REV	DESIGNATION	État / *Status*	DATE	VISA	DATE	VISA	DATE	VISA
B	Update without Point B		23/08/2024	CLO	28/04/2023	MHA	28/04/2023	GMI
A	92MW		21/04/2023	CLO	28/04/2023	MHA	28/04/2023	GMI
			Auteur *Issued by*		Verifié par *Checked by*		Approuvé par *Approved by*	

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Mitsubishi Power Europe GmbH

UK WtoE project

NOTE DE CALCUL

BILAN GLOBAL CHAUDIERE

CALCULATION NOTE

BOILER BALANCE

Client / *Customer*	**British Power Development Partners**
Projet / *Project*	**Selby**
Cde interne N° / *Int. order N°*	**HP23008**

Référence du document / *Document reference number*

Issuer	*Project number*	*Doc type*	*Doc number*	*Rev*
LLT	**HP23008**	**NCL**	**0200**	**A**

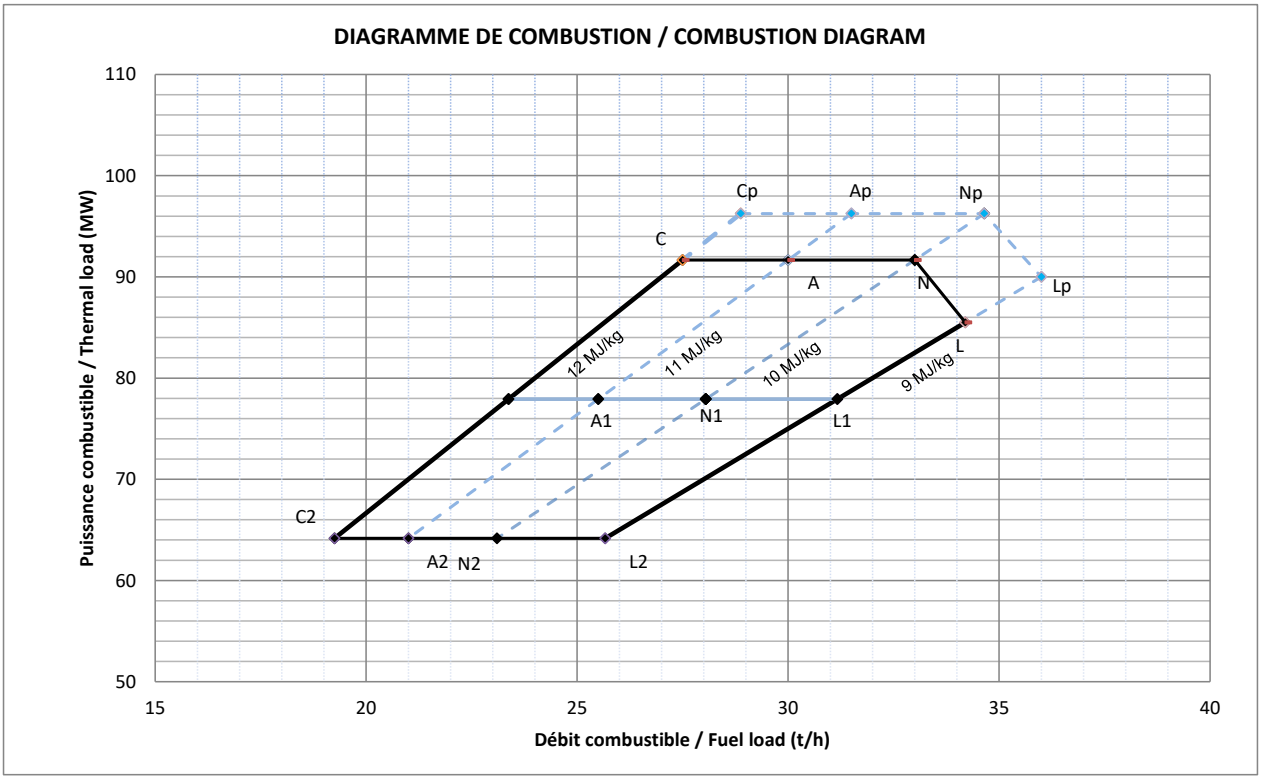
FUEL CHARACTERISTICS		**Reference fuel**	**Min values**	**Max values**
Net Calorific Value (NCV) / Low Heating Value (LHV)	kJ/kg	10000	9000	12000
LHV	kWh/t	2777,8	2500,0	3333,3
Elementary analysis (on dry base)				
C	% daf	56,6	refer to Feedstock Specification	
H	% daf	8,8		
O	% daf	31,9		
N	% daf	1,45		
S	% daf	0,30		
Cl	% daf	1,00		
Alkaline	% dry	0,0		
Inerts	% dry	0,0		
Ashes	% dry	35,7		
Initial ash distorsion temperature (acc. NFM03048)	°C			
Density	kg/m^3	220		
Particules size distribution accepted		refer to Feedstock Specification		

Note :

During waranty period, the fuel will be analysed, according to our offer waranty paragraph.

