ARS-ALTMANN SYSTEMS

Vacuum Separator VS-06
CLIMABOX

OPERATING INSTRUCTIONS 2009

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Chapter 1 . Technical data

Power supply voltage	400 V (or on request)
Power supply frequency	50 Hz (or on request)
Power consumption:	
without oil heater	850 W
with oil heater PO-01	5200 W maximum
Air-condition unit	300W
Oil throughput	10 m^3 per day maximum
Outlet water content	10 ppm nominal , 4 ppm minimum
Outlet gas content	1% nominal, 0.3 % minimum
Outlet filtering grade	0.1 µm
Weight – CLIMABOX version (separator, heater ultrafilter, external water trap, etc.)	
Dry weight (without oil)	520 kg
Operating weight (oil filled)	580 kg
Hydraulical connection	2 x flexible 1/2“ hose
Communication:	faxmodem GSM modem

Operational condition:
Max. surroundings temperature: 60°C
Max. humidity: 100 %

Min. temperature of dehydrated transformer 40°C

For succeful dehydration of transformer and succefull oil drying it is neccesary to ensure:
hold the temperature of transformer over 40°C

Chapter 2 . Installation

The separator VS-06 A CLIMABOX is attached to the transformer as shown in Fig.1.

Installation procedure:

- attach the oil-inlet set (coupling, insulation insert and servo valve YV4 See Fig.1) to the lower access of the transformer (i.e. bottom filter press cock), then connect to the open end of the servovalve YV4 the in-let hose H1, then connect the opposite end of the hose H1 to the hydraulic connector HC1 (see Fig.2 – right side of the CLIMABOX -cock K-IN), open the cock K-IN
- attach the oil-outlet set (coupling, insulation insert and servo valve YV3 See Fig.1) to the upper access of the transformer (i.e. upper filter press cock), then connect to the open end of the servovalve YV3 the out-let hose H2, then connect the opposite end of the hose H2 to the hydraulic connector HC2 (K-OUT), open cock K-OUT
- remove the face and rear cover of the CLIMABOX
- check if all cocks on right and left side of separator and at the rear side are full open
- check if all 3 filter insterts of the ultrafilter are installed
- connect cable of servo valve YV4 to the input servo-connector
- connect cable of servo valve YV3 to the output servo- connector
- check the correct level of the supply voltage (required 400 V +/- 15V) Five wire connection cable and connector (3x400V, PE,N) is neccesary (N-light blue 0-phase, PE-green-yellow security)
- set the supply circuit breaker (in the power-supply box) for a minimum load of 16A, then connect the separator to the power-supply box.
- check DC voltage of the data line (required 42-45V), then connect the data transmission cable to the telephone connector

Right side of VS-06 which is used for a hydraulic connection to the transformer, the power supply and the communication, is shown on Fig.2.

Left side of VS-06 is equipped either with air-condition unit (for air temperatures over 40C) or in the left niche is installed the stainless-steel sieve – for air temperatures under 40C.

Flow diagram of VS-06 is shown on Fig. 3.

Detailed internal layout of VS-06 – the face part - inclusive external water trap is shown in Fig. 4.

Rear part of VS-06 is shown in Fig. 5 .

First start-up of the VS-06 has to be carried out by the manufacturer himself or through from him authorized service technicians.

ATTENTION !

Check the oil-level in the conservator tank always before first start up of the VS-06.

- oil level should exceed the minimum mark by 1/3 of the scale in the conservator
- survey this level continuously during the start-up procedure and during the operational condition – the oil level in the conservator tank shall never fall below the minimum level indicator
- if the oil level would fall below the minimum mark of the conservator tank, refill oil immediately or/and use a auxiliary conservator

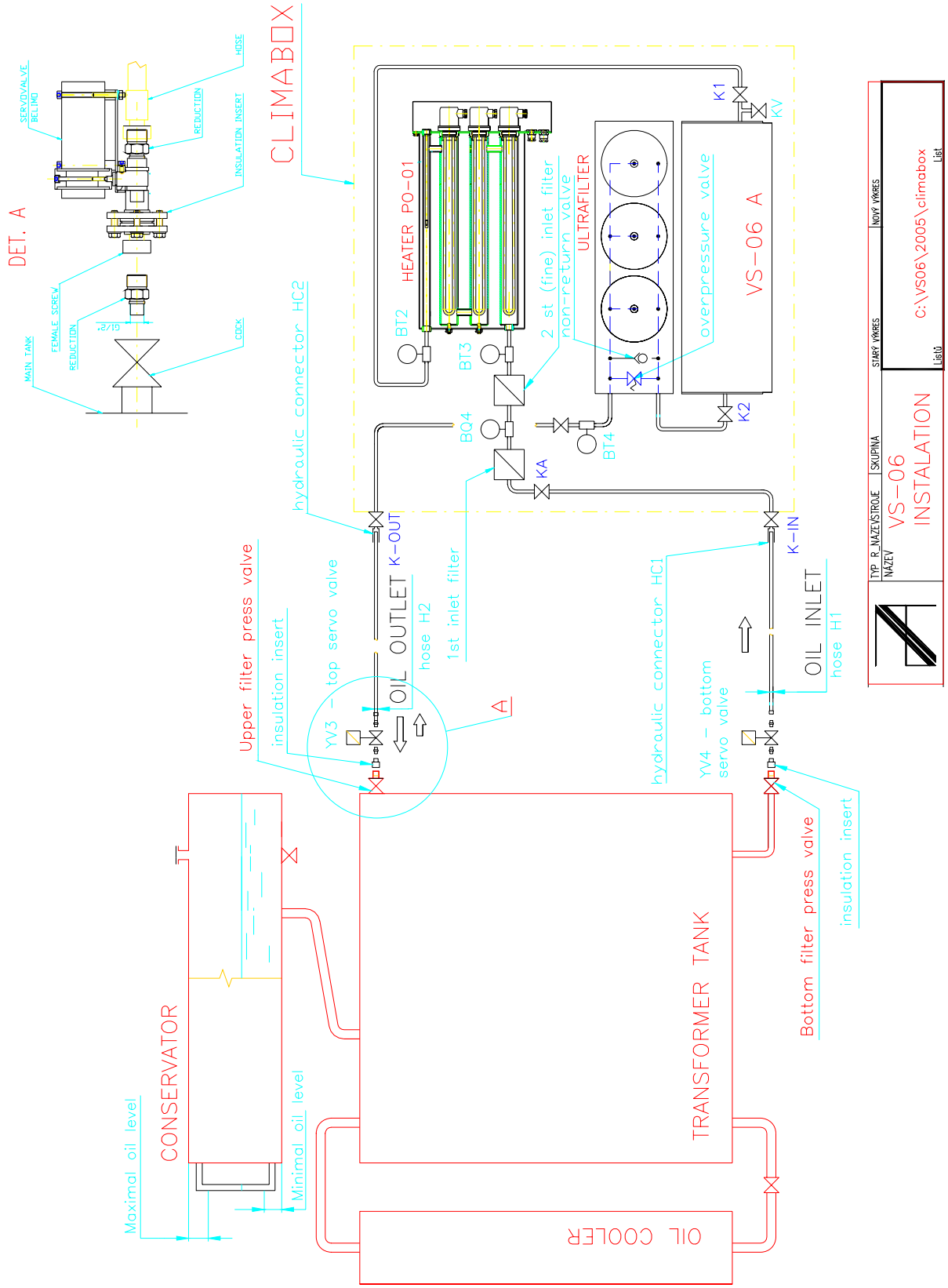


Fig.1 Instalation of VS-06

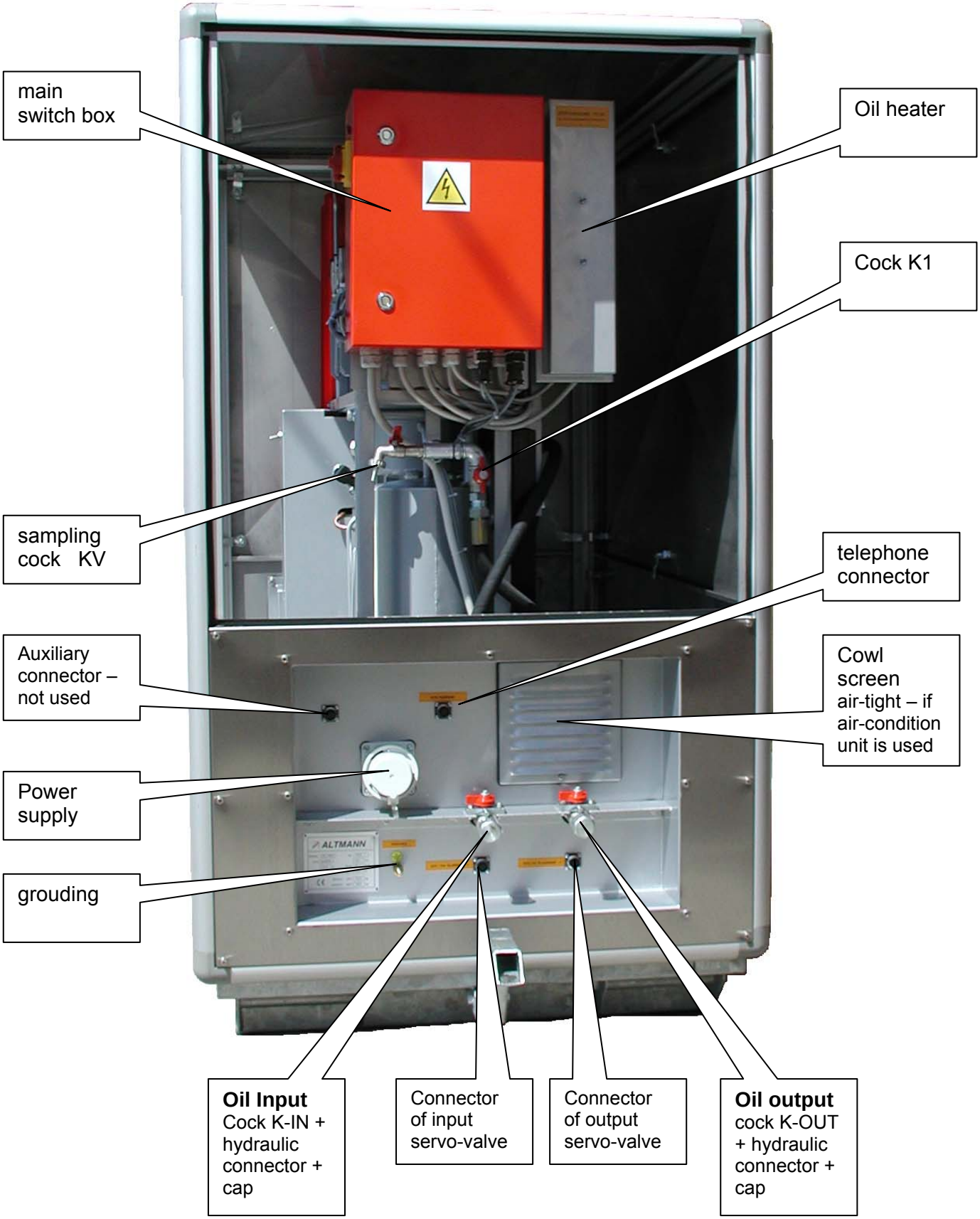
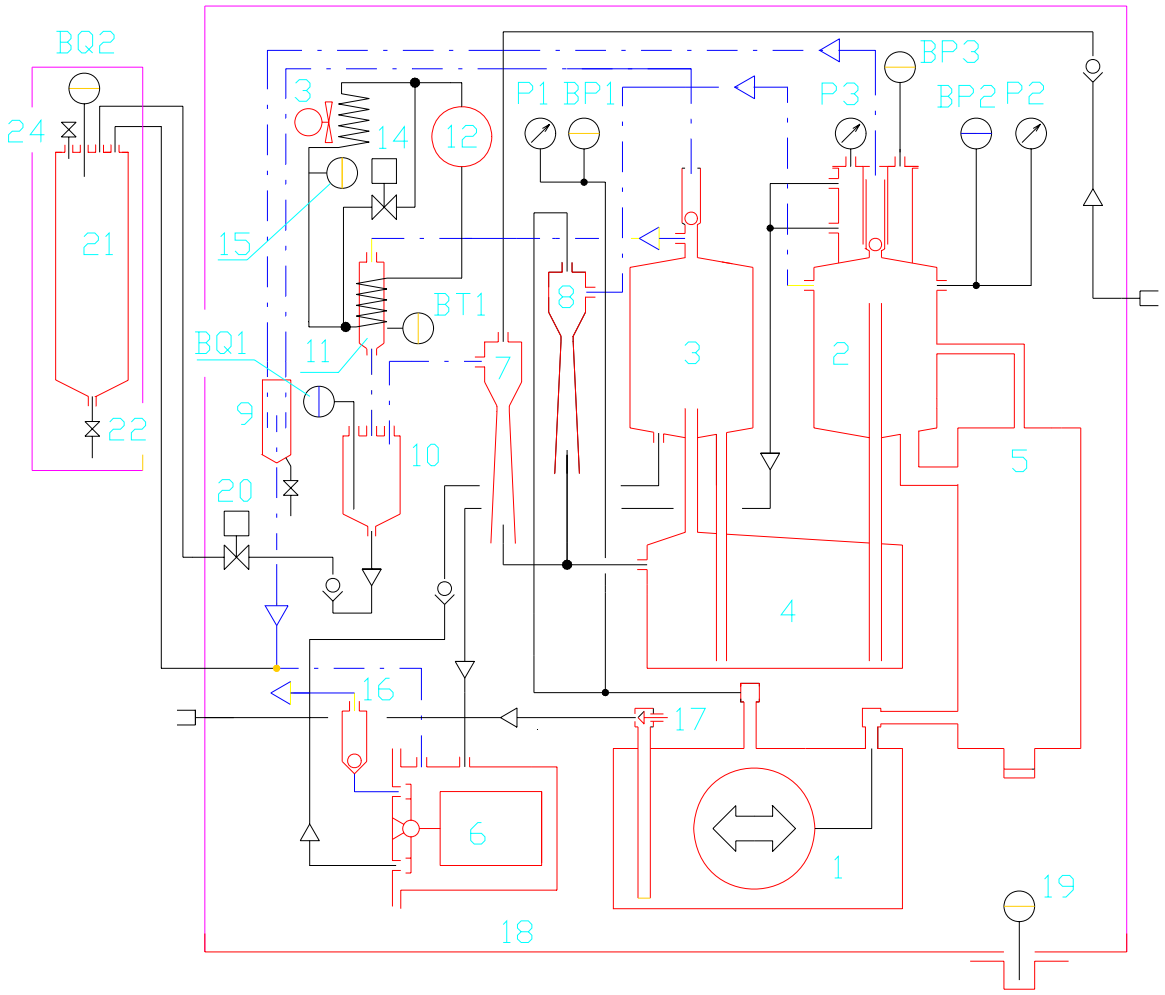
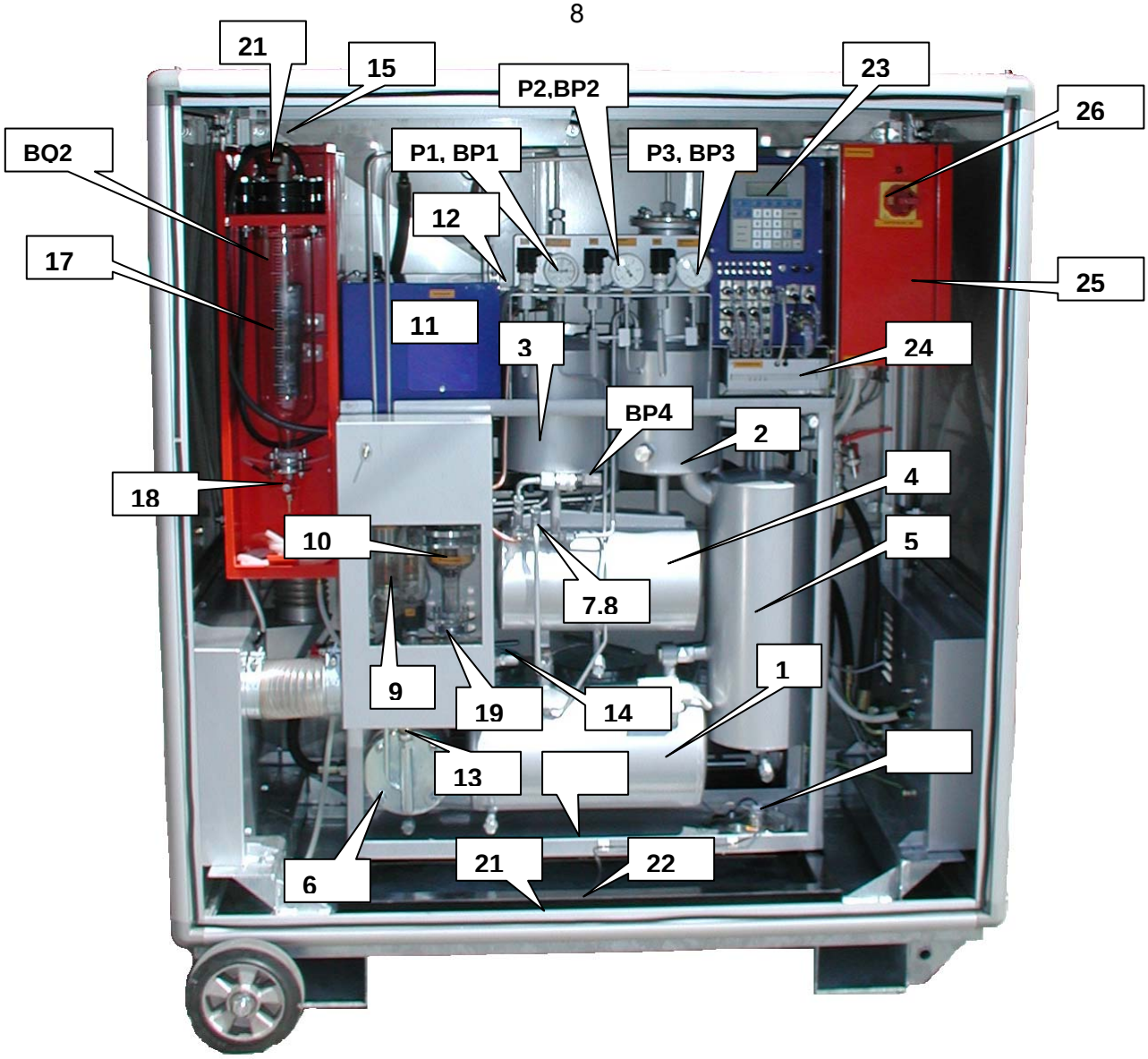


