FINAL VERSION
INSTRUCTION MANUAL

Instruction Manual

Membrane Plant

UF Unit

Doc No: CZ-5314002.01

VERSION: 06/2017

ORIGINAL INSTRUCTION

DO NOT OPERATE OR SERVICE THIS EQUIPMENT (MACHINE) UNTIL YOU HAVE READ AND UNDERSTOOD THIS SAFETY INSTRUCTION AND THE OPERATION MANUAL.

Think safety

1. Do not operate the equipment (machine) with safety and guard devices bypassed.
2. Only qualified personnel should operate the equipment (machine).
3. Do not start the equipment (machine) until all personnel are clear.
4. Never perform service or maintenance procedures on equipment (machine) in motion.
5. To avoid shock or serious injury, only qualified personnel should perform maintenance on the electrical system.
6. All air, hydraulic and electric power must be OFF before servicing the equipment (machine). For maximum protection, the power source should be locked by means of a lock for which only the person in charge has the key. This prevents anyone from accidentally switching on the power while the equipment (machine) is being serviced.

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1 General Information

The following Operation Manual is giving you an overview and description of the plant. Read it carefully before operating the plant. In case of any questions please contact SPX. This manual is the property of SPX and protected by intellectual property rights. The client has the right of use of this documentation/ manual.

If any damage or defect is observed on receipt of the plant, please contact the shipping agency in writing and forward a copy of the letter and freight bill to SPX.

Plant:	Membrane Plant, UF Unit
Year of Construction:	2017
Order No.:	1650068.R2
Project No.:	CZ–5314002
Project Manager:	Jiří Valášek
Customer:	Pannontej Zrt. Zalaegerszeg (Savencia Group)

Design:

Plant Drawing No.:	CZ-5314002 SBP 00
UF Plant Capacity:	1.500 l/h
Products:	UF Retentate 18,66% TS, UF Permeate

Symbols



This Symbol alerts to hazards. Failure to observe these warnings may result in injury or damage to equipment.



This symbol indicates important information. Failure to observe this information may result in damage to equipment.



Corrosive! The product may destroy living tissues on contact with them and can burn your skin or eyes. If swallowed, it will damage your throat and stomach.



Hot surfaces! Do not touch!

Safety Information

USER'S RESPONSIBILITY

The basic rules of safety set forth in this manual are intended as a guide for the safe operation of SPX plants and machines. This general safety information, along with explicit service, maintenance and operational materials for each specific machine, make up the complete instruction manual. All personnel who will operate service or be involved with this equipment in any way should become totally familiar with this information prior to start-up.

It is the buyer's responsibility to make certain that the procedures set forth are followed and should any major deviation or change in use from the original specifications be required, appropriate procedures should be established for the continued safe operation of the machine. It is strongly recommended that you contact SPX to make certain that the machine can be converted to the new use and continue to function in a reasonably safe manner.

All installation, service, maintenance and operations must be performed in strict accordance with all applicable codes and standards.

SAFETY FIRST

SPX equipment is designed and manufactured with due consideration and care for generally accepted safety standards. However, like any mechanical device, the proper and safe performance of this equipment depends upon using sound and prudent operating, maintenance and servicing procedures under properly trained supervision.

For your protection, and the protections of others, learn and always follow the safety rules outlines in this manual. Observe warning signs on machines and act accordingly. Form safe working habits by reading the rules and abiding by them. Keep this manual handy and review it from time to time to refresh your understanding of the rules.

Do not take chances. The odds are stacked against you!

OPERATING ZONE

An operating zone should be established around all plants/ machines. A brightly painted guardrail or warning stripe should define the zone. Only the operator or other authorized personnel should be within the operating zone when machine control circuits are energized or the machine is running. No tools or other equipment should be kept within the operating zone.

INSTALLATION

Power sources, such as electric, air and hydraulic, should be installed by trained and authorized personnel only. Installations must comply with all applicable codes and standards.

SAFETY INSPECTION

Before Starting a Machine:

1. Be absolutely positive all compulsory guards and safety devices are installed and operative. It is forbidden to disconnect, de-install or bypass the safety guards and devices.
2. Be sure all personnel are clear of the machine.
3. Remove - from the operating zone - any materials, tools or other foreign objects that could cause injury to personnel or damage the plant/ machine.
4. Make certain the machine is in operating condition.
5. Make certain all indicating lights, horns, pressure gauges or other safety devices or indicators are in working order.

After Shutdown:

Make certain all air, hydraulic and electrical power is turned off.

GENERAL OPERATING SAFETY

1. Do not operate this machine until you read and understand the operating instructions and become thoroughly familiar with the machine and its controls
2. Never operate a machine while a safety device or guard is removed or disconnected
3. Always wear safety glasses, hats, shoes, ear protection or any other required safety equipment
4. Never remove "Warnings" that are displayed on the machine. Torn or worn labels should be replaced.
5. Do not start the machine until all personnel in the area have been warned and have moved outside the operating zone
6. Remove any tools or other foreign objects from the operating zone before starting
7. Absolutely do not have loose clothing, neckties, necklaces or unrestrained long hair near an operating machine
8. Do not wear gloves, rings, watches, bracelets or other jewellery near an operating machine
9. Keep the operating zone free of obstacles that could cause a person to trip or fall towards an operating machine
10. Never sit or stand on anything that might cause you to fall against the machine
11. "Horseplay" around a machine at any time is dangerous and prohibited
12. Know the EMERGENCY STOP procedure for the machine
13. Air, hydraulic and electrical power must be off when the machine is not in use.

    Note: For maximum protection, the power source should be locked out using a lock for which only you have the key. This prevents anyone from accidentally turning on the power while you are servicing the machine.

14. Never operate the machine above specified speeds, pressures or temperatures
15. Never manually operate limit switches with power on
16. Keep alert and observe indicator lights and warnings that are displayed on the machine
17. Never leave the machine unattended while in operation
18. Do not operate faulty or damaged equipment. Make certain proper service and maintenance procedures have been performed.
19. Avoid placing fingers, hands, or any part of your body into the machine or near moving parts when control circuits are energized

20. A safe work surface should be provided, including proper guarding of platform areas and the design and use of ladders
21. Never install valves downstream of the plant that can be closed against the flow of the plant. Blockage of the plant can result in severe damage.
22. Before opening swing bends or blanking caps be aware of that there might be pressurized fluid behind them.

SERVICE AND MAINTENANCE SAFETY

1. Do not service a machine until you are thoroughly qualified and familiar with the tasks to be performed
2. Never operate any controls while other persons are performing maintenance on the machine
3. Do not bypass a safety device
4. Always use the proper tool for the job
5. Never open covers that house electrical components when power is on
6. Only perform maintenance on a machine in motion when properly trained and required to do so. When directed to make adjustments on machines in motion, extreme care must be taken.
7. All air and hydraulic pressure must be relieved before performing maintenance or loosening connection on any pressurized system.
8. Air, hydraulic and electrical power is to be turned off unless they are absolutely required for the specific servicing being performed.

   Note: For maximum protection, the power source should be locked out using a lock for which only you have the key. This prevents anyone from accidentally turning on the power while you are servicing the machine.
9. Replace fuses only when electrical power is off (locked out)
10. Do not enter a confined space without first checking for toxic fumes and providing standby personnel on the site

ELECTRICAL SAFETY

1. All electrical/ electronic maintenance and service should be performed by trained and authorized electricians only
2. Always assume that power is on and treat all conditions as live. This practice assures a cautious approach, which may prevent an accident or injury.
3. To remove the load from circuit or equipment, open disconnect or breaker and lock in open position.
   Note: For maximum protection, the power source should be locked out using a lock for which only you have the key. This prevents anyone from accidentally turning on the power while you are servicing the machine.
4. Make certain that the circuit is open by using the proper test equipment. Note: Test equipment must be checked at regular intervals.
5. Capacitators must be given time to discharge, otherwise it should be done manually with care.
6. There may be circumstances where 'trouble-shooting' on live equipment may be required. Under such conditions, special precautions must be taken as follows:
   - Make certain your tools and body are clear of the ground
   - Extra safety measures should be taken in damp areas
   - Be alert and avoid any outside distractions

7. Before applying power to any equipment, make certain that all personnel are clear of the machine
8. Control panel doors should be open only when checking out the electrical equipment or wiring. After closing the panel door, make certain that – on those panels where applicable – the disconnect handle mechanism is operating properly.
9. All covers on junction panels should be closed before leaving any job
10. All electrical apparatus must be properly grounded and overload protected
11. All electrical connections should be protected by confining them within a sealed junction box.
12. Control panel, motors, measuring equipment and other electrical components must be protected against humidity.
13. Do not operate damaged plant items connected or operated with electrical power!

HYDRAULIC SYSTEM SAFETY

1. Never operate a hydraulic system unless covers, safety devices and indicators are operating and in place
2. Never operate a hydraulic system above the pressure specified
3. Hydraulic fluid should never be allowed to collect on floors or equipment
4. Skin contact with hydraulic fluid should be avoided. Always wear proper protective clothing when handling hydraulic fluid.
5. Never loosen any hydraulic connection when the system is under pressure
6. Never operate a machine that has leaks in the hydraulic system. Most hydraulic fluids are flammable and constitute a fire hazard.
7. A hydraulic system retains the power to complete its intended motion even after the power is off. Care is required to avoid injury.

AIR SYSTEM SAFETY

1. Never operate an air system unless covers, safety devices and indicators are operating and in place
2. Compressed air retains the power to complete its intended motion even after the power is off. Care is required to avoid injury.
3. Never move the compressor after plugging in

CLEANING SAFETY

Manual cleaning Procedures:

1. Do not use toxic and/ or flammable solvents to clean a machine
2. Turn off air, hydraulic and electrical power (lock out) prior to cleaning a machine
3. Keep electrical panel covers closed and power off when washing a machine. **Note: For maximum protection, the power source should be locked out using a lock for which only you have the key. This prevents anyone from accidentally turning on the power while you are servicing the machine.**
4. Always clean up spills around the machine as soon as possible
5. Never attempt to clean a machine while it is operating

Cleaning-In-Place Procedures:

1. Make certain that all connections in the cleaning circuit are tight to avoid contact with hot water or cleaning solutions
2. When the cleaning cycle is controlled from a remote or automated control centre, establish fail-safe procedures to avoid automatic start-up while servicing equipment in the circuit.
3. On equipment, which includes manway(s), make certain covers are closed and latched prior to starting the cleaning cycle.

CONFINED SPACE SAFETY

1. Entering any area, which meets the definition of a confined space, may create a serious hazard for a worker.
2. All maintenance and service procedures must be performed in strict accordance with all applicable codes and standards.

BEFORE STARTING THE PLANT

The operators and managers must have knowledge of general, preventive safety and accident regulations and knowledge of laboratory and practical regulations. The test/ plant assembly and the process line, respectively, must be approved by the safety and practical management, respectively a trained and authorized operator must be present.

For hygienic reasons only foods should be produced on the plant. The hygienic regulations in force must be observed.

Only qualified personnel may carry out electrical installations or perform maintenance on the electrical system.

1. Read and understand the entire manual before installation and starting up of the plant. In case of any doubt or need of assistance, consult SPX.
2. Make sure that all motors and their drives are mounted correctly. Make also sure that all protective covers of the motors are mounted and secured.
3. Before starting, check that all piping is correctly mounted and all connections securely tightened.
4. The flow selector panel/ swing bend connections must be set before the plant is started.
5. The plant must be used indoors at max. 35°C/ 95°F ambient temperature and 80% RH humidity.
6. Servicing of the electrical equipment and the neighbouring electrical connections must only take place when:
   - the plant is cooled down and in pressure less condition
   - the plant is disconnected
   - the plant is secured against accidental turning-on of power
   - a trained and authorized person is present.

DURING PRE-STERILIZATION, OPERATION AND CIP

1. The plant contains rotating parts (pumps etc.). Do not put anything into machinery in operation. No solid particles are allowed during all running modes (start-up, water circulation, pre-sterilization, operation and CIP).
2. Do not attempt to loosen nor disconnect pipe unions or clamp fittings while the plant is in operation. The plant must be cooled down, completely stopped and in pressure less condition before any pipe fittings are disconnected. The same applies to plants, which are provided with flow plate.
3. Never overload the plant or any parts of it. For correct running conditions see this manual.

4. Always use proper safety equipment, such as face shield, rubber gloves, apron and boots when handling CIP solutions or other aggressive liquids.
5. Always use hearing protection when operating the plant or working in the area around the plant.
6. The centrifugal pumps of the plant are provided with slide ring gaskets, and must never operate without lubrication with water (or condensate).
7. Do not touch any pipes, valves, pumps, heat exchangers, vessels or electrical motors during operation since they may be very hot (150°C) and even a short contact may lead to severe burns.
8. Be careful when closing any valves during operation. If a pump is run without circulation, the media may be heated to vapor and could be explosive.
9. The emergency stop must not be used as operation stop or shut down.

BEFORE STARTING SERVICE AND MAINTENANCE PROCEDURES

1. Only qualified personnel may carry out service, maintenance, electrical and other installations.
2. Set warning signs or other noticeable markings at the plant when giving service or maintenance. Follow all safety rules and guidelines to prevent any accidents during service and maintenance.
3. Before starting and conducting the maintenance read the documentation and maintenance instruction for the particular parts carefully. In case of any doubt or need of information please contact SPX.
4. The entire plant must be cooled down, completely stopped and in pressure less condition before service and maintenance is carried out.
5. Before service and maintenance firmly close and secure the main valves of the steam line and service media.
6. Before service and maintenance close and secure the local power switch (service switch) of the pumps to prevent any unintentional starting of the motors. If there is no local switch, turn off and secure the main power switch at the MCC panel.
7. In connection with electrical parts ensure that the power has been turned off and the isolators securely locked.
8. All air hydraulic must be OFF before servicing the plant.

DURING SERVICE AND MAINTENANCE

1. Remove all assembly tools and exchanged parts from the plant after service and maintenance.
2. Only use approved and faultless lifting devices/ lifting gears. Make sure the rope or chain used for lifting the item is not accidentally cut or disconnected during installation and has sufficient strength in relation to the item load.
3. Never stand underneath a lifted or suspended pump, motor, etc.!
4. Never dismantle any parts or loosen nor disconnect pipe unions or clamp fittings before the entire plant is completely stopped, de-pressurized and cooled down.
5. Be careful when servicing items in contact with CIP fluids. Clean them with water prior to service or maintenance. Wear suitable protection gloves, face shields and clothing. Severe bums on the eyes, skin and flesh might result from splashes of such substances on the body. After handling of CIP fluids wash your hands.
6. When handling a toxic or odorant liquid, ventilate the working area well. In addition the operator must wear protection gear (such as safety mask, safety goggles, safety gloves, apron, etc.)
7. Never hose down or wash direct at motors or any other electrical parts.
8. In connection with electrical parts ensure that the power has been turned off and the isolators securely locked.

9. When lifting electrical motors do not lift at the covers/ shrouds, as these are not designed to carry the weight of the motor. When lifting remove the shroud and secure the strap at the motor.
10. After service and maintenance before starting the plant again check that all piping is correctly mounted and all connections securely tightened.
11. Pay attention to the vent hole of the water circuit pump and take care to ensure that the escaping water does not cause injury to persons or damage to the motor or other components. In hot-water installations, special attention should be paid to the risk of injury caused by scalding hot water.
12. After service and maintenance install all safety guards and devices and make sure that they are working in the original manner.
13. Before opening swing bends or blanking caps be aware of that there might be pressurized fluid behind them.

Emergency Stop

The emergency stop button is placed at the panel. When pressing the emergency stop the entire plant comes to an immediate full stop.

The emergency stop button must not be used for shut down of the plant!

The Emergency Stop button location at the panel:

Breaker



Turn this switch to break the power circuit for the pumps. A label is indicating to which pump the breaker refers e.g. pump F101XME01.

Service Media

There are certain demands on the supply of **water**, **steam** and **air** to the plant. The capacities and other requirements of the service media must be met at all times during operation of the plant. A non-variable supply of water should be available at all seasons of the year to allow a standard manufacturing process to be established.

Water

Water must be free from visibly suspended matter, color, odor and taste, from disease-causing organisms and dissolved calcium salts that may cause scaling on the heating surfaces in the plant (see Drinking water quality conforming to the European Council Directive 98/83/EC of 3rd November 1998). If other local regulations or demands regarding water in products are present, these regulations and demands should also be fulfilled. The water may be purified by filtration, ion exchange or similar.

Demands on quality of water:

Total bacteria count	<1000 cfu/ ml
E. coli/ coliforms	0 in 100 ml
pH-value	6.8 – 7.5
Total hardness (German degrees) $CaCO_3$	max. 12°d max. 200 mg/l
Temporary hardness $CaCO_3$	max. 3°d max. 50 mg/l
Iron (Fe)	<50 µg/l
Manganese (Mn)	<20 µg/l
Silicium dioxide (SiO_2)	<15 µg/l
Calcium (Ca^{2+})	max. 30 mg/l
Magnesium (Mg^{2+})	max. 30 mg/l
Chlorides[1]	<5 mg/l
Chlorine	NIL
Slurry	NIL
Copper	<0,01mg/l

In case of the above-specified criteria for water quality cannot be met, the guarantee of the plant can be affected and requires confirmation by SPX.

Raw Water should fulfil above mentioned general conditions and values for iron, chlorides, magnesium and dissolved calcium salts, which may cause deposits on the surfaces in the plant. If the quality of water causes problems, a water treatment plant must be installed.

Cooling media must be clean and free from foreign materials to avoid blockage, building up an insulation layer on the service side, or restrict the flow. Additives should be reduced to the necessary/ possible minimum, and the allowed quantities (positive list) should be kept in mind.

[1] The water should not be aggressive/ corrosive.

Soft water is treated water by means of ion exchange, filtration, distillation etc. to reduce the minerals – 'soften' the water. This softening is also affecting the conductivity. Distilled water with a conductivity of < 5 µS/cm is not suitable as process water, because of measurement instruments like flow meters, level switches etc. cannot operate with such low conductivity.

Steam

A supply of clean, dry saturated steam at a steady pressure is necessary for proper equipment operation. Injection and infusion systems must be operated with culinary steam, and since it is mixed with the product directly, it is of the greatest importance to emphasise the highest possible quality in producing the steam (dry, clean, saturated and filtered to 1 µm).

The steam should be produced from potable water in accordance to FDA/ 3A practice. The boiler feed water may be treated by filtration, ion exchange or similar. In case of using additives for steam production check that only approved agents for removal or prevention of scaling and sludge may be used.

For safe operation and plant protection the steam pressure supply to the plant (customer supply) must not exceed 7 bar(g).

Instrument Air

The supply air must be dry, clean and free of water, oil and particles and supplied at constant pressure in order to allow the control equipment in the system to perform reliably. When contact between product and compressed air is possible, or if compressed air is mixed into products, the air quality to be used has to be according to the Quality Guide for Compressed Air 1-3-1, International Standard ISO 8573-1, latest edition.

The air has to be filtered with a pre-filter of 1 µm and furthermore with a filter of 0.2 µm. If other local regulations or demands regarding air in products are present, these regulations and demands should also be fulfilled.

Raw Materials

Microbiology and Membrane Processing

Microorganisms surviving the temperature treatment of low-acid foods are always gram-positive organisms. Often they are thermophilic bacteria but usually spore-formers. The most common sources are high spore counts in the raw material or intermediate product e.g. added powders. If powders are added to the product formulation proper soaking is essential.

When microbiological problems occur in the product, failure of the membrane process as such is less frequent. The cause can be a reinfection (secondary contamination) of the product, which is resulting in a mixed flora (vegetative, non-spore-forming). A pure reinfection of sporeformers is possible, especially with inadequate cleaning and/ or sterilization as well as leakage in some equipment.

The groups of bacteria identified are indications and not proof. *Bacillus* do not multiply in high-acid products and is typically proteolytic by causing a bitter flavour, a soft coagulation and is producing rarely gas. *Lactobacillus, Streptococcus* and *Enterobacteriaceae* are forming acid and often gas and the pH value in the product drops below 5.

Micrococcus, Actinomyces and *Pseudomonas* cause only limited product changes. *Pseudomonas* develop a fruity or fishy off-flavour and can raise the pH value sometimes. *Bacillus* are mostly process

survivors, *Actinomyces, Lactobacillus, Streptococcus* and *Micrococcus* are mostly found as the cause of reinfection. *Pseudomonas* and *Enterobacteriaceae* are always the cause of reinfection.

Milk

The membrane unit requires raw materials of good quality and special attention should be paid to quality specifications. They should cover physical, chemical and microbiological parameters. These quality specifications will vary in accordance with the quality control of the company.

Protein instability is causing mainly the deposit formation in membranes, thus shortening the production time and reducing the interval between cleaning.

The bacteriological quality of the untreated milk should be checked in regards to a low bacterial count and initial low spore content.

In untreated milk varying amounts of thermoresistant proteases and lipases may be present, which have been produced mainly by the bacteria *Pseudomonas* and *Bacillus*. Age thickening which can lead to gelation or coagulation is caused by thermo-resistant proteases of bacterial origin. Inactivation of these enzymes by heat treatment is limited. The enzyme levels must be kept to a minimum by handling the untreated milk and carrying out pre-processing treatment. Longer periods of cold storage at the dairy or farm increase the risk of forming unacceptable high levels of these enzymes.

2 Operator overview

In general product is forwarded into the balance tank and to the membrane unit where is split between retentate and permeate. In case of any problem unit went to product circulation and operator make an action to restart or stop production.

The normal program sequence is water circulation, pre-concentration, production, displacement and final CIP cleaning. If the unit is not regularly in use a CIP cleaning prior to production can be required.

Before starting the unit(s) the following Daily Operating Routine has to be followed. Do not operate the plant with safety devices bypassed or guards removed! Check and tighten all clamp connections.

Daily Operating Routine

Even though the control system handles most of the operation, there are a few actions, which have to be carried out manually.

Every hour

1. Fulfil the log sheets, also the water flux
2. Check the solids / composition in the retentate and adjust if necessary

Daily

Some parts of the plant require daily inspection and service attention and it is recommended to consult the operator's manual and designated manual sections of the various components.

The plant has to be inspected on a daily basis and the operator has to make recordings and checklists of all irregularities, leaks, or other malfunctions, which require service or maintenance. When starting up the plant and before starting production the operator has to inspect the plant for leakages, functioning items, noise, loose clamp connections or any other irregularities or unfamiliar behavior. During the circulation mode most of the plant is under pressure and any leakage or unfamiliar behavior of the plant is easily discovered. Also during production and cleaning mode the plant has to be inspected frequently during shift.