Reference defines the fuel composition for which performance tests would be done - it is named Feedstock Guarantee Reference Conditions ('FGRC').

DIAGRAMME DE COMBUSTION / COMBUSTION DIAGRAM



Load		**Feedstock Net calorific values**					
		FGRC	**High LHV**	**MCR**	**Low LHV**		
		10 MJ/kg	**12 MJ/kg**	**11 MJ/kg**	**9 MJ/kg**		
Nominal- MCR Load	100%	N	C	A	L		
Auxiliary firing load limitation load	85%	N1	C1	A1	L1		
Minimum load	70%	N2	C2	A2	L2		
Peak load (1h/24h)	105%	Np	Cp	Ap	Lp		

Diagram points		**N**	**N1**	**N2**	**Np**		
Load	**%**	**100%**	**85%**	**70%**	**105%**		
Fuel load	**t/h**	**33,00**	**28,05**	**23,10**	**34,65**		
Number of operating hours	h	8000	8000	8000	8000		
FUEL DATA		Reference fuel					
LHV	kJ/ kg	10000	10000	10000	10000		
BOILER DATA		IN-DOOR					
Maximum allowable pressure	bar eff.	56	56	56	56		
Steam drum pressure	bar eff.	51	49	47	52		
Superheated steam pressure	bar eff.	44	44	44	44		
Feed water temperature	°C	140,5	140,5	140,5	140,5		
Superheated steam temperature	°C	400	400	370	400		
Useful steam output	kg/h	105 217	89 099	75 164	110 524		
continuous drain closed and without sootblowing							
Steam drum extraction	kg/h	0	0	0	0		
Reference temperature	°C	25	25	25	25		
COMBUSTION AIR							
Air excess	%	60	63	66	60		
Primary air temperature	°C	150	150	150	150		
Secondary air temperature	°C	25	25	25	25		
Primary air preheating :							
Internal power	kW	4710	4077	3418	4946		
External heat from LP steam turbine	kW	0	0	0	0		
Secondary air preheating :							
Internal power	kW	0	0	0	0		
External heat from LP steam turbine	kW	0	0	0	0		
EXPECTED RESULTS							
Boiler useful heat provided to customer	**kW**	**77 085**	**65 279**	**53 524**	**80 971**		
Real boiler heat with internal air preheating	kW	81 795	69 357	56 942	85 917		
Theoritical LHV efficiency	**% LHV**	**84,09**	**83,78**	**83,41**	**84,13**		
%O2 in the flue gas	% vol./dry	8,06	8,31	8,54	8,06		
Fuel mass flow	kg/h	33 000	28 050	23 100	34 650		
Fuel volume flow	m^3/h	150,0	127,5	105,0	157,5		
Fuel inlet power	kW	91 667	77 917	64 167	96 250		
Fluegas mass flow	kg/h	216 139	186 722	156 243	226 967		
Fluegas volume flow	Nm^3/h	172 742	149 179	124 785	181 395		
Combustion air mass flow	kg/h	191 754	165 995	139 173	201 363		
Combustion air volume flow	Nm^3/h	149 727	129 614	108 671	157 230		
Combustion adiabatic temperature	°C	1 262	1 247	1 232	1 262		
Outlet flue gas temperature	°C	190	190	190	190		

Nota :

(1) *For fuel in accordance with characteristics defined above, compound concentration reduced to 11% of O2 on dry flue gas (FDX 2037).*

Efficiency is calculated according to the NF EN 12952-15 standard.

Convective and radiative heat losses are calculated according to the NF EN 12952-15 standard with a coefficient of 0,022 (houille curve).

Peak load at 105% is allowable 1h/24h maximal.