Fig. 2 Right side of VS-06 CLIMABOX without cover



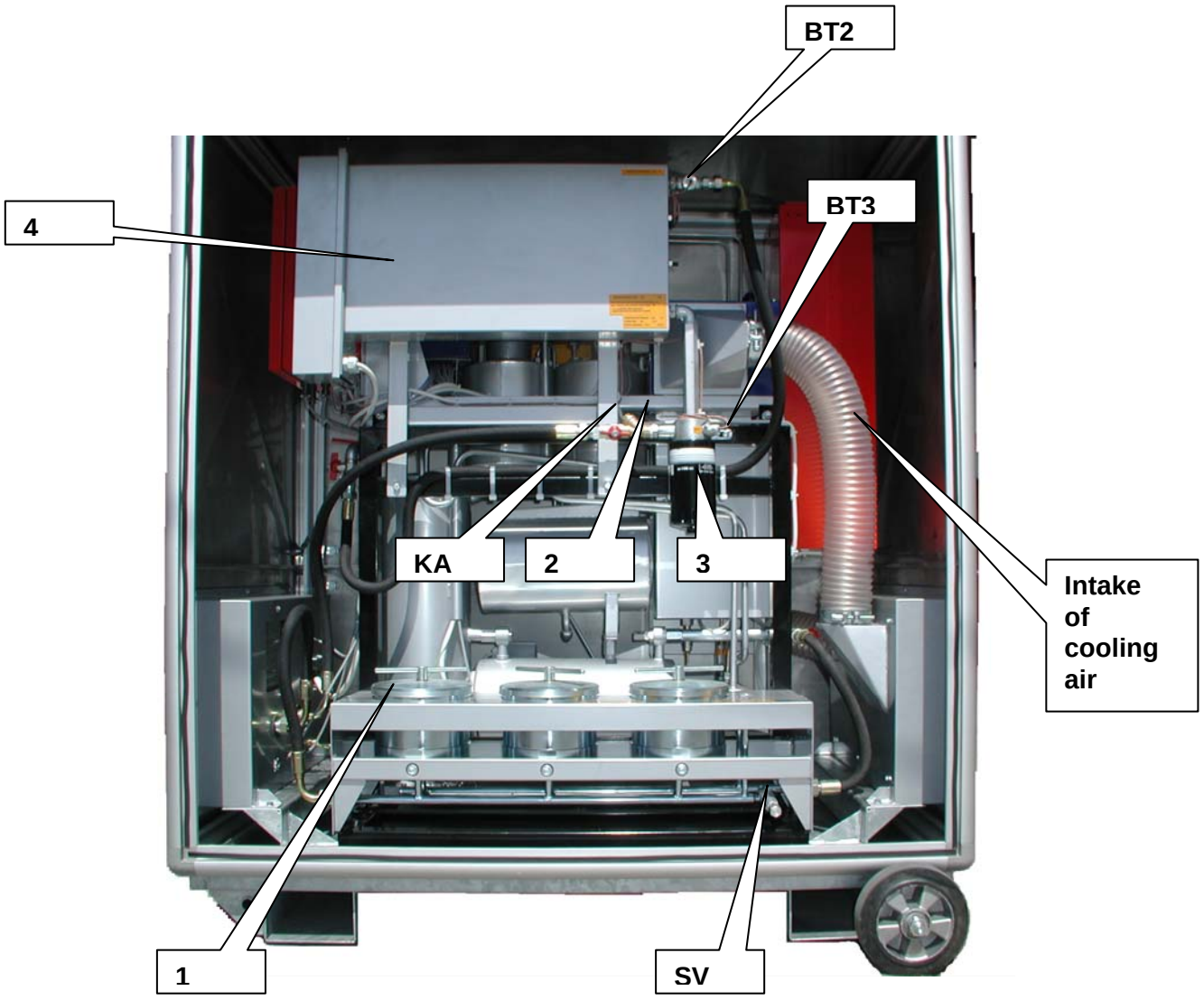
1	Hermetized pump	19	oil leakage sensor..... BQ3
2	main vacuum chamber	20	flusching valve
3	wet gas accumulation chamber	21	external water trap
4	wet gas separator	22	water removal cock
5	oil accumulator	24	air bleed valve
6	collecting chamber		
7	inlet ejector		
8	process ejector	P1	pump mano-vacuum gauge
9	gas flow monitoring chamber	BP1	pump pressure sensor
10	batch unit	P2	main chamber gauge
11	cooling chamber	BP2	main chamber pressure sensor
12	cooling compressor..... M3	P3	collecting chamber gauge
13	fan..... M2	BP3	collecting chamber pressure sensor
14	Defrosting valve.....YV1	BT1	freezing chamber temperature sensor
15	fan thermostat ST1	BQ1	batch unit water level sensor
16	Exhaust valve	BQ2	ext. water trap water level sensor
17	throtle valve		
18	oil trap tube		

Fig. 3 The flow diagram of the internal part of the VS-06 CLIMABOX



1	Hermetized pump	22	Second oil leakage sensor
2	main vacuum chamber	23	Proces Control Unit AMIT 4001 A
3	wet gas accumulator	24	Modem US Robotics (or GSM Modem)
4	wet gas separator	25	Main switch box
5	oil accumulator	26	Main switch …… QM1
6	collecting chamber		
7,8	Inlet, process ejector	P1	pump gauge
9	gas flow monitoring chamber	BP1	pump pressure sensor
10	batch unit	P2	main chamber gauge
11	cooling unit	BP2	main chamber pressure sensor
12	fan thermostat .....…ST1	P3	collecting chamber gauge
13	exhaust valve	BP3	collecting chamber pressure sensor
14	throtle valve	BP4	throughflow pressure sensor
15	Water level sensor ext. water trap		
17	External water trap		
18	water removal cock		
19	Desluging cock		
20	Air bleed valve		
21	Main oil trap tube		

Fig.4 Internal layout of main components in separator VS-06 (without cover)



1	Ultrafilter	BT2	Heater output temperature sensor
2	Inlet rough filter	BT3	Inlet temperature sensor
3	Inlet fine filter		
4	Oil heater		
SV	Safety valve		
KA	auxiliary cock (used e.g. by the exchange of the fine filter (4) or by the cleaning of filter (2)		

Fig.5 Layout of main components in rear part of separator (without cover)

Chapter 3 . Function

3.1 Computer control

The Altmann System VS-06 (Vacuum Separator) is designated for on-power dehydration of oil-immersed cellulose insulation systems of power transformers.

The separator is controlled by the „**P**rocess **C**ontrol **D**evice“ AMIT ART 4000 F.

Through remote data collection and transmission, **PCD** manages on-line the dehydration process in the separator and in the whole transformer.

PCD enables the remote-monitoring of all important parameters of the dehydration process inside of the transformer, and of separator‘s operation itself.

PCD allows to change by remote-control important operative parameters of the separator in order to guarantee optimum efficiency.

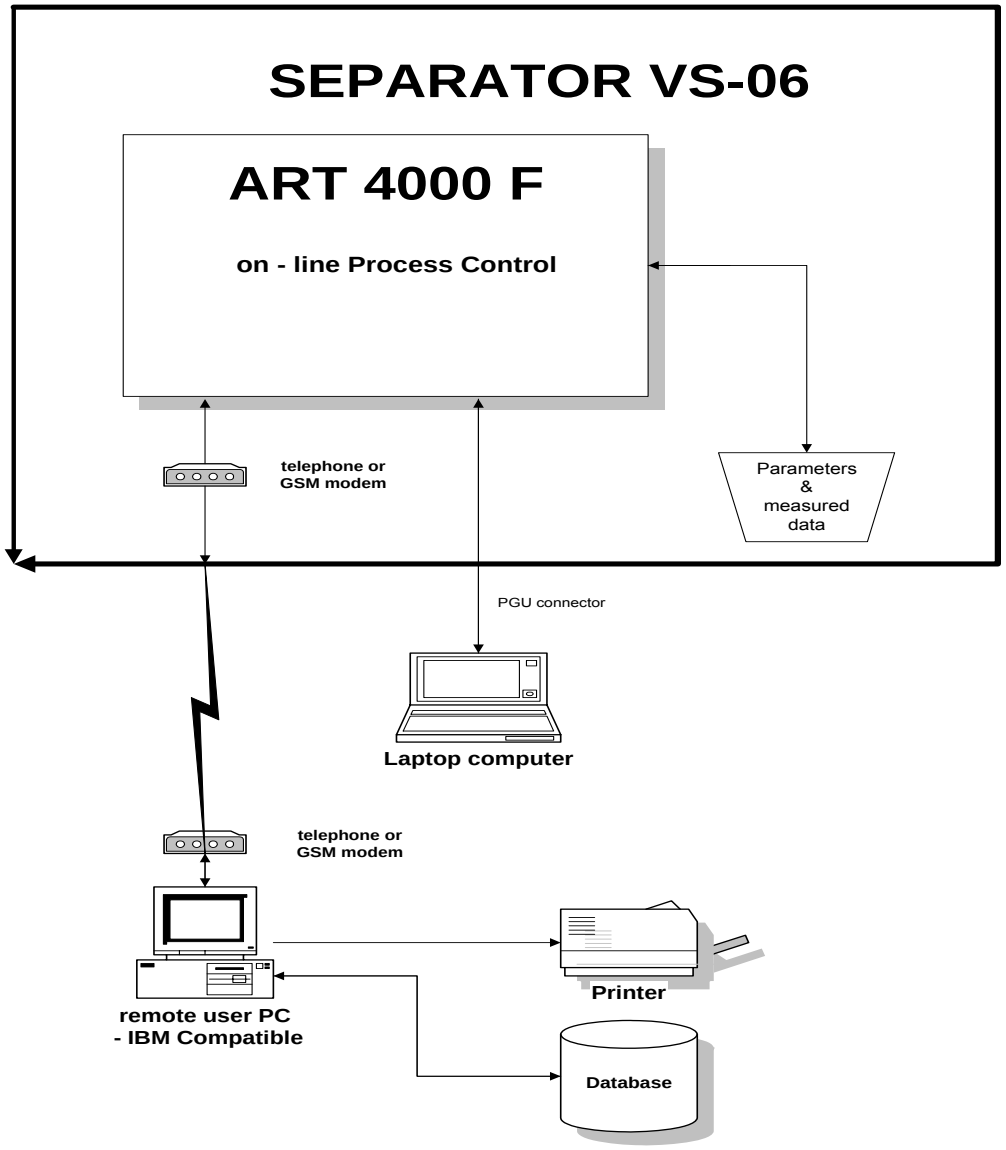


Fig. 6 Structure of control & communication of VS-06

For more details about VS-06 A Remote Control See Chapter 8.

The separator is working practically without any local operator intervention or any necessary operator supervision. The **PCD** is increasing the self-governing autonomy of the separator.

The operator‘s intervention is limited to:

⇒ connecting & disconnecting of the separator to the transformer
(See 2. **Installation**)

⇒ startup of the separator by main-switch **QM1**
(See **Startup – Procedure**)

⇒ shutdown of the separator (by main-switch **QM1** or pushing **F2** key on **AMIT** terminal)
(See **Shutdown – Procedure**)

Any other in-situ usual activities of the operator are:

⇒ changing the input and output filter inserts - pushing **F4** key on **AMIT Terminal**
(See **Filter Changing - Procedure**)

⇒ removing water from the external water collector - pushing **F3** key on **AMIT** terminal
(See **Water removal – Procedure**)

All this activities are computer controlled and supported. Computer recommends operator desired activity on terminal AMIT and checks the results.

