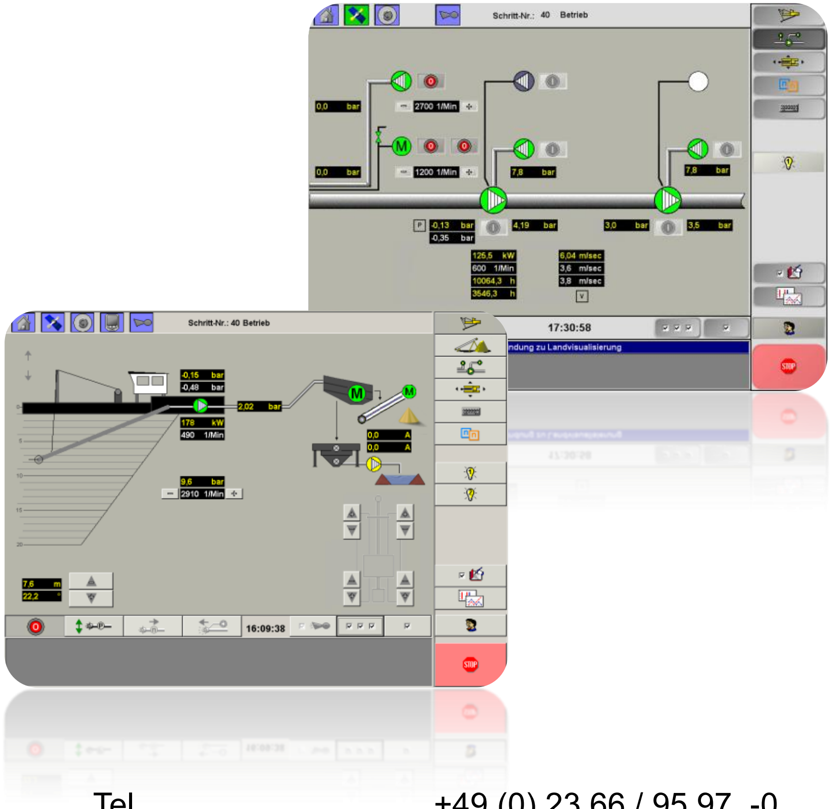
Systembeschreibung **DredgerControl**

DredgerControl

Suction dredger control for the gravel and sand industry

Version 14.0.0



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1. *Equipment - Computers and sensors*

The equipment of the DredgerControl systems essentially consists of:

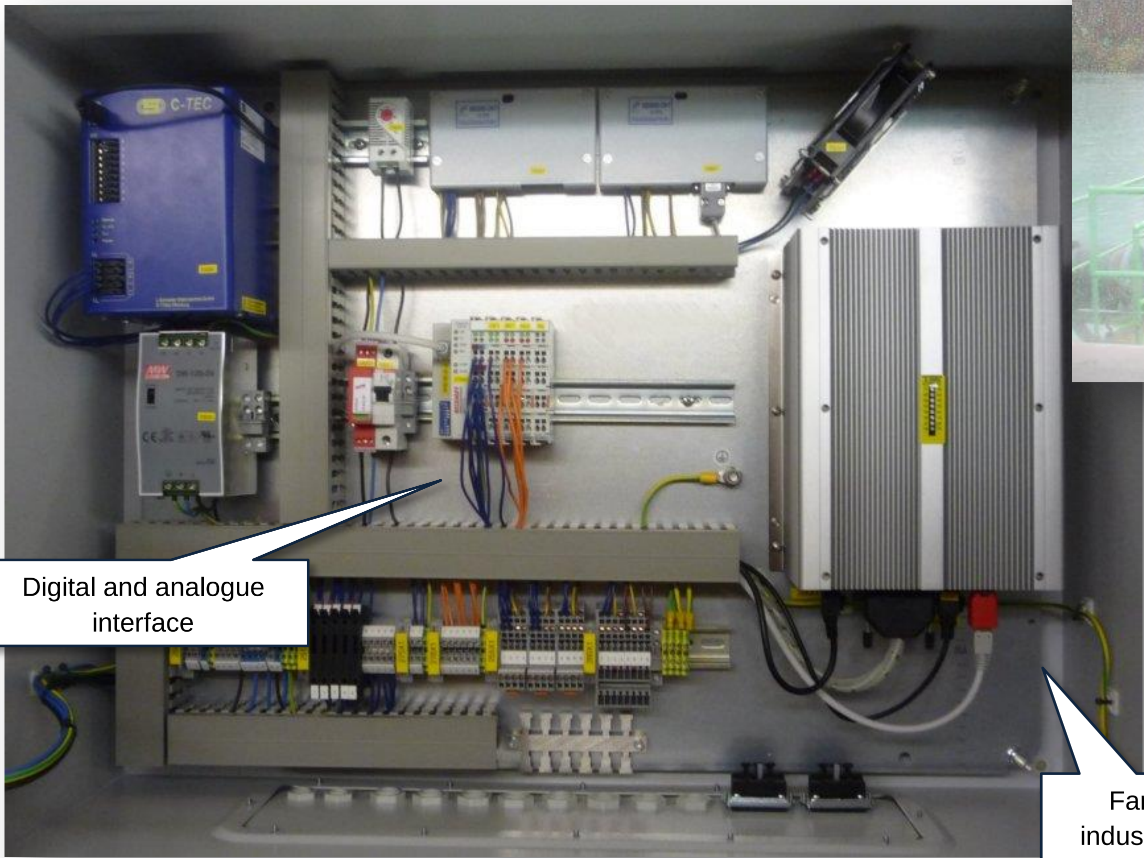
- *Computer and display*
- *Beckhoff bus system*
- *Limit switch, pressure sensors, position sensor and flow velocity sensor*

2. *System technology in combination with DredgerNaut*

22“-Display

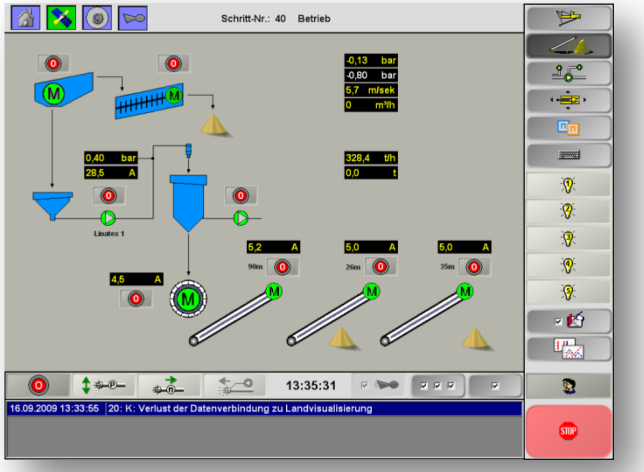
*(here in the example with a **DredgerControl system** with split display)*

