SUOMEN SOODAKATTILAYHDISTYS
FINNISH RECOVERY BOILER COMMITTEE

Suomen Soodakattilayhdistys ry

Konemestaripäivä 2013

Rantasipi Imatran Valtionhotelli, Imatra
Metsä Fibre Oy, Joutsenon tehtaat

24.1.2013

Raportti 1/2013

(16A0913-E0140)

Raportti 1/2013 Konemestaripäivä 2013

KONEMESTARIPÄIVÄ 2013
Rantasipi, Imatran Valtionhotelli
Metsä Fibre Oy, Joutsenon tehdas

torstai 24.1.2013

klo	
09.00	**Ilmoittautuminen ja aamukahvi** ***Imatran Valtionhotelli, Imatra-sali*** ***Torkkelinkatu 2, 55100 Imatra***
09.20	**Tilaisuuden avaus** ***Timo-Pekka Veijonen, Soodakattilayhdistyksen puheenjohtaja***
09.30	**Soodakattila- ja turbiinivauriot** ***Thomas Åström, NDT-Consulting***
10.30	**Kahvitauko**
11.00	**Soodakattilan 1-lieriömuutos** ***Jouni Koskinen, Metso Power Oy***
11.30	**Henkilöturvallisuuden parantaminen soodakattilalaitoksessa RFID avulla** ***Jari Aapio, Visi Oy***
12.00	**Lounas**
13.00	**Älykäs nuohous, tehostaa puhdistusta ja vähentää nuohoushöyryn kulutusta** ***Carl-Johan Fogelholm, Endat Oy***
13.45	**Tauko**
14.00	**Bussikuljetus Joutsenon tehtaille**
14.30	**Kahvi ja tehtaan edustajan tervehdys**
15.15	**Tehdaskierros**
16.30	**Bussikuljetus Imatran Valtionhotelliin**
17.00 - 19.00	**Sauna**
19.30 ->	**Illallinen, *Linnaravintola***

SUOMEN SOODAKATTILAYHDISTYS RY
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FIN-01621 VANTAA

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+358 10 33 21163

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SOODAKATTILA- JA TURBIINIVAURIOT

Thomas Åström
T. Åström NDT-Consulting

SOODAKATTILA- JA TURBIINIVAURIOT

KONEMESTARIPÄIVÄT
Suomen Soodakattilayhdistys
Rantasipi Imatran Valtionhotelli
24.1.2013

Tekn. Toht. Thomas Åström
T.Åström NDT-Consulting

T

Sisältö

- Konediagnostiikan filosofia
- NDT-perusmenetelmien periaatteet:
- VT, MT, PT, UT, AKU
- Uusia paksuusmittausmenetelmiä:
- T-Scan
- Magnetiitin paksuusmittaus: Korkeataajuus-UT
- SKY:n vauriotilasto 2012
- Soodakattilavaurioita Suomesta
- IMIA:n konerikkotilasto
- Turbiinivaurioita Suomesta

POHJOLA

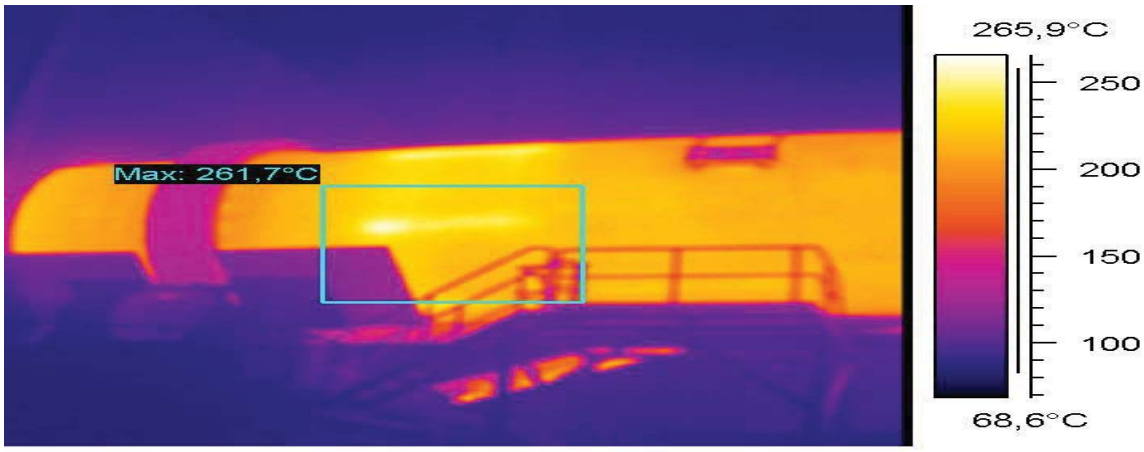
KONEDIAGNOSTIIKKA

- PROSESSIN HYÖTYSUHDEMITTAUKSET: $T; p; \dot{m} \Rightarrow \eta$
- MEKAANISET MITTAUKSET: LINJAUS; TOLERANSSIT
- VÄRÄHTELYMITTAUS
- ÖLJYANALYYSIT, LÄMPÖKUVAUS, SÄHKÖISET MONITOROINTI-MITTAUKSET
- NDT- JA NDC- MENETELMÄT

→

- VAURIOIDEN ENNALTAEHKÄISY
- VAURIOTAPAUSTEN SELVITYS
- VAURIOIDEN JÄLKIHOITO

ThermaCAM
inframetrics
inframetrics
THERMACAM


Max: 261,7°C
265,9°C
250
200
150
100
68,6°C

Ryhmä I	Ryhmä II	Ryhmä III
VISUAALINEN	PINTA	VOLUMETRINEN

– ilman apuvälineitä
– apuvälinein
	– magneettijauhe
	– tunkeumaneste
	– pyörrevirta
	– muut sähköiset
		– ultraääni
		– radiografia
		  – röntgen
		  – isotooppi
		  – kiihdytin

POHJOLA

FROM FIFTEEN TO TWOHUNDRED NDT-METHODS IN FIFTY YEARS

17:th WCNDT
25…28.10. 2008
Shanghai
China

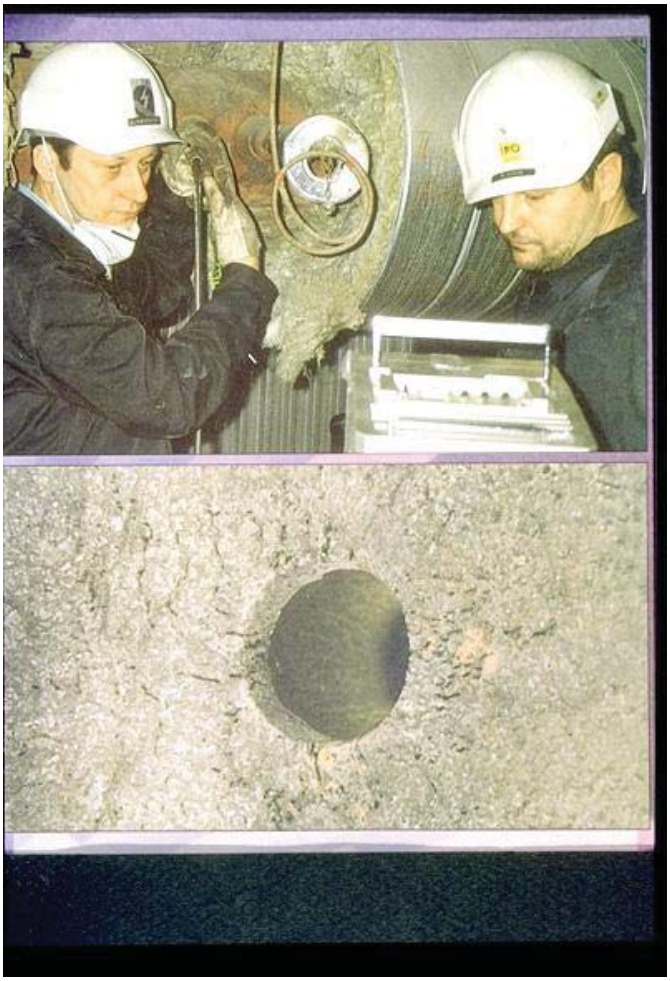
Dr. Tech. Thomas Åström
Pohjola Insurance Ltd
Finland

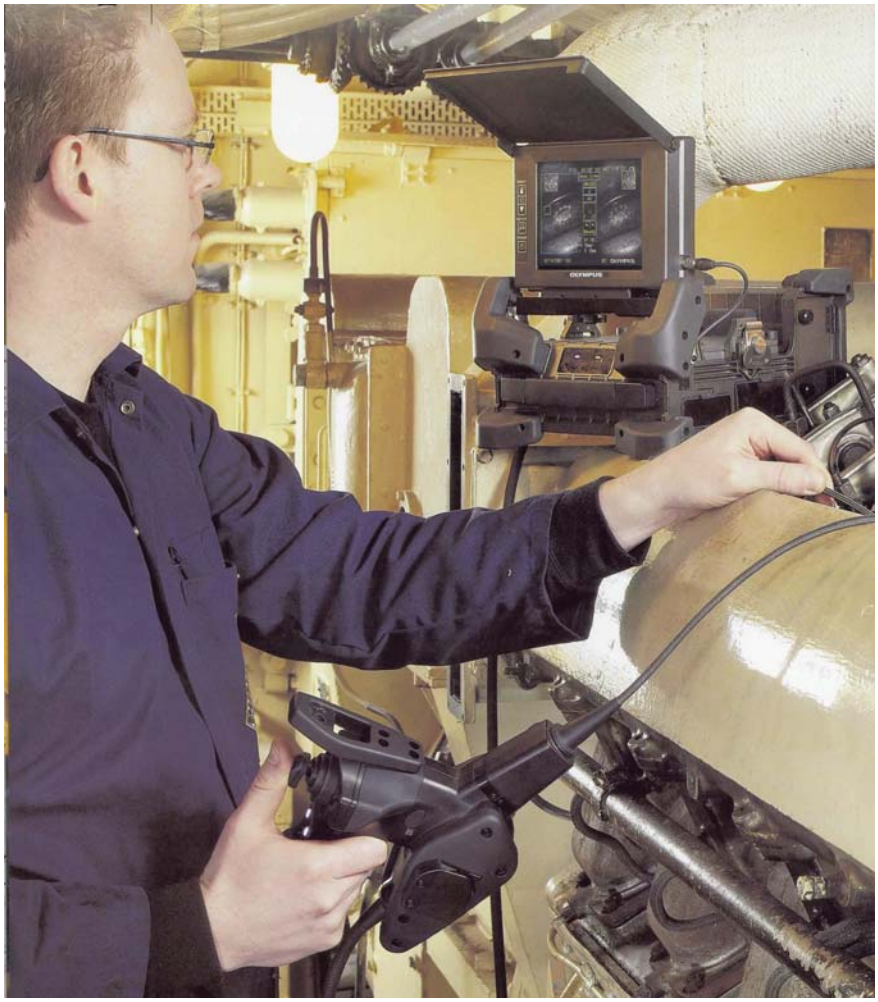
LIST OF NON - DESTRUCTIVE TESTING AND - CHARACTERIZATION METHODS

1. NDT-methods

1. Visual Inspection
    - 1.1 General without aid
    - 1.2 Aided inspection
        - 1.2.1 Magnifiers, mirrors, etc.
        - 1.2.2 Boroscopes
        - 1.2.3 Endoscopes
        - 1.2.4 Videoscopes
        - 1.2.5 TV-units (e.g. pipe testing)
    - 1.3 Stroboscopic inspection
    - 1.4 Surface microscopy
2. Magnetic Particle Testing
    - 2.1 Magnetization
        - 2.1.1 Current flow
            - 2.1.1.1 Axial
            - 2.1.1.2 Prods
            - 2.1.1.3 Induced
        - 2.1.2 Magnetic flow
            - 2.1.2.1 Threading conductor
            - 2.1.2.2 Adjacent conductor(s)
            - 2.1.2.3 Fixed installation
            - 2.1.2.4 Portable electromagnet (Yoke)
            - 2.1.2.5 Flexible coil
        - 2.1.3 Permanent magnet
    - 2.2 Viewing
        - 2.2.1 Colored
        - 2.2.2 Fluorescent
    - 2.3 Media
        - 2.3.1 Wet
        - 2.3.2 Dry
        - 2.3.3 Magnetic Rubber Inspection
3. Penetrant testing
    - 3.1 Application
        - 3.1.1 Spot testing
        - 3.1.2 Immersion testing
    - 3.2 Viewing
        - 3.2.1 Colored
        - 3.2.2 Fluorescent
        - 3.2.3 Dual purpose (Fluorescent color contrast)
    - 3.3 Excess penetrant remover
        - 3.3.1 Water
        - 3.3.2 Lipophilic
        - 3.3.3 Solvent
        - 3.3.4 Hydrophilic
        - 3.3.5 Water and solvent

4. PMI Positive Material Identification
    - 4.1 EDXRF Energy Dispersive X-ray Fluorescence (i.e. X-MET)
    - 4.2 Optical Emission Spectroscopy (i.e. ARC-MET)
    - 4.3 NAA Neutron Activation Analyses
    - 4.4 EDX Energy Dispersive X-ray analysis
    - 4.5 WDX Wave-length Dispersive X-ray analysis
5. Micro-magnetic analysis methods
    - 5.1 CM Coersitivity Measurements
    - 5.2 MIVC Magnetically Induced Velocity Changes
    - 5.3 Incremental permeability measurements
    - 5.4 Analysis of harmonic magnetic vibrations
    - 5.5 Analysis of dynamic magnetostriction
    - 5.6. BEMI Barkhausen noise and Eddy current Microscopy
    - 5.7 MIPN Magnetically Induced Potential Noise (not Barkhausen noise)
    - 5.8 MI Magneto Impedance sensor Technique (testing of surface flaws)
    - 5.9 The Jumpsum method (mechanical properties of ferromagnetic materials)
    - 5.10 TEM Thermoelectric Method (non-contacting for residual stress measurements)
    - 5.11 SMA Stress Induced Magnetic Anisotropy
6. Other methods
    - 6.1 SEM Scanninng Electron Microscopy
    - 6.2 TEM Transmission Electron microscopy
    - 6.3 ERUM Electromagnetic Resonance Ultrasound Microscopy (e.g. elastic constant)
    - 6.4 TEP Thermo Electric Power Measurement (ageing of duplex steels)
    - 6.5 MRE Magnetic Resonance Elastography (elastic properties of tissues)
    - 6.6 TR Dielectric transmission / reflection measurement (material properties)
    - 6.7 TEM Magnetic transmission/reflection measurement (material properties)
    - 6.8 IS Impedance spectroscopy (testing of coating degradation)
    - 6.9 LIBS Laser-induced breakdown spectroscopy (e.g. material composition analysis)
    - 6.10 GMR Giant Magnetoresistance technique
    - 6.11 Dielectric spectroscopy (e.g. measuring of polymer curing)
    - 6.12 Mogneto Optical Microscopy (e.g. detection of hidden defects/ Kerr effect)
    - 6.14 UAFM Ultrasonic Atomic Force Microscopy (elastic modulus measurement of pietsoelectric domain boundaries)



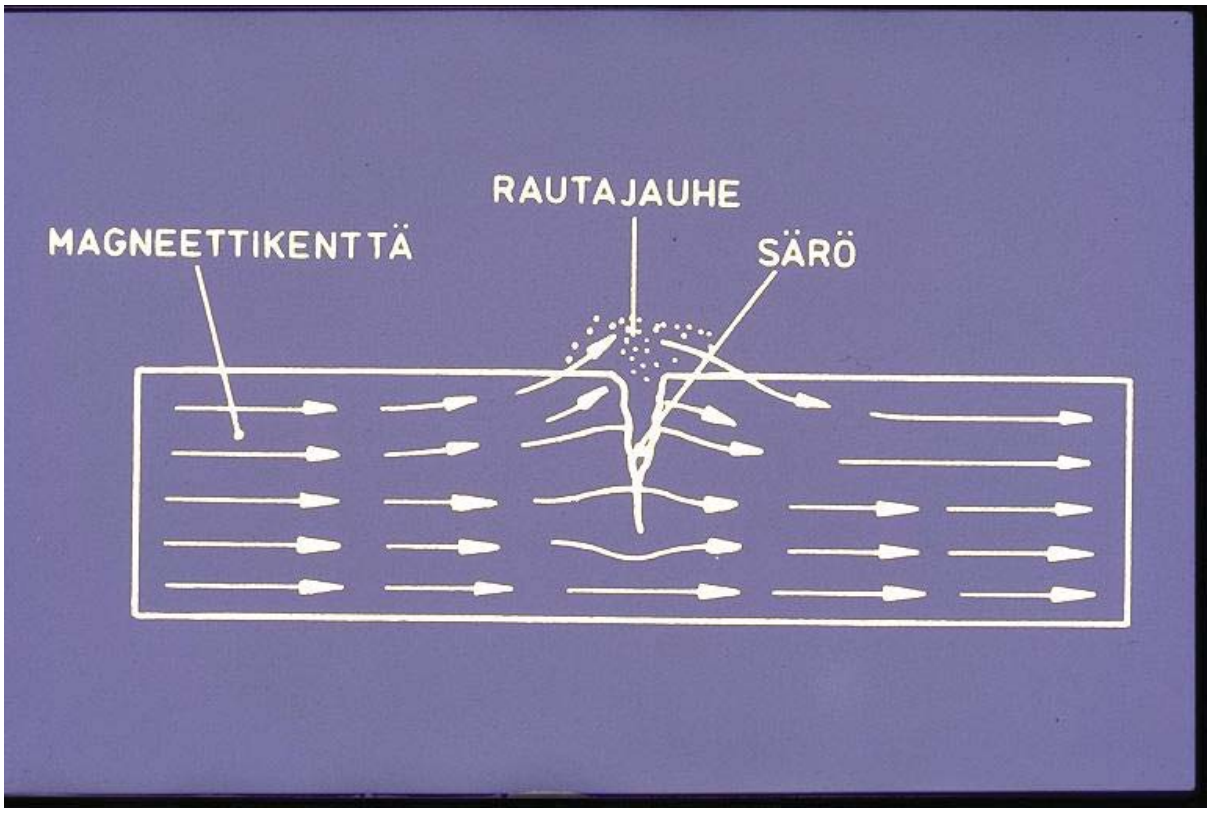

OLYMPUS

BEFORE 6 BEERS

AFTER 6 BEERS

AFTER 6 BEERS

BEFORE 6 BEERS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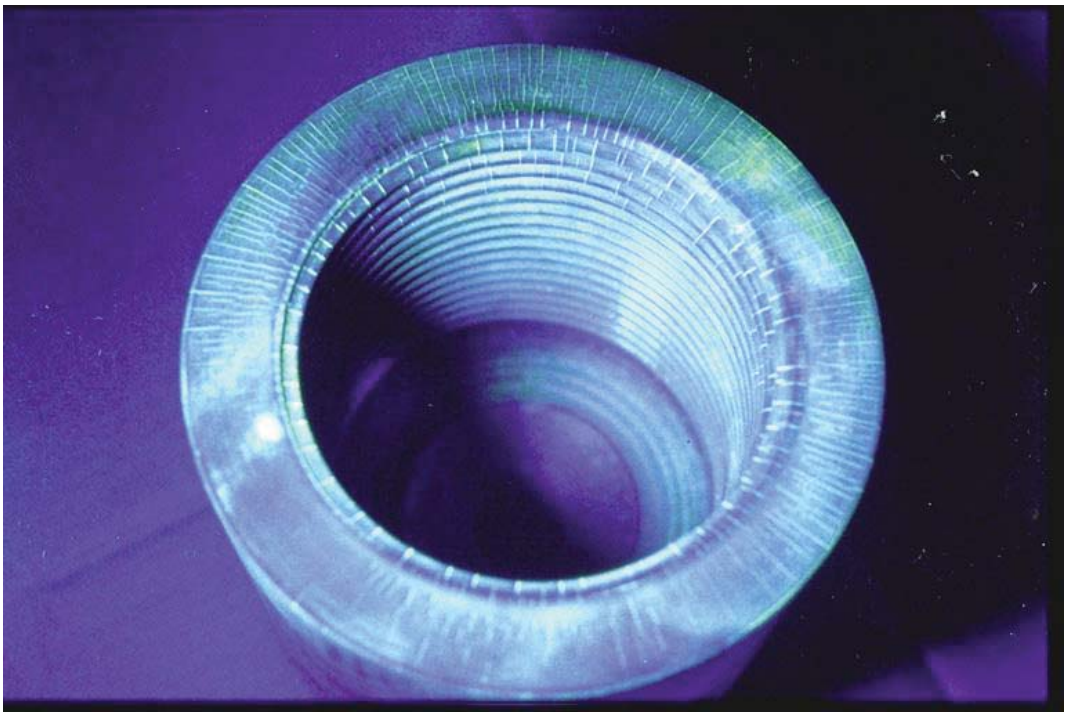
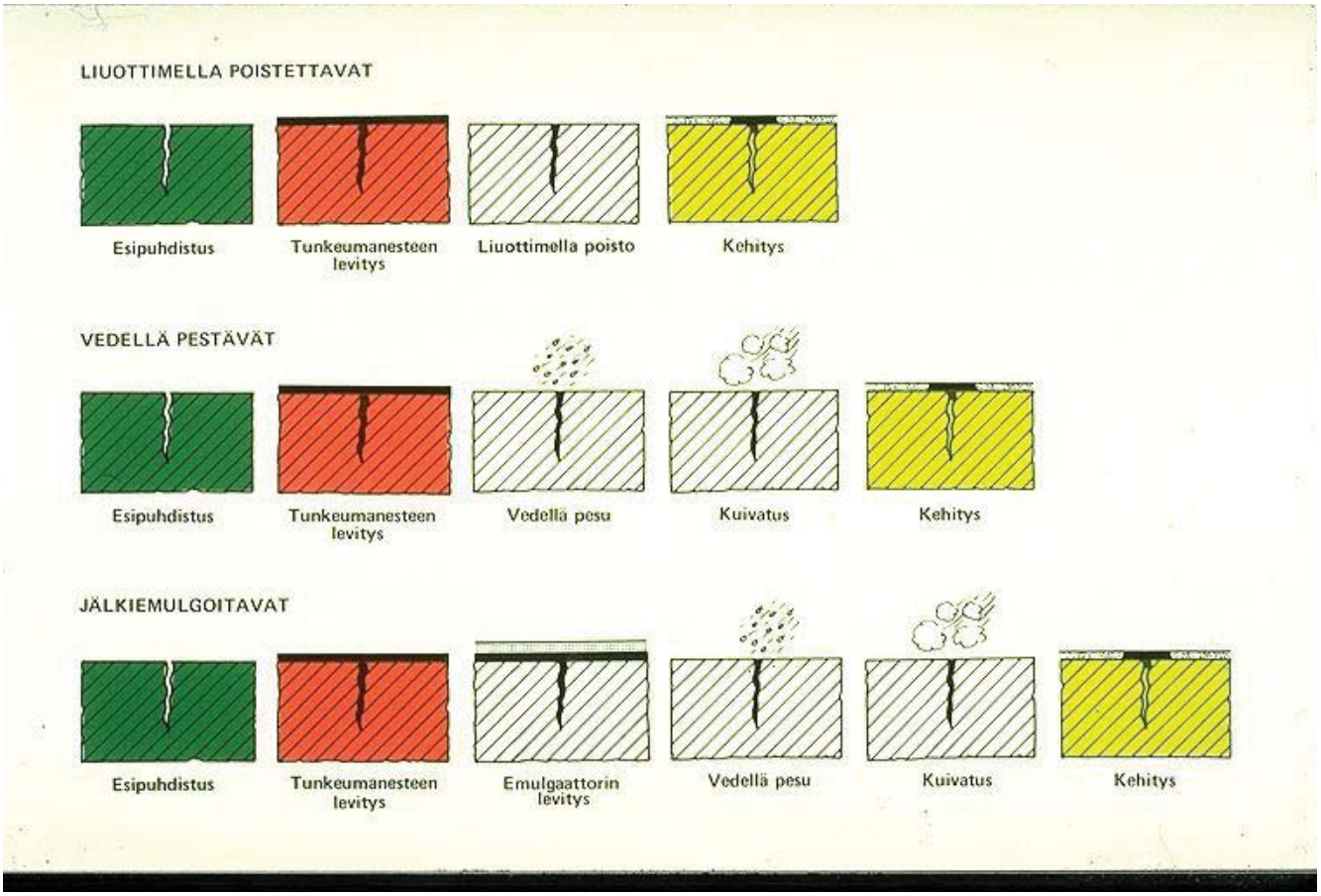
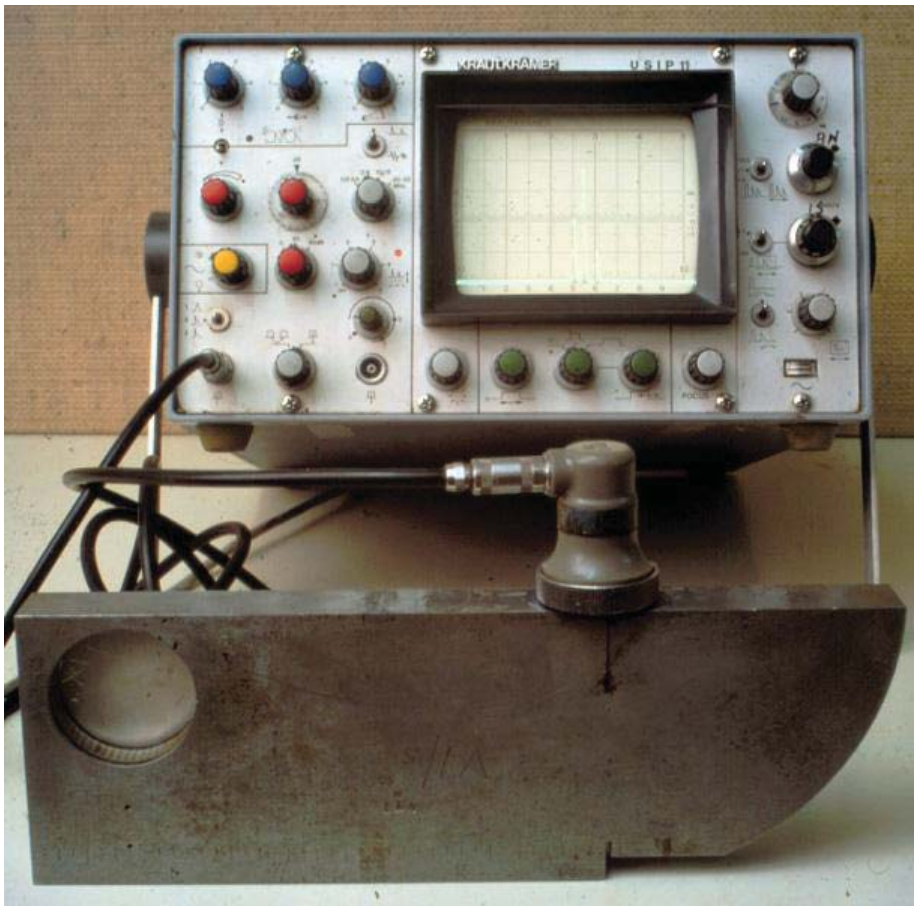
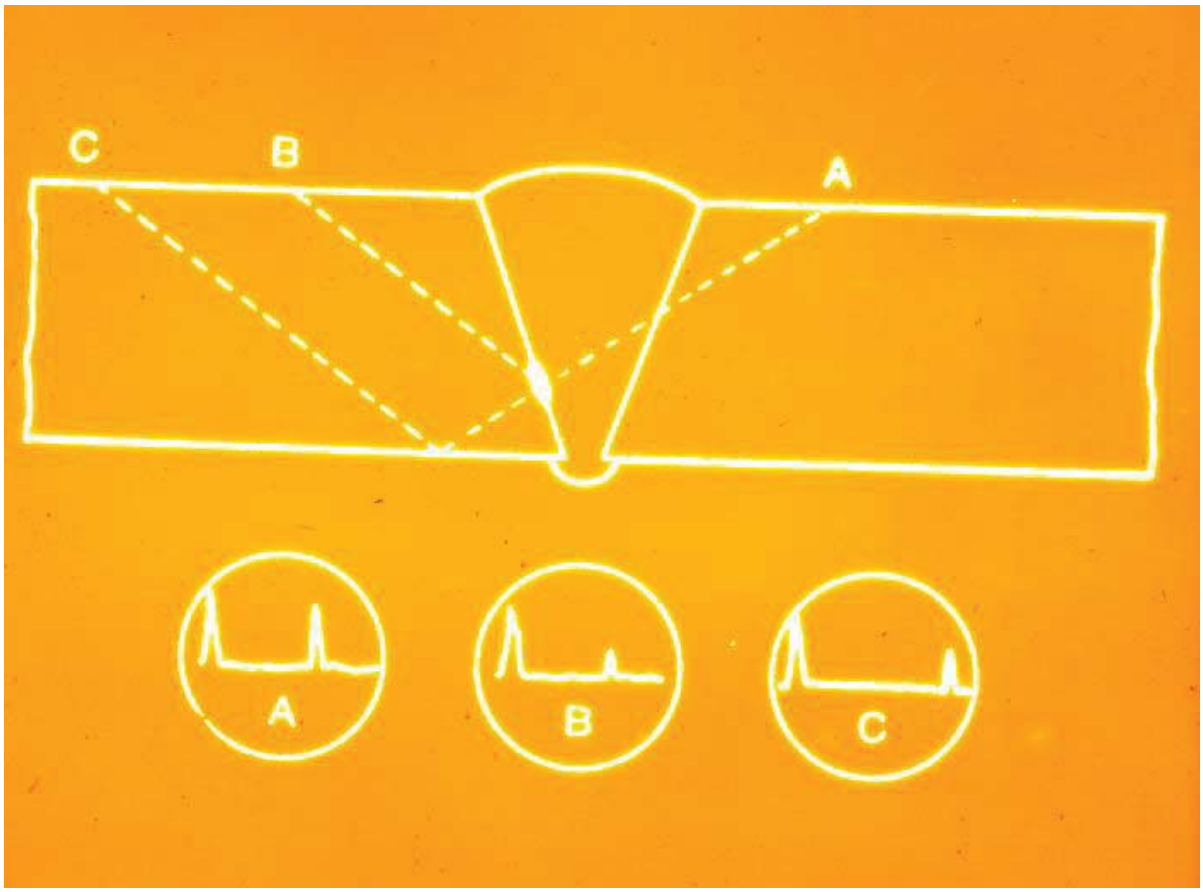
MAGNEETTIKENTTÄ
SÄRÖ