Exceptional or uncommon events like low main air pressure, low main steam pressure, dirty or smelling water, different product composition, etc. should be marked on the shift protocol and changed, if the unit(s) cannot perform in the usual way.

For correction of leaks and other faults, please see the designated sections of the documentation. In case of any doubt or need of assistance how to service and maintain particular parts, please consult SPX.

Finally, for continuous, trouble-free production it is recommended to check the units(s) for product residues after CIP and carry out regular service.

1. Check sealing water on the pumps
2. Check the water flux after the cleaning and note it in the log sheets
3. Check the permeate quality in the permeate tank or flow transmitter
4. If the liquid accumulate at the flat top of balance tank(s) should be removed.

5. Overflow pipe of the balance tank(s) should be cleaned separately.

Weekly

1. Clean the safety filters and check for feed pressure problems.
2. Check the delta pressure over the water filter. If the delta pressure is more than 2 bar, then change or clean the filter inserts.
3. Check the tightness of the connections (clamp, union etc.)
4. Calibrate the pH transmitter.

Calibration Procedure (see manual of pH-meter)

- Standardize pH electrode before each set of sample measurements. Bracket samples with appropriate pH buffers, pH 7.0 buffer to pH 4.0 buffer or pH 7.0 buffer to pH 10.0 buffer.
- Immerse the electrode and temperature compensator in pH 7.0 buffer. Start the measurement. Wait until the pH reading has stabilized. Repeat with pH 4.0 buffer or pH 10.0 buffer for a two-point calibration.

  NOTE: Samples with pH values above 7.00 may be standardized with 4.0 and 7.0 pH buffers if the accuracy of the results are verified by repeating a few of the samples with a 7.0 and 10.0 pH buffer calibration. Repeats should be within 0.10 pH units.
- Check for accuracy with control samples. Use 0.00001 N HCl (pH = 5.10 +/- 0.15) or 0.0001 N HCl (pH = 4.10 +/- 0.15), low ionic strength solutions. A NADP Check Sample may also be used. If the control results are not within the specified limits, troubleshoot the problem before analysing any samples.

Every second month

1. Check the air pressure supply, especially for oil and water

3 General membrane information

INTRODUCTION:

A membrane filtration plant is a very sensitive installation where small faults may cause heavy membrane damages with heavy expenses as a consequence. A membrane filtration plant is not like a separator, which can always be cleaned after a bad production. Therefore, an SPX membrane filtration plant is designed in such a way that the membranes are protected by an alarm system and other technical parameters to ensure as long a lifetime as possible of the membranes.

CIP / WATER FLUX:

CIP of an SPX membrane filtration plant must be carried out very carefully. The cleaning procedure approved by SPX must be followed if the membrane guarantee shall be valid. The cleaning must be checked daily. The water flux is an indication of the quality of the cleaning. The water flux must be stable from cleaning to cleaning. If the water flux is not stable, it is important to take action and check the following:

- Is the water flux temperature the same every day?
- Is the water flux pressure the same every day?
- Is the dosing system OK, e.g. empty agent container?
- Has anything been changed before the membrane filtration plant?
- Is the feed product pasteurized below 75°C?
- Has anything been changed in the cleaning program?

If every item of the list is OK, SPX is ready with service.

If the water flux is decreasing, the plant capacity and production time is normally also decreasing. It is very important that the water flux is stable. If no action is taken, it may be difficult to clean up the membranes sufficiently so that the old flux and capacity is restored. The stable water flux is part of the service on the membrane filtration plant. If no action is taken on an unstable water flux, the SPX membrane guarantee is not valid.

4 Fault finding on leaking membranes

UF membranes:

The look of permeate indicates the membrane quality. Permeate produced on new membranes is as clear as water but with a green/yellow color. If the membranes are leaking, the look of permeate will change. Permeate becomes cloudy. The reason for the cloudy look is normally that the protein is passing through the membrane and into permeates.

A leaking membrane is found in the following way:

- During production, find the leaking housing by removing the permeate bend where the permeate is leaving the pipe and check whether it is cloudy.
- When the leaking housing has been found, enter the leakage detector into the permeate tube.
- Enter it until the brush of the leaking detector touches the front plate of the housing.
- Hold the outlet of the leaking detector at the same level as the permeate outlet of the housing.
- Keep the leaking detector in this position for 1–2 minutes and check the clarity of the permeate, (we recommend using a jug made of glass).
- If the permeate is clear, pull out the leaking detector, find and adjust the brush to be inside the first ATD. Keep the leaking detector in this position for 1–2 minutes and check the clarity of the permeate. If it is clear, repeat item 6 on the other ATDs.

If the permeate is not clear, a leaking ATD has been found on the first membrane of the housing.

When the leakage has been located, the next step is to check the O-rings/lip seals of the ATDs in item 7 when the plant has been cleaned. If the permeate is still cloudy, the membrane must be changed before the ATD and the O-rings/lip seals are changed.

NF membranes:

The procedure is equal to that of the UF membranes but the permeate looks like water. The rest is the same.

Log sheets:

On the log sheets from SPX, all the important production details must be taken down every hour, e.g. feed pressure, booster pressure; permeate flow from the different loops, water flux, etc.

There are especially 2 important reasons for filling in log sheets:

- If the membrane filtration plant causes problems, and the log sheets have been completed, they may be faxed / mailed to SPX where we can help if needed.
- When the operator fills in the log sheets, he will be led to all the important spots of the plant, and if something is wrong, the operator must take action. If e.g. the water flux is decreasing, the operator must compare the water flux and take action.

5 Protection of Membrane Filtration Plant

Traditional dairy equipment like separators, plate heat exchangers, pumps, tanks and pipes are much less sensitive to damage then membrane filtration equipment in case anything goes wrong.

With the introduction of membrane filtration equipment in dairies, the operators are forced to think in a new way in relation to protection of the equipment.

Membranes are very sensitive to:

1. Pressure
2. Temperature
3. pH
4. Flow
5. Viscosity
6. Other

Pressure

Membranes are very sensitive to high as well as low pressures:

If the feed pressure becomes too low, there is a risk that the membranes start to “flutter” by means of which, damage may occur around the lock rings.

If the inlet pressure to the module becomes too high, the membrane will be deformed and, after some time of stress, it will crack. Furthermore, it is very likely that the modules will start leaking.

Temperature

All types of membranes have an upper temperature limit. There are also upper temperature limits for operation with alkaline and acid cleaning agents, disinfectants and product, respectively.

Repeated exceeding of these temperature limits will have the following consequences:

Operation with alkaline cleaning agents as well as disinfectants will cause gradual disintegration of the membrane with effect of increased protein loss and shorter life of the membrane.

Operation with water as well as acid cleaning agents will cause a contraction of the membrane (decrease pore size) with the effect of increase retention of total solids and lower capacity.

Operation with product will cause a precipitation of total solids components, with foul the membranes extraordinary. It may be very difficult to remove this fouling again. Furthermore, the product will be damaged in many cases.

pH

All types of membranes have upper as well as lower pH limit.
Repeated exceeding these pH limits will have the following consequences:

Too high pH will gradually cause disintegration of the membranes with effect of increased protein loss and shorter life of the membrane.

Too low pH will cause a contraction of the membrane (decrease pore size) with the effect of increase retention of total solids and lower capacity.

Flow

The flow (speed of product) over the membrane is very important during production as well during cleaning:

Too low flow during production will cause blocking of the membranes resulting in low capacity and difficulty with subsequent cleaning.
If the flow stops totally, the product may coagulate in the module, which cannot be cleaned again.

Too low flow during cleaning will result in inefficient cleaning of the plant with the effect of low production capacity.

Viscosity

During production on a membrane filtration plant, it is very important to observe the viscosity of the product, which is depending on composition of product, total solids, temperature and pre-treatment. If the viscosity increases, pressure will grow and flow drops (does not apply for modules with positive pumps) with the effects mentioned under item 1 and 4.

Other

If particles, such as metal shavings, get into the plant, these will tear holes in the membrane.

Bad water quality may result in coating on membranes, which cannot, or with difficulty, only, be removed again.

The above is not intended to frighten away operators from membrane filtration plants. There is no reason, whatever, to be afraid of these types of plants, but it is important to be aware that membrane filtration plants are considerably more sensitive than traditional dairy equipment.

6 Control Process Description for the Membrane Plant

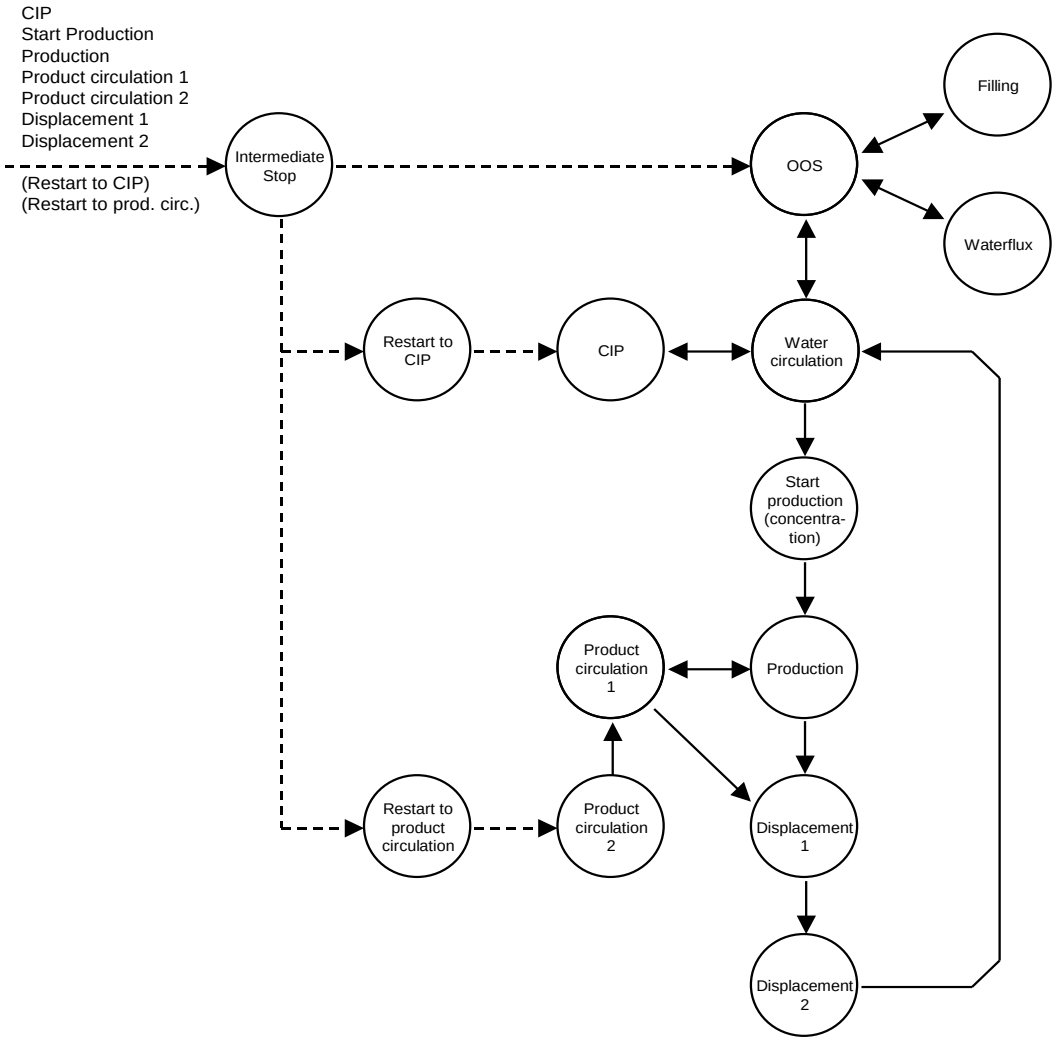
This instruction gives a description of the manual and automatic functions of the membrane plant executed from the control panel. A more detailed description of the electronic components and trouble shooting in connection with these is found in our electrical hardware documentation.

Operating Modes

The following operating modes are available:

-Water Circulation (Start mode)
-CIP
-Start Production
-Product Circulation 1, 2
-Displacement 1, 2

These modes and their purpose will be described in this section.



OOS (Out Of Service):

'OOS' is the default-stopped state of the membrane filtration plant. All valves and pumps are in initial position (as shown on the P&I diagram). All regulations are passive, and their analog outputs are 0%.

Filling / Water Flux:

If the plant has been out of operation for a long time (more than 2 days) or physically opened, the operator must run the filling step before the plant can be started up in WATER RECIRCULATION, the operator must run the filling step until the air is out of the permeate indicator, or the permeate flow is stable (plants with permeate flow transmitter).

Water Flux:

In this state, the effect of the cleaning must be checked. The water flux (the flow rate of each permeate outlet of the loops) must be checked at the same temperature and the same pressure every day in order to be able to compare the results from cleaning to cleaning. The temperature must be very constant, within +/-1°C of the set point (normally 20°C).

If the water flux is unstable, it means that the cleaning was not sufficient and the operator must take some actions to restore the flux level. SPX recommends an extra CIP. It is very important to restore the water flux levels. If no action is taken, the plant capacity as well as the production time will be reduced. If the plant has been running a long time with a bad capacity, it can be difficult to clean the membranes to restore good water flux and capacity and in the worst case, the membranes must be changed.

In some of the SPX plants the water flux is done automatically in the end of CIP, but in most of the plants it must be done manually after the CIP.

Start Plant:

In this step the feed pump is started and regulates the feed pressure. When the feed pressure is OK, the loop pump / pumps will start up one by one upon which the plant is in WATER RECIRCULATION.

Water Recirculation:

In water recirculation, the water from the retentate and permeate lines is led back to the feed tank. The feed pump is regulating the feed pressure. The valves are in initial positions and the level in the feed tank is regulated by means of water. The water recirculation step is also a main step where CIP, FLUSH, START PRODUCTION, STOP PLANT can be selected.

Temperature Adjust:

If the production temperature is e.g. 50°C, then the plant temperature must be adjusted before is the plant is put onto production. To heat the plant, the heating system must be activated. If the plant temperature is too high or too low, the capacity will typically be reduced.

Flushing:

Total flush is where retentate and permeate is led to drain and all the loops are flushed at the same time.

Concentration:

First step of PRODUCTION. The plant takes in product and pumps out permeate. Retentate is recirculated in the plant by being led back to the feed tank. There are two concentration steps, CONCENTRATION 1, and CONCENTRATION 2.

In CONCENTRATION 1 there is one fixed position of the retentate valve, and in CONCENTRATION 2 there is another fixed position of the retentate valve for the following reason:

In CONCENTRATION 1 the retentate valve is % open to mix up the product in the plant.

In CONCENTRATION 2 the retentate valve is more closed in order to start concentration of the retentate though the plant. This means high solids in the rear end of the plant and low solids in the front of the plant.

The reason for the two types of concentrations is to ensure a retentate flow during the first part of the production. If the retentate flow during this step is too low, there is a large risk that the plant will over concentrate in some of the loops, which will reduce the capacity a lot.

Start Production:

Next step after CONCENTRATION. Retentate is led out from the plant.

Ratio regulation: After the concentration step where the retentate valve is running with a fixed position, the program changes to START PRODUCTION and the retentate valve changes from manual mode to automatic mode, which means that the retentate valve regulates the retentate flow according to feed capacity of the plant. In order to reduce the first thin retentate product, some plants are designed with a start ratio set point, which is higher than the production ratio set point. After the higher ratio set point in the beginning of the process, the ratio ramping begins which means that the ratio set point slowly decreases until the production set point is reached. After this the plant is in production.

Production:

The feed product is routed into the plant. Permeate and retentate is pumped out of the plant. The TS level in the retentate is stabilized by means of the retentate regulation. The capacity regulation is described under specific plant setup.

Product temperature through the membrane systems is maintained about 10°C and finally cooled in PHE down to 4°C. All temperatures are monitored and recorded.

Product Recirculation 1:

Routing of feed product into the plant is stopped. Retentate and permeate is circulated back to the feed tank. Just like in PRODUCTION, the retentate concentration level is regulated by the retentate regulation. From PRODUCT RECIRCULATION 1 back into the production state, the retentate is produced with the same TS level as before PRODUCT RECIRCULATION.

Product Recirculation 2:

In principle similar to PRODUCT RECIRCULATION 1, but not 100%. The difference is that the retentate bypass valve is open. If the plant is designed without a retentate bypass valve, the retentate valve will be 100% open with the output 0 because it is a normally open valve. PRODUCT RECIRCULATION 2 is used in the alarm system. The alarm “high TS” in the retentate will automatically step the main from PRODUCTION to PRODUCT RECIRCULATION 2.

The open retentate bypass valve is to ensure a fast reduction of the solids content in the retentate. Too high TS level in the retentate may cause membrane damage.

The way back into production is through PRODUCT RECIRCULATION 1 because in this step, the retentate will be concentrated up to the production level and then the retentate is ready to be used in the production.

Displacement 1:

When the plant has finished production, the operator must activate DISPLACEMENT and the main will change to DISPLACEMENT (stop production). Some plants change automatically when the production has finished.

The product in the plant will be displaced with water. The level in the feed tank is regulated by means of water. Permeate and retentate is routed out of the plant until all the individual loops have been displaced with water. The TS level of the retentate is regulated like in production, but the retentate flow will decrease slowly and automatically.

Permeate may be recirculated during part of the displacement in order to avoid diafiltration in the last product from the plant.

Displacement 2:

The retentate flow will be very low because of no more product in the plant. By means of a timer or the position of the retentate valve, the main steps from DISPLACEMENT 1 to DISPLACEMENT 2. In DISPLACEMENT 2, the retentate valve is fully open in order to completely remove the last thin retentate left in the plant. The plant will be kept in this position until the retentate is so thin that the plant can be flushed. The main steps to WATER RECIRCULATION and the plant are ready for CIP.

Intermediate Stop:

An alarm immediately stops the plant. If necessary, valves and regulations may keep their position in order to keep some lines open. When the problem has been resolved, the plant can be restarted to either CIP or PRODUCT RECIRCULATION.

Automatic CIP

The CIP state includes a selection of CIP programs, one for intermediate cleaning and one for full cleaning. In the CIP state, the selected cleaning program is automatically carried out: Heating, dosing of cleaning agent, circulation of the cleaning solution, and flushing.

For a full cleaning, this cycle is carried out several times with different cleaning agents according to the cleaning procedure approved by SPX.

The plant flow during CIP sequences is like water recirculation. Permeate and retentate is routed back to the feed tank. The feed tank is level adjusted by means of plant water supply, which is active during the whole CIP.

The cleaning flush is a “Total flush”

Total flush where retentate and permeate is led to drain and all the loops are flushed at the same time. The sequences of the plant flush are based on the capacity of the water supply to the plant.

Shutdown procedures

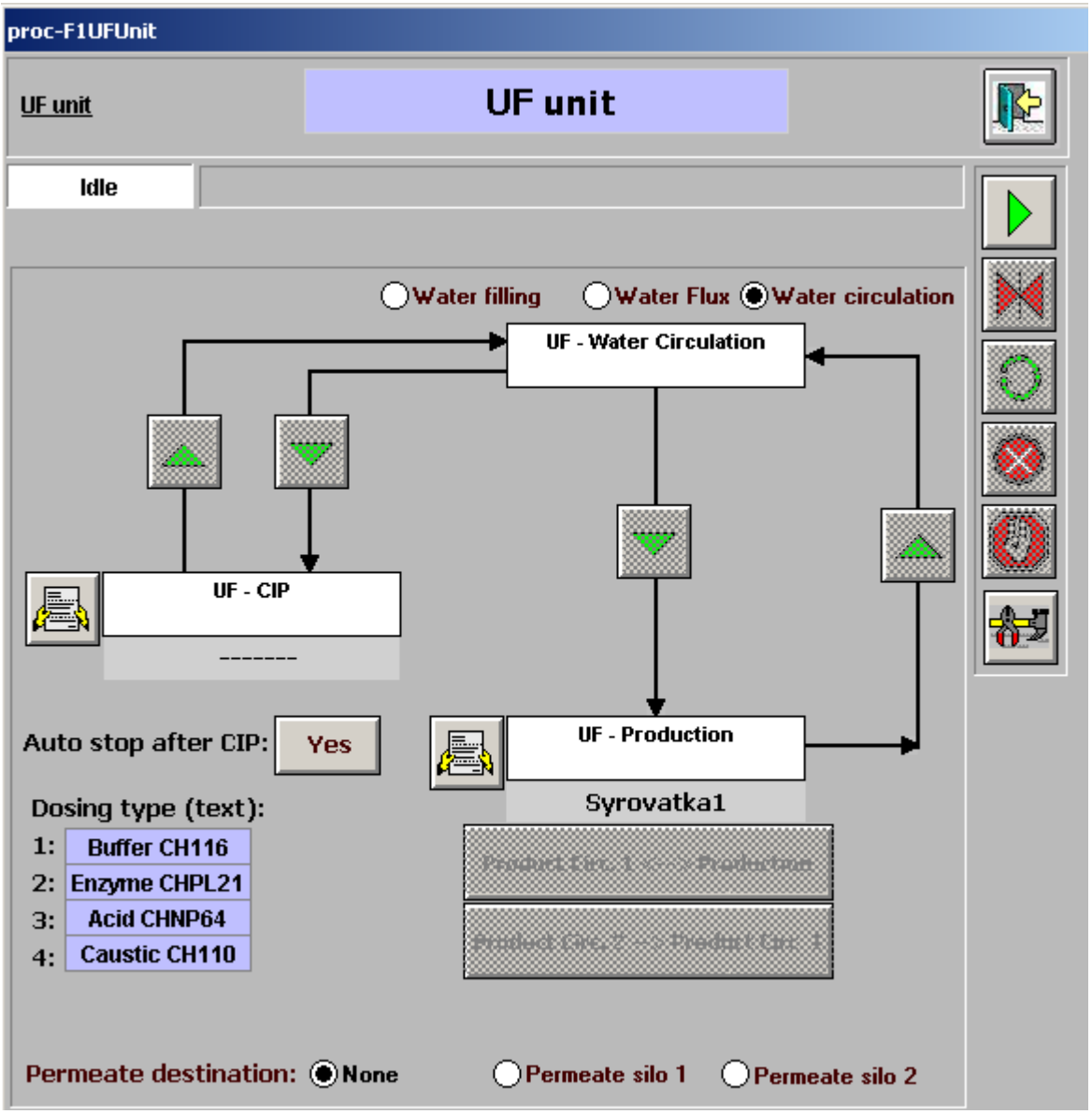
Membrane Plant operations are done with consideration to be able to stop the plant safely – in an emergency situation immediately or in controlled way by putting the plant into a safe conditions to be able to minimalize the risk for the plant or personal injury:

1. Emergency Stop – caused by power supply cut.
   This ensure inactivating all pumps, closing all valves and stopping all control loops. This operation starts by the activation of the E Stop button in process area.