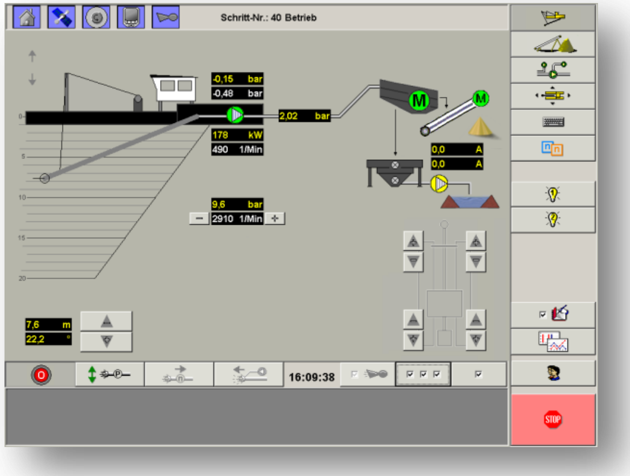
Electrical cabinet

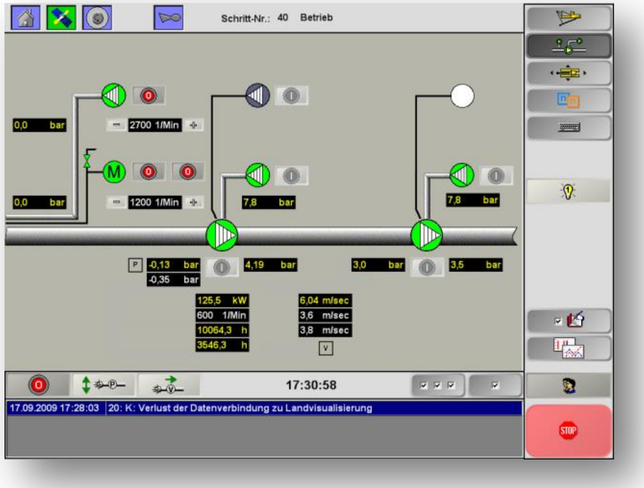


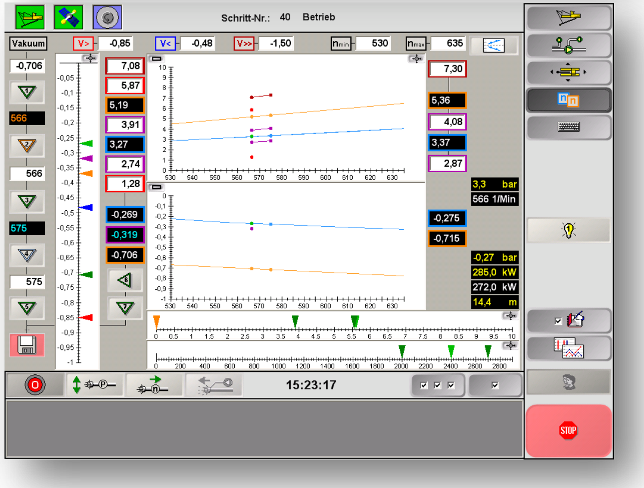
3. *Functionalities of the control system*

- *Automatic start-up of the suction dredger and the extraction components*
- *Visualisation functions*
- *Monitoring and messaging functions*
- *Regulation functions*
- *Remote control function*
- *Connection of excavation monitoring systems*
- *Documentation functions*









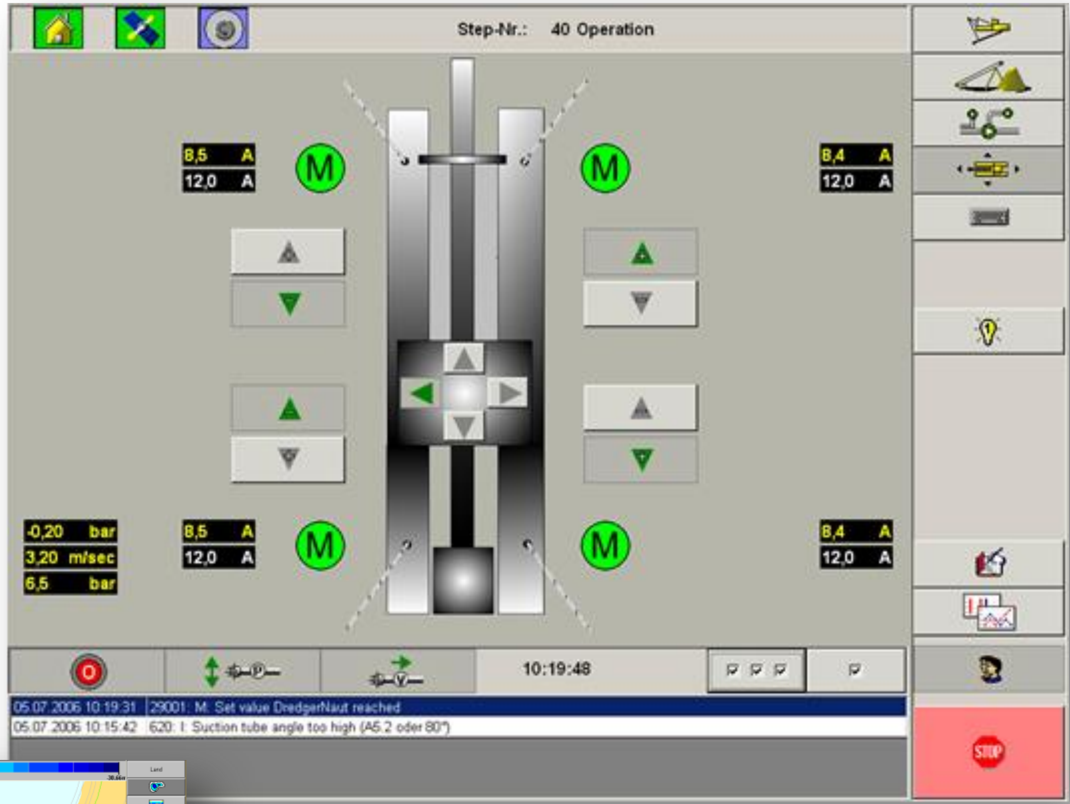
4. *Winch functionalities*

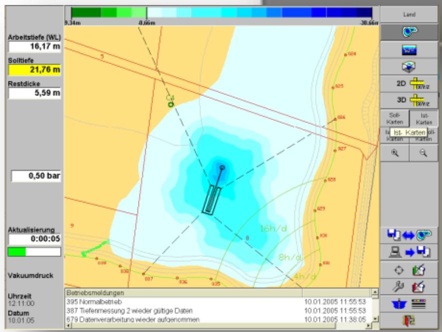
4.1 Work current monitoring

In the navigation view, the mooring winches are shown. If the pull or release button is pressed on a winch, the winch reacts accordingly.

The work current monitoring of the mooring winches integrated in ***DredgerControl*** *prevents the drives from being overloaded (the motor protection switches do not trip), so that all four winches can be controlled simultaneously via direction keys.*

Recommendation: *With the* ***DredgerNaut*** *excavation monitoring system, the position of the suction dredger and the position of the mooring ropes can be visualised. With this technology, safe, remote-controlled hauling of the dredger is possible, because the angles at which the ropes attach to the dredger and the dredger movement become visible.*





4.2 Torque-controlled compound operation

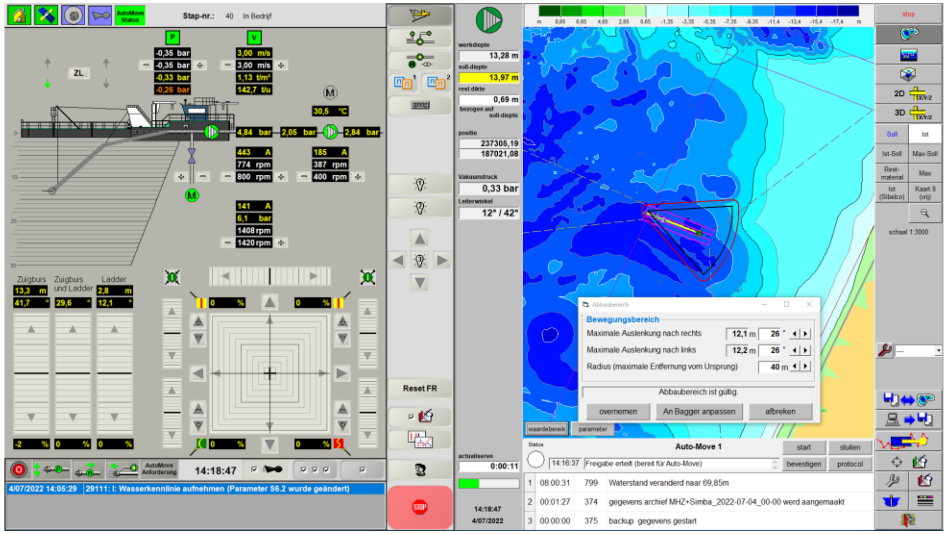
*The **torque-controlled compound operation** function for the mooring winches enables very smooth movement of the suction dredger even during mining operations*.

Hardware requirements

- *At least the bow winches have to be equipped with frequency converters.*
- *An analogue joystick is integrated into the control panel to control the winches.*

4.3 AutoMove

The function **AutoMove** is a combination of DredgerControl and DredgerNaut. In the DredgerNaut system, a working area is defined in which the excavator moves with DredgerControl and removes material. With the help of the vacuum regulator, the DredgerControl system processes the positions moved to depending on the maximum depth, the slack rope function and the relative vacuum.



