



SIEMENS



Feb. 2017

Siemens Hoist Solutions

Mine Hoists

The Challenge



availability

- The performance of an underground mine depends significantly on the efficiency and safety of the hoisting machine.
- The efficiency is to be increased as much as possible ...
- ... without endangering the safety of people and material transported in the shaft.

Understanding of AVAILABILITY

Operate a hoist at special load conditions:

- rope shortening
- single site lift

Result :

Maintenance is going to be easy and fast, shut down time is reduced

Operate the hoist under smooth conditions (mainly torque):

- mathematical hoist model
- . . .

Result :

Minimized mechanical stress; less unexpected shut downs
Longer operation between maintenance shut downs

Keep production against all odds (damages)

- broken transformer
- . . .

Result :

Production is going ahead, while the operator is waiting for spares or repair personnel

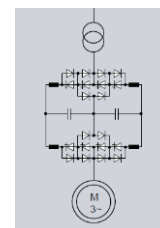
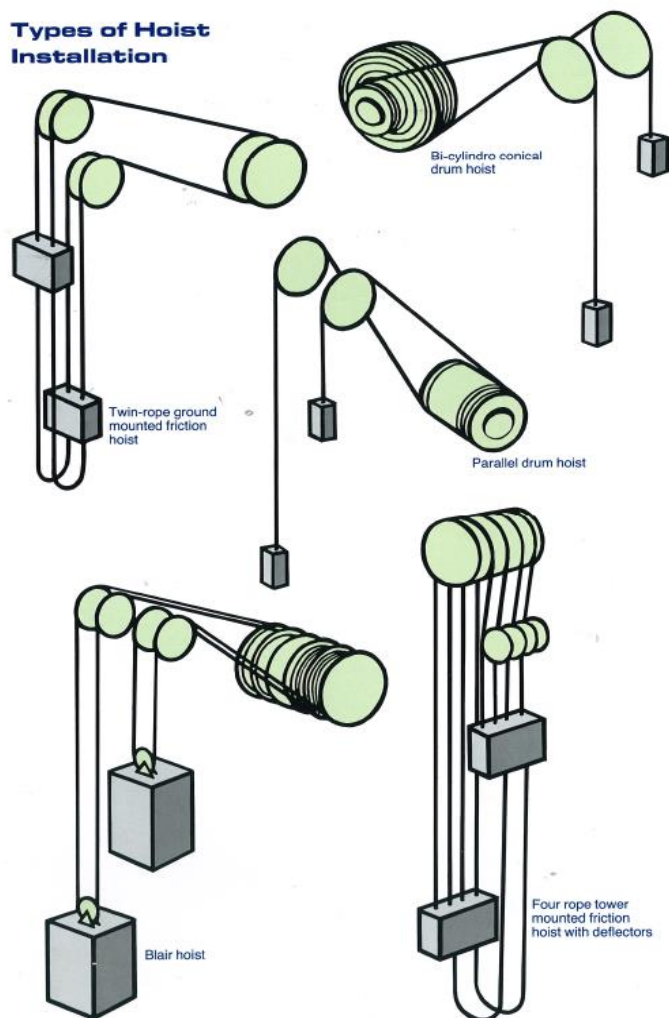
The challenge

How must a hoist be designed, that:

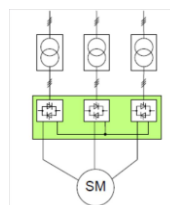
- The hoist can be kept in operation; not every peanut lets to a shut down
- A problem will be fixed in the shortest possible time

Different solutions need different concepts

Types of Hoist Installation



PWM LV Converter
High Speed gerad
Motors



Cycloconverter
6pulse
Direct coupled low
speed motors

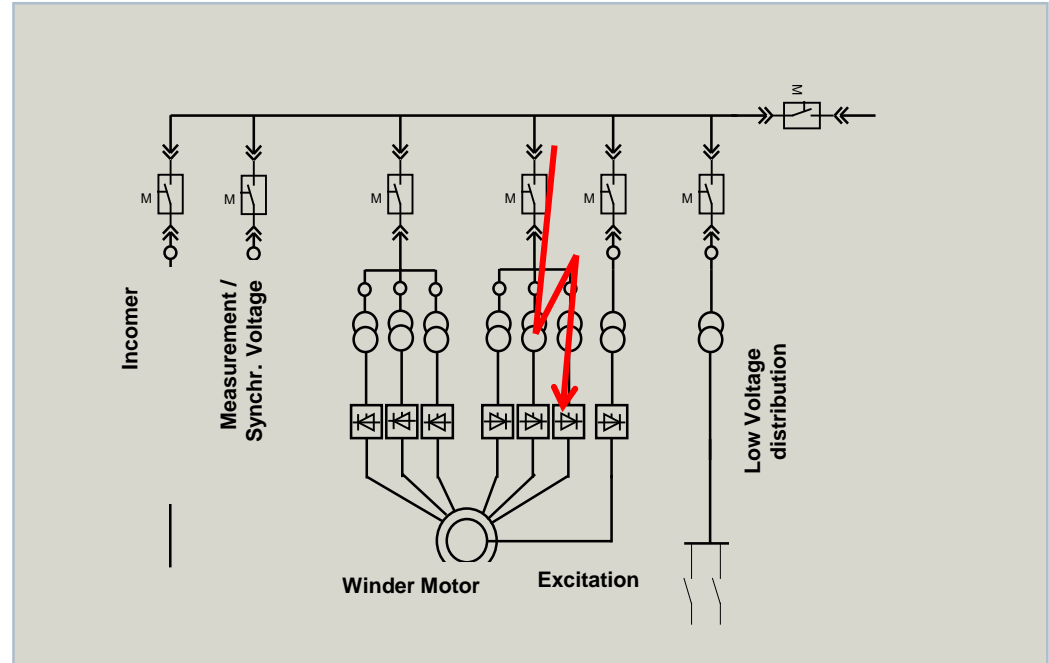
Cycloconverter
12pulse
Direct coupled low
speed motors

