”Högre ångdata vid biobränsleeldning – Nytt forskningsprogram”

Lars Wrangensten,
Programområdesansvarig El- och Värmeproduktion samt Kärnkraft
ELFORSK

KME

KME – Consortium Material technology for development and demonstration of thermal Energy processes, 2010-2013

- **KME**, was established in 1997, today consisting of 7 industrial companies including Elforsk. Elforsk is representing 18 Swedish energy companies.
- All KME-projects are performed as a cooperation between industries and universities or institutes. This is an important task for KME, a close cooperation between these organisations.
- Budget 103 MSEK (10 Milj €) in 4 years of which the contribution from Swedish Energy Agency (Swedish State) is 40 % through Elforsk. The companies can contribute with in-kind resources or cash.
- The programme is supervised by a board with representatives from the stakeholders. Elforsk is responsible for programme administration.

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KME 2010-2013
Participating companies

- AB Sandvik Materials Technology
- Energi-företagen via Elforsk AB*)
- Sandvik Heating Technology AB
- Metso Power
- Outokumpu Stainless AB
- Siemens Industrial Turbomachinery AB
- Volvo Aero
- Swedish Energy Agency

***) Elforsk represents:**

AB Fortum Värme samägt med Stockholm stad
Dong Energy A/S
ENA Energi AB
E.ON Climate and Renewables
E.ON Värme Sverige AB
Eskilstuna Energi och Miljö AB
Falu Energi & Vatten AB
Göteborg Energi AB
Kraftringen Produktion AB
Mälarenergi AB
Skellefteå Kraft AB
Svensk Fjärrvärme AB
Söderenergi AB
Tekniska Verken i Linköping AB
Umeå Energi AB
Växjö Energi AB
Vattenfall AB
Öresundskraft AB

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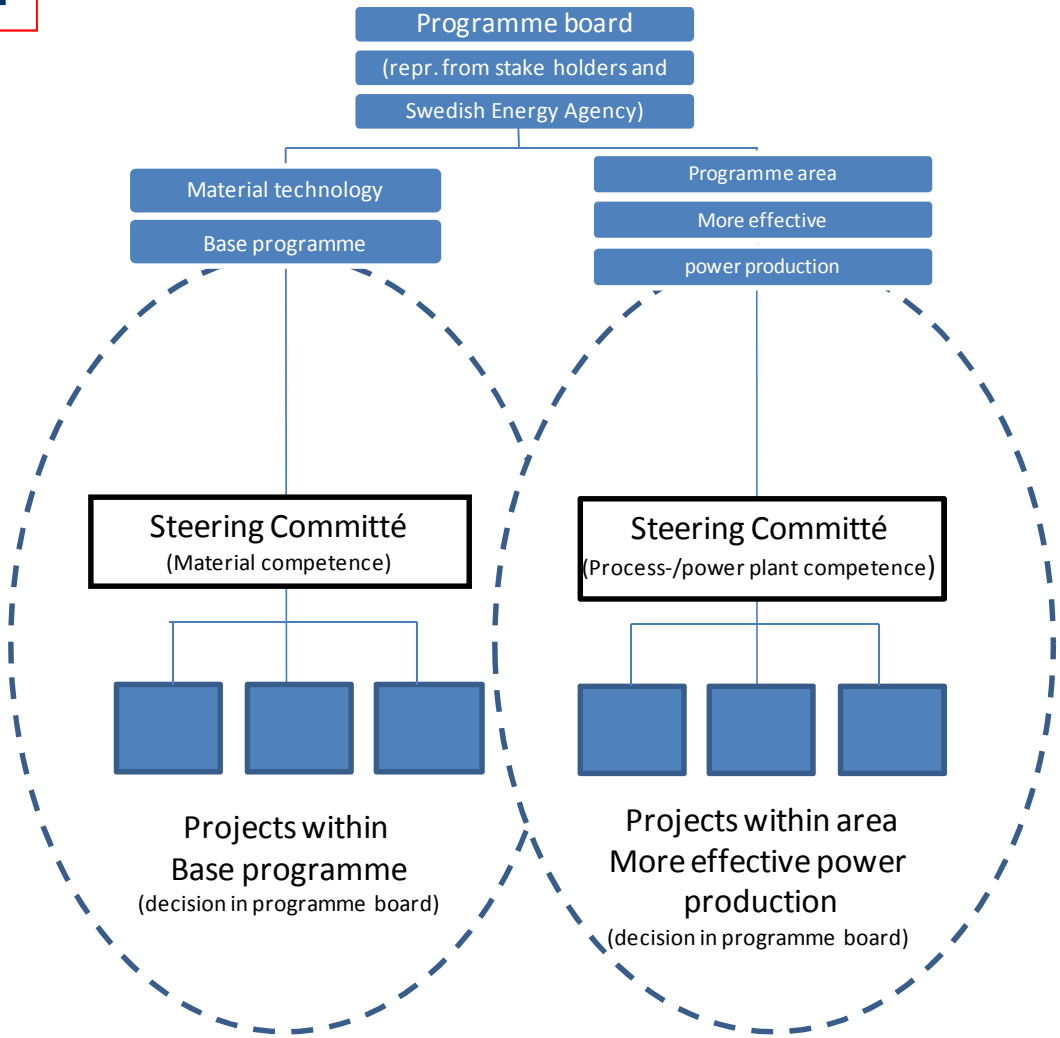
Programme
area and organisation:

