PPP PROJECT FOR THE CITY OF BELGRADE FOR THE PROVISION OF SERVICES OF TREATMENT AND DISPOSAL OF RESIDUAL MUNICIPAL SOLID WASTE

SUEZ Groupe SAS

and

I-ENVIRONMENT INVESTMENTS LIMITED

July 13th, 2017

suez

I-Environment Investments Limited

INPUTS TO THE PPP CONTRACT

Form T.1.1 Contract Waste Tonnages

Table 1 – Contract Waste Tonnages			
Contract Waste		**During Interim Services Period (in tonnes per year)**	**During Services Period (in tonnes per year)**
RMW	Treatable Tonnage Limit	Not Applicable	340 000
CDW	Recoverable CDW Tonnage Limit	200 000	200 000

Table 2 – Contract Waste Tonnages over the Contract Period		
Contract Waste		**During Interim Services Period and Services Period (in tonnes over the Contract Period)**
RMW	Pre-Agreed Surplus RMW Tonnage	5 500 000
CDW	Pre-Agreed Surplus CDW Tonnage	300 000
	Pre-agreed Recycled CDW Storage Tonnage	420 000

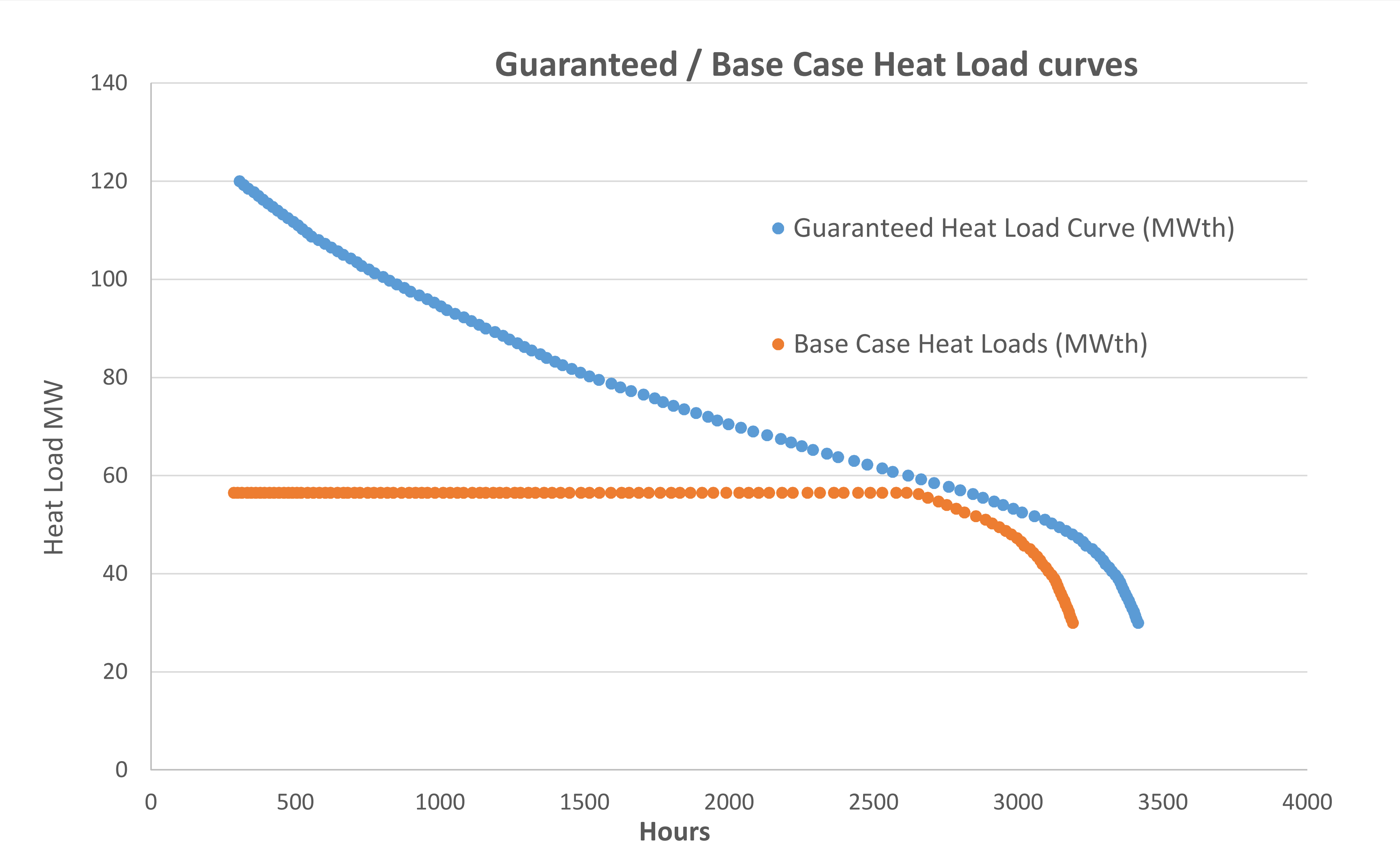
Table 3 - New Landfill Tonnages and Volumes (over the Contract Period)			
New Landfill (section)[1]	**Waste type**	**Total New Landfills tonnages and volumes over the Contract Period for the Base Case of 510,000 t/a RMW and 200,000 t/a CDW**	
		in tonnes **excluding material for intermediate covers and final capping**	**in m³** **including material for intermediate covers and final capping**
	RMW Landfilled Unprocessed	*5 200 000 t*	*5 500 000 m3*
Residues	Landfilled MW Process Residues - bottom ash	*1 390 000 t*	*1 025 000 m3*
Residues	Landfilled MW Process Residues - solidified flue gas treatment residues	*816 000 t*	*605 000 m3*
Inert Landfill	Inert CDW Landfilled Unprocessed and Landfilled CDW Process Residues	*1 600 000 t*	*1 080 000 m3*
Inert Landfill	Surplus CDW	*330 000 t*	*220 000 m3*
Total landfill volume for all landfill sections	**All waste types above**	**9 336 000 t**	**8 430 000 m3**

[1] *Instructions: Please specify in line with the Final Disposal Plan*

Form T.1.2 Key Performance Indicators

Table 1 - Key Performance Indicators			
KPI no.	**Key Performance Indicator**	**Guaranteed Value**	**Monitoring Frequency**
1	Landfill Diversion Target Rate	**70 %** *calculated based on* Landfill Diversion Target tonnage of **238 000 t/a**	Annually from Service Commencement Date
2	BMW Diversion Target Rate (if the Bidder's solution include a PTF Facility)	N/A % *calculated based on* BMW Diversion Target tonnage of N/A t/a	Annually from Service Commencement Date
3	CDW Recovery Target Rate	**70 % by weight**	Annually from Interim Service Commencement Date
4	MW Recycling/Recovery Target Rate	N/A % by weight *if*	Annually from Service Commencement Date