PWM MV Converter
DC-Link Converter
Direct coupled low
speed motors

DC Converter
Direct coupled low
speed motors

DC Converter
High Speed gerad
Motors

12 pulse cycloconverter



Fault scenarios:

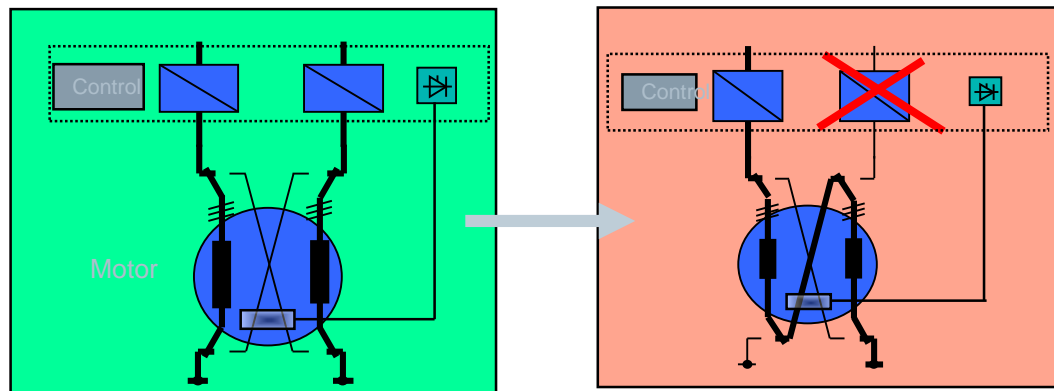
- Broken fuse in power section
- Broken Thyristor
- Damaged transformer
- Fault in MV switchgear
- ...

The solution:

- > 6 pulse emergency mode

In case of any fault at one MV breaker, Transformer or converter, it is possible to run the converter and the motor in a 6 pulse “emergency” mode.

- Operate the winder at **full load, half speed**.
- Both motor windings (which are normally working parallel) are put into serial connection.
- The disabled converter system can be disconnected and will not be energised.

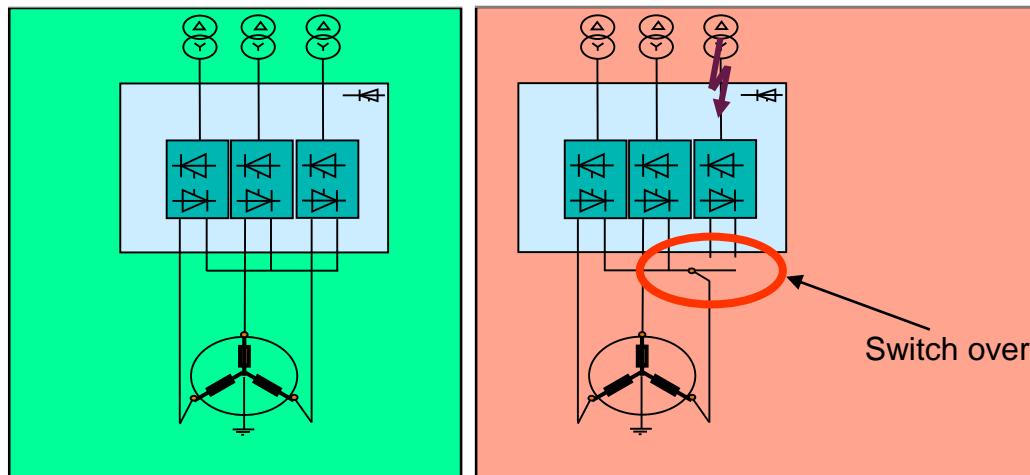


The solution:

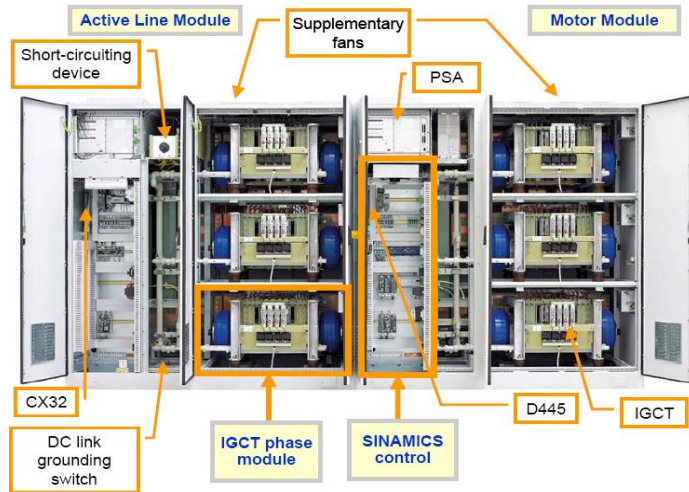
- > V-Connection

In case of any fault at one Transformer or Thyristor, it is possible to run the converter and the motor in a V-connection “emergency” mode.

- Operate the winder at full load, half speed.
- One motor winding is connected to the converter STAR-POINT
- The disabled phase system is disconnected and will not be energised.