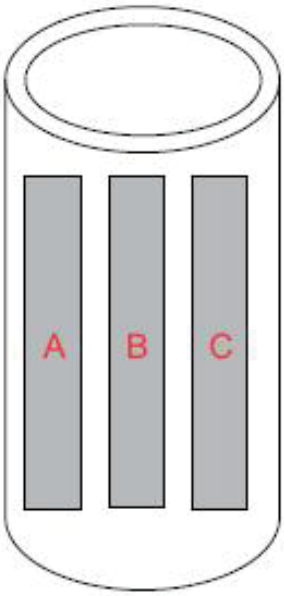

LIUOTTIMELLA POISTETTAVAT
Esipuhdistus
Tunkeumanesteen levitys
Liuottimella poisto
Kehitys
VEDELLÄ PESTÄVÄT
Esipuhdistus
Tunkeumanesteen levitys
Vedellä pesu
Kuivatus
Kehitys
JÄLKIEMULGOITAVAT
Esipuhdistus
Tunkeumanesteen levitys
Emulgaattorin levitys
Vedellä pesu
Kuivatus
Kehitys

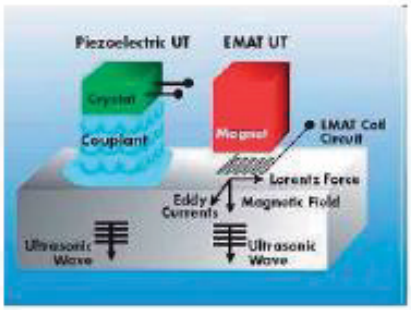

KRAUTKRAMER
USIP 11

9.61
Krautkramer Branson
DMS

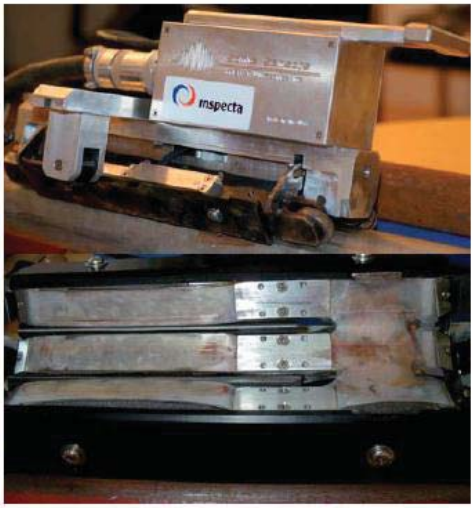

C
B
A
A
B
C

TScan menetelmä



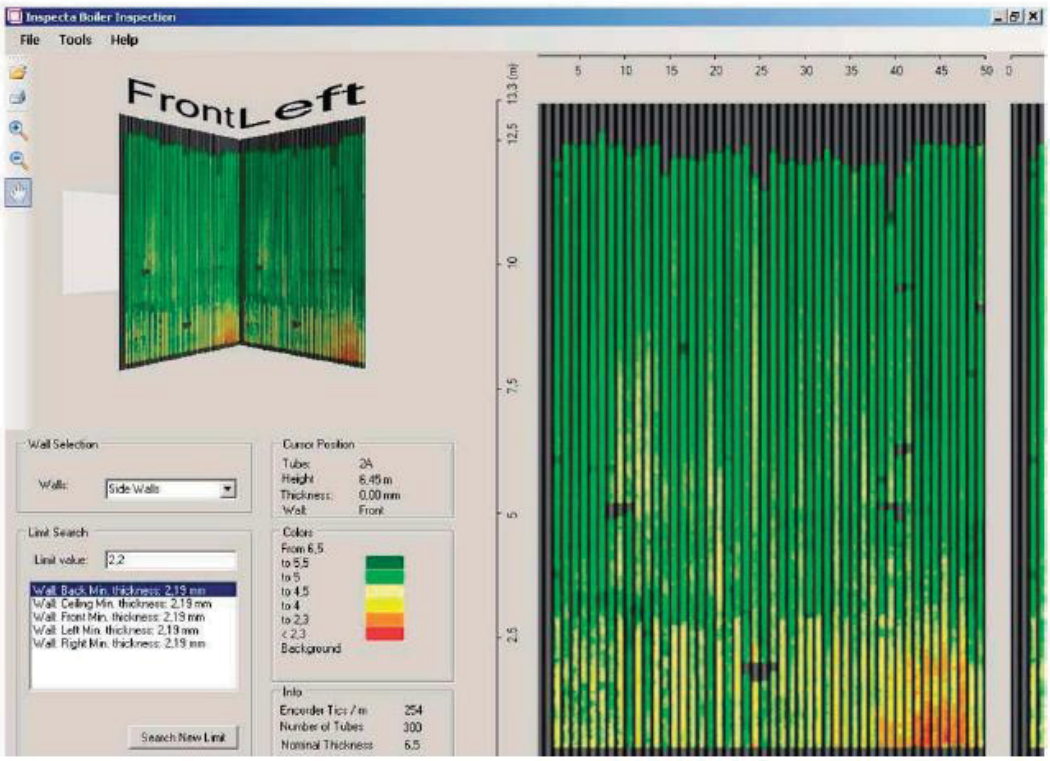


TScan laitteisto



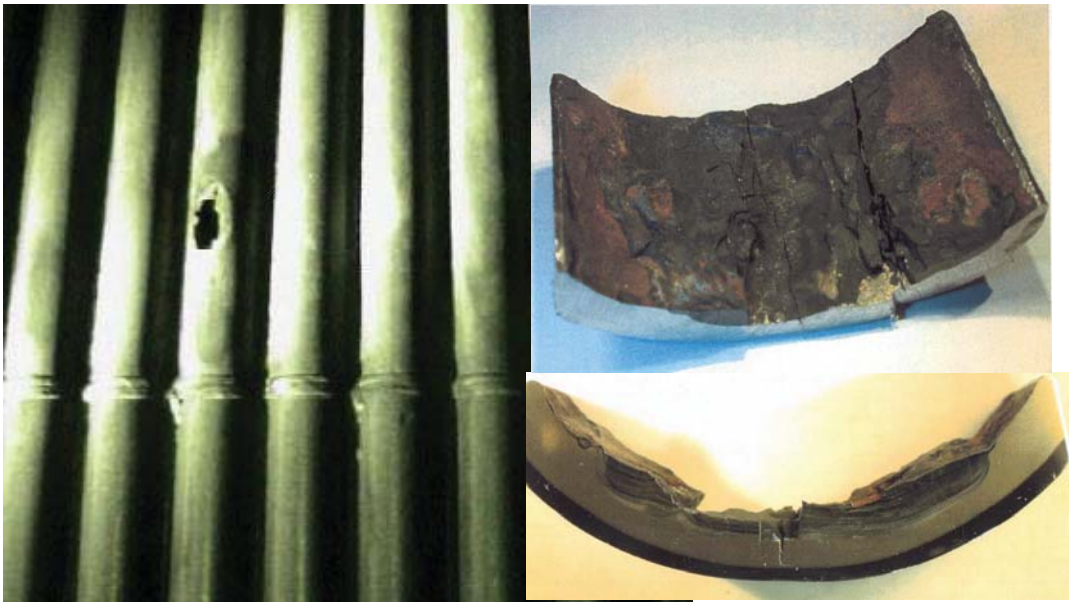
TScan - seinäputkia mittaamassa

Tscan clientview – kattilan yleiskunto yhdellä silmäyksellä



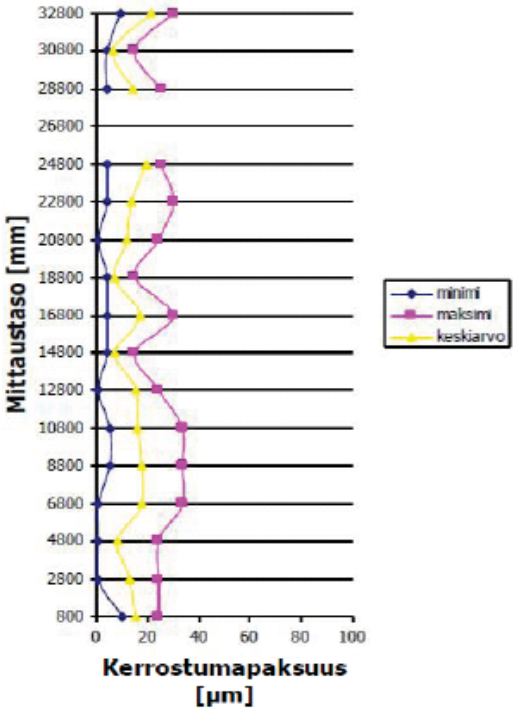
Esimerkki sisäpuolisista korroosiovaurioista

Suomalaisen massatehtaan soodakattila 2001

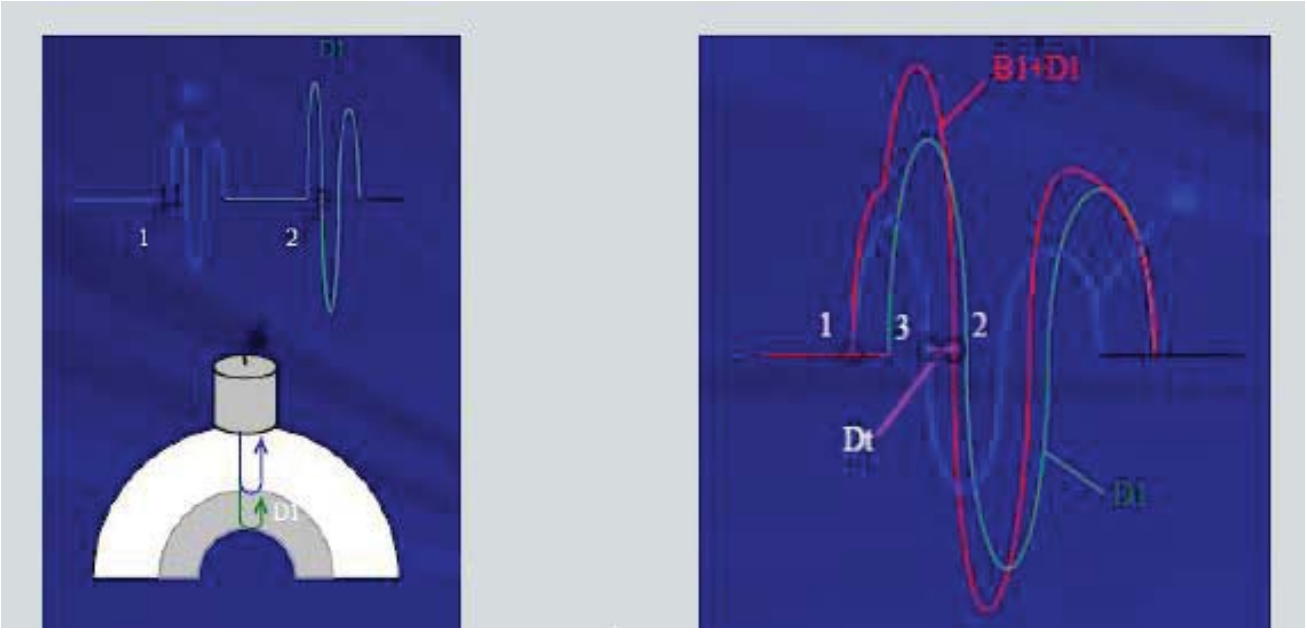


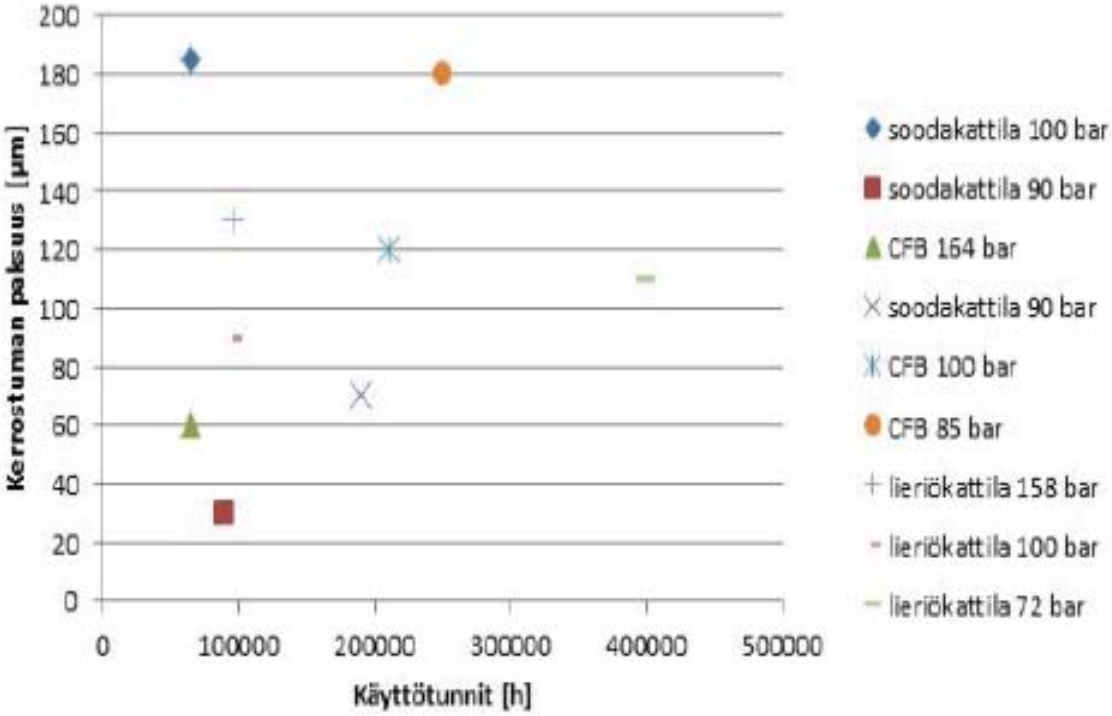
Vaurioita useissa putkissa, kaikki tulipesän seinäputket vaihdettiin

Seinäputkien sisäpinnat

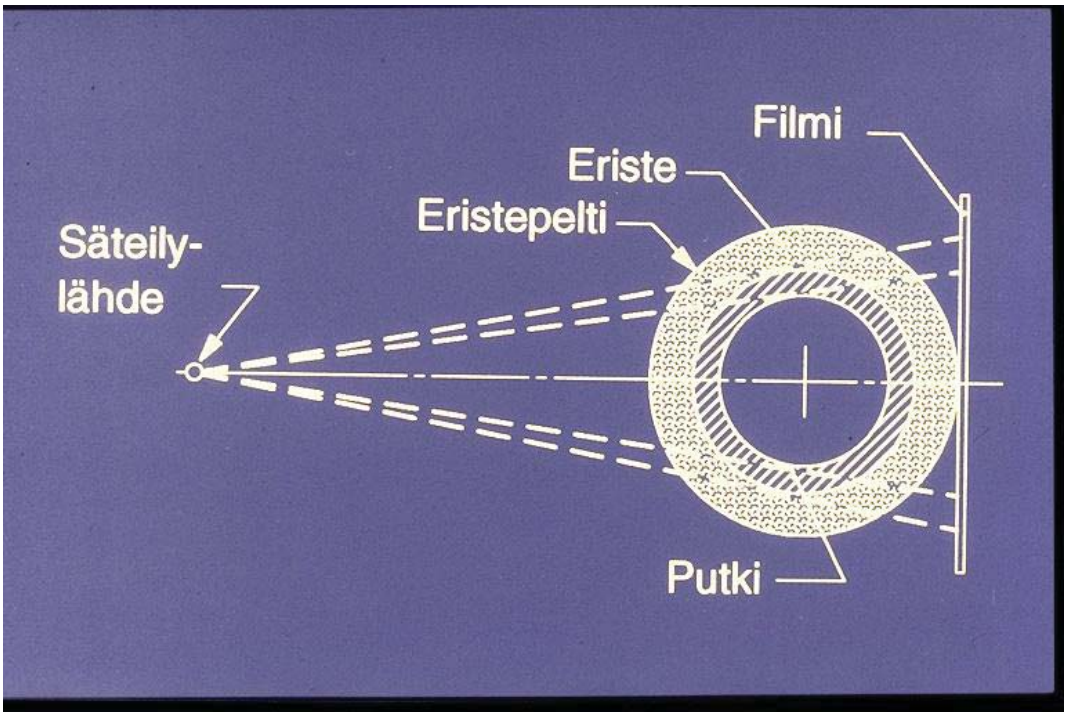


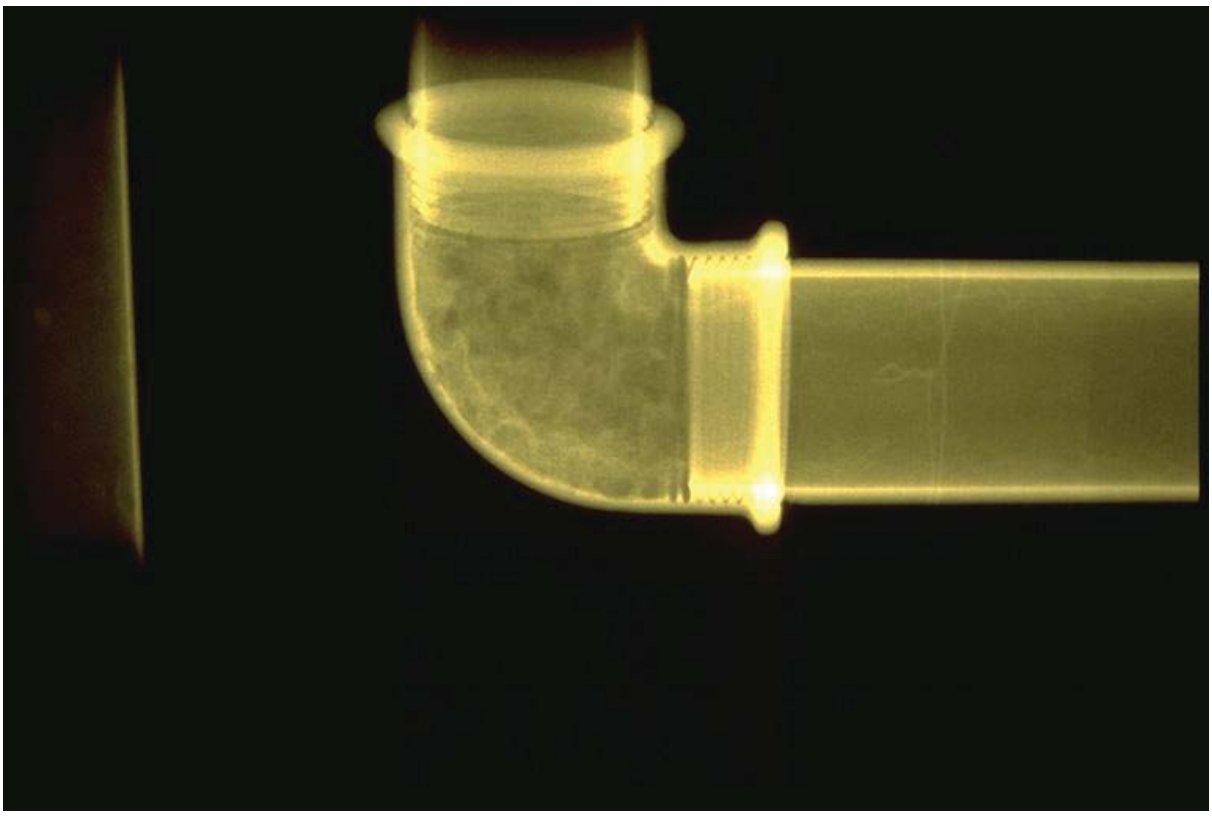
Mitattuja kerrostumapaksuuksia leijupetikattilassa, jonka sisäpuoliset kerrostumat ovat ohuita, eikä tarvetta lisätarkastuksiin tai korjaaviin toimenpiteisiin ole.





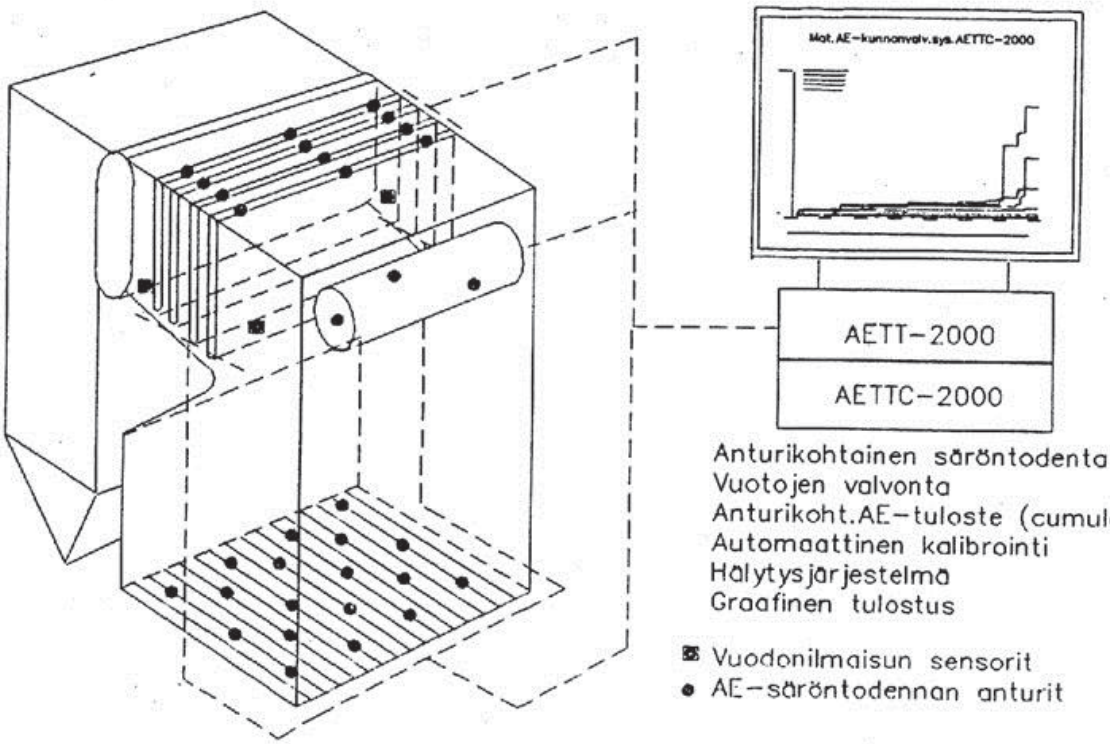
Mitattuja sisäpuolisten kerrostumien muodostumisnopeuksia erilaisissa kattiloissa.


