Demonstration of a grate furnace boiler burning municipal solid waste (MSW).

High corrosion and high fouling are the main features of the combustion products of MSW. To prevent the boiler heat exchanger surface from corrosion and fouling, various of precautions are made to ensure that the flue gas entering the convective pass carries low amount of fly ash and the heat exchanger outside surface temperature is sufficiently low: 1) a U-shape radiant cooler is designed between the furnace and the convective heat exchangers to provide long residence time for fly ash to be separated from flue gas; 2) an evaporator, instead of a superheater as in a conventional coal power plant, is designed immediately downstream of the radiant cooler; 3) the two superheaters (CS2 & CS3) are designed as parallel flow heat exchangers.

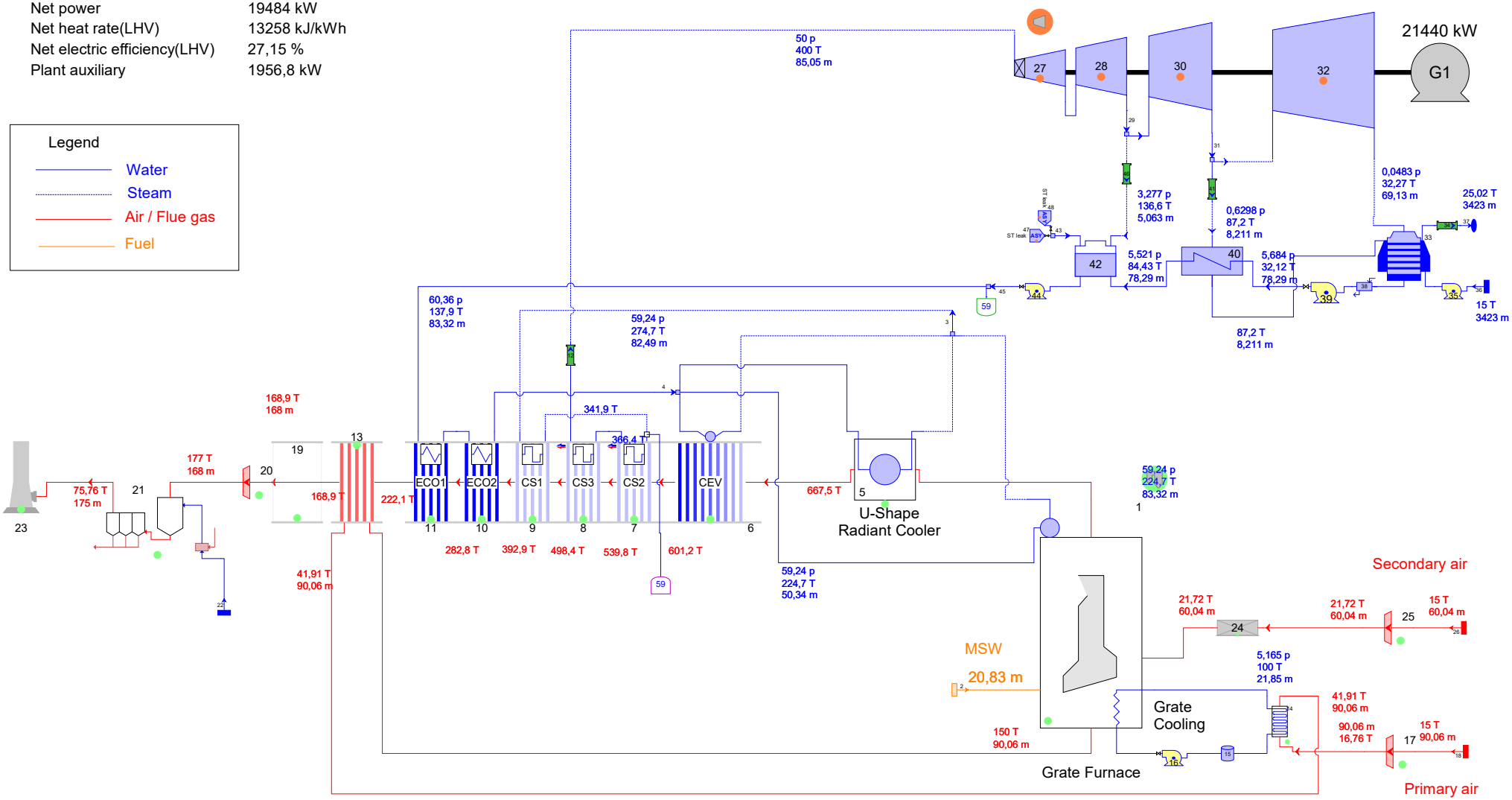
A unique design of this plant design is the closed loop water cooling system for furnace grate cooling. Water heated in the grate is cooled in the coil which in turn transfers heat to the primary air. Another version of grate cooling design is shown in (S1-15b), in which the grate is cooled by feedwater.