KME – Consortium Material technology for development and demonstration of thermal Energy processes, 2010-2013



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KME 2010-2013 Budget:

Projektbudget, 4 år, MSEK	Materialtekn. Basprogram	Programomr. Eff. elproduktion	Totalt:
Summa:	**54,9**	**48,6**	**103,5**

Industriföretag, 60%	62,5
Energimyndigheten, 40 %	41

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Vision and goal for KME-programme:

Vision with the programme 2010-2013:

The long-term vision with the programme is that by material technology development improve electrical efficiency and overall (combined heat and power, CHP) efficiency when utilising climate neutral fuels in thermal energy conversion processes. The aim is more effective power and heat production with high fuel flexibility and also to improve utilisation of limited fuel sources and heat sinks for CHP as well as to reduce environmental impact.

The long-term vision includes an erection of a new full scale demonstration CHP plant in 2017-2018, fired with renewable bio fuels and refuse fractions, with at least 3-4 % (percentage points) higher electrical efficiency, compared with commercial plants that has been built today.

Overall programme goal:

The programme will contribute to the conversion to a sustainable energy system by development of more effective energy processes. As for previous KME-programmes will HTC (Competence center for high-temperature Corrosion) be a knowledge base and a programme partner.

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Goals for this programme period:

- ✓ Presentation of technical solution for a commercial feasible reference power plant (RPP) as a basis for the demonstration plant.
- ✓ Deeper understandning and knowledge of material process solutions to prevent super heater and furnace corrosion with advanced steam data. Material pilot tests in existing boilers with at least 50 °C higher steam temperature than today will be performed.
- ✓ Lab tests to appoint mechanisms affecting material life time during new advanced steam data requirements. Creeping, cracking etc. of new design materials for the demonstration will be studied.
- ✓ Exposure tests with partly new boiler super heater materials and compare them with results from cooled material probe tests.
- ✓ Exposure tests with new alumina forming FeCrAl materials and explore the possibilities for future use.
- ✓ Development of improved analysis methods to determine weldability of Ni – based super alloys.
- ✓ To show that conventional materials can be joined by welding with high temperature materials in order to get more cost effective solutions.

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Goals for this programme period (cont.):

- ✓ Integration between a new KME-project and the international welding project Weldmat for increased knowledge base. The plattform for this work is results from earlier KME-projects.
- ✓ Validation of materials and surface coatings for coming industrial gas turbine plants optimised for requirements concerning efficiency and robust design (availability and long technical life time). Components must be qualified for machinery tests in 2013.
- ✓ Continue to build networks between industry and universities;
  - ❑ Contribute to introduction of new associate professors at universities
  - ❑ Project participation from post-PhD:s, if possible full- or part time employed at one of the industry stake holders.
  - ❑ At least two licentiate thesis and two PhD:s will graduate during the programme period with financial support from the KME-programme.
  - ❑ At least one degree thesis yearly will be supervised by an industrial stake holder during the programme period.
  - ❑ Project cooperation with at least one international leading university.