2. Hold command
   This ensures inactivating all pumps and holding all control loops in current stage. Process can be held in Start and CIP phase (low temperature area). Held process can be restart to the state prior the holding command. Hold command can be started by certain Alarms generated by the plant or by the Hold button on the SCADA screen.

Procedure description

Picture describes basic operations, procedures of starting and stopping the plant.



Emergency Stop

When the Emergency stop button is activated, the power supply is cut and all items go to the de-energized state. Emergency stop is hardware feature without consideration of running phase and can be activated in any phase of running plant. In such event, the most likely operation required to be started by the rinsing out after the Emergency Action or the fault causing the Stop has been rectified. No cooling sequence or rinse cycle etc. will be started. Before going onto production again, the plant must be flushed with water to remove the product in the plant. A CIP cleaning has to be started and the efficiency visually checked. No product residues have to be discovered.

The Emergency Stop action can be started by the operator by pressing the E-Stop button situated in the process area in response to a critical emergency condition taking place on the Membrane Plant.

The following items initiate an immediate stop of the plant operation

- Emergency stop

After emergency stop the plant will stay partially under pressure and temperature. Is not allowed to open manhole on balance tank, valves, connections, or to do any maintenance work until the plant is cooled (in case of CIP) and depressurized.

Shut down

To shut down the plant for maintenance or termination of production you need to be in Start mode. Before shutting the plant down for maintenance etc. a CIP cleaning is recommended. By pressing the STOP button the pumps on the product side will be stopped with a delay. During this operation all other operations are interlocked, but the Emergency Stop button is still be active to give the operator possibility to stop the plant if necessary and if fails to achieve the desired effect. Shut down procedure is the standard way how to stop the plant after production or CIP is finished.

The Shutdown action can be started by the program automatically if program remains in Start phase (water circulation) for long time (for example 1800 Sec – will be set during commissioning).

The Shutdown action can be started by operator, using SCADA command when required.

Hold command

The Hold command may be set in Start phase or CIP phase. The Hold command aim is to stop plant running the safe way, with possibility to restart it again, when faults are fixed. During this operation all other operations are interlocked. The Emergency Stop button must still be active to give the operator chance to stop the plant if it fails to achieve the desired effect.

The Hold command can be started by the program automatically, in response to a Plant Item failure

The Hold command can by started by operator, using SCADA command.

In case item failure of following items Hold command can be set automatically.

- Any Item failure
- Watch dog timer expired

Power Cut

In case of a power cut the plant comes to an immediate full stop which means that all motors are stopped and all valves goes to the initial (safe) position. The remaining product in the plant needs to be pushed out and the plant cleaned manually prior to a full CIP cleaning. Product/water/superheated water/CIP solution goes to balance tank and by overflow to drain. After a CIP cleaning the plant has to be inspected for cleanliness. Any blockages and remaining product need to be removed.

7 Control Panel – Program Description

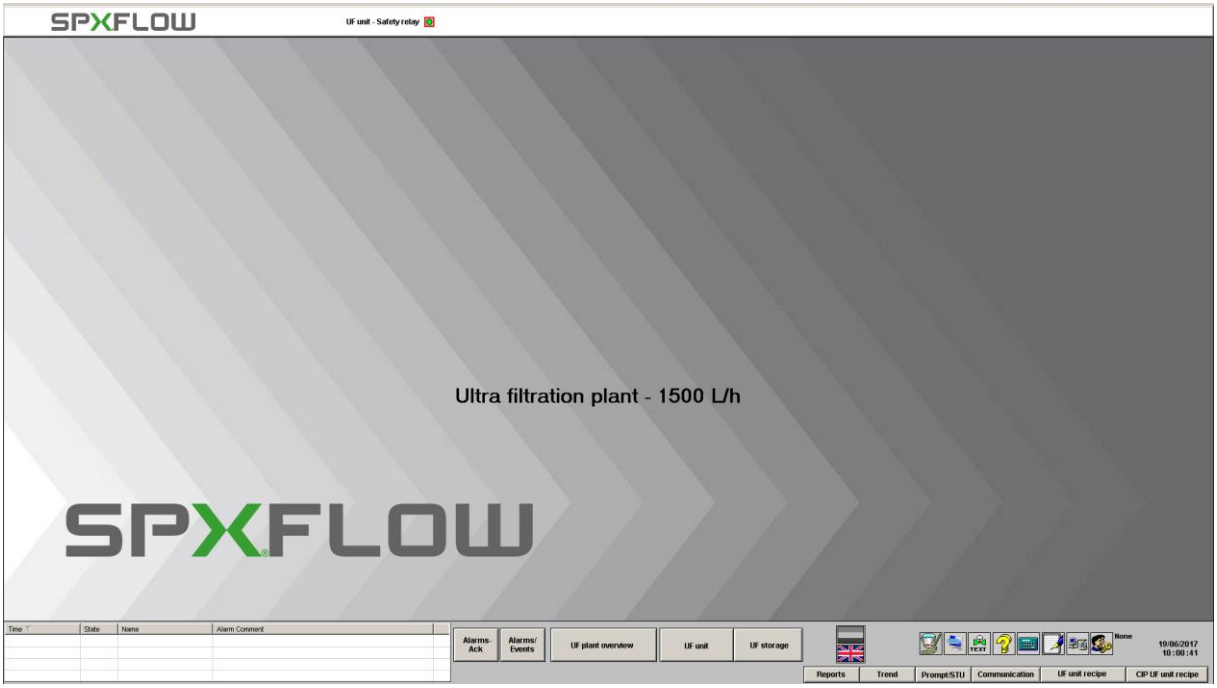
The plant is operated by using the SCADA (**S**upervisory **C**ontrol **A**nd **D**ata **A**cquisition). The SCADA is a mouse-based environment. The mouse is used for selecting pictures and other kinds of actions. Only 'clicks' with the left mouse button are required. The operators need to have basic knowledge and experience with personal computer and PC- tools based on Microsoft Windows®. The control system is based on Wonderware's InTouch HMI Software.

The structure of the control panel allows the operator to start program steps by clicking onto buttons and view process data, recipes, setpoints etc. on screen. For setpoint changes the corresponding cell is selected, the new setpoint keyed in and acknowledged. To change from one screen picture to another only the button in the bottom of the screen has to be clicked on.

Use only a damp cloth for cleaning of the touch screen and if necessary only mild cleaners/ soap. Do not use sharp objects (metal or hard brushes, knives etc.) to clean the screen.

Start Screen Picture

The **Start Screen Picture** will open after starting up. By clicking the buttons in the bottom of this picture other screen pictures, setpoints, help menu, alarm lists etc. will open or can be viewed.



General Operating Buttons

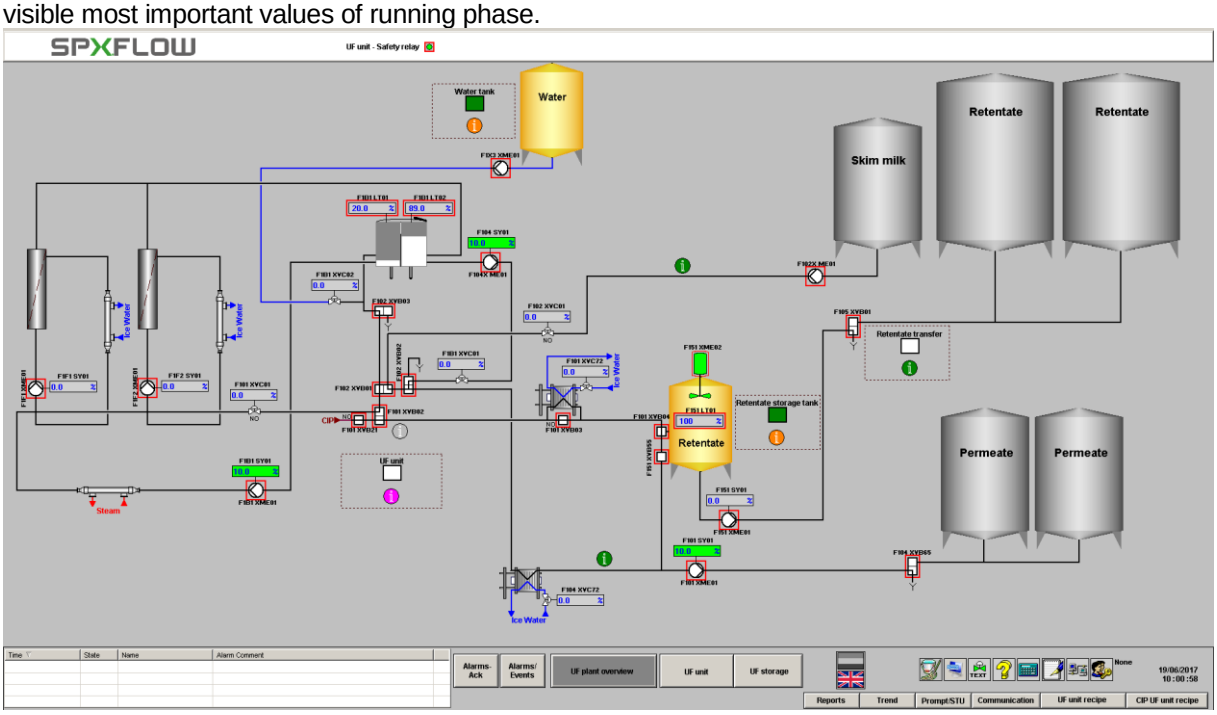
The buttons in the bottom are visible at all times, even when changing to other screen pictures. Alarm and event messages are displayed in the left message box. The latest messages are displayed. The colors of the messages are according to alarm (red), actual message and acknowledged message (active or not active) → blue or black.



Process overview

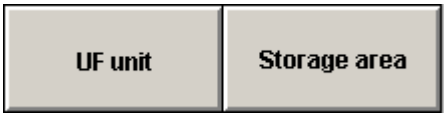


By clicking onto this button is opening the **plant overview picture** of the membrane plant(s). There is also visible most important values of running phase.

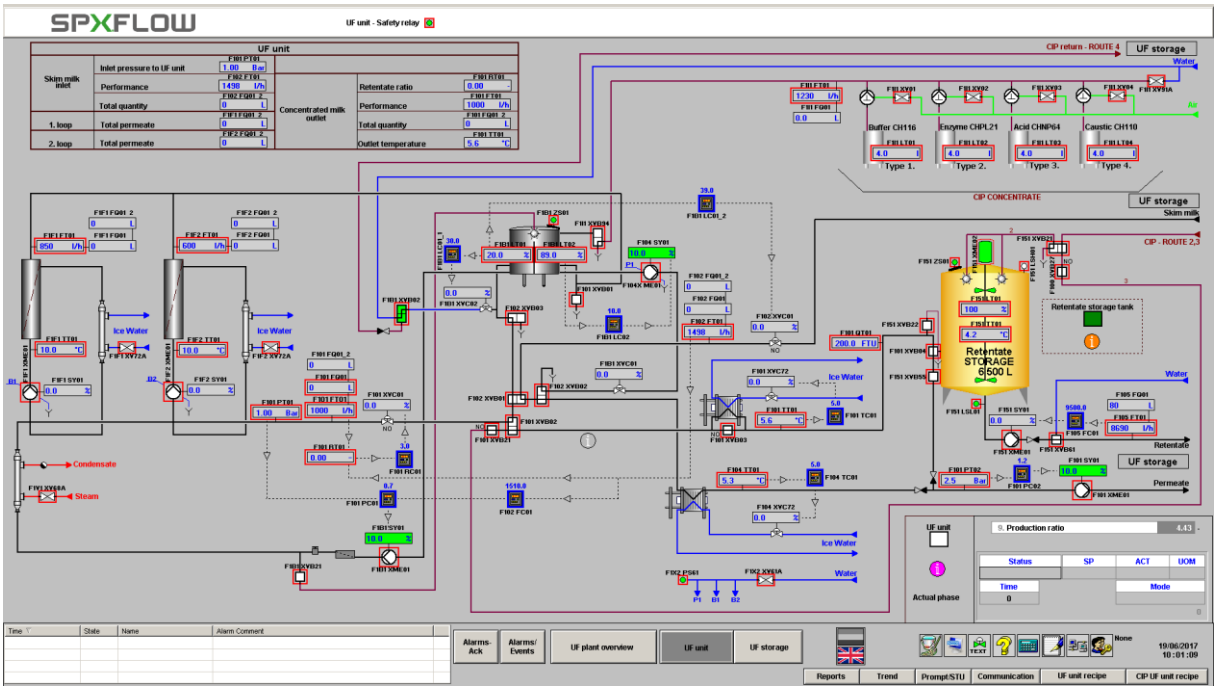


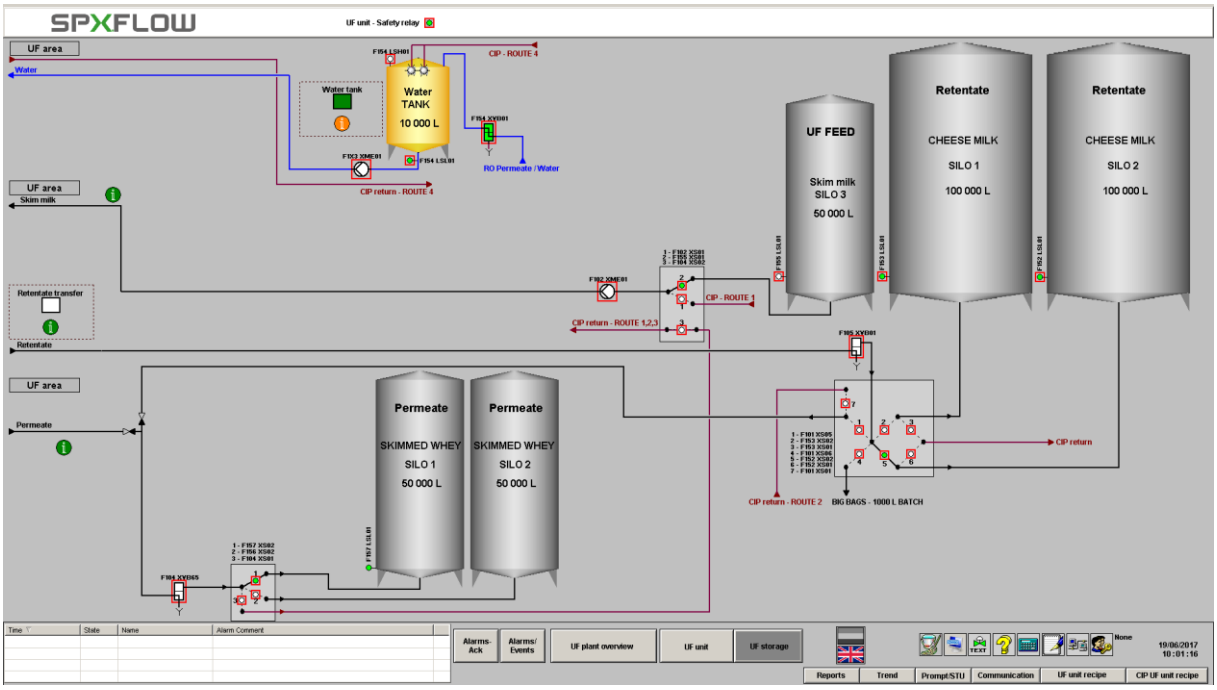
Detailed screen pictures

On the detailed screen picture are visible all valves, motors, switches, temperature transmitters and other relevant items and pipelines.



By clicking onto this buttons the detail screen picture is opening. The balance tank, valves, product pumps can be viewed. Product, water and CIP lines are marked in different colors.





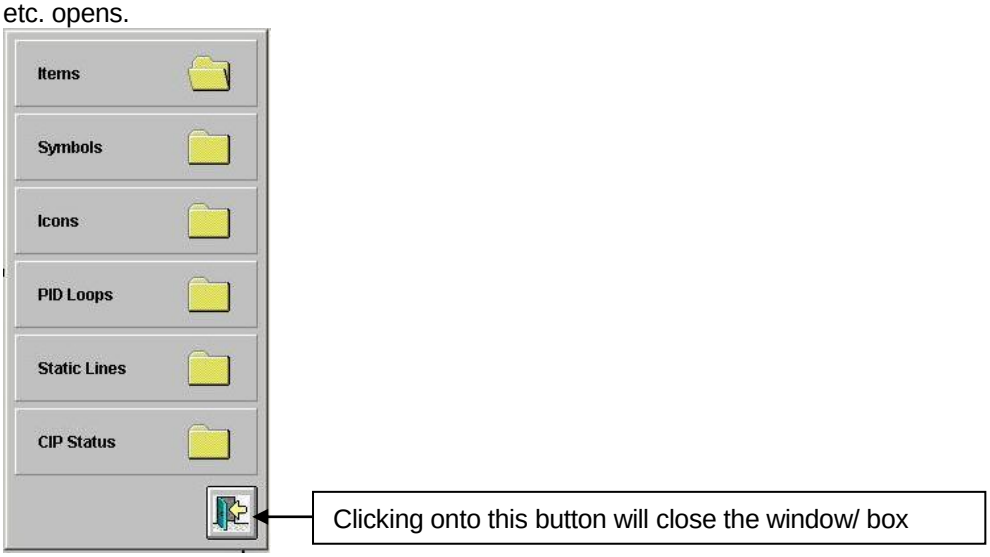
PLC Status



The ‘red blinking’ symbol is indicating lost communication of the OP - PLC (programmable logic controllers)

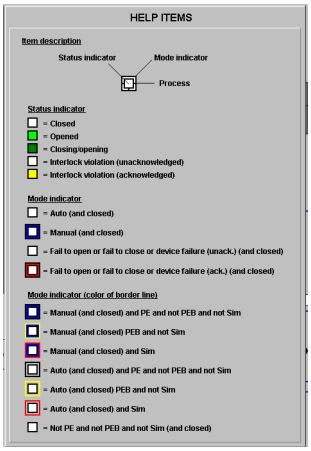
Help Menu

By clicking onto this symbol a window with explanations of colored symbols, lines, items, PID loops etc. opens.



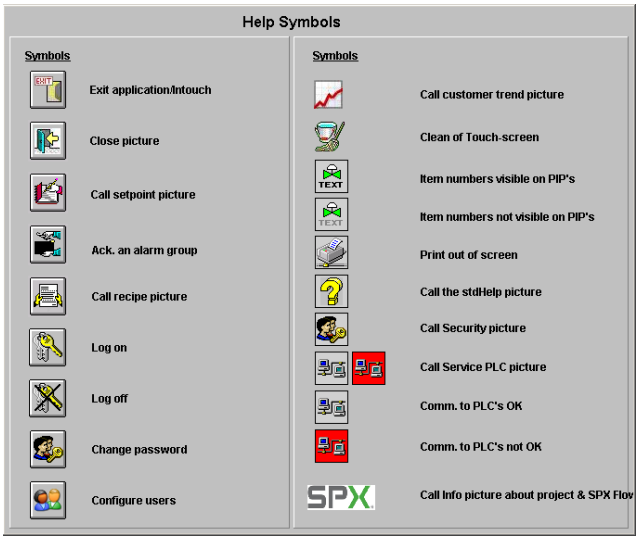
Help Items

By clicking onto the **Items** folder information box is opening. Explanations of analog inputs, outputs and counters can be found here.



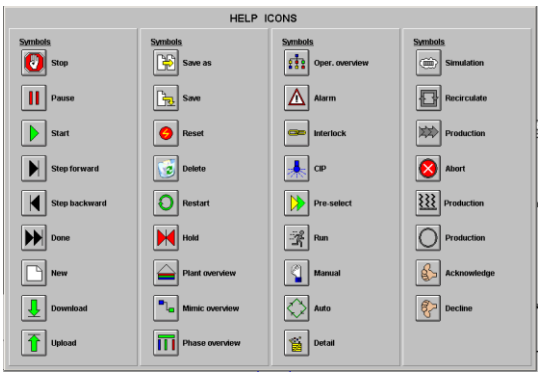
Help Symbols

By clicking onto the **Symbols folder** the following information box is opening. Explanations of symbols, cons and buttons can be found here.



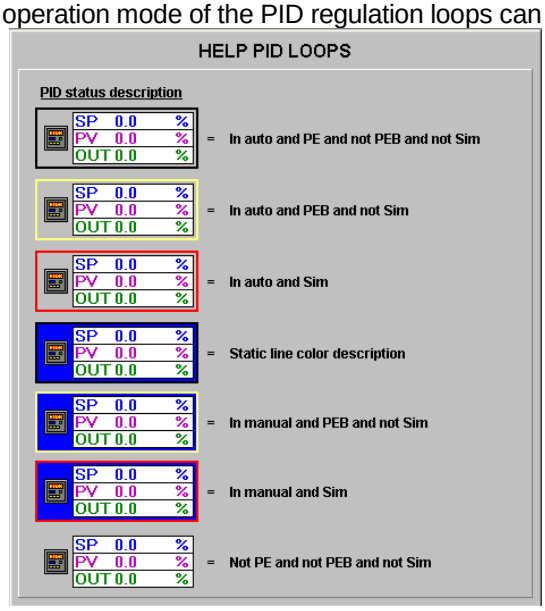
Help Icons

By clicking onto the **Icons folder** the following information box is opening. Explanations of operating icons and buttons can be found here.



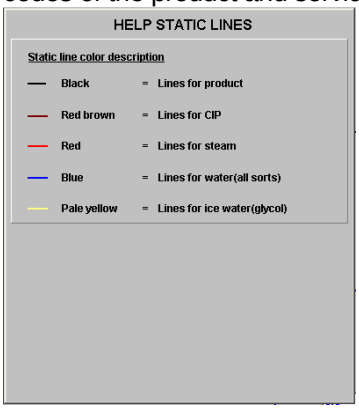
Help PID Loops

By clicking onto the **PID Loops folder** the following information box is opening. Explanations of color or operation mode of the PID regulation loops can be found here.