Form T.1.3 Base Case Heat Load Curve



Base Case Heat Loads (MWth)	Hours over Heat Load (considering EfW Availability)
30	3189
30,75	3184
31,5	3179
32,25	3175
33	3170
33,75	3164
34,5	3159
35,25	3153
36	3147
36,75	3142
37,5	3136
38,25	3131
39	3125
39,75	3115
40,5	3104
41,25	3096
42	3084
42,75	3076
43,5	3066
44,25	3053
45	3041
45,75	3021
46,5	3011
47,25	2996
48	2976
48,75	2957
49,5	2934
50,25	2910
51	2888
51,75	2854
52,5	2814
53,25	2786
54	2753
54,75	2724
55,5	2688
56,25	2655
56,5	2614

Form T.1.4 Heat Load Levels, and Electricity Load Levels

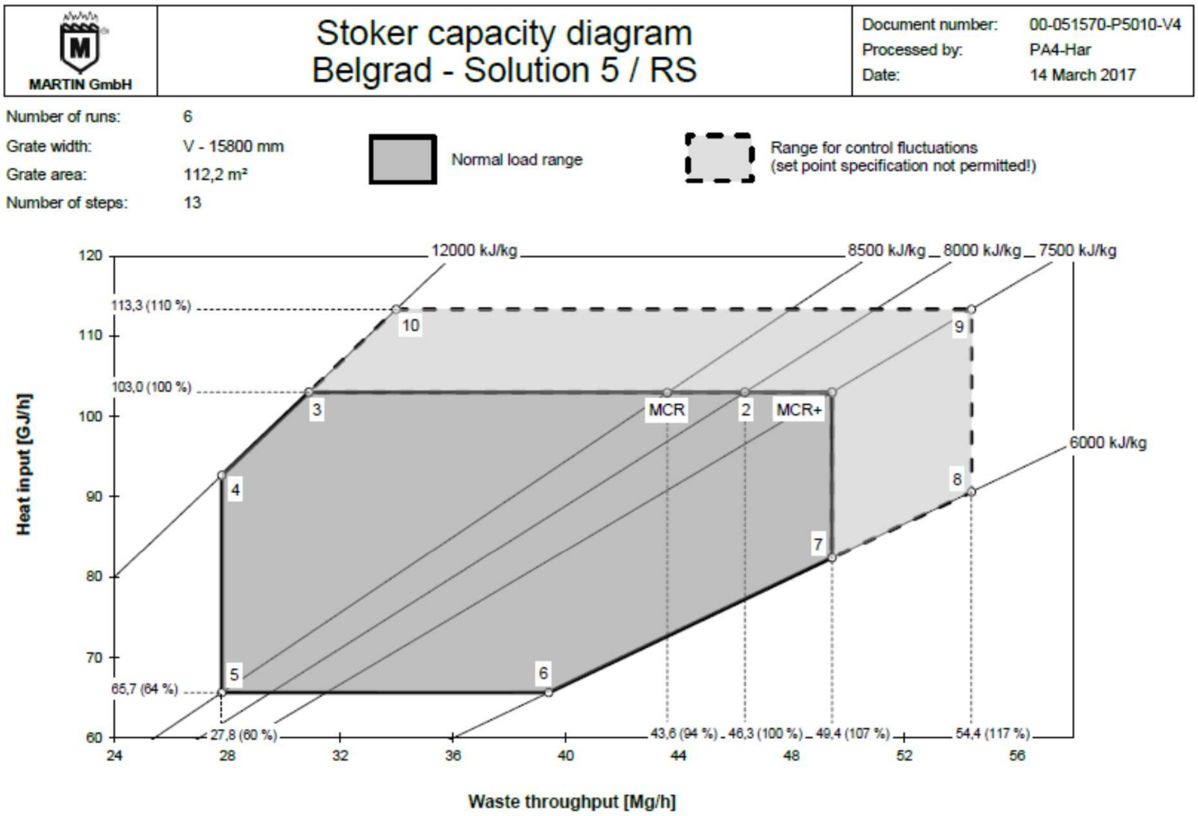
Table 1: Guaranteed Heat Load Levels and Electricity Load Levels	
Heat Load Level MWth	**Corresponding Electricity Load Level at MCR of the Contractor's Combustion Diagram MWe**
56,5	16,43
56,0	16,50
55,0	16,64
54,0	16,79
53,0	16,93
52,0	17,08
51,0	17,23
50,0	17,37
49,0	17,52
48,0	17,66
47,0	17,81
46,0	17,95
45,0	18,10
44,0	18,24
43,0	18,39
42,0	18,53
41,0	18,68
40,0	18,82
39,0	18,97
38,0	19,11
37,0	19,26
36,0	19,40
35,0	19,55
34,0	19,69
33,0	19,84
32,0	19,99
31,0	20,13
30,0	20,28

Heat Load Level MWth	Corresponding Electricity Load Level at MCR of the Contractor's Combustion Diagram MWe
29,0	20,42
28,0	20,57
27,0	20,71
26,0	20,86
25,0	21,00
24,0	21,15
23,0	21,29
22,0	21,44
21,0	21,58
20,0	21,73
19,0	21,87
18,0	22,02
17,0	22,16
16,0	22,31
15,0	22,45
14,0	22,60
13,0	22,75
12,0	22,89
11,0	23,04
10,0	23,18
9,0	23,33
8,0	23,47
7,0	23,62
6,0	23,76
5,0	23,91
4,0	24,05
3,0	24,20
2,0	24,34
1,0	24,49
0,0	24,63

Form T.1.5 Combustion Diagram

Parameters for the Combustion Diagram

Parameter	Value	
Nominal point (Facility)	Nominal throughput: 43.6.Mg/h – 1046.4 Mg/Day	Design LHV: 8,500 kJ/kg
Thermal input from waste at nominal point (100 per cent MCR) excluding heat input from air pre-heaters	103 megawatt thermal	
Minimum LHV of the waste to be processed	6,000 kJ/kg	
Maximum LHV of the waste to be processed	12,000 kJ/kg	
LHV range at 100% MCR	7,500 – 12,000 kJ/kg	



Form T.1.6 Energy Efficiency R1 factor

According to the Guidelines on the interpretation of the R1 Energy efficiency formula for Incineration facilities dedicated for the processing of municipal solid waste according to Annex II of Directive 2008/98/EC on waste

The plant is designed to meet an expected efficiency performance value of approximately 0,726 in Electrcity only mode and 0,885 in CHP mode, with the efficiency calculated in accordance with the following formula:

[Ep - (Ef + Ei)] / [0,97 * (Ew + Ef)] > 0.65

The definition and expected values for the different parameters are provided below and are calculated on an annual basis (at nominal conditions Xno):