Fig. 7 AMIT Terminal & Supply Unit

Protection and any other function of separator are solved in the same way.

Periodical monitoring, change of parameters and all other functions can be realized by remote control.

Table 1 shows list basic programs of VS-06.

These programs are initialized by pushing F1…F4 keys on **AMIT** terminal, or using the keyboard (for parameter changing).

Tree structure is used:

- First step: Select common program by pusching of F1…F4 key
- APT display then shows another menu (second level)

Example:

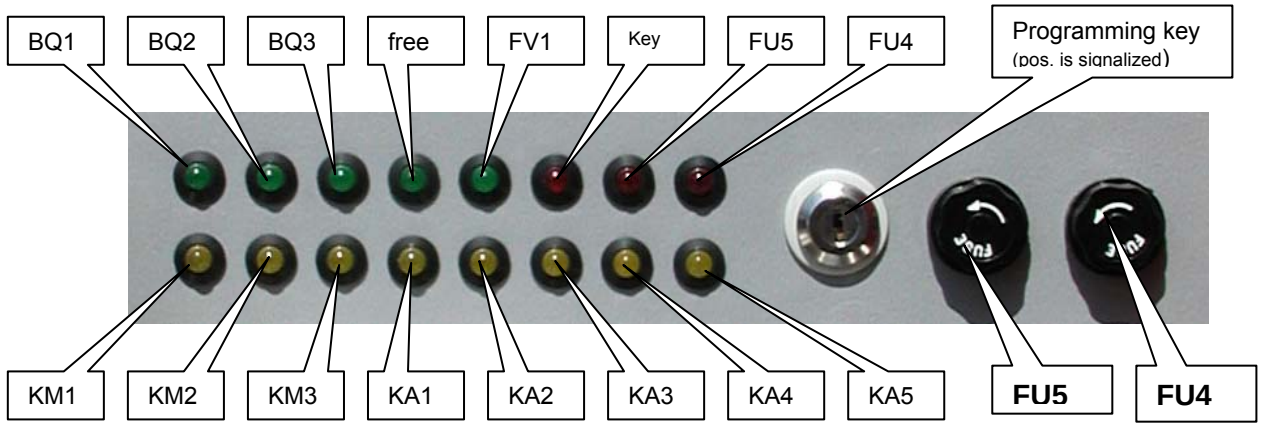
After pusching the F1 key in the first step, another choice of menues appears: pushing again F1 key for **Parameter change (Parameter Table)** , or F2 for **Manual Defrost** , or F3 for **Manual Control**

- Second step: Pusching of selected key will start the choosen program.

Table 1 Key control

KEY	Activity
F1	F1 – Parameter change , F2 – Manual Defrost , F3 – Manual Control
F2	Computer controlled shutdown
F3	Computer controlled Water Removal
F4	Computer controlled filter Check & Replacement.
F5	Computer controlled Oil Sampling

The visual control of input / output relation of the PCD AMIT can be followed by means of LEDs situated under the AMIT Terminal.



LED lighting = ON

Inputs		Outputs	
BQ1	Batch unit water sensor	KM2	Gear pump – direct run
BQ2	Water trap water sensor	KA1	Cooling
BQ3	Oil lekage sensor	KA2	Defrost
FV1	Phase relays	KA3	Flushing
KM1	Oil heating	KA4	Oil input servovalve
KM3	Gear pump – reverse run	KA5	Oil output servovalve
FU5	Fuse 9VAC - modem supply LED lighting = OFF (burned)	FU4	Fuse 24 DVC – control circuits LED lighting = OFF

3.2 Startup - Procedure

Note: Components are identified by names and numbers on the diagrams in Fig.1, Fig 2 , Fig.3 and Fig. 4. In the following text, the component numbers are in bold type enveloped by round brackets. Physical locations of these components are indicated in Fig.3 and Fig.4.

*Identification of given component is done by figure and position number (or name) – for example inlet ejector in Figure 3 is identified as (**F3,7**) or Ultrafilter in Fig. 5 is identified as (**F5,1**)*

Preprogrammed parameters are identified by* [ ] *brackets.

To start the separator switch the main switch **QM1** (**F4, 26**) on the position I (ON).

The **APT** display (**F4,23**) shows „date“ and „time“ for checking. You have 5 sec for zero setting of values for T (total time of dehydration), MWC (total amout of separated water until this time in ml) and MW (total water volume in the external water trap in ml).

VACUUM SEPARATOR
VS-06
”date**”** **”**time**”**
ZERO SETTING - ENTER

When the separator is conected to a new transformer for a new dehydration process, the values for T (time of dehydration), MWC (total volume of separated water), MW (actual water volume in the water trap) need to be set to zero.

By pushing ENTER all the registers for T, MWC and MW are set to zero. The display confirms the procedure as follows:

VACUUM SEPARATOR
VS-06
MWC = MW = 0
T = 0

When we need to conserve the old values for T, MWC and MW, (continuing the dehydration of the transformer in cure, after shut-down of main switch) - do nothing - only wait ca 5 sec and separator will start to work again with the earlier values..

The automatic start-up procedure first evacuates the whole outflow section of separator, display shows:

SEPARATOR START UP
VACUUM PROCESSING
IN OUTLET SECTION
P1 = P1 **P2=** P2 **(kPa)**

If pressure **P1** in his section decreases below the preprogrammed absolute pressure **[P1MIN],** then the servovalve **YV3** will open automatically, but the sampling cock is still closed.

Attention : If the pressure **P1** will not decrease below **[P1MIN]** level, then the Startup procedure will remain in the first step. The vacuumizing of the outflow section is not succeful and the outflow servovalve remains in closed position.

The **AMIT Terminal** reports that the desired vaccuum is reached and demands the opening of the upper valve (cock) on the transformer main tank

OUTLET SECTION

ON VACUUM P1 = P1 **OPEN UPPER VALVE(S)** **AT MAIN TANK**

And the oil from the main tank will flush this section.The flush of oil from the transformer continues automatically until the whole separator is filled with oil. The **AMIT Terminal** will report:

GAS COMPRESSION **P1 =** P1 **P2 =** P2 **(kPa)**

If pressure **P2** exceeds preprogrammed absolute pressure **[P2AUTO]** and gases are expelled from main chamber and gas acumulator, the **AMIT Terminal** will report Gas Exhaust. This is visible as a stream of gas-bubbles in the glas of the control chamber (**F4,9**) and then in the plexi glas extension of the exhaust valve (**F4,13**)

GAS EXHAUST **P1 =** P1 **P2 =** P2 **(kPa)**

If the hydrostatic head of the transformer is lower then ca. 1,.5 m of the separator, then the filling of the separator is too slow. Automatically the separator pump switches on reverse ON-OFF to force the oil into the separator.

The **AMIT** terminal will report the end of this step and the automatic transition to the next step

VACUUM PROCESSING **IN INLET SECTION** **P1 =** P1 **P2=** P 2 **(kPa)**

If pressure **P2** in the separator and in the suction section decreases below the preprogrammed absolute pressure **[P2MIN],** then the servovalve **YV4** will open automatically. The **AMIT Terminal** will report:

INFLOW SECTION **ON VACUUM** **OPEN BOTTOM VALVE(S)** **AT MAIN TANK**

The whole inlet section is flushed by the oil from the transformer and **AMIT Terminal** will report the end of startup procedure:

STARTUP FINISHED **SEPARATOR READY** **FOR TRANFORMER** **DRYING**

PCD – computer controll of the separator will automatically start main hydraulic-vacuum cycle.

3.3 Separation of moisture and gases

The VS-06 separator provides moderate vacuum, moderate heat and large interfacial surface, needed to separate gases and vapours from the oil.

All procedures are fully automatized and remote controled, local operator action is not necessary.

3.4 Water removal - Procedure

Water removal procedure from **water trap (F4,17)** can be effected any time by pushing **F3** key on **AMIT Terminal**.

The **AMIT Terminal** will report start of water removal procedure accustically and on display:

WATER REMOVAL ON
PRESSURE
EQUALIZATION, WAIT
P2 = *xxx* **kPa**

CAUTION The water removal cock (**F4, 18**) can be opened only if pressure equalizition is indicated. Then a water removal procedure is realized, and cock (**F4,18**) must be closed again.

OPEN BOTTOM COCK
OF WATER TRAP
DRAIN OFF WATER
PUSH ENTER

After pusching ENTER separator goes back to normal separation process

3.5 Oil sampling procedure

Oil sampling procedure can be started any time by pushing **F5** key on **AMIT Terminal**.
The **AMIT Terminal** will report this status as:
.

OIL SAMPLING ON
WAIT
FOR PRESSURE
EQUALIZATION

CAUTION Sampling cock (**F2, KV**) , situated under main switch box , can be opened only if pressure equalization (PRESSURE OK) is indicated. When a sampling procedure is made, cock (**F2, KV**) must be of course closed again.

PRESSURE OK
SAMPLING FINISHED ?
YES - ENTER

After pusching ENTER separator goes back to normal separation process

3.6 Shutdown - procedure

Separator VS-06 can be any time shut down by :

- main switch **QM1**
- key **K2**

3.6.1 Main switch

When main switch **QM1** is setted **OFF** in ca 10 sec are closed both servo valves **YV3** and **YV4**. This way is separator quickly a safely disconnect from oil filling of transformer.

When **QM1** is setted **ON** is separator automatically started again

Computer controlled shut- down procedure is inicialized by key **F2.**
Display offers us two procedures

FOR SHORT-TERM
SHUTDOWN - PUSH F7
FOR LONG-TERM
SHUTDOWN - PUSH F8

3.6.2 Short-term shutdown

After click on F7 display shows

SHORT-TERM
SHUTDOWN ON
WAIT

and standard sequence **Water removal** 3.4 is started at first.

Using of **Water removal** procedure as internal procedure of **Short-term shutdown** is necessary especially under very low surrounding temperatures.

When is this procedure finished goes separator back to normal Short-term shutdown procedure.

: **SHORT-TERM**
SHUTDOWN FINISHED
FOR START TURN OFF/ON
MAIN SWITCH QM1

3.6.3 Long-term shut down

When water content in the transformer decreases under desired level is dehydration process stopped and separator is transported and connected to another wet transformer .

Separator should be transported without oil and therefore following procedure is used
After pusshing of F2 is following display shown again

FOR SHORT-TERM
SHUTDOWN - PUSH F7
FOR LONG-TERM
SHUTDOWN - PUSH F8

and after pusching **F8** is displayed

SHUTDOWN FOR

TRANSPORTATION ?

YES - ENTER

and sequence of another instructions and mesages are the same as by SHORT-TERM procedure.
When WATER REMOVAL is finished and on the display is indicated

LONG-TERM SHUTDOWN
ON
VACUUM PROCESSING ON
WAIT

and servo valve **YV4** closes immediately and stopts oil inflow in the separator. The pump is turned on, vacuum is builded up and this process continues until separator is emptied.

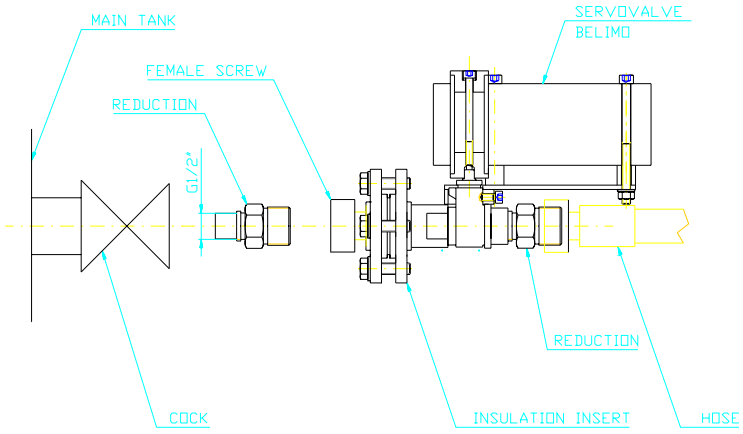
When proper vacuum is reached, the pump turns off and this state is reported as

CLOSE BOTTOM COCK
OF TRANSFORMER
DISMOUNTE VALVE YV4
PUSH ENTER

DISMOUNTING OF SERVOVALVE HAVE TO BE ALWAYS CARRIED OUT WITHOUT DISENGAGE OF HOSE only by unscrew of female screw – See following Fig.

Only this way remains the hose under vacuum and separator shut-down is not disturbed !!

THIS PROCEDURE IS THEREFORE VALID FOR DISMOUNTING BOTH SERVO VALVES



after click on **ENTER** servo valve **YV4** opens and the infowing air is forcing the oil from hose H1 and preheater PO-01 back into separator.

End of this process is reported as

OIL EXHAUST FINISHED
CLOSE COCK K-IN
DISMOUNT HOSE H1
PUSH ENTER

and then follows the next procedure for oil-discharging from outflow section.

Beggin of this process is indicated as

LONG-TERM SHUTDOWN ON
VACUUM PROCESSING ON
WAIT

and

CLOSE UPPER COCK OF TRANSFORMER
DISMOUNTE VALVE YV3
PUSH ENTER

after pusching of **ENTER** is servo valve **YV3** (dismantled by **unscrew of female screw** from upper cock of transformer) openned and air from surrounding forcess out the oil from hose H2 and ultrafilter back into separator.

End of this process is reported as

OIL EXHAUST FINISHED
CLOSE COCK K-OUT
DISMOUNT HOSE H2
PUSH ENTER

and end of long-term shut-down is reported as

LONG-TERM
SHUT-DOWN FINISHED
TURN OFF
MAIN SWITCH QM1

Long-term shutdown od separator is finished when QM1 is switched OFF and power suplly cable is dismantled.

CAUTION !

Separator should be transported in vertical position only !

3.8 On-line volume measuring of separated water

The quantity of separated water is measured by volume, and is stored in the PCD AMIT. From there remote collecting of these data is possible at any time.

At the later stage of the defrosting procedure, water dropps will fall by gravity from the cooling chamber (**F3, 11**) down into the bottom of the glas cylinder of the batch unit (**F3,10**). When the level of this collected water reaches the water sensor (**F3, BQ1**), a signal as (ca 20 ml of collected water) is passed on to the PCD control unit, and the separator goes to the batch procedure.