Hard- and software requirements

- *The mooring winches have to be equipped with frequency converters.*
- *The mooring winches require tight and slack rope sensors*
- *The suction pipe/ladder combination must be equipped with limit switches to monitor the horizontal deflection of the suction pipe.*
- *In addition to the DredgerControl system, the DredgerNaut system must be installed.*
- *Signal lamps for indicating the activated AutoMove function have to be installed.*
- *The freedom of movement of the suction dredger must be ensured by sensible arrangement of the anchor cables and position of the pressure pipe line.*

5. *Vacuum regulation and variations*

Vacuum regulation

- *Regulation of the suction pipe and the ladder by vacuum setpoint specifications*
- *Direct control of the winches via star-delta contactors or in FD operation*

Vacuum modulation

- *If the slack rope signal is often present, the suction pipe is lifted cyclically to loosen the material.*

Vacuum reduction

- *If the suction dredger is not the weakest link in the extraction line, the bucket wheel load or the currents of belts, for example, can be monitored. When a limit value is reached, the vacuum setpoint is reduced by a fixed factor. The monitored units can "recover". Subsequently, the preset operating point is approached again.*

Vacuum adaption

- *The vacuum adaptation is the extended vacuum reduction. In this regulation, however, no preset vacuum setpoint is approached, but the optimum operating point for the system is sought via a dynamic setpoint during operation.*

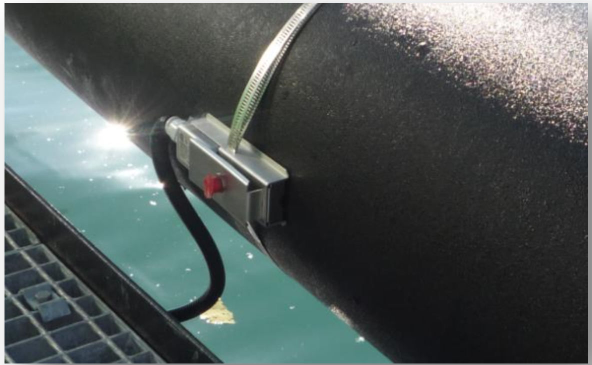
6. *Speed regulation and variations*

- ***Speed regulation via flow velocity measurement***
- ***Back pressure monitoring***
- ***Torque regulation***
- ***Jet pump regulation***

Which speed control should be used depends very much on the possibilities of the mining equipment, the sensors and the material occurrence. Each regulation has its own advantages.

6.1 Speed regulation via flow velocity measurement

On the suction dredger, the flow velocity is measured contactless. The speed of the pump is controlled by this measured value. If the flow velocity drops, the speed is increased. If the flow velocity increases, the speed is reduced.



Advantage:

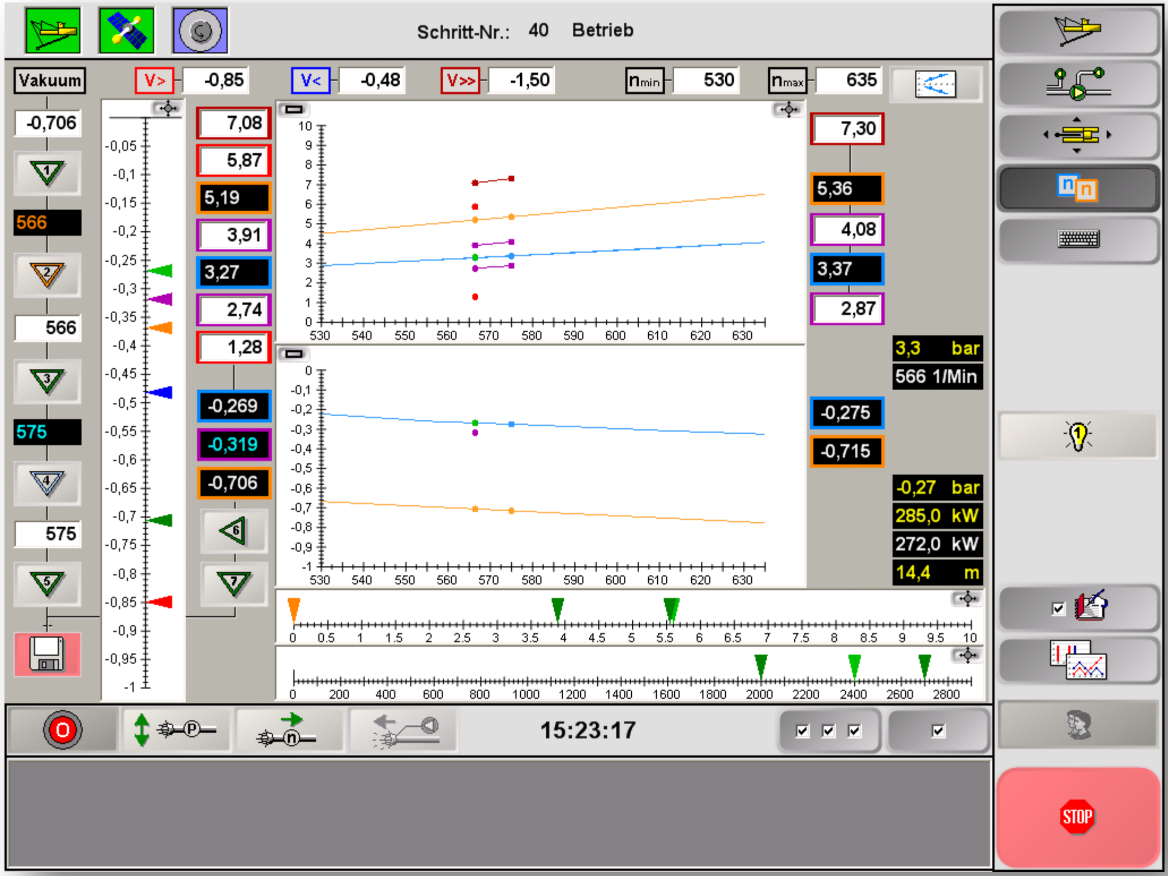
In the case of difficult material deposits, the speed is continuously adjusted to the current flow velocity.

6.2 Back pressure monitoring

For back pressure monitoring, automated water and material characteristic curves (back pressure and vacuum depending on the operating speed) are recorded.

In addition, back pressure threshold values are set.

Flushing processes are triggered when critical back pressure values are exceeded.



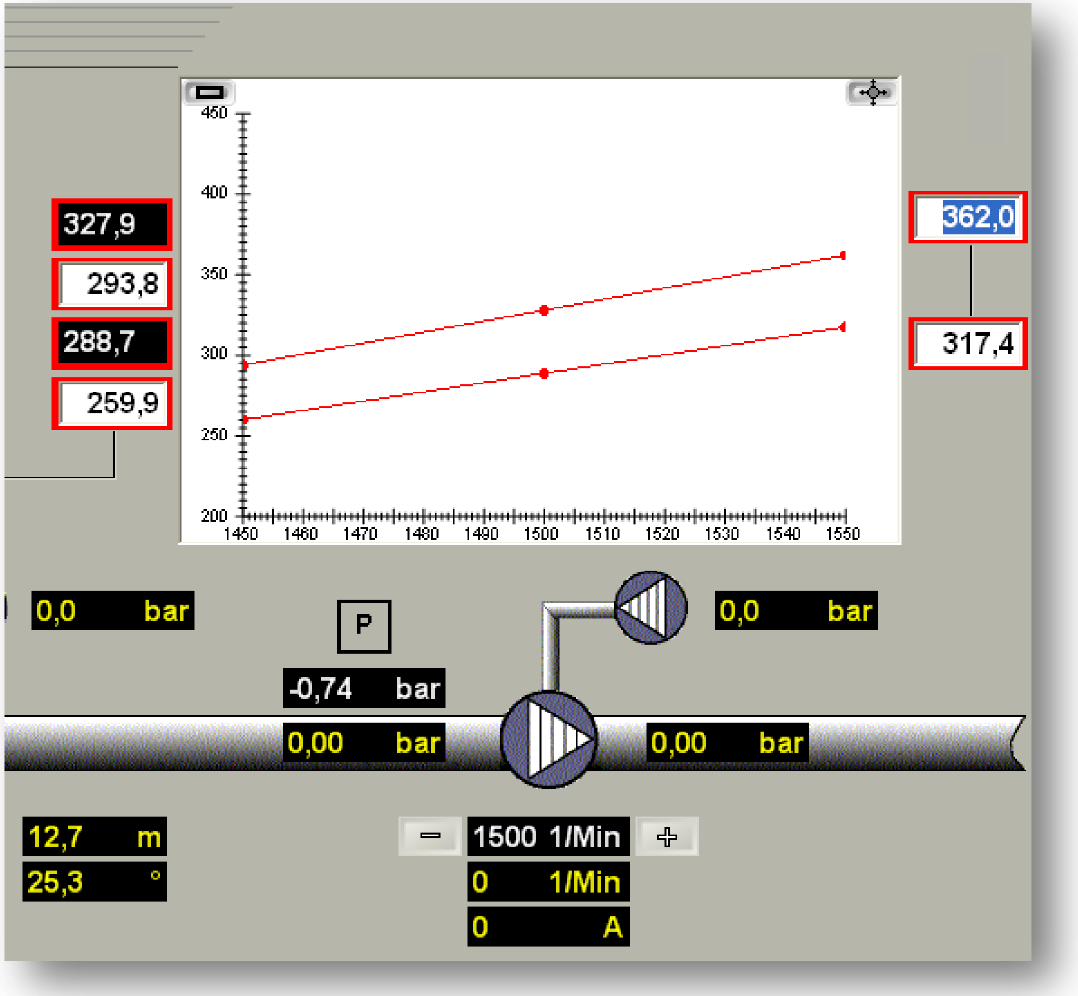
Advantage: *Very low wear with an extremely even extraction process, as work is carried out with fixed speeds and occasional flushing processes.*

6.3 Torque regulation

For torque control, the current of the sand pump is monitored. Two characteristic curves (minimum and maximum current) are parametrised in the speed range of the pump.

