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from
STORA ENSO

Skoghall Mill



FACTS SKOGHALL MILL

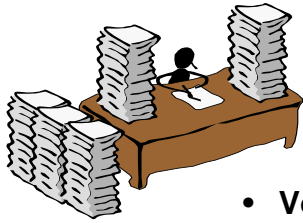
NETWORK VOLTAGE 130 KV

MILL DISTRIBUTION VOLTAGE 10 KV

POWER CONSUMPTION 145 MW

POWER PRODUCED IN MILL 60 MW

Problems and measures with
voltage disturbances
at Skoghall Mill



ELECTRICITY SUPPLIES QUALITY PARAMETERS

- Voltage dips
- Interruptions
- Harmonic distortion
- Flicker
- Voltage variations
- Voltage transients
- Electric and magnetic fields
- Nonlinear loads

WHICH OF THESE PARAMETERS IMPACTS OUR PRODUCTION?

Voltage Dips!



WHAT IS THE MOST CRITICAL EQUIPMENT FOR DIPS IN THE INDUSTRY?

- Control-systems, fixed by UPS systems
- Frequency converters and their capacitors in DC-link and their undervoltage protection

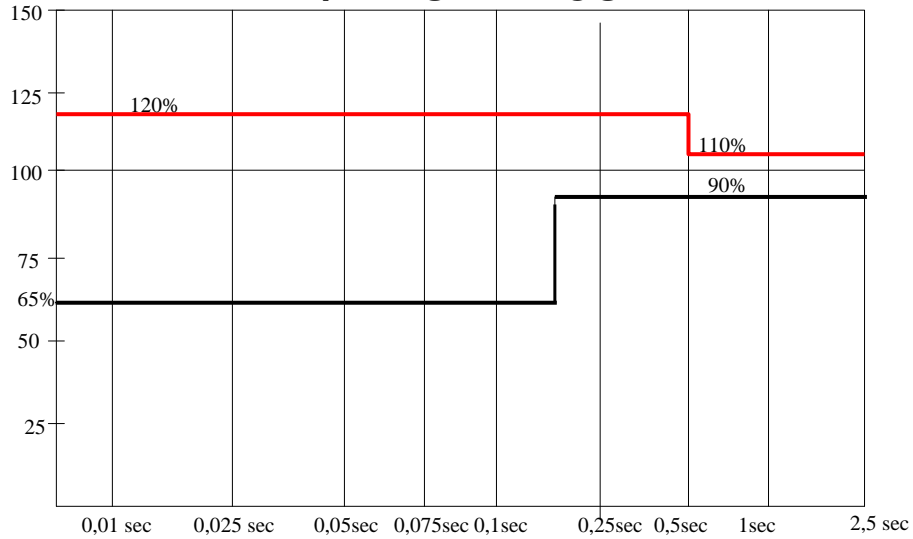


WHICH OF THE VOLTAGE DIPS CAN WE HANDLE?

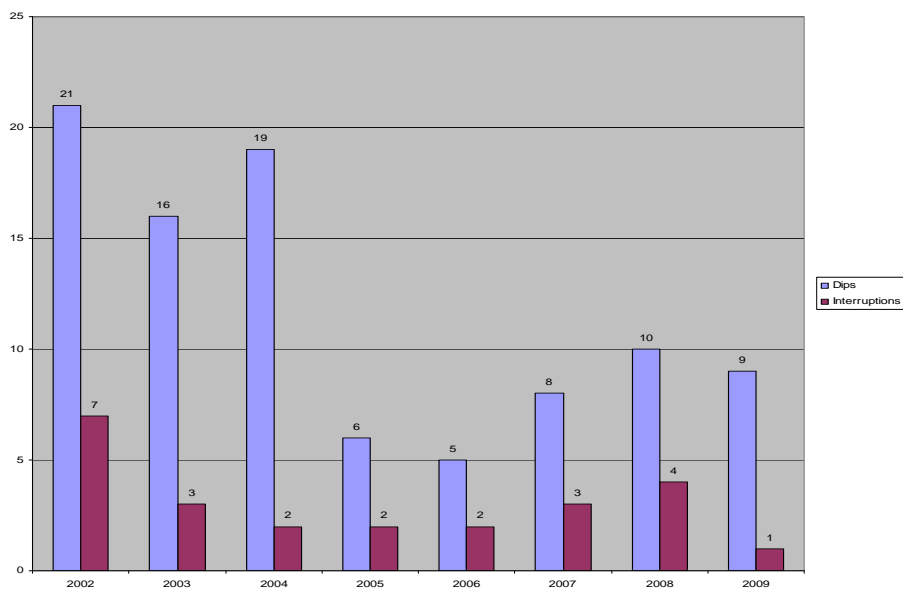
- Technically, our facilities operate down to 65% of nominal voltage without any problems
- 150 ms is the time that our process can run without interference on the process