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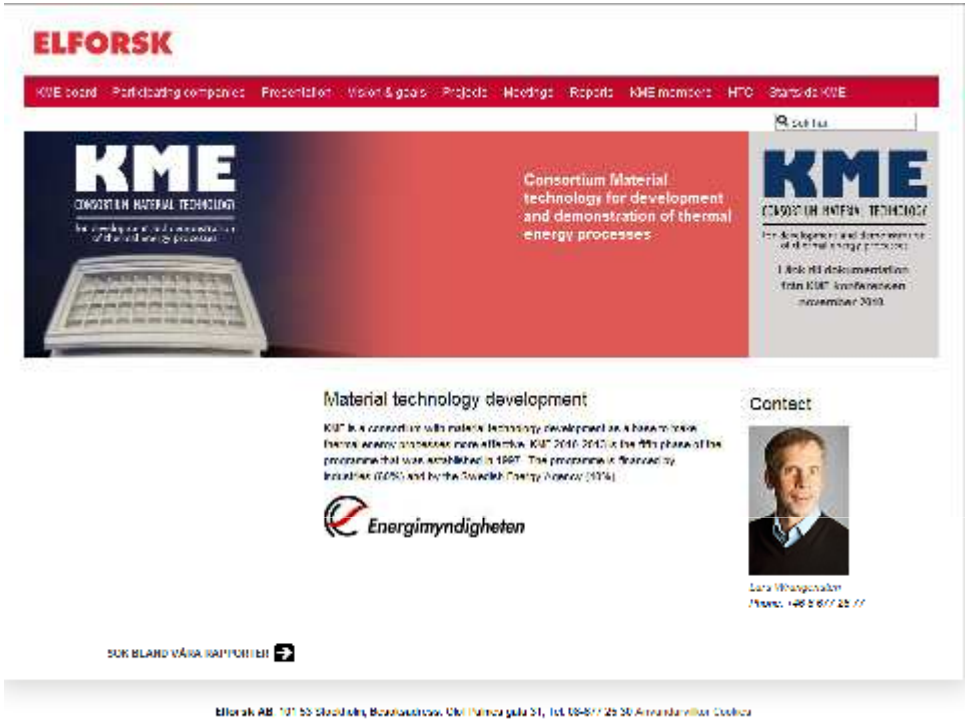

Information – web site

http://www.kme-elforsk.se

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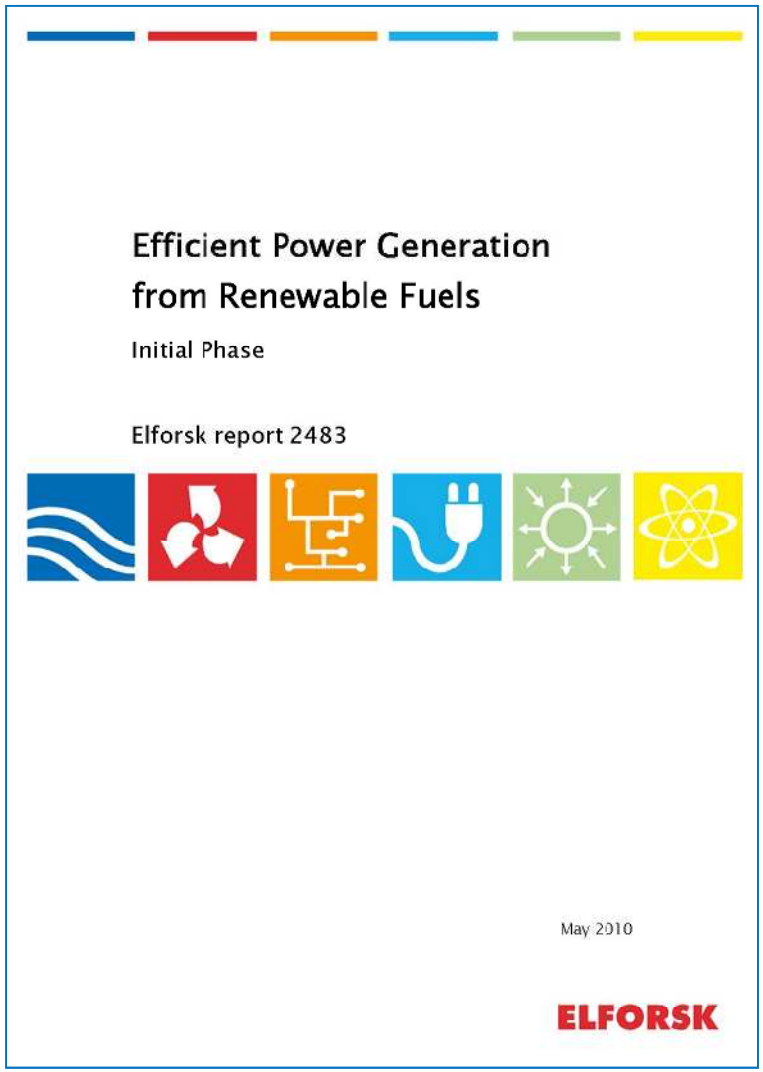