The batch procedure is reported on the **AMIT Terminal** as:

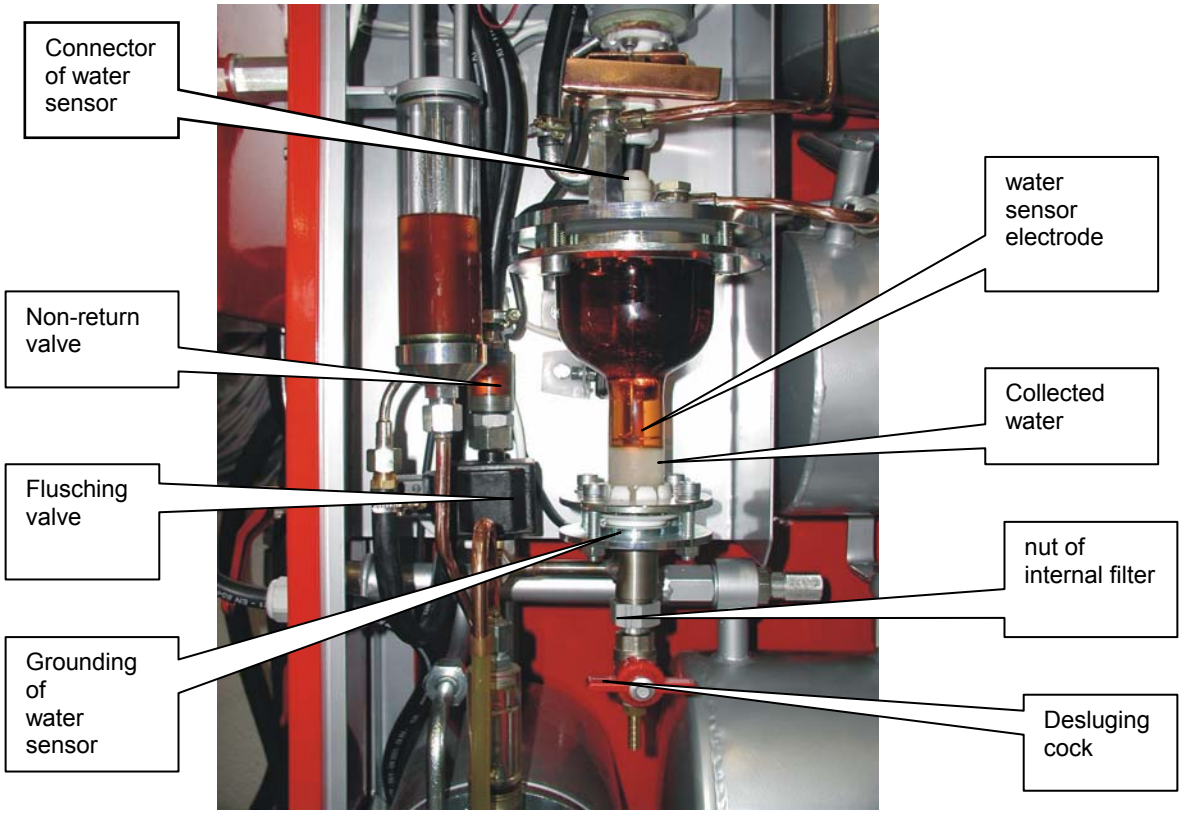
WATER BATCHING
ON

WAIT FOR
FLUSHING

The gear pump will run on reverse, and if the pressure **P2** exceeds the preprogrammed pressure level **[P2AUTO]** , the flusching valve (**F3,20**) will be opened, and water (and oil) will be pumped from the batch unit into the water trap (**F3,21**). See function diagram on Fig. 3.

The batching unit will be flushed twice in order to remove the last water residua, before the whole batching procedure is finalized.

From the time interval between the last and the present batch procedure, and the volume of transported water, PCD calculates the water removal efficiency **MWT** (ml/24 hod) of separator.



Chapter 4 . Protections

The separator VS-06 is designed and build speciffically with remote control in order to operate for prolonged time periods without the necessity of any local supervision.

Therefore it is very important that any significant oil-loss will be ruled-out under any circumstances.

4.1 Oil loss

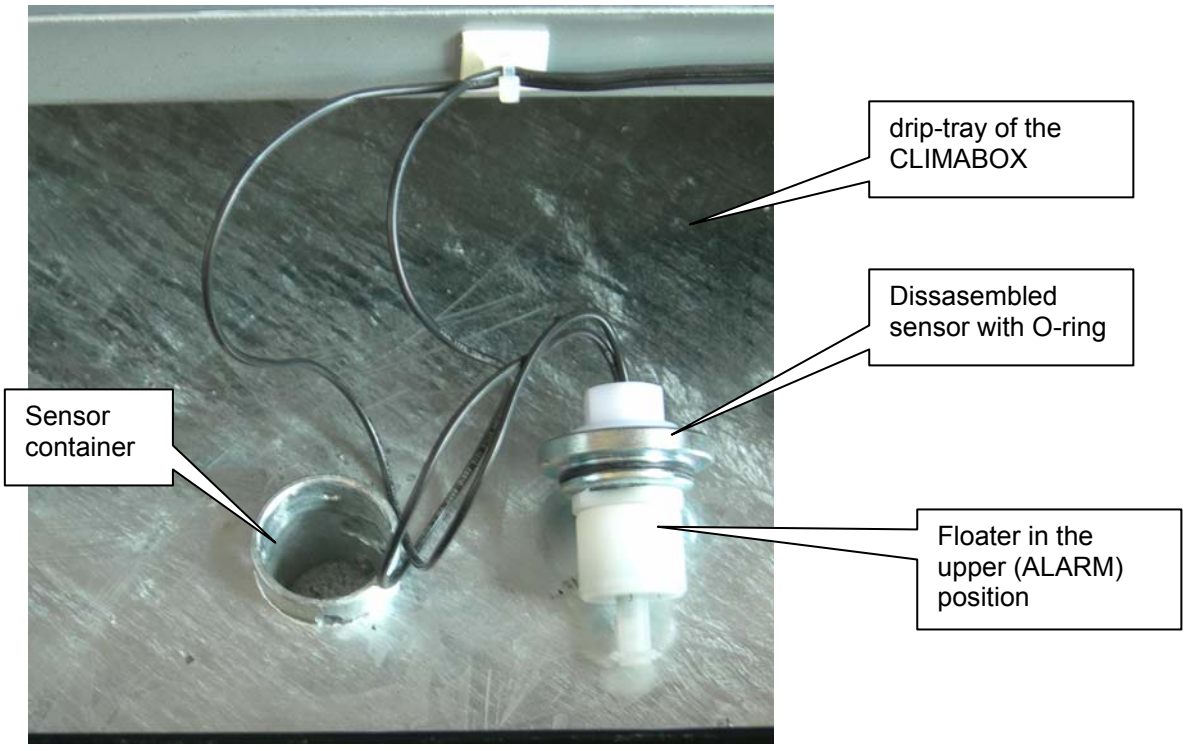
The separator system consists of hermetically sealed hydraulic and condensation circuits and at the rear side is situated the external heater and ultrafilter (See Fig.1 and Fig 4). All these parts are hydraulically connected to the leakage tube in the bottom of the CLIMABOX. Any oil spil in the separator system will be collected in this leakage tube. In the unlikely event of spill, leakage sensor BQ3 (**F4,16**) mounted in the lowest part the drip tray of the CLIMABOX will then generate oil loss alarm. Immediatedly the separator is stopped, and the servo valves shut-off.

Thus, in 10 seconds of detecting oil-spill, the transformer will be hydraulically isolated from the separator by closing down of the two servo valves **YV3** and **YV4**,.

The oil-leak alarm is indicated acustically and on the display of the **AMIT Terminal**.

OIL LEAK
FIND & REPAIR LEAKAGE
DRY OUT SENSOR BQ3
RESET BY QM1 OFF/ON

After the detecting and sealing of leakage (and drying of container of leakage sensor BQ3 See (F4,16) and the photograph picture showing disassembled sensor), reset the separator by switching main switch **QM1** OFF and ON.



4.2 Overpressure

Hydraulic and vaccum chambers of separator, heater and ultrafilter are protected against overpressure in two levels:

- PCD controls the pressure **P1** and **P2**, and will recognize if these values will exceed the allowed limits **[P1MAX]** / **[P2MAX]** . If this happens, the separator is automatically shut off, and this state is indicated accustically and on the display

If pressure P1 on the pump exceeds **[P1MAX]** , acustic alarm is generated, and display on **AMIT Terminal** will indicate:

OVERPRESSURE P1
ALL VALVES & COCKS
ON OUTFLOW ARE OPEN ?
RESET BY QM1 OFF/ON

If pressure P2 in the main chamber exceeds **[P2MAX]** , acustic alarm is generated, and display on **AMIT Terminal** will indicate:

OVERPRESSURE P2
CHECK SENSORE BP2
BY MEANS GAUGE P2
RESET - QM1 OFF/ON

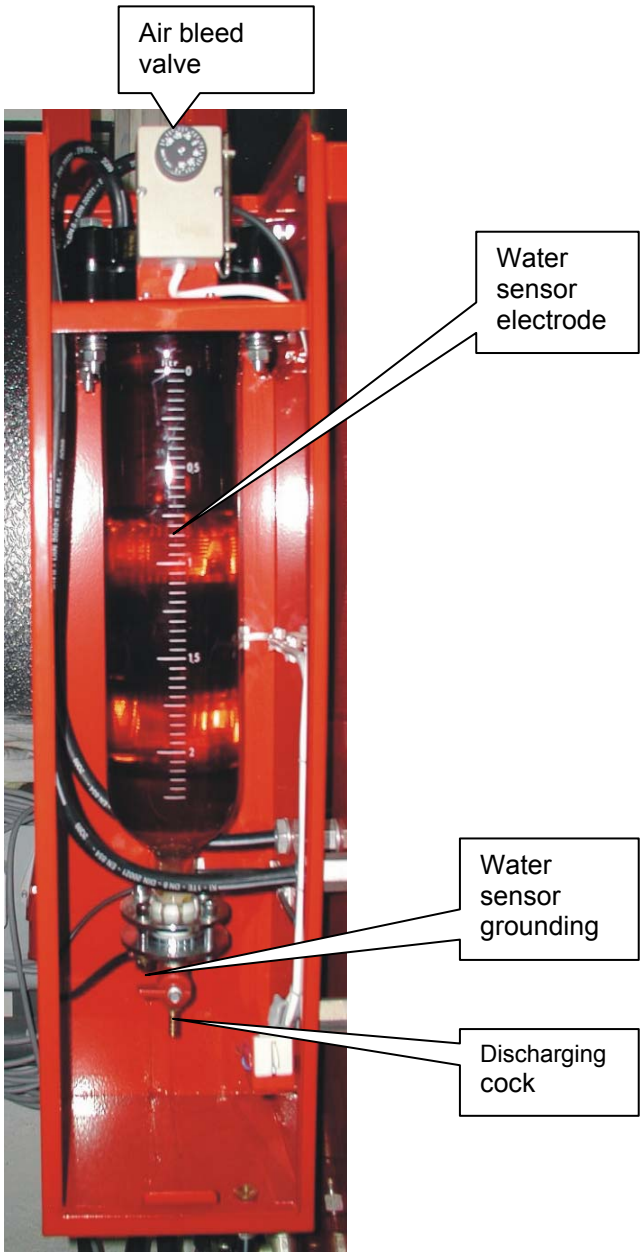
4.3 Overfill of external water trap, and discharge of external water trap

If water level in the water trap (See Fig.3 Position 18) exceeds allowed level, then the water level sensor BQ2 (**F2,BQ2**) will be activated and separator is shut down. **AMIT Terminal** will display:

WATER TRAP FULL
FOR DISCHARGING
PUSH F3

Manual water removal from water trap can be made any time under normal operation of the separator, if one simple condition is fulfilled:

The pressure P2 has to be below 100 kPa during the whole removal procedure in order to rule out any unwanted oil-spill.



Manual water removal procedure:

- check the pressure level P2
- remoove cap of air bleed valve
- slowly open the air bleed valve
- slowly open the discharging cock and discharge all water from water trap
- close both cocks
- close air bleed valve with cap

ATENTION !

When the separator is shutted-down and the ambient temperatures are deep below 0°C, the water from the external water trap has to be completely removed.

Chapter 5 . Alarms

All vital functions of separator are continuously observed, recognized and supervised by PCD.

ALARM is generated and indicated if PCD recognizes, that measured parameters will exceed preprogrammed and given criteria.

ALARM is indicated on AMIT Terminal and acustically:

ALARM is transmitted to the supervisor by remote PC – See Manual **VS-06 Remote Control** .

5.1 STARTUP - ALARM

	WRONG VOLTAGE OR
	ROTATION DIRECTION
	TURN QM1 OFF , REPAIR
	TURN QM1 ON

5.2 BATCH UNIT - ALARM

This alarm indicates, that the water sensor **BQ1** of batch unit (**F3,BQ1**) is contiuously under water. PDS evaluates this as choked internal batch filter and the separator is automatically shut off.

AMIT Terminal displays:

BATCH UNIT CHOKED **CLEAN INTERNAL** **FILTER - FOR START** **TURN QM1 OFF AND ON**

The filter is situated in the lower part of batch unit. After Shut-Off of the separator, empty the batch unit by opening the desluging cock, and open the nut of internal filter. The filter can be easily cleaned with brush, solvent and pressurized air. See picture in Chapter 3.7

Chapter 6 . Maintenance

The VS-06 Separator requires minimum maintenance. Neverthelless, it is recommended that a regular maintenance schedule be establisched as described in the following sections .

6.1 Cleaning of internal surfraces of glas chambers

By dehydration of wet transformer with heavy aged oil is necessary regular cleaning of all glas chambers and cylinders. The cleaning is provided by serviceman of producer or other authorized person.

6.2 Input filters – Check & Replacement

Intensity of inflow of oil in separator is computer controled. If the actual volume of delivered oil decreases under given limit (under setting point of flow indicator BQ4 → BQ4 is OFF), is this evaluated as a fault and indicated on display of APT as ALARM:

INFLOW TO LOW
FOR CHECK & REPLACE
INPUT FILTERS
PUSH F4

Now is computer asking which filter we want check or replace

FILTER INSERTS
REPLACEMENT -
FOR INLET FILTERS - F1
FOR OUTLET FILTERS - F2

Because we have trouble with oil inflow the key F1 is used.

INLET FILTERS
CHECK & REPLACEMENT
VACUATION
WAIT

Suction side of separator is provided with two filters - first stage drum (metal cloth) rough filter (See Position 2 on Fig.4) and second stage fine (car) filter (See Position 3 on Fig 4). Both are situated on rear side of separator and have to be checked or replaced together.

To avoid the oil loss is the whole check & removal procedure made under proper vacuum in the separator.

Inlet filter removal procedure always begins with checks of drum (rough) filter.

End of vacuation procedure is indicated as

UNSCREW CAP OF
ROUGH FILTER AND
CHECK HIS CHOKING

After checking and cleaning of rough filter we get following display

ROUGH FILTER OK ?

YES – ENTER

if is rough filter closed with cap again we can confirm it by ENTER

and replacement procedure of fine filter (See Position 3 on Fig.4) is performed

UNSCREW FINE FILTER **SCREW ON NEW FILTER**

As fine filter normal car filter can be used See Table

Alternative Inlet Filters

FIAAM	FT 5044
FRAM	PH 4854
MANN & H	W 950/4
PUROLATOR	PER 316 - OC 105

And computer asks if the procedure is finisched

INLET FILTERS **CHECKED & REPLACED ?** **YES - ENTER**

and after pushing ENTER goes back to STARTUP Procedure

6.3 Replacement of filter inserts of ultrafilter

The degree of choking of filter inserts of ultrafilter is computer controlled.

