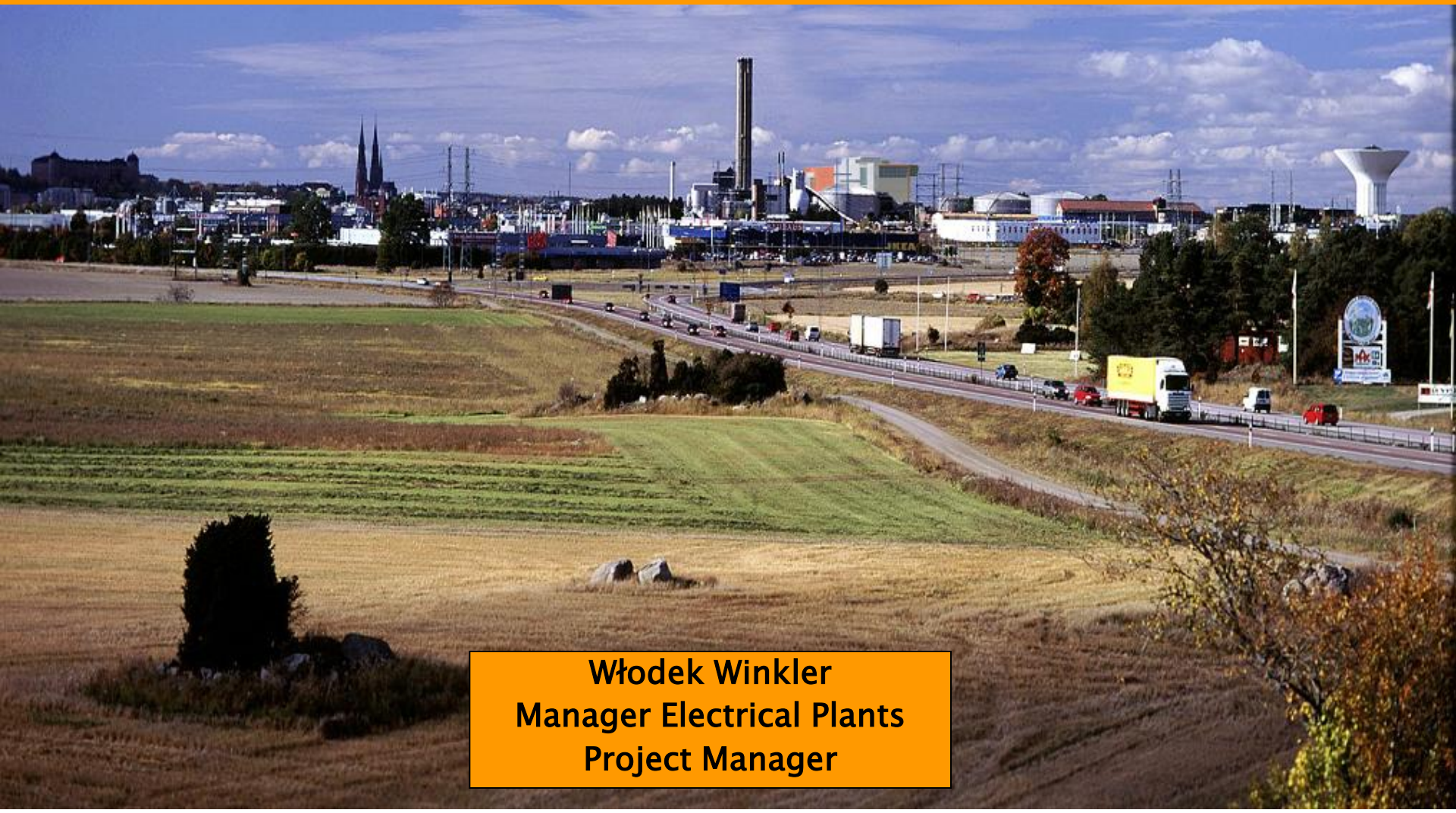
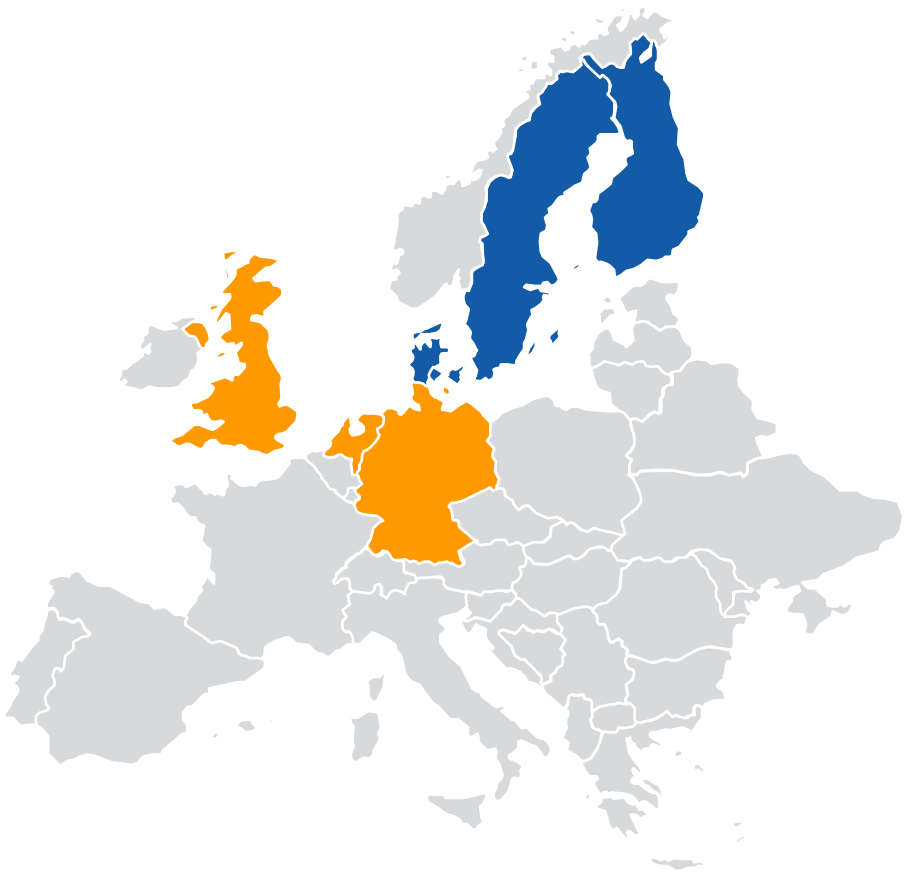
Vattenfall AB Heat Generation Uppsala
Major Overhaul 200 MW Turbine; OEM vs Non-OEM