- Feasibility study 2009:
  - Time schedule/activities
  - Calculations RPP-concept
    (**R**eference **P**ower **P**lant)
  - Prioritized research areas

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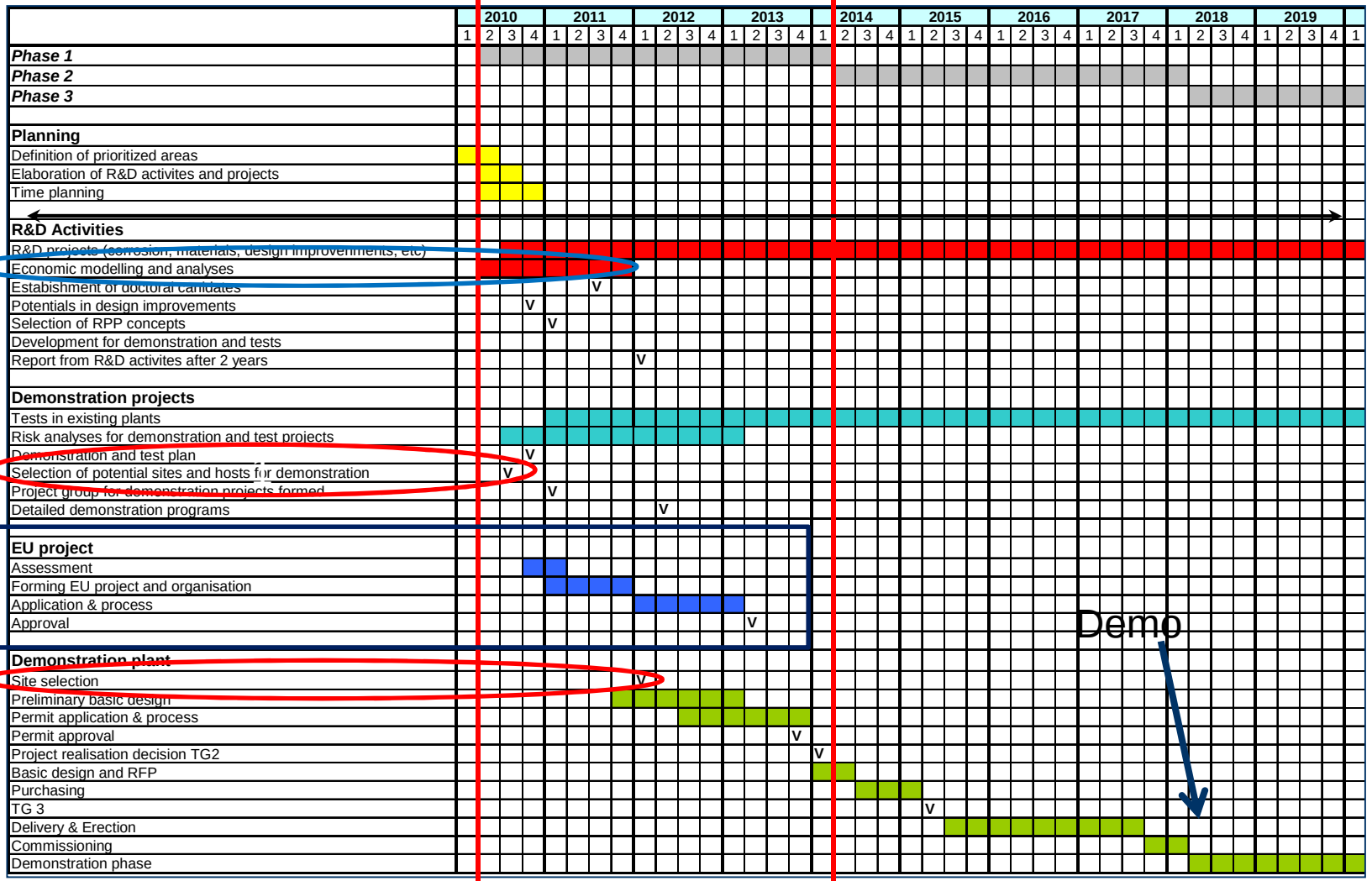
KME 2010-2014