Filmi
Eriste
Eristepelti
Säteily-
lähde
Putki



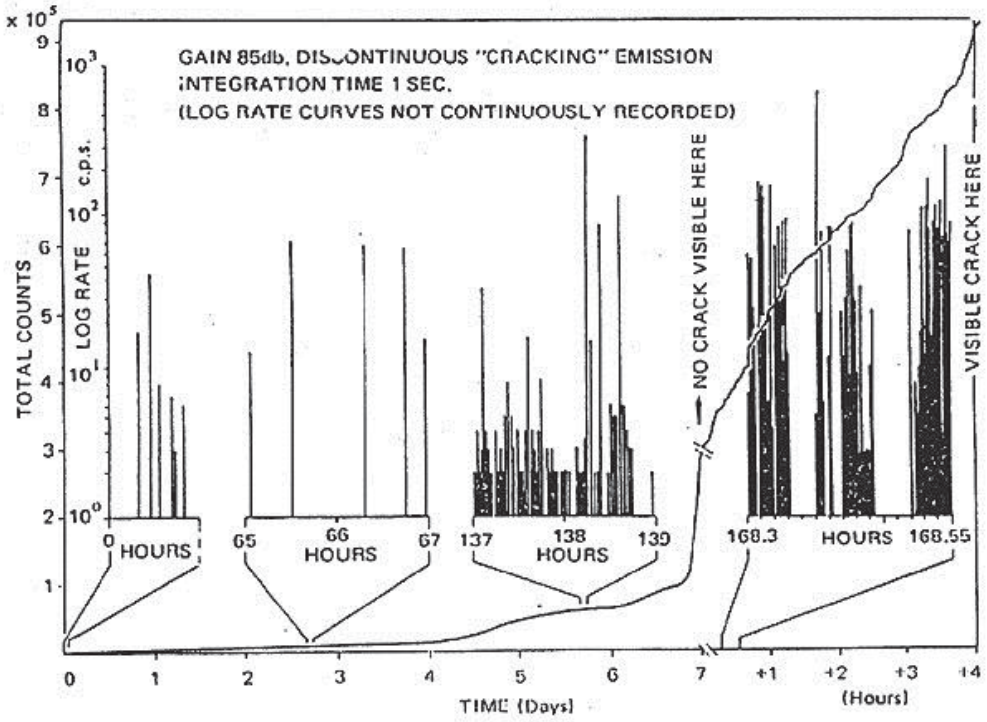
Acoustic emission systems / Recovery Boiler

On-line kunnonvalv.sys. AETTC-2000

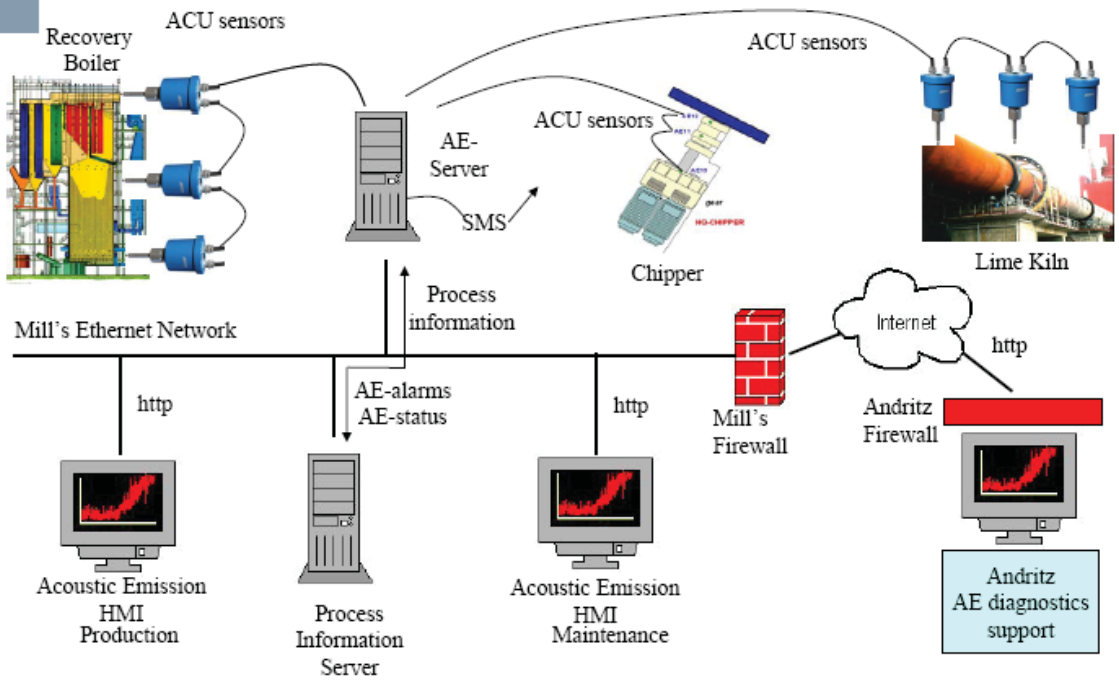


Anturikohtainen säröntodenta
Vuotojen valvonta
Anturikoht.AE-tuloste (cumulat)
Automaattinen kalibrointi
Hälytysjärjestelmä
Graafinen tulostus

■ Vuodonilmaisun sensorit
● AE-säröntodennan anturit



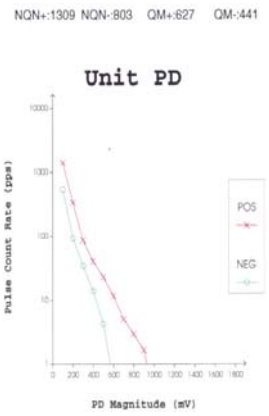
ACU-technology, AE-system key components & Pulp Mill



Case: 6 kV Jauhinmoottorin PD mittaukset

- 6 kV jauhinmoottorin PD-mittaus tulokset
- PD mittaus tulos 7.1.2001 osoitti kohonnutta PD aktiivisuutta jotka kohdistuivat erityisesti positiivisiin pulsseihin Qm+ arvo = 1323 mV
- PD mittauksen jälkeen moottori otettiin huoltoon ja huomattiin, että käämityksen uran pään alueen puolijohdepinta oli heikentynyt
- Puolijohdepinta korjattiin huollossa
- Huollon jälkeen, 16.8.2001, PD aktiivisuus oli pienentynyt huomattavasti, Qm+ arvo = 627 mV
- Moottorin elinikä jatkui merkittävästi

Grinder motor line 6 phase S - 7.2.2001



Grinder motor line 6 phase S - 16.8.2001

ELCID - Electromagnetic Core Imperfection Detector

Just 1 day to test the condition of the stator laminations!

ELCID measuring

ELCID-measuring

We use the ELCID method for large generator inspections as it is important to check the condition of the stator laminations bearing in mind the lamination's insulation. The ELCID method can also be recommended in connection with slot wedge wrapping, rewinding or other work where there is a need to verify the quality of the laminated core.

The ELCID measurement is characterised by:

- Alternative or supplement to full scale ring testing
- Accurate and precise localisation of defects
- Detection of surface and deep lying defects
- Low magnetisation requirement and thereby low risks to personnel
- Quick implementation with minimum personnel resources
- Possibility of trend analysis with subsequent inspections

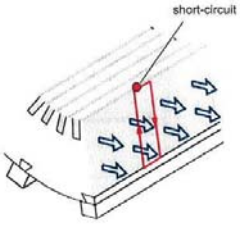
The laminated core is built up of 0.3-0,5 mm thick sheet laminations, which are insulated by a thin coat of lacquer. The lamninations are normally short circuited along the back.

If damage occurs so that a number of laminations are short circuited a current will flow through the damaged section.
Several short circuited laminations give a heavier induced current and thereby a higher temperature at the fault during operations.

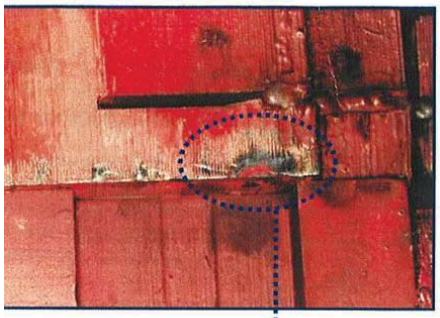
If the temperature becomes too high this can result in an expanding and rapid breakdown of the insulation and the laminations. At extremely high temperatures there is a risk of serious damage to the laminations as well as the windings with downtime as a real possibility.

Lamination damage can be due to several reasons:

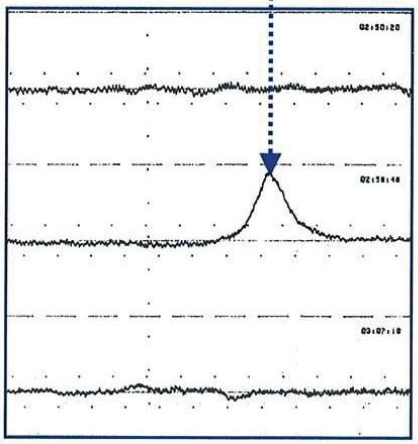
- Foreign objects entering through the air gap
- Wear damage caused by vibration, due to low lamination pressure
- Insufficient cleaning
- Damage caused by coil replacement or slot wedge wrapping
- Incorrect handling during rotor assembly/dismantling

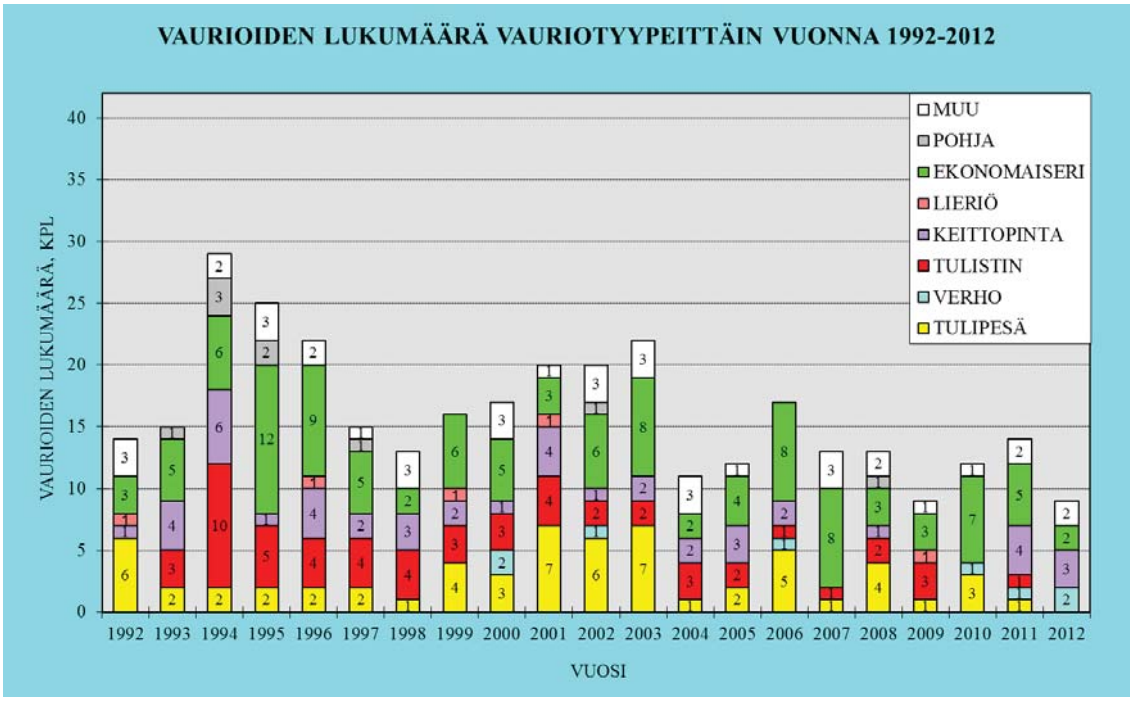


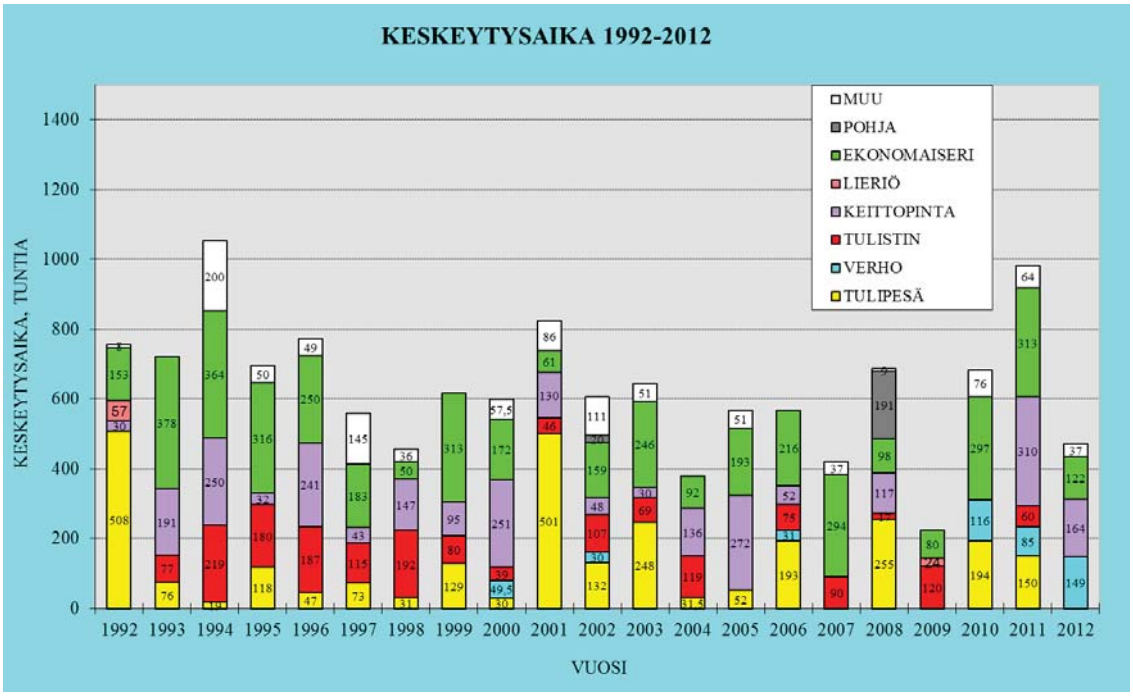
Schematic diagram illustrating how a current is induced in a short circuit which results in a local hot spot



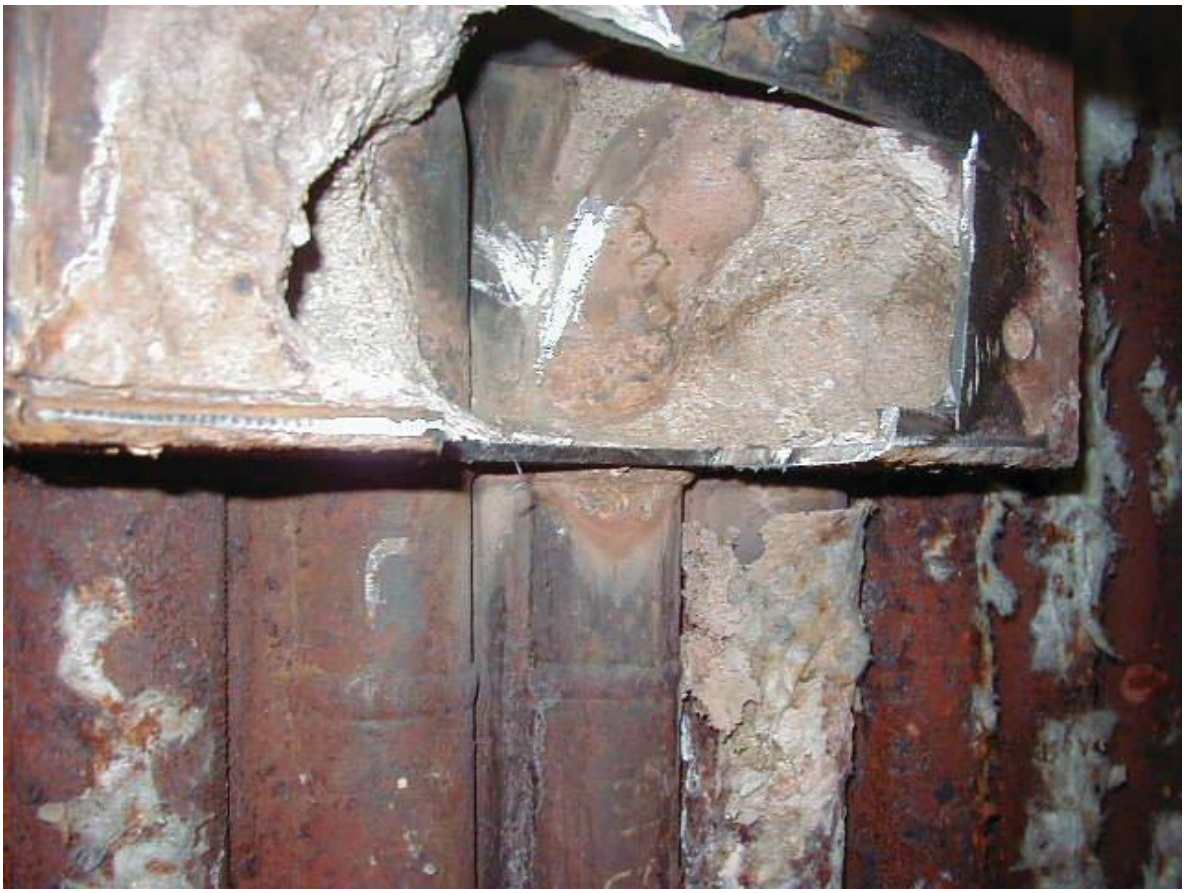
Lamination damage and read out during ELCID testing

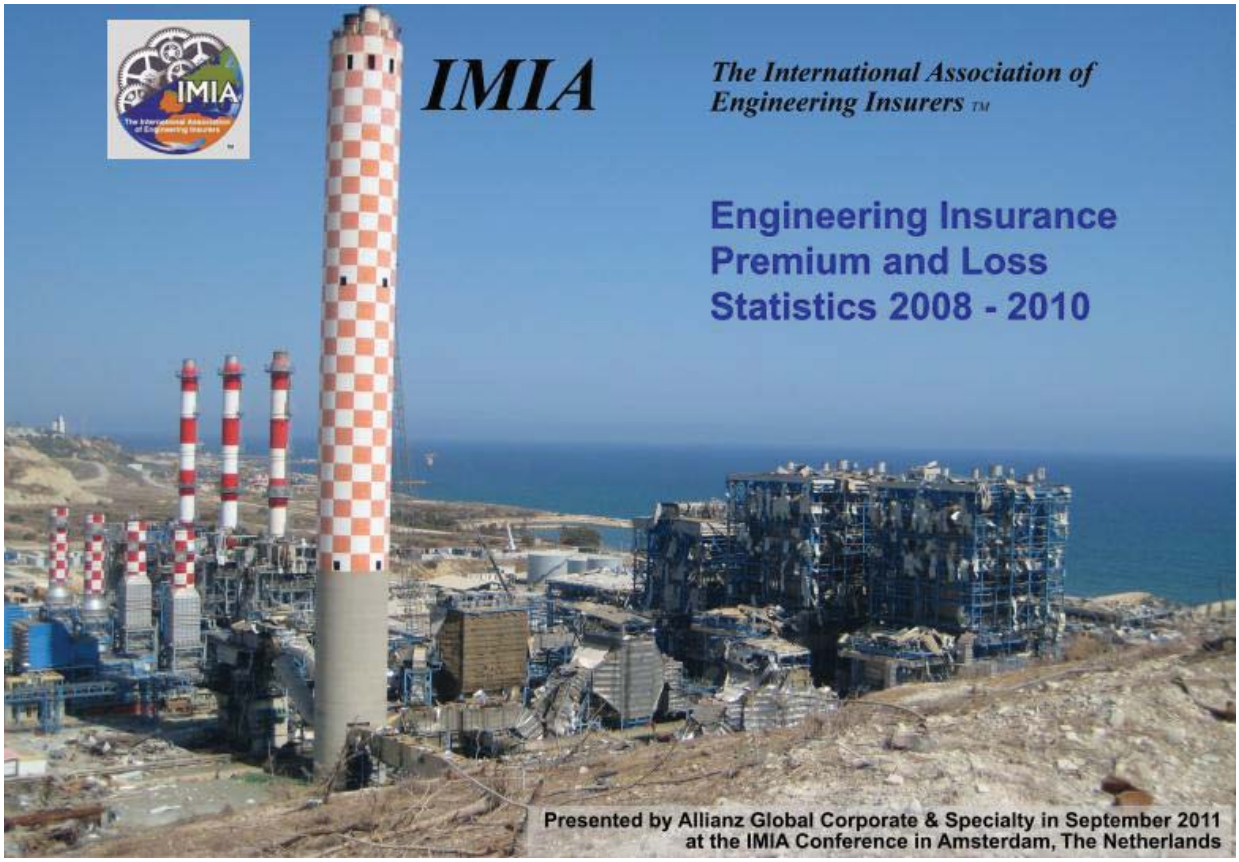



VAURIOIDEN LUKUMÄÄRÄ VAURIOTYYPEITTÄIN VUONNA 1992-2012
VAURIOIDEN LUKUMÄÄRÄ, KPL
VUOSI
MUU
POHJA
EKONOMAISERI
LIERIÖ
KEITTOPINTA
TULISTIN
VERHO
TULIPESÄ

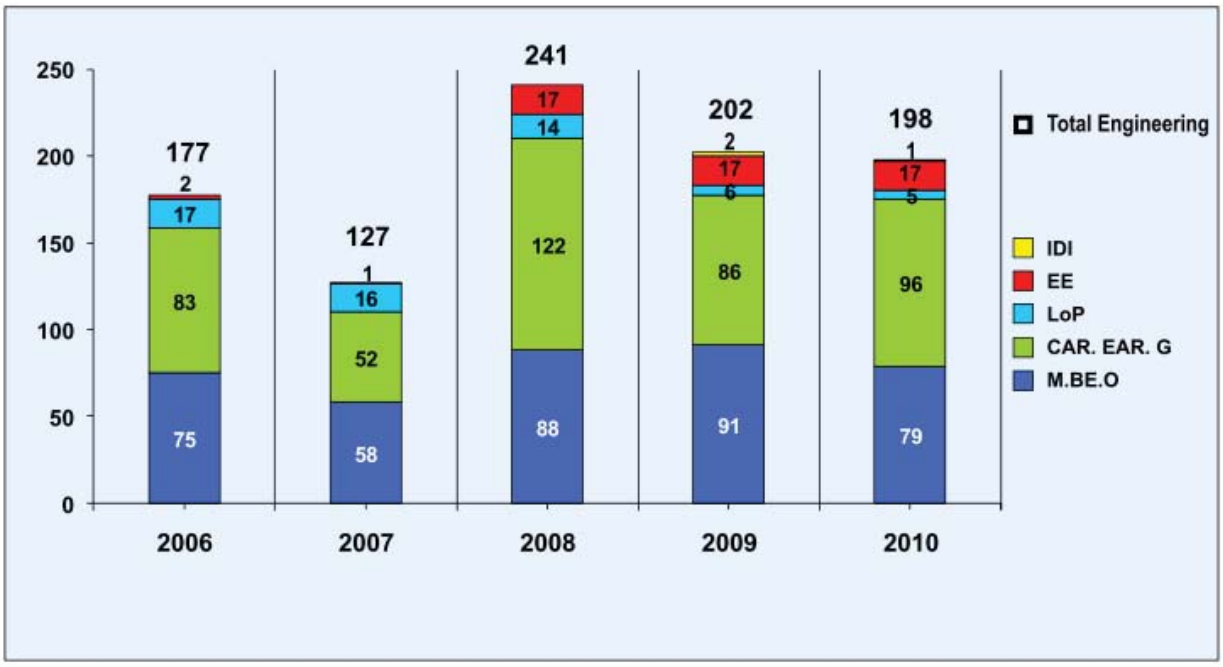

KESKEYTYSAIKA 1992-2012
KESKEYTYSAIKA, TUNTIA
VUOSI
MUU
POHJA
EKONOMAISERI
LIERIÖ
KEITTOPINTA
TULISTIN
VERHO
TULIPESÄ

Kuva 3

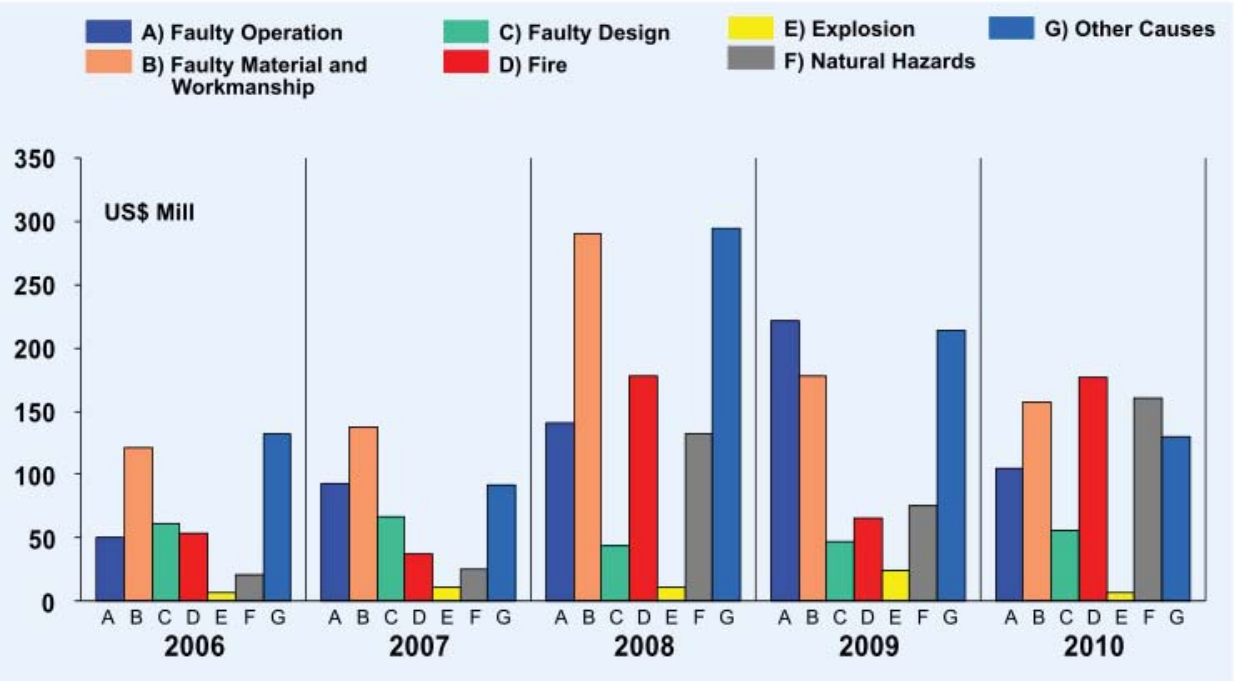




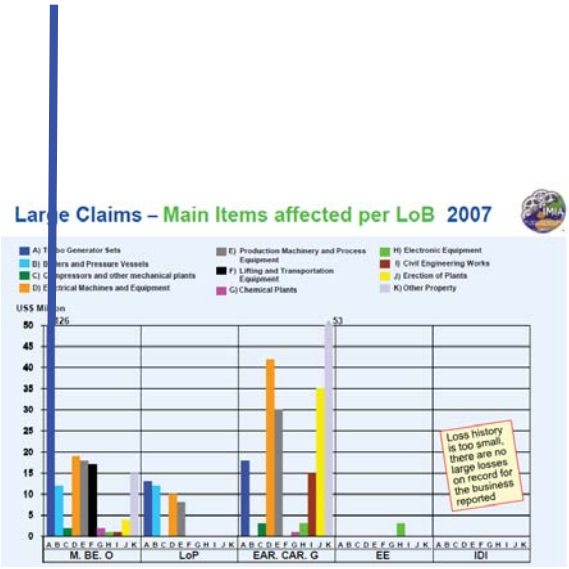
Number of Large Claims per LoB 2006 - 2010