As for emission control, a dry FGD is installed on the gas path. The dry FGD is composed of a dry scrubber and a baghouse. This combination is effective in sorbent utilization and control of pollutants such as SO2, HCL, dioxin, furan and heavy metals, etc.

MSW processing capacity of the plant is 500 tonne/day (550 ton/day), or 20.8 tonne/hr (23 ton/hr). The plant's gross output is 21.4 MWe and net is 19.6 MWe. Net efficiency is 27.3%. HP steam condition is 50 BarA /400 C (725 psia / 752 F).

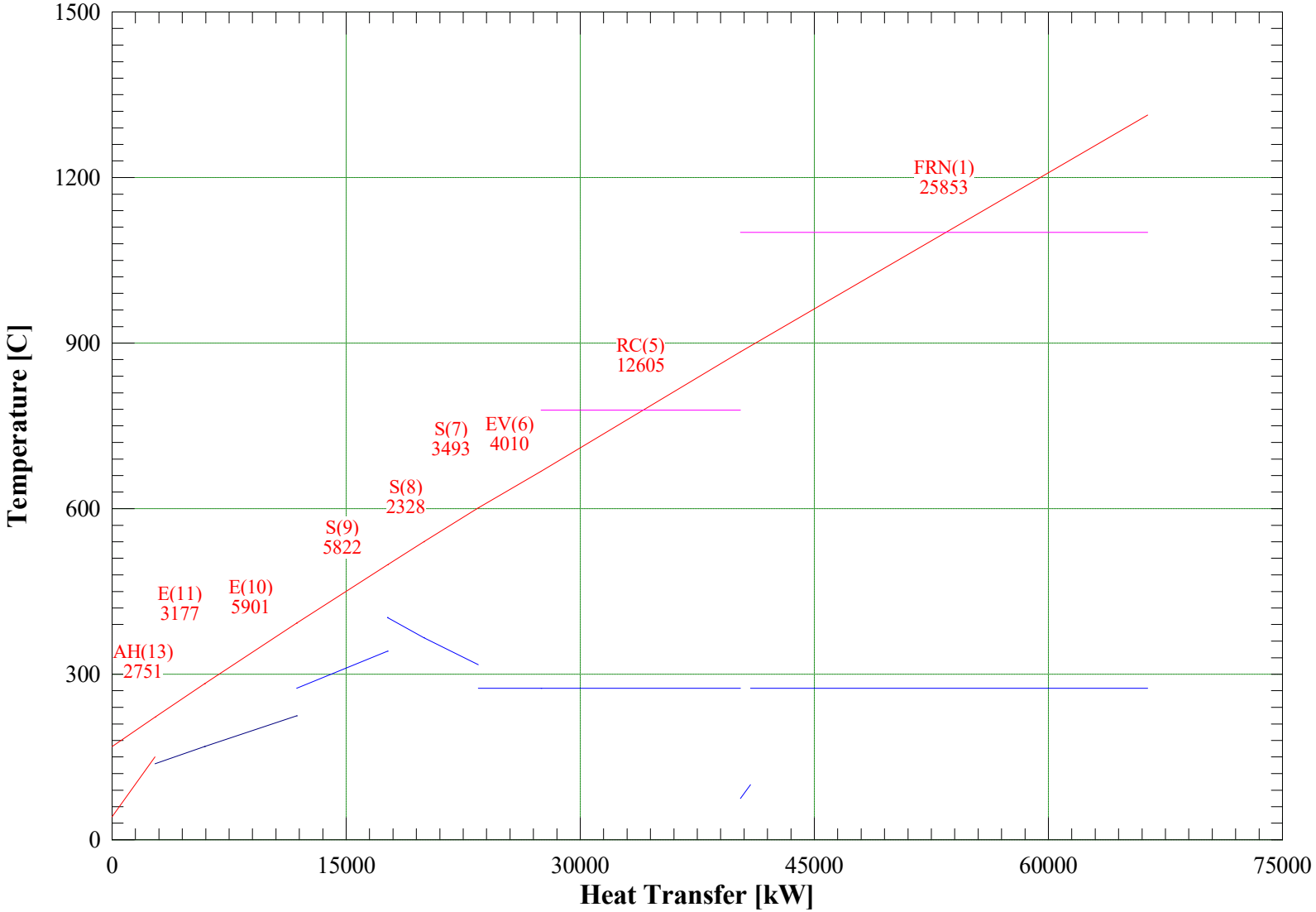
As of Version 26, this model was updated to integrate the components of the boiler into a Boiler Assembly, enabling a cost estimation as well as output of overall dimensions, weight, and performance parameters.