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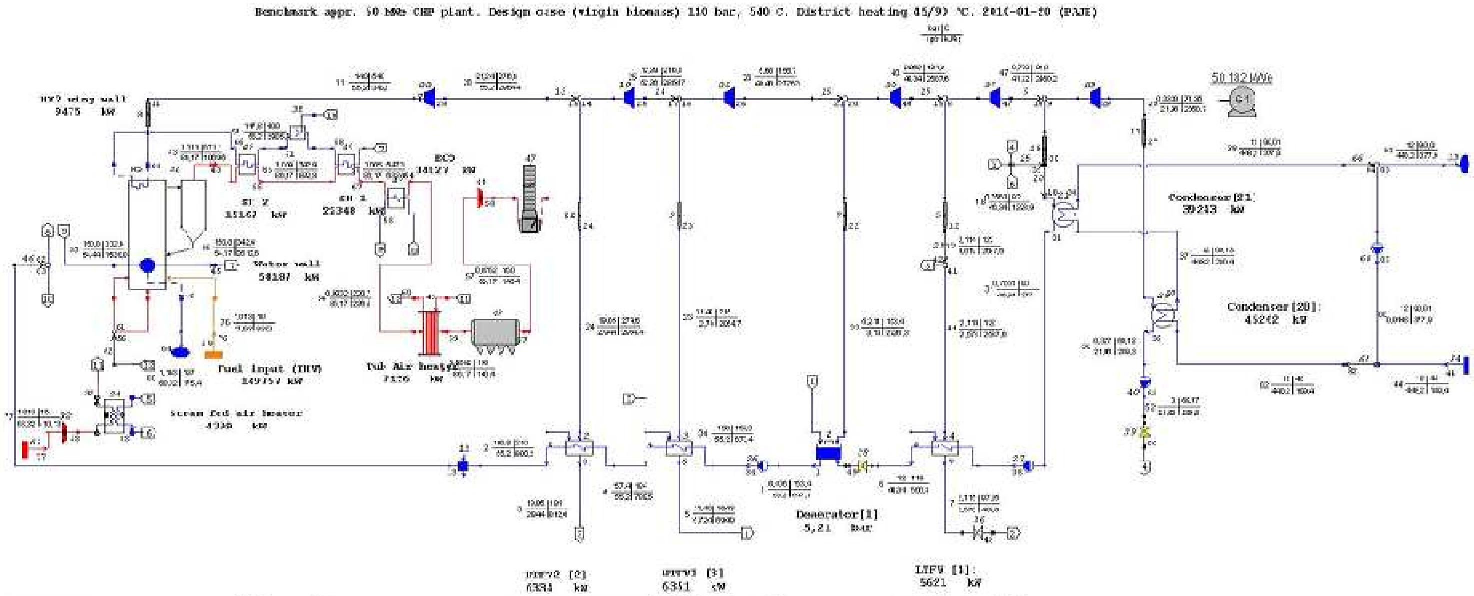
The main conclusions from this initial phase are:

- **The main challenge is to control and minimise the fouling and corrosion problems connected with the enhanced steam data.**
- **Preliminary targets for advanced CHP plants, "Reference Power Plants" (RPP):**
  - **RPP: 165 bar/585°C, reheat 37 bar/580℃**
  - **RPP enhanced: 190 bar/600 C, reheat 40 bar/600℃.**
- **The main requirement, beside higher efficiency**, is the **fuel flexibility.**
- **Two main fuels and fuel mix ranges:**
  - **Virgin biomass fuel range**
  - **Wide fuel range with recycled wood and agro fuels**
- **Two plant size ranges are proposed:**
  - **20-25 MW_e**
  - **50+ MW_e**
- **Two defined RPP targets. Compared to the benchmark process (140 bar/540° C) the electrical efficiency would increase by 3,2 and 4,0 percentage points respectively, for the two proposed RPP configurations.**

THERMOFLEX Version 19.0 Vattenfall Workplace User Vattenfall Power Consultant AB

Benschmark 50 Mwe, 140 bar, 540 °C, ηel=33,51 %



Gross power	50182	kW
Gross electric efficiency(LHV)	33 51	%
Net power	45428	kW
Net electric efficiency(LHV)	30 34	%
Net fuel input(LHV)	149742	kW
Net process output	84502	kW
CHP efficiency	86 73	%
Plant auxiliary	4754	kW

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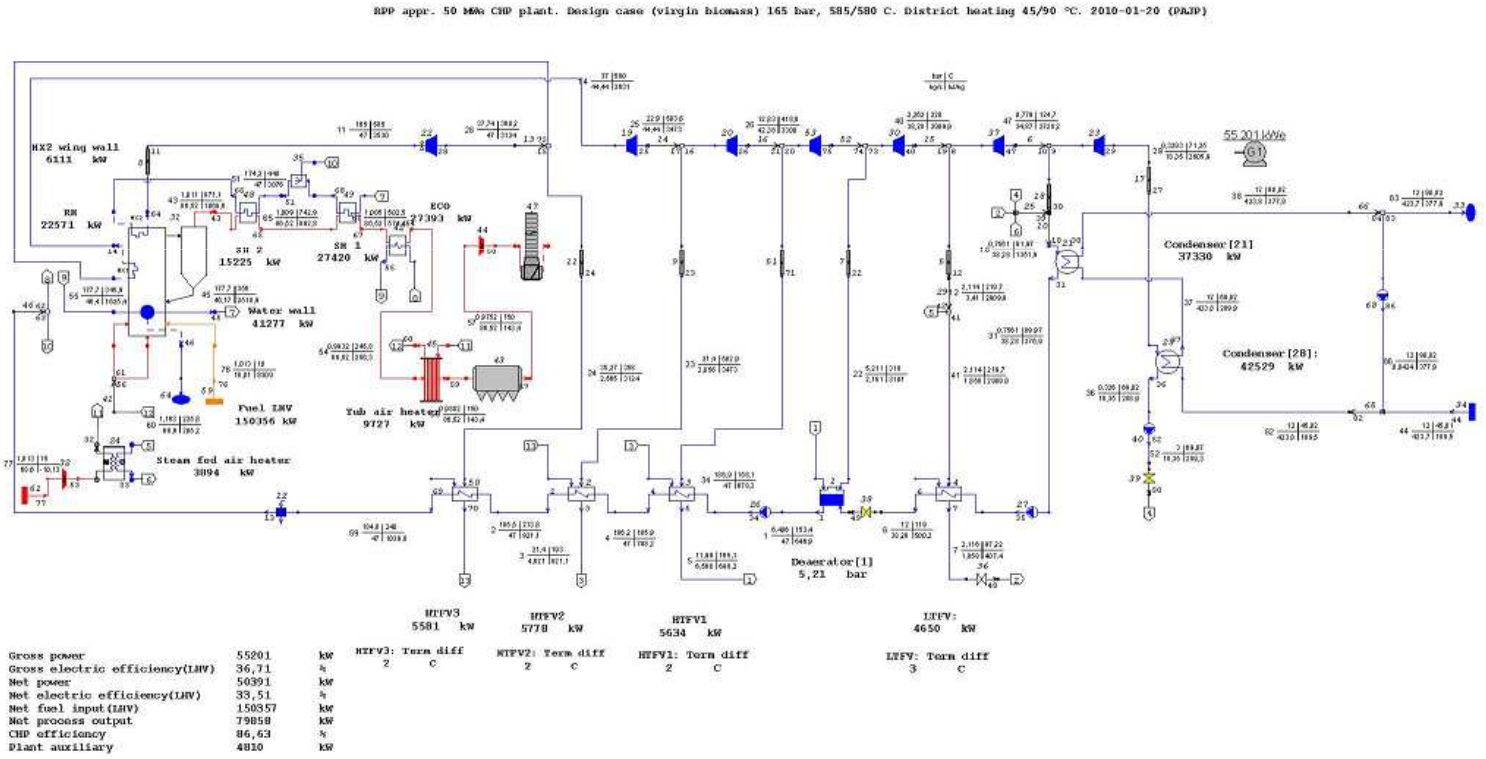
THERMOFLEX Version19.0 Vattenfall Workplace User Vattenfall Power Consultant AB

