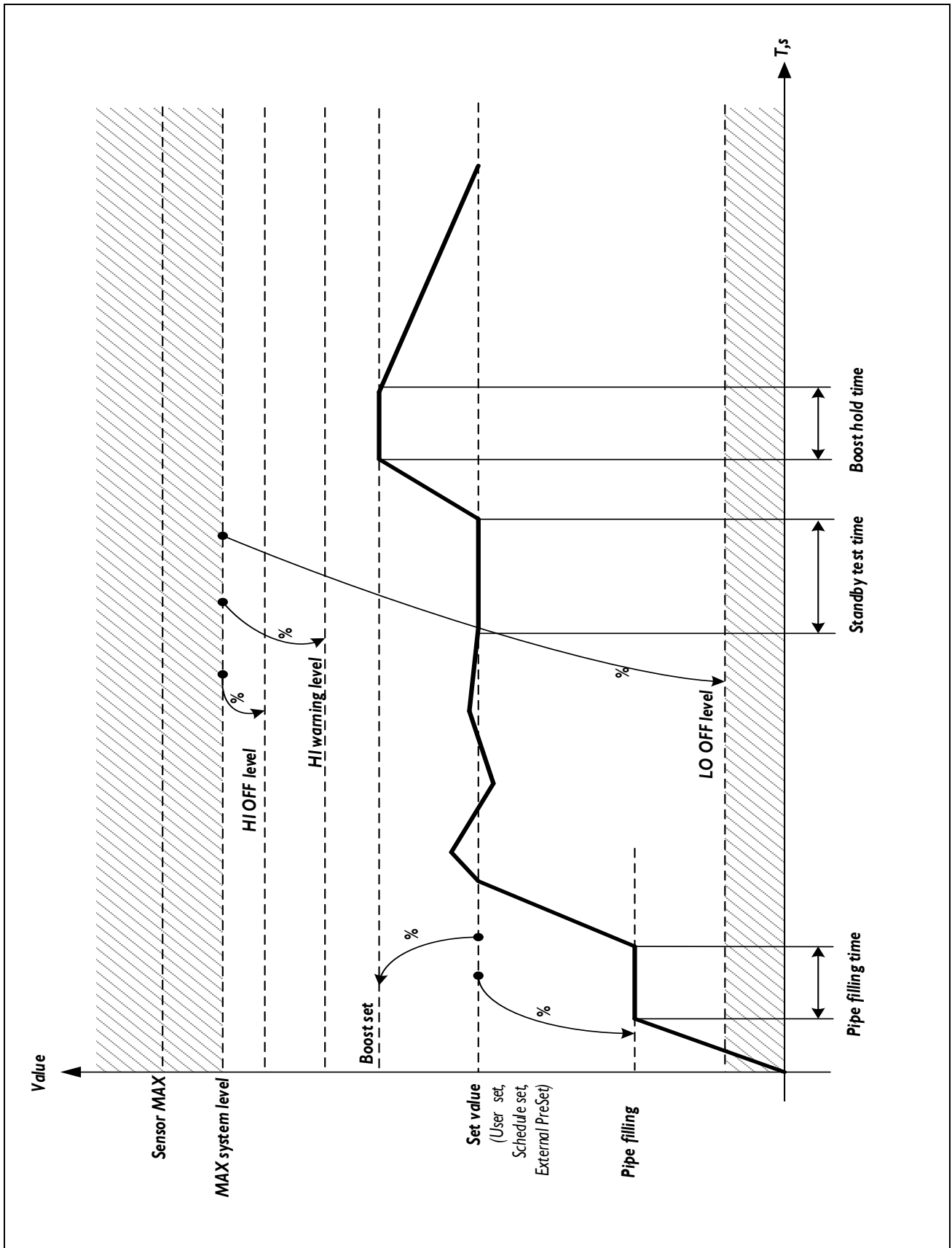
Appendix B – System Messages

Message	Level
Low Level Cut Out	alarm
Emergency Stop	alarm
HI Pressure cut off	alarm
Low Pressure cut off	alarm
Pipe Fill Error	alarm
HI Pressure warning	warning
Sensor wrong set	warning
All Pumps alarm	alarm
System in AUTO mode	notice
System in STOP mode	notice
System Paused	notice
SetPoint Out of Range	warning
Extrn. SetPoint active	notice
Bost Func Active	notice
Pipe Filling	notice
Pipe Filling Error	alarm
Wekly Timer activated	notice
Pump Force stopped (ON)	warning
Pump Manual mode	warning
Pump Work hours reset	notice
Pump Work starts reset	notice
Pump Force stopped (OFF)	warning
Acknowledged	notice
Pump Alarm.VFD fault	alarm
Pump Alarm.Speed error	alarm
Pump Alarm.Conn. error	alarm
Temperature alarm	alarm
Fan is on	notice
HI Pressure Emergency Stop	alarm
Pump Alarm.ThermalTrip	alarm
Pump Alarm.Operate err	alarm
Alarms are stored to USB	notice
No Flow	warning
UV1 Fault	alarm
UV2 Fault	alarm
UV1 Fault	alarm
UV2 Fault	alarm
Filter 1 Fault	alarm
Filter 2 Fault	alarm
UV1 ON	notice
UV2 ON	notice
High Level	warning
High Level (System Pause)	alarm

Appendix C – Modbus Registers List

Reg.	Bit	Description	Read/Write	Units	Note
System Status Modbus Registers					
System Status					
100		System Pressure	R	in acc.Reg104	
101		Panel Temperature	R	0,1 °C	
102		Duty Pump Status	R		Pumps available for run (Pump Sequence to run)