Włodek Winkler
Manager Electrical Plants
Project Manager

VATTENFALL

This is Vattenfall



- One of Europe's largest electricity producers
- 100%-owned by the Swedish state
- Main markets:
  Nordic countries, Germany, Netherlands
- Vattenfall also has operations in:
  UK (mainly within wind power)
- Main products:
  Electricity, Heat, Gas
- Operations span the entire energy value chain:
  Production, Distribution, Trading, Sales and energy advice

Vattenfall Heat in Sweden

The district heating plants in Sweden owned by Vattenfall

Uppsala is the largest plant and with 240 employees including maintenance and service

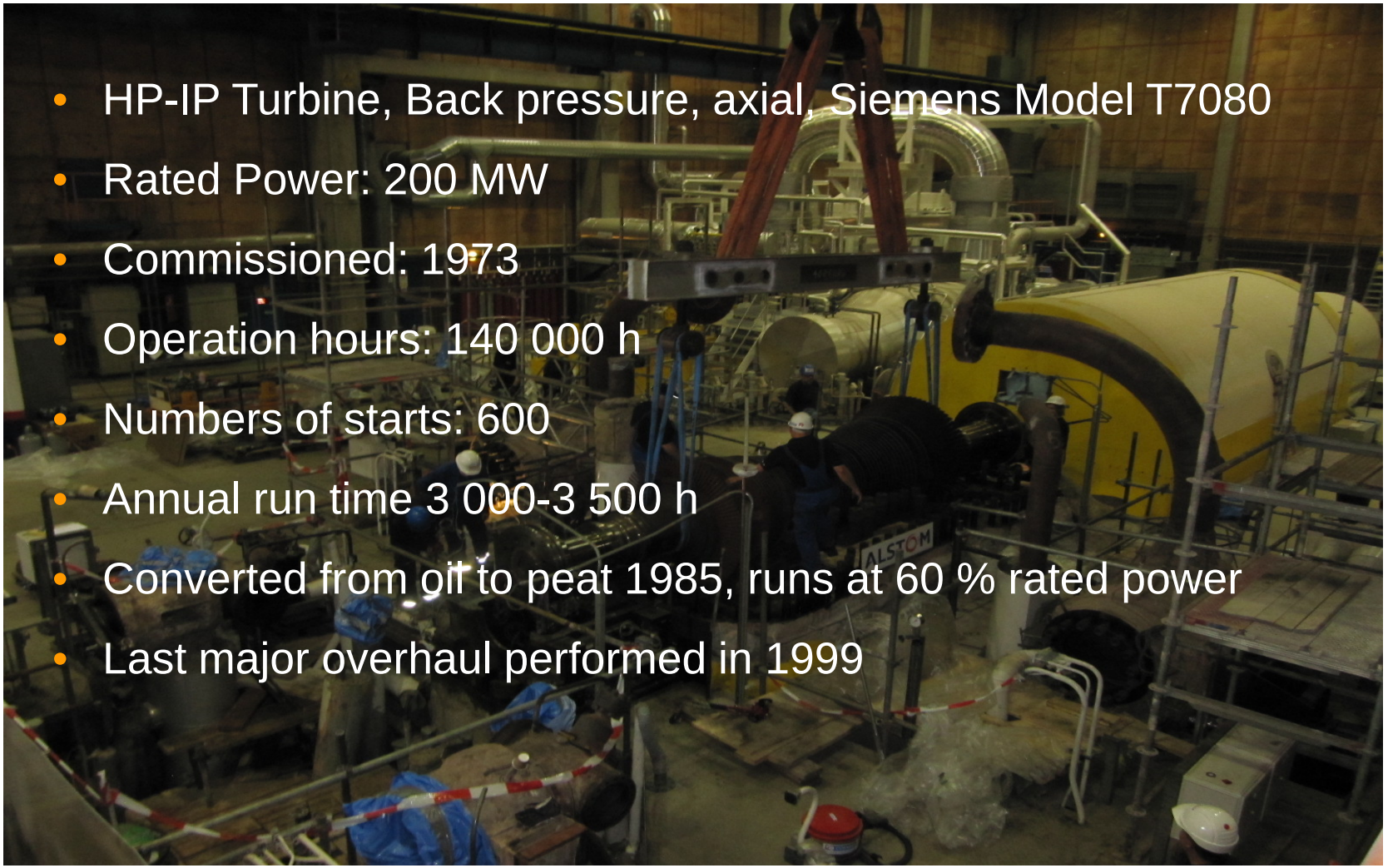
VATTENFALL

Some basic facts Vattenfall Heat Uppsala

- Co-workers 200
- Production 1 900 GWh
- Grid (heat, cooling, steam) 500 km
- Turnover 1 400 MSEK
- Investments (since 2000) 2 900 MSEK

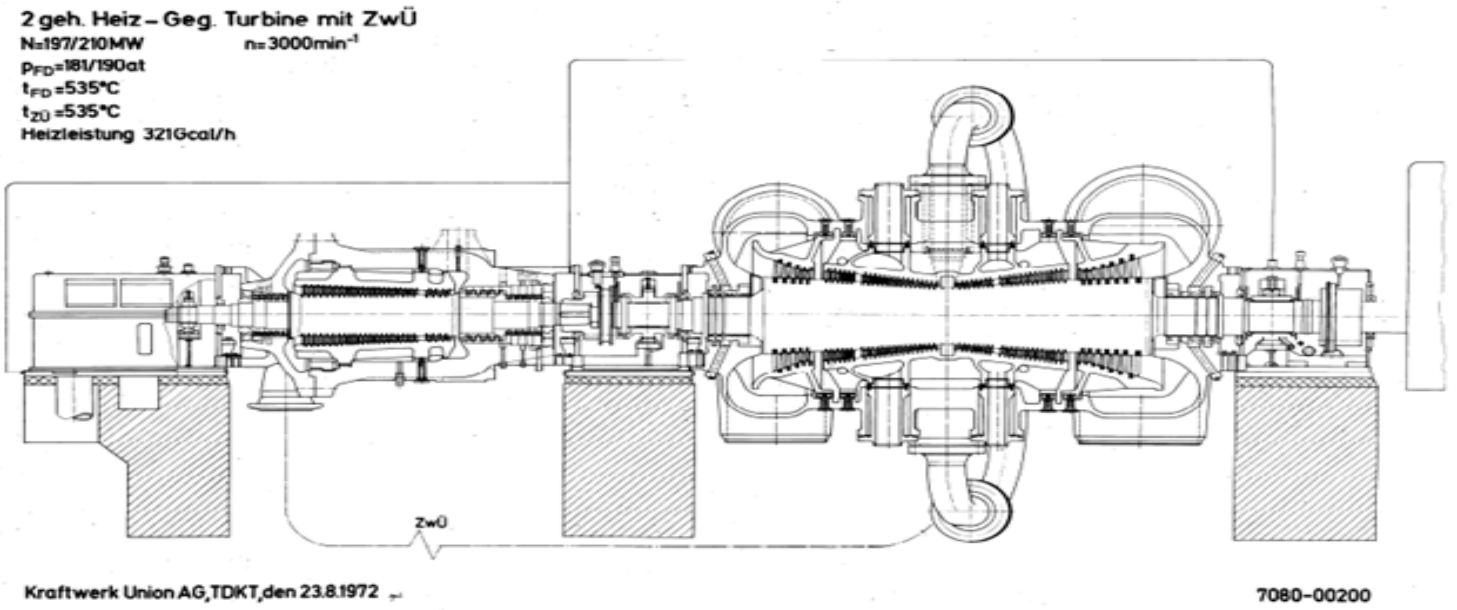
VATTENFALL

Turbine data



- HP-IP Turbine, Back pressure, axial, Siemens Model T7080
- Rated Power: 200 MW
- Commissioned: 1973
- Operation hours: 140 000 h
- Numbers of starts: 600
- Annual run time 3 000-3 500 h
- Converted from oil to peat 1985, runs at 60 % rated power
- Last major overhaul performed in 1999

Turbine Design



VATTENFALL

Remaining Lifetime Study

- Major steam turbine components of conventional power plants like Uppsala T7080 are exposed to creep damage and low cycle fatigue, which grow continuously over the operating period.
- This remaining lifetime analysis for the HP and IP turbine rotors is intended to derive a recommendation, if the inlet and first blade grooves should be machined during the major outage planned for 2013.
- An operation until 2020 with finally 165,000 operational hours and 616 starts is planned for the steam turbine.