RPP I, 165 bar, 585 °C/580 °C, ηel=36,71 %



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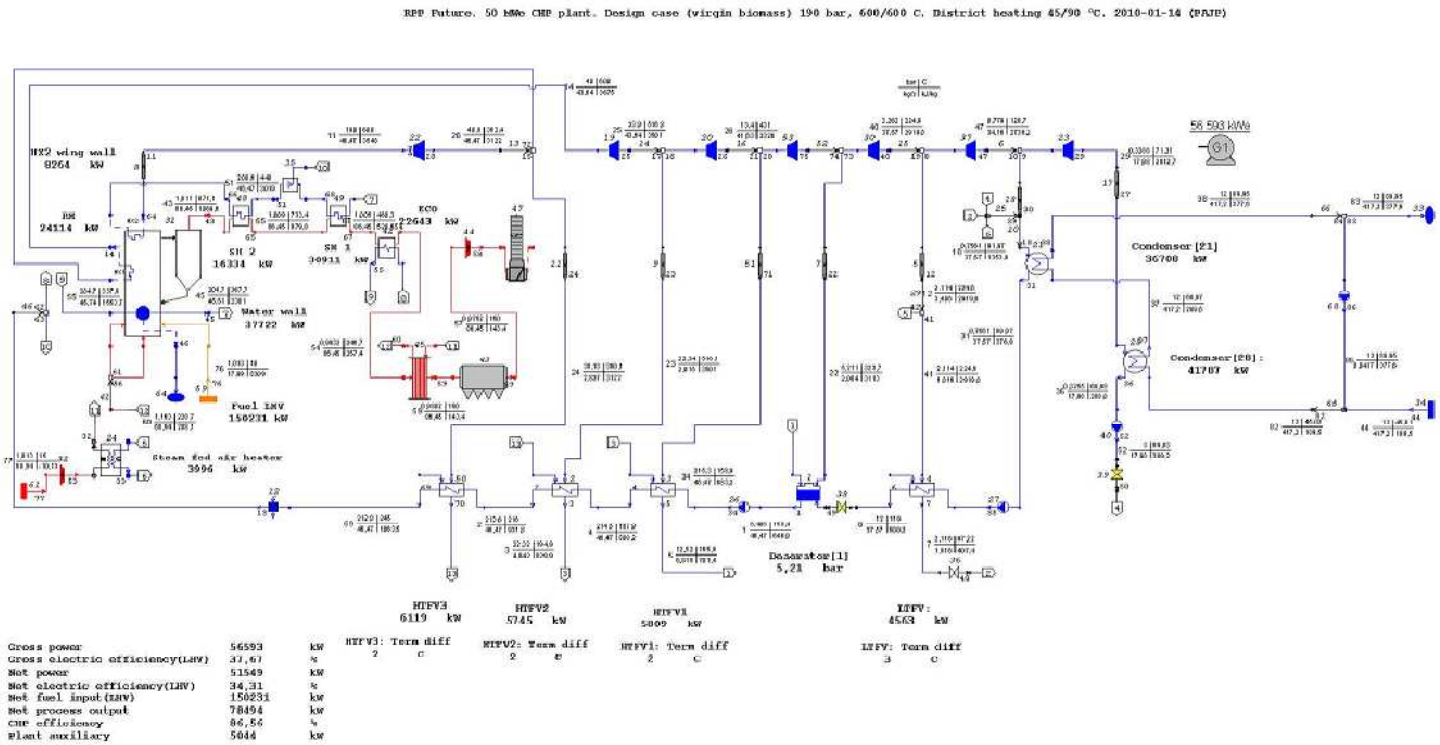
THERMOFLEX Version19.0 Vattenfall Workplace User Vattenfall Power Consultant AB