If the maximum current is exceeded, the speed of the sand pump is reduced.

If the current falls below the minimum, the speed is increased.

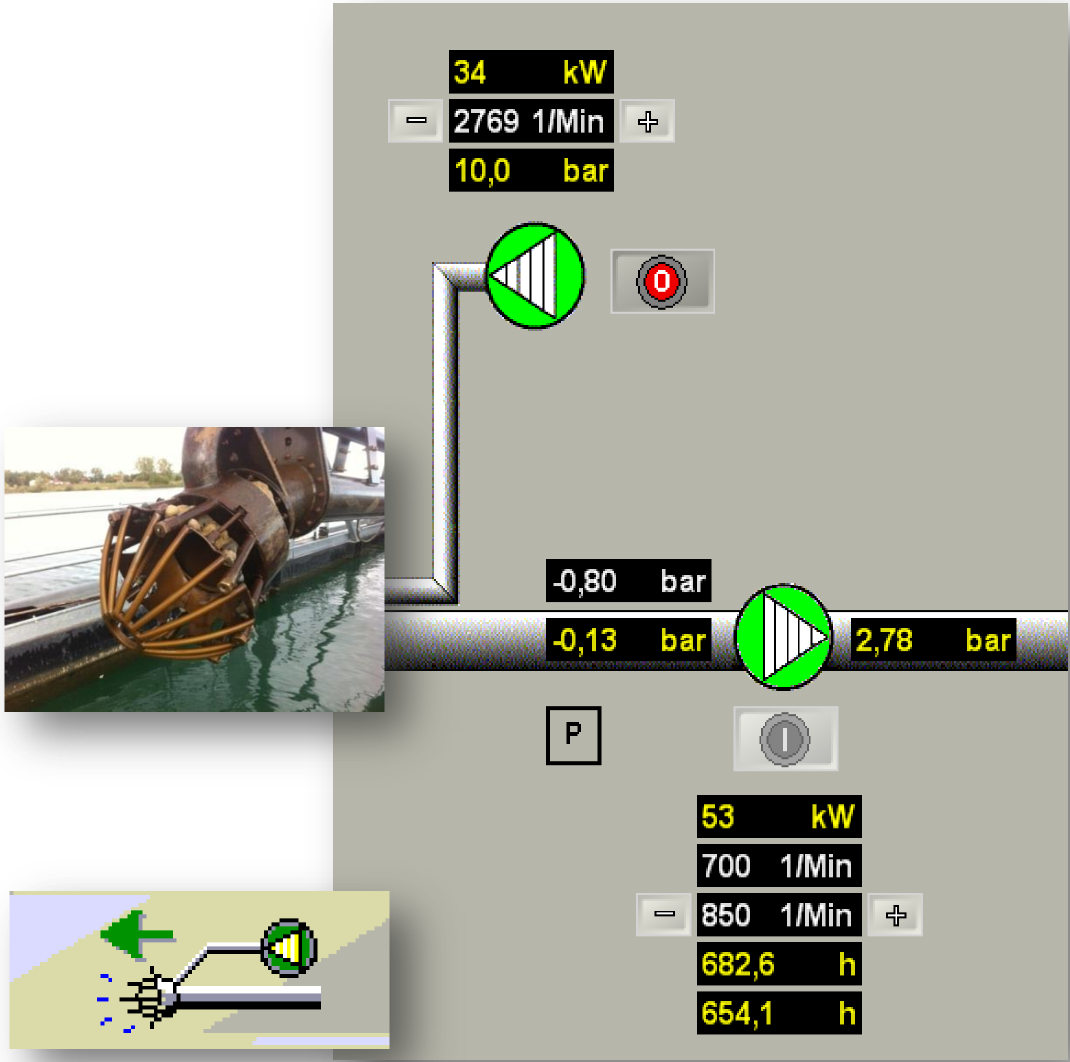


***Advantage:** Speed regulation/control without additional sensors with even extraction process, as the speed is rarely varied.*

6.4 Jet pump regulation

A frequency converter before the jet pump is the prerequisite for jet pump control.

If the vacuum setpoint is reached in the extraction process, the speed of the jet pump can be reduced. If the material flows even without jet water and the extraction process continues, the jet pump is ideally also switched off. If the extraction process comes to a standstill, the jet pump is switched on again or its speed is increased.



Advantage: *Saving energy without reducing material extraction. Without speed control, continuous jet water can even be counterproductive with good-flowing material. The material is flushed away from the suction pipe head.*

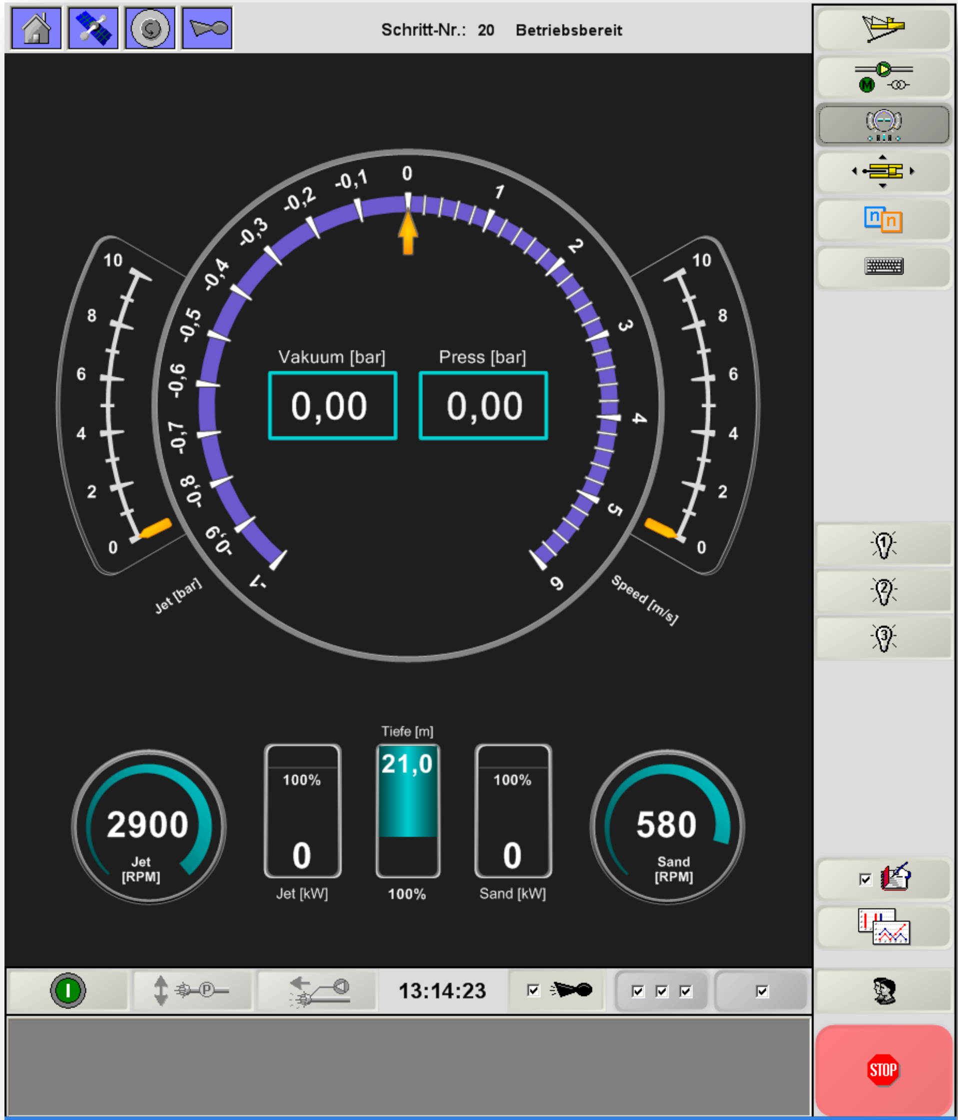
7. *DredgerControl Cockpit*

In the DredgerControl Cockpit, all important process variables are shown in one display. The arrows indicate the current process value.