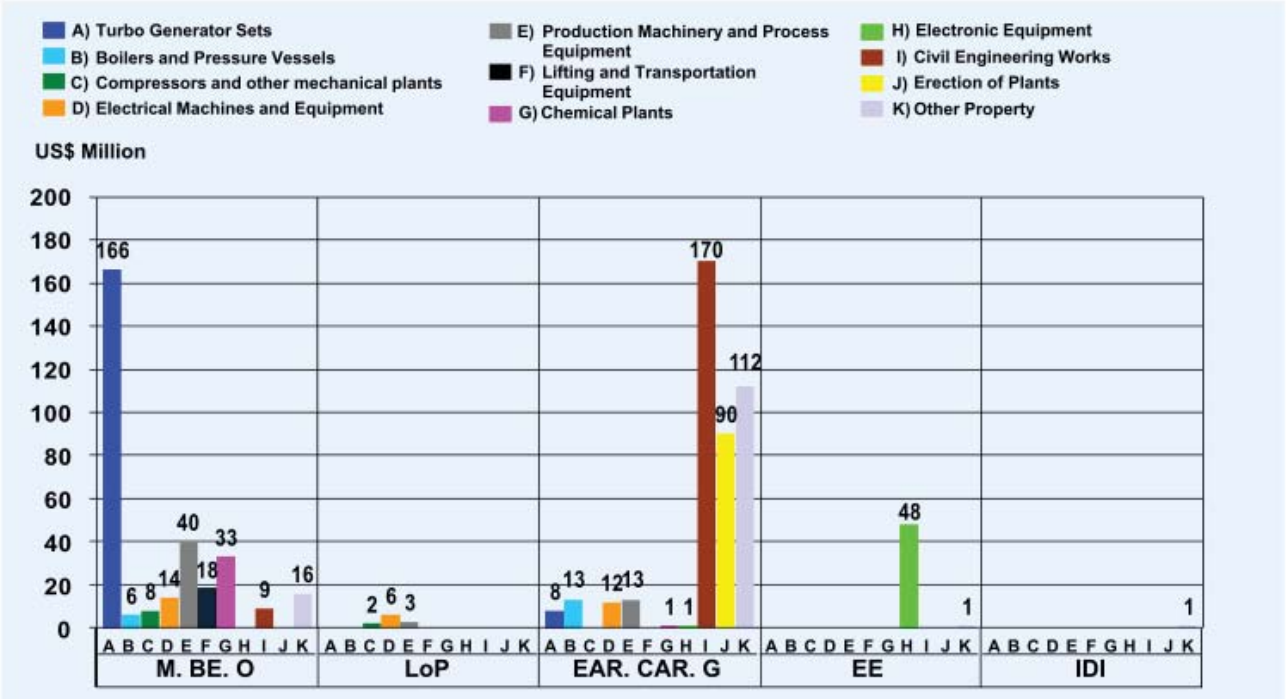
Large Claims - Cause of Loss: all LoB 2006 - 2010

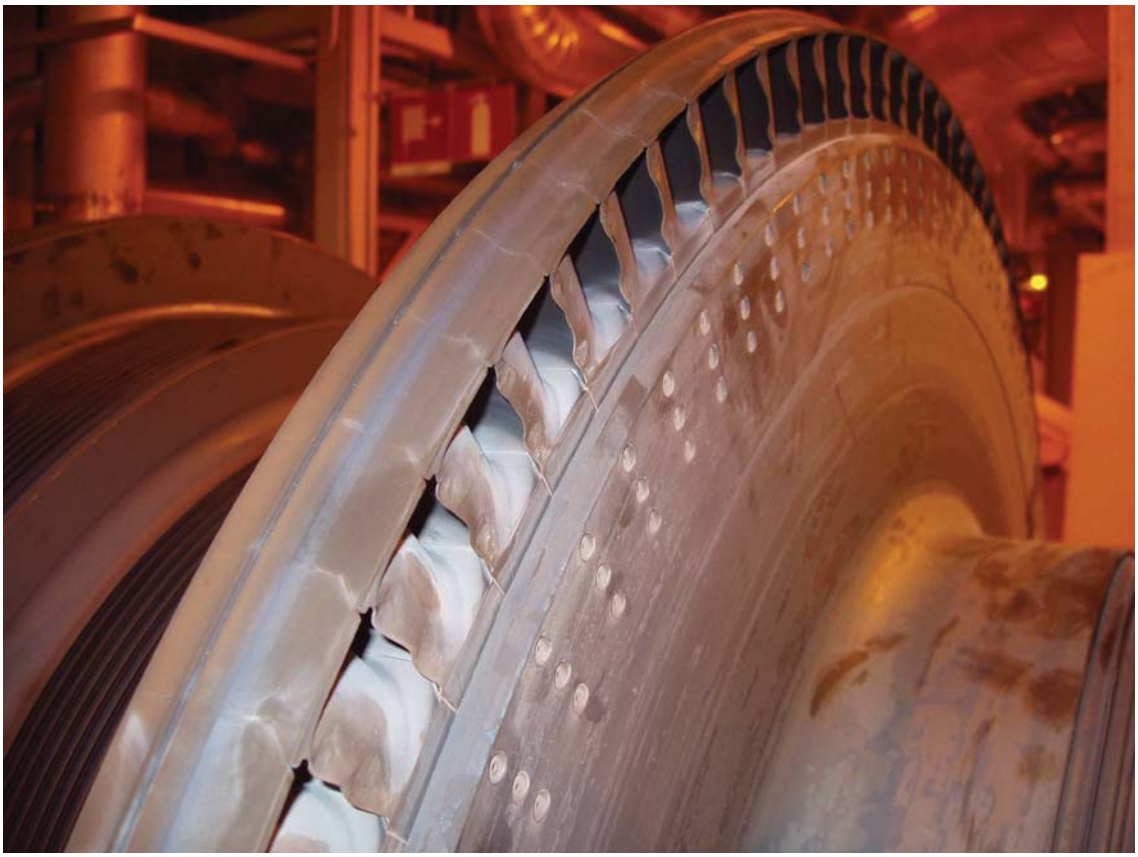


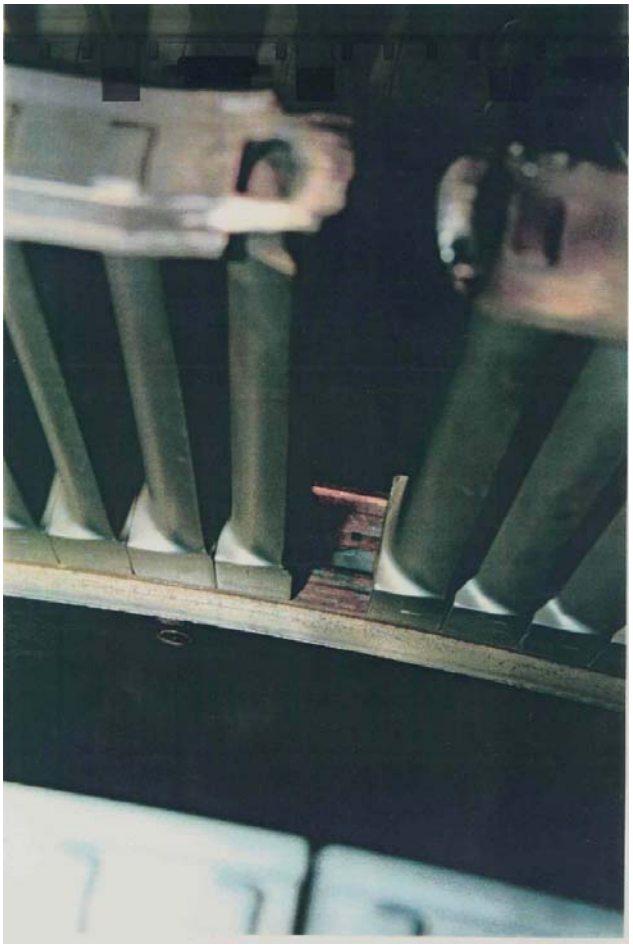
Criticality of Combustion Turbines

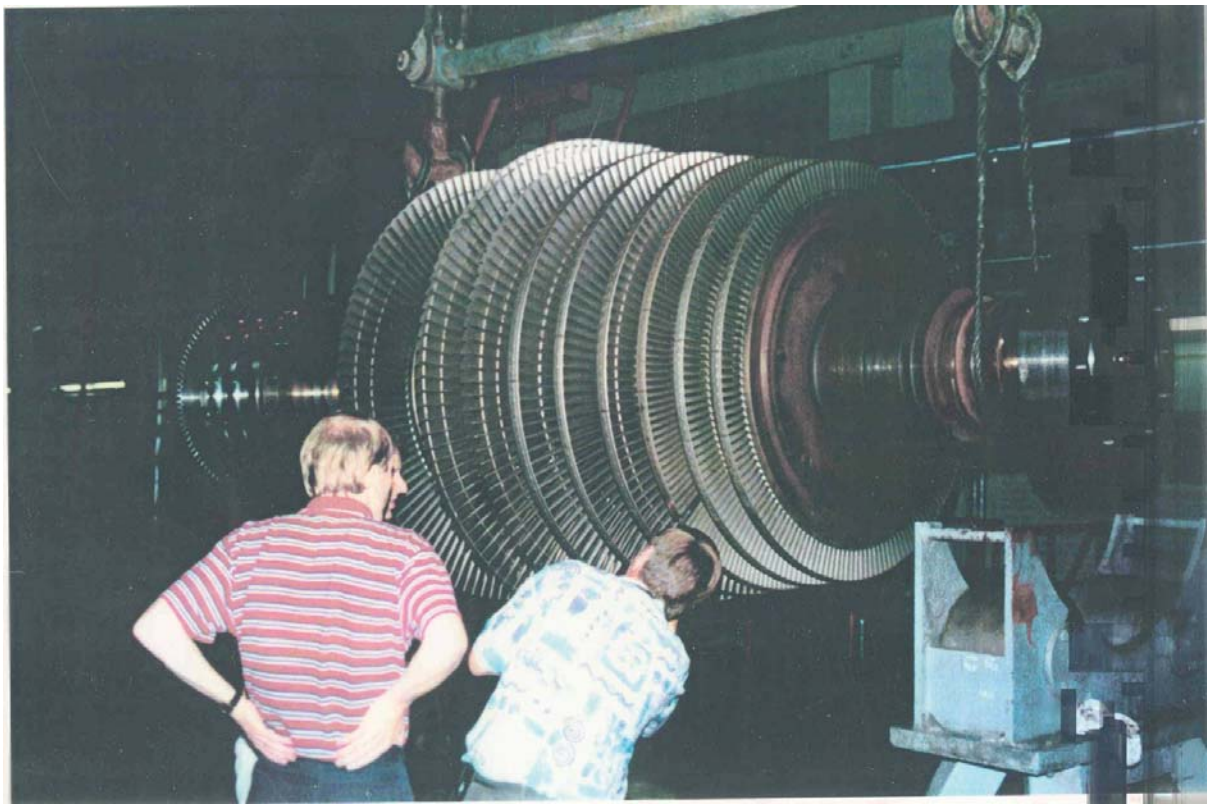


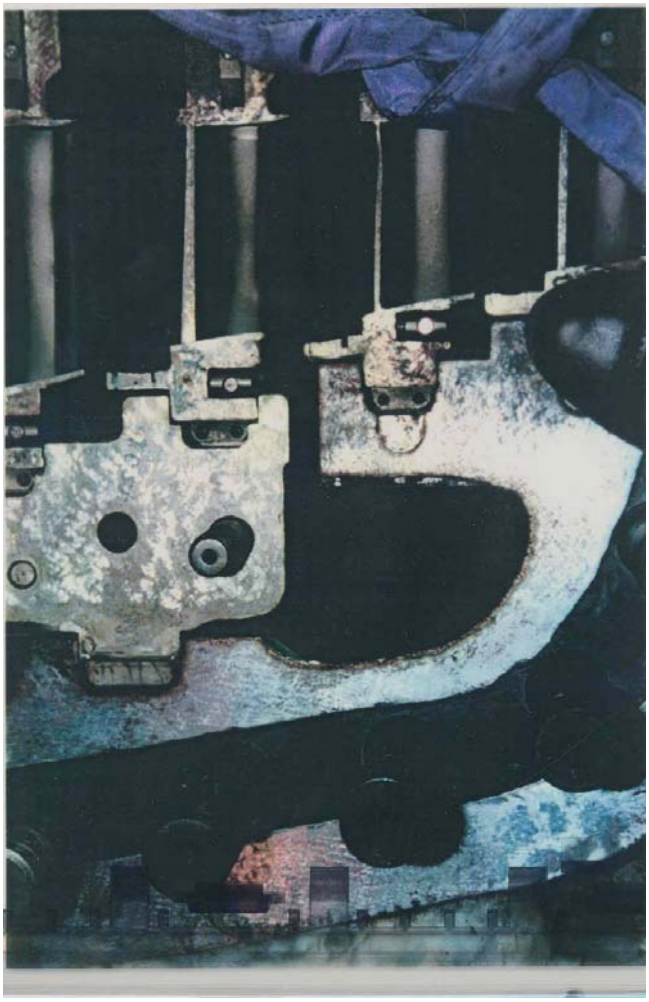
Large Claims – Main Items affected per LoB 2010

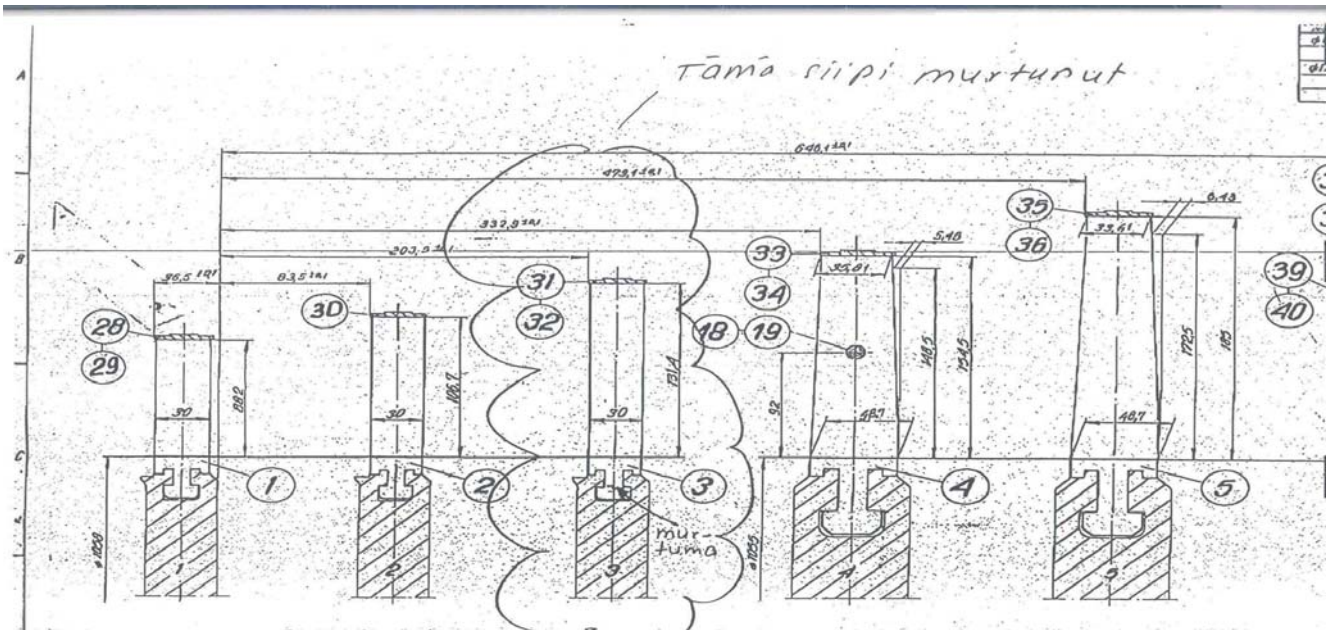











Tämä siipi murtunut
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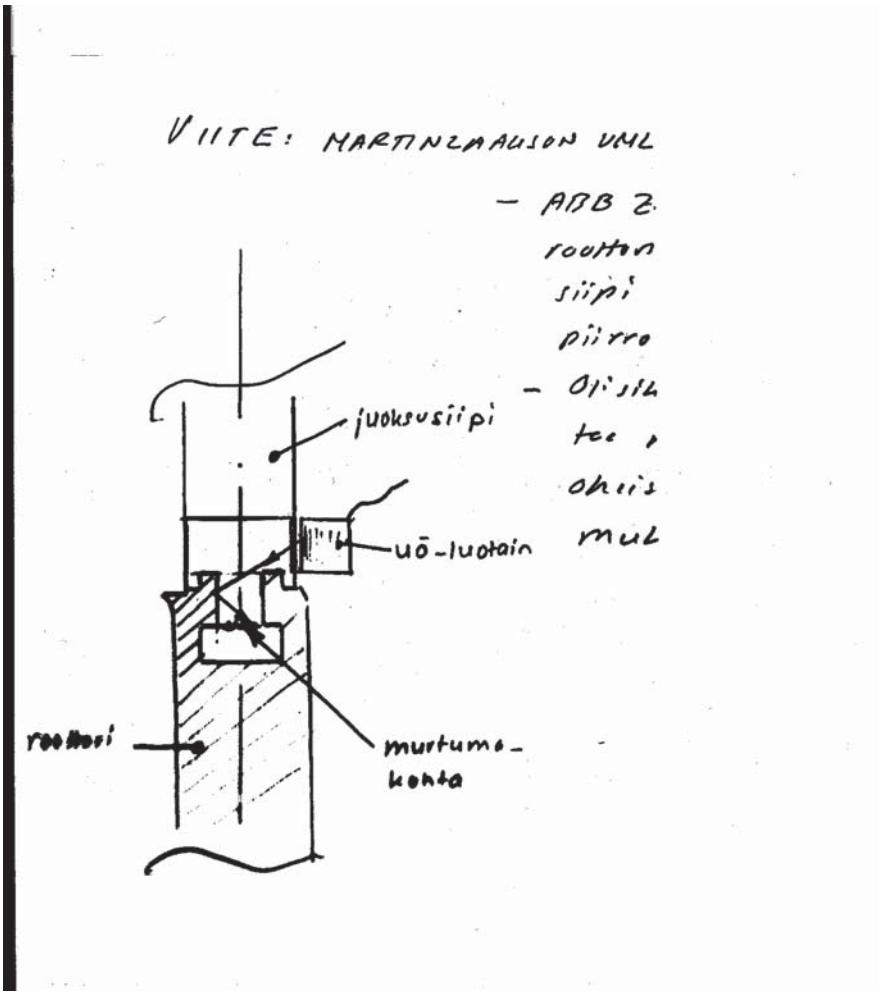

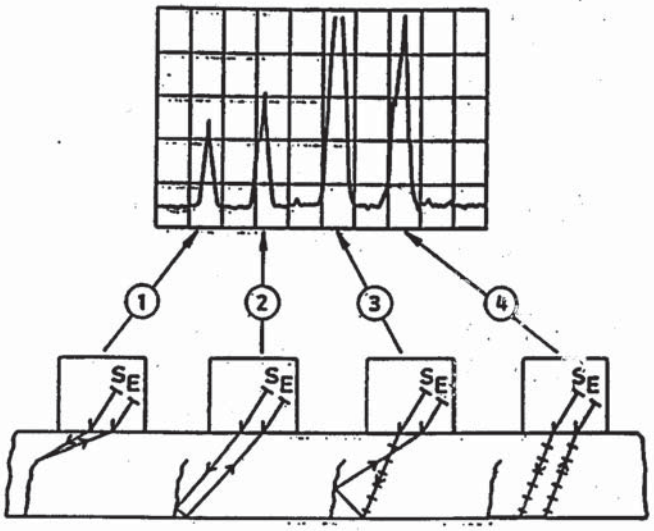

1. Pitkittäisaalto, särön kärki
2. Pitkittäisaalto, särön nurkka
3. Aaltomuodonmuutos, 30 – 70 – 70
4. Aaltomuodonmuutos, sisäpinnan ryömintä

Kuva 10. Monikaikutekniikan periaate /10/.

VTT VALMISTUSTEKNIIKKA
MANUFACTURING TECHNOLOGY

LIITE 1

Sivu/Page

Asiakirja/Document	Tunnus/Ident./No VAL65-.
Laatija/Prepared by	Pvm/Date

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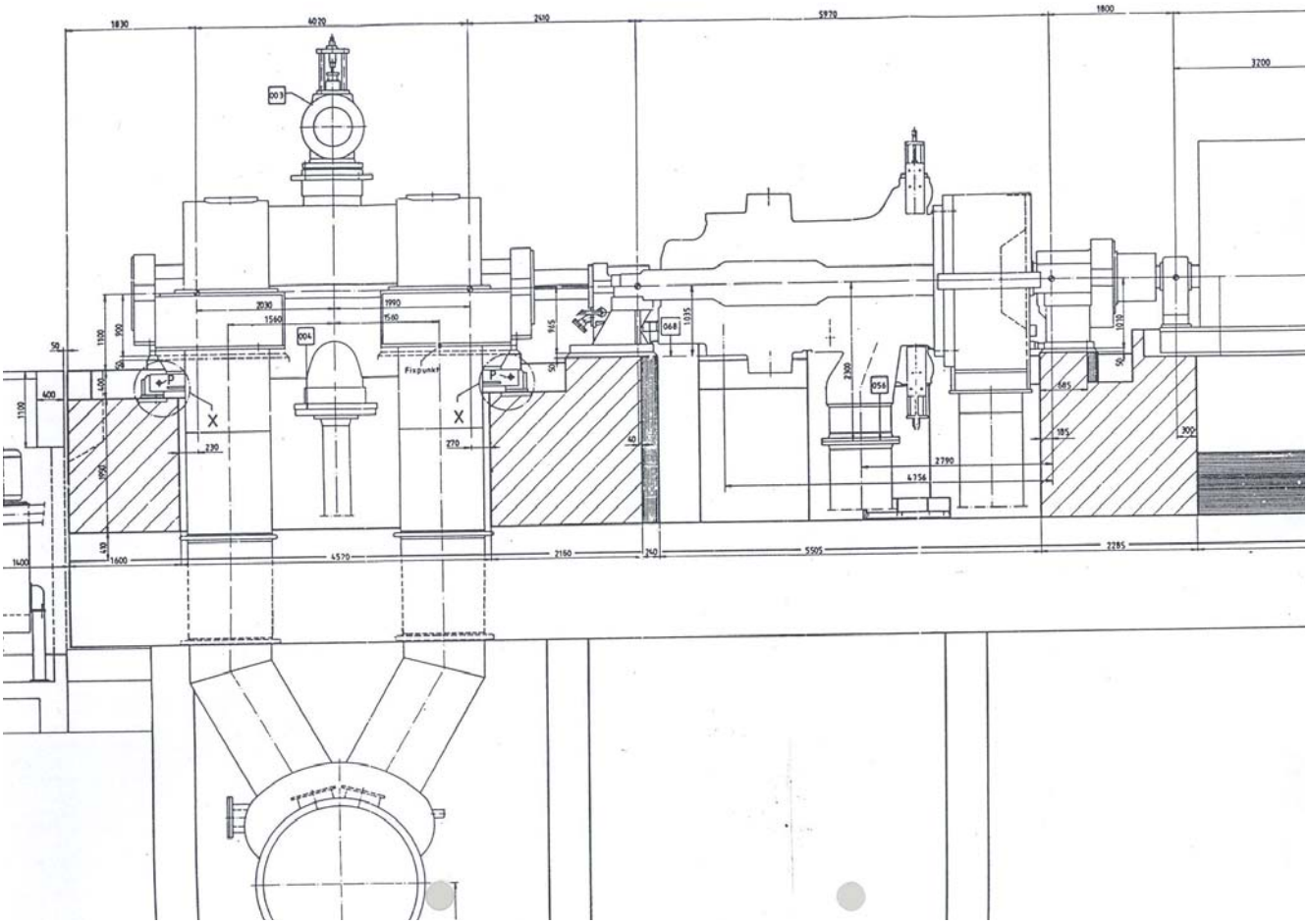
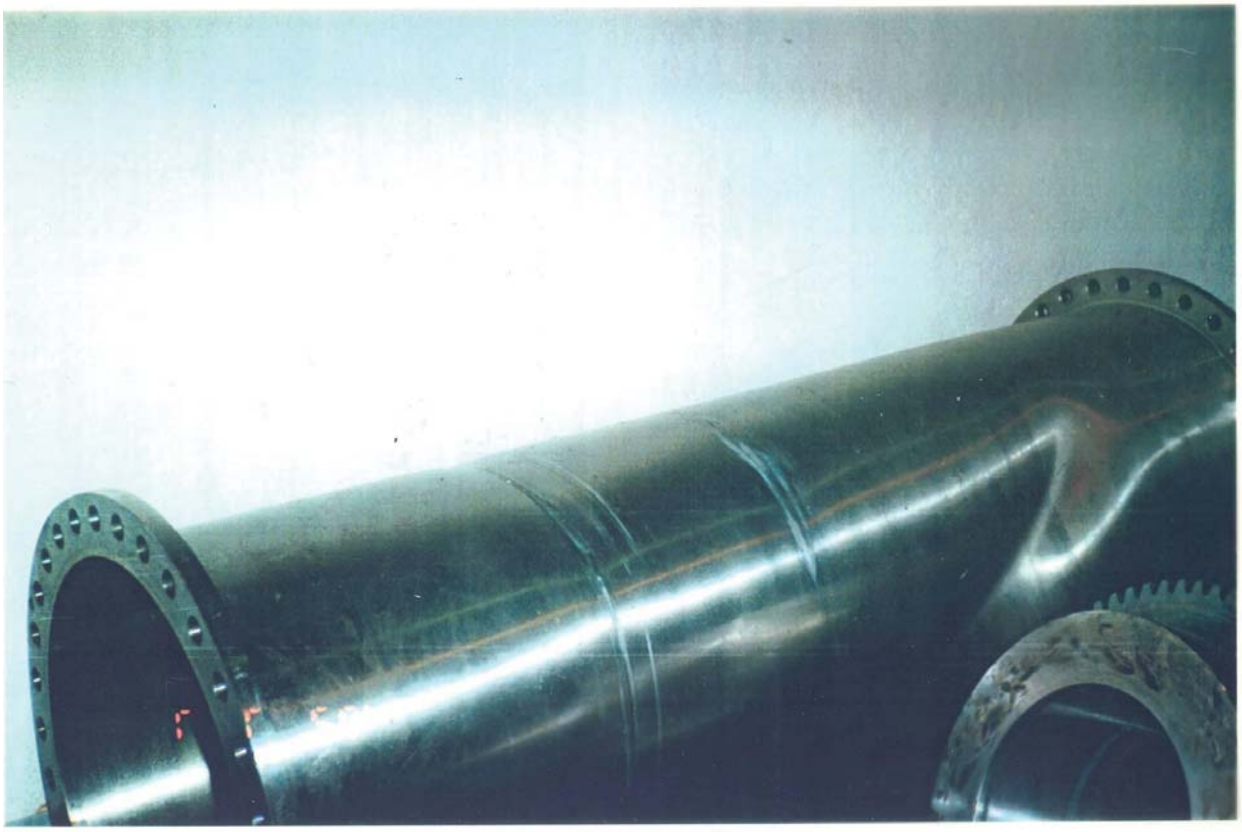
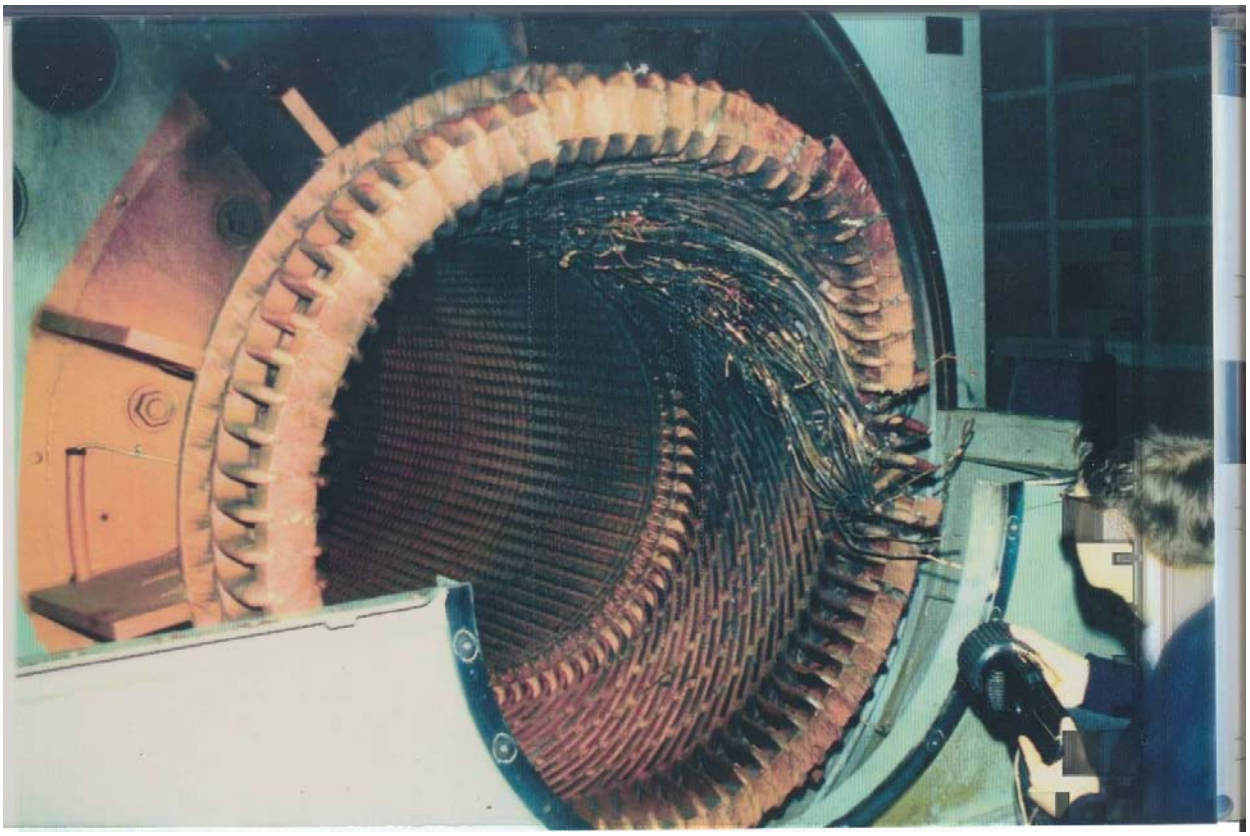
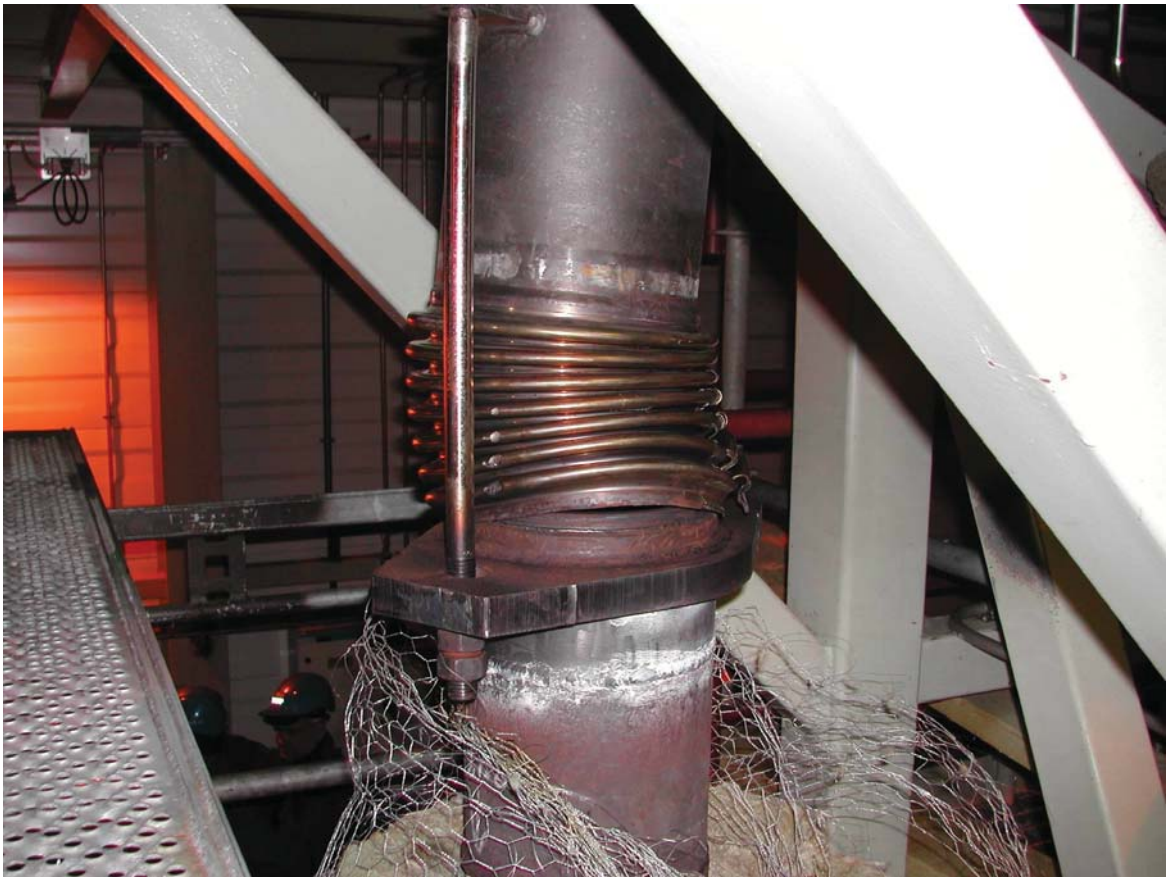
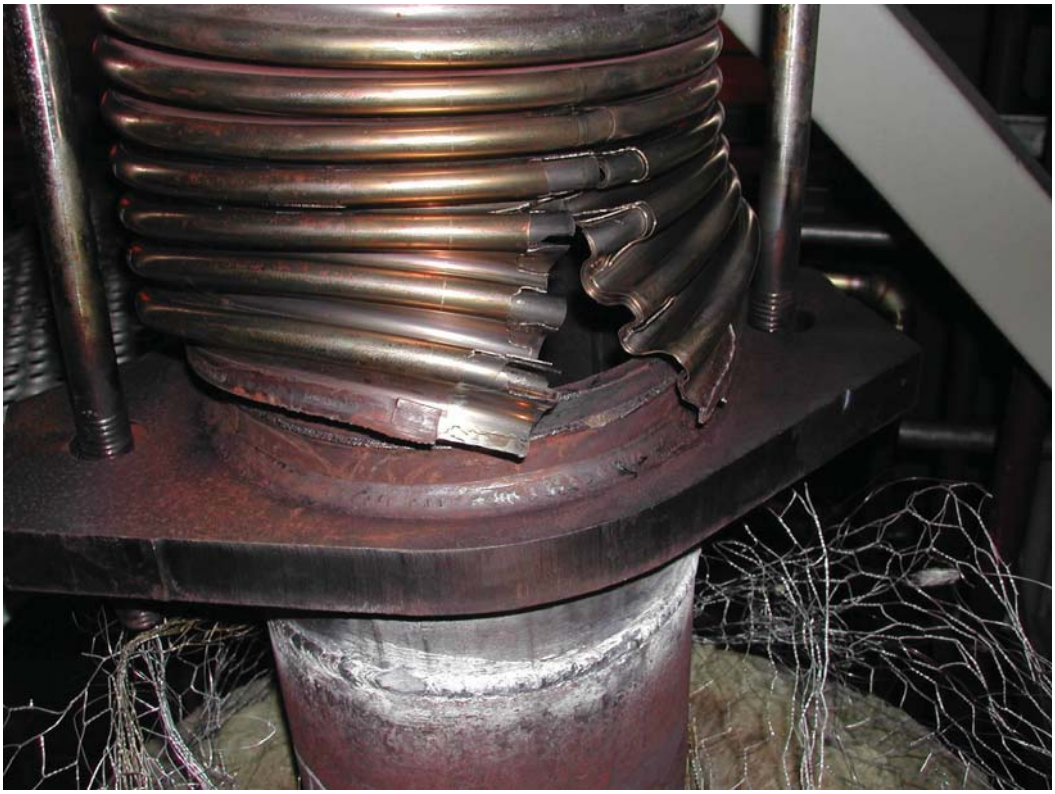
Schnitt A-A