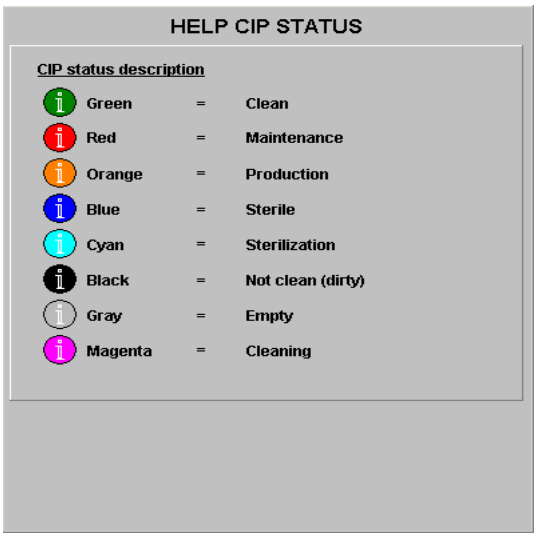
Help Static Lines

By clicking onto the **Static Lines folder** the following information box is opening. Explanations of color codes of the product and service lines can be found here.



Help CIP Status

By clicking onto the **CIP Status folder** the following information box is opening. Explanations of color codes of the states can be found here.

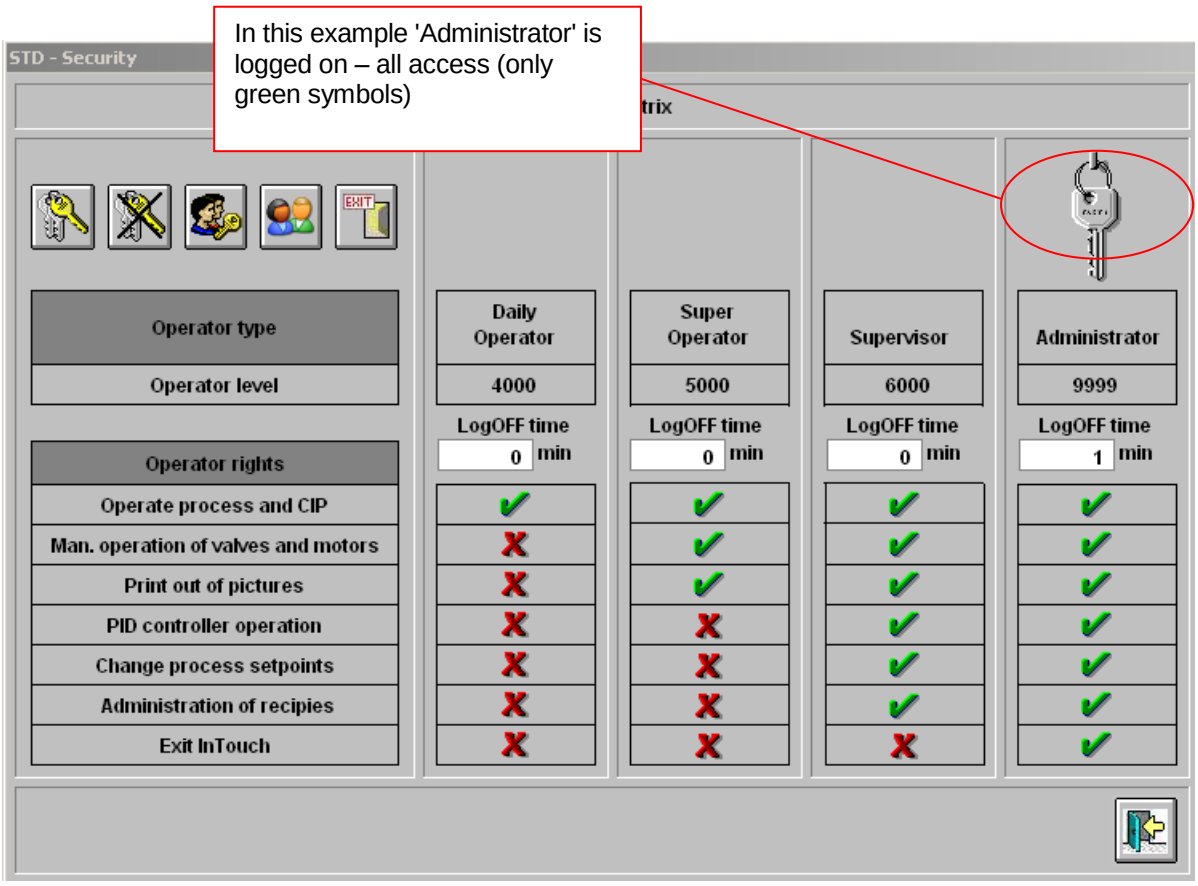


Operator Log on/ Log off

Before the plant can be operated the operator has to log on first. When an operator is logged on the operator's or user's name will appear on screen. In this example administrator is logged on → the user name 'administrator' is next to the user's symbol. If no user/ operator is logged on the plant cannot be started. The operator can also log off.



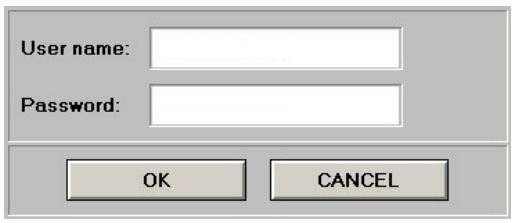
When clicking onto this button the **operator matrix screen picture** is opening.

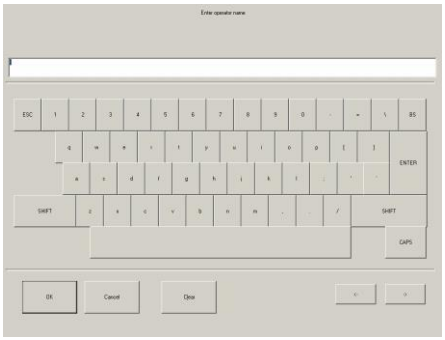


Log on/ log off



By clicking onto the key symbol an on screen keyboard is opening. The users or operator's name and password must be keyed in. With successful **log on** the operator's name appears on the operator matrix. All rights are shown with a ticked symbol.





This on-screen keyboard is popping up to key in the operator's name and password.



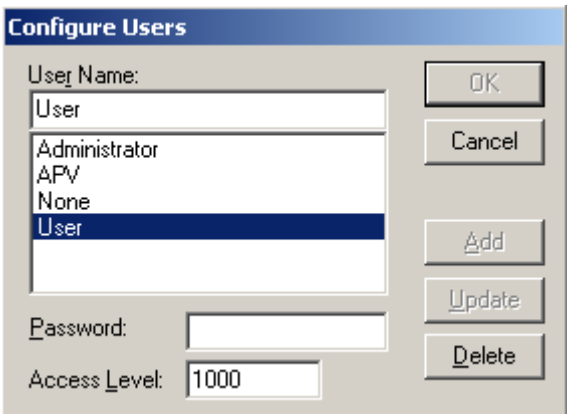
This symbol has to be clicked on to **log off**. 'None' will appear again.

User configuration and access level

For **user configuration** the administrator has to be logged on (access level > 9000). All other operators or users have access levels of below 9000.



By clicking onto this symbol the different user/ user groups will be defined and the following box is opening:



The operators/ users will be configured here. By pressing the corresponding button a user can be **added**, **updated** or **deleted**.

Password



By clicking onto this symbol the following box for changing the password is opening:



Old and new passwords can be keyed in and verified. This action is terminated by pressing the **OK** button.

By pressing **Cancel** the password change is not accomplished.

Exit application/ InTouch



By clicking onto this symbol **Exit application** the program/ InTouch will be closed.

The program can only be shut down when the administrator is logged on.

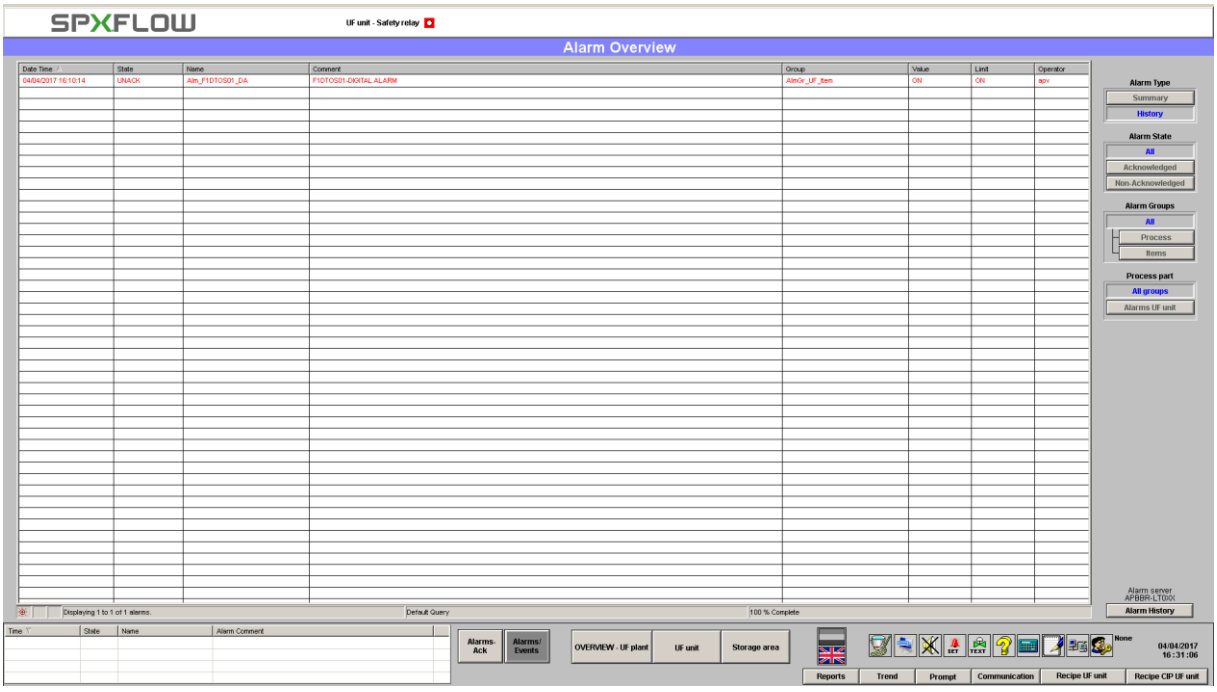
There is auto-logoff feature. Superoperator, Supervisor and Administrator can adjust logoff time delay for his user level and those of its inferior.
When there is set “0”, it means that auto-logoff is deactivated. Other numbers represents delay of automatic logoff in minutes.

Alarm Messages

These alarms will appear under start-up-, process- and cleaning steps, indicating the fault or condition the operator has to take action on.



By clicking onto this button the **Alarm overview** of all alarms is opening. By clicking on the buttons page up/ down previous alarm messages are displayed.

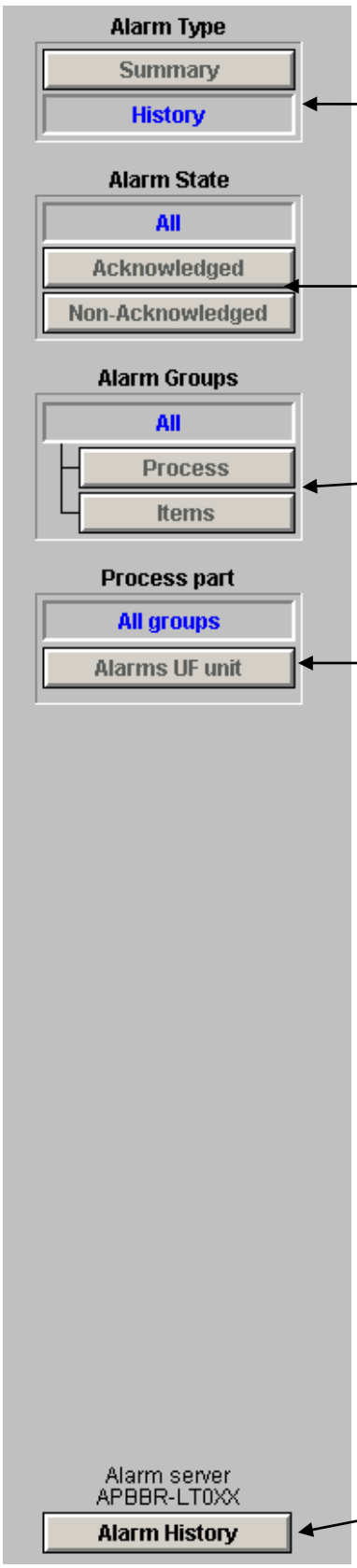


Alarm message color codes:

active and not acknowledged alarm messages:	displayed in red
active but acknowledged alarm messages:	displayed in black
not active and not acknowledged alarm messages:	displayed in blue



By clicking the button **'Acknowledge alarms'** the alarms can be acknowledged by the operator. By selecting the alarm message (row) only this alarm message is acknowledged, by selecting the tab all alarm messages of the area are acknowledged.



Summary show active alarms
History show all alarms

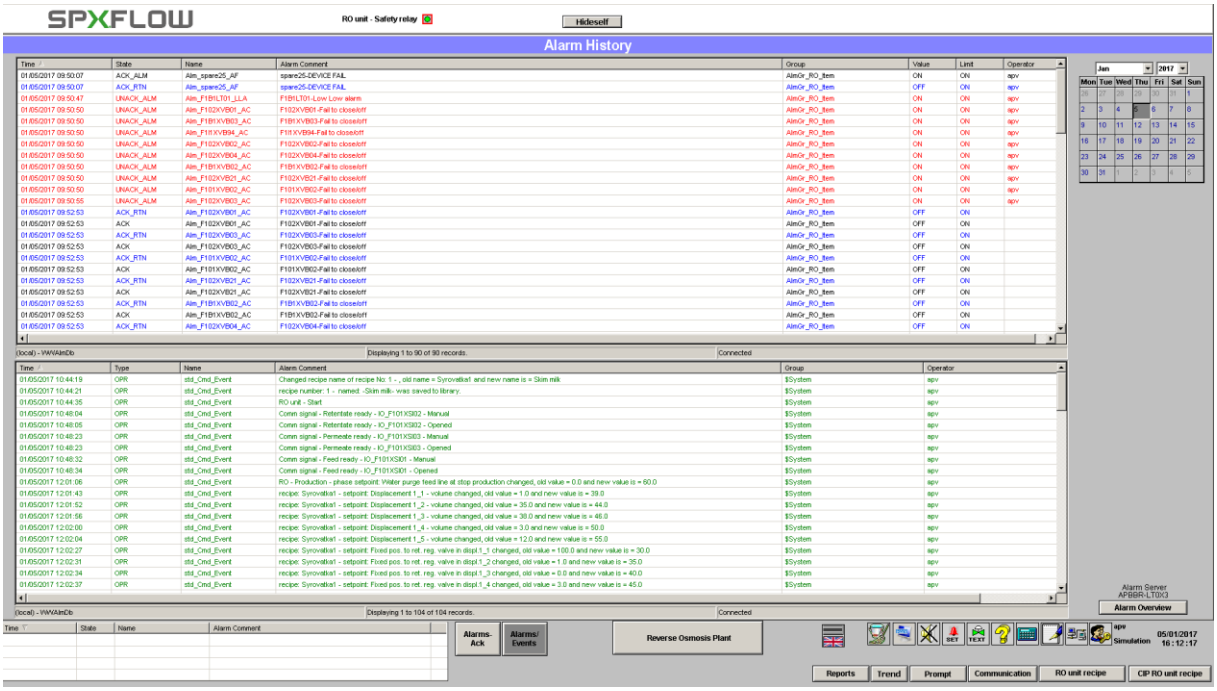
Acknowledged – show only acknowledge alarms
Non-acknowledged – show only non-acknowledge alarms
All – show all alarms

Process – show alarms, phase and procedures
Items – show alarms of each equipment separately

Allow selection of alarms from only one process area

Switching between historical and actual alarms.

By clicking on the button **Historical** Alarms the following picture is opening:



A particular date can be keyed into the calendar. Alarm messages of this period will be displayed. Use the arrow up and down keys to scroll the alarm display. Upper table shows alarms and the bottom shows events.

Trend Curves

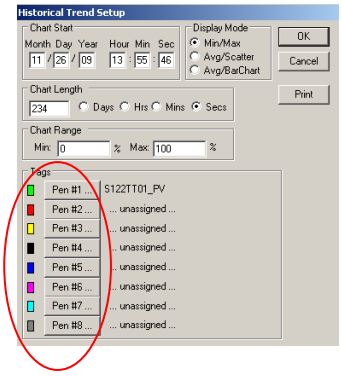


By clicking onto this button the trend screen is opening. Temperatures, pressures, flow rates etc. can be viewed in actual or selected periods. Eight selected color coded parameters can be viewed at a time. By clicking onto the arrows, buttons or zoom the requested time frame can be adjusted.

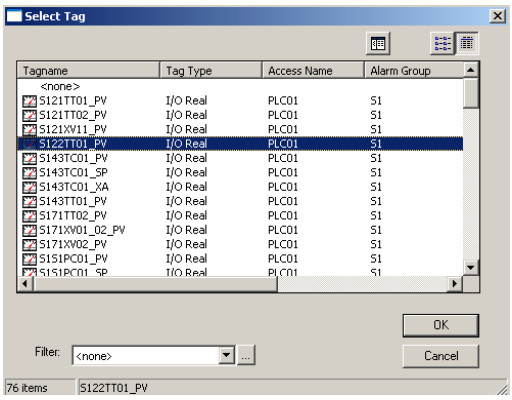


Pen Selection

Clicking onto the center field the monitored items can be changed and corresponding pens assigned.



Clicking on one of the pen buttons, which should be assigned a list is opening with all monitored items the operator can choose for trending.

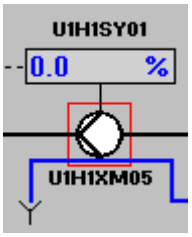


Item Number Display

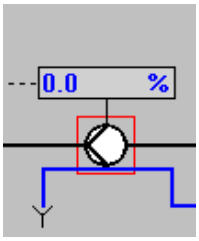


By clicking onto this button the **item numbers** on the screen pictures will be shown. This button has a toggle function: when pressed and all item numbers are shown, the button will show a cross on the icon. By clicking on it all item numbers will disappear.

In this example the item numbers are **shown** on screen:



In this example the item numbers are **hidden**:



Item or Component Information

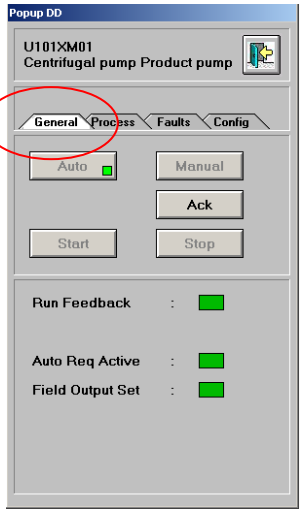
When clicking onto an item like a valve, pump and temperature transmitter etc. **an item information** box is popping up. The item number and designation is displayed. Four tabs – general, process, faults and configuration - are giving further information or operation options.



All settings are protected by the operator's access level. Changes must be noted in the operator's logbook.

Pump information box:

General tab:

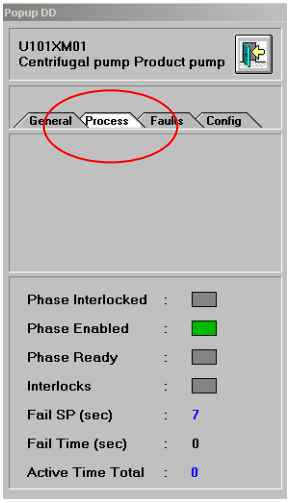


Pump number and designation

By clicking onto the buttons the pump can be set to **Auto** or **manual mode.**
When the phase is enabled manual mode is disabled.
Auto: Automatic mode
Manual: Manual mode
Ack: Acknowledge and reset alarm
Enabled when the pump is in manual mode:

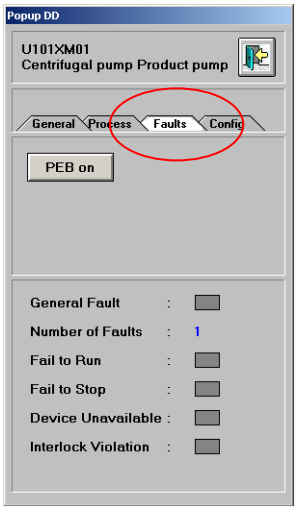
Run Feedback: Pump is activated
Auto Req Active: Request from the automatic program
Field Output Set: The physical output is set

Process tab:



Phase Interlocked: The pump is interlocked and cannot be controlled by automatic programs
Phase Enabled: A phase is using the pump
Phase Ready: Pump is ready for automatic control
Interlocks: Pump is interlocked
Fail SP (sec.): Max time for the pump run feedback
Fail Time (sec.): Actual time of the pump run feedback
Active Time Total: run time

Faults tab:



PEB (Phase Enabled Bypass) On: By activating PEB it is possible to operate the pump in manual mode even when the automatic program is active.

General Fault: The pump is faulty
Number of Faults: Number of faults for the pump
Fail to Run: Indication that the pump failed to run
Fail to Stop: Indication that the pump failed to stop
Device Unavailable: Fault on ASI Bus
Interlock Violation: Pump is not in interlock position

Configuration tab:

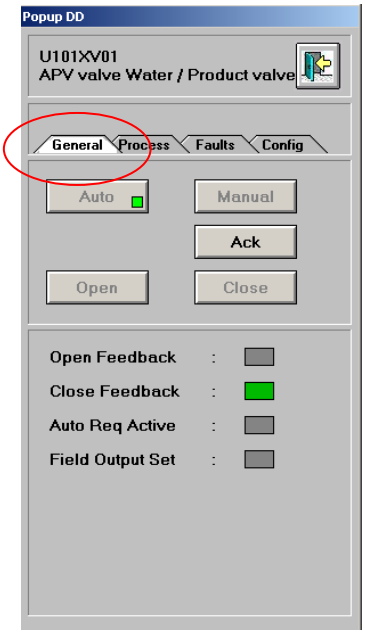


Sim Off: By Activating Sim on, it is possible to operate the pump without physically setting the output. Not for operator mode.