103	0	ModBus broadcasting	R/W		=1 enable R/W for all other Modbus registers
	1	Alarm Reset	R/W		=1 activated System Reset. Back to 0 automatically
104		System messure	R/W		1-kPa, 2-MPa, 3-bar, 4-psi, 5-Pa
105		Decimal point place	R		for system values calc. (Exmpl.:Reg100=10000, Reg105=2->Value=100,00)
111	0	Any Pump Run	R		=1 if any of pump is running
	1	Any Pump Fault	R		=1 if any of pump is in fault state
	2	System Mode Off/Auto	R		=1-System in AUTO, =0-in OFF state
	3	System Common Fault	R		=1-if System in FAULT state
	4	Low Level Cut Out	R		=1-if Low Level in inlet there is
	5	Low Pressure Shut Down	R		=1 -if Low value level is reached
	6	High Pressure Warning	R		=1 -if HI warning value level is reached
	7	High Pressure Shut Down	R		=1 -if HI fault value level is reached
	8	System Paused	R		=1 -if system paused (in standby mode)
	9	Pipe Fill Active	R		=1 -if pipe filling function is active
	10	Boost Function Active	R		=1 -if boosting function is active
	11	UV 1 Fault	R		=1 -if UV1 is fault
	12	UV 2 Fault	R		=1 -if UV2 is fault
	13	Filter 1 Fault	R		=1 -if Filter1 is fault
	14	Filter 2 Fault	R		=1 -if Filter2 is fault
	15	Panel Temperature Warning	R		=1 -if Alarm temperature is reached
System Settings Modbus Registers					
115		Number of pumps	R/W		System number of pumps (range 1...6)
116		Number of duty pumps	R/W		System number of duty pumps (range 1...6, can't be more Reg. 115)
117		Max System Pressure	R/W	in acc. Reg 104	Maximum system presure value.