				A	B
Parameter	**Definition**	**Equivalence Factor**	**Unit**	**Expected Value Electricity Only**	**Expected Value CHP mode**
1)Ep	**Ep** means annual energy produced as heat or electricity. It is calculated with energy in the form of electricity being multiplied by 2.6 and heat produced for commercial use multiplied by 1.1		GJ/year	2 062 944	2 507 762
	Ep = (Epe + Eph) with:				
Epe	**Epe** = total **generated** electricity	**x 2.6**	GJ/year	2 062 944	1 814 762
	= power output at generator outlet **at nominal load** after 8'000 hours [of operation MW] x 8000 [h/y] x 0.95 x 3.6 [GJ/MWh]				
	0.95 is a correction factor that accounts for boiler continuous blow-down and for potential turbine lower efficiency with load variations, ambient Temperature variations, fouling of the ACC				
Eph	**Eph** = total exported heat	**x 1.1**	GJ/year	-	693 000
Nota:	**Transport losses, inefficient use by third parties and transformation of heat into electricity by third parties** Ep is the energy produced by the incineration facility. The fact that energy is used inefficiently by third parties shall not be taken into account and shall have no effect on the R1 energy efficiency formula. The same applies in the case of energy losses due to transport of heat energy.				
	Backflows and return flows of generated energies Backflows from external sources shall be deducted from Ep as they directly lower the rate of energy recovery from waste.				
2)Ef	**Ef** means annual energy input to the system from fuels contributing to the production of steam	**x 1.0**	GJ/year	6 909	6 909
	Ef = 50% of heat input used in start-up/auxiliary burners				
	= 50% x LHV oil/gas x number of boilers x (4.5 x guaranteed oil/gas usage for cold start-up per boiler + 6 x guaranteed oil/gas usage for shutdown per boiler) [GJ/y]				
Nota:	50% is an accepted ratio for the part of the heat usage through the burners that produces steam				
	4.5 accounts for 3 cold start-ups and 3 warm start-ups per year, assuming oil/gas consumption for warm start-up being half of a cold start-up				
	LHV of gas oil of 42.65 MJ/kg is assumed				
	No equivalence factor applies for fuels (fuel-oil, gas …), i.e. the actor is 1				
3)Ew	**Ew** means annual energy contained in the treated waste calculated using the lower net calorific value of the waste		GJ/year	2 890 000	2 890 000
	Ew = **Nominal** plant throughput [t/y] x design LHV [GJ/t]				
4)Ei	**Ei** means annual energy imported excluding Ew and Ef		GJ/year	15 170	15 170
	Ei = Eie + Eih with:				
Eie	**Eie** = Electricity import	**x 2.6**	GJ/year	8 260	8 260
	= (Guaranteed Plant electrical consumption [MW] x 150 h/annum + 0.5 MW x 760 h/annum) x 3.6 [GJ/MWh]				
	150 h/annum accounts for electricity import during unplanned turbine shutdown + the annual time required for start-ups				
Nota:	500 kW x 760 h/annum accounts for for electricity import for maintenance during total plant shutdowna nd when no incineration takes place				
Eih	**Eih =** External heat consumed for process purposes (SCR…)	**x 1.1**	GJ/year	6 909	6 909
	+ 50% x total oil/gas usage start-ups and shutdwons	**x 1.0**			
Nota:	The consumption at the burner during start-up and shut down periods is roughly 50%without steam being produced (Ei) and 50 % with steam production (Ef)				
0,97	**0.97** is a factor accounting for energy losses due to bottom ash and radiation.			0,97	0,97
R1 - Efficiency Performance	**[Ep - (Ef + Ei)] / [0,97 * (Ew + Ef)]**			0,726	0,885

Form T.1.7 Guaranteed Performance Levels

Instructions: Bidder to use this template for Schedule [2], Part [5] and for Schedule [12] setting out the applicable parameter in accordance with the Schedules and to extend the tables to reflect the performance of its technical proposal, if required.

Table 1: Main Facility					
Guaranteed Performance Levels for			**Main Facility : Energy from Waste**		
No	**Parameter**	**Unit**	**Reference Level *(value)***	**Monitoring frequency**	**Monitoring methodo-logy**
Operating Parameters					
1	Minimum flue gas temperature for at least 2 seconds residence time after introduction of last combustion air (without additional fuel when working between 75 and 110% of Xmcr),	°C	850	Continuous	Temperature Sensor
2	Point Xmcr on the Combustion Diagram, continuous Acceptable Waste throughput at MCR (corrected in function of the actual LCV)	t/h	43,6	continuous	Weighing on grab
3	Continuous thermal capacity	MW(th)	103	Taking over	FDBR
4	Minimum gross electrical power output capacity at 100% MCR clean boiler, without any heat export	MW (e)	29,15	Continuous	Electricity meter
5	Minimum net electrical power output capacity at 100% MCR, clean boiler, without any heat export	MW (e)	25,8	Continuous	Electricity meter
6	Gross heat output at 100% MCR and 100% demand maximum heat load to the Heat Off-Taker	MW(th)	56,5	Continuous	Heat offtake meter
7	Minimum net electrical power output capacity at 100% MCR, clean boiler, maximum heat export to the Heat Off-Taker	MW (e)	20,6	Continuous	Electricity meter
8	Energy efficiency R1 factor			*Schedule [12]:* Once after 6 months Services *Schedule [2], Part [5]:* Once every year	
9	Landfilled MW Process Residues	t/d	245	Truck outlet	Weighing
9a	Bottom ash (Unburned matter)				
	a) TOC	% w/Lw	3	Yearly	EN 13137

Table 1: Main Facility					
Guaranteed Performance Levels for			**Main Facility : Energy from Waste**		
No	**Parameter**	**Unit**	**Reference Level *(value)***	**Monitoring frequency**	**Monitoring methodo-logy**
	b) Ignition loss	% w/w	5	Yearly	EN 12879
9b	Fly ash				
	a) leachability after solidification for acceptability in a landfill for non hazardous waste (not applicable if treatment as hazardous waste by an external company) **Soluble fraction**	%	6	Soluble fraction daily Full analysis yearly	Soluble fraction in % (NFT 90 029) Leaching test from a massive sample (NF X 31-211)
9c	FGT Residues				
	a) leachability after solidification for acceptability in a landfill for non hazardous waste (not applicable if treatment as hazardous waste by an external company) **Soluble fraction**	%	6	Soluble fraction daily Full analysis yearly	Soluble fraction in % (NFT 90 029) Leaching test from a massive sample (NF X 31-211)
Emission monitoring					
1	Noise	dB (A)	55	Taking Over	Noise measurement
2	Air emissions				
	a) HCl	mg/Nm³	10	Continuous	Sensor
	b) HF	mg/Nm³	1	Continuous	Sensor
	c) SOx as SO2	mg/Nm³	50	Continuous	Sensor
	d) NOx as NO2	mg/Nm³	200	Continuous	Sensor
	e) Particulates	mg/Nm³	10	Continuous	Sensor
	f) PCDD/F	ng/Nm3	0,1	Yearly 6 to 8 h sample	Laboratory analysis
	g) Hg	mg/Nm³	0,05	0,5 to 8 h sample	Laboratory analysis
	h) Cd + Tl	mg/Nm³	0,05	0,5 to 8 h sample	Laboratory analysis
	i) Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V	mg/Nm³	0,5	0,5 to 8 h sample	Laboratory analysis
Quality monitoring of recyclable/recoverable products and/or materials *(please specify monitored parameters required by market)*					
Ferrous metal : % magnetic metal recoverable		%	>55	1/ 3months	Mass balance done by buyer
Ferrous metal : % water		%	<10	1/ 3months	Mass balance done by buyer
Non-ferrous metals		N/A	N/A	N/A	N/A
other materials *(please specify)*		N/A	N/A	N/A	N/A