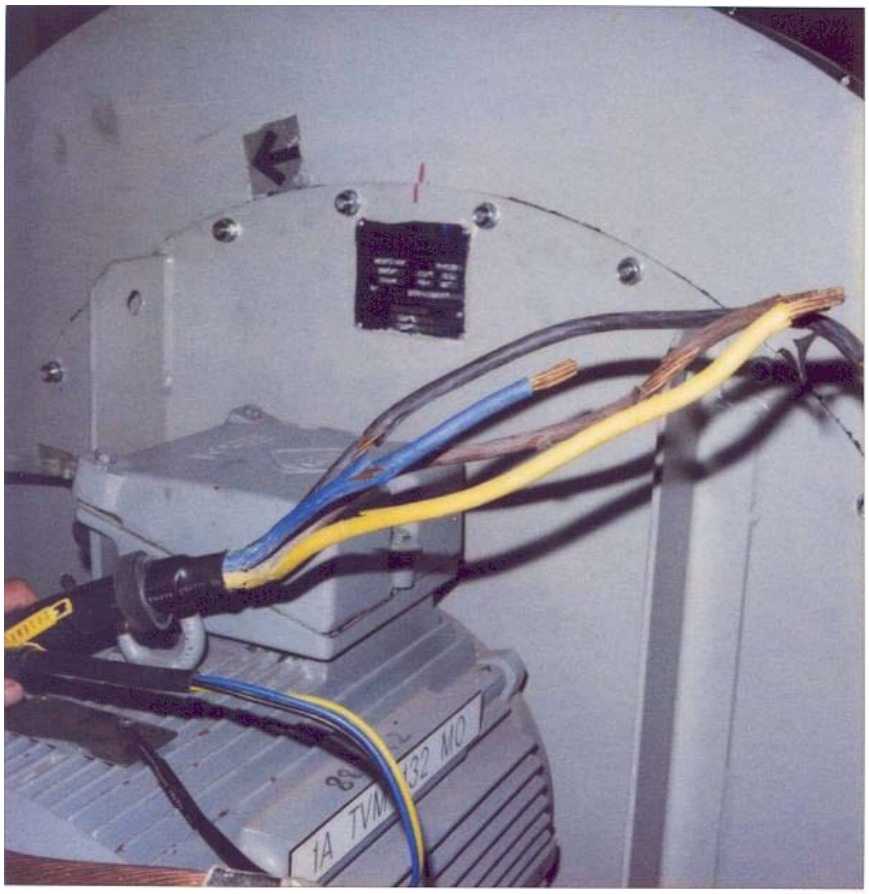




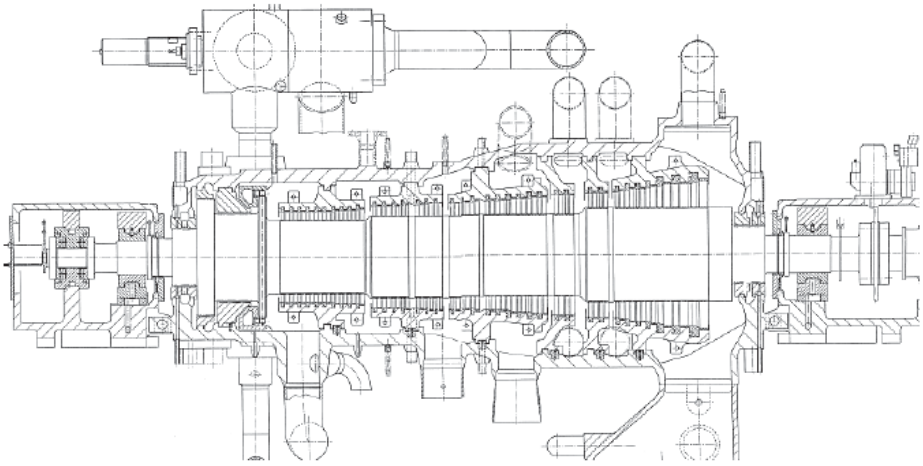


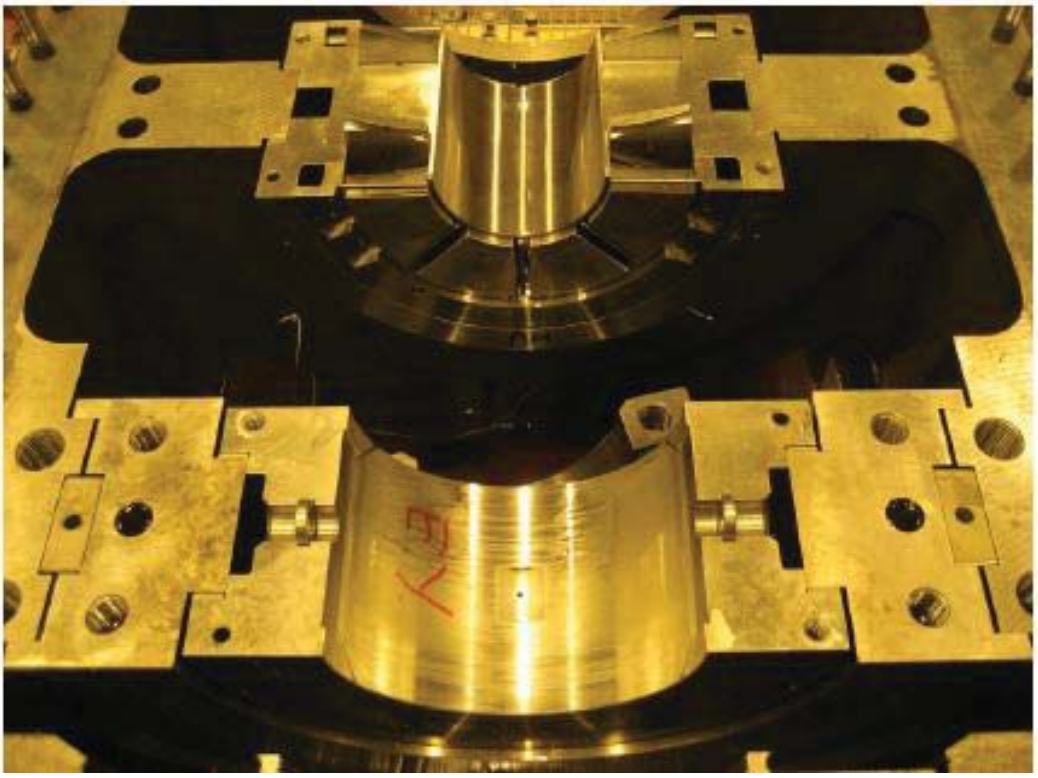


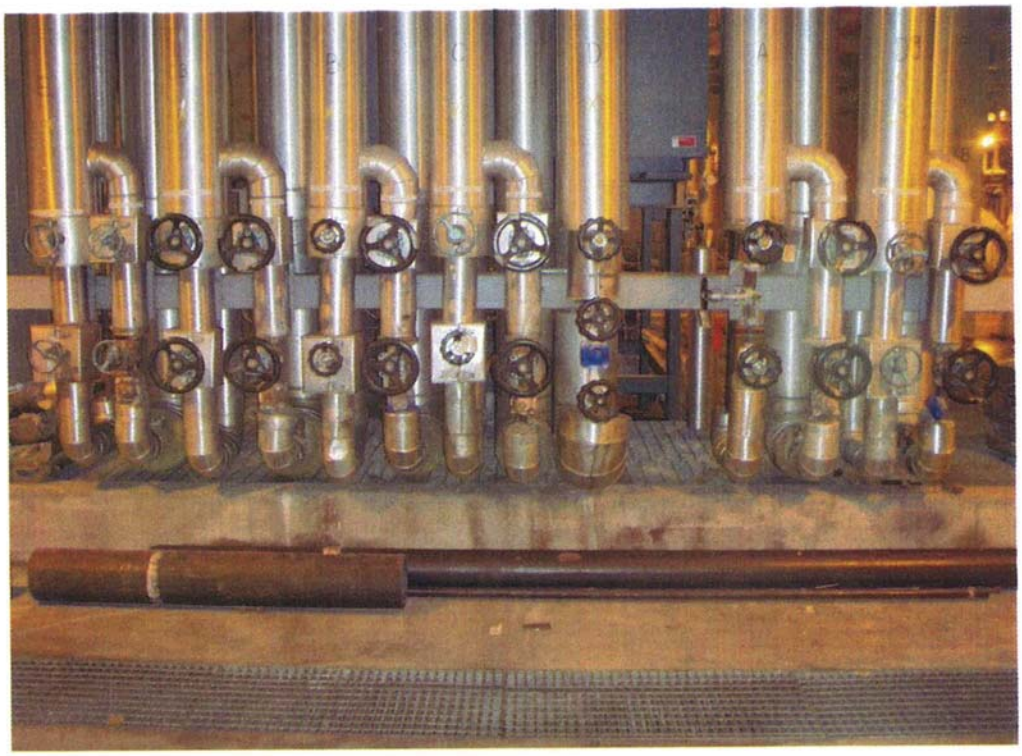


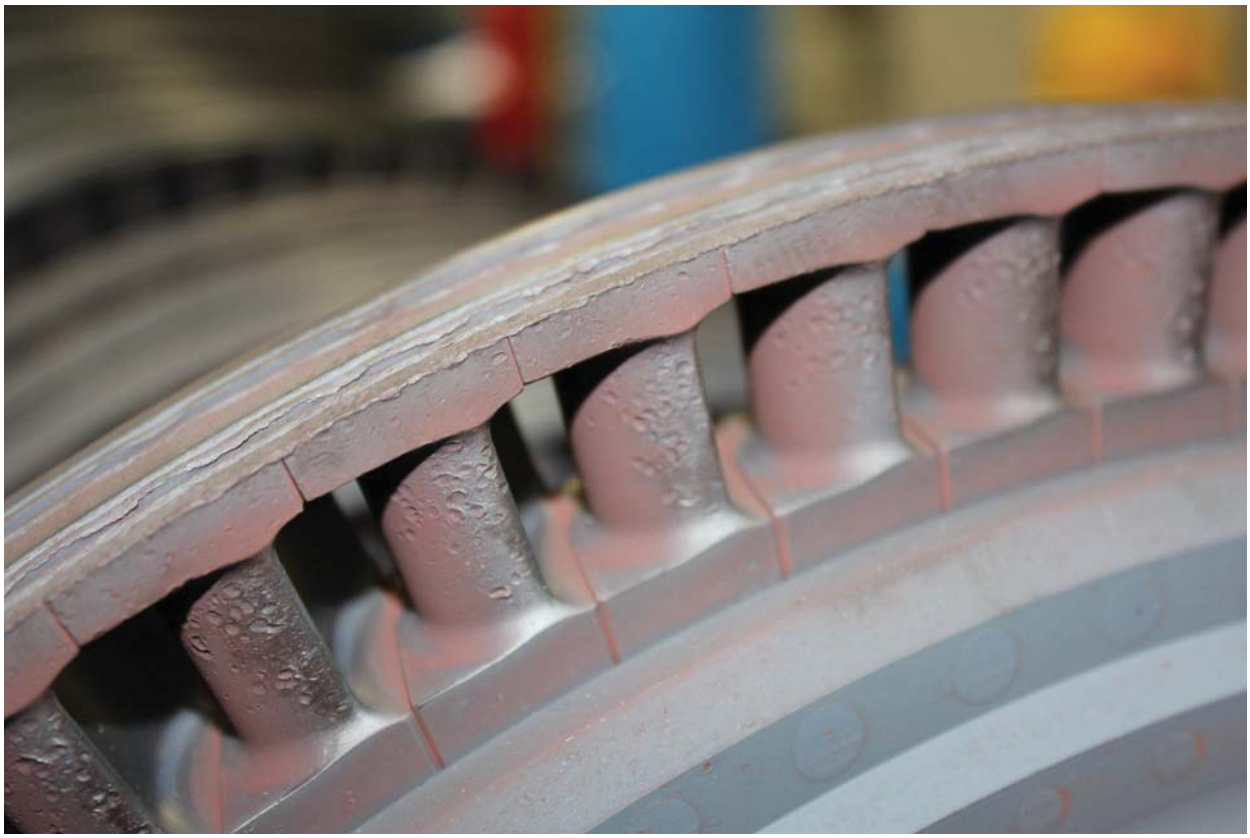


The turbine case:









International Association of Engineering Insurers
38th Annual Conference – Moscow 2005

Maintenance and Overhaul of Steam Turbines

HMN Series Steam Turbine – Courtesy Siemens Power Corporation

Working Group

John Latcovich, The Hartford Steam Boiler Inspection & Insurance Company, Hartford, Connecticut (Chairman)
Thomas Åstrom, Pohjola, Helsinki
Peter Frankhuizen, Praevenio, Amsterdam
Seigou Fukushima, Tokyo Marine, Tokyo
Håkan Hamberg, If P&C, Sundsvall
Stefan Keller, Swiss National, Basel

Steam Turbine Failures

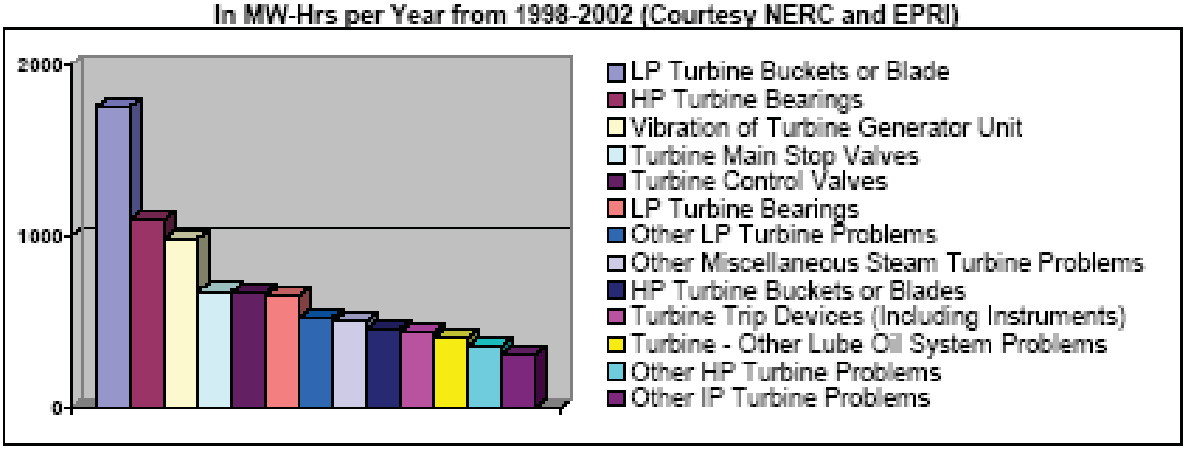
Fatigue Failure Compounded by Condenser Extraction Line Backflow

Water Induction Rub Compounded by Attempts to Turn Thermally Locked Rotor

Rotor/Seals Welded to Inner Shell from Rub

SCC Failure in LP Blade LE

Figure 13 – Ranking of Top 15 Failure Causes for Fossil Steam Turbine Lost Availability In MW-Hrs per Year from 1998-2002 (Courtesy NERC and EPRI)



International Association of Engineering Insurers

42nd Annual Conference – Istanbul 2009

Working Group
Thomas Åström, Pohjola Insurance Ltd, Helsinki - Chairman
Michael Bove, The Hartford Steam Boiler Inspection & Insurance Company, Hartford
Spencer Clark, Concordia Consultancy Ltd, London
Steven Clayton, Cunningham Lindsey, Mexico
Steve Kelly, Royal & Sun Alliance Insurance plc, London
Bernd Luckey, Munich Re, Munich
Patrice Nigon, Swiss Re, Munich
Richard Radevsky, Charles Taylor Adjusting Ltd, London

Combustion Turbines: Critical Losses and Trends

Presented by:

Thomas Åström
Dr. Tech. (Mech. Eng.)

Pohjola Insurance Ltd

Eur Ing Richard Radevsky
BSc, CEng, CSci, CEnv, PEng, FICE, FCIWEM, MEI, MIFireE, FCIArb

Charles Taylor adjusting - Technical Director

Combustion Turbines: Critical Losses and Trends

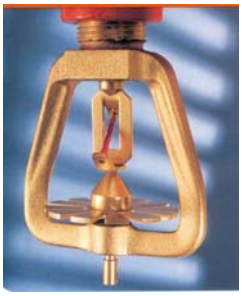
- Combined cycle cogeneration use
- The criticality of combustion turbines
- The types of machines
- Risk management means
  - on-line monitoring
  - planned overhauls
  - NDT-testing
  - metallography
- Parts and Service Agreements
- Loss Analysis
  - Technology and Machine Type
  - Loss Initiating Components
  - Causative process
- Root cause analysis
- Typical Damage
  - Technical and Design
  - Duty cycle, airflow, gas flow and fuel
  - Quality Assurance
  - Operations and Maintenance

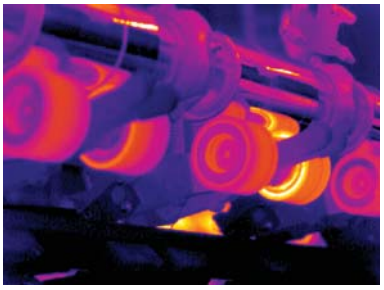
IMIA WGP 49 BOSTON Hazards in paper and pulp Industries – from an engineering insurance perspective

Presented by M Gådin and T Åström at the IMIA Conference, Boston 2006

Working Group:	Aki Ahonen	Pohjola	
	Ingvar Bodin	Zurich	
	Milan Dinets	Ingosstrakh	
	Mats Gådin	If P&C	Chairman
	Felix Staub	Swiss Re	
	Thomas Åström	Pohjola	

LOSS PREVENTION
CONVEYORS

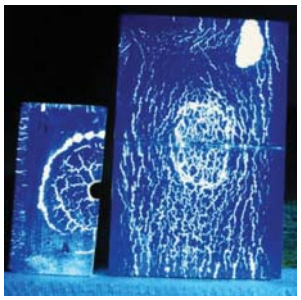




CHECK-LIST

- **sprinklers**
- **spark detection devices**
- **vibration measurement of bearings**
- **thermography of bearings**
- **rotation controllers for slippage control**
- **indicators for misalignment of the belts**
- **over-load warning devices for driving motors**

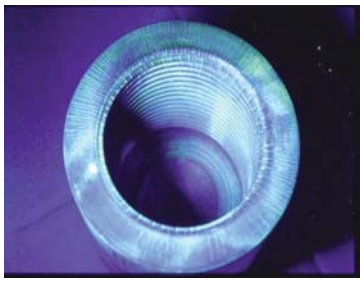
LOSS PREVENTION
BOILER FANS



CHECK LIST

- **on-line vibration monitoring of bearings or**
- **systematic periodic vibration measurements**
- **on-line or periodic temperature measurements of bearings**
- **in-service NDT for crack detection**
- **over-load warning devices for driving motors**

LOSS PREVENTION
TURBO-SETS



CHECK LIST

- **the in-service maintenance programme including the systematic function checks**
- **the inter-activeness of the in-service maintenance programme**
- **vibration, temperature and pressure sensors used as protection devices and not only as warning devices**
- **periodical endoscopy of blades**
- **periodical oil-analyses of both the hydraulic and the lubricating oil**
- **use of a Partial Discharge (PD-) system for monitoring agening of isolation material**

SOODAKATTILAN 1-LIERIÖMUUTOS

Jouni Koskinen

Metso Power Oy

Soodakattilan 1-lieriömuutos

Jouni Koskinen

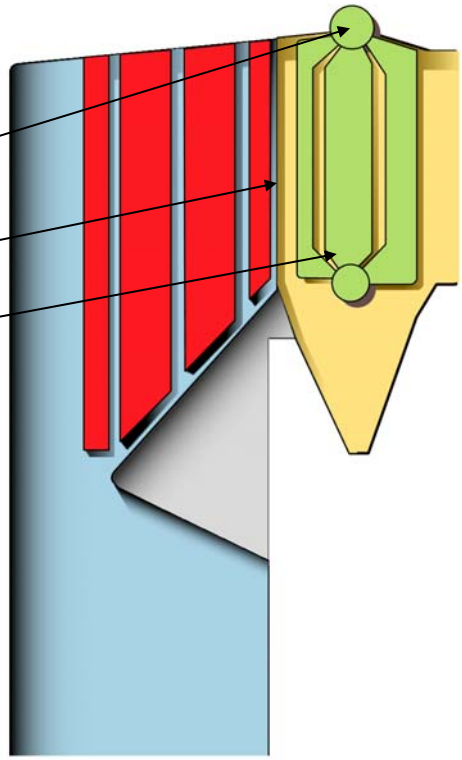
Konemestaripäivä 2013

Imatran Valtionhotelli

Miksi 1-lieriömuutos?