Device Type: Valve / Motor
Use Run FB: Yes / No according to pump

Valve information box:

General tab:

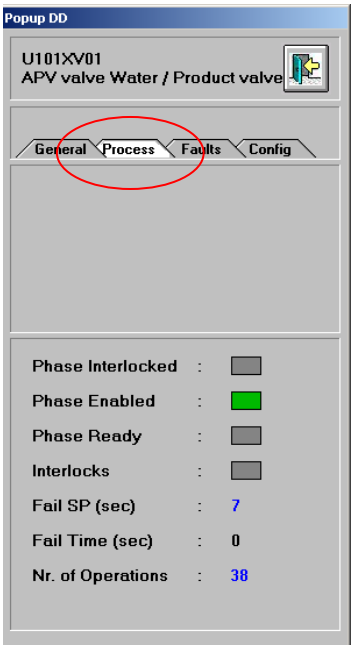


Valve number and designation

By clicking onto the buttons the valve can be set to **Auto** or **manual mode.**
When the phase is enabled manual mode is disabled.
Auto: Automatic mode
Manual: Manual mode
Ack: Acknowledge and reset alarm

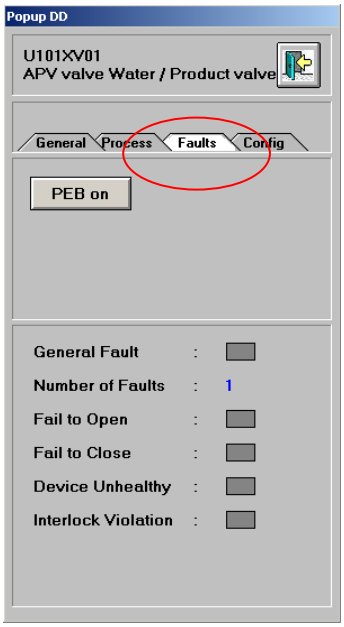
Open Feedback: Valve is activated
Close Feedback: Valve is deactivated
Auto Req Active: Request from the automatic program
Field Output Set: The physical output is set

Process tab:



Phase Interlocked: The valve is interlocked and cannot be controlled by automatic programs
Phase Enabled: A phase is using the valve
Phase Ready: Valve is ready for automatic control
Interlocks: Valve is interlocked
Fail SP (sec.): Max time for the valve seat to change position
Fail Time (sec.): Actual time when changing position of the valve seat

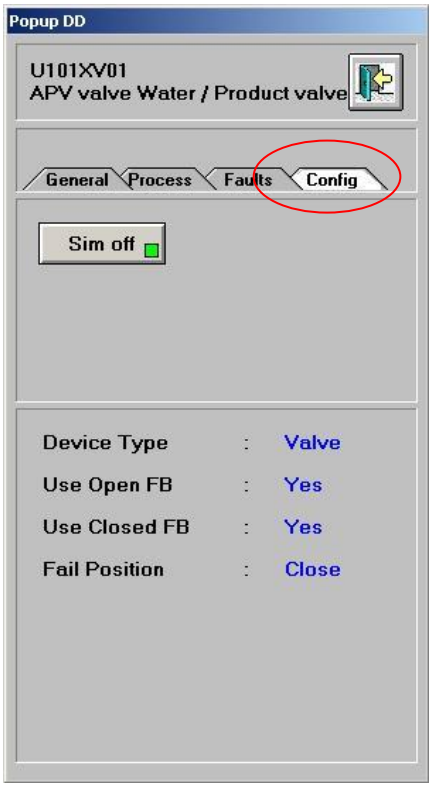
Faults tab:



PEB On: By activating PEB it is possible to operate the valve in manual mode even when the automatic program is active.

General Fault: The valve is faulty
Number of Faults: Number of faults for the valve
Fail to Run: Indication that the valve activation failed
Fail to Stop: Indication that the valve deactivation failed
Device Unavailable: Fault on ASI Bus
Interlock Violation: Valve is not in interlock position

Configuration tab:

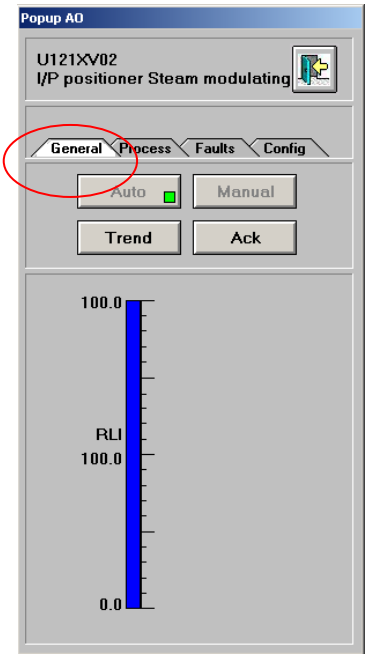


Sim Off: By Activating Sim on, it is possible to operate the valve without physically setting the output. The valve seat will change position but simulates the feedback to the program. Not for operator mode.

Device Type: Valve / Motor
Use Run FB: Yes / No according to physical valve

Regulating valve/ I/P positioner information box:

General tab:



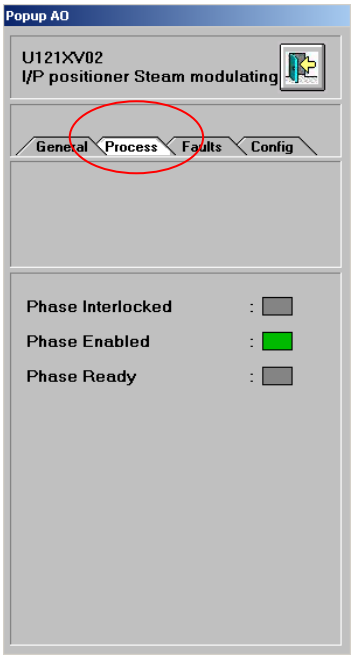
Item number and designation

By clicking onto the buttons the transmitter can be set to **Auto** or **manual mode.** When the phase is enabled manual mode is disabled
Auto: Automatic mode
Manual: Manual mode
Ack: Acknowledge and reset alarm
Trend: Open trend window for input

Maximum and minimum value according to the scale

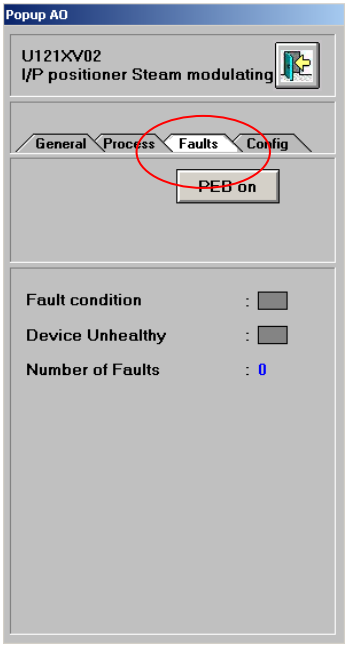
Unit of measure

Process tab:



Phase Interlocked: The I/P positioner is interlocked and cannot be controlled by automatic programs.
Phase Enabled: A phase is controlling the positioner
Phase Ready: The positioner is ready for automatic control

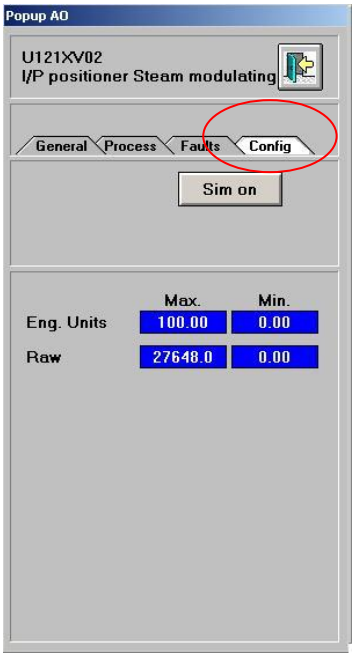
Faults tab:



PEB On: By activating PEB it is possible to operate analog in manual mode even when the automatic program is active.

Fault Condition: Positioner is faulty
Device Unhealthy: Fault from ASI or out of range alarm condition for more than 5 sec.

Configuration tab:

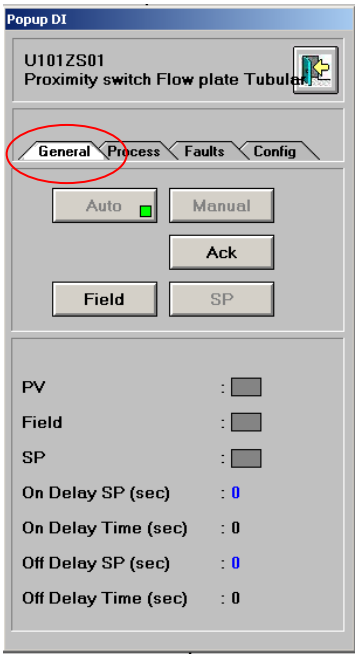


Sim On: By activating Sim on, it is possible to operate analog without responding to physically input. Not for operator mode.

Max/ Min on Engineering unit.
Raw: ASI Module 4-20 mA: 4000.0 – 20.000

Switch (digital input) information box:

General tab:



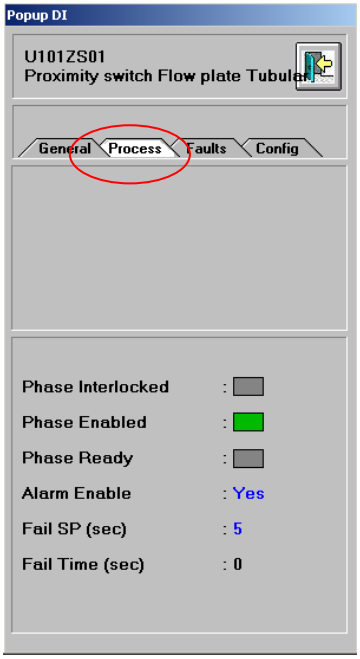
When the phase is enabled manual mode is disabled
Auto: Automatic Mode
Manual: Manual Mode
Ack: Acknowledge and reset alarm

Enabled when switch is in manual mode:
Field: Toggle Field On / Off
SP: Toggle Setpoint On / Off

PV: Process value feedback to program
Field: Actual field input
SP: Requested position (setpoint) by the program

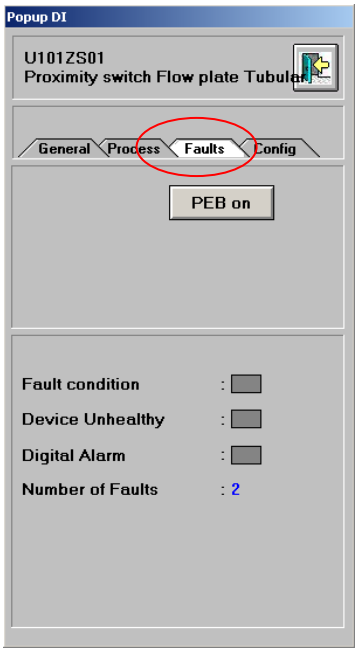
On Delay SP (sec): Delay for switch to respond to ON
On Delay Time (sec): Actual time for switch to respond to ON
Off Delay SP (sec): Delay for switch to respond to OFF
Off Delay Time (sec): Actual time for switch to respond to OFF

Process tab:



Phase Interlocked: The item is interlocked and cannot be controlled by automatic programs
Phase Enabled: A Phase is controlling this item
Phase Ready: Item is ready for automatic control
Alarm Enable: Yes / No. Is normally set by the program
"Yes" will compare PC with SP
Fail SP (sec.): Delay time for PV to equal SP before failure
Fail Time (sec.): Actual time when testing SP = PV

Faults tab:

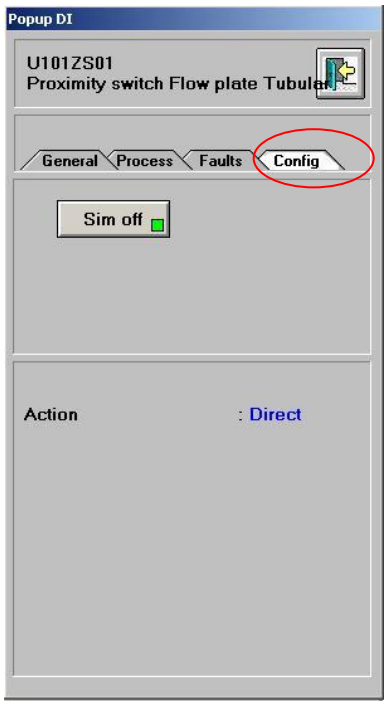


PEB On: By Activating PEB it is possible to operate the switch in manual mode even when the automatic program is active

Fault Condition: Switch is faulty
Device Unhealthy: Fault from ASI (Not used)

Digital Alarm: If the alarm is enabled and PV <> SP longer than Fail SP time, the digital alarm is activated
Nr of Faults: Number of faults for the switch

Configuration tab:

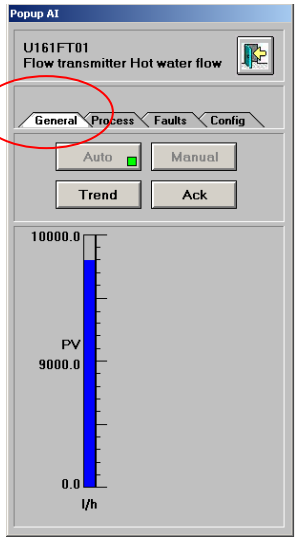


Sim On: By activating Sim on it is possible to operate the switch without responding to the physically input

Action: Direct or Reverse
Direct: NO connected (low level, proximity switch)
Reverse: NC connected (high level, safety switch). Reverse is the failsafe mode.

Analog transmitter information box:

General tab:



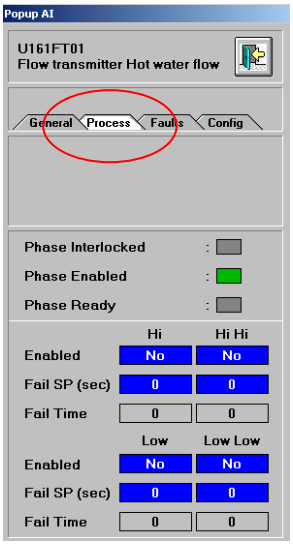
Item number and designation

By clicking onto the buttons the transmitter can be set to **Auto** or **manual mode.** When the phase is enabled manual mode is disabled
Auto: Automatic mode
Manual: Manual mode
Ack: Acknowledge and reset alarm
Trend: Open trend window for input

Maximum and minimum value according to the scale

Unit of measure

Process tab:

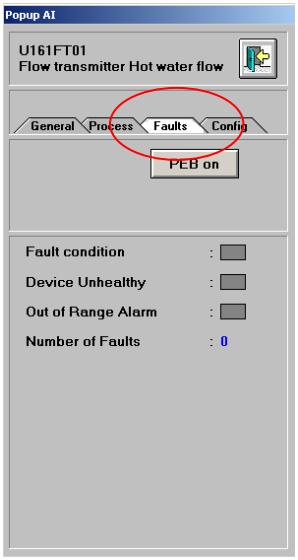


Phase Interlocked: The transmitter is interlocked and cannot be controlled by automatic programs.
Phase Enabled: A phase is controlling the transmitter
Phase Ready: The transmitter is ready for automatic control

Common for Hi and HiHi alarms:
Alarm Enable: Yes / No. Is normally set by the program
Fail SP (sec): is set by the program or during commissioning
“Yes” and PV > Limit: delay timer will start and generate an alarm when expired. If PV <= Limit timer is reset

Common for Lo and LoLo Alarms:
Alarm Enable: Yes / No. Is normally set by the program
Fail SP (sec): is set by the program or during commissioning
“Yes” and PV < Limit: delay timer will start and generate an alarm when expired. If PV >= Limit timer is reset.

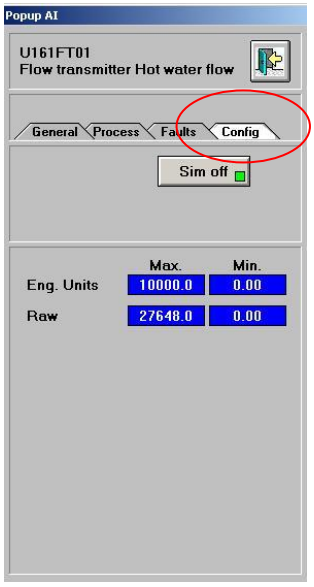
Faults tab:



PEB On: By activating PEB it is possible to operate analogue in manual mode even when the automatic program is active.

Fault Condition: Transmitter is faulty
Device Unhealthy: Fault from ASI (Not used) or out of range alarm condition for more than 5 sec.
Out of Range Alarm: If the input from the transmitter deviates +/- 10% of the range the alarm is set
(Example range is 0 – 160 then alarm if < than -16 or > than 176)
Number of Faults: Number of faults for input

Configuration tab:

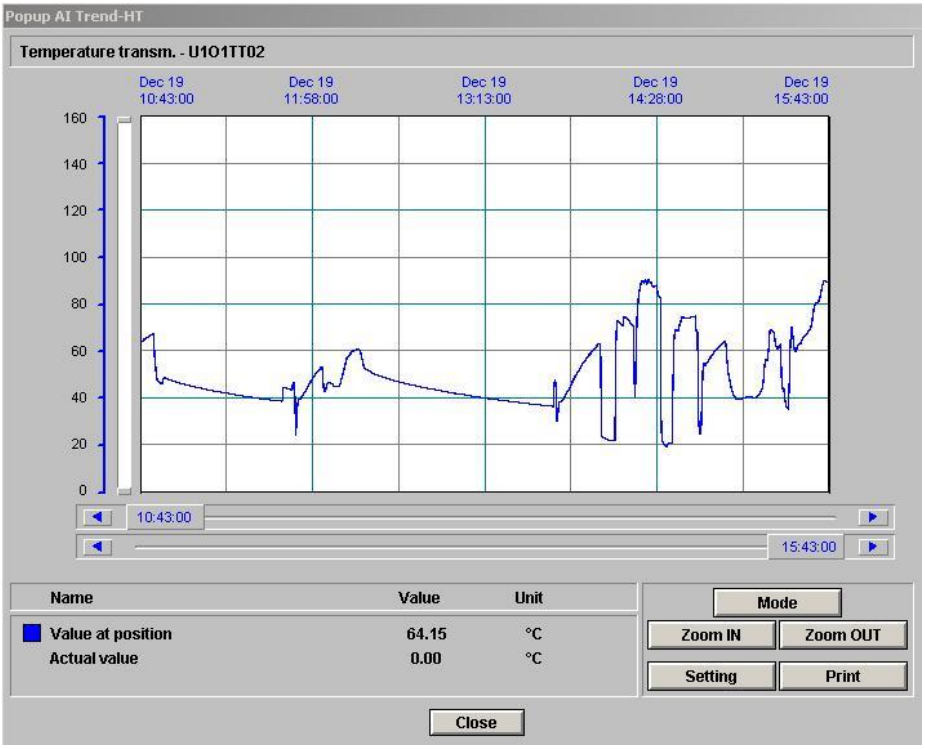


Sim On: By activating Sim on, it is possible to operate analogue without responding to physically input. Not for operator mode.

Max/ Min on Engineering unit.
Raw: ASI Module 4-20 mA: 4000.0 – 20.000

Trend picture:

By clicking onto the trend button a trend window is opening.



Mode button switches between Real time trend and Historical trend mode. Zoom buttons and Setting button are enabled in Historical trend mode. Setting button opens calendar for key in date and time to display in historical time.
Print buttons is for printing actual window.

STU Information



Clicking onto the information symbol is opening the **STU information box**. The STU (state unit Information) is used to select and display states of a unit (tank, line etc.). The different color codes are listed in the help menu for STU.

General tab:

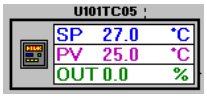


Clean To Dirty: Setpoint of the time and actual time before the tank will change state from Clean to Dirty.

Sterile to Clean: Setpoint of the time and actual time before the tank will change state from Sterile to Clean.

Max Production: Setpoint of the time and actual time before the tank production time is expired and is interlocked for filling and emptying.

PID Regulation

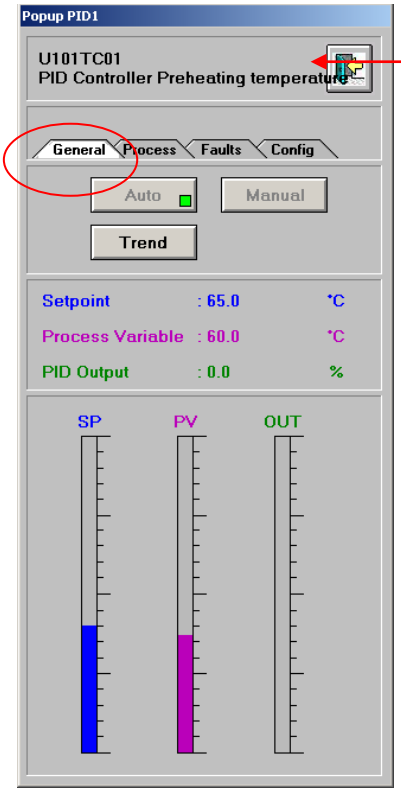


6 When pressing onto the regulator symbol the **regulator box** is opening. The designation of the regulation loop, status (program mode), scaling, process value, output and setpoint are shown. They are displayed as value as well as a scale.

7 The regulator can be set in AUTO or MANUAL mode when pressing onto the button.

All settings are protected by the access level. Changes must be noted in the operator's logbook.