If pressure loss of ultrafilter exceeds given level is this evaluated as Overpressure Alarm and after checking sequence described in Section 4.2 it is indicated as

ULTRAFILTER CHOKED **FOR REPLACEMENT** **PUSH F4**

After pusching of **F4** PCD asks again what filters we want check or replace

	FILTER INSERTS
	REPLACEMENT -
	FOR INLET FILTERS - F1
	FOR OUTLET FILTERS - F2

We confirm our decision by pusching F2

OUTFLOW FILTERS **CHECK & REPLACEMENT** **ULTRAFILTER** **VACUATED WAIT**

To avoid the oil loss the whole check & removal procedure have to be made under proper vacuum in the ultrafilter and separator.

Proper underpressure is indicated as

VACUUM OK , UNTIGHT
LIGHTLY ALL CENTRAL
SCREWS - WAIT
OIL EXHAUST IS ON

Under this conditions (all central screws are sligtly untight), atmospheric air slowly and uniformly forces oil from all chambers of ultrafilter back in vacuum in the separator. The end of this procedure is indicated as

LIFT OFF ALL CAPS
REPLACE FILTER INSERTS
IF ALL REPLACED
PUSH ENTER

After pusching ENTER goes PCD back into STARTUP procedure.

Chapter 7 . Electrical circuits

Power Circuit diagram is shown on Fig. 8

Name	Function	Designation	Qty.	Producer
MAIN SWITCH BOX				
QM1	Main switch	3LD2103-OTK53	1	Siemens
QF1	Heater breaker	5SX2 316-6	1	Siemens
QF2	Motor pump breaker	3RV11-1CA10	1	Siemens
QF3	Power supply unit breaker	5SX2 116-6	1	Siemens
KM1	Motor pump contractor-direct run	3RT1016-1BB42	1	Siemens
KM2	Heater contractor	3RT1016	1	Siemens
KM3	Motor pump contractor –reverse run	3RT1016	1	Siemens
FU1	Transformer	T2,5A, 5x20		GES Electronics
FU2	Cooling	T4,0A, 5x20		GES Electronics
FU3	Servovalve Belimo	T1,0A, 5x20		GES Electronics
FU4	Power supply 24DVC	T5,0A, 5x20		GES Electronics
FU5	Modem	T1,0A, 5x20		GES Electronics
FU6	Fan	T2,5A, 5x20		GES Electronics
HERMETIZED GEAR PUMP				
M1	Gear pump motor	1LA7080-4AA11	1	Siemens
HEATER				
EH1,1-1,3	Heating rod	14011/06 400V, 7500W	3	Eltop
ST1	Thermostat	TH160.2	1	Elfetex
COOLING UNIT				
M3	Compressor (standard version) or tropical climate over 40C	GD36AA, 230v YB-645 GTD	1 1	Electrolux Mitsubishi
YV1	Solenoid valve	HM2, 230V	1	Castel
ST0	Thermostat	F/2000	1	PRODIGY
M2	Fan motor	4656 N		Pabst

AC/DC Supply				
TM1	Transformer	51265-P1S2	1	NT MAGNETICS
VD1	rectifier		1	Altmann
TM0	Autotransformer (special order - only for insulated grids)	TAC 35052-0010	1	Elektrokov Znojmo

AIR CONDITIONER				
M4	Fan	7450 ES	1	Pabst
ST 01	Thermostat	F/2000	1	PRODIGY

CONTROL & SUPPLY UNIT				
PCD	Proces Control Unit	ART 4000F	1	AMIT
KA1,3,4	Power switch – compressor, water batch, oil input Belimo	3TX7004-1MBO	3	Siemens
KA2	Power switch - defrost	3TX7004-3AC03	1	Siemens
KA5	Power switch – oil ouput Belimo	3TX7002-1FB02	1	Siemens

COMMUNICATION UNIT				
	Modem		1	US Robotics
	or GSM Modem	TC35i Terminal	1	Siemens

Process sensors 4-20 mA

BP1	Pressure sensor	DMP331 0 – 6 b	1	BD Sensors
BP2,3,4	Pressure sensor	DMP331 0 – 2.5b	1	BD Sensors
BT1	Temperature sensor	Flexitemp 60 -50 +60^{o}C	1	JSP Jicin
BT2,3	Temperature sensor	TG5 0 – 100oC		APO Elmos

ON/OFF sensors

BQ1	Batch unit (water level)	WLS1	1	Altmann
BQ2	Water trap (water level)	WLS1	1	Altmann
BQ3	Leakage sensor	RSF54Z100RC	1	Cynergy 3
FV1	Rotation direction/Voltage check & Reading relay	3Ug4615-1CR20	1	Siemens

Lighting switch

S1	Limit switch	HL408	1	GES Electronics

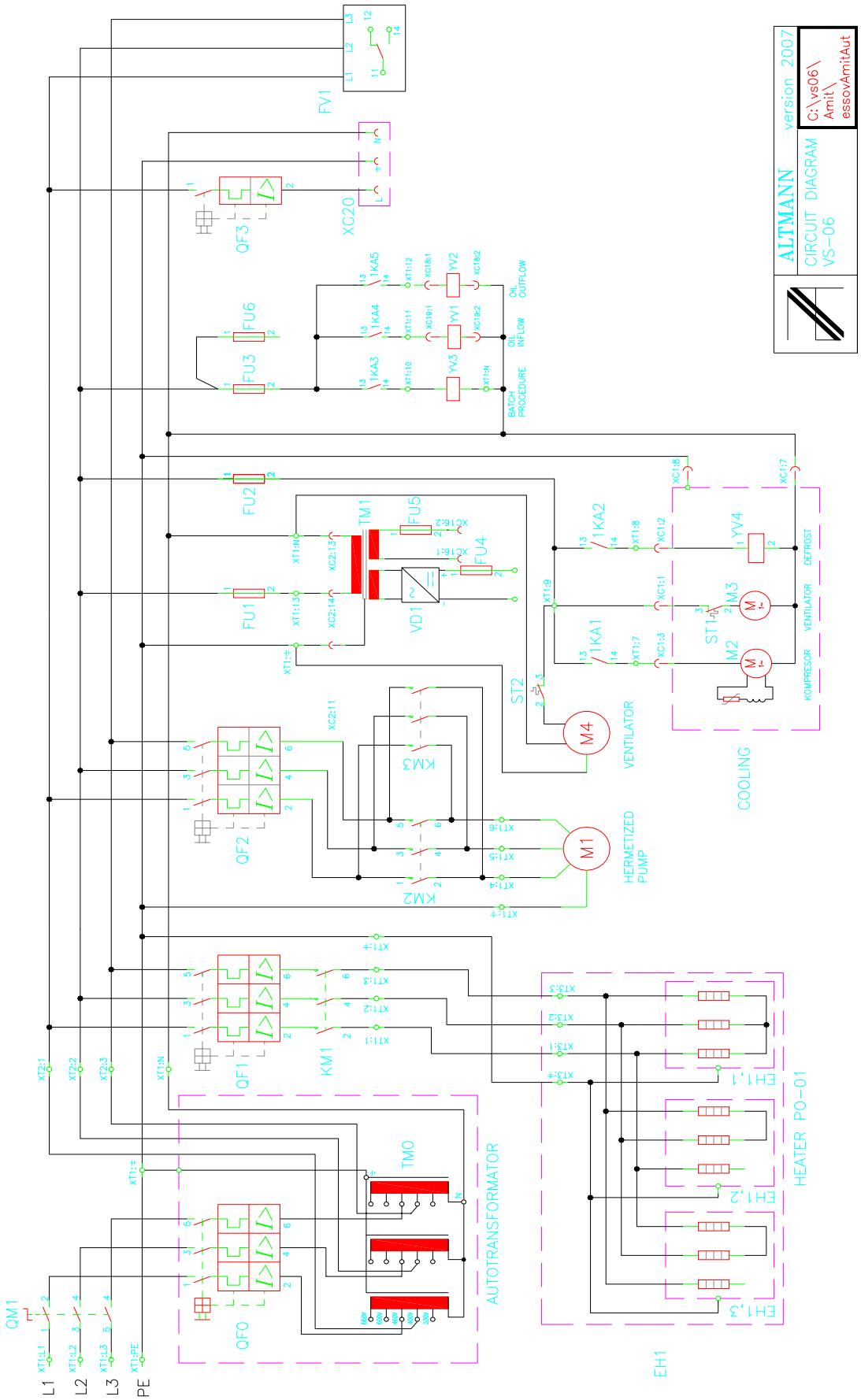


Fig. 8 Power circuit diagram

Chapter 8 - Remote Control

8.1 Program installation

Program ALTMANN V2.0 - delivered CD disk - contains the main program for the remote (and in situ) control and the monitoring of VS-06 and additional sub-programs that enable an easy installation of the whole firmware into your computer.

Installation procedure:

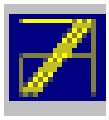
- insert ALTMANN CD into disk drive (usually **D**)

  under a normal operational condition is CD installed automatically

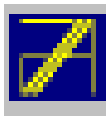
  if not

  - choose **START** and press **RUN**
  - type **D:\setup.exe**. into the command line
  - Press **OK (Enter)** to confirm the procedure.
  - After the **SETUP** panel has appeared, click on **TARGET** and choose the target directory into which you want to install the program. The program will offer you one of the possibilities (C:\ Altmann). Press OK to accept this offer
  - Click on **START** and program SETUP will install program ALTMANN into your computer
  - Press **OK (Enter)** to confirm the procedure

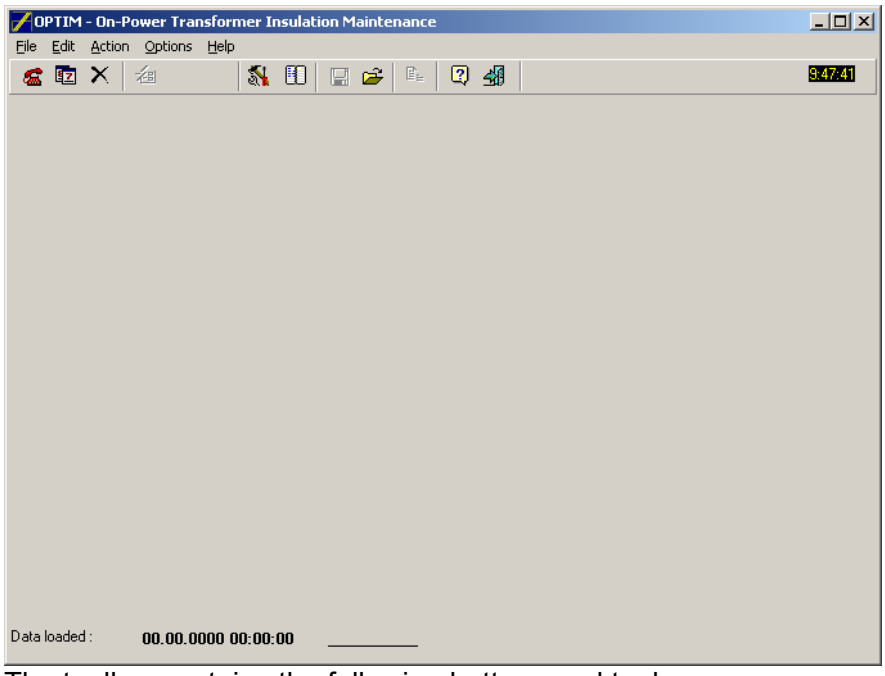
and your PC will offer you a window with the firm icon.



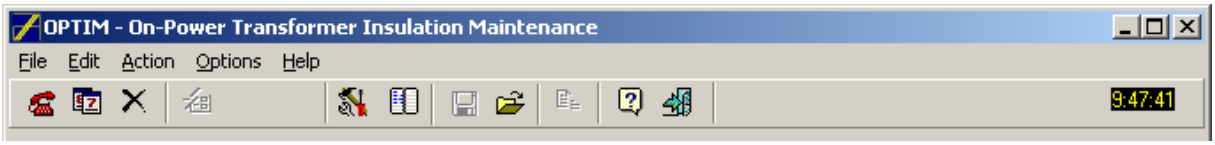
8.2 Starting the program

Click on the Altmann´s firm icon to  launch the program.

Having launched the program basic windows will appear.

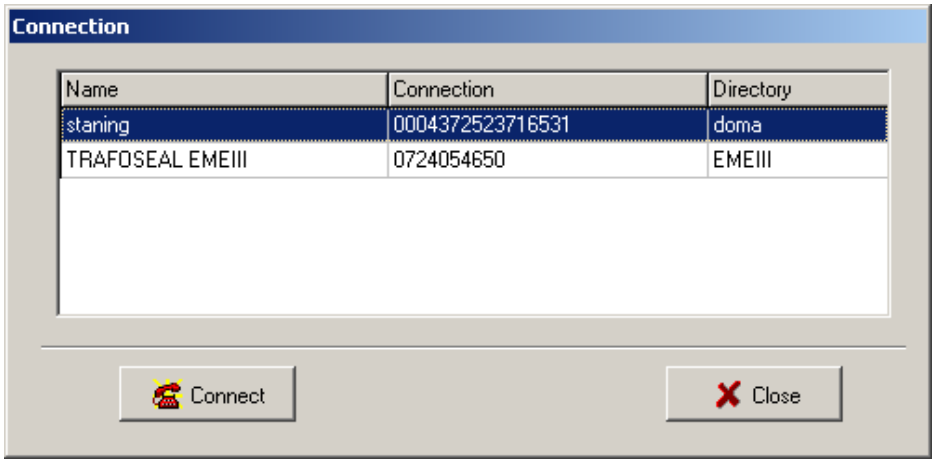


The toolbar contains the following buttons and tools -
click on particular buttons of the toolbar to enter various applications



8.3. Remote communication

Click on the icon opens the new window for the choice of the telephone number of the desired separator.