Mahdolliset ongelma-alueet:

- **Säröjä lieriön vaipassa**
- **Tukkeentumista keittopinnan sisääntulossa**
- **Korroosiota alalieriön alueella**
- **Suunnittelemattomia seisokkeja putkivuotojen takia**
- **Rajoittaa kattilan kapasiteettia**



➔ **Ratkaisu on 1-lieriömuutos**

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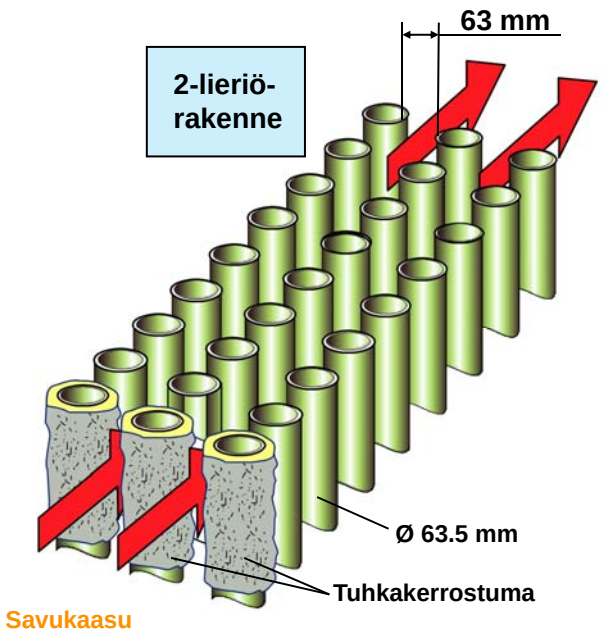
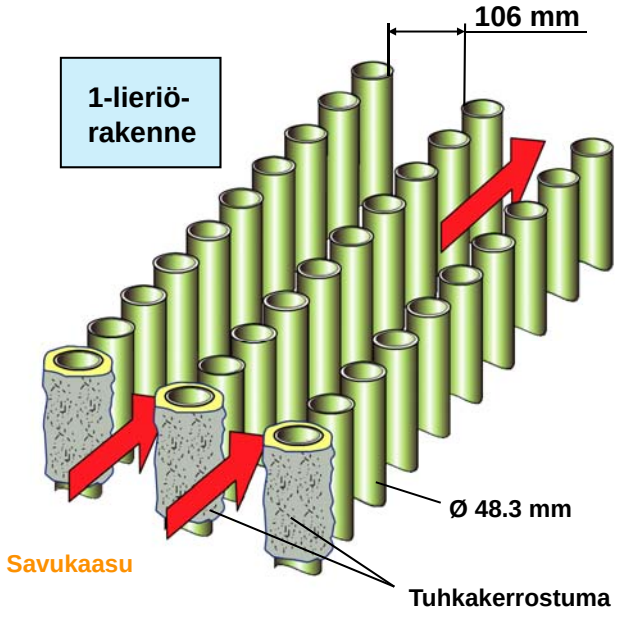
1-lieriömuutos

Billerud Karlsborg, Ruotsi

Väljempi putkijako ja pienempi putkikoko keittopinnassa vähentää savukaasun virtausnopeutta ja tukkeentumisriskiä





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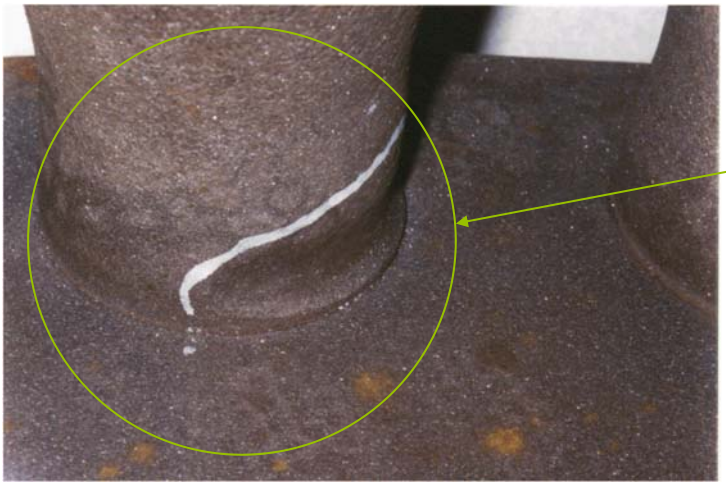
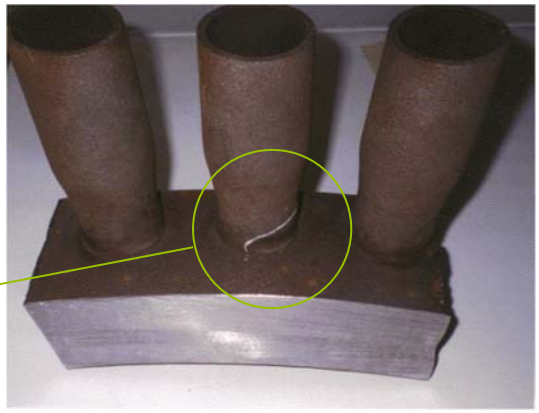
Korroosio-ongelmia alalieriön läheisyydessä

Billerud Karlsborg, Sweden
Lokakuu 1996





Tarkastus:
- **Noin 100 putkessa oli seinämävahvuus pudonnut puoleen alkuperäisestä**

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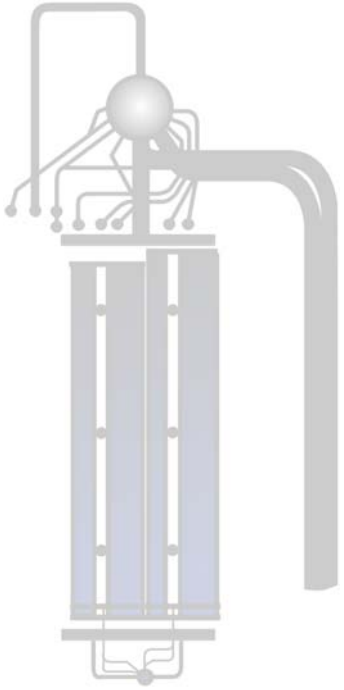
1-lieriömuutos – Innovatiivistä teknologiaa

Miksi 1-lieriömuutos?

- **Lisää käytettävyyttä**
  - **Billerud Karlsborg, Ruotsi**
  - **Billerud Skärblacka, Ruotsi**
  - **Stora Enso, Imatra, Suomi**
- **Lisää kapasiteettia**
  - **Södra Cell, Tofte, Norja**
  - **Potlatch McGehee, AR, USA**
  - **ENCE Navia, Espanja**
  - **Aracruz Celulose, Brasilia**
  - **Smurfit, Celluluse du Pin, Ranska**
  - **SCA Munksund, Ruotsi**
- **Vähemmän kunnossapitokustannuksia**
  - **Billerud Skärblacka, Sweden**
  - **Billerud Skärblacka, Ruotsi**
  - **Stora Enso, imatra, Suomi**
  - **SCA Munksund, Ruotsi**
- **Lisää turvallisuutta**
  - **Rosenthal, Germany**
  - **SCA Munksund, Ruotsi**



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Tyypilliset 1-lieriömuutoshankkeen tavoitteet ja onnistumisen edellytykset:

- Kilpailukykyinen hinta
  - Kyky muokata kenen tahansa valmistajan kattiloita
  - Luotettavat ja kilpailukykyiset yhteistyökumppanit
- Lyhyt seisokkiaika
  - Pitkän ajan kokemus soodakattiloiden prosessista ja laitteista
  - Asennuksen vaatimukset huomioitu suunnittelussa ja valmistuksessa
  - Asennus suunniteltava huomioiden kaikki osa-alueet
  - Kaikkeen mahdolliseen ja mahdottomaan varautuminen etukäteen on työlästä, kallista ja yleensä mahdotontakin, mutta kannattaa varautua ainakin kaikkeen minkä tietää ja mihin pystyy.
- Luotettava toimitus
  - ”Hyvin suunniteltu on puoliksi tehty”
  - Muutostyön 3D-mallinnus (mahdollisesti laserskannaus)
  - Vedenkiertolaskelmat
  - Useita 1-lieriömuutosreferenssejä

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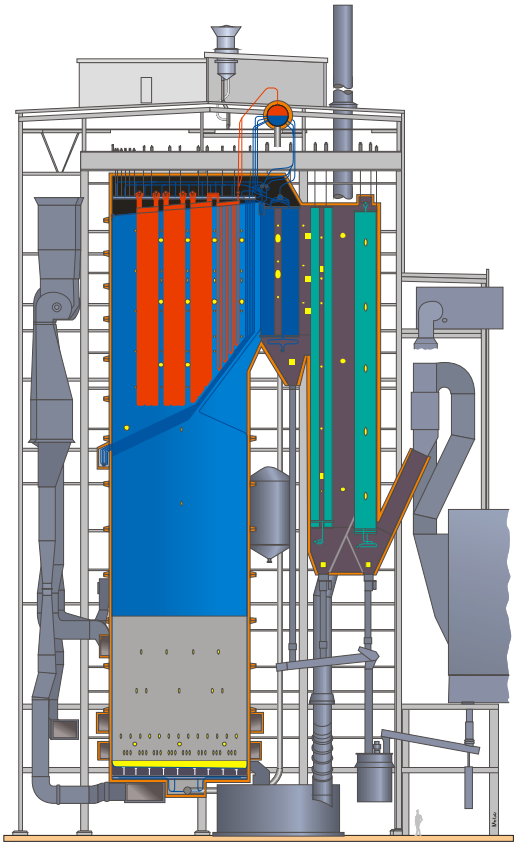
Case: Soodakattilan 1-lieriömuutos

Stora Enso
Imatran tehtaat
Suomi

Kapasiteetti 1700 t ds/24h
Höyryn arvot 68 kg/s
86 bar
480 °C
Käynnistys 2012



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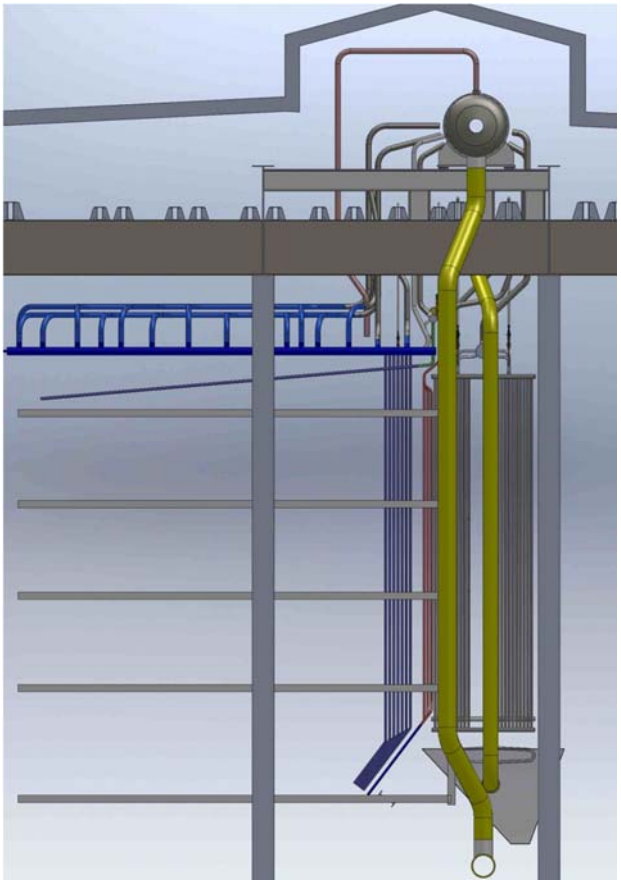
Toimituslaajuus

- **Uusi lieriö primääripalkkien päälle**
- **Nokan putket jatkettu keittopinnan eteen tulevina hilaputkina**
- **Uusi keittopinta ja sen alueelle uudet vesijäähdytetyt seinät**
- **Lasku-, ala- ja yläkiertoputket uusittu tai muutettu tarpeen mukaan**
- **Syve- ja kylläisen höyryn putkiston muutokset**
- **Eko II:n uusinta**
- **Uusi suppilo ja tuhkakuljetin suppilon alle**
- **Nuohoimia siirretty keittopinnan alueella ja tehty tarvittavat muutokset nuohoushöyryputkistoon**
- **Teräsrakennemuutokset (mm palkit, ripustustangot, tukikehät, tasot, portaat)**



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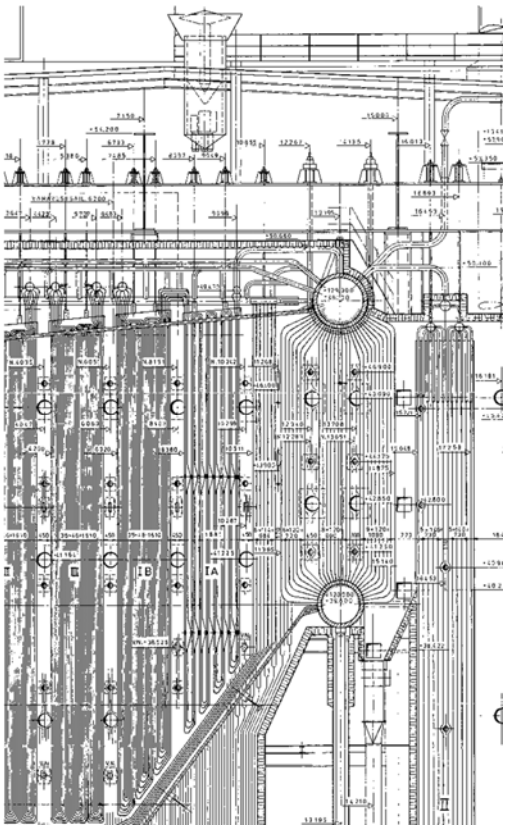
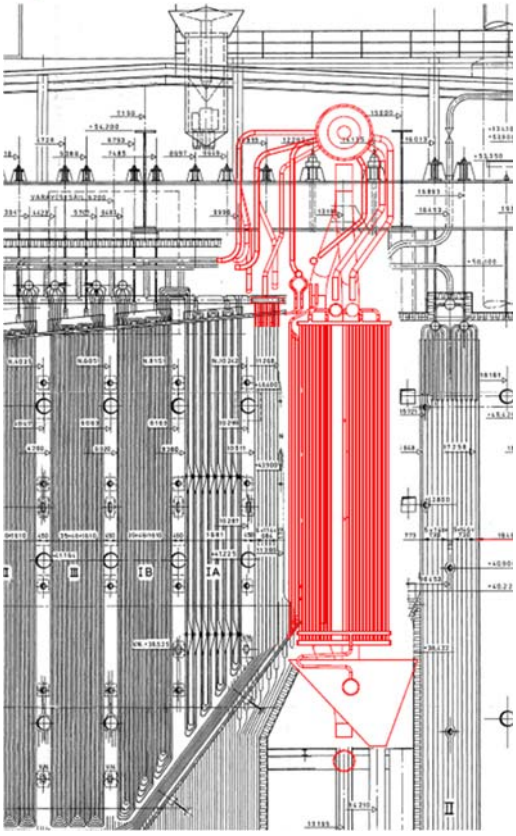
Imatra, SK5 / Ennen ja jälkeen 1-lieriömuutoksen





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Sisältyy

- Layout-, prosessi- ja mekaaninen suunnittelu
- Sähköistyksen ja automaation perussuunnittelu ja tarvittavat tiedot detaljisuunnittelun
- Telinetyöt
- Muuraukset ja massaukset
- Kemiallinen puhdistus (peittaus)
- Purkutyöt
- Asennustyöt (Asennusvalvonta, asennustyövoima, työkalut ja materiaalit)
- Uudet eristykset ja pellitykset
- Koulutus ja käyttöönottotuki
- Varaosat 2 vuoden käyttöä varten
- Rahti

Ei sisälly toimitukseen

- Lisäykset ja muutokset sähköistykseen ja instrumentointiin
  - Kaapelihyllyt, kaapelit, ym
  - Kenttälaitteet (ellei erikseen mainittu)
  - DCS muutokset ja ohjelmointi
  - Detaljisuunnittelu
- Rakennustekniset työt
  - katon aukaisu ja korotusosa, ilmastointi, palosuojelu, ym
- Kunnossapitotyyppiset työt olemassa oleville laitteille
- Asbestityöt

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HENKILÖTURVALLISUUDEN PARANTAMINEN SOODAKATTILALAITOKSESSA RFID AVULLA

Jari Aapio

Visi Oy

HENKILÖTURVALLISUUDEN PARANTAMINEN

VIDEOVALVONNAN JA RFID TEKNIIKAN AVULLA KATTILALAITOKSESSA

Kattila ympäristön vaarat

- VUODOT
  - höyry, vesi, öljy, lipeä, rikkiyhdisteet
- RÄJÄHDYKSET
  -tulipesä, kaasu, sulavesi
- ENNAKKOHUOLLON PUUTE
  - tulipalo, kuluminen/korroosio,
- INHIMILLISET EREHDYKSET
  - liukastuminen, palovamma, sähköisku, putoaminen, kaatuminen, väärä toimintatapa

VIDEOVALVONTA

Videovalvonnalla turvallisuutta

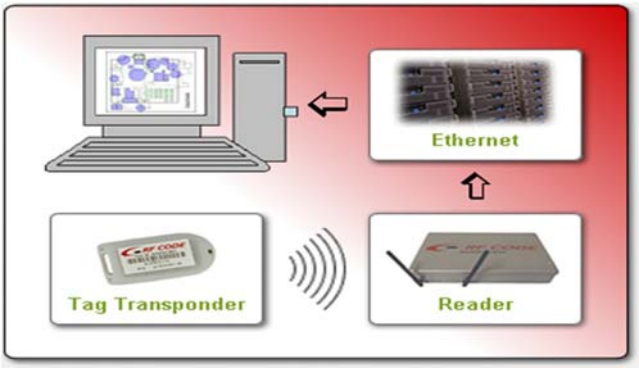
- RISKIEN REAALIAIKAINEN TUNNISTAMINEN
- LAITOKSEN POIKKEAVAT TAPAHTUMAT
  - vuodot, räjähdykset, tulipalot
- HENKILÖSTÖN TURVALLISUUS
  - lisääntynyt yksintyöskentely, tapaturmat
- TALLENNUS
  - tallentava järjestelmä todentaa, mitä oikeasti tapahtui

Videovalvontajärjestelmä

- KAMERA
  - IP / analoginen
- TIEDONSIIRTO
  - lähetys / vastaanotto, kaapelit / langaton, liittimet
- KESKUSLAITTEET
  - matriisi, tallennin, pc / softa
- MONITORI
  - videovalvontamonitori, pc:n näyttö, esitysmonitori
- VALAISTUS
  - natrium, halogen, loisteputki, LED
- LAITESIJOITUKSET YM.
  - valaistuserot, jännitesyötöt, kasaukset, koteloinnit,…

RFID

Radio Frequency IDentification



RFID

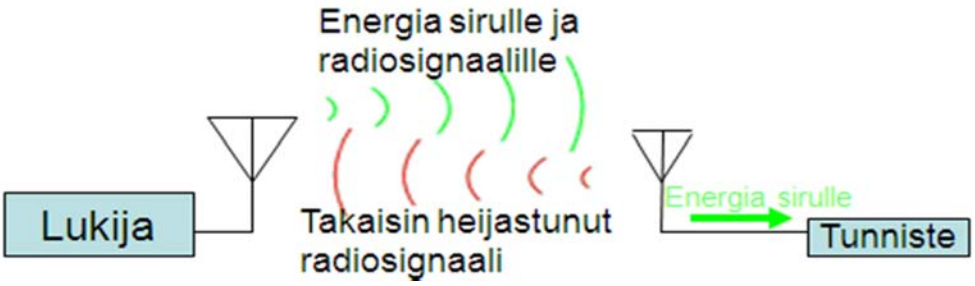
- Radiotaajuuteen perustuva etätunnistus
- Käyttö yleistyy jatkuvasti.

- Tähän ovat vaikuttaneet standardien tuoma varmuus laitteistojen yhteensopivuudesta, sekä tekniikan kypsyminen ja hintojen halpeneminen.
- RFID-teknologian sovellusalueita keksitään koko ajan lisää.

RFID perusteet:

RFID-järjestelmä koostuu:

1. tunnisteista
2. lukijoista
3. taustalla toimivasta tietojärjestelmästä.



Passiivisen RFID-tunnisteen toimintaperiaate. Tunniste kykenee toimimaan, kun se saa tarpeeksi energiaa RFID-lukijan kentästä.

RFID järjestelmä

Antennit

- Kerrostasanteella
- Seinä-/kattokiinnitys

Tunnisteet

- UHF Gen 2
- Esim. tarra kypärässä

Tietokone

Ethernet verkossa

Lukijat

Ethernet- verkossa

ACCO

Kulunhallintaohjelmisto

Henkilöt
- Nimi
- Organisaatio
- puhelinnumero

RFID - laitteet
- RFID-tunnisteet
- RFID-lukijat/antennit
- Antennien sijainnit

ACCO Ohjelmisto

Valvottavat alueet
- Soodakattilarakennus
- Kerrokset
- Sähkötilat
- Ovet
- Kulkuväylät

Mahdollistaa mm.
- Kulkuluvat
- Lukon ohjaukset

ACCO kulunhallinta

- toiminnallisuudet

ACCO Tapahtumat
- Henkilö, aika ja paikka

Raportointi
- Keitä on liikkunut
- Historiatiedot

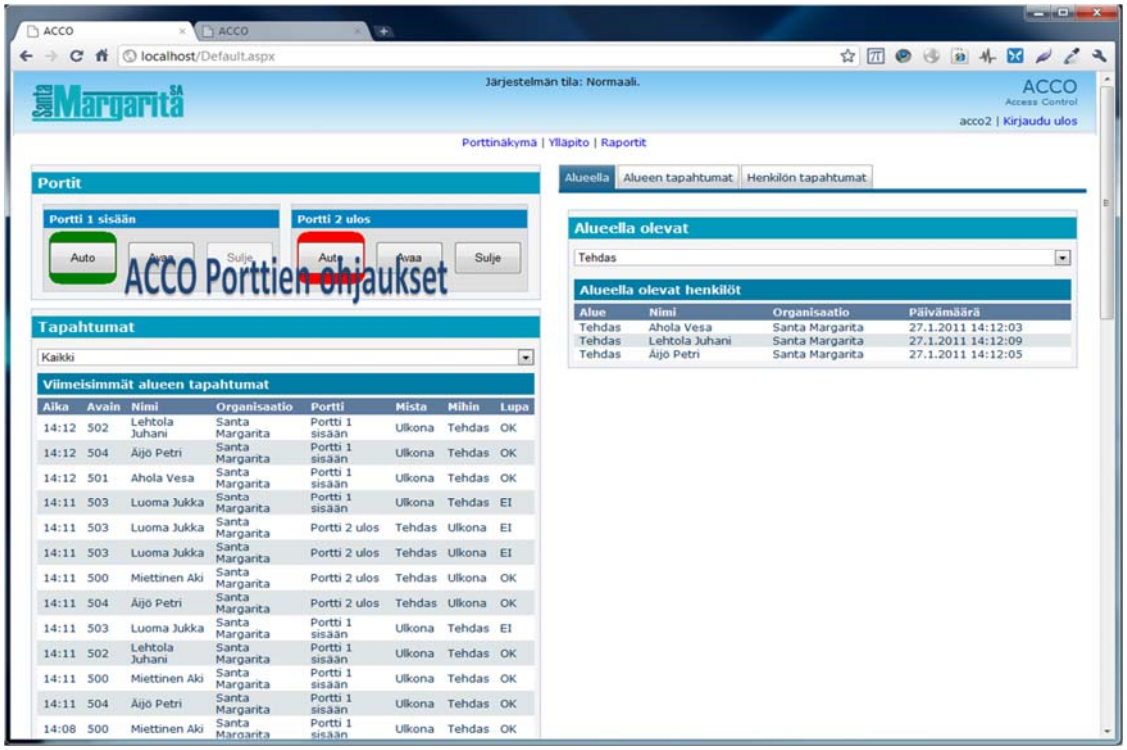
Tilannetieto - näkymä

Reaaliaikainen
- Henkilö, paikka ja aika
- Pelastushenkilöstön ohjaus

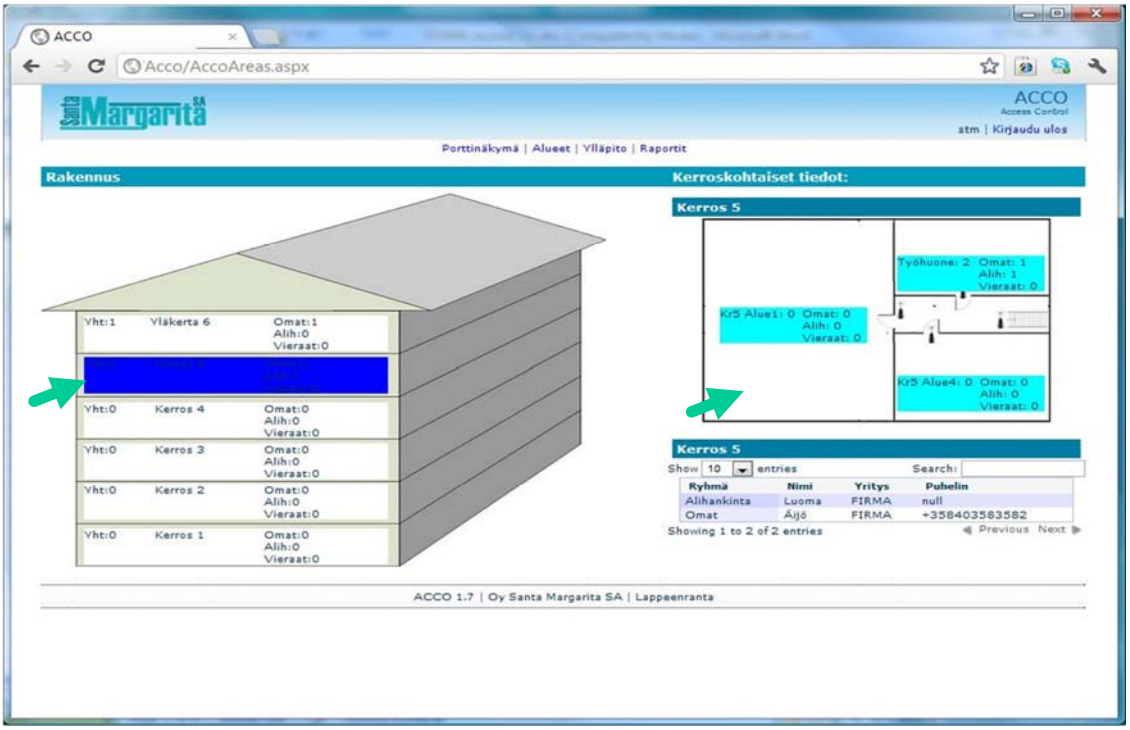
Visuaalinen
- Rakennuskuvat pohjana
- Helppo ymmärrettävyys

Mahdollistaa mm.
- Seisokkityöntekijöiden seuranta
- Erilaisia ohjauksia mm. valot, lukot, …

ACCO Tunnistustapahtumat



ACCO Tilannenäkymä



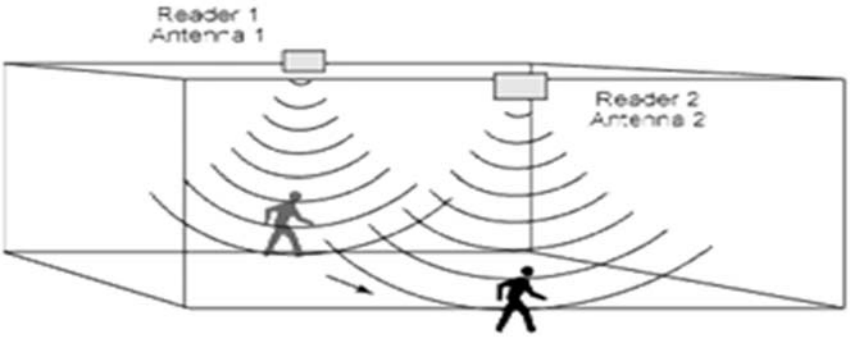
Esimerkkikohde

OUTOKUMPU OYJ

Tornion terästehtaan uusi 440M€ investointi kaksinkertaistaa ferrokromituotannon

REAALIAIKAINEN SEURANTA

- Tunniste kypärässä / kaulassa
- Antenni ja lukija verkossa
- Ohjelmisto + pc / pc:t
- Käyttöhenkilöt / -paikat



Esimerkkikohde, valvomo

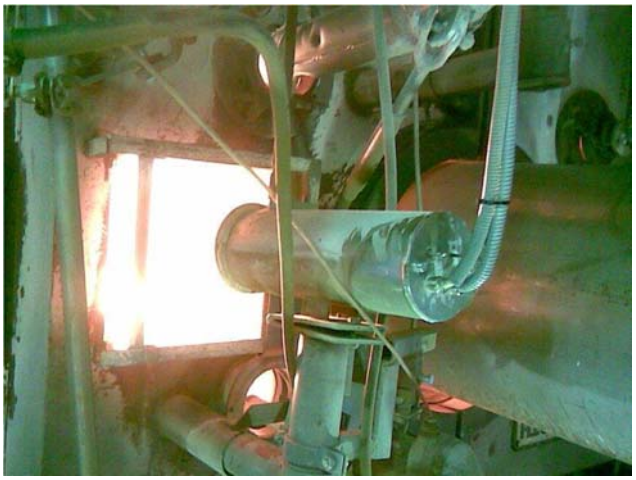
Esimerkkikohde, kamerat

Esimerkkikohde, kamerat

Turva- ja viestintätekniikkaa jo vuodesta 1955

Esimerkkikohde, kamerat

Esimerkkikohde, kamerat



Turva- ja viestintätekniikkaa jo vuodesta 1955

Esimerkkikohde, kamerat

Esimerkkikohde, kamerat

Turva- ja viestintätekniikkaa jo vuodesta 1955

Esimerkkikohde, kamerat

Kiitos !