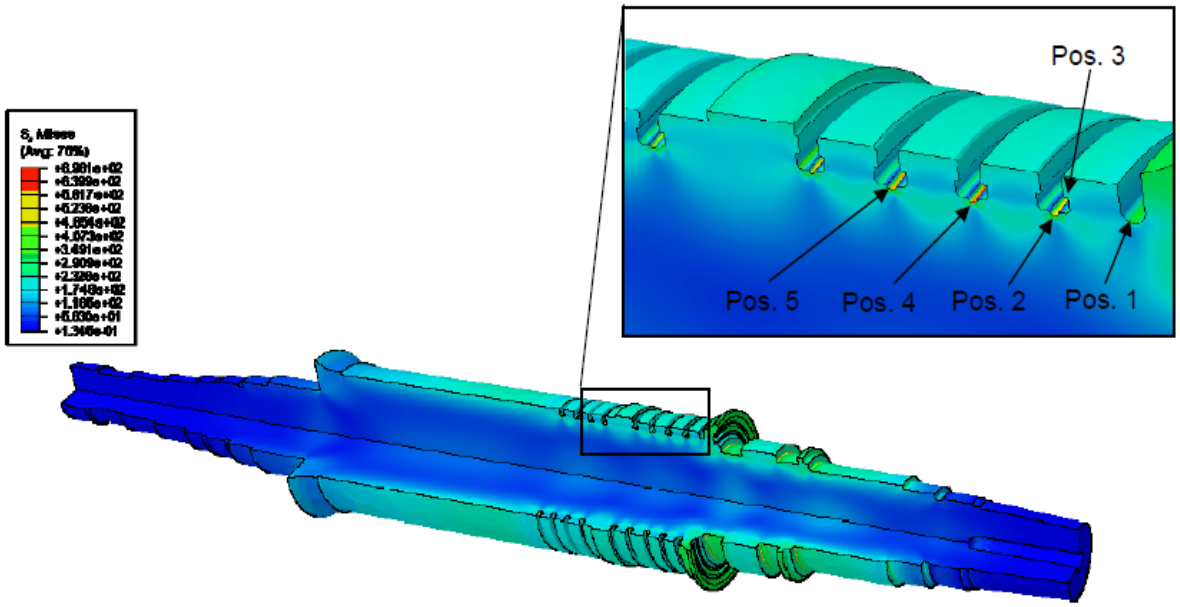


Figure 9: Stress concentrations during cold start and relevant locations for fatigue of HP rotor

Criteria of Evaluation, OEM vs Non-OEM

- Price 35%
- Engineering expertise 20%
- References 20%
- Supply of spare parts 15%
- Terms and conditions 10%

	Low cost offer	High cost offer	Expected offer	U-Supplier	V-	W-	X-	Y-	Z-
General	A1	A1	A1						
Valves	4.7.1	4.7.1	4.7.1						
Oil	4.7.3	4.7.3	4.7.3						
Cleaning of oil cooler	4.7.4	4.7.4	4.7.4						
IP Blades		4.7.5							
HP Blades		4.7.6							
Tools	4.7.7	4.7.7	4.7.7						
Low speed									
High speed		4.7.9							
In situ balancing		4.7.10	4.7.10						
Rotor labyrinths		4.7.11	4.7.11						
Bolts outer		4.7.12							
Bolts inner		4.7.13	4.7.13						
Two new spindles		4.7.14							
Complete manning	4.7.15	4.7.15	4.7.15						
Spare parts	4.7.16	4.7.16	4.7.16						
Commissioning	4.7.17	4.7.17	4.7.17						
Documentation	4.8	4.8	4.8						
Resor och hotell									
Sum				€	€	€			