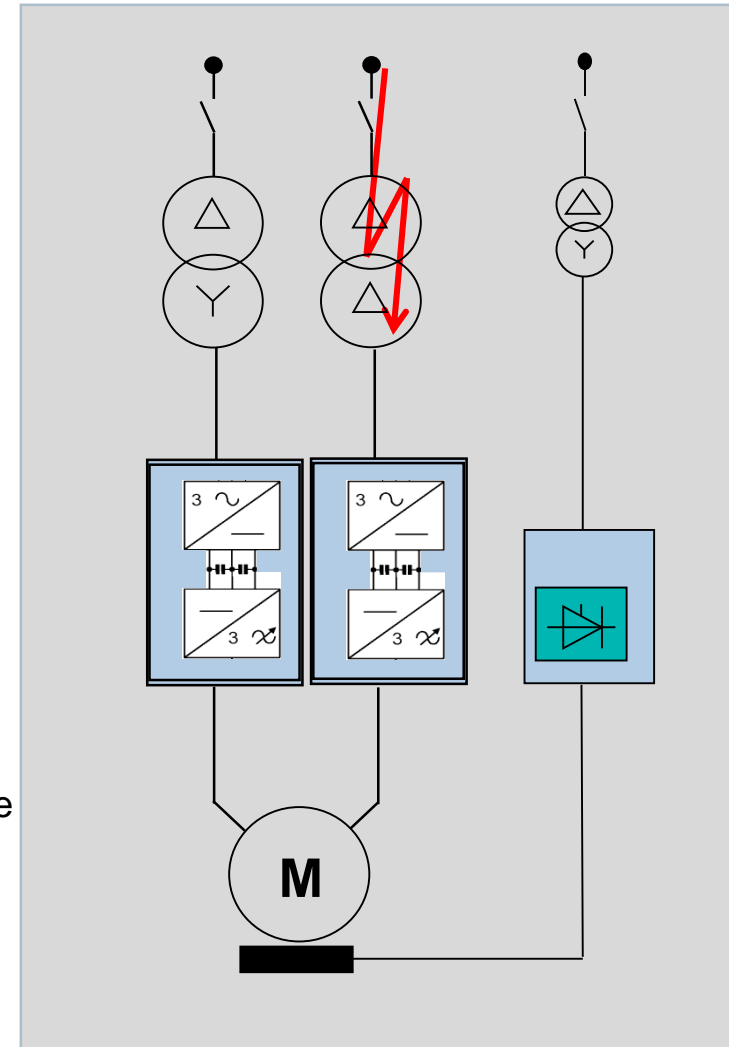


12pulse / parallel DC-Link SM150 converter



Fault scenarios:

- Broken MV switch
- Damaged phase module
- Damaged transformer
- ...

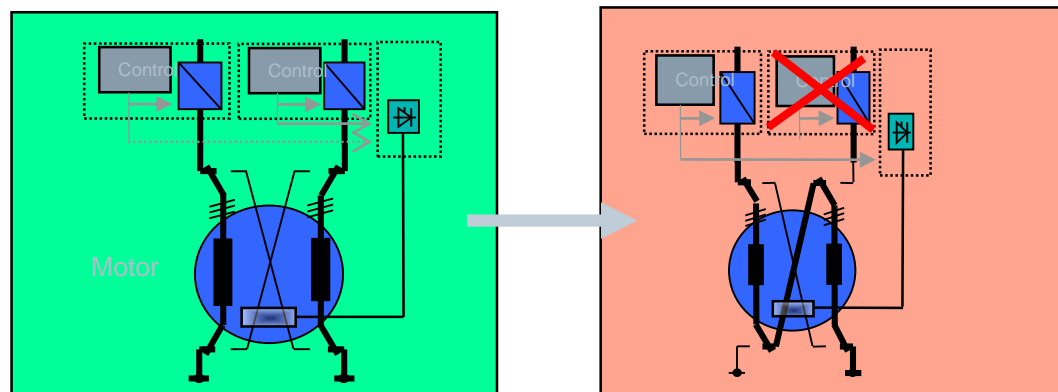


The solution:

- > 6 pulse emergency mode

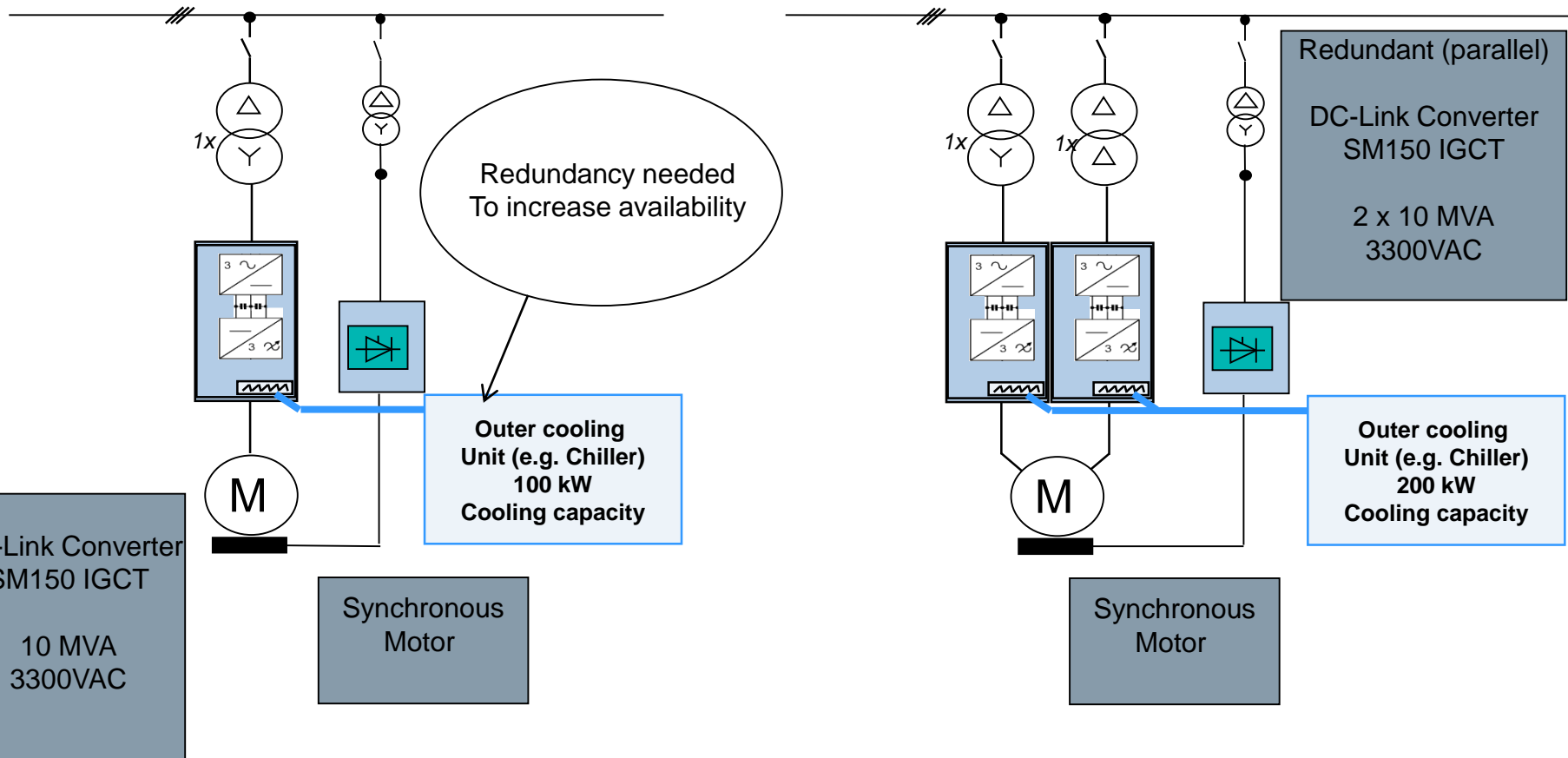
In case of any fault at one MV breaker, Transformer or converter, it is possible to run the converter and the motor in a 6 pulse “emergency” mode.

