

## Concentrating electrical equipment on moving machines

The old-fashioned way of controlling moving machines like, in this case, drag plough feeders is to concentrate the electrical components as much as possible in a switchgear room and bring only the absolutely necessary components into the field.

Two advantages of this design are:

1. Better conditions for the equipment in an air conditioned switchgear room
2. Better conditions for maintenance and repair in the switchgear room

But there are also big disadvantages which are, in my point of view, more important:

1. The machine can be delivered completely preassembled and pre-tested (depending on size, was possible for the below listed machines in steps 2 and 3
2. Searching for faults in the control and power circuits can be done in one place. The components are not spread over a large area.
3. The interconnections between cabinets are minimized. Only very few signals have to be checked on site. Especially this point can be seen very easily when comparing the numbers of cables in the below listed examples.
4. Checks on the machine can be done often by just 1 person, maximum 2 persons whereas the checks of the control circuits needed more personnel and additional equipment like radios that are sometimes not available or cannot be used due to the environment.
5. Additional problems can occur when cable length between inverter and motors is too long. This is also minimized when the inverter is mounted right next to the motors as shown in the last example.

The following examples are taken from machines that were realized some years ago and since then haven't been used regularly.

## 1. The old-fashioned way"



*Picture 1: Drag plough feeder coke step 1 (overall length ~12m)*

4 separate cabinets in switchgear house

1 cabinet mounted stationary mounted in the coke wharf

2 terminal boxes mounted stationary in the coke wharf

2 terminal boxes on the plough

1 cabinet mounted on the machine which had to be removed for transport

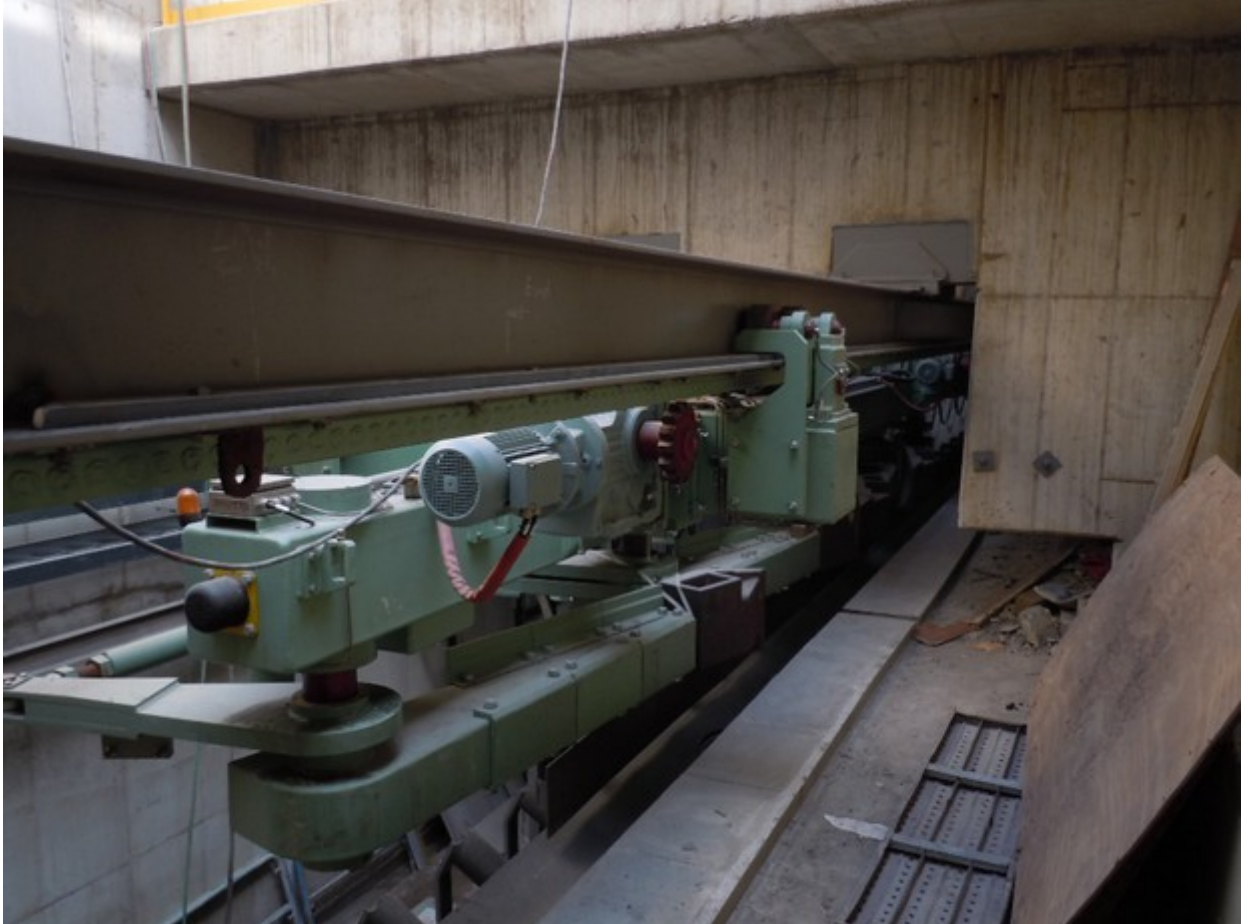
28 power cables including 8 festoon cables which had to be mounted/connected on site

29 control cables including 5 festoon cables (up to 12 cores) which had to be mounted/connected on site

All PLC-IO's were mounted in the switchgear room

Inverter mounted in the switchgear room

## 2. Remote IO's in the field and integration of the cabinets



*Picture 2: Drag plough feeder coke step 2*

- 1 cabinet in the switchgear house (could be split in 2 for transport)
- 1 cabinet mounted stationary in the coke wharf
- 1 cabinet mounted on the plough(could remain there for transport)
- 6 power cables including 2 festoon cables which had to be mounted/connected on site
- 4 control cables including 2 festoon cables which had to be mounted/connected on site
- Redesign of cable trays on the machine for better installation
- The time for electrical installation and tests was reduced by more than 50% compared to 1.

### 3. Inverter(IP66 protected) on the machine/no cabinet in switchgear room



*Picture 3: Drag plough feeder coke step 3 (transport completely assembled possible)*

2 small cabinets mounted stationary in the coke wharf (Terminal box / box for remote control)

1 cabinet mounted on the plough (could remain there for transport)

5 power cables including 4 festoon cables (single core to reduce cable diameter) which had to be mounted/connected on site

2 control cables including 1 festoon cable which had to be mounted/connected on site

Wifi control panel for machine

Another substantial reduction of time for electrical installation and tests (compared to step 2)

Machine is able to run completely autonomous when losing connection to tablet for approx. 40 minutes

#### **4. Summary:**

By concentrating the necessary electrical equipment on the machine it was possible to reduce the time for electrical installation and necessary checks by more than 60%.

At the same time it was possible to make maintenance and fault search much easier due to the fact that the I/O level of the plc (step 2) or even the plc itself (step 3) was placed on the machine itself. When checking for faults on the machine the I/O level of the plc can be directly seen.

EMC-problems with power cables are drastically reduced when cable lengths of inverter cables are reduced from approx. 400 m (step 1) to approx. 30 m (step 3)

EMC-problems with measuring cables are also drastically reduced when the I/O level is placed right next to the sensors.

Comparing the costs and giving relative numbers between the steps is rather difficult cause those machines were realized over a period of several years.

But it can definitely be said that the costs will be decreased by building the machines in a modern way.