ÄLYKÄS NUOHOUS, TEHOSTAA PUHDISTUSTA JA VÄHENTÄÄ NUOHOUSHÖYRYN KULUTUSTA

Carl-Johan Fogelholm

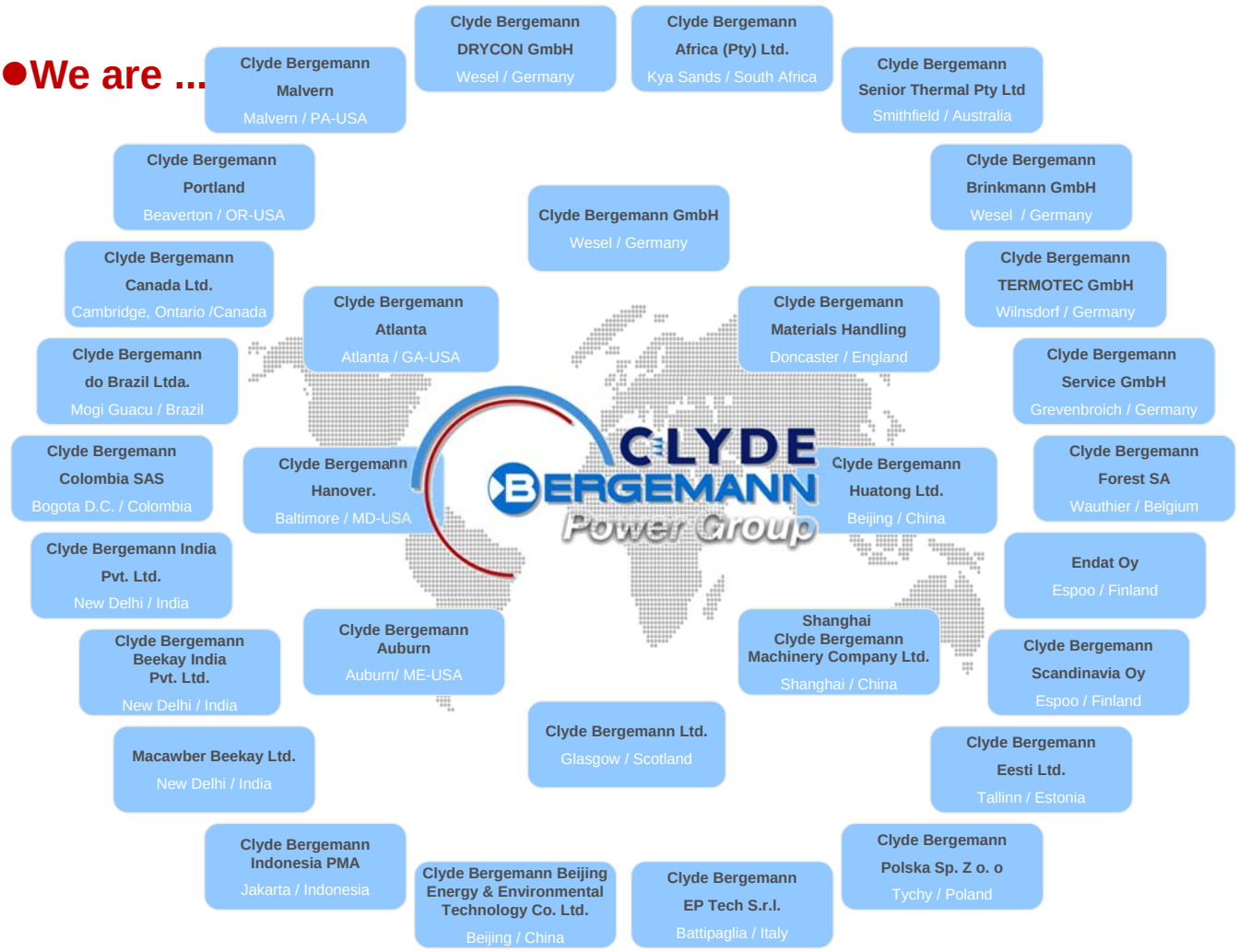
Endat Oy

Energy and Cost Savings by Advanced Boiler Cleaning Technology

Ati Manay
Carl-Johan Fogelholm
Antti Komulainen

2013

We are ...



Worldwide presence

- **30 business units worldwide**
- **Around 1600 employees**
- **17 manufacturing sites**

Clean Energy Solutions for…

- **Power**
- **Pulp and Paper**
- **Industrial**
- **Petrochemical**
- **Plastics and Chemicals**
- **Waste Incineration**
- **Marine**

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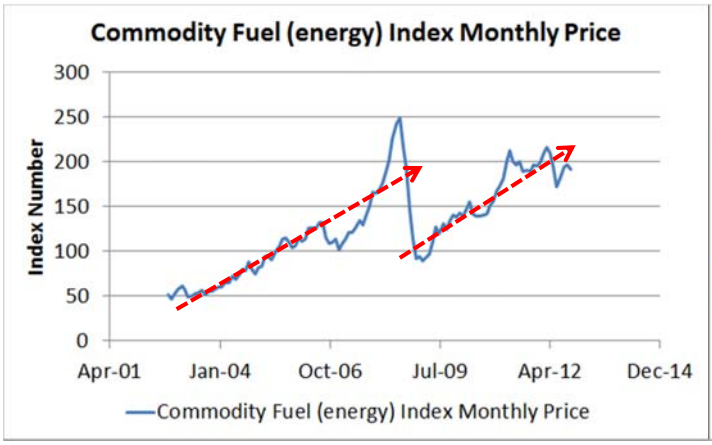
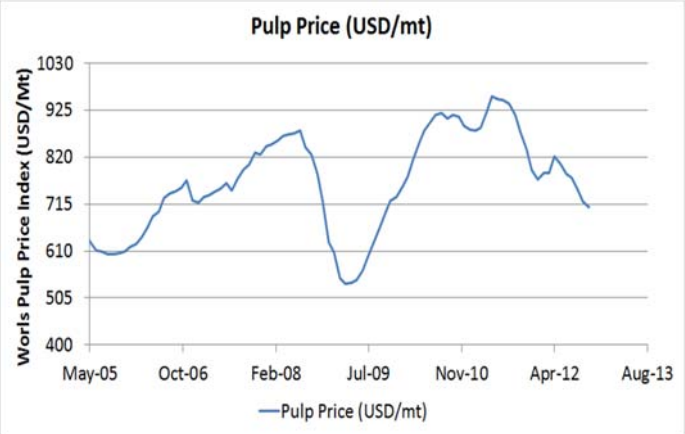
Energy Savings Initiative for P&P Industry

- Energy Savings Initiative is becoming a trend in Pulp and Paper Industry due to:
  - ➔ Soaring energy cost
  - ➔ Volatility in the price of pulp





Description: Commodity Fuel (energy) Index, 2005 = 100, includes Crude oil (petroleum), Natural Gas, and Coal Price Indices

Source: World Bank Commodity Price Data

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Sootblowing Steam Usage Benchmark

High Waste
- > 10% MCR
- Inefficient Sootblower operation and/or reactive maintenance

Medium Waste
- 5% - 10% MCR
- Average Sootblower operation and/or maintenance

Low Waste
- 2.5%- 5% MCR
- Good Sootblower operation and/or maintenance

Target
- <=2.5% MCR
- Clyde Bergemann Target

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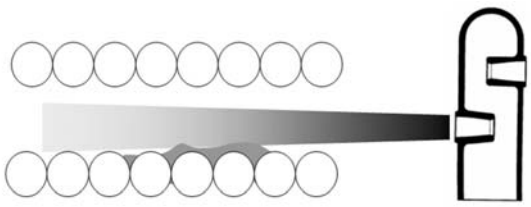
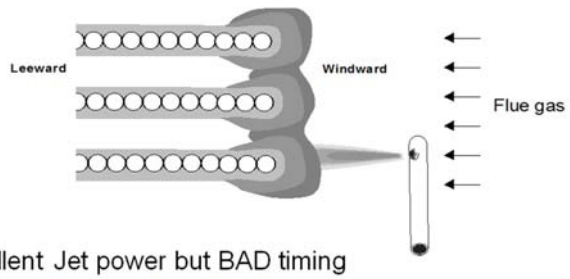
Basic Rule of Deposit Removal

- The success of deposit removal by a sootblower depends on two main important factors:
  - ➔ Jet Cleaning Force (lbf)
  - ➔ Sootblowing Timing



Excellent Jet power but BAD timing
- ➔ The deposit is still in the very early stage of deposit buildup
- ➔ Wasting valuable high pressure steam



Excellent Jet power but BAD timing
- ➔ The deposit has grown to a very large size
- ➔ Increasing jet power to remove may result in falling clinker, damaging boiler floors
- ➔ Wasting valuable high pressure steam

- Much research on how to improve jet cleaning force (i.e., Nozzle Tech) but little on sootblowing timing

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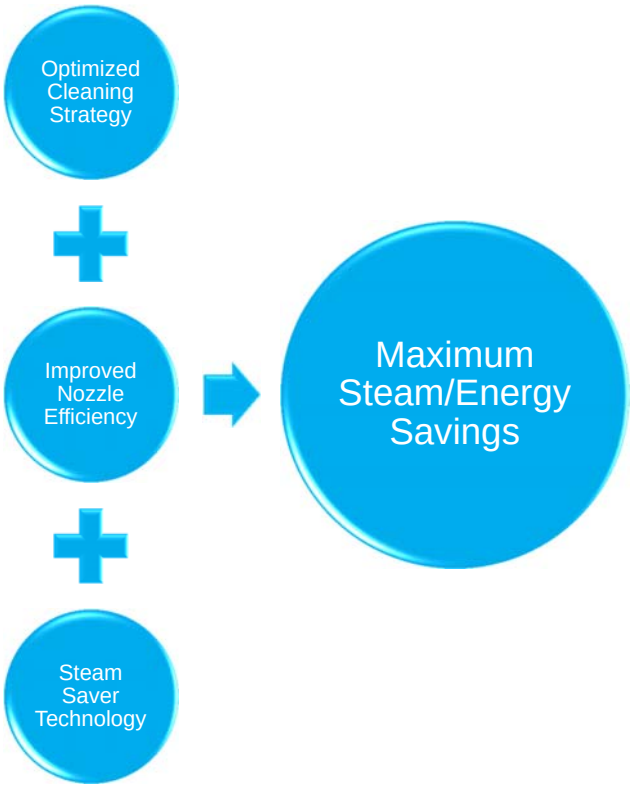
Solution



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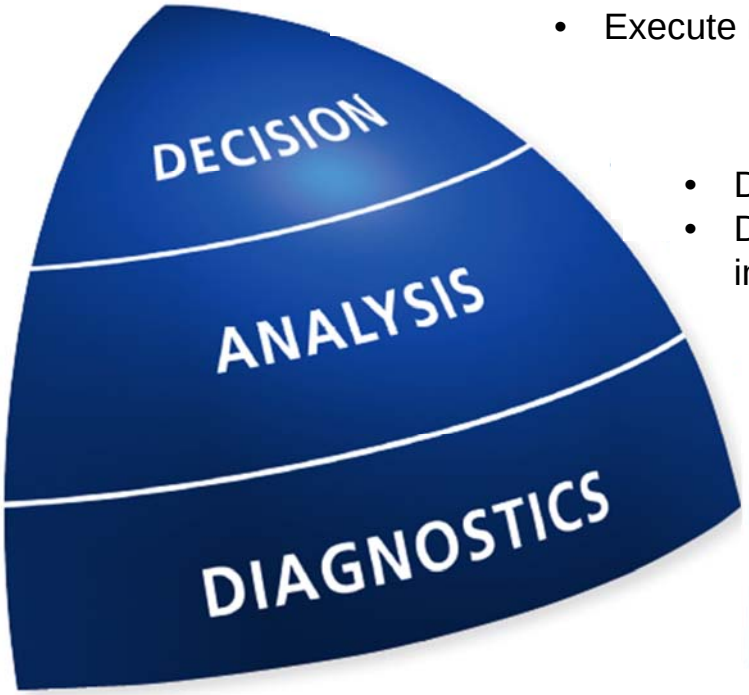
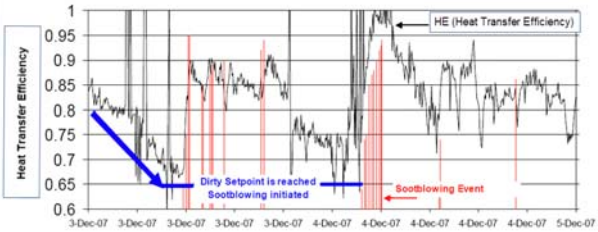
SMART Clean Optimization



- Execute required cleaning strategy

- Determine accumulation rate
- Determine required cleaning intensity

- Thermodynamic Model
- Flue Gas Draft Pressures



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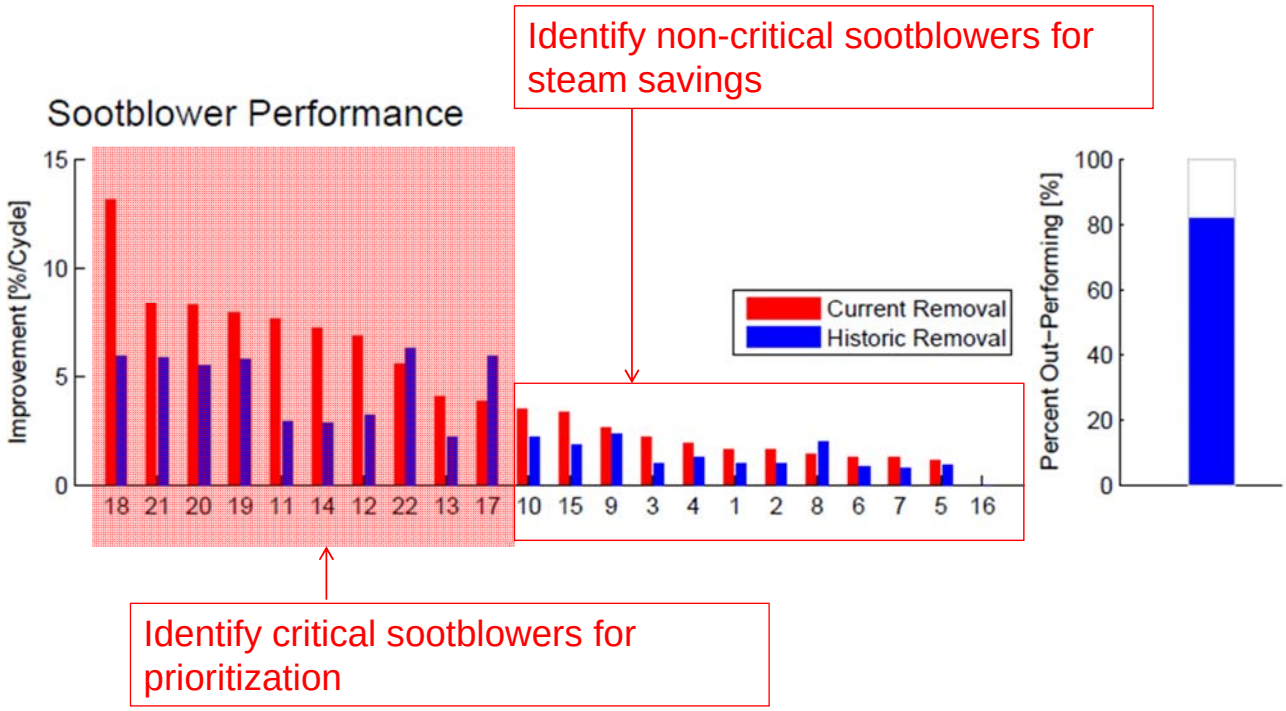
SMART Clean Process



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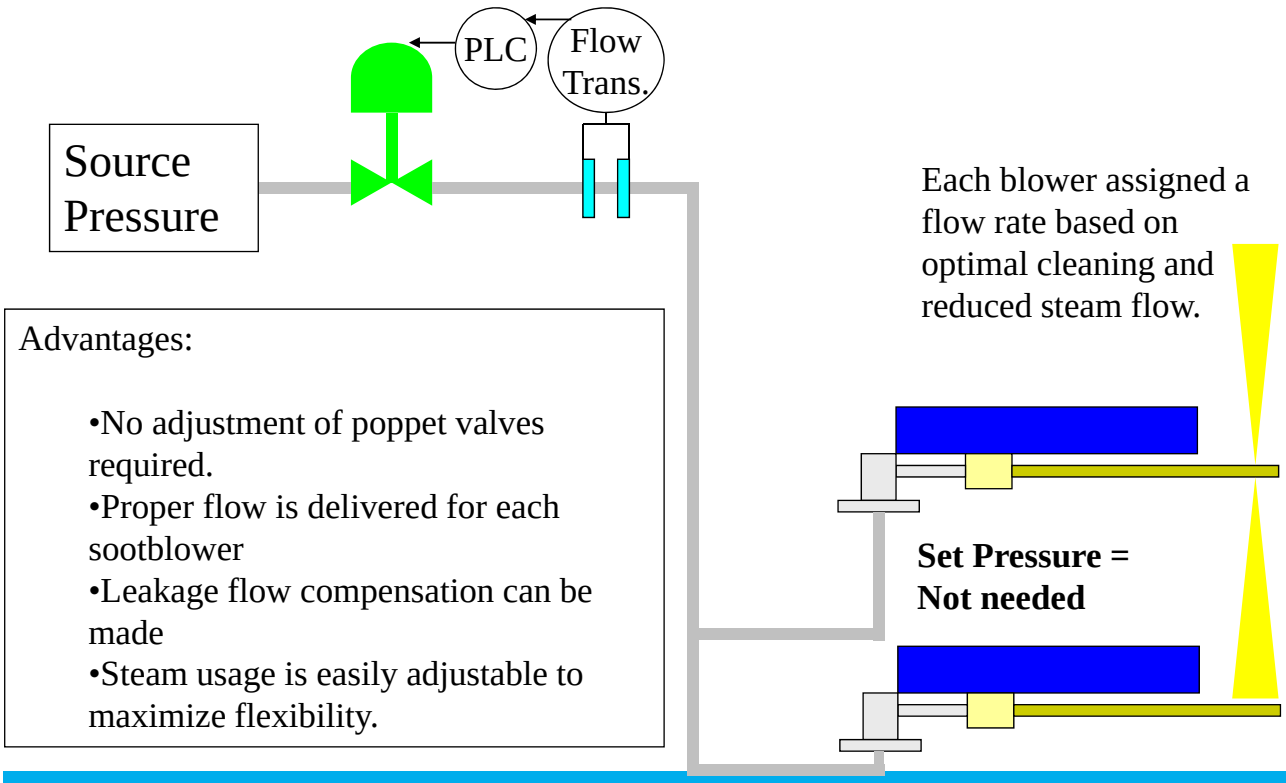
SMART Clean Dynamic Flow Method



Advantages:

- No adjustment of poppet valves required.
- Proper flow is delivered for each sootblower
- Leakage flow compensation can be made
- Steam usage is easily adjustable to maximize flexibility.

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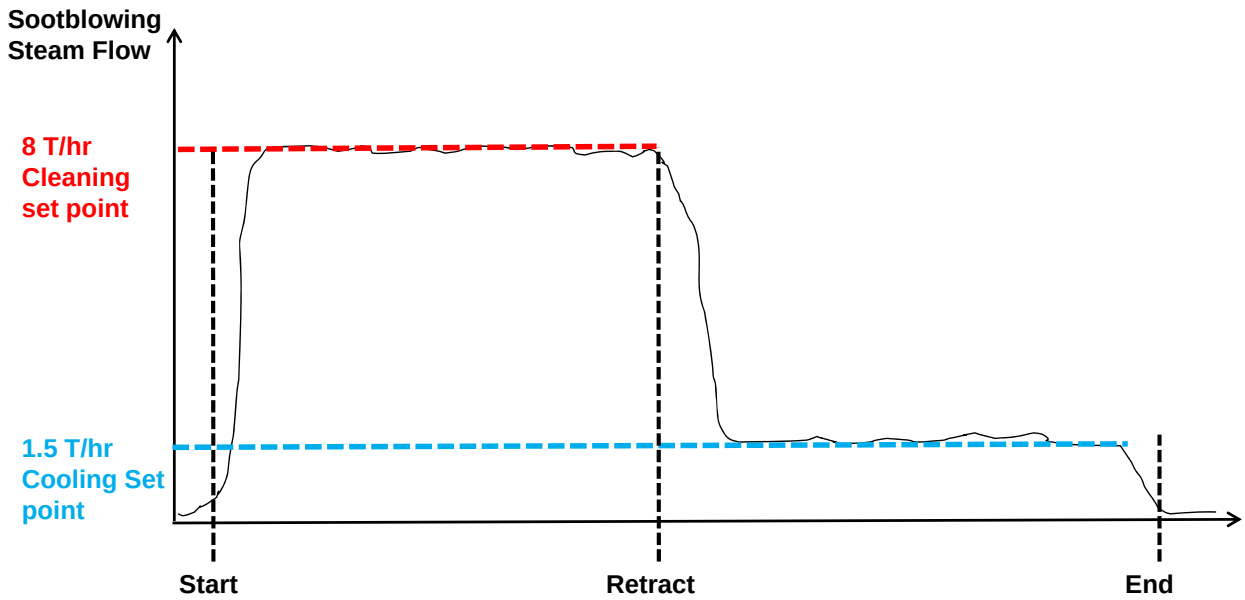
SMART Clean Dynamic Flow Method



- SMART Clean applies one-way sootblowing only for the suitable sootblowers.
- One-way sootblowers are determined based on their heat transfer improvement effectiveness on insertion and retraction.