General tab:



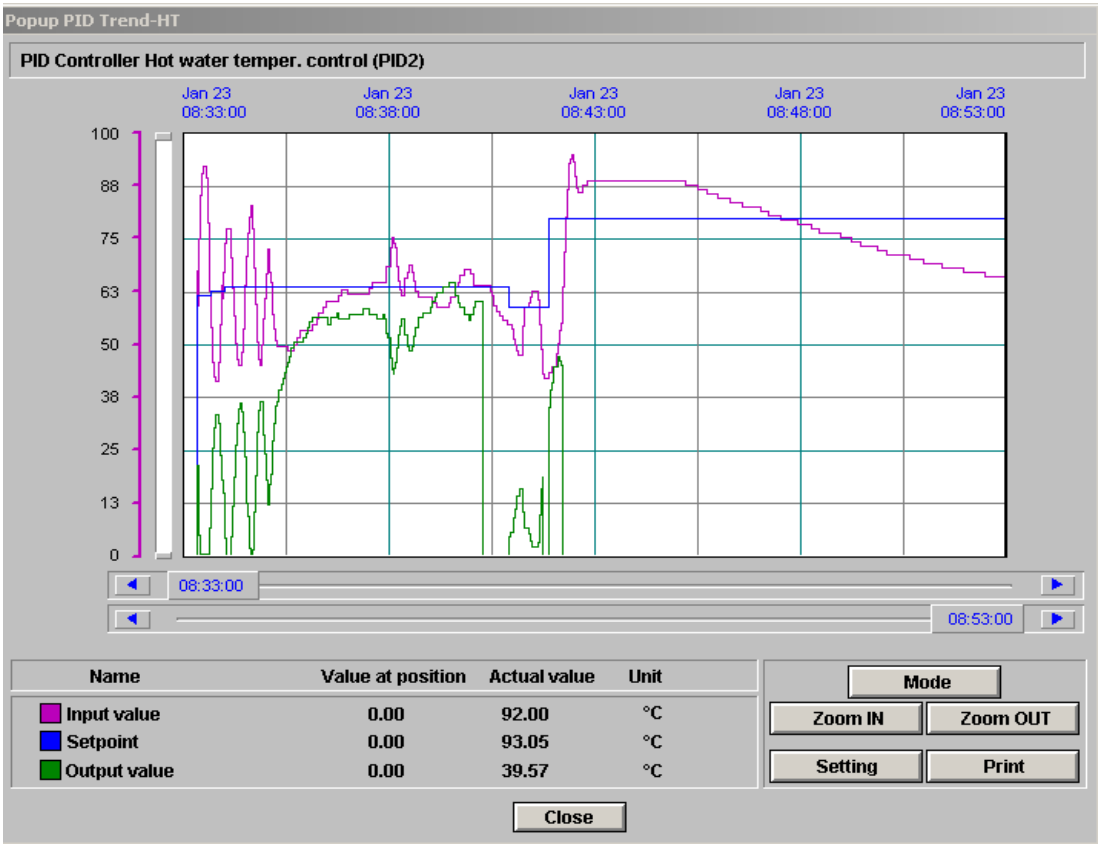
The name and designation of the regulating loop.

When the phase is enabled manual mode is disabled.
Auto: Automatic Mode
Manual: Manual Mode
Trend: Clicking on this button is opening a trend curve where setpoint, output and control value are displayed as curves.

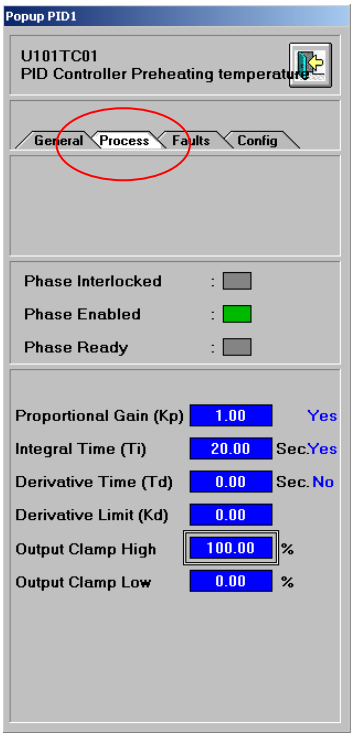
Setpoint: Setpoint to regulator
Process Variable: Process value
PID Output: Output from PID controller

SP, PV and output is shown as graph according to the scale

Trend window



Process tab:



P is the gain (Kp)
I is the integral time (Ti)
D is the derivate time (Td)

Phase Interlocked: The item is interlocked and cannot be controlled by automatic programs.
Phase Enabled: A phase is controlling these item
Phase Ready: Item is ready for automatic control

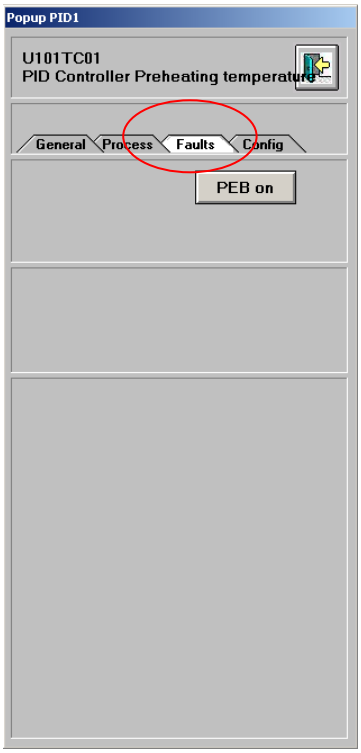
P, I, D values → P (gain) dimensionless, I and D- values in seconds
To enable the P, I and D "Yes" is selected. To deactivate select "No".

Derivative Limit: Limit for output when using Td

Output Clamp High: Maximum output from PID
Output Clamp Low: Minimum output from PID

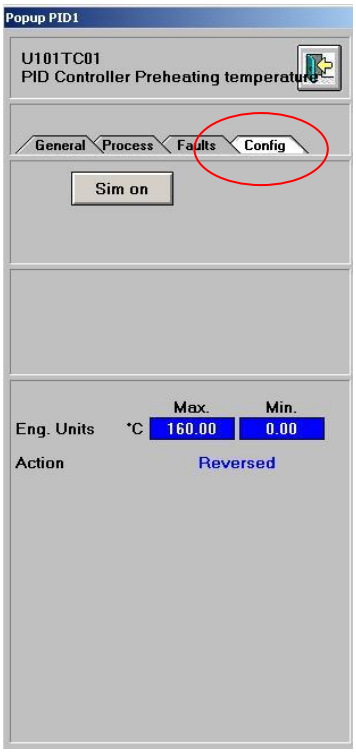
Setpoint changes must be noted in the operator's logbook!

Faults tab:



PEB On: By activating PEB it is possible to operate the PID controller in manual mode even when the automatic program is active.

Configuration tab:



Sim On: By activating Sim on it is possible to operate the PID controller without responding to the output.

Max/ Min on engineering unit.

Action: Direct or reverse
Direct: Flow Control, Heating Control, Level in control etc.
Reverse: Cooling Control, Level out control etc.

List with PID values

After commissioning all PID values should be written down and attached to the documentation or manual. When PID values are changed the operator should make a note to the shift protocol and add the new values to the PID list.

P, I and D- setpoint changes must be noted in the operator's logbook!

Trouble shooting

If the system is unstable, there may be two reasons:

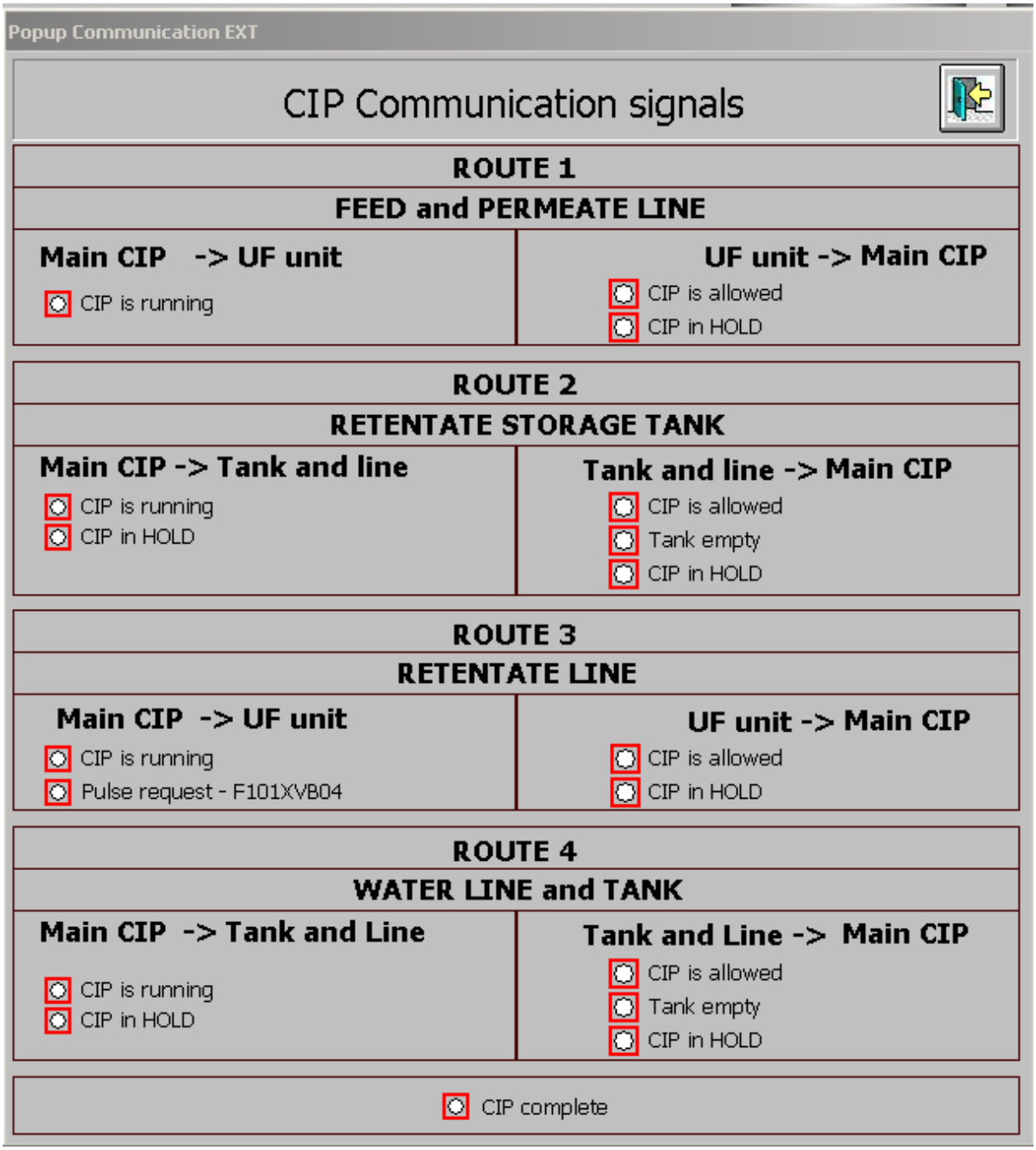
- The regulation system is set wrongly or
- The process is unstable

Try to set the controllers in manual at a fixed value. If the system becomes more stable, this indicates that the regulation needs further adjustment. If the system is still unstable, the process itself is unstable.

Communication signals



When clicking onto the **Communication** button a box with the signal exchange to and from The Inlet product or the outlet location is popping up:

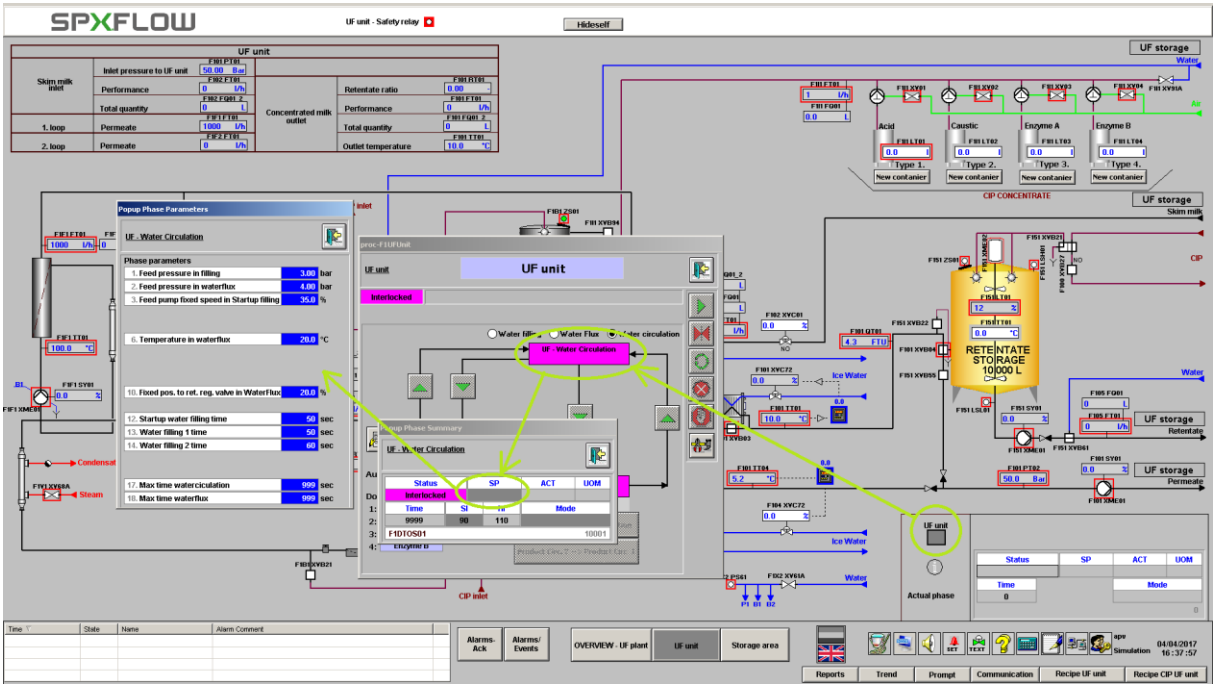

Popup Communication EXT
CIP Communication signals
ROUTE 1
FEED and PERMEATE LINE
Main CIP -> UF unit
CIP is running
UF unit -> Main CIP
CIP is allowed
CIP in HOLD
ROUTE 2
RETENTATE STORAGE TANK
Main CIP -> Tank and line
CIP is running
CIP in HOLD
Tank and line -> Main CIP
CIP is allowed
Tank empty
CIP in HOLD
ROUTE 3
RETENTATE LINE
Main CIP -> UF unit
CIP is running
Pulse request - F101XVB04
UF unit -> Main CIP
CIP is allowed
CIP in HOLD
ROUTE 4
WATER LINE and TANK
Main CIP -> Tank and Line
CIP is running
CIP in HOLD
Tank and Line -> Main CIP
CIP is allowed
Tank empty
CIP in HOLD
CIP complete

Setpoints

Setpoints are connected to several phases like start, stop, CIP, production etc. as well as recipes and are listed there. The setpoint values in the blue cells can be changed if required.

In the following example the **setpoints for the Water circilation phase** of the membrane- plant are listed:

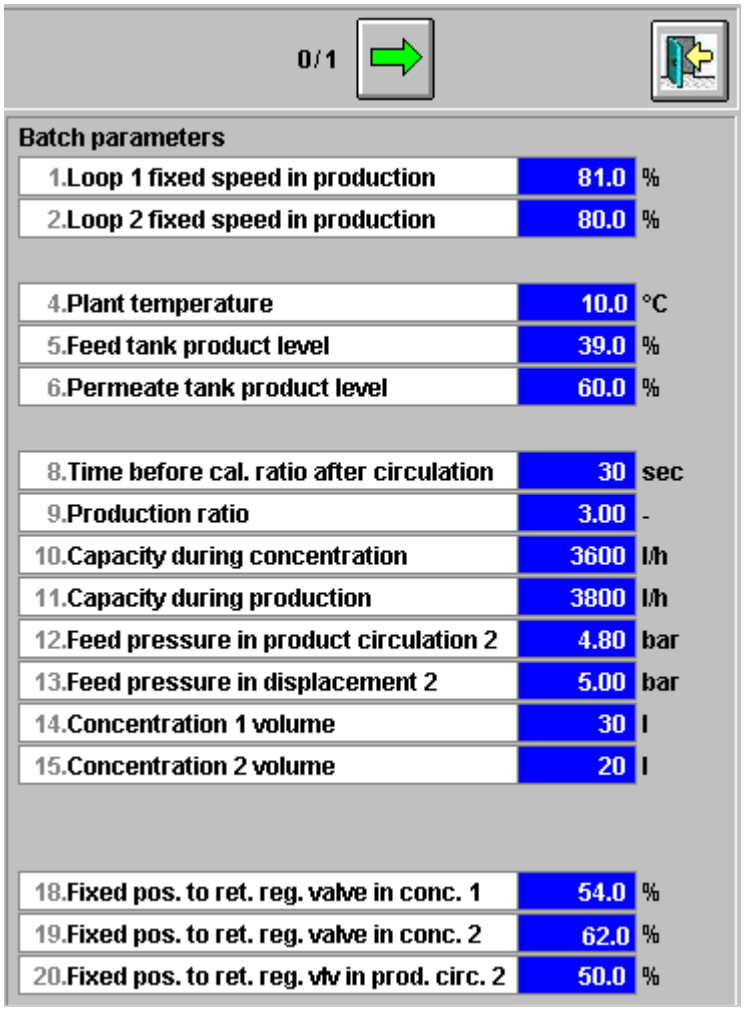
1. Click onto the button to open the phase overview for the membrane- plant
2. Click onto the start cell to open the phase summery box
3. Click onto the setpoint cell (SP) to open the setpoint list



The setpoints for the start **phase parameters** are listed.

The same procedure of viewing setpoints applies to the setpoint lists of the other phases.

4. Clicking onto the setpoint cell (SP) is opening also **batch parameters** for further setpoints (e.g. balance tank levels, drain and purge times, control temperatures etc.) of this phase/ unit.



Changing Setpoints

Only operators with the corresponding access rights can change setpoints.

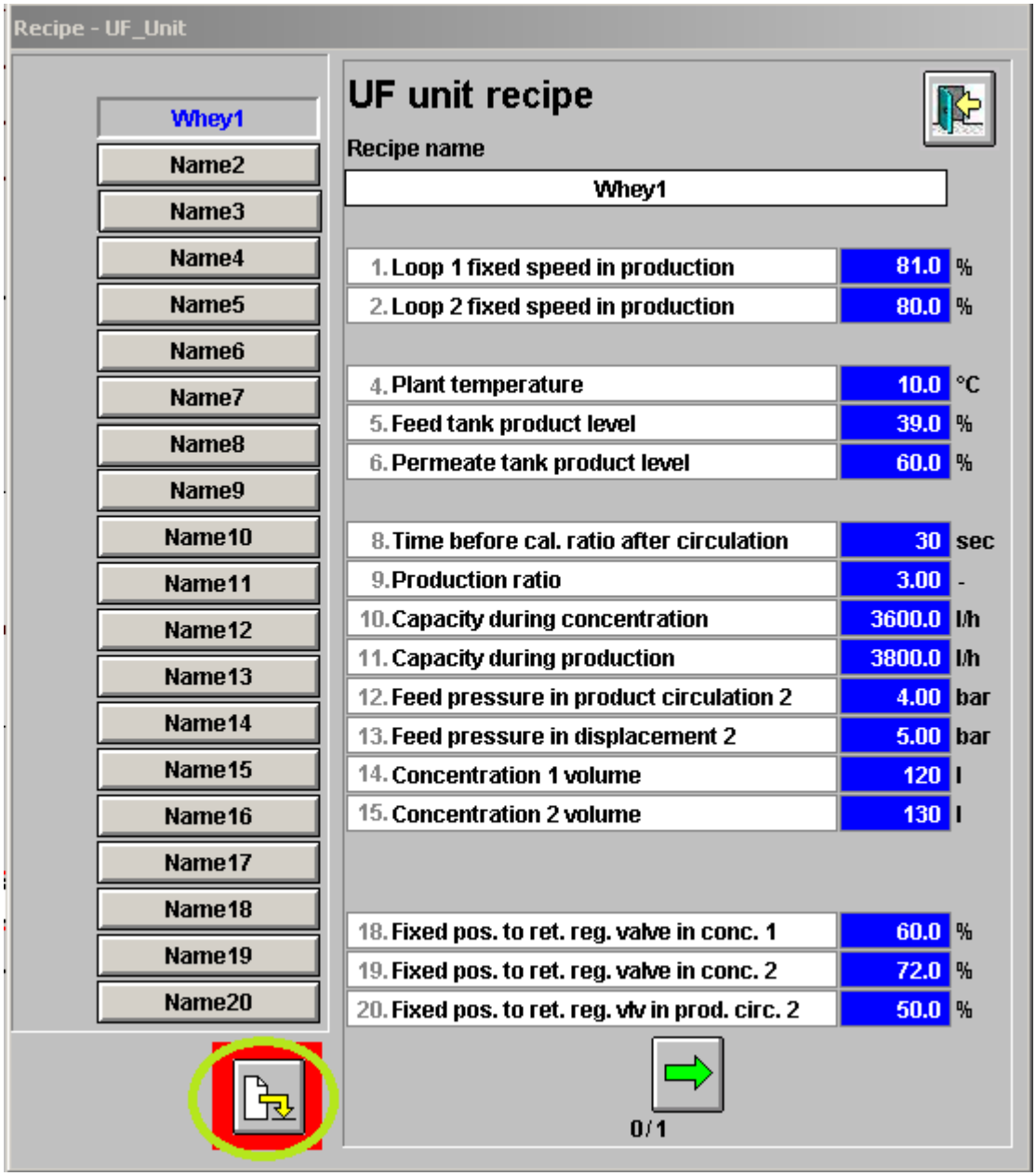
1. Select the phase and setpoint to be changed
2. By clicking onto the setpoint cell an on-screen keyboard pops up
3. Key in the new value and click OK

Setpoint changes must be noted in the operator's logbook!

Recipes



Clicking onto this button or **Recipes** button is opening the recipe window. When recipes are open by Recipes button, recipes can be only to edit.
The recipe can be selected and the recipe corresponding data will be transferred when the program is in the step recirculation or start mode.