RPP II Future, 190 bar, 600 °C/600 °C, ηel=37,67 %



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Prioritized areas, example :

Main area	Sub-area	Activities / Issues (examples)
Enhanced steam data		
Fuel handling & preparation	Fuel origins	• Growth factors for critical substances and compounds • Impact from handling of forestry residues • Impact from harvesting and handling of agro fuels (energy crops and straw) – Possible co-operation with Värmeforsk and SLU
	Fuel characterisation	• Fuel specifications • Identification of hazardous compounds • Interacting between different compounds • Requirements on fuel in terms of possible limits for critical compounds • Measures for control and measurements of critical compounds.

Steam turbine system	Steam turbine	• Technology selection options for the actual size range
		• Steam turbine configuration for different size, steam data levels
		  o Number of turbine houses
		  o Gear solution
		  o Generator solution
		• Improvement potentials within steam turbine system
		• Measures for improved isentropic efficiencies in
		  o HPT
		  o IPT
		  o LPT
		• HPT design for reduction of border losses
		• LPT moisture in last stages
		  o Improved design
		  o Reduced losses
		• Deterioration reduction measures

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On going projects
(EPP-programme):

Project	Project name	Project Goal	Contributing to KME programme goal
KME-601	Reference Power Plant (RPP) - project	The goal is to create and update Reference Power Plant(s) concepts in cooperation and dialogue with the steering group and the KME stakeholders.	Presentation of technical solution for a commercial feasible reference power plant (RPP) as a basis for the demonstration plant.

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On going projects
(Mat Base programme, with relevance for EPP-programme):

Project	Project name	Project Goal
KME-501	Long term high temperature behaviour of advanced heat resistant materials	To evaluate stress relaxation cracking behavior, tensile deformation and cracking behavior with very slow strain rate for advanced heat resistant materials.
KME 504	Correlation between deposit chemistry and initial corrosion of super heaters	The overall objectives of the project are to improve the description of the chemistry of a deposit and link it to the initial corrosion.
KME 507	FeCrAl alloys for components in biomass and refuse fueled boilers - prestudy	The aim of the project will be to identify and understand the usability and the limitations of alumina forming materials as components in biomass- and waste fired combustion plant.
KME 508	Furnace wall corrosion in biomass and waste-fired boilers at higher steam pressures	The goal is to give recommendations about how to avoid water wall corrosion at increased steam data when burning biomass and waste wood mixes.
KME 509	Concentrated approach on super heater corrosion in boilers fueled with biomass and refuse	The overall goal of the project is to improve plant economy by enabling an increased electricity production and enhancing fuel flexibility.
KME 510	Design of a new generation of 12% chromium steels	The goal with the project is that the research can lead to a new generation of steels, i.e. Z-phase strengthened steels, which fulfil basic requirements on mechanical properties and combine good long-term corrosion and creep resistance.

Tack för uppmärksamheten!