118		Set Point	R/W	in acc. Reg 104	System setpoint.
119		Low Pressure Shut Down Setpoint	R/W	%	Low Pressure Shut Down Setpoint
120		High Pressure Warning Setpoint	R/W	%	High Pressure Warning Setpoint
121		High Pressure Shut Down Setpoint	R/W	%	High Pressure Shut Down Setpoint
122		Boost Setpoint	R/W	%	Boost setpoint (range 100%...300%)
123		Fan Set Point	R/W	°C	Fan switch temperature setpoint
124		Temperature Warning Set Point	R/W	°C	Temperature alarm setpoint
125		Pipe Fill Setpoint	R/W	%	Pipe filling pressure setpoint
126		Preset Input 1 Setpoint	R/W	in acc. Reg 104	System preset Setpoint activated by input 1
127		Preset Input 2 Setpoint	R/W	in acc. Reg 104	System preset Setpoint activated by input 2
128		Preset Input 3 Setpoint	R/W	in acc. Reg 104	System preset Setpoint activated by input 3
129		Preset Input 4 Setpoint	R/W	in acc. Reg 104	System preset Setpoint activated by input 4
130		Preset Input 5 Setpoint	R/W	in acc. Reg 104	System preset Setpoint activated by input 5
131					
Weekly Timer					
140		System Weekly Timer on/Off	R/W		=1 Weekly Timer is ON, =0 - OFF
141		Monday On Time	R/W	h	Monday system ON time (first range of five schedules)
142		Monday Off Time	R/W	h	Monday system OFF time (first range of five schedules)
143		Tuesday On Time	R/W	h	Tuesday system ON time (first range of five schedules)
144		Tuesday Off Time	R/W	h	Tuesday system OFF time (first range of five schedules)
145		Wednesday On Time	R/W	h	Wednesday system ON time (first range of five schedules)
146		Wednesday Off Time	R/W	h	Wednesday system OFF time (first range of five schedules)
147		Thursday On Time	R/W	h	Thursday system ON time (first range of five schedules)
148		Thursday Off Time	R/W	h	Thursday system OFF time (first range of five schedules)
149		Friday On Time	R/W	h	Friday system ON time (first range of five schedules)
150		Friday Off Time	R/W	h	Friday system OFF time (first range of five schedules)
151		Saturday On Time	R/W	h	Saturday system ON time (first range of five schedules)
152		Saturday Off Time	R/W	h	Saturday system OFF time (first range of five schedules)
153		Sunday On Time	R/W	h	Sunday system ON time (first range of five schedules)

154		Sunday Off Time	R/W	h	Sunday system OFF time (first range of five schedules)
155		Monday Pressure Setpoint	R/W	in acc. Reg 104	Monday Pressure Setpoint (first range of five schedules)
156		Tuesday Pressure Setpoint	R/W	in acc. Reg 104	Tuesday Pressure Setpoint (first range of five schedules)
157		Wednesday Pressure Setpoint	R/W	in acc. Reg 104	Wednesday Pressure Setpoint (first range of five schedules)
158		Thursday Pressure Setpoint	R/W	in acc. Reg 104	Thursday Pressure Setpoint (first range of five schedules)
159		Friday Pressure Setpoint	R/W	in acc. Reg 104	Friday Pressure Setpoint (first range of five schedules)
160		Saturday Pressure Setpoint	R/W	in acc. Reg 104	Saturday Pressure Setpoint (first range of five schedules)
161		Sunday Pressure Setpoint	R/W	in acc. Reg 104	Sunday Pressure Setpoint (first range of five schedules)
System Timing/Tuning Modbus Registers					
170		High Pressure Shut Down Delay	R/W	s	High Pressure Shut Down Delay (range 0..999s)
171		Low Pressure Shut Down Delay	R/W	s	Low Pressure Shut Down Delay (range 0..999s)
172		Boost Hold Time	R/W	s	Boost Hold Time (range 0..999s)
173		Boost Test Time	R/W	s	Boost Test Time (range 0..999s)
174		Pipe Fill Time	R/W	s	Pipe Fill Time (range 0..999s)
175		Pipe Fill Alarm Delay	R/W	s	Pipe Fill Alarm Delay (range 0..999s)
176		Pipe Fill Maximum Speed	R/W	%	Pipe Filling Pumps Speed
177					
210	0	Pump 1 Run	R		=1 if Pump is runing
	1	Pump 1 Fault	R		=1 if Pump in fault state
	2	Pump 1 Auto Mode	R/W		=1 if Pump in in Auto
	3	Pump 1 Off Mode	R/W		=1 if Pump is Off
	4	Pump 1 Manual Mode	R/W		=1 if Pump in Manual
	5	Pump 1 Manual Start/Stop	R/W		Pump Start/Stop command (set to 1 for Start, 0-to Stop)
211		Pump 1 Speed	R/W	%	Pump speed command. Available to write for Pump Manual mode
212		Pump 1 Run Time	R	h	Pump worked hours
213		Pump 1 Starts	R		Pumps Starts
214		Pump 1 Current Draw	R	A	Pump curerent
215		Pump 1 Voltage	R	V	Pump line voltage
220	0	Pump 2 Run	R		=1 if Pump is runing
	1	Pump 2 Fault	R		=1 if Pump in fault state
	2	Pump 2 Auto Mode	R/W		=1 if Pump in in Auto
	3	Pump 2 Off Mode	R/W		=1 if Pump is Off
	4	Pump 2 Manual Mode	R/W		=1 if Pump in Manual