Diagram points		**C**	**C2**	**A**	**A2**	**L**	**L2**
Load	**%**	**100%**	**70%**	**100%**	**70%**	**93%**	**70%**
Fuel load	**t/h**	**27,50**	**19,25**	**30,00**	**21,00**	**34,20**	**25,67**
Number of operating hours	h	8000	8000	8000	8000	8000	8000
FUEL DATA							
LHV	kJ/kg	12000	12000	11000	11000	9000	9000
Ashes	% on raw mat.	30,0	30,0	25,0	25,0	28,5	28,5
BOILER DATA		IN-DOOR	IN-DOOR	IN-DOOR	IN-DOOR	IN-DOOR	IN-DOOR
Maximum allowable pressure	bar eff.	56	56	56	56	56	56
Steam drum pressure	bar eff.	51	47	51	47	50	47
Superheated steam pressure	bar eff.	44	44	44	44	44	44
Feed water temperature	°C	140,5	140,5	140,5	140,5	140,5	140,5
Superheated steam temperature	°C	400	370	400	370	400	370
Useful steam output	kg/h	106 287	75 950	105 934	75 692	97 624	74 805
continuous drain closed and without sootblowing							
Steam drum extraction	kg/h	0	0	0	0	0	0
Air reference temperature	°C	25	25	25	25	25	25
COMBUSTION AIR							
Air excess	%	60	66	60	66	60	66
Primary air temperature	°C	150	150	150	150	150	150
Secondary air temperature	°C	25	25	25	25	25	25
Primary air preheating :							
Internal heat	kW	4550	3302	4596	3336	4504	3505
External heat from LP steam turbine	kW	0	0	0	0	0	0
Secondary air preheating :							
Internal heat	kW	0	0	0	0	0	0
External heat from LP steam turbine	kW	0	0	0	0	0	0
EXPECTED RESULTS							
Boiler useful heat provided to customer	**kW**	**77 868**	**54 083**	**77 610**	**53 899**	**71 524**	**53 268**
Real boiler heat with internal air preheating	kW	82 418	57 385	82 206	57 235	76 028	56 773
Theoritical LHV efficiency	**% LHV**	**84,95**	**84,28**	**84,67**	**84,00**	**83,65**	**83,01**
%O2 in the flue gas	% vol./dry	8,06	8,54	7,99	8,47	8,06	8,54
Fuel mass flow	kg/h	27 500	19 250	30 000	21 000	34 200	25 667
Fuel volume flow	m^3/h	275,0	192,5	93,8	65,6	92,4	69,4
Fuel inlet power	kW	91 667	64 167	91 667	64 167	85 500	64 167
Flue gas mass flow	kg/h	204 137	147 655	209 259	151 292	207 485	160 805
Flue gas volume flow	Nm^3/h	161 104	116 494	164 675	119 034	166 174	128 690
Combustion air mass flow	kg/h	185 250	134 433	187 127	135 800	183 374	142 710
Combustion air volume flow	Nm^3/h	144 649	104 970	146 114	106 037	143 184	111 432
Combustion adiabatic temperature	°C	1 346	1 313	1 316	1 284	1 229	1 200
Outlet flue gas temperature	°C	190	190	190	190	190	190

Nota :

(1) *For fuel in accordance with characteristics defined above, compound concentration reduced to % of O2 on dry flue gas (FDX 2037).*

Efficiency is calculated according to the NF EN 12952-15 standard.

Convective and radiative heat losses are calculated according to the NF EN 12952-15 standard with a coefficient of 0,022 (houille curve).

Peak load is allowable 1h/24h maximal.

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Material Balance (Waste, Ash, Air; Flue Gas) @ MCR
Expected Balance (Not Guaranteed)