Table 3: CDW Treatment Facilities					
Guaranteed Performance Levels for			**CDW Treatment Facility Non-Inert CDW separation**............................ *(name of Facility)*		
No	**Parameter**	**Unit**	**Reference Level** ***(value)***	**Monitoring frequency**	**Monitoring Methodology**
Operating Parameters					
1	CDW throughput capacity	t/d	2400		
	a) Reference operating hours	h/d	8		
	b) Reference operating hours	h/a	2080		
2	Design outputs at Base Case *(please specify)*				
	a) Inert CDW quantity	t/d	2 400		
Emission monitoring					
1	Noise	dB (A)	70 at Site boundaries	As required	EU standard
2	Air emissions				
	a) Dust	mg/m³	30	As required	EU standard
	b) others *(please specify)*				
Guaranteed Performance Levels for			**.CDW Treatment Facility Inert CDW Treatment..**		
Operating Parameters					
1	CDW throughput capacity	t/d	2400		
	a) reference operating hours	h/d	8		
	b) reference operating hours	h/a	2080		
2	Design outputs at Base Case				
	a) Recovered Inert CDW quantity	t/d	1 680		
Emission monitoring					
1	Noise	dB (A)	70 at Site boundaries	As required	EU standard
2	Air emissions				
	a) Dust	mg/m³	30	As required	EU standard
Quality monitoring of recyclable/recoverable products and/or materials					
1	Crushed concrete	mm	0-32	As per needs	Sieving
2	Crushed concrete	mm	32-80	As per needs	Sieving
3	Crushed concrete	mm	80-150	As per needs	Sieving

Table 4: Leachate Treatment Facility					
Guaranteed Performance Levels for			**Leachate Treatment Facility.........................** *(name of Facility)*		
No	**Parameter**	**Unit**	**Reference Level *(value)***	**Monitoring frequency**	**Monitoring Methodo-logy**
Operating Parameters					
1	Design capacity	m^3/d	310 m3/d	Continuous	Flowmeter
Environmental monitoring					
1	Noise		<70 dB at 10 m	On taking over and as required after	Noise measurement at 10m from the Equipment
2	Air emissions		None		
	a) Odour		None	On taking over	Emission concentration / Odor Unit
3	Effluent Water				
	a) BOD5	mgO2/l	<20	1/month	Lab analysis
	b) COD	mgO2/l	<200	1/week	Lab analysis
	c) pH		6.5-9	Continuous	Online analyser
	d) suspended solids	mg/l	<35	1/week	On site lab analysis
	e) Total inorganic niotrogen (NH4-N, NO3-N, NO2-N)	mg/l	<70	1/week	On site colorimetric laboratory analysis
	f) AOH	mg Cl/l	<0.5	1/month	Lab analysis
	others (please specify) Conductivity g) Temperature	µS/cm °C	< 100 < 30°C	Continuous Continuous	online analyser Online analyser

Table 5: Landfill Gas Facility					
Guaranteed Performance Levels for			**Landfill Gas Facility.........................** *(name of Facility)*		
No	**Parameter**	**Unit**	**Reference Level *(value)***	**Monitoring frequency**	**Monitoring Methodology**
Operating Parameters					
1	Minimum gross electrical power output capacity	MW(e)	1,56 x 2 units	Continuous	Electricity meter
2	Minimum net electrical power output capacity	MW(e)	1.48 x 2 units	Continuous	Electricity meter
4	Flare Temperature	°C	900°C	Continuous	Thermocouple sensor for temperature monitoring + UV probe as flame detector
5	Availability of flare	h/a	8736		
Environmental monitoring					
1	Noise		65 dB at 10 m for gas engine	On taking over and as required after	Noise measurement at 10m from the motor's building
2	Air emissions				
	for gas engine *(please specify)*		Emissions on mg/Nm3 @ 5% O_2 : NO_x < 500 CO < 50 VOCNM < 650 Dust < 100	Yearly	Site sampling and laboratory analysis
	for flare *(please specify)*		T°C > 900°C during 0.3s Emissions on mg/Nm3 @ 5% O_2 : SO_2 < 300 CO < 150	On taking over and as required after Yearly	Temperature probe Site sampling and Laboratory analysis

Form T.1.8 Key Dates

Milestone	Date
Effective Date Longstop Date	means 31 December 2018
Shared Risk Consent Longstop Date	means: (a) in relation to the Use Permit, the date falling 1,341 days after the Effective Date; (b) in relation to the Integrated Permit, the date falling 1,783 days after the Effective Date]; and (c) in relation to the ruling from the relevant Ministry confirming the fitness of the Contractor to provide communal services, the date falling 1,187 days after the Effective Date; and (d) in relation to the EMS Connection, the date falling 995 days after the Effective Date]; (e) in relation to the electricity (generation) license required under the energy Law, the date falling 1,374 days after the Effective Date]; and (f) in relation to license required under Applicable Law for the production of heat, the date falling 1,374 days after the Effective Date].
Planned Works Commencement Date	means the date falling 1 day after the Effective Date
Works Commencement Longstop Date	means the date falling 12 months after the Effective Date
Planned Interim Services Commencement Date	means the date falling 366 days after the Effective Date
Planned Readiness Date	means the date falling 952 days after the Effective Date
Readiness Longstop Date	means the date falling eighteen (18) Months after the Planned Readiness Date
Planned Acceptance Date	means the date falling 1,005 days after the Effective Date

Planned Services Commencement Date	means the date falling 1,005 days after the Effective Date
Acceptance Longstop Date	means the date falling eighteen (18) Months after the Planned Acceptance Date
Planned Existing Landfill Remediation Works Completion Date	means the date falling 1,277 days after the Effective Date
Landfill Remediation Works Completion Longstop Date	means the date falling forty eight (48) Months after the Planned Landfill Remediation Works Completion Date
Expiry Date	means the [25th] anniversary of the Planned Services Commencement Date

Heat Transmission Infrastructure Dates	**Date**
Planned Heat Transmission Infrastructure Works Commencement Date	means the date falling 30 days after the Effective Date
Planned Heat Transmission Infrastructure Readiness Date	means the date falling 69 days before the Planned Readiness Date
Planned Heat Transmission Infrastructure Acceptance Date	means the date falling 52 days before the Planned Acceptance Date

Form T.1.9 Reviewable Design Data

The Consortium generally intends to submit to the City under the Review Procedure the Design Data related to the conceptual design of all Facilities (Serbian: *idejno rešenje - IDR*)

WORKS DELIVERY PLANS

Form T.2.2 Conceptual Project Overview

The Consortium formed by Suez-Itochu for the Project will develop the following facilities in order to achieve the Project objectives in a safe, reliable and cost-efficient manner.