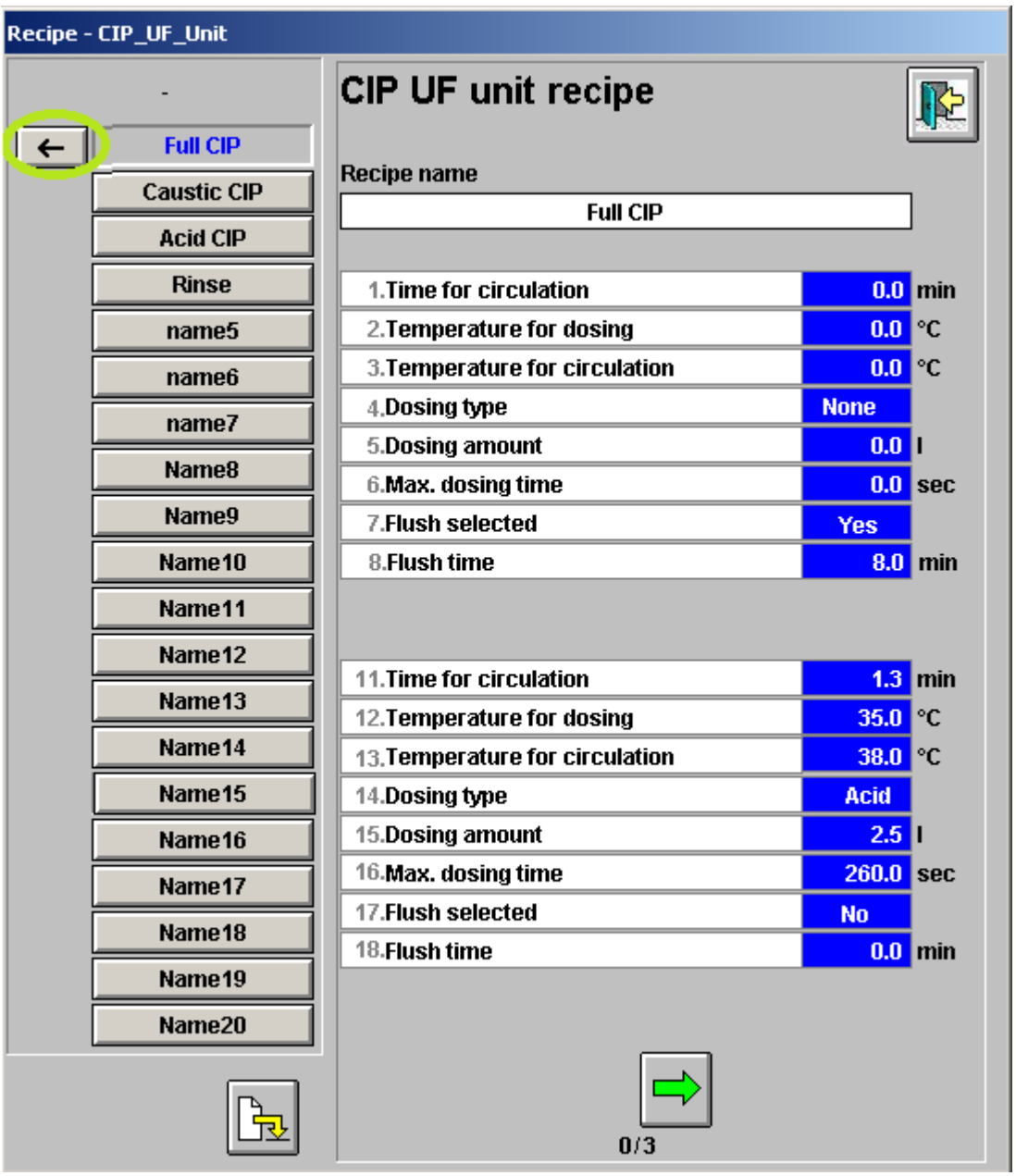
Twenty recipes for Production and CIP can be stored. By clicking onto one of the 20 buttons a recipe is selected. The recipe name and setpoints are displayed in the blue cells and can be changed if required. To save the changed setpoints click onto the 'save button'.

Recipe changes must be noted in the operator's logbook!

To change a setpoint click onto the corresponding cell. A keyboard is popping up. Key into the new value and confirm by clicking OK.

When deleting the recipe name the recipe becomes inactive ('empty' button and grey cells).

The recipe can be selected when clicking onto the arrow button on the recipe picture for the plant.

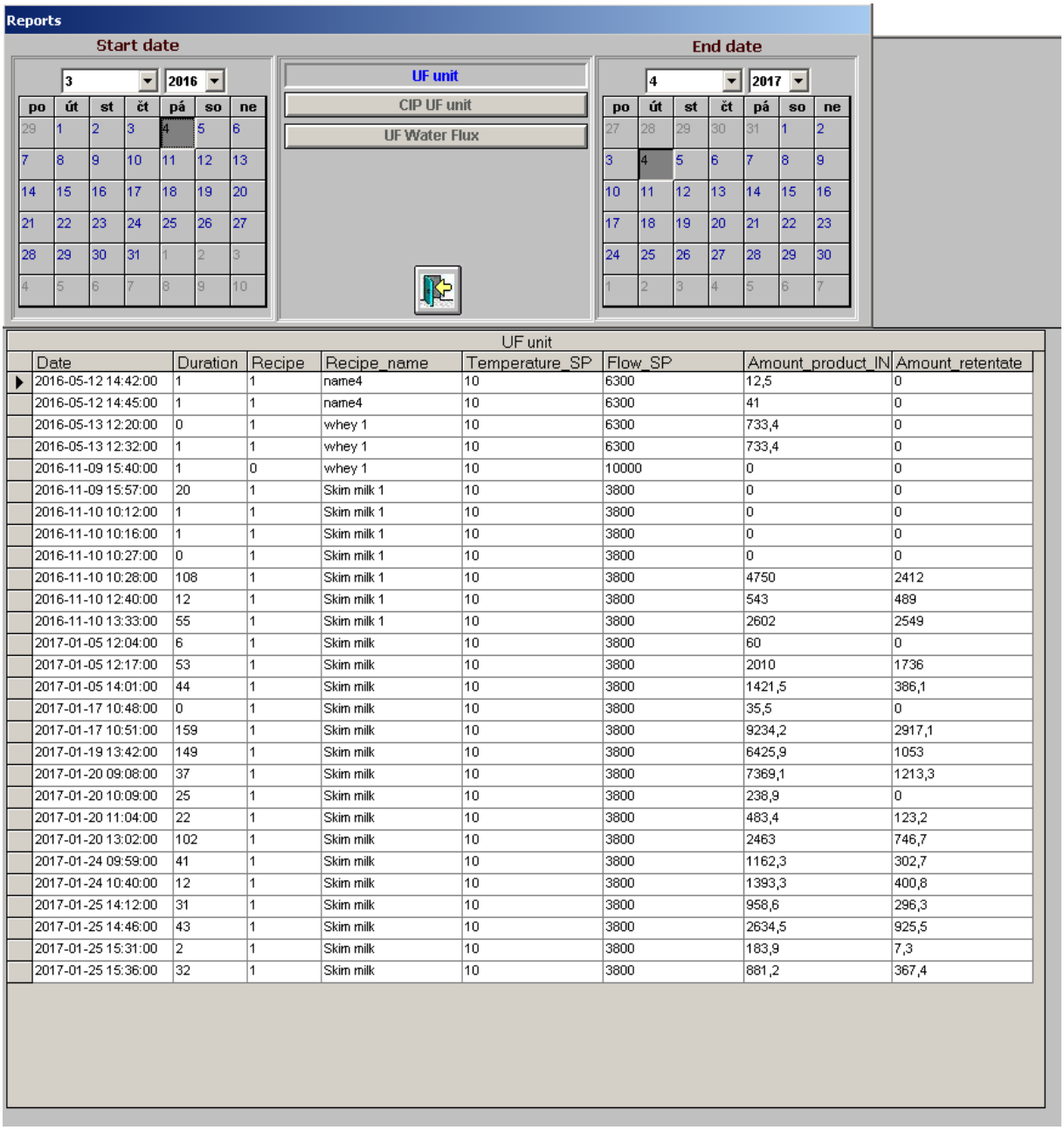


Reports (Optional)

After finishing of Production, CIP or Water flux, corresponding report is created and saved.



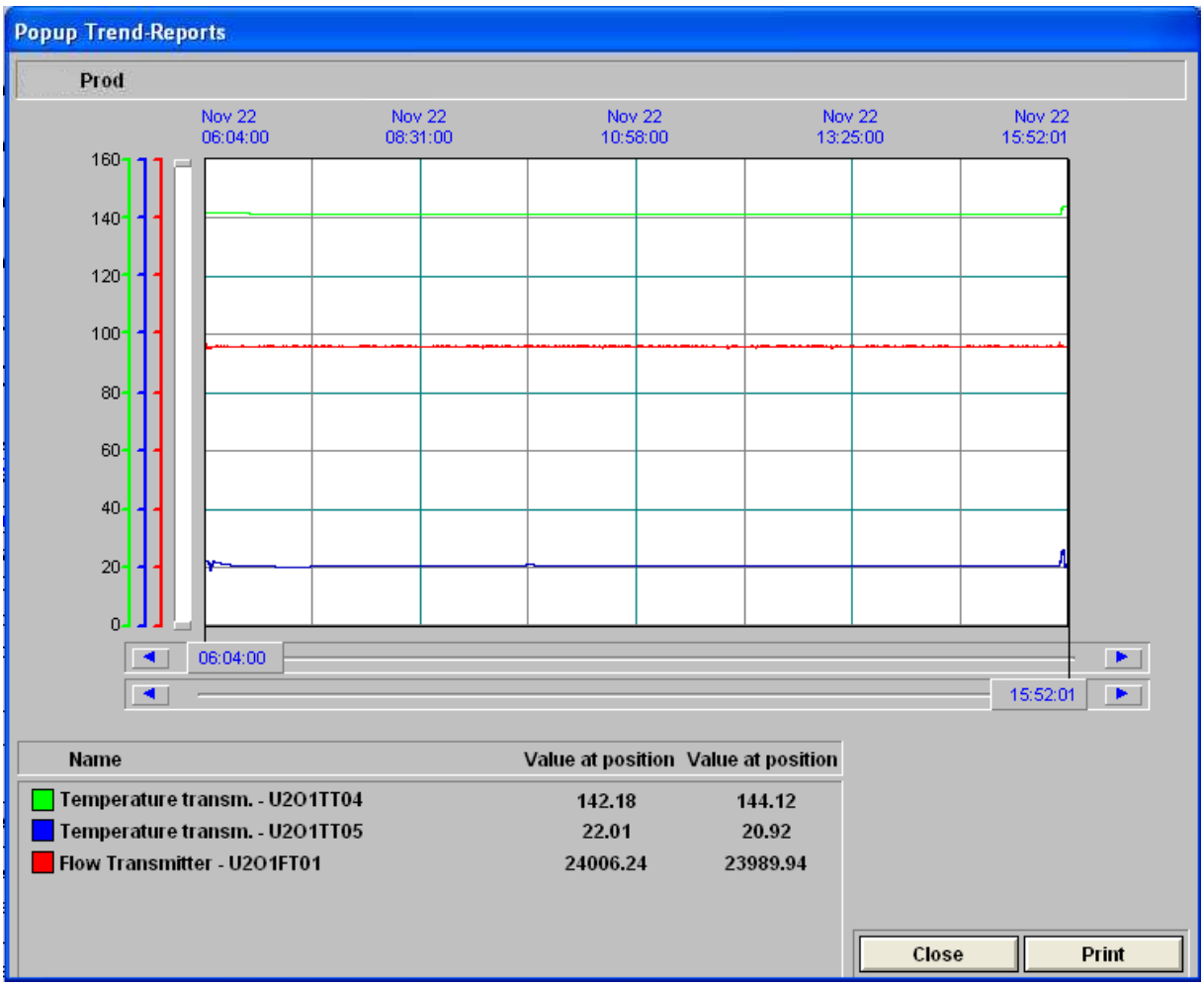
This button opens Report Calendar window. On the left side of the calendar there are buttons for selecting, which Reports you want to find – Production or CIP. Production is selected on example picture below. On the calendar you have to select date of desired report. After both selections are made, program show all reports, matching your selection in the window below.
Each row represents one report.
Report shows date and time of creation of report (time of production finish), duration in minutes, used recipe number, used recipe name, quantity of produced product in litres and some of Recipe setpoints.



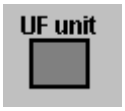
UF unit

Date	Duration	Recipe	Recipe_name	Temperature_SP	Flow_SP	Amount_product_IN	Amount_retentate
2016-05-12 14:42:00	1	1	name4	10	6300	12,5	0
2016-05-12 14:45:00	1	1	name4	10	6300	41	0
2016-05-13 12:20:00	0	1	whey 1	10	6300	733,4	0
2016-05-13 12:32:00	1	1	whey 1	10	6300	733,4	0
2016-11-09 15:40:00	1	0	whey 1	10	10000	0	0
2016-11-09 15:57:00	20	1	Skim milk 1	10	3800	0	0
2016-11-10 10:12:00	1	1	Skim milk 1	10	3800	0	0
2016-11-10 10:16:00	1	1	Skim milk 1	10	3800	0	0
2016-11-10 10:27:00	0	1	Skim milk 1	10	3800	0	0
2016-11-10 10:28:00	108	1	Skim milk 1	10	3800	4750	2412
2016-11-10 12:40:00	12	1	Skim milk 1	10	3800	543	489
2016-11-10 13:33:00	55	1	Skim milk 1	10	3800	2602	2549
2017-01-05 12:04:00	6	1	Skim milk	10	3800	60	0
2017-01-05 12:17:00	53	1	Skim milk	10	3800	2010	1736
2017-01-05 14:01:00	44	1	Skim milk	10	3800	1421,5	386,1
2017-01-17 10:48:00	0	1	Skim milk	10	3800	35,5	0
2017-01-17 10:51:00	159	1	Skim milk	10	3800	9234,2	2917,1
2017-01-19 13:42:00	149	1	Skim milk	10	3800	6425,9	1053
2017-01-20 09:08:00	37	1	Skim milk	10	3800	7369,1	1213,3
2017-01-20 10:09:00	25	1	Skim milk	10	3800	238,9	0
2017-01-20 11:04:00	22	1	Skim milk	10	3800	483,4	123,2
2017-01-20 13:02:00	102	1	Skim milk	10	3800	2463	746,7
2017-01-24 09:59:00	41	1	Skim milk	10	3800	1162,3	302,7
2017-01-24 10:40:00	12	1	Skim milk	10	3800	1393,3	400,8
2017-01-25 14:12:00	31	1	Skim milk	10	3800	958,6	296,3
2017-01-25 14:46:00	43	1	Skim milk	10	3800	2634,5	925,5
2017-01-25 15:31:00	2	1	Skim milk	10	3800	183,9	7,3
2017-01-25 15:36:00	32	1	Skim milk	10	3800	881,2	367,4

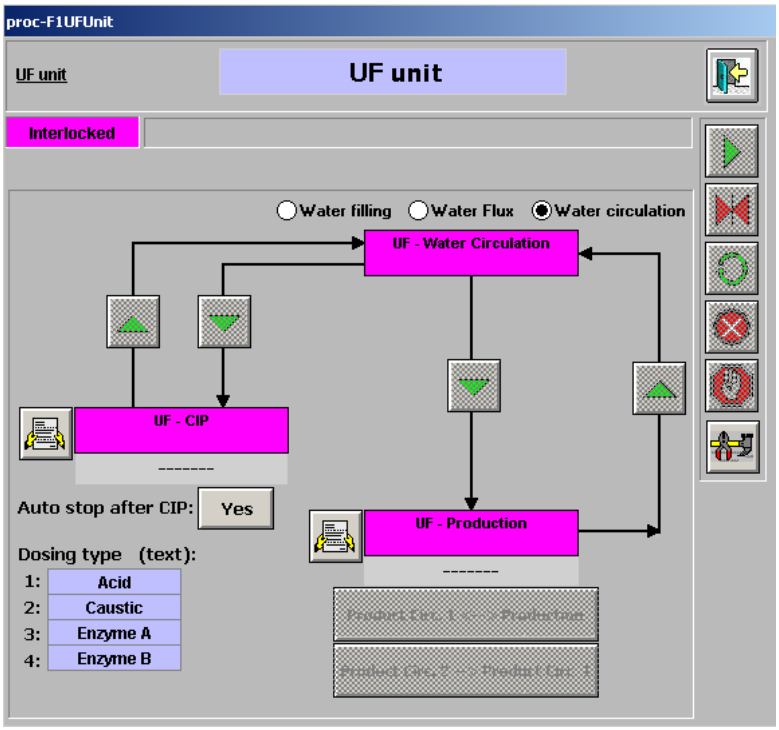
Double-clicking on arrow on left side on selected report row, opens Report trend window.
In the trend you can see history values of most crucial temperatures and product flow during selected process (Production or CIP).



Operating the Membrane Plant



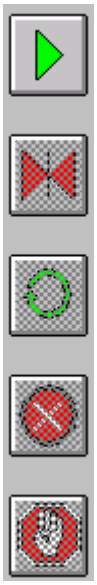
By clicking onto this button the **Membrane plant** window is opening. The plant can be started, CIP-cleaned etc. by clicking onto the corresponding buttons. The sequences are followed by each other according to the connecting lines of the phases → the membrane plant can only be CIP cleaned when the plant is started.



The operator has to start the plant prior to production or CIP cleaning.

The below listed buttons are only active when it is possible to start or stop the corresponding sequence. When the plant is already started the start button will be inactive, but the stop, pause and abort buttons become active.

Button explanations:



Clicking onto this button is starting the phase. In this example the membrane plant is already started.

Hold

Restart

Abort → emergency stop when in hold/ pause mode. This button is only active in hold mode.

Stop



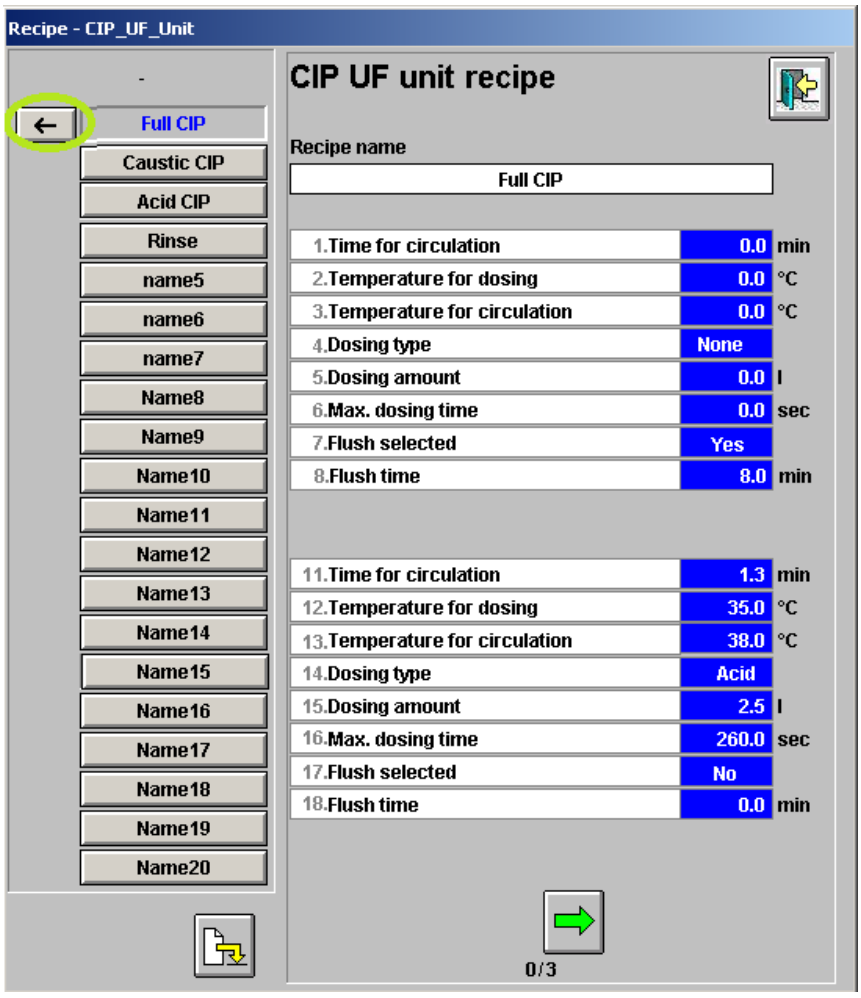
Clicking onto this button is opening unit setpoints list. For more detail information see section “Setpoints”.



Filling / refilling of the membrane unit. By clicking onto water filling selection operator chose start of the membrane water filling sequence (first start up / after maintenance of the unit).

By clicking onto Water Flux selection operator chose start of the membrane water flux sequence.

CIP selection

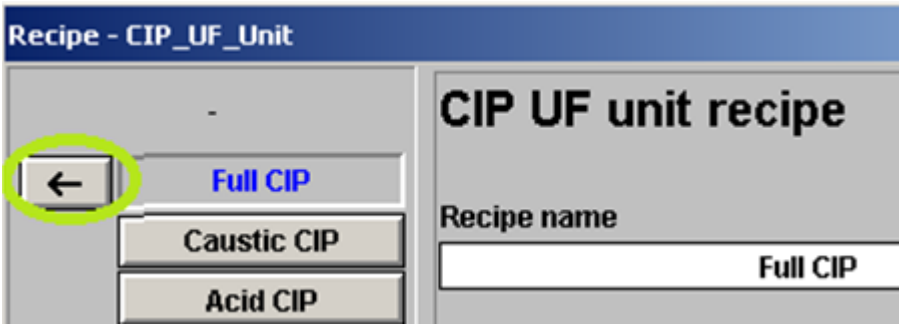


Selection of the CIP cleaning: when membrane is in the start mode only Complete CIP recipe is possible chose. When membrane is in step recirculation the operator can select between Complete CIP and other preset cleaning recipes. If time for rinse / flushing is set 0 sec, cleaning will be without rinse / water flushing.

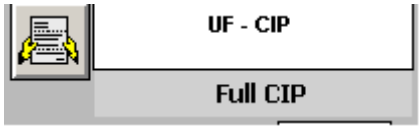
Recipe selection



Clicking onto this button is opening the **recipe box** to select one of the twenty recipes. The recipe name can be changed when editing the recipe → see separate description.



The selected recipe is shown in the window for control of the plant.



8 CIP (Cleaning in Place)

Under normal dairy and food plant operations the variations in the surface finish of stainless steel has little influence on cleaning efficiency under practical conditions. The surface finish of the material must be considered in cleaning compound selection for materials such as aluminium, rubber parts and plastic materials. In these cases, the compatibility of the material with the cleaning compounds must also be considered.

Water quality cannot be overemphasized in cleaning operations. If the water is heavily loaded with scale forming minerals (calcium, magnesium, iron or sulphate), the cleaning compound must be adjusted to eliminate the depositing minerals or the water must be treated to reduce the mineral content.

The efficiency of post-cleaning rinses is related directly to water quality. Magnesium, calcium, iron and manganese salts in rinse water will precipitate more readily from alkaline solution than from acid solution. Therefore, the conditioning of rinse water with acid (to pH 6.5 or less) can minimize the deposition of mineral water salts on cleaned equipment surfaces.

For sufficient CIP cleaning the following five parameters are important:

1. Temperature
2. Flow rate
3. Concentration of CIP detergents, e.g. pH
4. Time (Duration of CIP circulation)
5. Deposits/ soil load

Temperature is extremely significant in cleaning operations (see section 7). The composition of the cleaning compound and the concentration required will depend upon the nature and amount of soil on the surface. In some instances, the amount of soil on the surface is controlled by more frequent cleaning of the equipment. Consideration must be given to the type of cleaner to be used, its strength and in certain instances where two or more cleaning materials are used, the proper sequence of application. First when reaching the required temperature and concentration the CIP cleaning is becoming efficient.