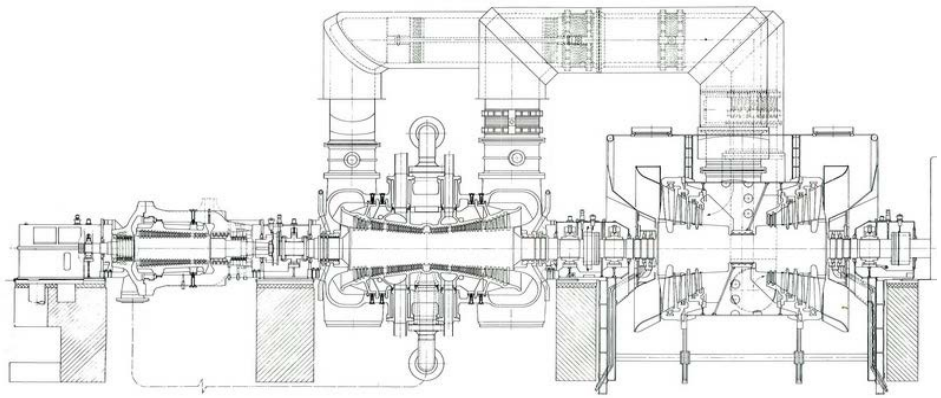
Scope of Major Overhaul

- HP Major Overhaul in ALSTOM workshop in Berlin
- IP Major Overhaul on Site
- HP Stop and control valve Overhaul on Site
- IP Stop and control valve Overhaul on Site
- Overhaul Hydraulic control components in ALSTOM work shop in Mannheim
- Commissioning

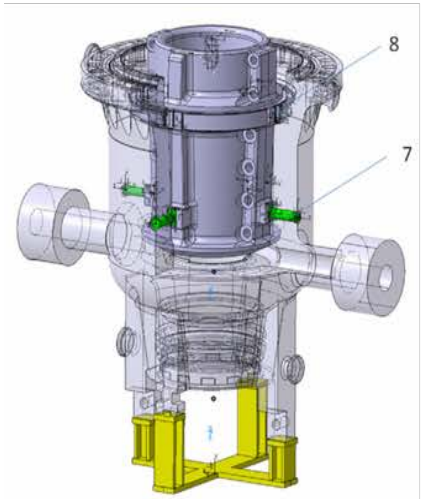
ALSTOM purchased a retired turbine for development and training

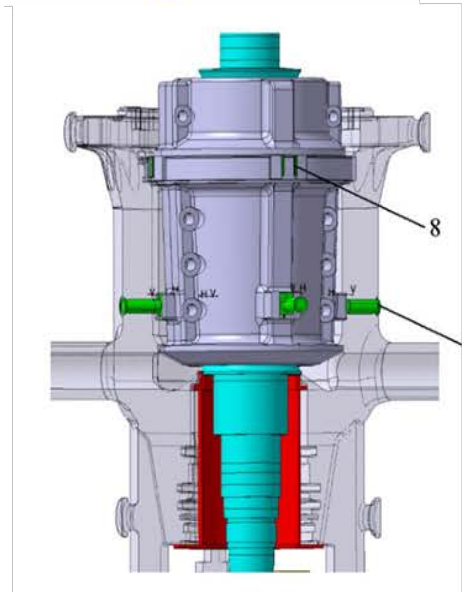
To develop and ensure the capability to maintain this specific barrel type HP turbine ALSTOM purchased a retired turbine from a sister plant in Norrköping (Bråvalla)

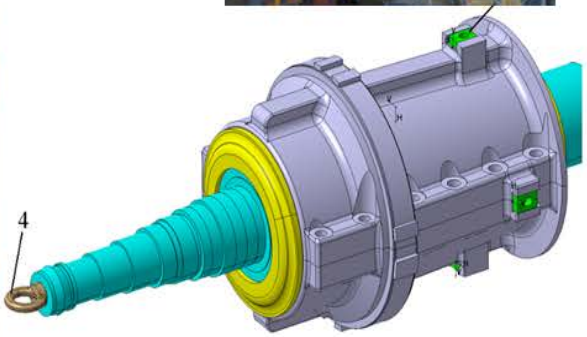
- Build up know how for the special assembly and disassembly process of barrel type turbines
- Train Field Service personnel for Erection and TFA in Berlin
- Reverse engineering