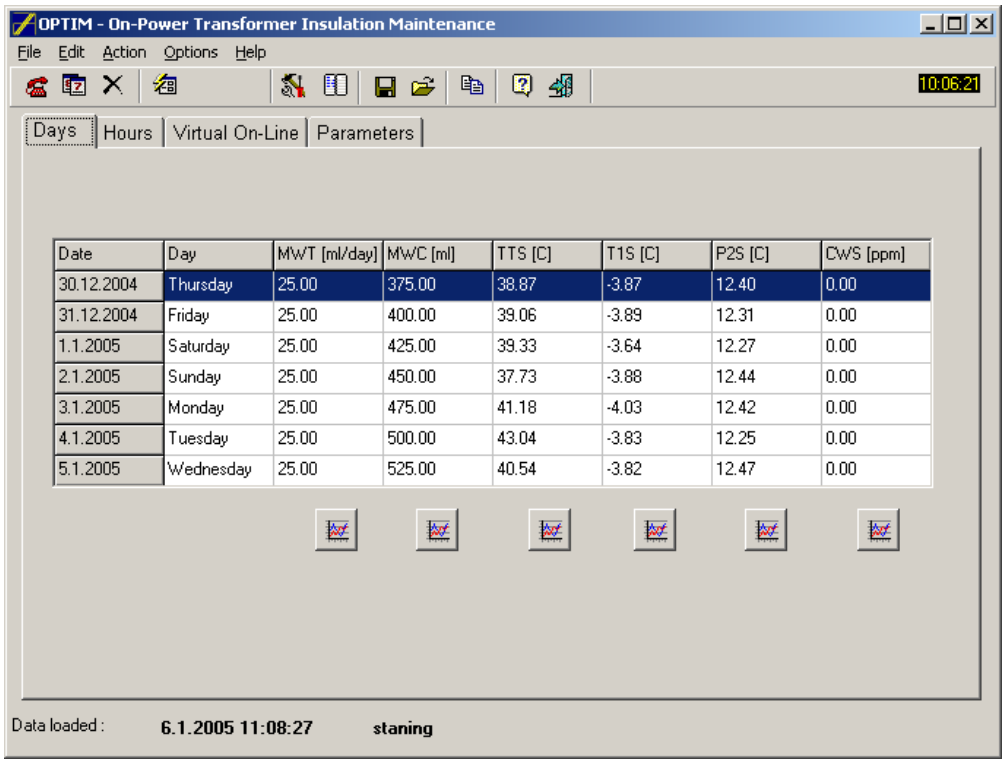


Attention : Before beginning a communication the programming of ***Communication Setup*** *and* ***Telephone directory*** *is neccessary*

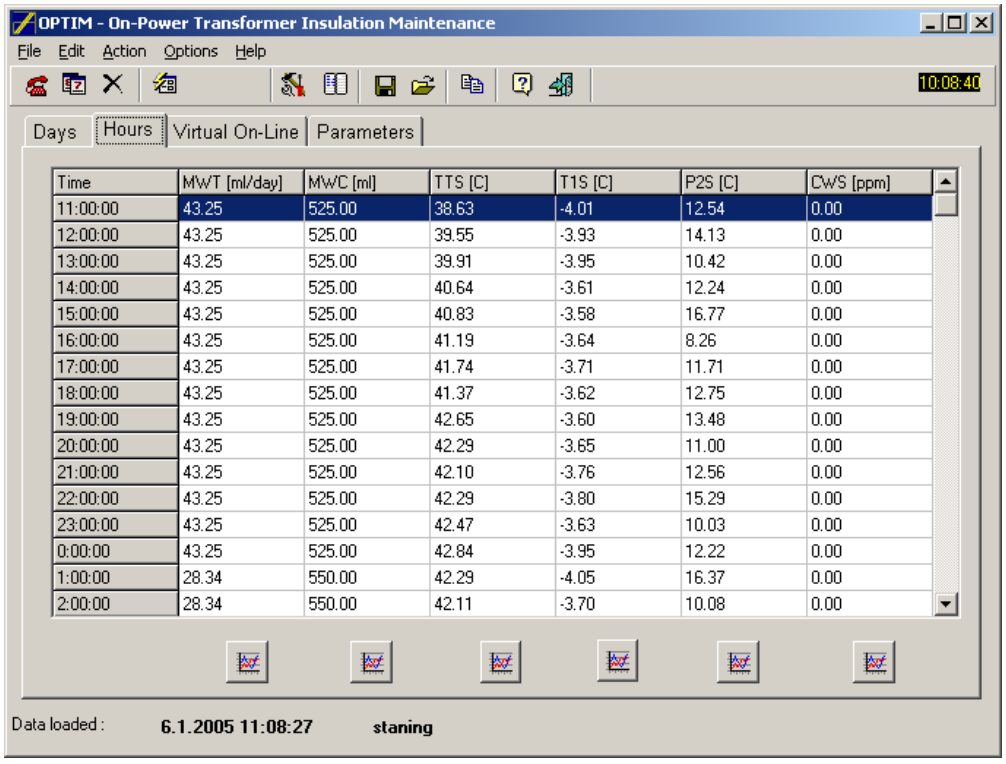
After click on the **Connect** the modem is started and the connection realized. The operational data separator are transfered at three time levels and summoned under auxiliary toolbar:

8.4 Data Transfer Button

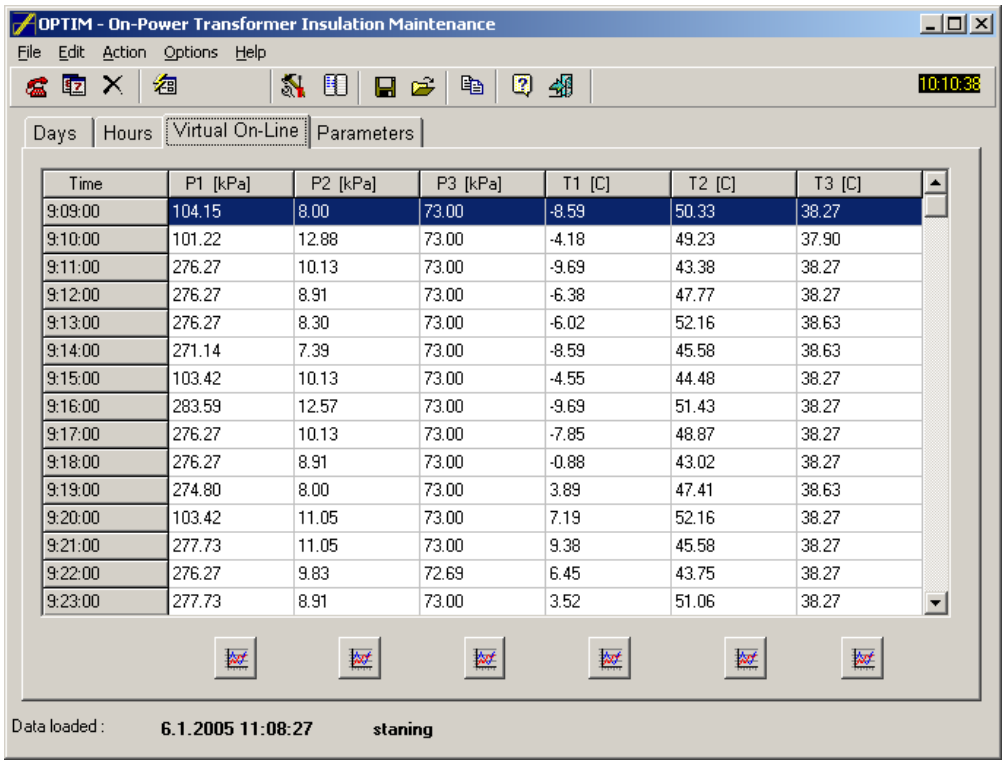
- last seven days (button **Days**)



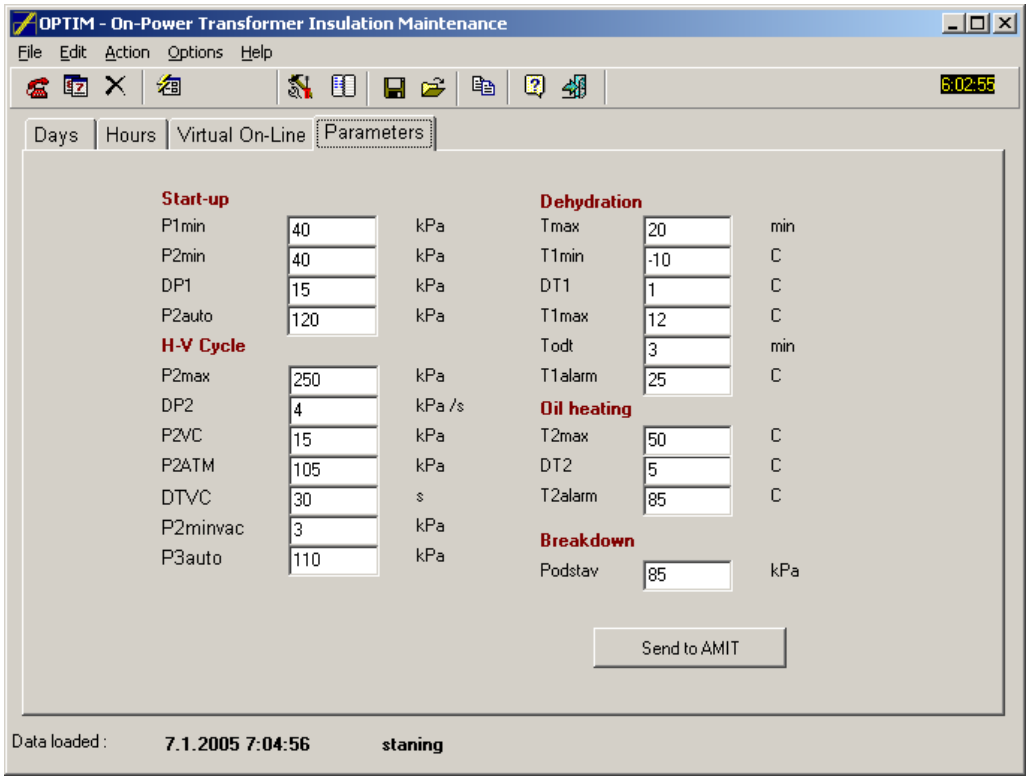
- last 24 hours (button **Hours**)



- last 240 min. (button **VirtualOn-Line**)



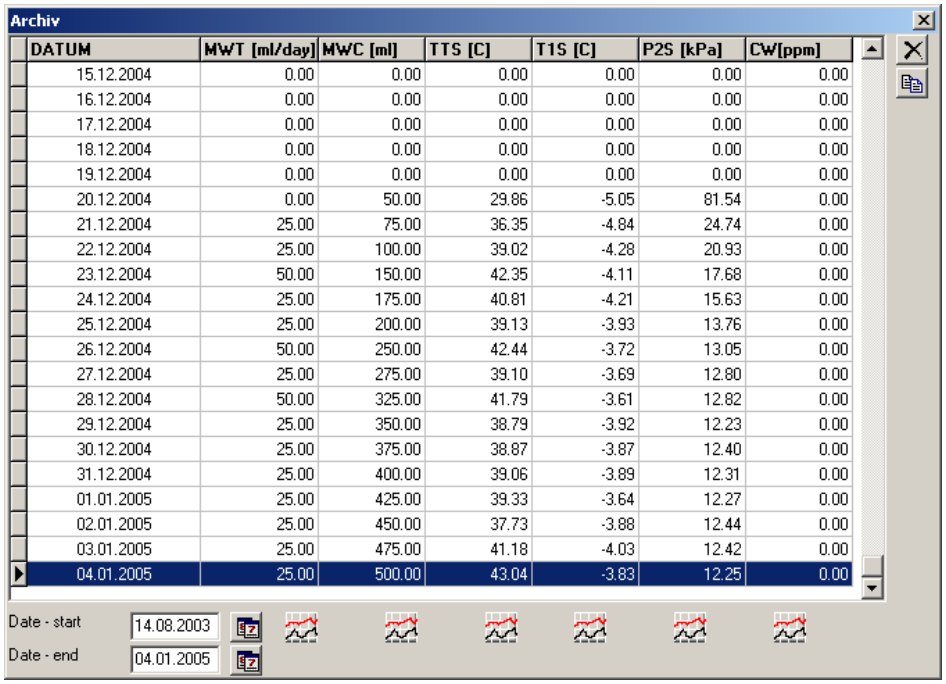
and the same toolbar contains a table **Parameters** which enables the remote re-programing of the vacuum separator (See Parametrical Programming)



8.5 . Return button – enables return from the Data Transfer into a main window

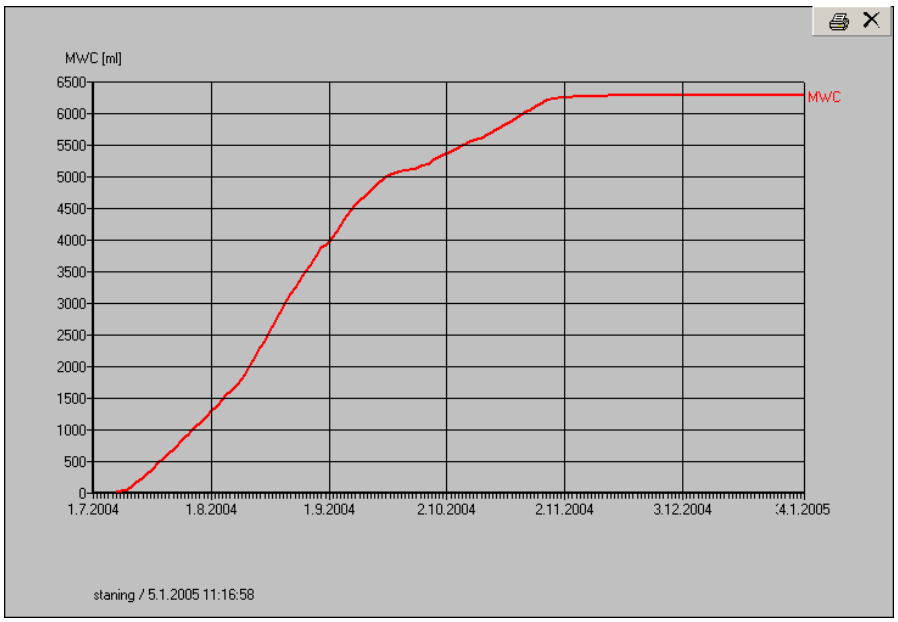
8.6 Archive

Click on button **Archive** opens a data table which contains all **Days** data from the beginning a drying procedure at the given transformer. This database is automatically actualized by click on **Connect**. The database Archive contains data all maintained transformers by the given separator and is saved at a remote PC level .