1. Energy from Waste Facility

The Energy-from-Waste Facility will be designed, built and commissioned by CNIM, a leading EPC Contractor in the field of waste incineration (please note that the EPC Contract with CNIM has been fully negotiated and developed in agreed form and is ready for execution on the Contract Date).

The Facility will have a single line capacity of 43.6 t/h of MSW at LHV of 8,500 KJ/kg allowing to process every year between 340,000 and 380,000 tons of waste depending on the effective LHV. The facility is based on the proven reverse acting grate technology and a vertical heat recovery boiler. The 60bar/400°C steam cycle coupled to a turbine and air-cooled condensers will deliver approx. 29 MW gross power and 26 MW net power to the grid. In case of connection to the district heating system, the facility will be able to deliver up to 56 MWth. Due to its high energy efficiency, the EfW facility will comply with the R1 energy factor irrespective of the energy output mode (CHP or power only).

Flue gases will be cleaned by injection of lime and activated carbon. Non-catalytic selective reduction (SNCR) of Nox will be achieved by liquid urea solution injection. The Air Pollution Control Residues (APCRs) will be then processed into a dedicated facility and mixed with cement, blast furnace slag and leachates from the Landfills to produce a solidified and stabilized concrete satisfying the criteria of non-hazardous waste. Solidified APCRs (assumed to be produced in the amount of approx. 33,000 tpa from 13,600 tpa extracted from the FGT system) will be landfilled at a dedicated area at the New Landfills for Treatment Residues.

Incineration Bottom Ashes (approx. 91,000 tpa) will be processed at a plant within the EfW Site to remove metals (approx. 4,300 tpa) and prepare two aggregate fractions of 0-40mm and 40-300mm. Processed IBAs will be cured during 12 weeks before they can be off-taken for reuse in external roadworks or for intermediate covers and capping at the New Landfills. In the Base Case Model, the Consortium took the conservative approach to assume that there will be no commercial off-take available for IBA aggregates, and that 25,500 tpa can be reused at the New Landfills (assuming a coefficient of 0,14 m3 of cover/capping for each m3 of compacted waste landfilled). The remaining IBA production (55,600 tpa) is assumed to be disposed at the New Landfill for Treatment Residues.

Overall, the EfW Facility will allow to divert from landfill approx. 252,000 tpa and thus achieve a recovery rate of 73%. The Consortium is therefore able and willing to commit on the Key Performance Indicator of diverting minimum 238,000 tpa of waste from landfill.

Starting from the Effective Date, the EfW Facility will be built over an expected time of 34 months, allowing to achieve Services Commencement Date in October 2021.

2. Construction and Demolition Waste Facility

The CDW recovery facility will have a 200,000 tpa capacity and is designed to process various types of demolition waste and excavated materials in a flexible and efficient manner; the infrastructure will be designed and built by Energoprojekt Niskogradnja, a prime Serbian engineering and civil works contractor, who will also deliver the whole of the Landfill Works (please note that the EPC Contract with Energoprojekt Niskogradnja has been fully negotiated and developed in agreed form and is ready for execution on the Contract Date);

This installation will be developed as a heavy-duty platform on a 1.7ha plot and fitted with Metso (or equivalent) crusher and sieving unit producing aggregates in sizes of 0-40, 40-80 and 80-150mm. The plant will be serviced by heavy machinery (hydraulic excavator with multiple fittings and a wheel loader). The process capacity is estimated to 300 tons/hour so the technology will in no way limit the ability to process CDW into recoverable materials. In case of lack of external off-take possibility, the processed CDW will be stored on a designated area at the Existing Landfill (post remediation works) up to the minimum Pre-Agreed Recycled CDW Storage Tonnage. The CDW Facility is planned to be built within 1 year of the Effective Date to allow achieving the Interim Services Commencement date at the end of 2019. Based on the above, the Consortium is able and willing to commit on the Key Performance Indicator of achieving a 70% recovery rate on CDW.

3. New Landfills

The Consortium has designed the New Landfills with the purpose of maximising the available voidspace to cover the full project lifetime and several years thereafter. In particular, the voidspace available at the New Landfills for RMW Unprocessed and Treatment Residues will be approx.. 8.5 million m3, thus exceeding by 20% the required voidspace of 7.1 million m3 calculated in the Base Case Waste Flow Model for the purposes of the project.

The full capacity will be developed overtime, but it is planned that during the Works Phase, the Landfill EPC Contractor (Energoprojekt Niskogradnja) will develop as much as 1,3 million m3, of which 0.9 million from 1 year of the Effective Date to allow starting of the Interim Services. The works on the New Landfills will continue until end of 2020 in parallel with the Exisiting Landfill Remediation Works

The New Landfills will be designed and built in accordance with the Landfill Directive by Energoprojekt Niskogradnja, and comprise several ancillary facilities including an Operations platform, reservoirs for leachates and run-off water, access roads etc.

4. Leachate Treatment Facility

The Leachate Treatment Facility will be based on reverse osmosis (RO) technology to concentrate leachates followed by reduction of brines through a vacuum evaporator equipped with mechanical vapor compression separating condensates from clean water

The Facility will have a capacity of 90,000 m3/year which is the peak estimated production of leachates from both the Existing and the New Landfills. The Facility will be installed, tested and commissioned by SUEZ (acting through the O&M Contractor) during the Works Period and be available at the Interim Services Commencement Date. Considering its location at the downstream point of the Existing Landfill, it is however crucial that the City timely executes the Dam in order to allow access to the facility's planned area.

5. Landfill Gas Facility

The Landfill Gas Recovery Facility will be be comprised of 2 flares and 2 biogas gensets of 1,5 MW each, connected to the collection networks of the Existing Landfill and the New Landfill. The engines will be installed on the EfW site in order to enhance energy recovery by connecting a heat loop to the EfW primary air heating system, whereas the flares will be located at the landfill's operation platform..