Virtuell as well as physical assembly training on the barrel type HP turbine

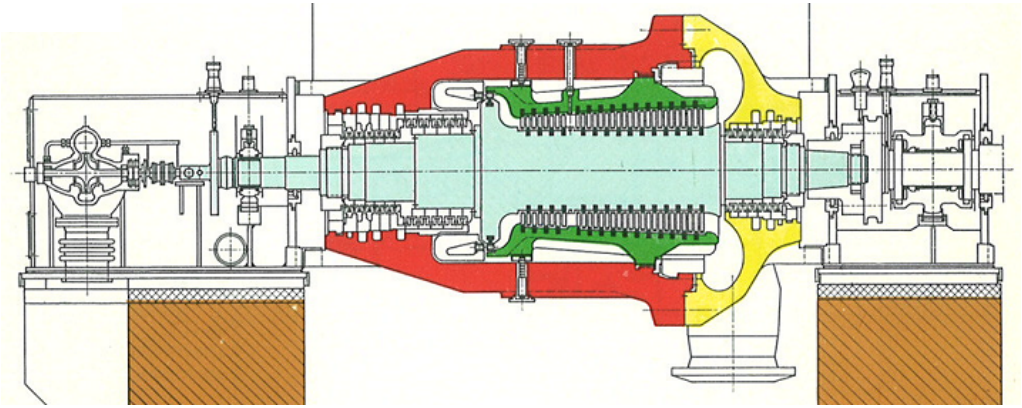


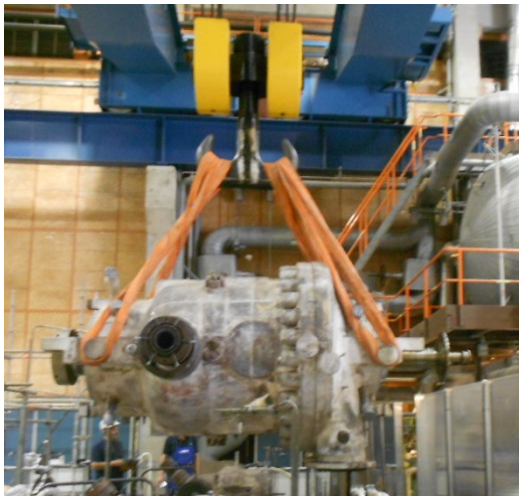




VATTENFALL

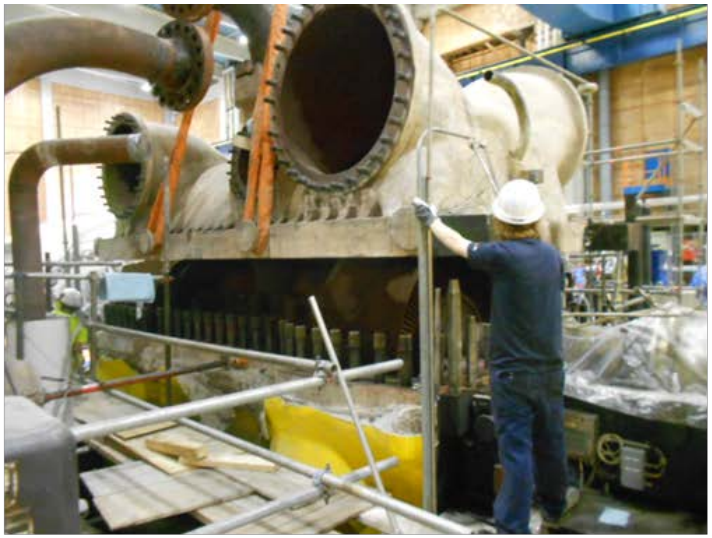
The HP Turbine of barrel type was overhauled in Alstom service workshop in Berlin

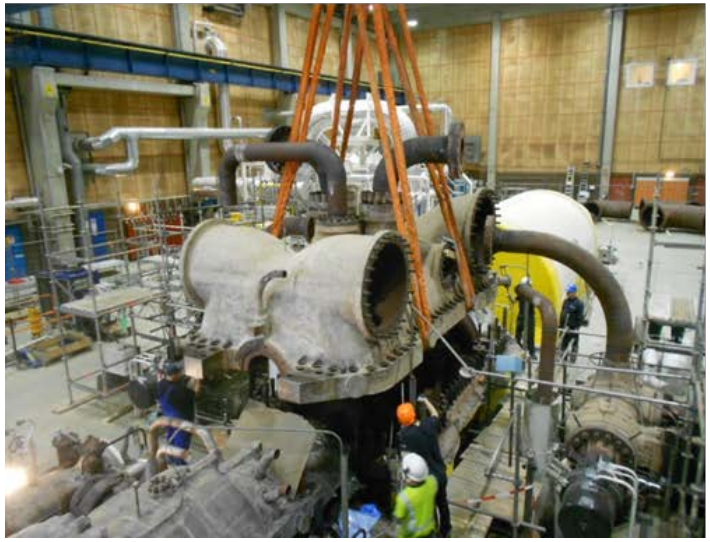




VATTENFALL

Overhaul of the MP turbine and main steam valves at the site in Uppsala





VATTENFALL

Cracks, outer turbine casing, HT

Prüfprotokoll *Test Certificate*	Titel / Title Protokoll - Anlage *certificate - enclosure*	Prüfberichts Nr. / *Test rep. No.*: **902 / 13** **Rev.** - TÜV-Abruf 226 / 13 **FA** 742127 **AG** 350