Process values

- Performances
- Speeds
- Pressures
- Depth
- Flow velocity

Advantage: *All important indicators at a glance.*

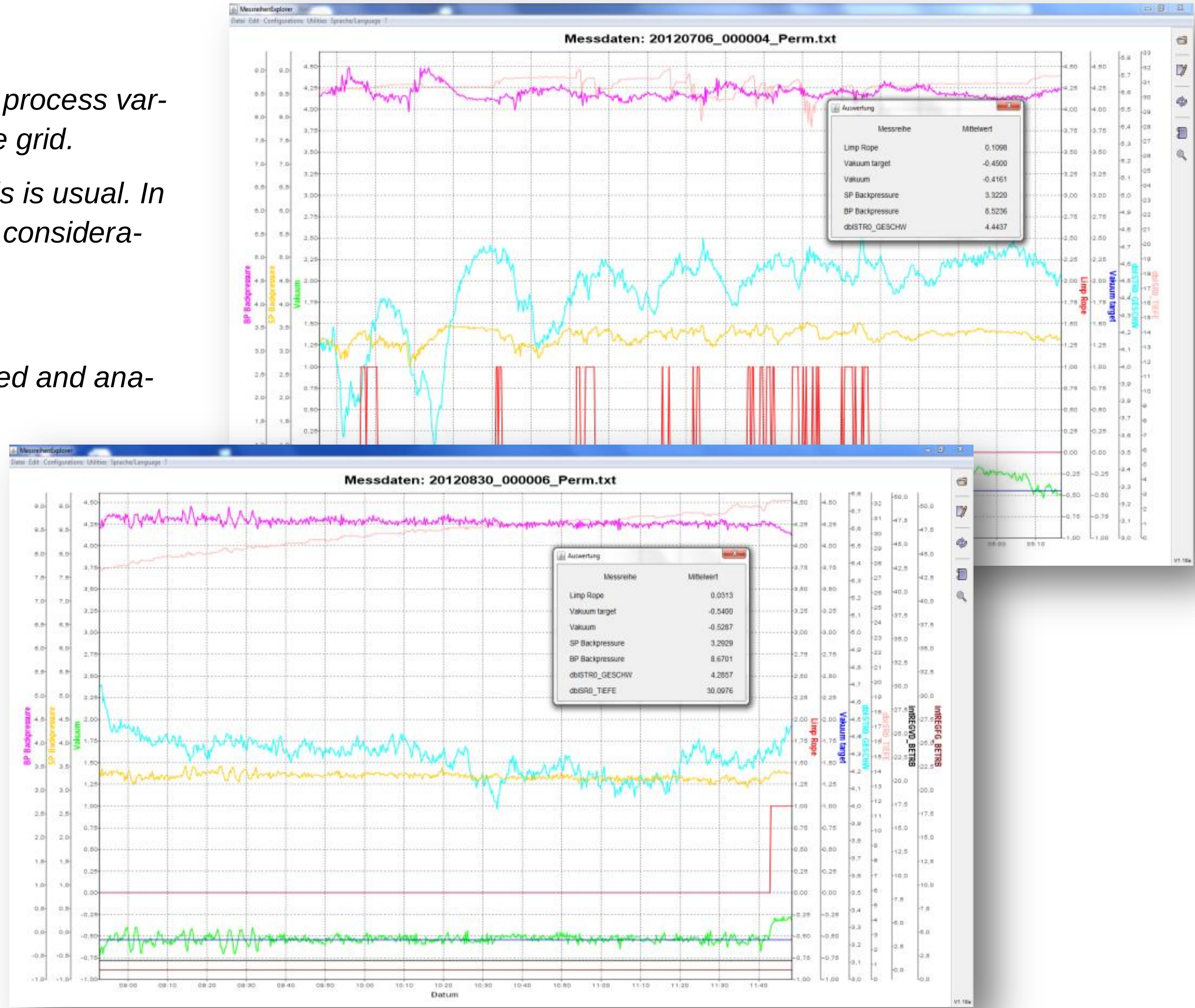


8. *DTinsight*

*The **DredgerControl** system records preselected process variables in the background in a parameterisable time grid.*

For normal operation, a time interval of 10 seconds is usual. In case of analysis, the time interval can be reduced considerably.

*These recorded process variables can be visualised and analysed with the additional program **DTinsight**.*



Advantages and objective:

- *Visualisation of the extraction process*
- *Analysis of the extraction process*
- *Optimisation of the extraction process*

9. *DTreport*

The protocol files of the DredgerControl system are saved daily. These daily protocols can be evaluated with DTreport. The data outputs and calculations of consumption data and key figures are configured for the suction dredger in coordination with the customer.

Advantages and objective:

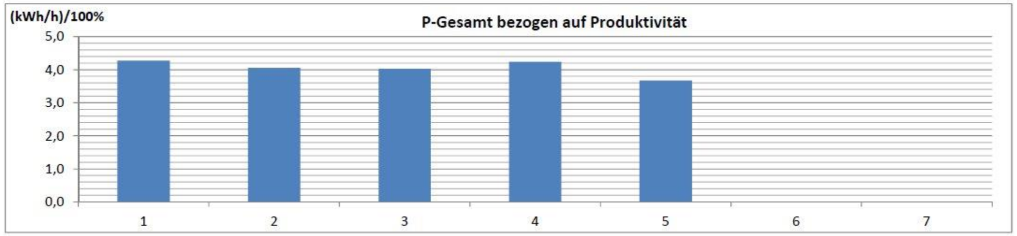
- *Daily evaluations of the protocol files*
- *Comparability of the daily, weekly or monthly reports*
- *Optimisation of the extraction process*

Firma	Abgrabung	Jahr	KW
Kiesgrube Mustermann	Sandstraße	2016	32

Saugbagger													Kommentar Betriebsleiter
Tag	RPF	Vakuum_Rel	T_Schlaffseil	T_VakuumReglerAn	T_Sandpumpe	T_Einsturz	Durchschnittsvakuum	Produktivitaet Steigband auf 90A normiert	E-Gesamt (Bagger)	P-Gesamt pro Produktionsstunde	P-Gesamt bezogen auf Produktivität		Wochenkommentar:
-	%	bar	h	h	h	h	bar	%	kWh	kWh/h	kW/%		*Tageskommentare*
Mo 01.08.	74	-0,283	0,08	7,51	7,63	0,02	-0,564	83,9	2.771	358	4,27		...
Di 02.08.	87	-0,294	0,07	7,89	8,00	0,01	-0,583	89,9	2.957	365	4,06		
Mi 03.08.	85	-0,294	0,02	6,67	6,71	0,02	-0,586	91,4	2.504	368	4,02		
Do 04.08.	86	-0,294	0,16	5,98	6,03	0,02	-0,589	86,7	2.254	368	4,24		
Fr 05.08.	85	-0,296	0,03	4,89	4,95	0,02	-0,587	100,5	1.866	369	3,67		
Sa 06.08.	0	0,000	0,00	0,00	0,00	0,00	0,000	0,0	36	-	-		
So 07.08.	0	0,000	0,00	0,00	0,00	0,00	0,000	0,0	37	-	-		
ø*	84	-0,292	0,07	6,59	6,66	0,02	-0,582	90,5	2.470	366	4,05		
Σ			0,36	32,95	33,31	0,09			12.426				
R											0,59		

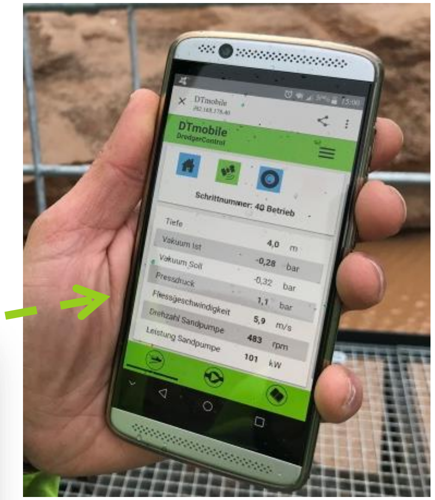
schlecht
gut

*) ohne Wochenenden



10. *DTmobile*

*By connecting the suction dredger to the shore control and the company network, the complete observability of the excavator is guaranteed. If a WLAN is also available on the company premises, the most important process and performance data of the dredger can be visualised online via the **DTmobile-WEB server** on any smartphone or tablet.*