WHICH GIVES US THIS LIMIT-/IMMUNITY-CURVE

Remaining
voltage in%



REGISTRATED VOLTAGE DIPS





WHAT HAS BEEN DONE?

1993 Radio and telekommunication immunity level established

1997 Vattenfall registrered all voltage dips during summer season

1997-1998 Most critical positions fixed

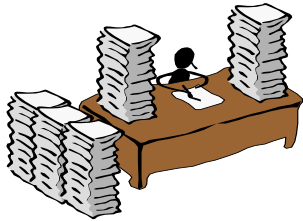


WHAT HAS BEEN DONE?

2001 Measuring equipment for dips registration installed

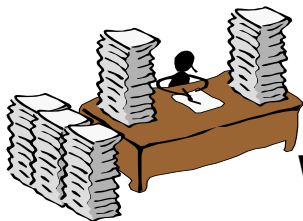
2002 Increased capacitor bank installed on drive systems for Board Machine

**2003-
and forward** Continously following up at all dips. All registrations have been followed up resulting in a plan of action



ECONOMICAL RESULTS?

- To be able to follow the immunity curve, investments for approximately 600.000 EURO has been done during period 1997-2004
- 2005-2008 invested 50.000 EURO per year
- This gives increased incomes from 2002 and forward 2.500.000 EURO per year



WHAT MORE CAN BE DONE?

- Continue change old equipment to new once
- Increase cooperation with network owner to find a way to solve the problems that cannot be handled in the mills



ELECTRICITY DELIVERING

- The only raw material that is not quality certified delivery, which means;
- We don't know what we get
- Focus on wrong quality parameters?

RESEARCH ON A SUBTRANSMISSION NETWORK

- A region with combination of heavy and light industry was chosen for a complete study
- Involved in the study were Fortum, (network operator), STRI AB and a number of pulp and paper industries

FROM DIP TO PRODUCTION INTERRUPTIONS



Dips start

Dips transport way

End-goal for dips

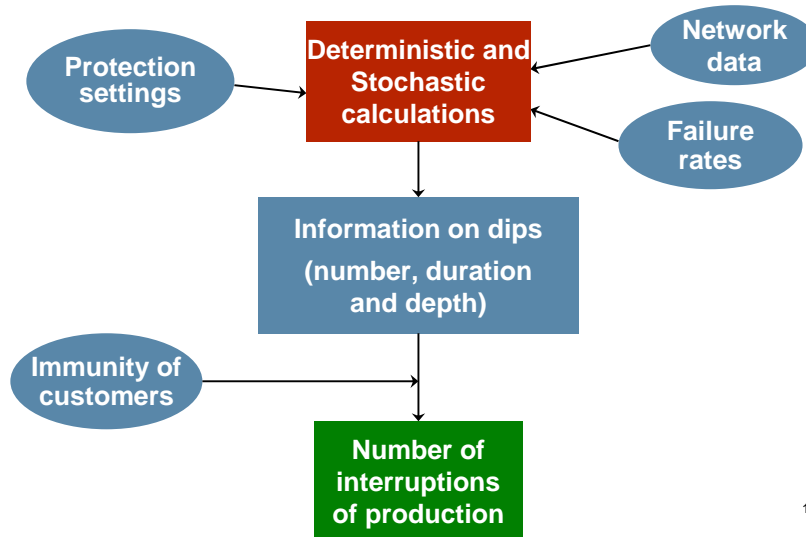
17

RESEARCH ON A SUBTRANSMISSION NETWORK

- 26 different solutions was simulated
- The number of production interupts and their costs was compared from the different solutions