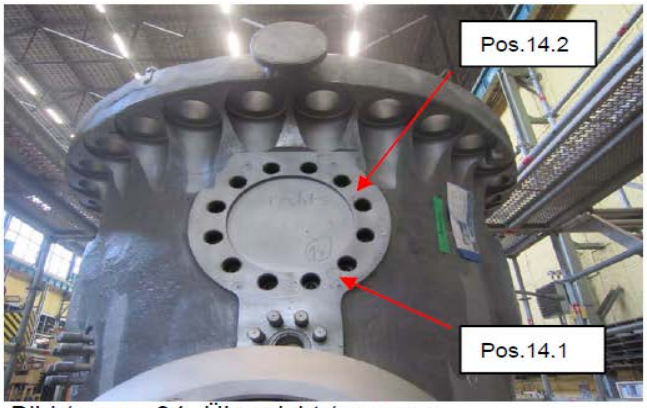


Bild / *pict.* 34 Übersicht / *overview*
rechts / *right*

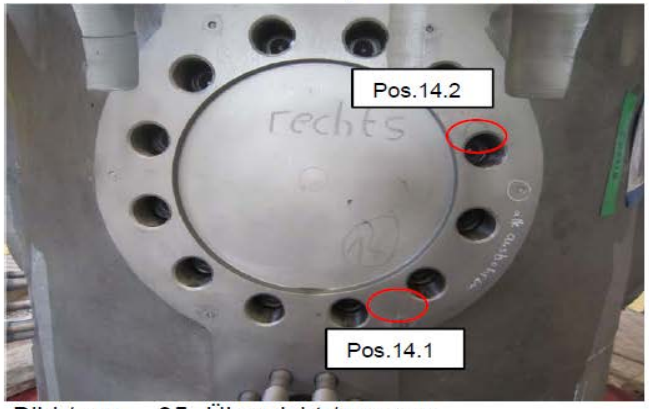


Bild / *pict.* 35 Übersicht / *overview*
rechts / *right*

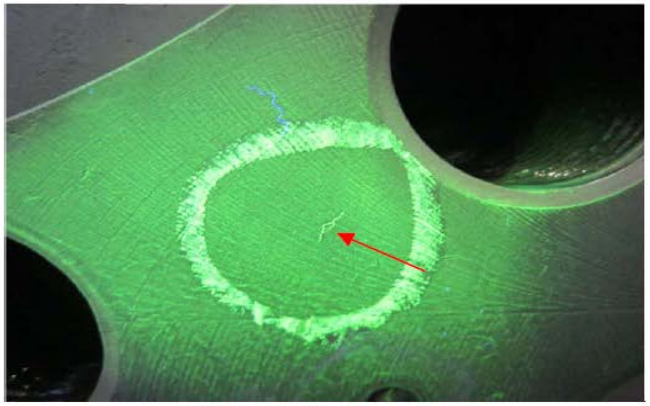


Bild / *pict.* 36 Detail / *detail* Pos.14.1
lineare Anzeige 10mm
linear indication 10mm

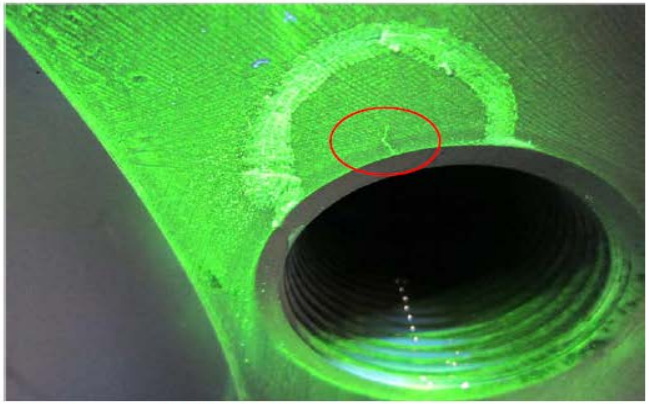


Bild / *pict.* 37 Detail / *detail* Pos.14.2
lineare Anzeige 6mm
linear indication 6mm

VATTENFALL

Cracks, inner turbine casing, HP

Prüfprotokoll *Test Certificate*	Titel / Title: Protokoll - Anlage *certificate - enclosure*	Prüfberichts Nr. / *Test rep. No.*: **936 / 13** Rev. - TÜV-Abruf 226 / 13
		FA 742128 **AG** 350

Bild / *pict.* 7 Übersicht / *overview* Pos.4

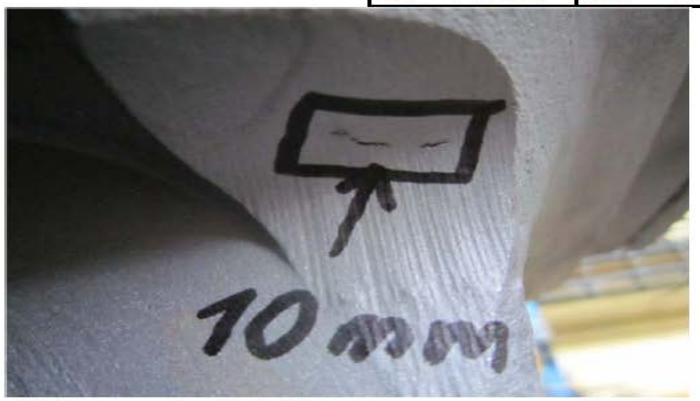


Bild / *pict.* 8 Detail / *detail* Pos.4
lineare Anzeige 10mm (mit Unterbrechung)
linear indication 10mm (with interruption)