- Operate the winder at **full load, half speed**.
- Both motor windings (which are normally working parallel) are put into serial connection.
- The disabled converter system can be disconnected and will not be energised.

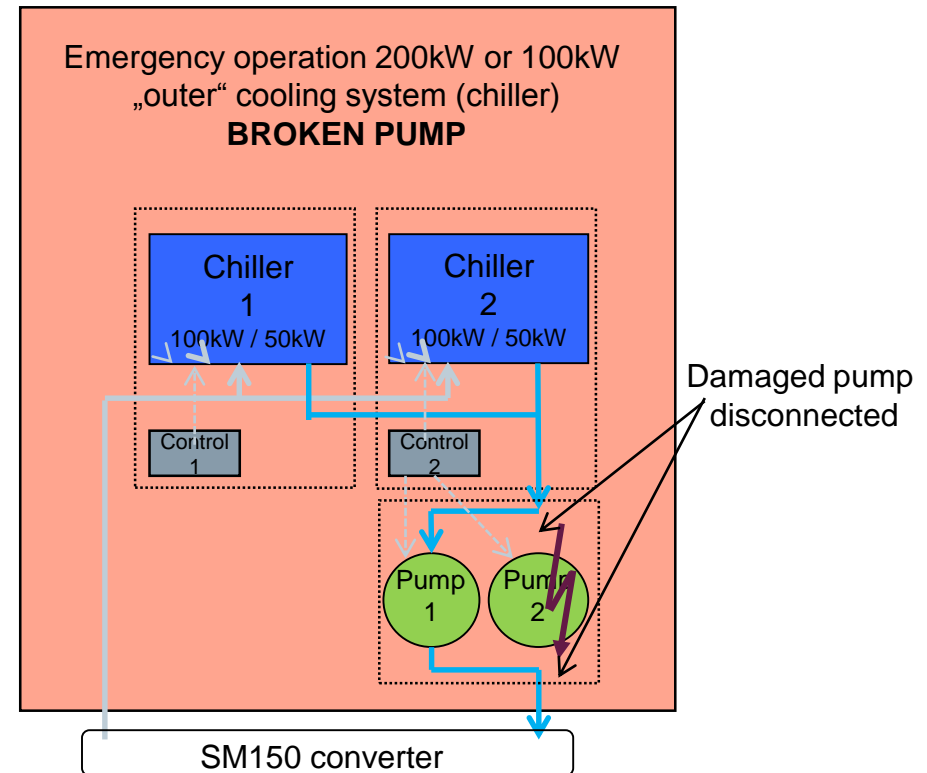
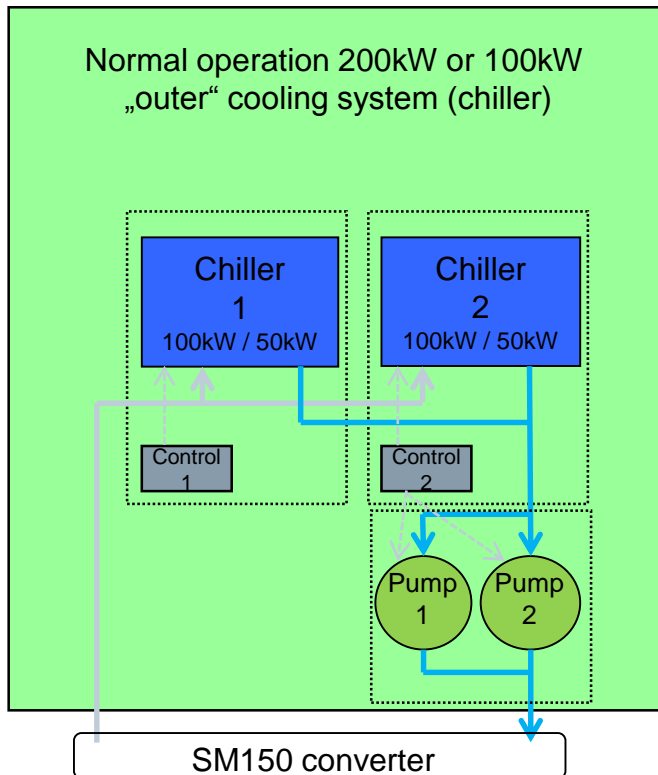