All equipment will be installed, tested and commissioned by SUEZ (acting through the O&M Contractor) during the Works Period. It is planned that the flares shall be operational by the Interim Services Commencement Date and the biogas engines by the Services Commencement Date (in parallel with the 110 kV connection to the grid).

6. Existing Landfill Remediation Works

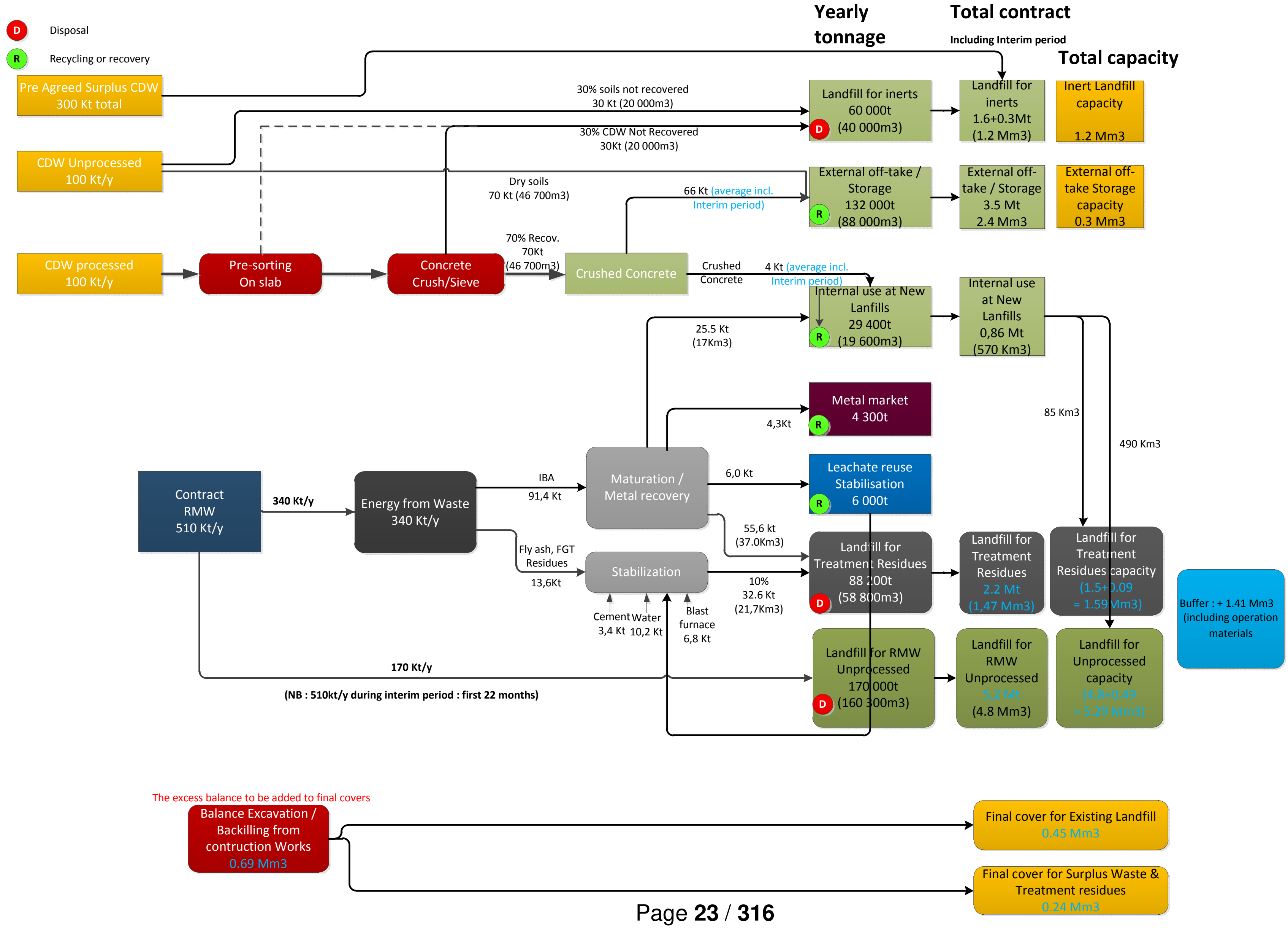
The Existing Landfill Remediation Works will be carried out by Energoprojekt Niskogradnja as of the Interim Services Commencement Date and will comprise a full reshaping of the landfill body, involving the movement of 800,000 m3 of waste. The landfill will be surrounded by a dyke with leachate drains on its internal slope and run-off water ditches on the external side. The dyke will not fulfill a stabilization purpose as stability calculations guarantee that the remediated landfill will be self-stable. The capping concept will include a double liner to divert run-off water and conduct biogas to the landfill Gas Facility. Biogas wells will be drilled every 25 meters to allow an optimum capture ratio. Finally, an area will be dedicated on the Existing Landfill to accommodate the Pre-Agreed Recycled CDW tonnage.

The Landfill Remediation Works are planned to be completed mid-2022 at the latest.

7. Project Management

The overall project supervision will be undertaken by Suez under a specific Project management Agreement entered into with the SPV. The supervision will cover all aspects of the supervision of the EPC Contractors and other suppliers.

The Waste Flow Diagram attached in the following page illustrates the intended waste management strategy of the Consortium for the Project.



Disposal
Recycling or recovery
Yearly tonnage
Total contract
Including Interim period
Total capacity
Pre Agreed Surplus CDW 300 Kt total
CDW Unprocessed 100 Kt/y
CDW processed 100 Kt/y
Pre-sorting On slab
Concrete Crush/Sieve
Crushed Concrete
30% soils not recovered 30 Kt (20 000m3)
30% CDW Not Recovered 30Kt (20 000m3)
Dry soils 70 Kt (46 700m3)
66 Kt (average incl. Interim period)
70% Recov. 70Kt (46 700m3)
Crushed Concrete
4 Kt (average incl. Interim period)
25.5 Kt (17Km3)
Landfill for inerts 60 000t (40 000m3)
Landfill for inerts 1.6+0.3Mt (1.2 Mm3)
Inert Landfill capacity 1.2 Mm3
External off-take / Storage 132 000t (88 000m3)
External off-take / Storage 3.5 Mt 2.4 Mm3
External off-take Storage capacity 0.3 Mm3
Internal use at New Lanfills 29 400t (19 600m3)
Internal use at New Lanfills 0,86 Mt (570 Km3)
Metal market 4 300t
4,3Kt
85 Km3
490 Km3
Contract RMW 510 Kt/y
340 Kt/y
Energy from Waste 340 Kt/y
IBA 91,4 Kt
Maturation / Metal recovery
6,0 Kt
Leachate reuse Stabilisation 6 000t
55,6 kt (37.0Km3)
Fly ash, FGT Residues 13,6Kt
Stabilization
10% 32.6 Kt (21,7Km3)
Cement 3,4 Kt
Water 10,2 Kt
Blast furnace 6,8 Kt
Landfill for Treatment Residues 88 200t (58 800m3)
Landfill for Treatment Residues 2.2 Mt (1,47 Mm3)
Landfill for Treatment Residues capacity (1.5+0.09 = 1.59 Mm3)
Buffer : + 1.41 Mm3 (including operation materials
170 Kt/y
(NB : 510kt/y during interim period : first 22 months)
Landfill for RMW Unprocessed 170 000t (160 300m3)
Landfill for RMW Unprocessed 5.2 Mt (4.8 Mm3)
Landfill for Unprocessed capacity (4.8+0.49 = 5.29 Mm3)
The excess balance to be added to final covers
Balance Excavation / Backilling from contruction Works 0.69 Mm3
Final cover for Existing Landfill 0.45 Mm3
Final cover for Surplus Waste & Treatment residues 0.24 Mm3