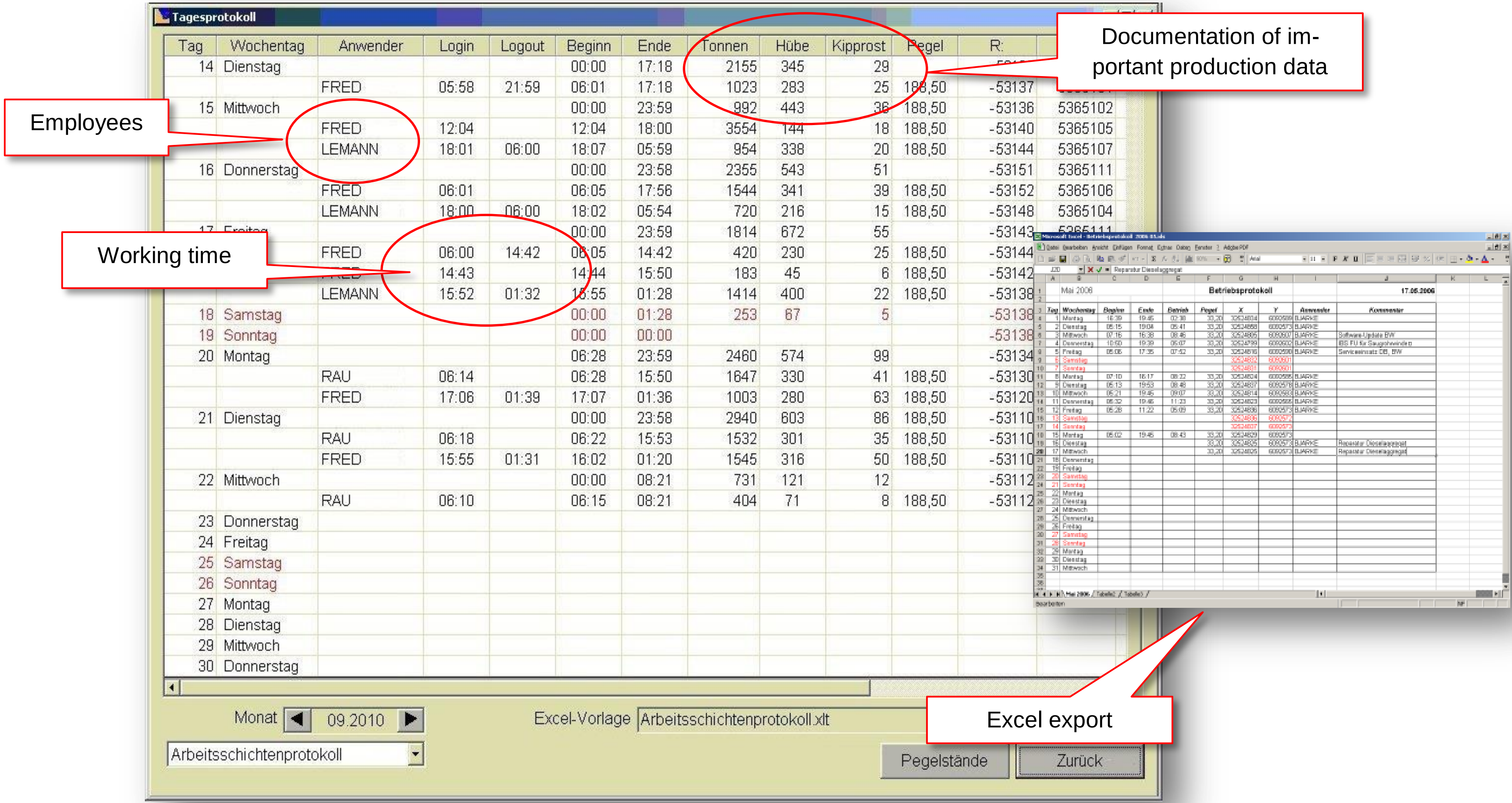


11. *DTconnect*

*The DredgerControl system saves daily protocol files with selected process data (see also DTreport) as required. If an internet access is also available, these protocol files can be sent as reports daily at 0.00 o'clock with the additional module **DTconnect**. If the dredger is not in operation at 0.00 o'clock, the mail is sent at the next system start.*

12. *Production data acquisition (in DredgerNaut)*

DredgerControl transfers important production data to DredgerNaut. The creation of the operating protocol in DredgerNaut can be employee-related as working time and production data recording and is password-protected if required.



13. *Shore station for online connection*

The shore station is connected online via a LAN or WLAN network to the computer on the excavating device. The same range of functions is available on both computers.

*Three modes are available for the shore visualisation in the **DredgerControl** system:*

1. *Observation mode*

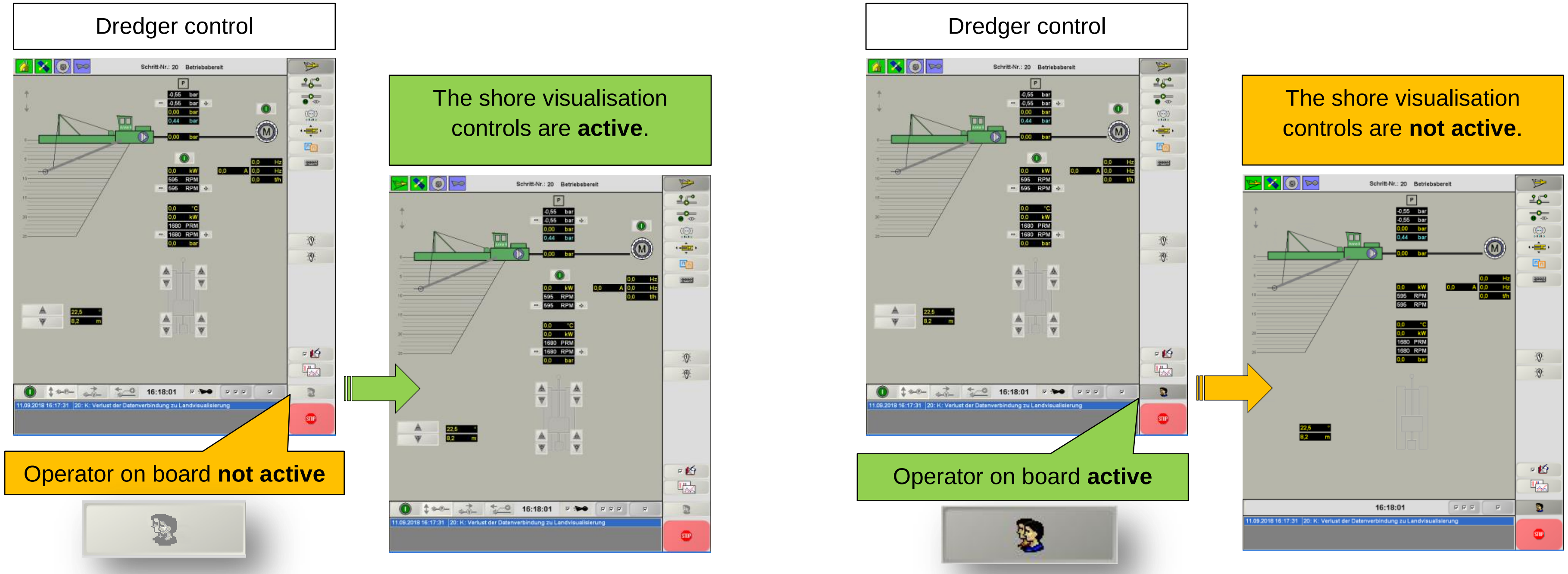
   In observation mode, no controls are available on the shore side.

2. *Control mode*

   In control mode, the controls are always available on the shore side.