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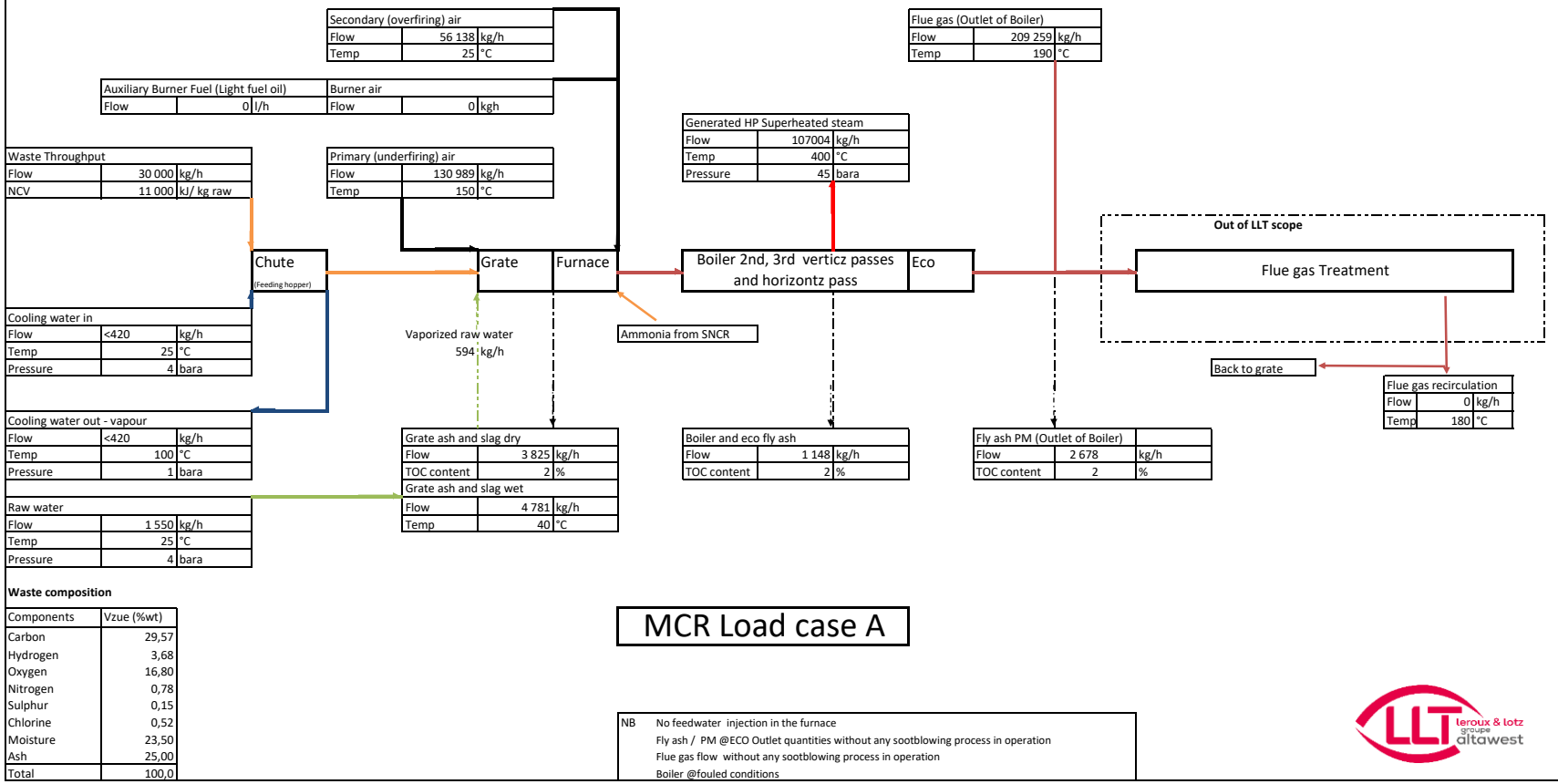

Waste composition

Components	Vzue (%wt)
Carbon	29,57
Hydrogen	3,68
Oxygen	16,80
Nitrogen	0,78
Sulphur	0,15
Chlorine	0,52
Moisture	23,50
Ash	25,00
Total	100,0

MCR Load case A

NB No feedwater injection in the furnace
Fly ash / PM @ECO Outlet quantities without any sootblowing process in operation
Flue gas flow without any sootblowing process in operation
Boiler @fouled conditions

Assumptions: expected values only not guaranteed !

		Bottom ash	Boiler Fly ash	Bag House Filter Fly ash
Share of ash		50%	15%	35%
Ash flow in kg /h		3750	1125	2625
TOC grate ash and slag, maximum	2%	75	22,5	52,5
Bottom ash flow considering XX% moisture content in kg /h	30%	5464		

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Material Balance (Waste, Ash, Air; Flue Gas) @ MCR
Expected Balance (Not Guaranteed)