Actual situation:

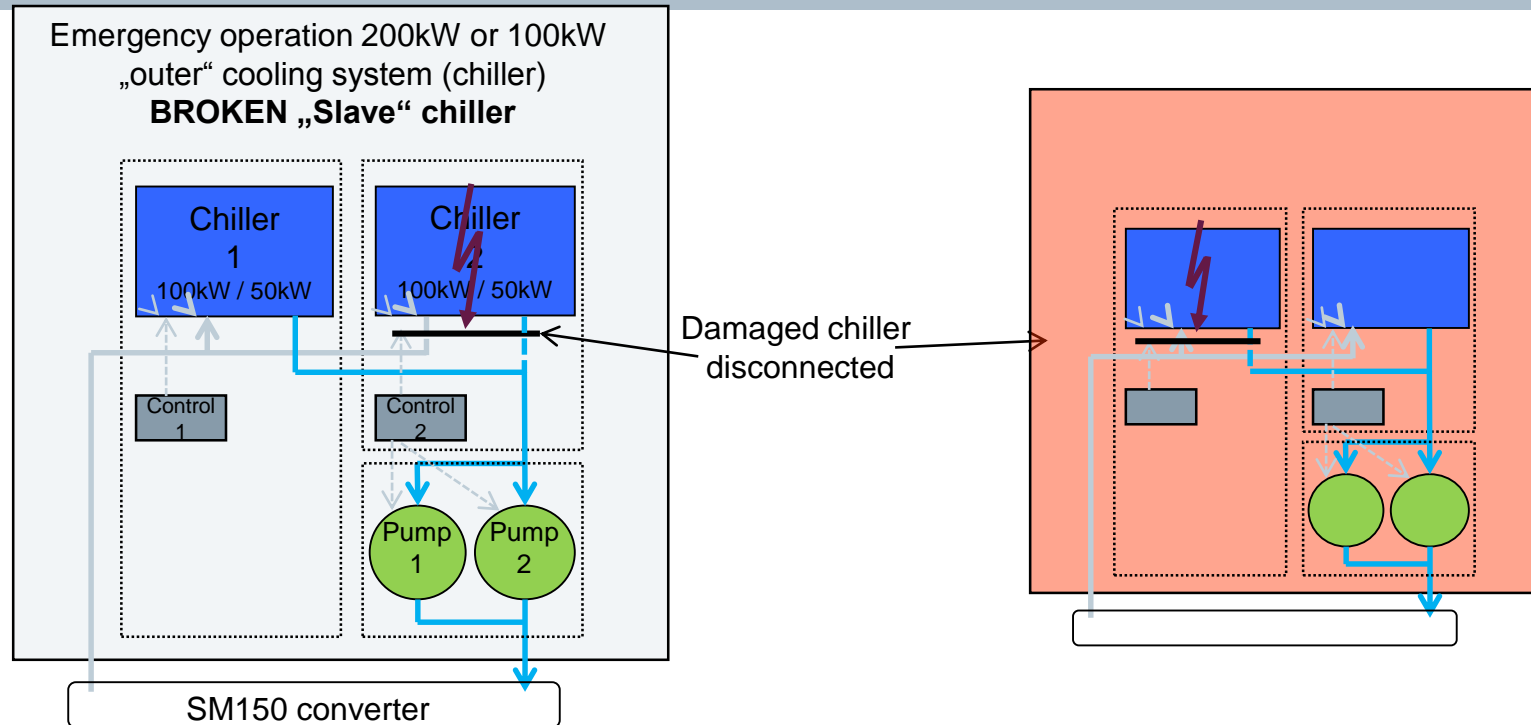
Or:



The solution:



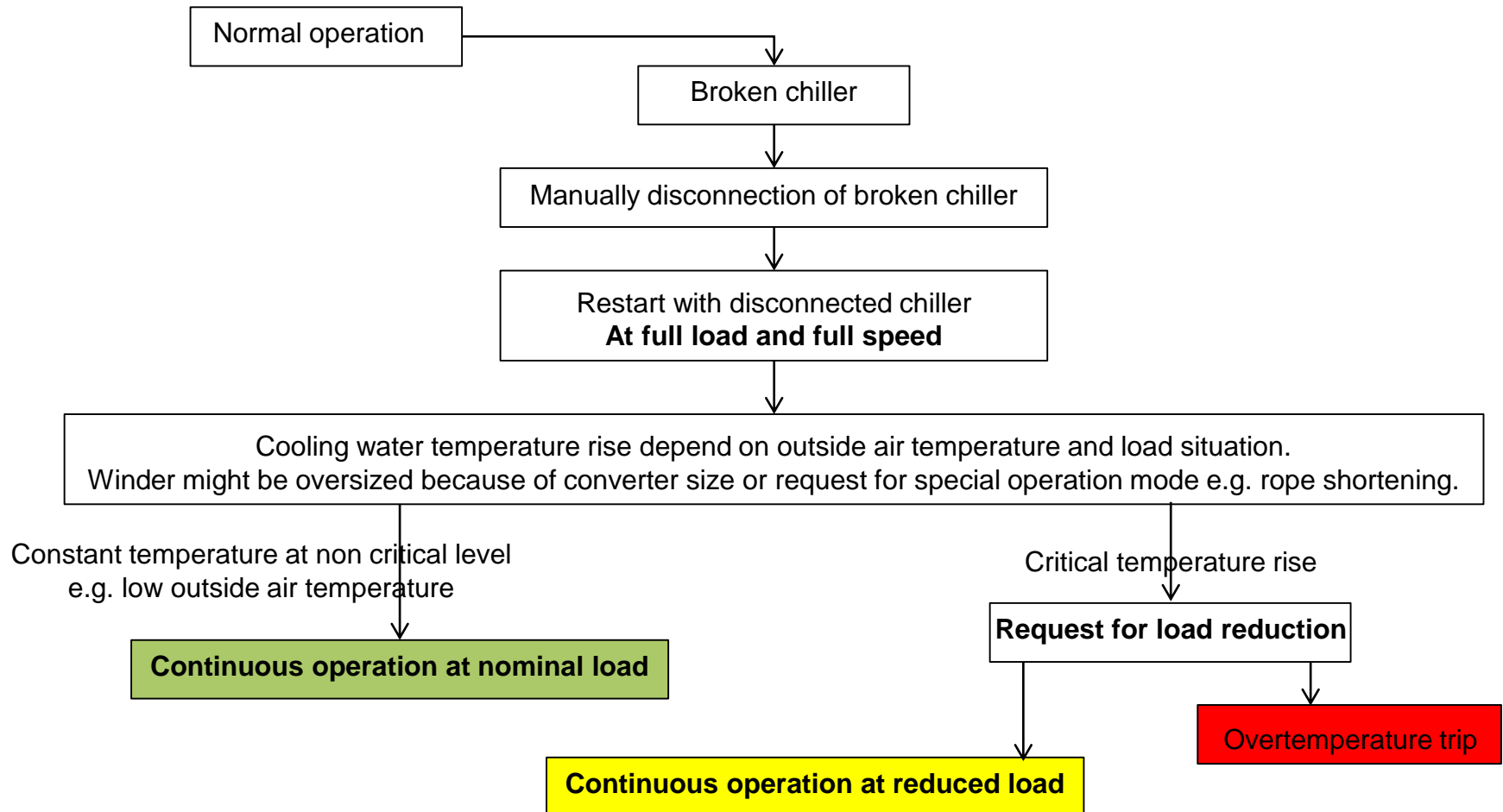
In case of a broken cooling pump it is possible to run the winder with one pump and full cooling capacity at normal operation



In case of a broken chiller it is possible to run the winder at 50% cooling capacity. The broken chiller will be disconnected and can be repaired.

At a 200kW cooling system 100kW of cooling power are available. The winder can be operated at 100% of capacity (mean full load and full speed) until the internal temperature warning requires a reduced hoisting power, mean a reduction of the hoisting load.

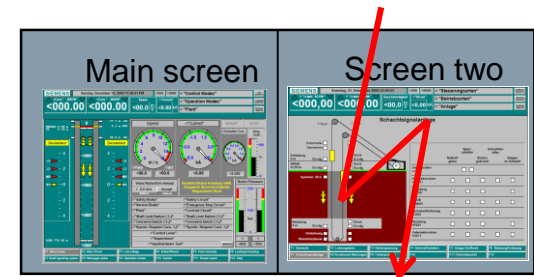
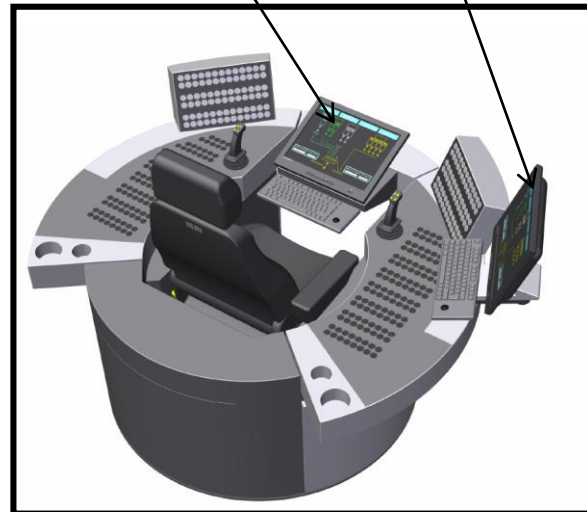
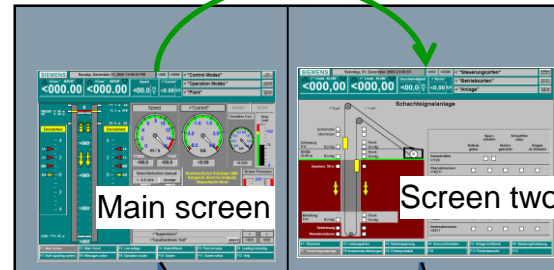
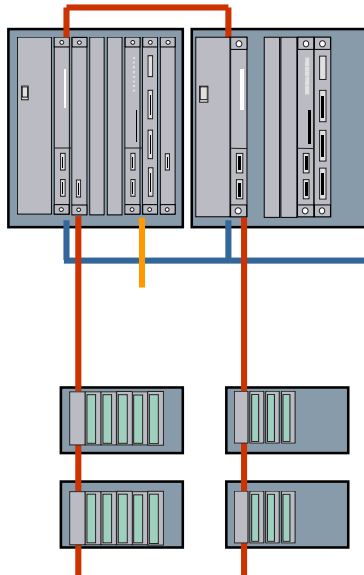
Depending on outside air temperature this request may happen after several hours or never.