18

METHOD USED

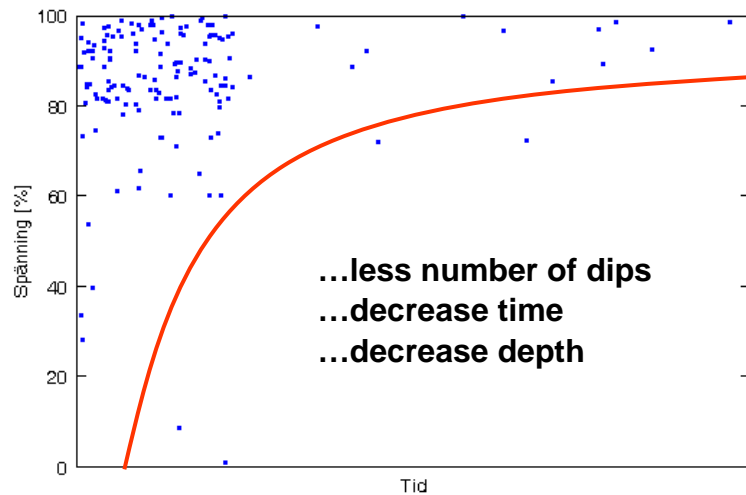


19

RESULT OF THE STUDY

- **Is there any technical possible solutions to get rid of the problems?**
 - Yes, both in network and in the production areas
- **Is it cost efficient to get rid of the disturbances?**
 - Yes, but the investments have to be done in the right places

WHAT CAN BE DONE IN THE NETWORK?



21

WHAT CAN BE DONE IN THE NETWORK?

Less number of dips by:

- **Tree trimming**
- **Cables instead of overhead lines**
- **Longer insulation distance**
- **Lines with surge arresters**
- **Protection against birds**
- **Shielding wires**
- **Bus splitting**
- **Diagnostics and maintenancel**

22

WHAT CAN BE DONE IN THE NETWORK?

Shorter time by:

- **Optimized time setting on relay protections**
- **Bus-communication between relays**

23

WHAT CAN BE DONE IN THE NETWORK?

Less deep on the dips by:

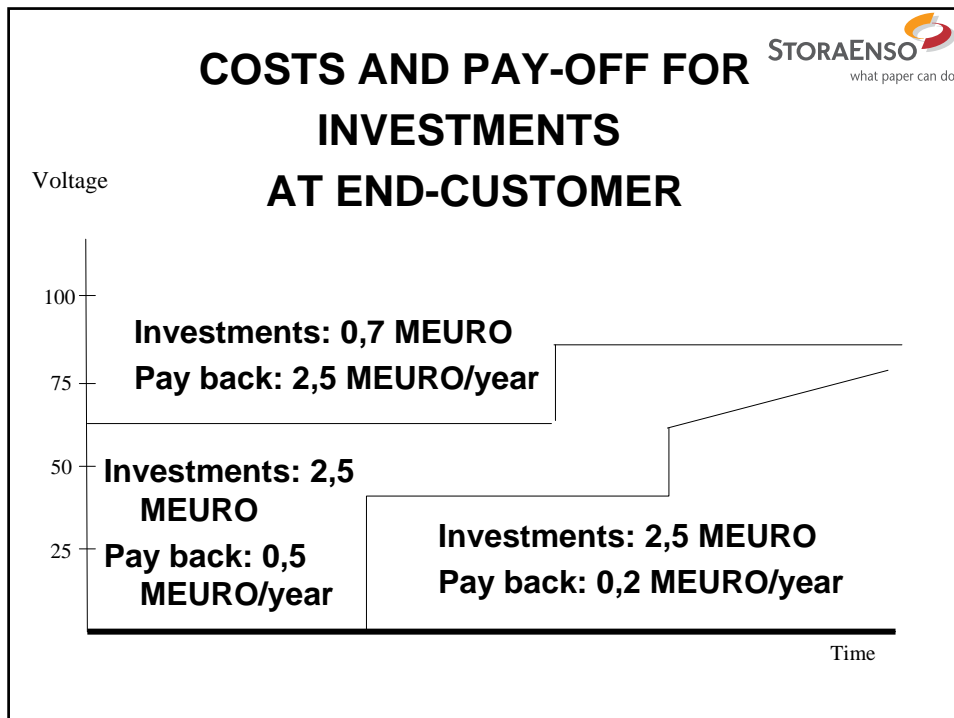
- **Limit the fault current**
- **Change the connection of lines to the substation; bus splitting to limit the exposed area**
- **Change 3-phase faults to 1-phase faults (by earthing of wood poles, shielding wires, surge protection, etc.)**