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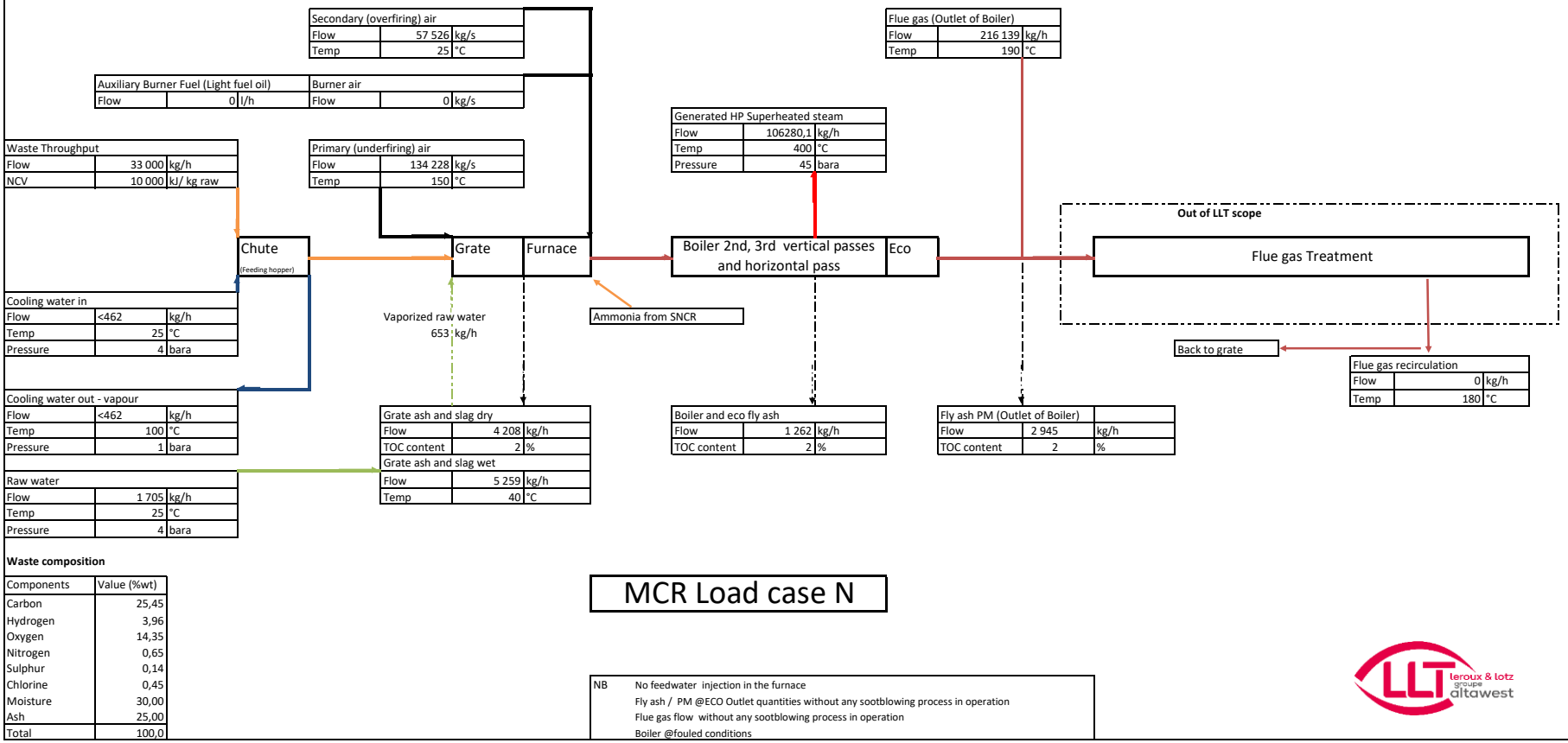


Waste composition

Components	Value (%wt)
Carbon	25,45
Hydrogen	3,96
Oxygen	14,35
Nitrogen	0,65
Sulphur	0,14
Chlorine	0,45
Moisture	30,00
Ash	25,00
Total	100,0

MCR Load case N

NB
- No feedwater injection in the furnace
- Fly ash / PM @ECO Outlet quantities without any sootblowing process in operation
- Flue gas flow without any sootblowing process in operation
- Boiler @fouled conditions