DATUM	MWT [ml/day]	MWC [ml]	TTS [C]	T1S [C]	P2S [kPa]	CW[ppm]
15.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
16.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
17.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
18.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
19.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
20.12.2004	0.00	50.00	29.86	-5.05	81.54	0.00
21.12.2004	25.00	75.00	36.35	-4.84	24.74	0.00
22.12.2004	25.00	100.00	39.02	-4.28	20.93	0.00
23.12.2004	50.00	150.00	42.35	-4.11	17.68	0.00
24.12.2004	25.00	175.00	40.81	-4.21	15.63	0.00
25.12.2004	25.00	200.00	39.13	-3.93	13.76	0.00
26.12.2004	50.00	250.00	42.44	-3.72	13.05	0.00
27.12.2004	25.00	275.00	39.10	-3.69	12.80	0.00
28.12.2004	50.00	325.00	41.79	-3.61	12.82	0.00
29.12.2004	25.00	350.00	38.79	-3.92	12.23	0.00
30.12.2004	25.00	375.00	38.87	-3.87	12.40	0.00
31.12.2004	25.00	400.00	39.06	-3.89	12.31	0.00
01.01.2005	25.00	425.00	39.33	-3.64	12.27	0.00
02.01.2005	25.00	450.00	37.73	-3.88	12.44	0.00
03.01.2005	25.00	475.00	41.18	-4.03	12.42	0.00
04.01.2005	25.00	500.00	43.04	-3.83	12.25	0.00

and click on the graph button under the data column opens time-related data visualisation

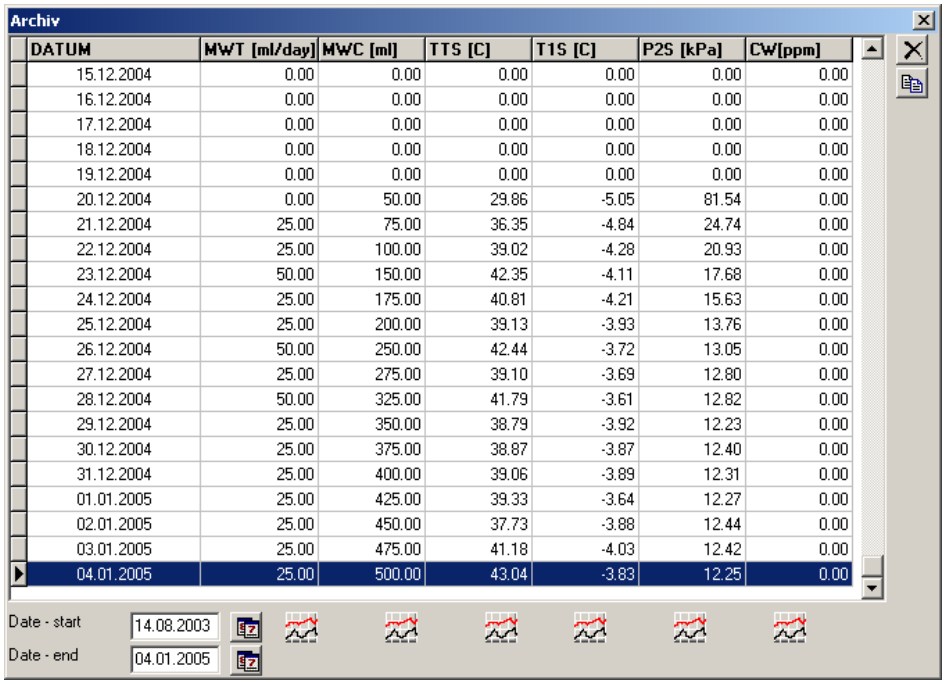


For detailed data evaluation See Section 12 and 13.

8.5 . Return button – enables return from the Data Transfer into a main window

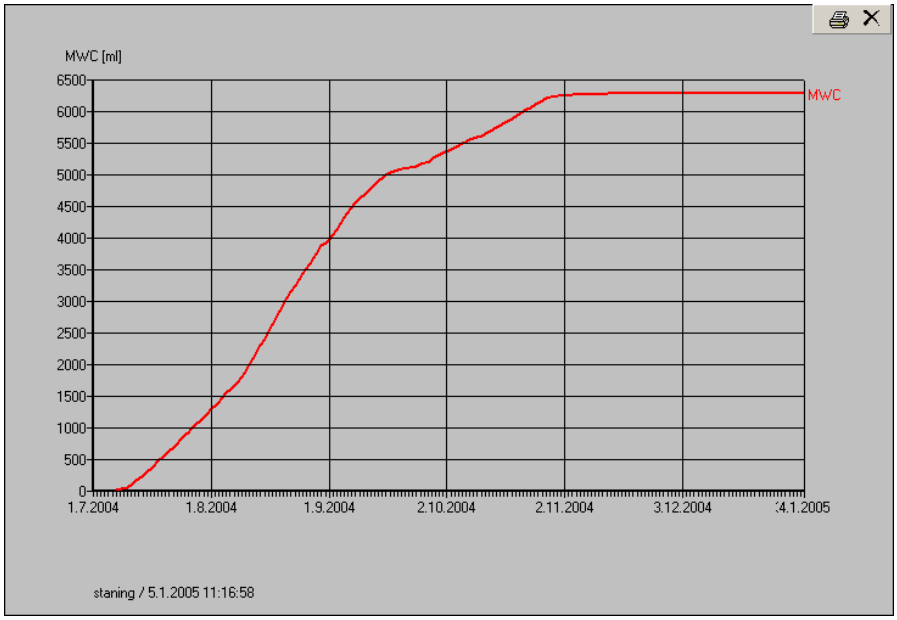
8.6 Archive

Click on button **Archive** opens a data table which contains all **Days** data from the beginning a drying procedure at the given transformer. This database is automatically actualized by click on **Connect**. The database Archive contains data all maintained transformers by the given separator and is saved at a remote PC level .



DATUM	MWT [ml/day]	MWC [ml]	TTS [C]	T1S [C]	P2S [kPa]	CW[ppm]
15.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
16.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
17.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
18.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
19.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
20.12.2004	0.00	50.00	29.86	-5.05	81.54	0.00
21.12.2004	25.00	75.00	36.35	-4.84	24.74	0.00
22.12.2004	25.00	100.00	39.02	-4.28	20.93	0.00
23.12.2004	50.00	150.00	42.35	-4.11	17.68	0.00
24.12.2004	25.00	175.00	40.81	-4.21	15.63	0.00
25.12.2004	25.00	200.00	39.13	-3.93	13.76	0.00
26.12.2004	50.00	250.00	42.44	-3.72	13.05	0.00
27.12.2004	25.00	275.00	39.10	-3.69	12.80	0.00
28.12.2004	50.00	325.00	41.79	-3.61	12.82	0.00
29.12.2004	25.00	350.00	38.79	-3.92	12.23	0.00
30.12.2004	25.00	375.00	38.87	-3.87	12.40	0.00
31.12.2004	25.00	400.00	39.06	-3.89	12.31	0.00
01.01.2005	25.00	425.00	39.33	-3.64	12.27	0.00
02.01.2005	25.00	450.00	37.73	-3.88	12.44	0.00
03.01.2005	25.00	475.00	41.18	-4.03	12.42	0.00
04.01.2005	25.00	500.00	43.04	-3.83	12.25	0.00

and click on the graph button under the data column opens time-related data visualisation

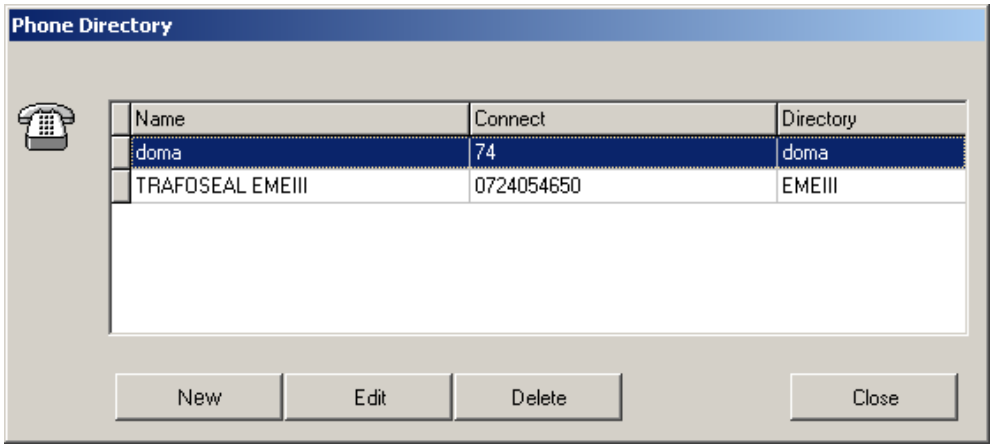


For detailed data evaluation See Section 12 and 13.

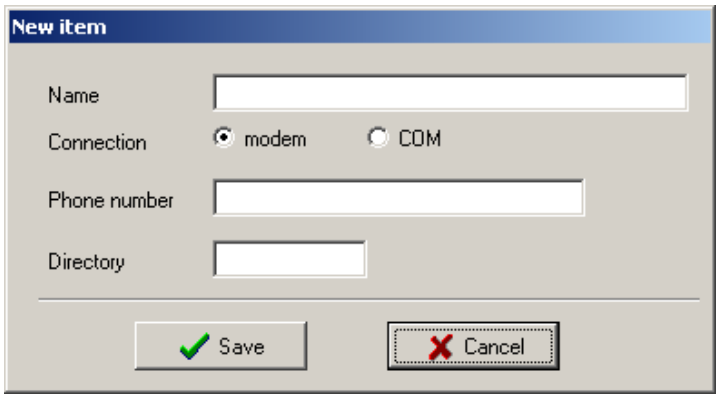
8.8 Telephone directory

The „telephone directory“ database is used to avoid mistakes and for fast choice of the communication with the separator.

For actualizing choose button on the toolbar



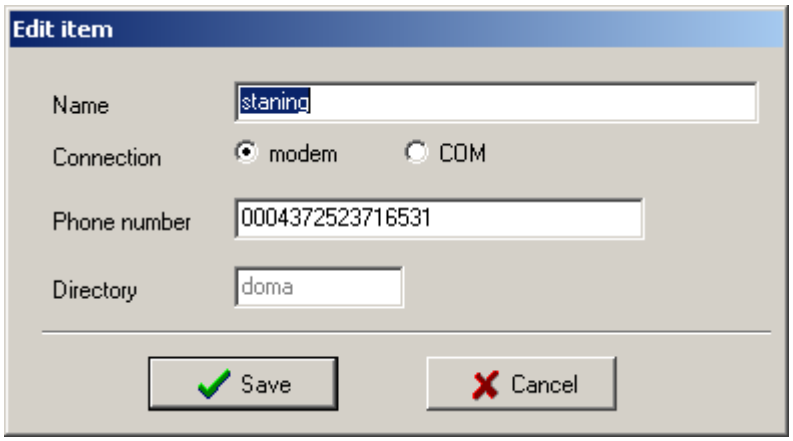
Click on **NEW** to define the connection with a newly installed separator - a new „card“ of the telephone directory will appear.



It is possible to write down in the **new record** very carefully all desired data concerning given transformer to avoid a very unpleasant mutual exchange of maintained transformers.

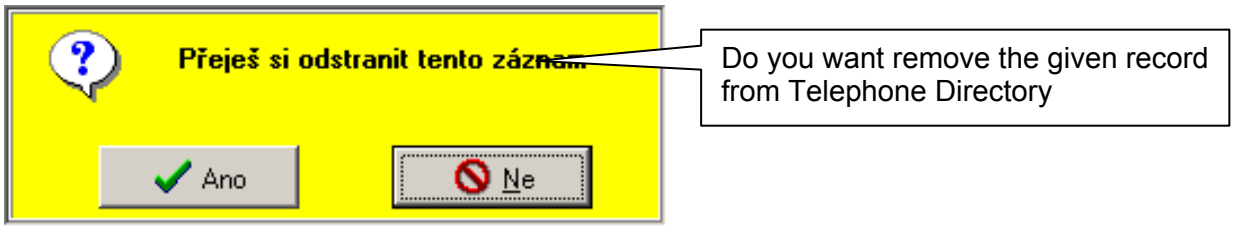
- (identification) name - **customer name, location, Serial Number** (S/N) of a given transformer
- connection
  - having chosen the **modem** connection write down into the **Phone** window:
    - the number of the telephone line assigned to the separator
    - or the number of the separator GSM modem
    - the COM connection is destined for a direct cable connection of PC or lap-top with an internal computer (for detailed in-situ data transfer procedure See ….)
- Put down the name of the directory where you will archive the monitored data
- Click on **Save** to put down required connection in memory

Button **Edit** serves to actualize records in the telephone directory. Click on **Edit** to open the following window



where you can change any items and confirm it by the button **Save** or you can the change cancel by click on button **Cancel.**

If you need to cancel any record from the **Telephone directory** you can do it very easy by click on **Delete** and the following window will be opened



and confirm clicking on **Ano** (Yes) or you can go back to **Telephone Directory** by click on **Ne** (No).

8.9 Save

click on Save will store data Days, Hours, Virtual-On line a Parameters of a given separator into a time- specified file.

8.10 Open

This command opens time-specified files and shows them under Optim A enviroment (See Data Transfer).

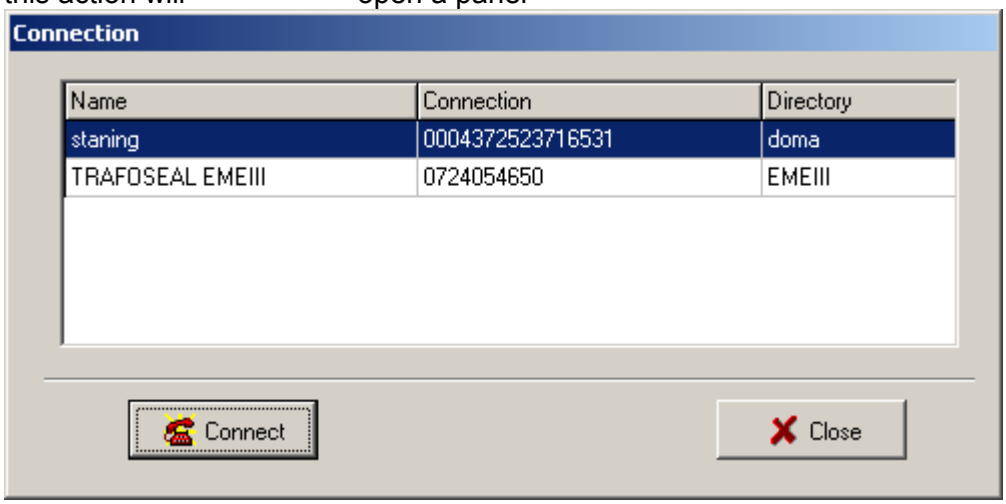
8.11 Copy to Clipboard

Command **Copy to Clipboard** saves the data from the actual screen into a clipboard file and this packet can be freely used e.g. by Excel.

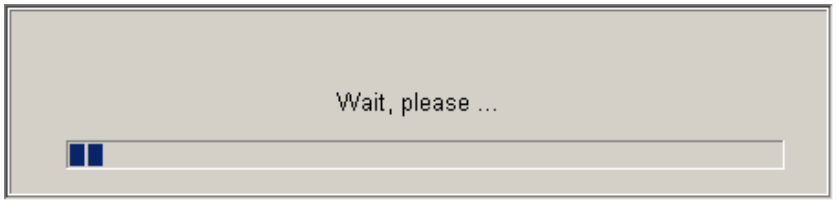
8.12 Standard communication with the separator

After setup you can start proper communication between your PC and the separator pushing button

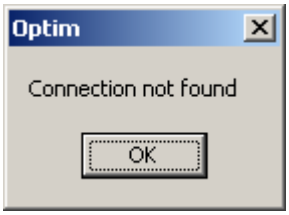
this action will  open a panel



after you have finished the choice of a particular number, click on **Connect** – it will start the communication (RUNDMODEM procedure) and will show the following panel

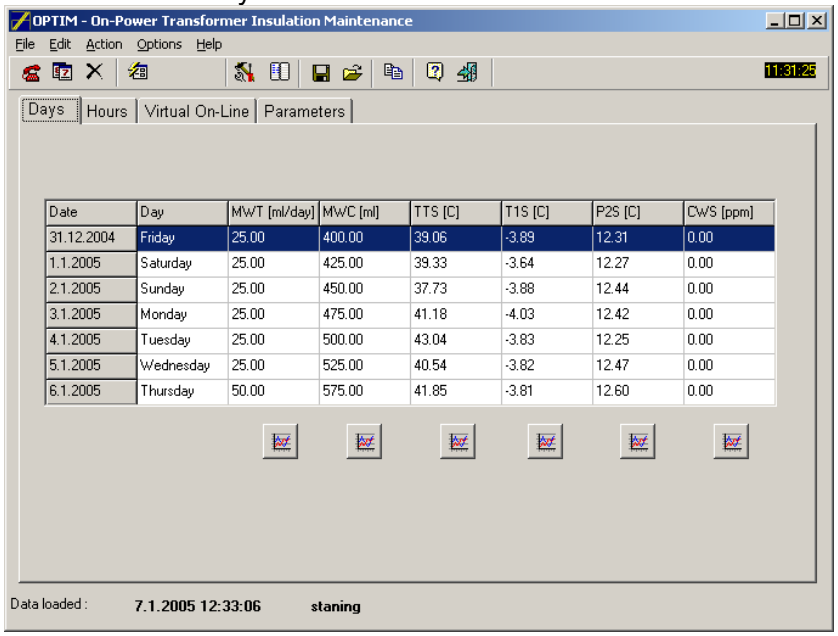


if the connection fails, the program opens the following window



This may happen when the phone or GSM network is busy – simply repeat the process to get the connection.