	5	Pump 2 Manual Start/Stop	R/W		Pump Start/Stop command (set to 1 for Start, 0-to Stop)
221		Pump 2 Speed	R/W		Pump speed command. Available to write for Pump Manual mode
222		Pump 2 Run Time	R		Pump worked hours
223		Pump 2 Starts	R		Pumps Starts
224		Pump 2 Current Draw	R		Pump curerent
225		Pump 2 Voltage	R		Pump line voltage
230	0	Pump 3 Run	R		=1 if Pump is runing
	1	Pump 3 Fault	R		=1 if Pump in fault state
	2	pump 3 Auto Mode	R/W		=1 if Pump in in Auto
	3	Pump 3 Off Mode	R/W		=1 if Pump is Off
	4	Pump 3 Manual Mode	R/W		=1 if Pump in Manual
	5	Pump 3 Manual Start/Stop	R/W		Pump Start/Stop command (set to 1 for Start, 0-to Stop)
231		Pump 3 Speed	R/W		Pump speed command. Available to write for Pump Manual mode
232		Pump 3 Run Time	R		Pump worked hours
233		Pump 3 Starts	R		Pumps Starts
234		Pump 3 Current Draw	R		Pump curerent
235		Pump 3 Voltage	R		Pump line voltage
240	0	Pump 4 Run	R		=1 if Pump is runing
	1	Pump 4 Fault	R		=1 if Pump in fault state
	2	pump 4 Auto Mode	R/W		=1 if Pump in in Auto
	3	Pump 4 Off Mode	R/W		=1 if Pump is Off
	4	Pump 4 Manual Mode	R/W		=1 if Pump in Manual
	5	Pump 4 Manual Start/Stop	R/W		Pump Start/Stop command (set to 1 for Start, 0-to Stop)
241		Pump 4 Speed	R/W		Pump speed command. Available to write for Pump Manual mode
242		Pump 4 Run Time	R		Pump worked hours
243		Pump 4 Starts	R		Pumps Starts
244		Pump 4 Current Draw	R		Pump curerent
245		Pump 4 Voltage	R		Pump line voltage
250	0	Pump 5 Run	R		=1 if Pump is runing
	1	Pump 5 Fault	R		=1 if Pump in fault state
	2	pump 5 Auto Mode	R/W		=1 if Pump in in Auto
	3	Pump 5 Off Mode	R/W		=1 if Pump is Off
	4	Pump 5 Manual Mode	R/W		=1 if Pump in Manual
	5	Pump 5 Manual Start/Stop	R/W		Pump Start/Stop command (set to 1 for Start, 0-to Stop)