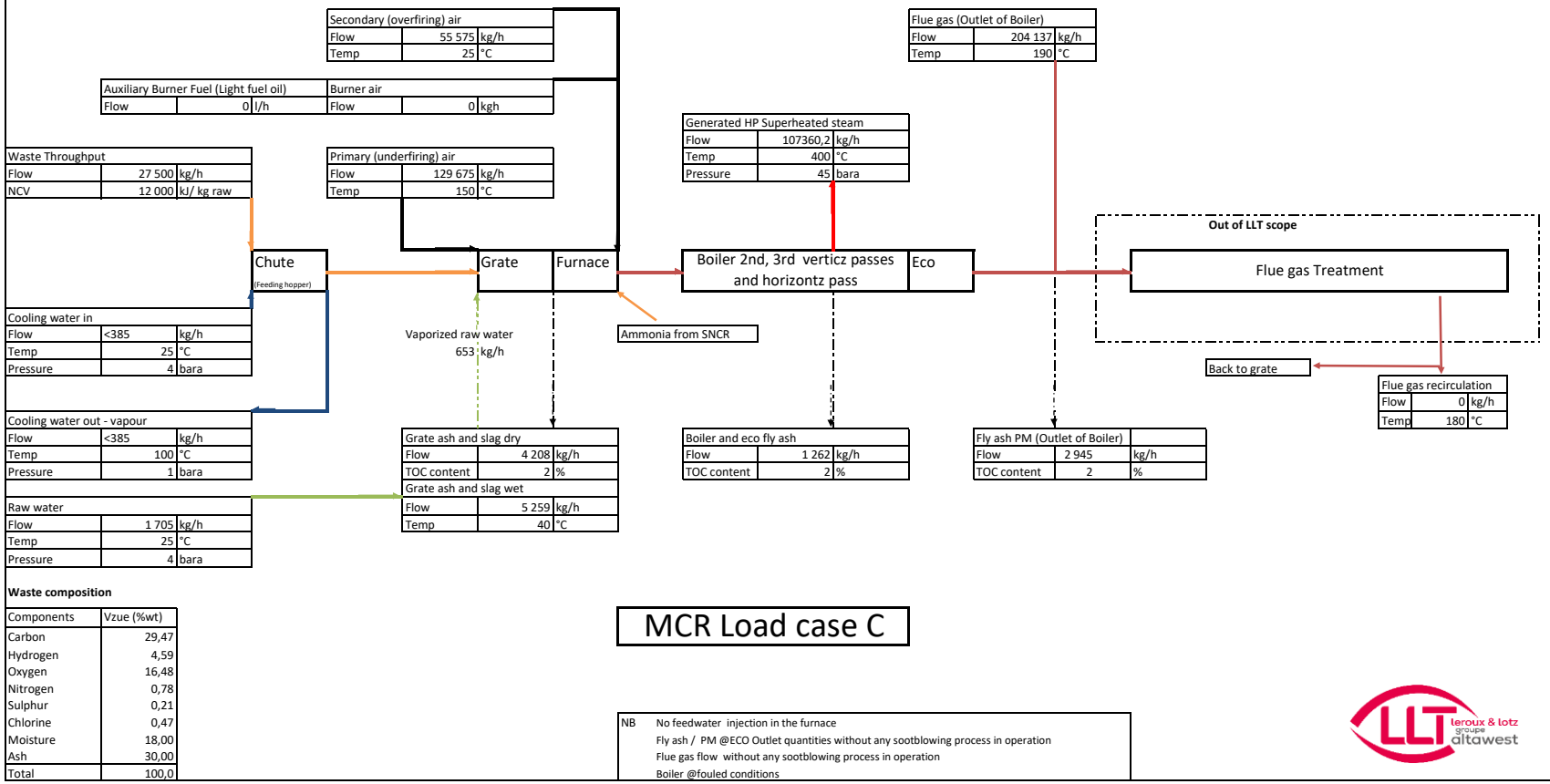
Assumptions: expected values only not guaranteed !

		Bottom ash	Boiler Fly ash	Bag House Filter Fly ash
Share of ash		50%	15%	35%
Ash flow in kg /h		4125	1238	2888
TOC grate ash and slag, maximum	2%	82,5	24,75	57,75
Bottom ash flow considering XX% moisture content in kg /h	30%	6011		

Selby

Material Balance (Waste, Ash, Air; Flue Gas) @ MCR
Expected Balance (Not Guaranteed)

rev 23rd Aug - 2024



Waste composition

Components	Vzue (%wt)
Carbon	29,47
Hydrogen	4,59
Oxygen	16,48
Nitrogen	0,78
Sulphur	0,21
Chlorine	0,47
Moisture	18,00
Ash	30,00
Total	100,0

MCR Load case C

NB No feedwater injection in the furnace
Fly ash / PM @ECO Outlet quantities without any sootblowing process in operation
Flue gas flow without any sootblowing process in operation
Boiler @fouled conditions

Assumptions: expected values only not guaranteed !

		Bottom ash	Boiler Fly ash	Bag House Filter Fly ash
Share of ash		50%	15%	35%
Ash flow in kg /h		4125	1238	2888
TOC grate ash and slag, maximum	2%	82,5	24,75	57,75
Bottom ash flow considering XX% moisture content in kg /h	30%	6011		