24

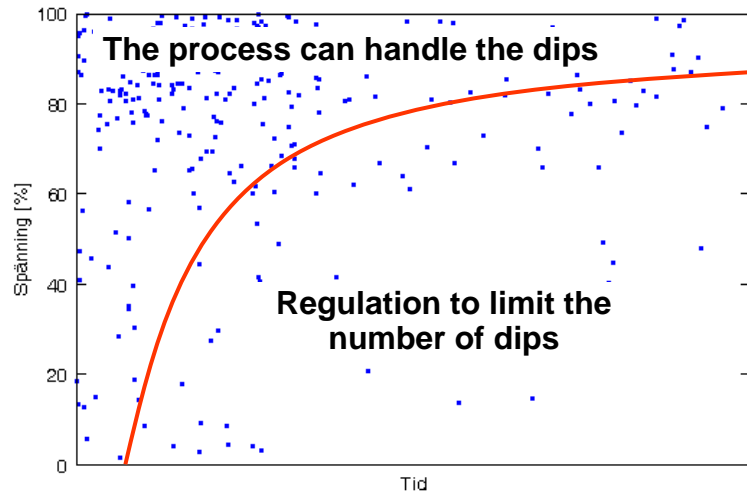
RESULT OF THE STUDY

- The study shows which of the solutions that gives the best effects. The best of them all was:
 - Install separate surge arresters on two of the lines which reduce the number of dips with 12 % and reduce the costs with 0,4 MEURO per year
 - Investment costs for this is 1,3 MEURO
 - Pay-off time 3 years

25



WHO IS RESPONSIBLE?



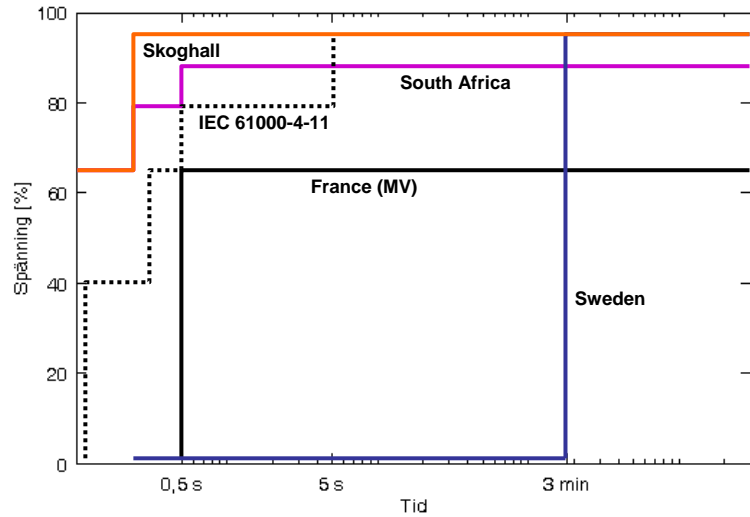
27

WHO IS RESPONSIBLE?

- Responsibility at the network gives limits for
 - ... **numbers of**
 - ... **length**
 - ... **depth**
- End customer is responsible for that the equipment can handle dips up to a certain limit according to
 - ... **length**
 - ... **depth**

28

EXISTING RESPONSIBILITY SHARING



29

SUMMARY

- Voltage dips are the main problem for our industry
- Improvements in the installations are possible and economically justified
- Improvements in the network are possible as well
- A responsibility sharing curve is needed

30