Form T.2.2.1 Project Overview

Form T.2.2.2 Complete List of Facilities

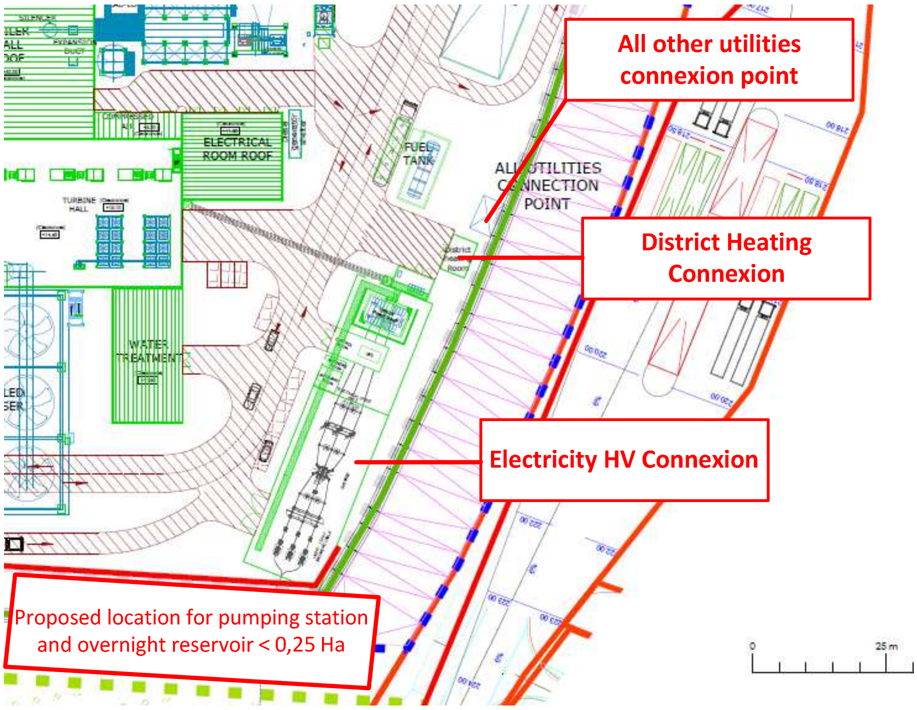
No. of Facility	Works Delivery Plan	Name of Facility
0	WDP 0	Registration/Weighing
1.2	WDP 1	Main Facility
2	WDP 2	CDW Treatment and Storage Facility
3.1	WDP 3.1	New Landfill for RMW Landfilled Unprocessed
3.2	WDP 3.2	New Landfill for Landfilled MW Process Residues
3.3	WDP 3.3	New Landfill for Inert Waste
4	WDP 4	Leachate Treatment Facility
5	WDP 5	Landfill Gas Facility
6	WDP 6	Existing Landfill Remediation Works

Form T.2.2.3 Site

Form T.2.2.3.1 Site Layout

The Overall Site Layout showing the Project Facilities is provided in the Schedule of Maps and Drawings under reference WDP04 – General Plan of New Landfill.

The following drawing shows the main utilities connexions and a proposition of location for the overnight reservoir and the pumping station requested by City.



The following drawing indicates an hypothetical extension area for the Main Facility in the future but would require the relocation of the IBA maturation area. Please refer to Schedule of Maps and Drawings under reference 0A1401-0202-62G509-B-Footprint possible extentions.pdf.

DRAWING - 0A1401-0202-62G509-B-Footprint possible extentions.pdf.

Form T.2.2.3.2 Site Information

The Plan "Vinca Landfill Site Property 01" in the Schedule of Maps and Drawings provides an overall view on the intended use of the Site by the Consortium and the respective footprint of each of the Project Facilities.

The land requirements and topographical levels for each Facility are presented here below:

No. of Facility	Works Delivery Plan	Name of Facility	Total Land requirement	Topographical levels Min/max	
0	WDP 0	Registration/Weighing	1,500 m^2	220m	
1.2	WDP 1.2	EfW Facility	40,000 m^2	214m	219m
2	WDP 2	CDW Treatment and Storage Facility	18,200 m^2	210m	
3.1	WDP 3.1	New Landfill for RMW Landfilled Unprocessed	211,400 m^2	174m	260m (after backfilling)
3.2	WDP 3.2	New Landfill for Landfilled MW Process Residues	80,600 m^2		
3.3	WDP 3.3	New Landfill for Inert Waste	113,100 m^2	130m	207m (after backfilling)
4	WDP 4	Leachate Treatment Facility	10,500 m^2 (upper) 11,500 m^2 (lower)	160m 90m	
5	WDP 5	Landfill Gas Facility	within EfW site	214m	219m
6	WDP 6	Existing Landfill Remediation Works	426,000 m^2	107.5m	192.5m

Amendments of the PDR to be procured by City.

In accordance with the City's obligations to align the spatial and urbanistic planning documents to the extent required in order to allow the Contractor to implement the Project, it will be necessary that the City update the Detailed Plan of Regulations in all necessary aspects to make it compliant with the objectives of the Project, the type, size, footprint and capacity of the Facilities.

City's attention is particularly drawn on :

- the differences in the list of facilities, namely on the K4 area : the Consortium's solution does not include municipal waste sorting/ recycling facility, a bulky waste dismantling facility, a mechanical-biological treatment facility or a RDF cogeneration facility – as currently described in the DPR - and provides instead for a mass-burning energy-from-waste facility

- the difference in capacity between the planned RDF cogeneration facility (150,000-200,000 tons) in the DPR and the EfW facility proposed by the Consortium (340,000 tons)

- the required changes to the footprint and destination of the DPR zones (K1 to K5) as well as their respective sub-zones.