3. *Control mode with automatic deactivation (see graphics)*

   *If the button **Operator on board** is pressed on the suction dredger, the controls on the shore side are hidden. Direct control of the units from shore is then not possible.*



14. *Summary - System Features*

<u>Standard scope of delivery (in the basic system)</u>

- ***Display styles***

  - Overview

  - Pump system

  - Navigation view
- ***Vacuum regulation***
- ***Speed setting of the sand pump***
- ***Visualisation of process variables***
- ***Monitoring of analogue values***
- ***Monitoring of limit angles***
- ***Monitoring of maximum depths***
- ***DredgerControl Cockpit***

<u>Additional options (according to need/application)</u>

- ***Water and material characteristic curves***
- ***Operating point regulator***

  - Speed regulation - flow velocity

  - Speed regulation - current control

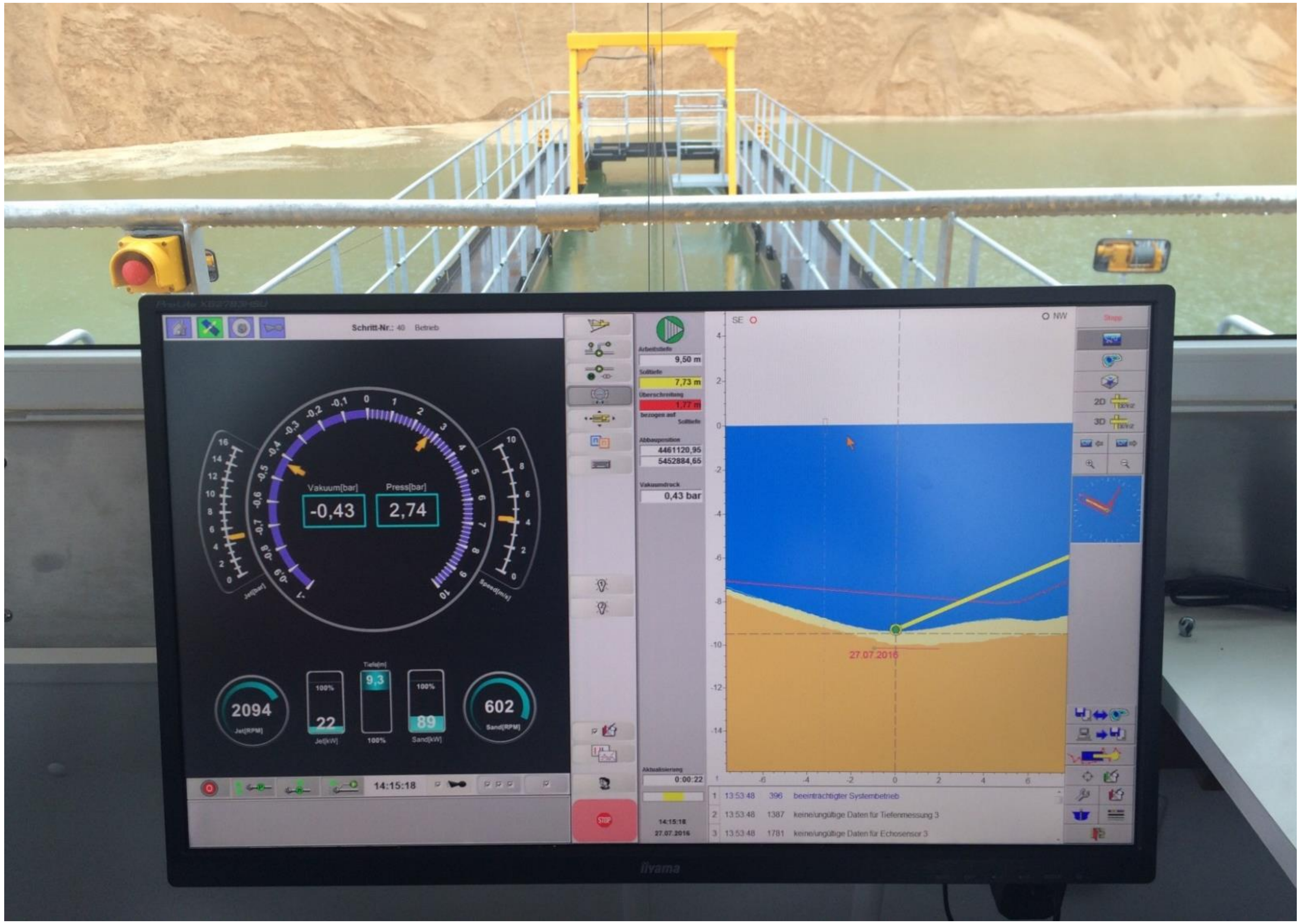
  - Speed regulation – back pressure monitoring

  - Speed regulation - main / intermediate pump

  - Vacuum reduction/ modulation/ adaptation

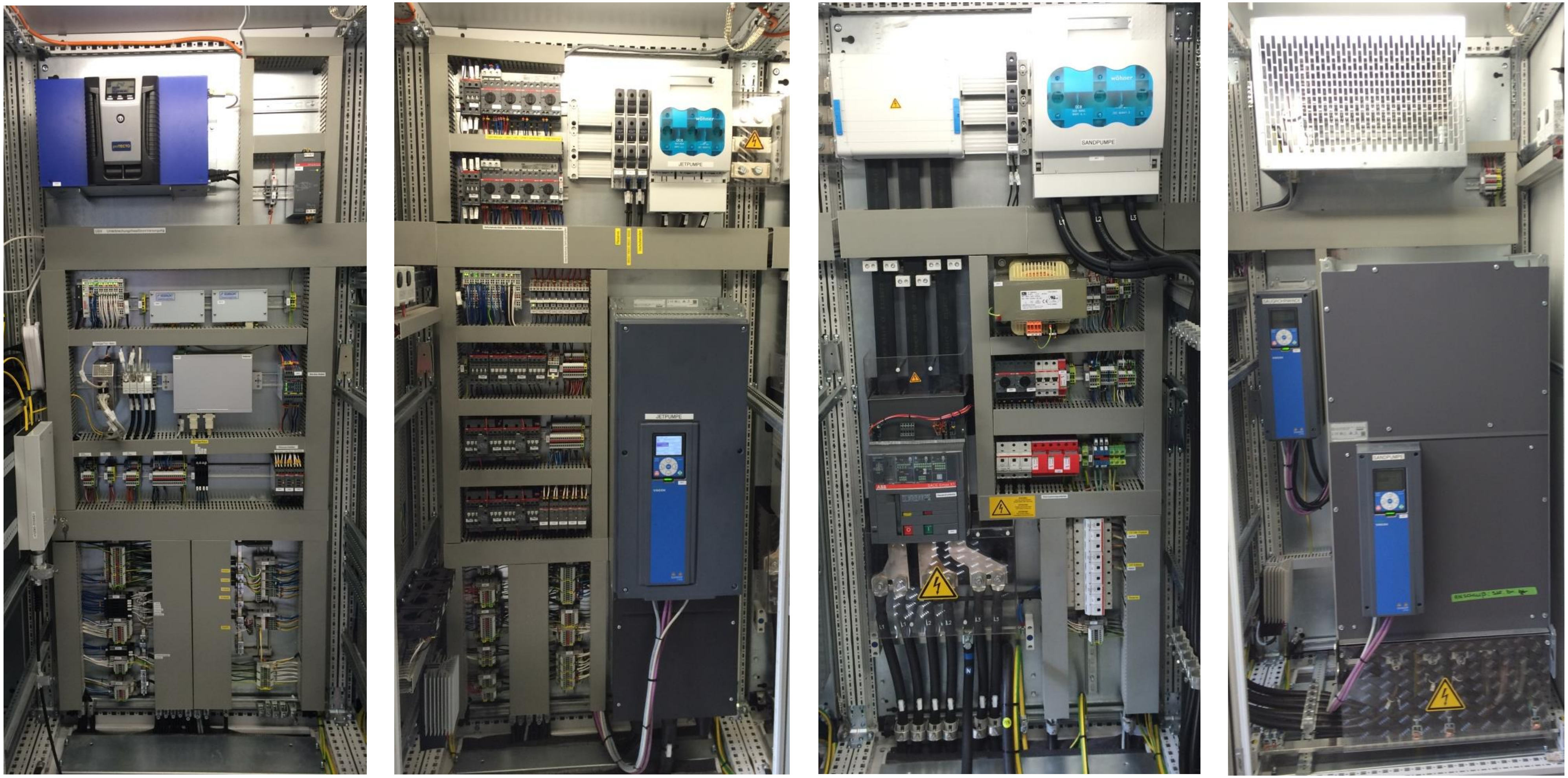
  - Jet pump regulation
- ***Connection of land components***
- ***Connection of a remote control***
- ***Connection of an excavation monitoring system***
- ***Winch functionalities***
- ***DTinsight and DTreport***
- ***DTmobil***
- ***DTconnect***