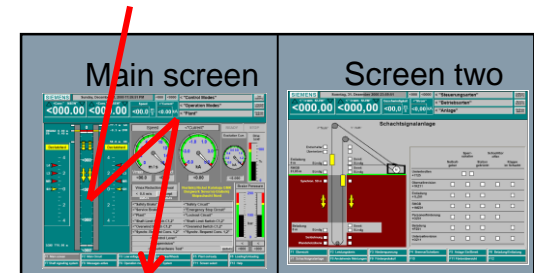
Redundancy at automation systems

Functional switch over

Channel A Channel B



Screen two brakes:
Winder still in full operation



Man Screen brakes:
Screen two is switched to
Main screen mode
Winder can be operated



Shilauwusu, China 2013 – 16

Redundancy



The task

Minimize footprint;
Maximize availability.

Installation of the motor

Two tower mounted
production winders



The Solution

- Synchronous winder motor with two electrical system each connected to a PWM DC-Link converter: Sinamics SM150.
- At a broken converter or transformer the winder can run at full load and half speed

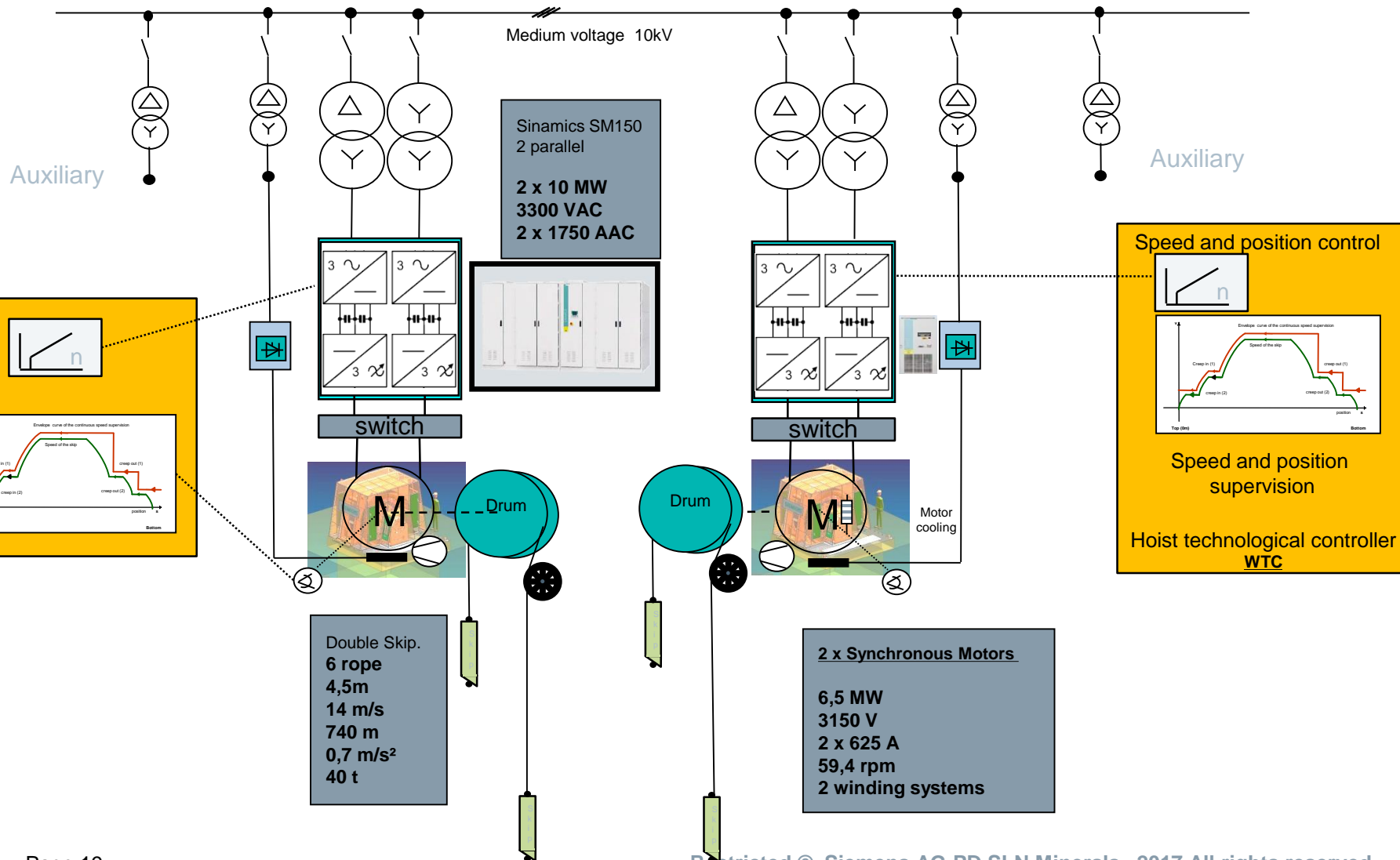
Siemens scope

- Power system; converter, motor transformer
- Supply of a new automation control and supervision system
- Installation and commissioning of the system
- In addition to the production winders Siemens also equipped Service winder for this mine