After achieved the satisfactory connection the program loads the data from PCD in your PC and shows them in the main window.



In order to cut communication fees, the program always works off-line – takes the pre-worked data from PCD, checks them and switches off.the connection.

The program offers implicitly so called Days data first – this means the PCD measured 6 quantities are averaged over 24 hours and stored in PCD for 7 days.

Together with the day values the program also loads so called Hours data – PCD measured 5 quantities are averaged over 1 hour and stored in PCD for 24 hours.

Day and hour averages can be also showed in the form of diagrams pushing the graph button below each column of the values.

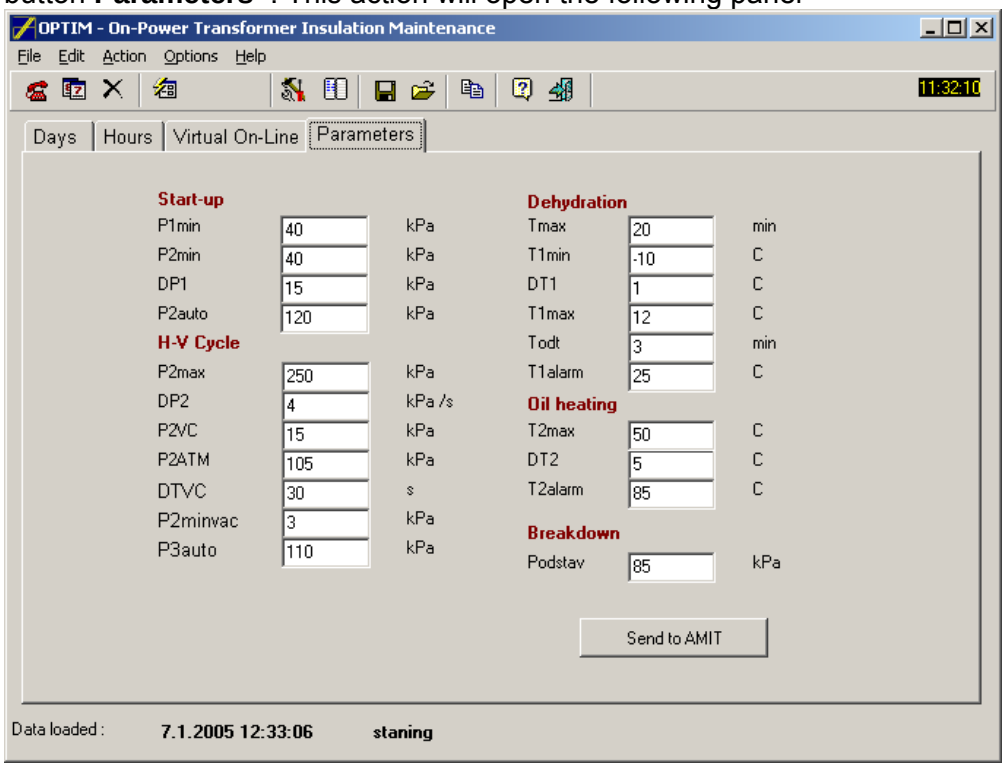
The same is used for the Virtual On-Line procedure which dominantly serves as a check of the proper function of vacuum separator self.

The PCD of the separator can (only on demand of PC !) implicitly scan , average and store the following basic values send at any time to the remote user PC:

MWT ….	water removal rate (ml/24 day)
MWC…..	total amount of water removed from a particular transformer (ml)
TTS ….	temperature of the transformer derived from oil temperature inflowing into the separator [°C]
T1S …..	temperature of freezing trap [°C]
P2S	averaged vacuum of separation process [kPa]
CWS	water content in inflowing oil [ppm] (if humidity sensor is installed)

8.13 Parametric process control

To optimize of the separator function and the dehydration process of the transformer, click on button **Parameters** . This action will open the following panel



Every basic function of the separator (from start up to shut down) can be parametrically programmed, but:

ATTENTION !!

Except for the temperature T2MAX (the required output temperature of the preheater), no change of parameters is advisable. Parameters are already optimally pre-set.

If you want to change any parameter consult it with your dealer or producer of the separator first.

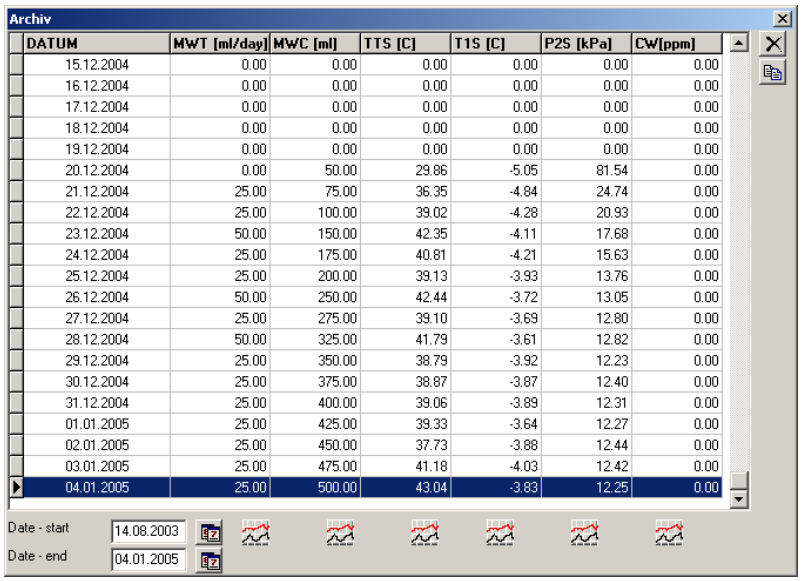
Adjusting parameters

- Re-write the given parameter to change it
- Click on button **Send to AMIT** to send the changed value back to the separator PCD

8.14 Transformer dehydration record

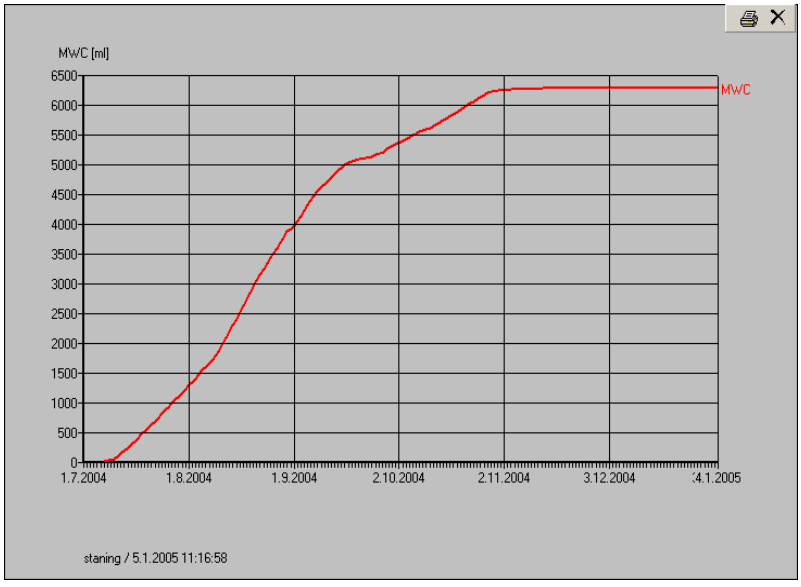
For the dehydration record and an evaluation of achieved results the procedure **Archive** is obviously used.

Click on  and this step will be confirmed showing the panel

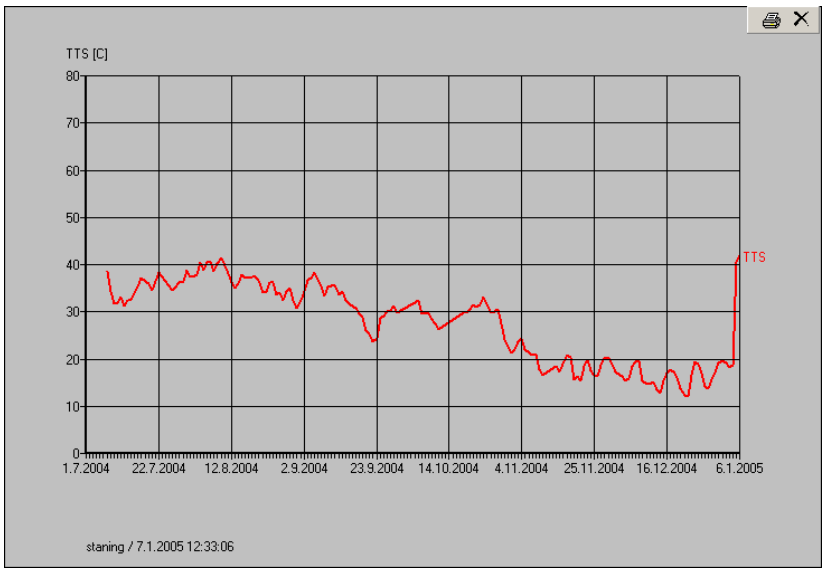


DATUM	MWT [ml/day]	MWC [ml]	TTS [C]	T1S [C]	P2S [kPa]	CW[ppm]
15.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
16.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
17.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
18.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
19.12.2004	0.00	0.00	0.00	0.00	0.00	0.00
20.12.2004	0.00	50.00	29.86	-5.05	81.54	0.00
21.12.2004	25.00	75.00	36.35	-4.84	24.74	0.00
22.12.2004	25.00	100.00	39.02	-4.28	20.93	0.00
23.12.2004	50.00	150.00	42.35	-4.11	17.68	0.00
24.12.2004	25.00	175.00	40.81	-4.21	15.63	0.00
25.12.2004	25.00	200.00	39.13	-3.93	13.76	0.00
26.12.2004	50.00	250.00	42.44	-3.72	13.05	0.00
27.12.2004	25.00	275.00	39.10	-3.69	12.80	0.00
28.12.2004	50.00	325.00	41.79	-3.61	12.82	0.00
29.12.2004	25.00	350.00	38.79	-3.92	12.23	0.00
30.12.2004	25.00	375.00	38.87	-3.87	12.40	0.00
31.12.2004	25.00	400.00	39.06	-3.89	12.31	0.00
01.01.2005	25.00	425.00	39.33	-3.64	12.27	0.00
02.01.2005	25.00	450.00	37.73	-3.88	12.44	0.00
03.01.2005	25.00	475.00	41.18	-4.03	12.42	0.00
04.01.2005	25.00	500.00	43.04	-3.83	12.25	0.00

For a better understanding of a on-line drying process of a transformer is most often used time-related graphical output which is inicialized by click on the graph button under chosen columns e.g. MWC (total amount of water removed from the given transformer)



and TTS (transformer temperature)



The comparison of both time-related graphs gives us very often plausible answer at a basic questions about the drying process.

In this case is quite obvious that the reduction of the amount of removed water was induced by the strong decline of the transformer temperature.

8.15 Optimization of the on-power dehydration of transformers .

The relevant moisture and dielectric diagnostics is always absolutely necessary before the beginning of any dehydration procedure.

The SIMMS and TRACONAL should be used to evaluate
the water content in the cellulose materials of the transformer.

To avoid a overdrying of transformer the dehydration target has to be defined .

Do not forget, regardless of how efficient any method of **oil** dehydration might be, the water removal from the transformer under normal operational conditions - the **transformer dehydration** - is ultimately governed by slow diffusion of moisture from cellulose and this process can be accelerated only by high temperature.

That is why you always have to describe any dehydration process of **transformer** with at least two values – **MWT** (average water removal rate and) **or MWC** (total amount of removed water) and **TTS** (temperature of the transformer).

In order to avoid lowering the immediate reliability of the transformer we have to tune at least two antagonistic criteria:

- max. separating efficiency of the separator (max. water removal rate)
- dielectric strength of oil - has to be maintained or improved

The first criterion is fully understandable – we want to dehydrate the transformer as soon as possible. Thus we need to release maximum of water

from the cellulose into the oil filling by raising the temperature of the transformer.

This fundamentally collides with the second criterion – if the temperature of the wet transformer will be too high, water contents in oil may easy exceed 30 ppm limit and the dielectric strenght of oil drops relatively quickly under 40 – 50 kV/2.5mm.

If the moisture sensor is installed, follow always its on-line reading. The Cw-value should never exceed 30 ppm.

To solve the dilemma between both criterions the method of gradual heating of the transformer is recommended especially if an on-line Cw-reading isn´t available:

- check at first both actual values of water content in the oil (Cw-value) and dielectric strength of the oil (Ud-value).
    - If the Cw-value is substantially under 30 ppm, increase the temperature TTS of the transformer, about 10 C, wait 5 days and check the result, if necessary, repeat the procedure until the Cw-value is about 20 – 25 ppm is reached
    - If the Cw-value is about 30 ppm, decrease the temp. ca 5 C, check the result
    - If the Cw-value is substantially over 30 ppm, the temp. has to be immediately decreased until the allowed Cw-level is reached and simultaneously the Ud-level will be over 30 kV/2.5mm.

To make the whole procedure easier, the on-line reading of the Cw-value is recommended – the installation of a proper moisture sensor in the separator is very simple.

- check daily water removal rate MWT and the transformer temperature TTS on your PC
- when MWT is between 50 – 120 ml/day (and TTS is virtually constant) and the dehydration process is OK operate the transformer at this temperature until the output decreases below 50 ml per day (or any lower output the operator chooses)
- when MWT drops to less then 50 ml/day, increase the transformer temperature TTS about 5 – 7^{o}C .
- when MWT exeeds 120 ml/day decrease the temperature TTS about 2-5^{o}C
- Repeat the preceding steps as many times as necessary to reach the maximum operating temperature of the transformer. (usually 65- 85^{o}C)