Gross power	21440 kW
Net power	19484 kW
Net heat rate(LHV)	13258 kJ/kWh
Net electric efficiency(LHV)	27,15 %
Plant auxiliary	1956,8 kW



Thermoflow Sample File Created with Thermoflex 20 (2010)

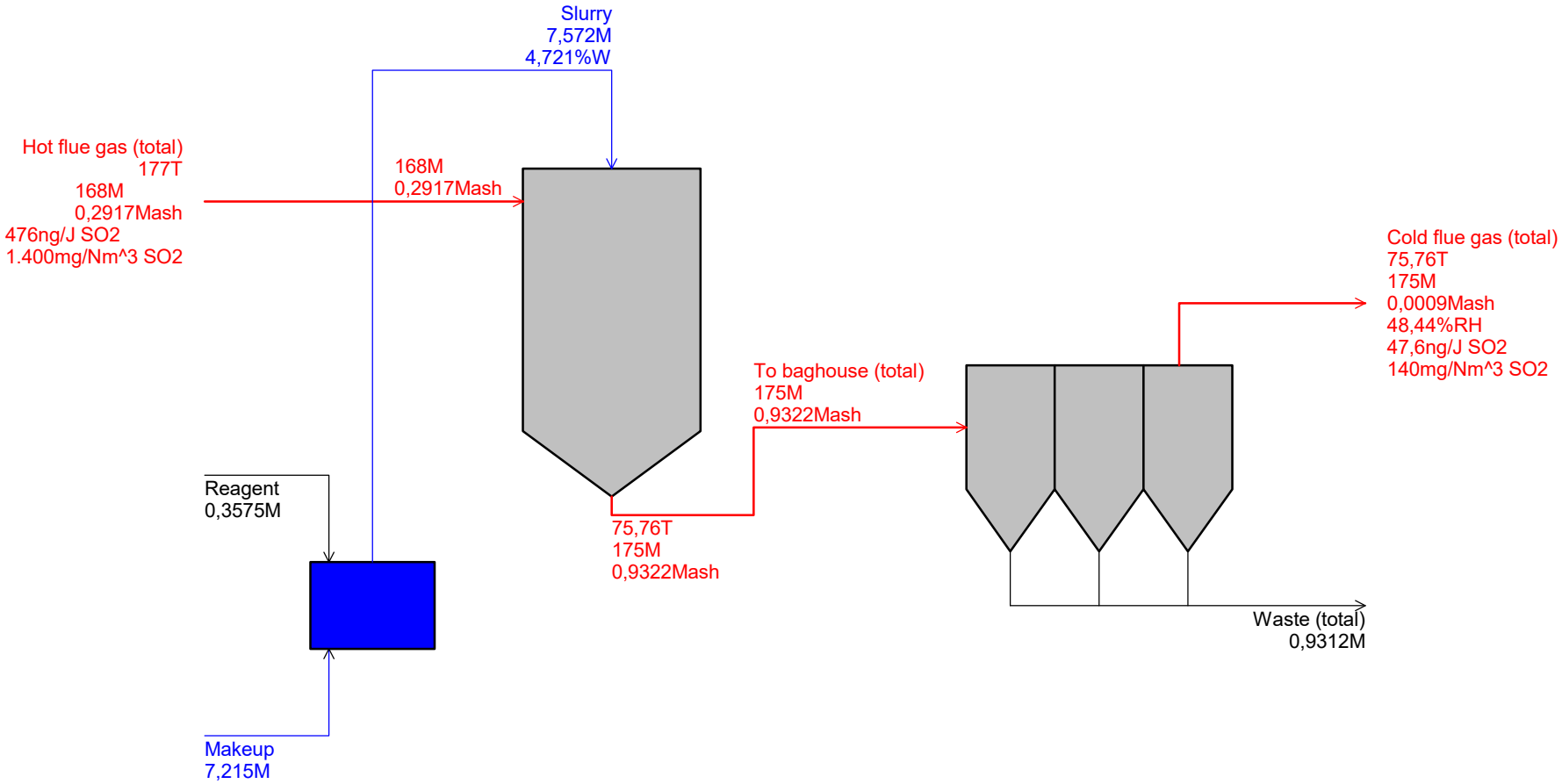
Boiler Assembly[1] T-Q Diagram



Boiler Assembly[1] - ASME Boiler Energy Balance

ASME Boiler Energy Balance			
	HHV Based	**LHV Based**	
Energy input from fuel	**80730**	**71755**	kW
Credit due to entering dry air	-261,3	-261,3	kW
Credit due to moisture in entering air	-3,056	-3,056	kW
Credit due to sensible heat in fuel	-0,0082	-0,0082	kW
Credit due to sulfation	0	0	kW
Credit due to sensible heat in sorbent	0	0	kW
Credit due to auxiliary equipment power	0	0	kW
Total credits	-264,4	-264,4	kW
Total Energy in	**80466**	**71490**	kW
Energy to steam and water	**62596**	**62596**	kW
Loss due to sensible heat in dry gas	6184	6184	kW
Loss due to moisture in fuel	3378	338,6	kW
Loss due to moisture from burning hydrogen	6599	661,4	kW
Loss due to moisture in air	71,47	71,47	kW
Loss due to unburned carbon	0	0	kW
Loss due to calcination of sorbent	0	0	kW
Loss due to radiation and unmeasured losses	2274,1	2274,1	kW
Total losses	18506	9530	kW
Total Energy out	**81102**	**72126**	kW
ASME fuel efficiency (Output/Input)	**77,54**	**87,24**	%
ASME gross efficiency (Output/(Input+Credits))	**77,79**	**87,56**	%
Energy input from fuel is based upon fuel heating value at 25 C.			
Zero enthalpy: dry gases & liquid water at 25 C.			
The entering air enthalpy is calculated based on air temperature before air heater.			
The leaving gas enthalpy is calculated based on flue gas temperature after the last heat exchanger at 168,9 C.			
Evaluation of this table per ASME PTC-4			

Dry FGD [21] Flow Circuit - One Unit (Engineering Design)



FGD SO2 removal efficiency = 90 %
Baghouse particle removal efficiency = 99,9 %
Flue gas approach to saturation = 15 C
Reagent feed ratio = 1,607
Total reagent consumption = 0,3575 t/h
Total SO2 removed = 0,1245 t/h
Total auxiliary power = 226,8 kW

P[bar] T[C] M[t/h] %W[wt% solid]