Shilauwusu, China 2013 – 16

Redundancy



Shilauwusu, China 2013 – 16

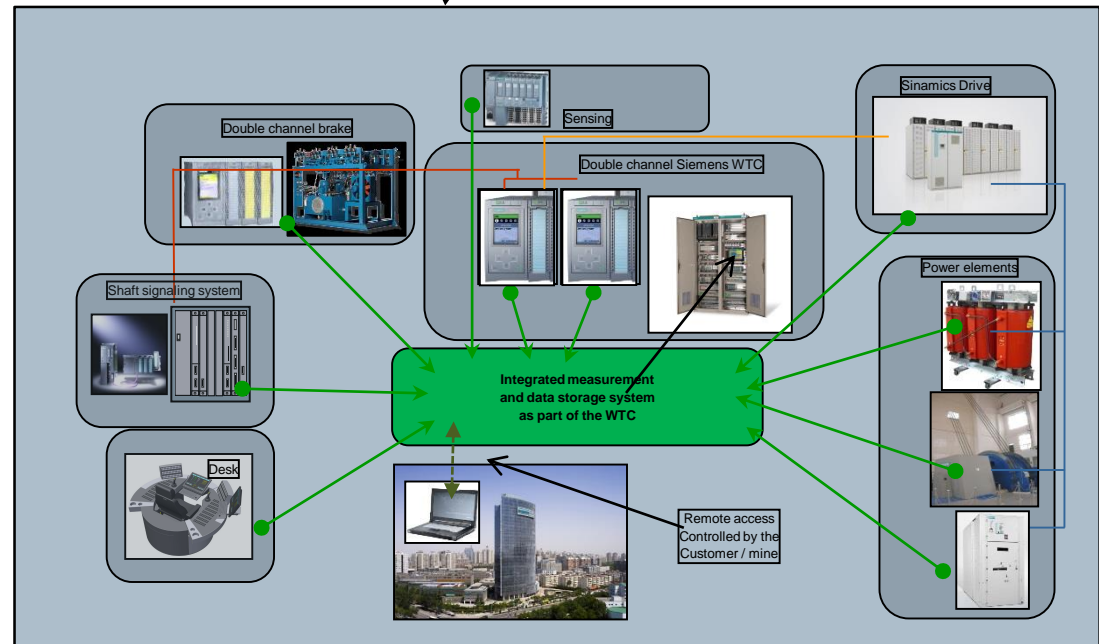
Redundancy

- Maximum availability step ;1 (hoisting system)
both hoists are operated independent
- Maximum availability step 2; (winder)
each hoist can still be operated with partly malfunctions
(e.g. transformers, converter, cooling system, HMI, ...)
- Maximum availability step 3; (remote service)
Short reaction time and fast repair

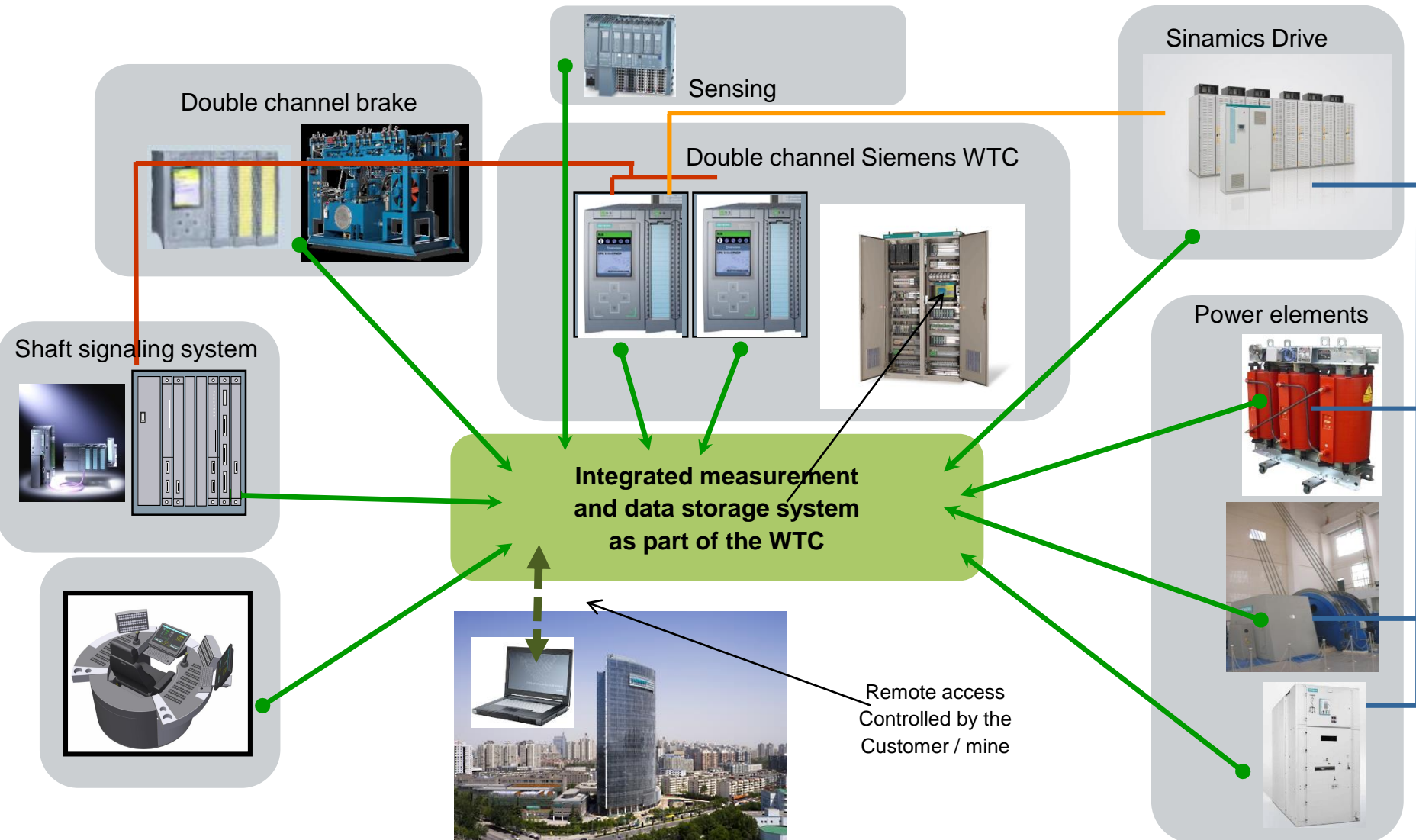
Two independent winders,
instead on one big

6 pulse emergency mode

All components are controlled by
one integrated measurement system



Analyzing faults Reducing reaction / shut down time



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THANK YOU!