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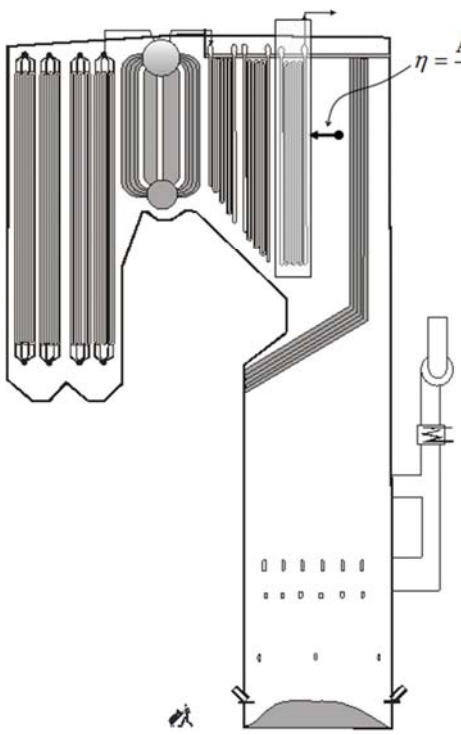
Heat Transfer Optimization



$$\eta = \frac{\text{Actual heat transfer to the water/steam inside the heat exchanger}}{\text{Total available heat input to the heat exchanger}}$$

$$\eta = \frac{Q_{Actual\ Heat\ Absorption}}{Q_{Heat\ Input}}$$

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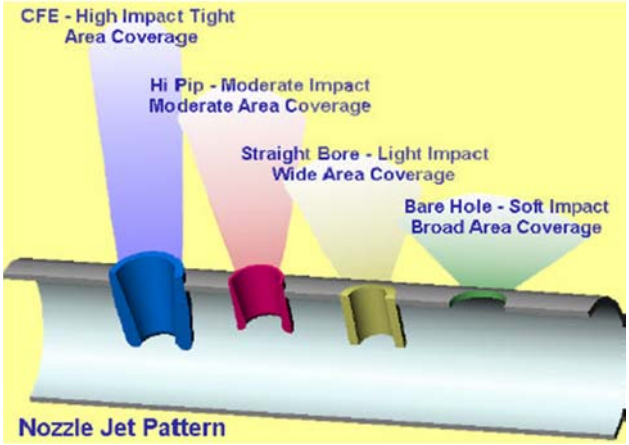
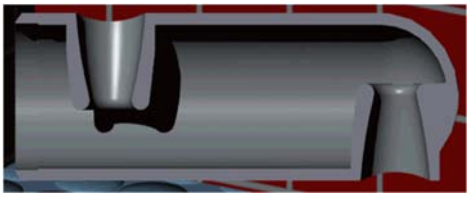
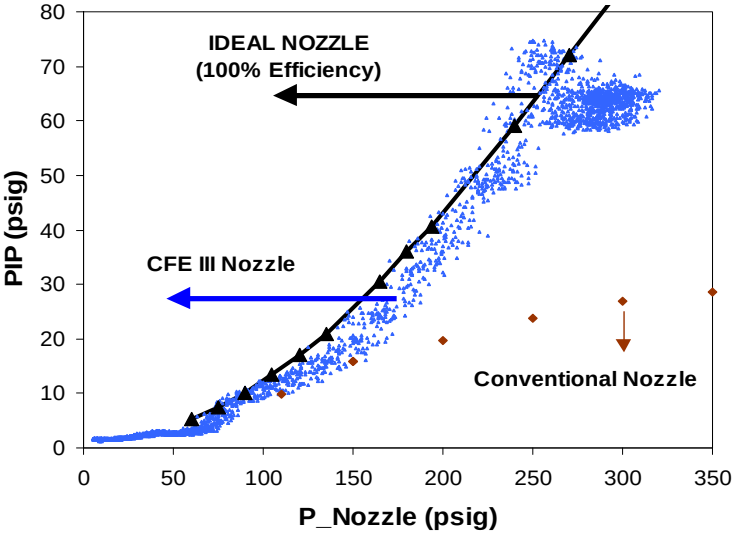
High Performance CFE Nozzles





CFEIII



Test Results from
Georgia Institute of Technology

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Performance Monitoring Department

- Focused on optimizing your boiler performance
- Remote or On-site Monitoring & Tuning
- Management Reports
- Full Training

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Clyde Bergemann's SMART Clean Projects in the World

216 Boilers

- **182 Coal, Waste Heat, Biomass Fired Boilers**
- **34 Pulp & Paper Recovery Boilers**

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Fleet Wide Results

- Clyde Bergemann has 34 SMART Clean installations in the Pulp and Paper Industry.
- The oldest system has been in closed loop operation since 2004.
- Implementation of CFEIII nozzle and SMART Clean technologies resulted with consumption ~ 2.5% MCR.
- Average payback period is < 9 months

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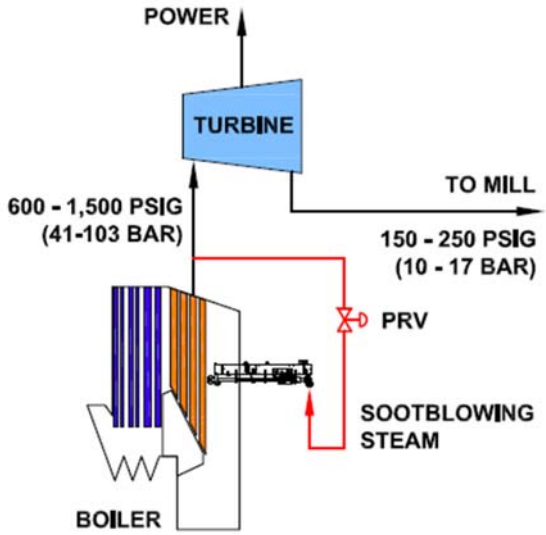
Steam Saver Sootblowing Technology

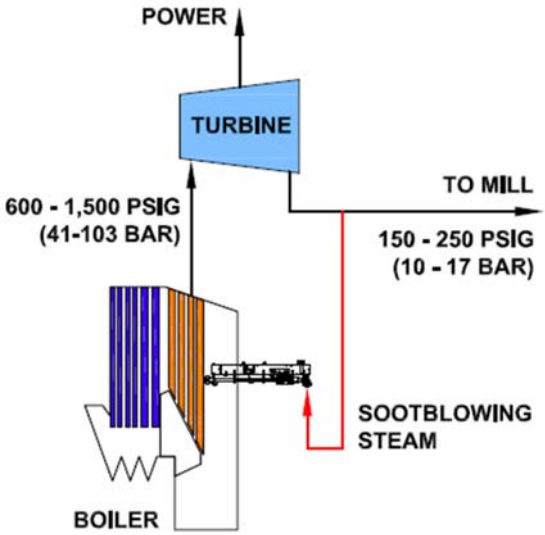
- Cleans with lower pressure steam source
- Typically generates 1-3 MW additional power

High Pressure Steam = $17/T



High Pressure Source

Low Pressure Steam = $9/T



Low Pressure Source

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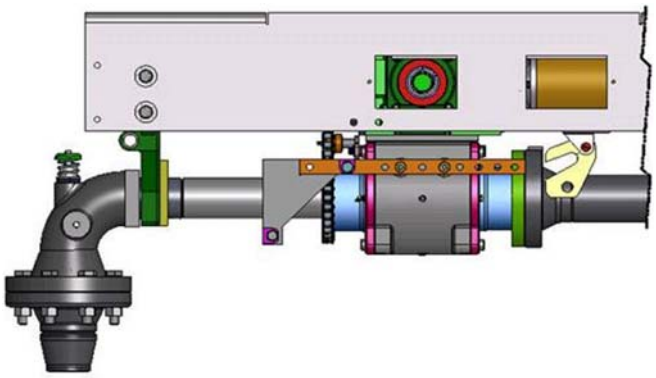
Steam Saver Sootblowing Technology

DESIGN GOALS

Minimize Pressure Drop

1. **Larger Diameter Poppet Valve**
2. **Larger Diameter Feed Tube**
3. **Larger Diameter Lance Tube**

High Nozzle Efficiency: 1 1/4" – 1 3/4" (32mm – 44.5mm) CFEIII



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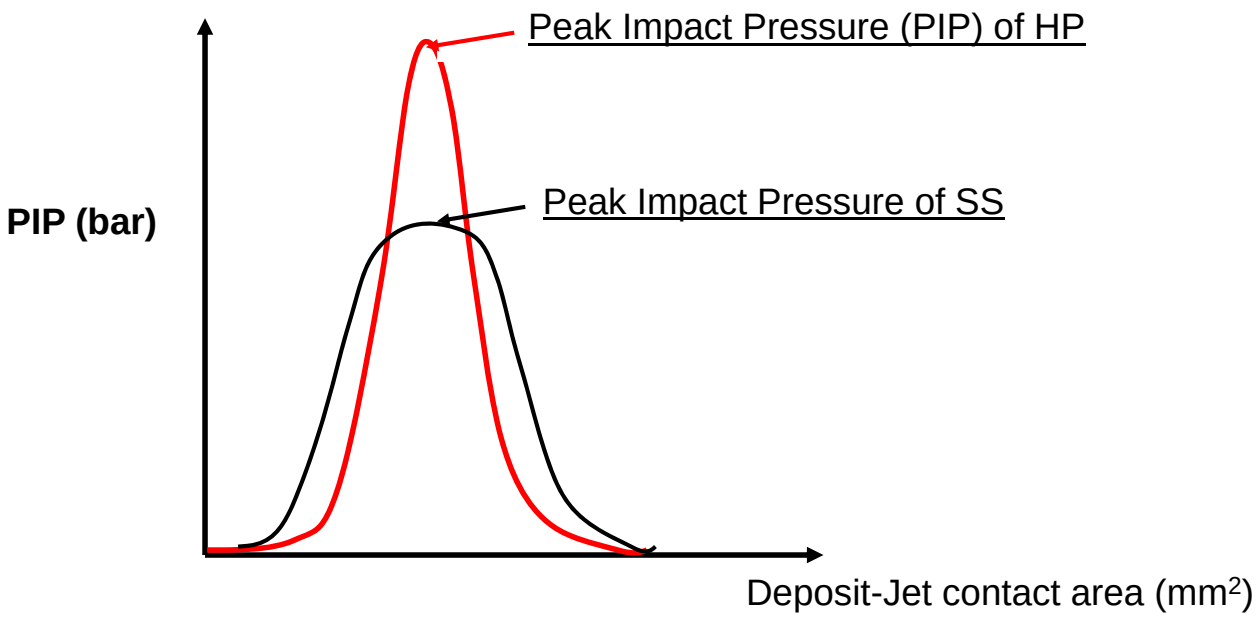
SS vs HP: A comparison



- PIP of HP is higher than the PIP of SS, but the area under the curve (which is force) of HP and LP are made comparable.

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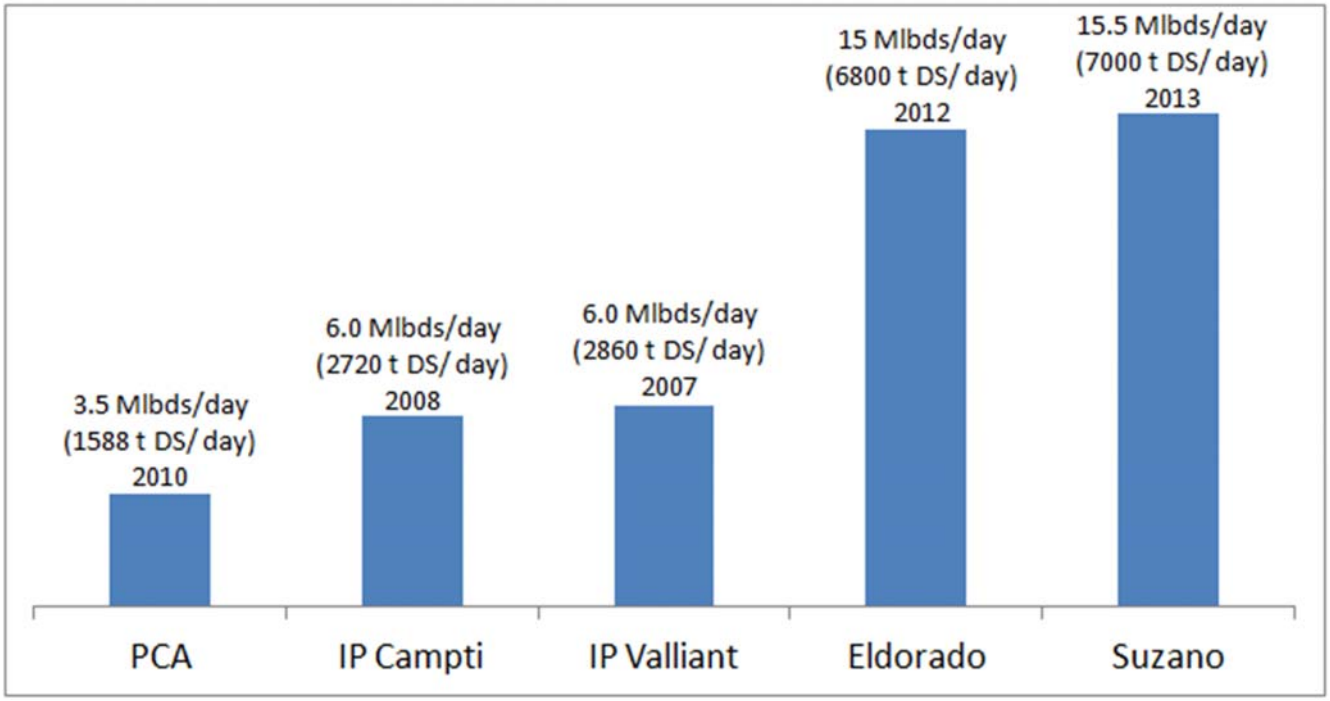
Steam Saver Sootblower Installations



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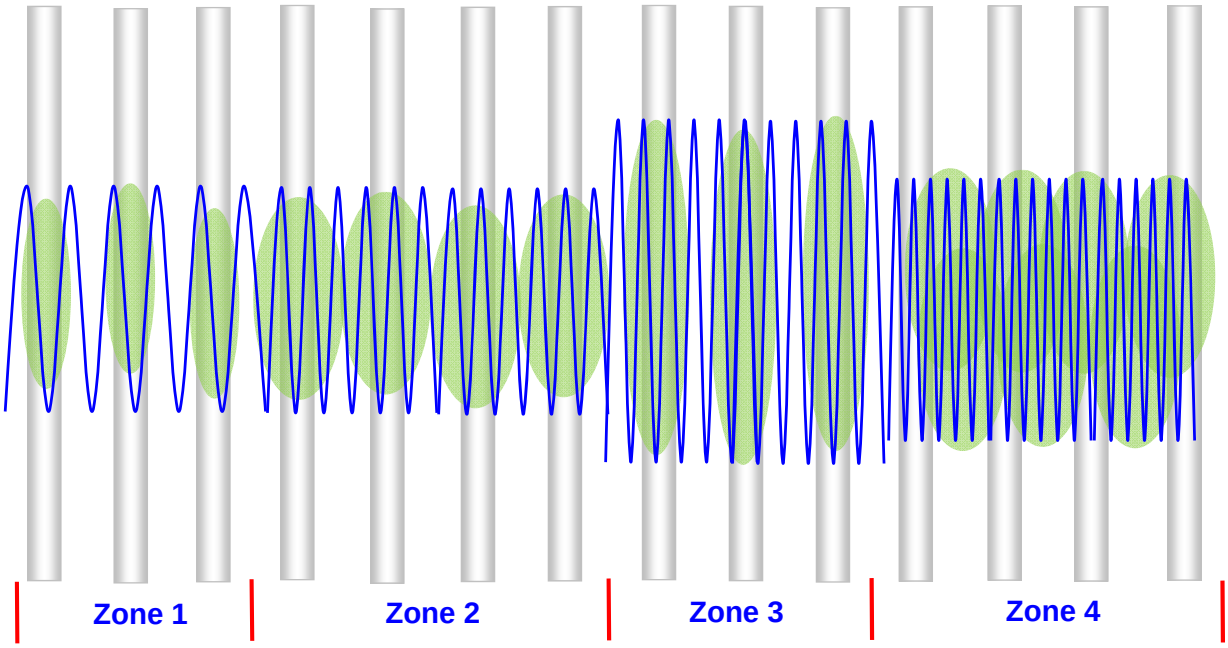
Dealing With Forced Outages

Cleaning Intensities



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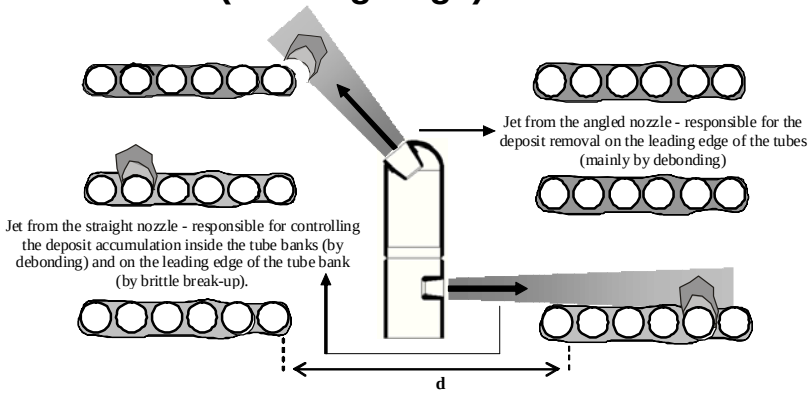
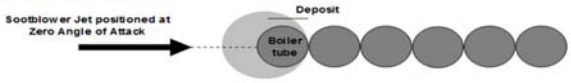
Dealing With Forced Outages

CFEIII-LE (Leading Edge)

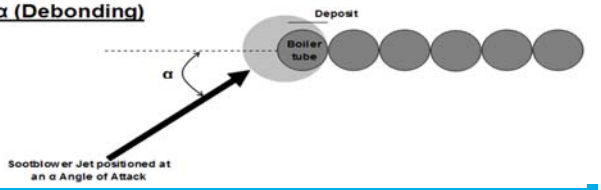


Principles

- Zero α (Brittle Break up)



- Non Zero α (Debonding)



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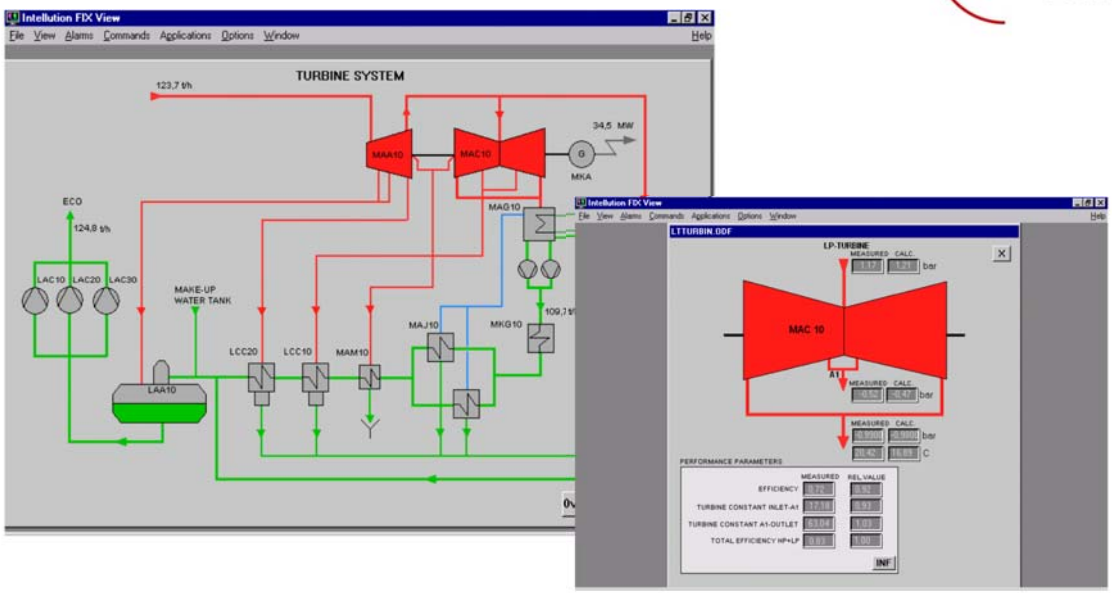
Steam turbine performance monitoring



In steam turbine performance monitoring the reference state is calculated using accurate turbine model. Model tells how turbine should work in different load points. This simulation calculation is compared to turbine measurements.

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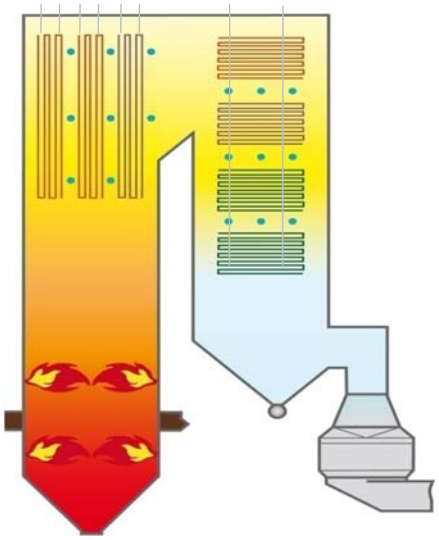
SMART CONVECTION - Diagnostics

Thermo Dynamic Model (**TDM / PHR**)

- Calculates in real-time depending on boundary conditions and process data:
  - ➔ Fuel and flue gas mass flow
  - ➔ Heat transfer coefficient of each heating surface incl. “Cleanliness Factor”
  - ➔ Flue gas temperature profile in different levels
  - ➔ Boiler heat capacity and efficiency calculation
- Criteria controlled soot blower request
- Efficiency optimization of main plant components



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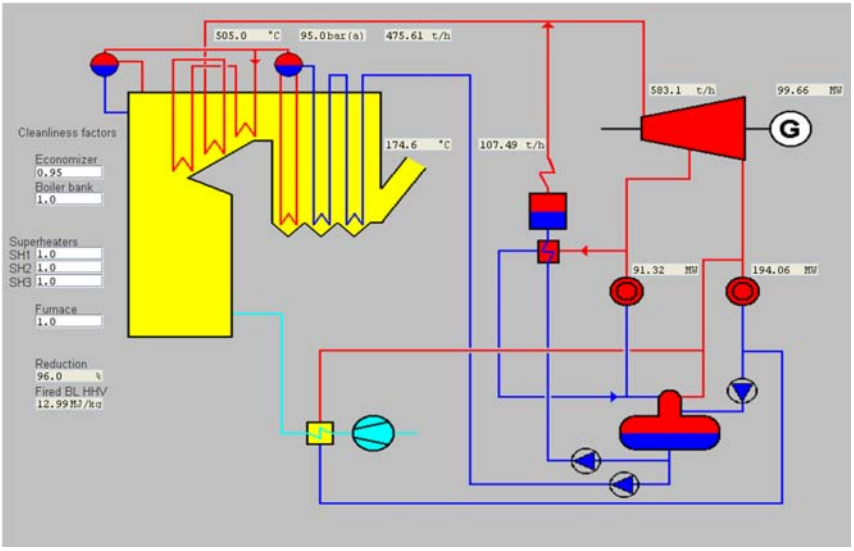
Power plant simulation

Power plant simulation can be used by operators and plant engineers.



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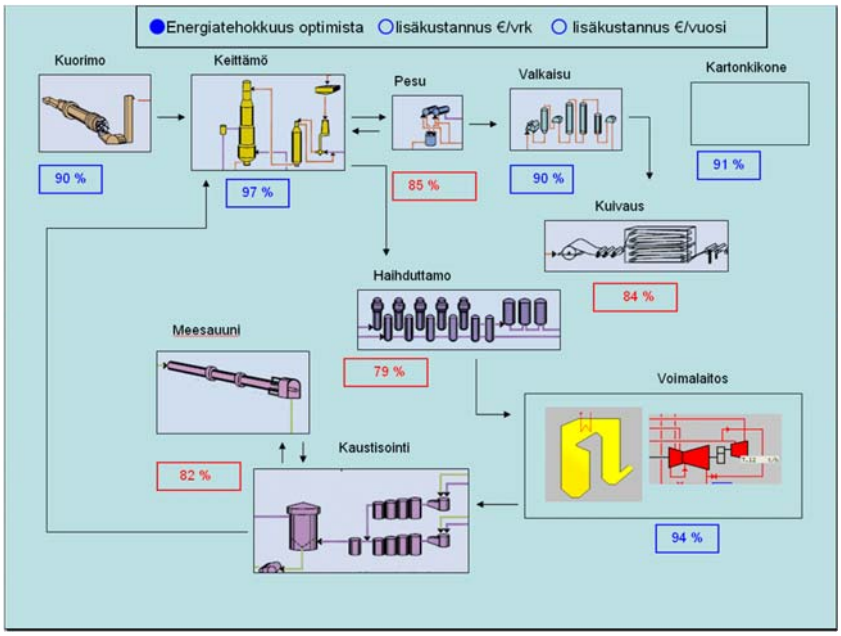
Energy consumption of kraft mill

Heat and power consumption at each department and benchmarking.



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Reporting

60 minutes average values for all data related to:
operational costs,
availability,
environmental reporting,
equipment condition,
Data is stored in a database, where from needed hour, day, week, month and year reports produced.

Utilization (%)	62 %	75 %	90 %	94 %	94 %	91 %	67 %	96 %	95 %	81 %	80 %	52 %
Operational time (%)	69 %	74 %	87 %	89 %	99 %	94 %	72 %	90 %	99 %	94 %	86 %	55 %
CEOS active of full load time (%)	69 %	89 %	92 %	100 %	61 %	99 %	75 %	74 %	95 %	100 %	45 %	99 %
Average combustion (MW)	1466	1794	2103	2106	2202	2121	1570	2260	2008	1699	1605	1005
Electricity produced (TWh)	1547	1757	2244	2264	2362	2202	1663	2410	2293	2024	1927	753
average (MW)	570	701	839	873	882	849	621	900	885	755	743	404
District heating (TWh)												
average (MW)												
Total production (TWh)	1547	1757	2244	2264	2362	2202	1663	2410	2293	2024	1927	753
Coal burned (kton)	332.7	384.1	452.5	471.7	505.5	465.7	359.4	500.5	470.1	417.7	405.3	159.8
average (kg/s)	124.2	153.3	169.2	182.0	188.7	179.7	134.2	186.9	184.4	155.7	156.4	102.8
Oil burned (ton)	302.4	249.2	46.3	44.0	47.4	45.0	343.3	48.2	45.9	150.2	154.8	434.9
average (kg/s)	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.3
Plant efficiency (%)	39.4	39.1	39.9	40.0	40.0	40.0	39.5	39.8	44.1	44.4	44.7	44.6
Boiler efficiency (%)	88.8	89.5	89.1	89.2	89.1	89.1	89.2	89.4	89.2	88.9	89.1	89.2
Grid												
Average target output (MW)												
Average error in production (MW)												
Ambient												
Inside temperature (°C)	42.7	39.8	45.9	43.7	45.0	45.7	44.2	42.0	46.1	44.2	43.3	42.4
Outside air temperature (°C)	4.5	5.8	9.1	10.9	17.2	17.1	20.2	21.3	16.8	10.8	7.7	5.2
Relative humidity (%)												
Coal												
LHV (MJ/kg)	10.1	11.0	11.0	11.0	11.0	11.0	11.0	11.0	10.8	11.0	10.8	10.8
Moisture (%)	54.35	51.00	51.00	51.00	51.00	51.00	51.00	51.03	51.64	50.80	51.54	51.56
Boiler												
Boiler efficiency % (indirect method)												
Flue gas losse	167.2	169.8	161.7	169.4	174.9	170.2	168.1	171.2	181.5	161.0	177.1	182.1
Unburnt in ash	5.4	5.6	5.3	5.6	5.7	5.6	5.6	5.8	6.0	5.4	5.9	6.0
Radiation losses	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Boiler efficiency % (direct method)												
Coal consumption (TJ)	3345	4216	4966	5178	5548	5111	3945	5488	5163	4607	4388	1730
Oil consumption (TJ)	13	11	2	2	2	2	15	2	2	6	7	19
Coal burned per TWh (ton/TWh)	215.1	218.7	201.6	208.4	214.0	211.5	216.1	207.7	208.5	206.4	210.4	212.2
Heat in combustion air MWh												

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Clean Energy Solutions

SUOMEN SOODAKATTILAYHDISTYS RY
RAPORTTISARJA

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Konemestaripäivä 26.1.2012, esitelmät
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(16A0913-E0130) 26.1.2012

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Soodakattila-alan yhteistoiminta
Vuosikertomus 2011
(16A0913-E0131) 29.3.2012

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Lappeenrannan teknillinen yliopisto
Marcelo Hamaguchi, Esa Vakkilainen
(16A0913-E0133) 25.6.2012

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Nikolai DeMartini, Niklas Vähä-Savo
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Savukaasuräjähdys soodakattilassa
Janne Pesonen
(16A0913-E0137) 28.8.2012

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Scandic Tampere City hotelli, Tampere
(16A0913-E0138) 25.10.2012

10/2012 Suomen Soodakattilayhdistys ry
Mustalipeän viskositeetti
Labtium Oy
(16A0913-E0139) 29.11.2012

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(16A0913-E0140) 24.1.2013