15. *Example fotos*

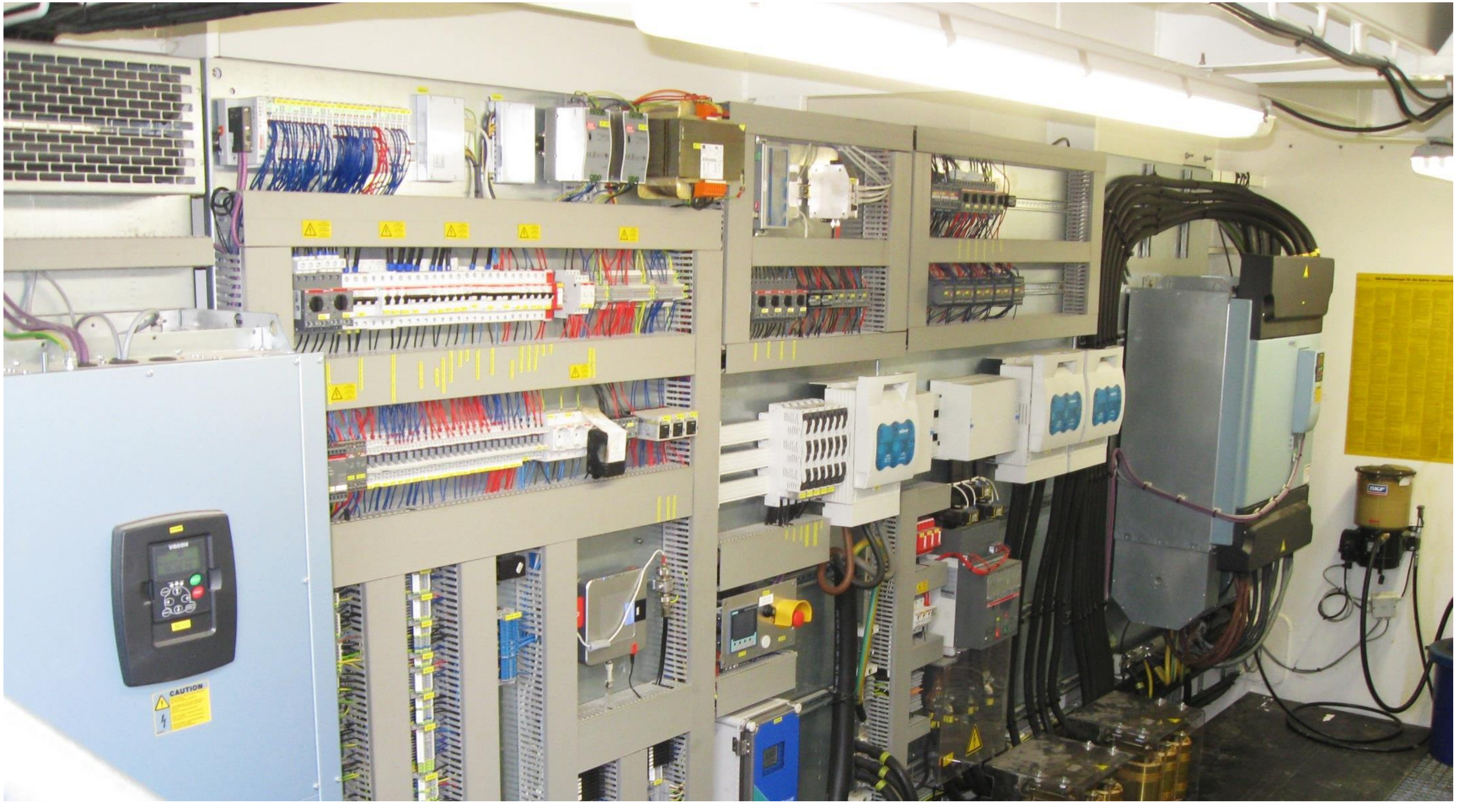


Picture 15-1: 27” display – installed in Sengenthal

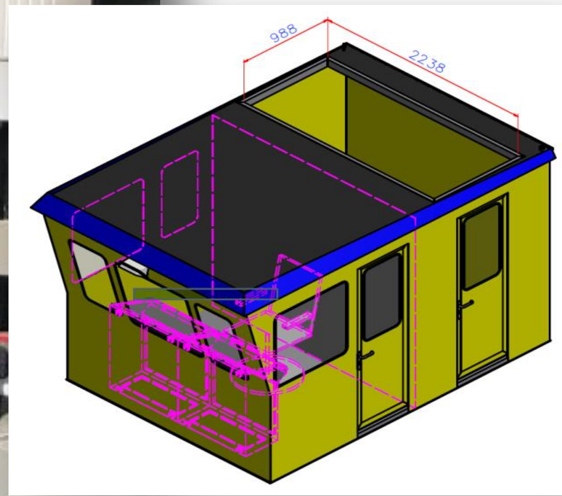
Picture 15-2: Electric pontoon (port) - enclosed design



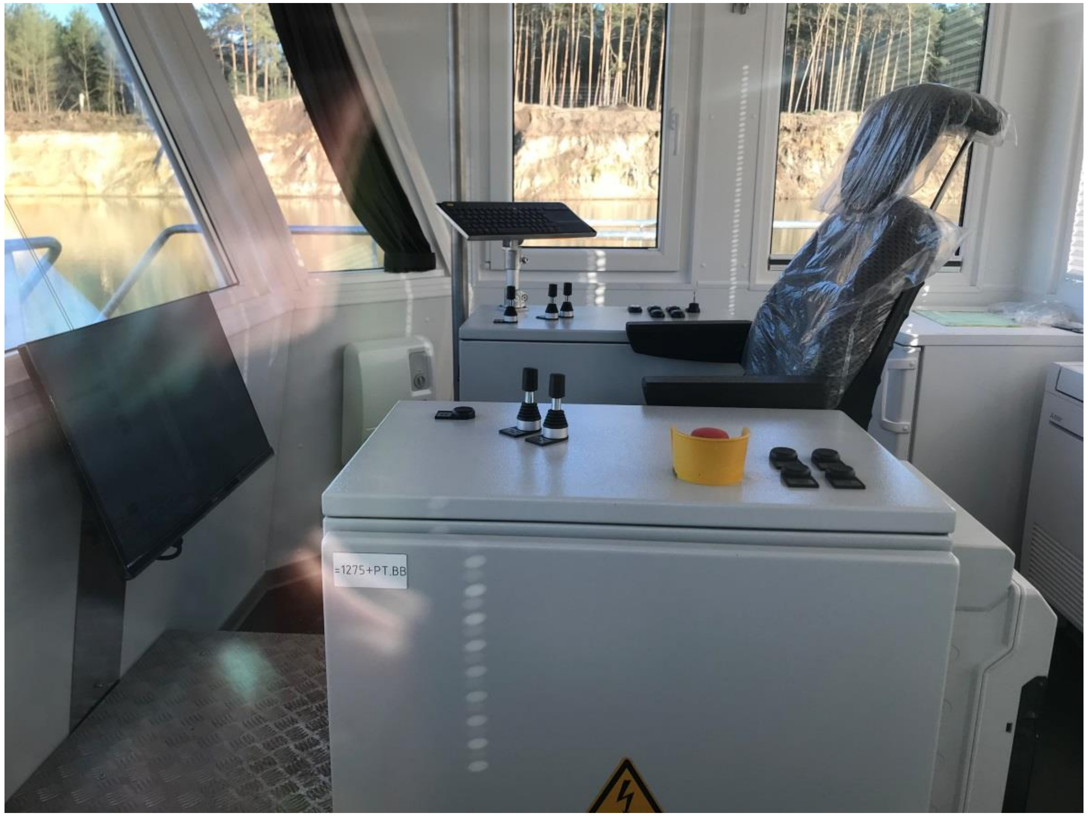
Picture 15-3: Electrical cabinets - enclosed construction



Picture 15-4: Elektro-Ponton (Backbord) – offene Bauweise



Picture 15-5: Electrical room integrated into the control cabin - open design



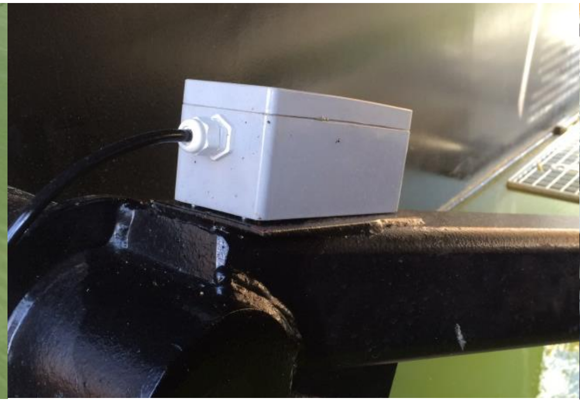
Lateral variant

Transverse variant

Picture 15-6: Console variants (lateral and transverse)

DGPS receiver

echosounder



angle sensor

pressure sensor

slack rope sensor

flow velocity
measurement system

pull-wire switch
at the suction tube

water detector
in pontoon

Picture 15-7: Sensors