251		Pump 5 Speed	R/W		Pump speed command. Available to write for Pump Manual mode
252		Pump 5 Run Time	R		Pump worked hours
253		Pump 5 Starts	R		Pumps Starts
254		Pump 5 Current Draw	R		Pump curerent
255		Pump 5 Voltage	R		Pump line voltage
260	0	Pump 6 Run	R		=1 if Pump is runing
	1	Pump 6 Fault	R		=1 if Pump in fault state
	2	pump 6 Auto Mode	R/W		=1 if Pump in in Auto
	3	Pump 6 Off Mode	R/W		=1 if Pump is Off
	4	Pump 6 Manual Mode	R/W		=1 if Pump in Manual
	5	Pump 6 Manual Start/Stop	R/W		Pump Start/Stop command (set to 1 for Start, 0-to Stop)
261		Pump 6 Speed	R/W		Pump speed command. Available to write for Pump Manual mode
262		Pump 6 Run Time	R		Pump worked hours
263		Pump 6 Starts	R		Pumps Starts
264		Pump 6 Current Draw	R		Pump curerent
265		Pump 6 Voltage	R		Pump line voltage
UV/ Filter					
270	0	UV 1 On/Off	R/W		Ultra Violet Lamp 1 On/Off command. (set 1-to Start, 0-to stop)
	1	UV 1 Fault	R		=1 if Ultra Violet Lamp1 Fault state
	2	UV 2 On/Off	R/W		Ultra Violet Lamp 2 On/Off command. (set 1-to Start, 0-to stop)
	3	UV 2 Fault	R		=2 if Ultra Violet Lamp1 Fault state
	5	Filter 1 Fault	R		=1 if Filter 1 is fault
	7	Filter 2 Fault	R		=1 if Filter 2 is fault
300	0	Preset Input 1 Active/Activate	R/W		=1 if Preset Value 1 (Reg. 126) is active. Set to 1 for activate.
	1	Preset Input 2 Active/Activate	R/W		=1 if Preset Value 2 (Reg. 127) is active. Set to 1 for activate.
	2	Preset Input 3 Active/Activate	R/W		=1 if Preset Value 3 (Reg. 128) is active. Set to 1 for activate.
	3	Preset Input 4 Active/Activate	R/W		=1 if Preset Value 4 (Reg. 129) is active. Set to 1 for activate.
	4	Preset Input 5 Active/Activate	R/W		=1 if Preset Value 4 (Reg. 130) is active. Set to 1 for activate.
301	0	Input 1	R		Input 1 state
	1	Input 2	R		Input 2 state
	2	Input 3	R		Input 3 state
	3	Input 4	R		Input 4 state

	4	Input 5	R		Input 5 state
	5	Input 6	R		Input 6 state
	6	Input 7	R		Input 7 state
	7	Input 8	R		Input 8 state
	8	Input 9	R		Input 9 state
	9	Input 10	R		Input 10 state
	10	Input 11	R		Input 11 state
	11	Input 12	R		Input 12 state
302	0	Output 1	R/W		Output 1 state. Available for forced activate.
	1	Output 2	R/W		Output 2 state. Available for forced activate.
	2	Output 3	R/W		Output 3 state. Available for forced activate.
	3	Output 4	R/W		Output 4 state. Available for forced activate.
	4	Output 5	R/W		Output 5 state. Available for forced activate.
	5	Output 6	R/W		Output 6 state. Available for forced activate.

Appendix D – Warranty & Services Information

Warranty is subject to Allied Pumps Pty Ltd terms and conditions of sale and limited to replacement or repair, at Manufacturer's discretion, of any parts or equipment, excluding and travel, site, removal or reinstallation costs, for a period of twelve months from date of invoice, provided such part of equipment that is deemed by the respective manufacturer to be faulty. Any work done on site to inspect or remedy faults that are subsequently not accepted as being under warranty by the manufacturer, or are caused by misuse, fair wear or operating procedures, will be charged at parts and labour and travelling time rates applicable at the time.

Warranty does not provide for circumstances outside Allied Pumps control including (but not limited to); seismic activity, base or ground movement, mechanical impact, abuse or negligence, or general wear and tear.

Warranty does not cover equipment that is not installed, continuously monitored and maintained in accordance with the manufacturer's requirements, including, but not limited to, regular servicing, and/or regulatory requirements and applicable Australian Standards. Warranty does not cover damage caused by dry running the pumps.

If Buyer requires our services in respect of site inspection or service outside of what is covered by Manufacturers' warranties, then Buyer should enter into a separate agreement with ALLIED PUMPS in respect to the same. In the event of no such separate agreement, all operations, calibrating, cleaning and maintenance of plant is the responsibility of the buyer.

ALLIED PUMPS have not acted as a consultant nor charged design fees on this project, and are in no way responsible for, nor guarantee any particular level or performance of the treatment plant supplied or effluent quality unless such guarantee is specially given in writing.

Under no circumstances is ALLIED PUMPS liable for any direct or consequential loss or business interruption or damage to persons or properties of any nature due to any cause whatsoever.

Application of warranties is conditional on ALLIED PUMPS having received in cash the total contract price. Furthermore, ALLIED PUMPS reserves the right to withdraw any code compliance, Australian Standard compliance or selection compliance, should the contract not be paid in full.

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