The CIP settings (setpoints) are based on our experience with product of good quality, but depends on local conditions and CIP detergents. The running time of the plant should also be considered regarding CIP time and CIP concentration.

To avoid problems with insufficient cleaning it is important to start a CIP cleaning as soon as production has terminated and inspect the plant for efficiency.

Areas that are more prone to biofilm development include dead ends, joints, valves, and gaskets. In addition, equipment surfaces can be corroded with age. Pits and cracks may develop in which soil and bacteria can collect.

CIP Detergents

Generally, cleaning compounds are classified in two groups: alkaline and acid cleaners. The alkaline cleaners are typically comprised of basic alkalies, polyphosphates and wetting agents.

Wetting agents are soluble in cold water and in the usual concentrations are not affected by water hardness. When added to cleaners, the wetting agents improve the wetting or penetrating power of the product. Even in low concentrations they reduce the surface tension of water to half of its original value.

A wide choice of acid-type cleaners is available from different suppliers. To be effective the acid type detergent should produce a pH 1,8-2 in final use solution. It should work well in hard as well as soft water and should show a minimum of corrosion on metals.

Any change to chemical compounds used in CIP, including the supplier, should lead to a re-validation of the CIP regime (e.g. checking that the concentration is sufficient).

Conducting CIP

Before CIP can commence the plant must be in recirculation/ start mode. The cleaning program consists of the following steps:

- Rinse with water
- Circulation of a caustic and enzymatic solution (e.g. P3 Ultrasil 110 & P3 Ultrasil 67)
- Intermediate rinse with water
- Circulation of an acid solution (e.g. P3 Ultrasil 76)
- Rinse with water
- Circulation of an caustic solution (e.g. P3 Ultrasil 110)

The cleaning program steps can be followed on the status line of the control panel. The cleaning period is set by timers and can be changed if required.

The concentration of the CIP solutions should be regularly checked. A sample of the circulating CIP solution should be taken at the end of the circulation time of each full CIP and pH results must be logged in the daily production journal.

To verify the efficiency of the CIP cleaning the plant must be inspected at different places and in case of insufficient cleanliness the CIP cleaning should be repeated.



Wear suitable protection gloves, face shields and clothings when taking samples for titration. Severe bums on the eyes, skin and flesh might result from splashes of such substances on the body.



Setpoint changes must be noted in the operator's logbook!

CIP modes

Total CIP for the Plant

A full CIP can be conducted when the plant is in start mode or in the recirculation at low temperature step.

At the end of production the "STOP" button has to be pressed and the plant is rinsed by water. When the lamp "CIP" starts flashing, the plant is ready for cleaning.

The standard CIP comprises the following steps with recommended minimum timers:

1. Water rinse approximate 10 min.
2. Caustic and enzymatic circulation for 40 minutes
3. Water rinse approximate 10 min.
4. Acid circulation for 30 minutes
5. Water rinse approximate 10 min.
6. Caustic rinse circulation for 30 minutes
7. Final water rinse for 10 min. (or until no caustic is traceable in the plant)

Note: Cleaning time of each step will be set during commissioning.

When the cleaning cycle has been completed, the plant will return automatically to recirculation at low temperature, and the plant is considered "clean" → CLEAN flag (for UF).
When the cleaning cycle has been completed, the plant will STOP and operator has to start water circulation again, the plant is considered "clean" → CLEAN flag (for NF).
After each CIP cycle water flux has to be measured at the same conditions.

CIP Set points

The setpoints for CIP cleaning are determined during commissioning. It can be necessary to adjust the setpoints to different products or cleaning fluids. CIP are stated in separate CIP report, additional CIP recipe can be used, eg. Conservation, Caustic cleaning after conservation etc.

Setpoints	**CIP UF (Standard full CIP)**	**CIP NF (Standard full CIP)**
Caustic concentration (dosing)	0,6% at 30°C (pH 9-10)	0,5% at 30°C (pH 9-10)
Enzymatic concentration (dosing)	0,3% at 48-50°C	0,2% at 48-50°C
Circulation temperature	50°C	50°C
Circulation	40 min	40 min
Acid concentration (dosing)	0,3% at 30°C (pH 1,8 - 2)	0,3% at 30°C (pH 1,8 - 2)
Circulation temperature	50°C	50°C
Circulation	30 min	30 min
Caustic concentration (dosing)	0,6% at 30°C (pH 11-11,5)	0,8% at 30°C (pH 11-11,5)
Circulation temperature	50°C	50°C
Circulation	40 min	40 min

See final Ekolab report.

Adjusting the Cleaning Solution Concentration

The strength of the circulating cleaning solution has to be checked by pH. A sample has to be taken at the end of the circulation time of each full CIP. In case of very hard water the concentration of the acid concentration has to be adapted.

When using other than these cleaning fluids, check the appropriate concentration with the cleaning fluid supplier. Make sure to use the proper instruction. Recommended to check with chemical supplier to validate CIP setting minimum every 3 months.

Inspection after CIP cleaning

In order to verify the efficiency of the CIP cleaning the plant should be inspected at regular intervals. Particular interest applies to plant areas with higher risk of burn on or deposits, like the heating sections in the heat exchanger, etc.

To avoid major procedures for inspection it is recommended to inspect points of interest by opening at easy access clamp connections, flow plates, pipe bendings etc. Cleanliness or eventual findings of residues should be noted in the operator's daily logbook/ shift protocol etc.

The major interest of a clean plant is on the product side of the plant, but it is also important, that the plant surface – also the bottom side of the plant and the floor - is clean and no product residues and other pollution are giving a risk of contamination.

In case of hard water the service side should be inspected if any bigger heating temperature differences between product and service side occur.

After a power cut the plant has to be CIP-cleaned (full CIP) and inspected for cleanliness/ blockage and the operator has to carry out another CIP-cleaning if required.

The spray balls of the entire plant/ test setup have to be inspected regularly for correct position, cleanliness, and blockage and have to be cleaned manually if required.

9 Health and Safety

Safety Guidance Notes for Safe Operation of Plant

Safety – Swing Bends and Hose Connections

1) If the CIP routing on the plant is by swing bend and hose connections, then the operator must check the following before proceeding with CIP route cleaning.

   Where pipes are to be sealed by union caps it is necessary for the operator to confirm that the nuts and clamps are tight, or the caps and hoses are fitted. Components must be fitted where the operating instructions specify.

2) The following operator safety rules must be followed:

   a) Check with the Senior Operator before moving a bend, cap or hose to ensure that no flowing route is involved.

   b) Close all associated isolation valves

   c) Cautiously ease or "crack" the union in case there is trapped pressure or product behind it. If residual product leaks from the joint once the union has been released, care must be taken, as the product could be hot and/or oily. In either event the leaked product must be cleaned up immediately.

   d) Cover ports either with a bend or with a cap, as operating instructions specify. Where hoses are used, always return a hose to its storage position when not connected.

   e) Tighten every union to seal when it is fitted; never leave a union loose.

Note: the procedure for this should be part of a **safe system of work** with a confirmatory checklist.

Safety – Vessels

1) Balance tank are cleaned using spray-balls. It is therefore potentially dangerous to open a man-way or lid during the cleaning cycle.
2) The following safety procedure is therefore essential:
   a) Check with the Senior Operator that the vessel is not being cleaned or about to be cleaned before opening the man-way.
   b) After opening ensure that the man-way is fully closed again and that any clamps fitted are fully tightened and safety switches in place

Note: The use of **permits to work** is recommended in these instances.

High Temperatures/Pressures

1) Parts of the plant may be subjected to high temperatures at all times when operating and some parts only during CIP and sterilizing. High pressures may also exist, at the discharge of pumps or in service supply lines in particular, with pressure relief valves to protect hardware.

2) The following safety procedure is therefore essential:

   a) Restrict the plant area to authorized persons only.

   b) Do not touch any item of process plant or piping as parts of the plant may be subjected to high temperatures (>60 °C). Carry out a risk assessment and install suitable insulation/guarding and warning labels if necessary.

   c) Do not tamper with relief valve settings after commissioning.

   d) Only operate manual valves in accordance with the operating instructions.

   e) Only operate pumps with valves in both the suction and discharge lines when both valves are in an open position.

   f) Do not disconnect pressure relief valves in discharge lines which have been routed to a safe place and do not install or close valves in or restrict in any way, a discharge line. Pressure relief valves are installed to protect equipment; they must not be tampered with in any way and must always be routed to a safe place for discharge.

   g) Do not remove heat exchanger spray shields while a heat exchanger is in operation.

   h) Ensure that all pipeline and line component unions are regularly checked to maintain integrity of seals.

   i) If a leak is discovered it must not be restricted in any way that would be detrimental to the safe working of the plant, but must be reported and the appropriate procedure followed.

   ADVICE SHOULD BE OBTAINED FORM THE APPROPRIATE PROFESSIONAL BODY.

Handling and storage of CIP Chemicals and Safety Precautions

IT IS ESSENTIAL THAT PROTECTIVE CLOTHING IS WORN – IMPERVIOUS COVERALLS, PVC OR RUBBER APRONS FOR INSTANCE, AND OF COURSE, GLOVES OF THE SAME MATERIAL. THE EYES ARE PARTICULARLY VULNERABLE AND THE WEARING OF CHEMICAL PROOF EYE PROTECTION IS ESSENTIAL.

CIP Chemicals

1) Industry is becoming more and more hygiene conscious and increasing numbers of personnel are becoming involved in the handling of a variety of cleaning and sanitising chemicals.

2) COSHH compliance requires that material safety data sheets be kept of all chemicals being stored or in use. These data sheets identify the substance, its effect on the human body and what precaution or first aid treatment should be taken/applied in the event of exposure or contamination.

   Users are obliged to assess the hazards and level of risk associated with use of substances and to take the necessary action to safeguard the people using them.

3) The following paragraphs in this section are offered for guidance and describe common sense precautions, which should be taken by everybody, and the immediate action to be taken in the event of an accident arising through careless handling or some unavoidable cause.

Strong Alkalis

1) Strong alkalis are corrosive and are termed caustic. They will cause severe damage to the skin if splashes are not treated immediately, and they will quickly eat through clothing, particularly if the solutions are hot, which is normally the case.

2) Perhaps the greatest danger of splashing arises when powders are added to the water to prepare the cleaning solutions, particularly when heavy-duty alkalis are involved. These will contain free caustic; this reacts strongly with water with the resulting evolution of heat, and if such powders are added to hot water the reaction can be very violent and result in a boiling-up of the solution. This is the cause of many accidents.

3) Safe procedure - Additions should always be made carefully – a little at a time stirring in between and taking extreme care when adding alkali salts to hot water, (if this latter procedure is unavoidable), by persons wearing appropriate Personal Protective Equipment, (PPE).

Mild Alkalis

1) Mild alkalis will rarely cause burns if rinsed off immediately. Their principal effect is one of drawing out the natural oils in the skin and thus causing irritation. Some operators, however, may have sensitive skins and could develop a rash, which might turn into the skin condition broadly described as industrial dermatitis. Consequently, the process for mixing or using chemicals must/should be followed by persons using appropriate PPE.

Storage of Alkaline Detergents

1) All alkaline detergents are generally hygroscopic and will absorb moisture from the air. Therefore it is **essential** to keep drums closed and bags well sealed and off the floor when in use.

2) Liquid detergents in bulk should be stored at room temperatures. Exposure to extremes of temperature when storing liquid detergents can cause ingredients to precipitate out of solution. Should this occur, it is often very difficult, if not impossible, to re-blend the mixture. This point should be borne in mind when storing concentrated detergent in exposed situations.

3) Great care must be taken when opening chemical containers since a slight pressure build up might have occurred giving rise to a risk of exposure to splashing or even vapour release. The operator is to open the container slowly, whilst wearing the appropriate PPE, to help avoid any accidental spillage.

4) When drums have been emptied, they must be flushed out with water taking particular care being taken to remove all particles of the product before the lid is replaced. If this is not done, a strong alkaline solution may be formed in the drum.

   Always follow the local procedure for the protection of the environment.

Acids

1) Most mineral acids are very corrosive and will destroy the skin tissue and eat into clothing. The rate of the attack will depend upon the concentration and naturally the more water there is present the milder the effect. Acid products require care in handling, and the chemical manufacturer's recommendations for COSSH must be followed.

2) Acid products must **never** be mixed with hypochlorite, since poisonous chlorine gas will be produced.

Sterilants

In view of the hazardous properties of these substances, it is essential – in addition to the COSSH regulations – that the following advice is fully understood by all persons involved in their use

1) Strong sodium hypochlorite solutions are powerful oxidising agents and rapidly produce burns when in contact with the skin. Anyone likely to be exposed to such solutions must use appropriate personnel protective equipment

2) Strong Peroxy Acetic Acid (PAA) solutions are powerful oxidising agents and rapidly produce burns when in contact with the skin. Personal Protective Equipment (PPE) should be worn, though it must be noted that PAA must not be brought into contact with oils, fats or rubber. If exposed to high temperatures, decomposition will occur which may generate explosive gases.

3) Accidental mixing of sodium hypochlorite with certain chemicals must be avoided. When mixed with acids, chlorine gas is liberated and with ammonia or ammonium compounds explosive products may be formed.

   Follow correct mixing procedures as recommended by the chemical supplier.

4) Certain organic compounds, such as acetone and formaldehyde, also react vigorously with sodium hypochlorite solutions. Organic contamination of any kind is liable to cause decomposition of the solution, which is especially dangerous.

   The stronger the solution the greater the danger.

Storage of Sodium Hypochlorite & Peroxy Acetic Acid (PAA)

1) Sodium hypochlorite & Peroxy Acetic Acid (PAA) should be stored in a cool place, preferably in the dark. In general, containers must have suitable vents to prevent any internal pressure build-up that may arise due to the liberation of gases.
   Manufactures Instructions for storage of chemicals should be followed at all times.

Emergency First-Aid Treatment

1) The first essential for the treatment of any chemical splashing is thorough washing with cold water and it follows that a clean source of cold water supply should be available near to every installation. Moreover, the position of that water source/emergency shower/eye wash point should be indicated clearly in boldsigns, with appropriate pictograms, so that no time is lost in an emergency.

2) A drench shower should be provided for particularly hazardous areas.

3) If any chemical/caustic solutions come into contact with the skin or eye, medical aid should be sought immediately. Meanwhile the affected area should be thoroughly irrigated with fresh water for at least 20 minutes or until such time as professional medical assistance arrives.

4) All eye injuries must immediately be referred to a doctor after first aid treatment has been given.

5) If any chemical solutions comes into contact with the skin or clothing, remove the clothing and thoroughly irrigate the affected area with fresh water for at least 10 minutes. The patient must immediately be referred to a doctor after the first aid treatment has been given.

6) In all cases of contact the patient should be referred to a doctor after first aid treatment has been given.

Operating Safety

1) Only trained and competent persons may operate the control system of any plant such persons must also be able to switch off the plant under normal and emergency conditions.

2) It should not be possible to operate a control system while a safety device or guard is removed or disconnected. However, should this be the case, **the plant must not be operated under these conditions**. The machine must be switched off and the defect reported.

3) Where access to a control system is permitted for manual operation only those doors, which provide access, should be unlocked. They should be relocked immediately the particular operation is completed.

4) ”Warning” labels should be placed.

5) Control systems must never be activated until all other personnel in the area have been warned.

6) Persons must never sit or stand on anything that might cause you to fall onto the control equipment or any associated peripheral equipment.

7) ‘Horseplay’ around the control system or associated controlled items at any time is dangerous and prohibited.

8) The system must never be operated outside specified parameters as indicated in the instruction / operating document.

9) Keep alert and observe and, if necessary, react to indicator lights and warnings that are displayed on the system.

10) The operator must never leave the system unattended while in operation.

11) Faulty or damaged equipment must **NOT** be operated. All defects must be reported. Proper service and maintenance procedures must be observed.

Plant Maintenance

Only trained and competent personnel may do this job.

1) Safety devices MUST NOT be by-passed/over-ridden

2) In the event of failure of plant items, it is important that such failures are recorded, reported to maintenance personnel and rectified as soon as possible; if faulty items are allowed to accumulate the plant could rapidly become inoperable.

3) Compliance with the maintenance schedule recommendations and adjusting these with experience should greatly reduce the failure rate. The operating and maintenance instruction manuals for the specific item must be referred to and the item must be disabled before commencing work.

4) Before working on any automated items, personnel must ensure that the items have been fully disabled. In the case of motors, the power supply must be isolated at the local isolator. Similarly in the case of automated valves, the air supply and/or power supply must be isolated before commencing work.

5) Note that, in some cases, automated items can be disabled from the operating screen using the device logic dialogue box. To disable an automated item, click on the item from the screens, and then click on 'MAINTENANCE'. This will prevent both automatic and manual actuation from the computer.

6) Where possible, manual isolation valves must be used to isolate any equipment being worked on.

7) On completion, all panel doors, junction boxes and access points must be securely closed and locked. In addition, if any process lines had been broken, these must be correctly reassembled and de-isolated.

8) Before power is reapplied all personnel must be clear of the associated plant.

Cleaning safety

Manual cleaning procedure:

Only competent and authorized personnel may do this job.

1) Toxic and/or flammable solvents must not be used to clean control system hardware.

2) Electrical power must be isolated and locked off prior to the cleaning of control system assemblies, and doors and covers must be closed before cleaning of an enclosure is commenced.
NOTE: For maximum protection the power source should be isolated and locked off using a personally assigned lock. This will prevent anyone from accidentally turning on the power while the machine is being serviced. An appropriate label must be attached outlining the reason for the fitting of the lock, and who by.

3) Spills around the equipment must be cleaned up as soon as possible.

4) Attempts to clean a control system must not be made while it is operating.

10 Service and Maintenance

The plant should be given a full service and maintenance at regular intervals in order to avoid any break down of the production. The service interval has to be set to one to two times a year – depending on the frequent use of the plant. Leakages, malfunction etc. have to be repaired immediately when appearing – check with corresponding manual of the item. The plant has to be pressure less, cooled down, clean and free of cleaning detergents before maintenance procedures start.

Some parts need frequent service/inspection, which are listed in the 50, 200, 500, 1000 and 2000 hours service routine. The electronic components normally require no maintenance.

Certain components such as pressure gauges, temperature and level transmitters have to be checked minimum once a year in regards of accuracy.

Keep records of all observations and maintenance work at the plant!

Maintenance Schedules

It is recommended to service the plant at regular intervals. The below listed schedule is a suggestion to the service – see also the manufacturer's documentation. For location of the particular items please use the flow diagram.

When opening clamp connections check the gaskets and replace if necessary (deformed, torn or hard). Inspect the gaskets regularly on product and service media side. Replace them, if you discover damaged or hard/ stiff gaskets.

Check with the manufacturer's documentation.



When lifting electrical motors, do not lift at the covers, as these are not designed to carry the weight of the motor. When lifting remove the cover and secure the strap at the motor.



Before starting service the entire plant must be cooled down, completely stopped and in pressure less condition.



Before any work with pumps and other rotating parts is carried out, it must be checked that the power supply has been disconnected by service stop and removal of fuses.



Be careful when servicing items in contact with CIP fluids. Clean them with water prior to service or maintenance. Wear suitable protection gloves, face shields and clothings. Severe bums on the eyes, skin and flesh might result from splashes of such substances on the body.

After 50 working hours

See documentation sections for support and instruction:

- Check the clamp connections for tightness and leakages
- Check Pt 100 sensors for accuracy
- Check Pt 100 sensor connections/bushings for leakages, moisture and corrosion
- Check temperature indicators for accuracy and leakages
- Check pressure gauges for accuracy and leakages
- Check pressure gauge membranes for cleanliness, dents, holes and corrosion
- Check valves with feedback units for correct signals and function of valves
- Check regulating valves for leakages and function
- Check manual valves for leakages
- Check joints and welding seams for leakages
- Check pressure transmitter for leakages and function
- Check steam traps for trouble-free operation
- Check level sensors for leakages

After 200 working hours

See documentation sections for support and instruction:

- Check the clamp connections for tightness and leakages
- Check pressure transmitter for leakage and function
- Check level sensor/transmitter for leakages, wear and tear
- Check flow transmitter for leakage and function
- Check level sensors for leakages
- Check membrane valves for leakages

After 500 working hours

See documentation sections for support and instruction:

- Check safety valves for correct operation by opening it manually
- Check steam traps for correct operation
- Check level sensors for leakages
- Check/inspect the valves for leakages/cleanliness

After 1000 working hours

See documentation sections for support and instruction:

- Check steam filters for cleanliness, corrosion etc.
- Check pneumatic connections/air supply to valves, regulators, etc.

- Check level sensors for leakages
- Check all spray balls for position and cleanliness

After 2000 working hours

See documentation sections for support and instruction:

- Check heat exchangers for tightness and cleanliness
- Examine the service media side of the tubular heat exchangers and remove possible deposits
- Replace gaskets of the heat exchangers
- Inspect and change shaft seals of the centrifugal pumps if necessary
- Change the O-rings if signs of hardness/stiffness of the material
- Check all spray balls for cleanliness and position
- Check membranes of pressure gauges for cleanliness, dents, holes and crevices
- Check membranes of level transmitter for cleanliness, dents, holes and crevices
- Check level sensors for leakages
- Check/inspect the valves for leakages/cleanliness

Inspection/Test

After service and maintenance conduct performance checks of valves, pumps, valve feed backs etc. before going onto production. Test each single component. Continue with a water test and after successful running start CIP and pre-sterilization.

Make notes of all leaks, noise, malfunction etc. or unusual behavior after the test runs and service the items before going onto production again. Remove all tools and replaced spare parts etc.

Start production and check for leaks and performance of the plant.

Keep recordings of the maintenance and test runs.

Special Instruction for Service and Maintenance

In case of any doubt or uncertainty how to service particular parts of the plant or need of information please see the documentation of these parts or contact SPX. The plant has to be pressure less, cooled down, clean and free of cleaning detergents before maintenance procedures start.



When lifting electrical motors, do not lift at the covers, as these are not designed to carry the weight of the motor. When lifting remove the cover and secure the strap at the motor.

Heat Exchangers

Check the tubular and plate heat exchangers for leakages and cleanliness. Make sure to have all necessary gaskets available. In case of any irregularities follow the service manual in the documentation or contact SPX for further advice.

If in doubt about trouble-free performance dye-test the plate heat exchanger.

Before dismantling the plate heat exchanger measure the length of the plate pack and write it down!

Water Circuits

Check regularly the water levels in the water circuits and refill if necessary when the plant is stopped and cooled down. In case of any leaks repair or replace the item.

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