Bild / *pict.* 9 Übersicht / *overview* Pos.5
Lunkerfeld auf Teilfuge links
blow hole on casing joint left

Bild / *pict.* 10 Detail / *detail* Pos.5
Lunkerfeld Ø 25mm mit Einzelanzeigen 1-5mm
blow hole Ø 25mm with single indications 1-5mm

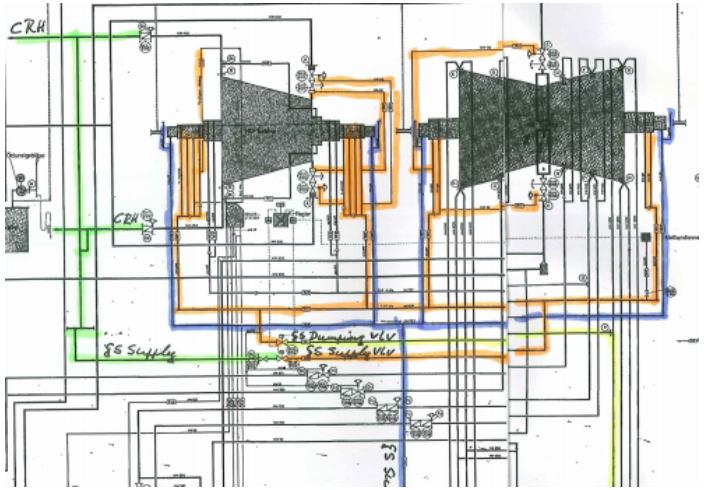
VATTENFALL

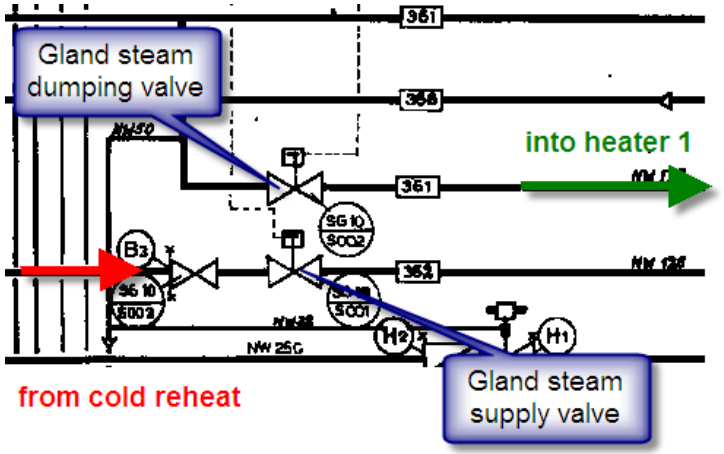
Specification, agreement and cost control of the rectification of findings occurred during the overhaul

Summary of additional costs for Uppsala Major Overhaul 2013

	July 3rd	Oct 25	delta
	Prize in SEK	Prize in SEK	Prize in SEK
Additional work on site	**549 400**	**919 800**	**370 400**
Oil system	26 400	54 400	28 000
HP Turbine	33 000	56 000	23 000
IP Turbine	365 000	237 000	-128 000
Pedestals	22 000	105 000	83 000
HP Valves	33 000	35 000	2 000
IP Valves	70 000	63 000	-7 000
Mobile machining	0	106 200	106 200
Additional work on site 346 h	0	263 200	263 200
Additional work in Berlin	**1 300 000**	**1 500 000**	**200 000**
			0
Additional work in Mannheim hydraulic test field	**200 000**	**200 000**	**0**
			0
Oil flushing	**300 000**	**0**	**-300 000**
Parts	**200 000**	**420 000**	**220 000**
Total additional cost	**2 549 400**	**3 039 800**	**490 400**

Throuble shooting of a steam leakage problem occured after a few weeks of operation





- Steam leakage at the HP main steam emergency safety valve as well as at the MP turbine shaft sealing glands
- Several trouble shooting activities revealed a problem with a gland steam dumping valve

Documentation of the overhaul

Oil System Overhaul	1
Steam Turbine Overhaul at site	2
Hydraulic control system Overhaul	3
Steam Turbine Overhaul in Berlin Work Shop	4
Hydraulic Control System Component Overhaul in Mannheim	5
Commissioning Report	6
Readings before and after the Overhaul SAT	7
Lessons Learned	8
	9
	10

Lessons learned meeting

The aim of this meeting was to identify lessons learned during the execution of the project during:

- EHS
- Project management and overall communication
- Purchasing and tendering
- Preparation of the overhaul
- Overhaul on site
  - EHS
  - Resources: Quality/Quantity
  - Subcontractors
  - Schedule
- Overhaul in Berlin
- Overhaul in Mannheim
- Cold commissioning
- Restart
- Handling of additional work

Vattenfall AB Heat Generation Uppsala
Major Overhaul 200MW Turbine; OEM vs Non-OEM

VATTENFALL