The Map "Vinca Site Facilities Footprint vs DPR Rev 01" attached in the Schedule of Maps and Drawings illustrates the respective footprint of each of the Facilities against the different zones currently defined in the DPR, that will need to be adjusted accordingly.

In order for the Consortium to timely develop its design and permitting activities and reach the Effective Date by 31 December 2018, it is necessary that the City undertake, in close cooperation with the Contractor, an amendment to the DPR that will need to be in full force by early May 2018 (see Form T.2.6 – Project Time Schedule, Tasks 16-40), in particular to allow the Contractor to apply for Location Conditions and proceed with subsequent design stages).

Form T.2.2.3 Base Case Waste Flow Summary with Calculations of Bidder's guaranteed Inputs to the PPP Contract

Form T.2.2.4 Final Disposal Plan

Form T.2.2.4.1 General Approach

The general approach for of the Consortium's disposal plan is based on the schedule of development of the Project Facilities.

Following the initial design and permitting phase necessary to reach the Effective Date, the Consortium will execute the construction programme as follows:

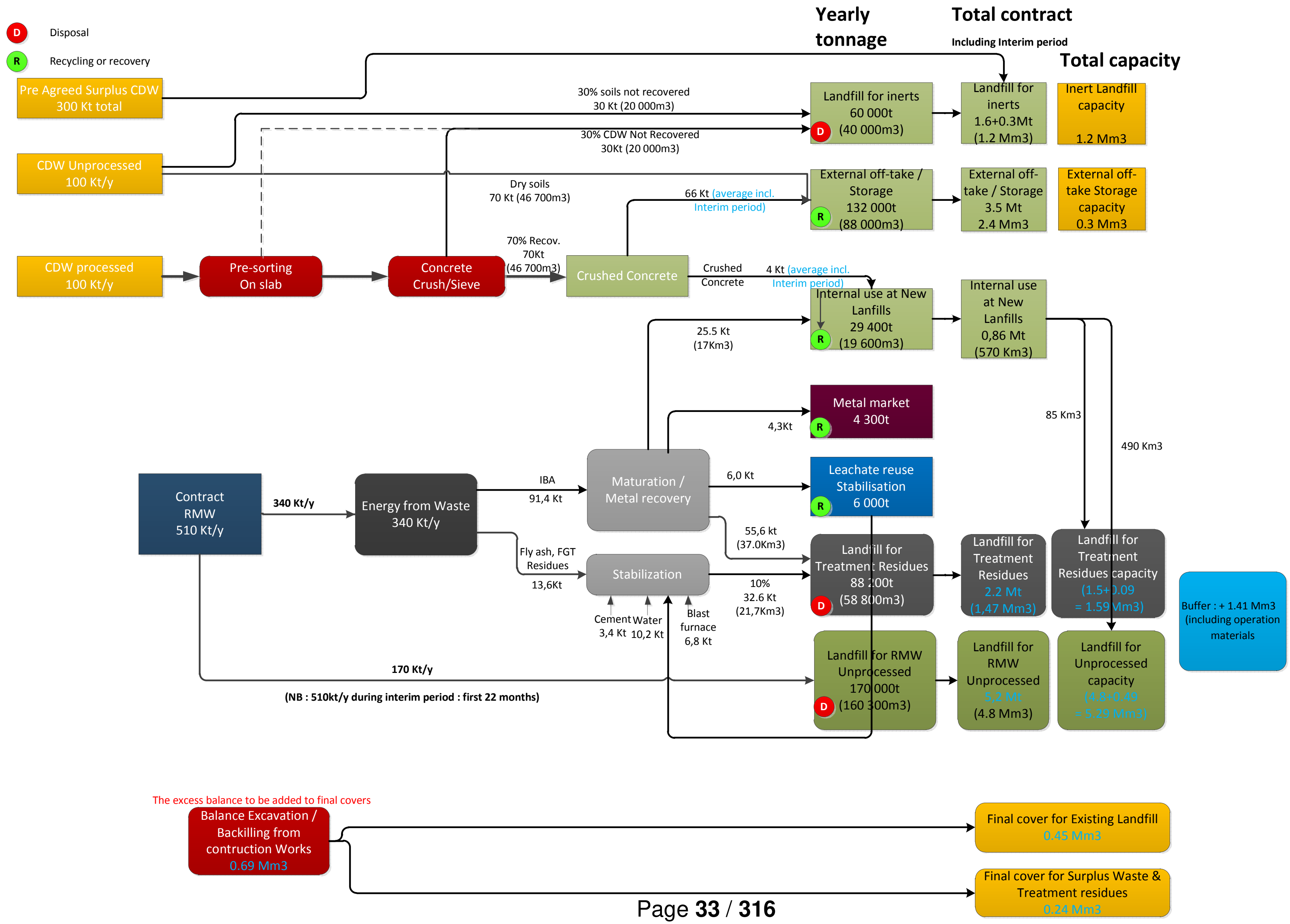
- from January through December 2019, the Consortium will build an initial capacity at the New Landfills and the ancillary facilities, in order to reach the Interim Services Commencement Date on 1 January 2020;

- in parallel with Interim Services, the Consortium will continue the construction of voidspace at the New Landfills, in order to create additional capacity for Surplus Waste and Treatment Residues before the completion of the EfW Facility at the end of September 2021;

The following table presents the total tonnage planned to be landfilled at the Site over the project lifetime, summarized from the Base Case Waste Flow Model:

	Tons	m^3
New Landfill for RMW Landfilled Unprocessed	**5 141 452**	4 850 426
Intermediate covers + final capping	*989 487*	659 658
New Landfill for Landfilled MW Process Residues - IBAs not recovered	**1 389 758**	926 505
Intermediate covers + final capping	148 704	99 136
New Landfill for Landfilled MW Process Residues - stabilized APCR s	**816 000**	544 000
Intermediate covers + final capping	87 312	58 208
New Landfill for Inert Waste	**1 928 877**	1 285 918
Pre-Agreed Recycled CDW Storage Tonnage	**420 000**	**280 000**

The following waste flow diagram gives a graphic representation of the planned generation of waste throughout the project lifetime, and the corresponding disposal capacity requirements.



Yearly tonnage
Total contract
Including Interim period
Total capacity
D Disposal
R Recycling or recovery
Pre Agreed Surplus CDW 300 Kt total
CDW Unprocessed 100 Kt/y
CDW processed 100 Kt/y
Pre-sorting On slab
Concrete Crush/Sieve
Crushed Concrete
30% soils not recovered 30 Kt (20 000m3)
30% CDW Not Recovered 30Kt (20 000m3)
Dry soils 70 Kt (46 700m3)
66 Kt (average incl. Interim period)
70% Recov. 70Kt (46 700m3)
Crushed Concrete
4 Kt (average incl. Interim period)
25.5 Kt (17Km3)
Landfill for inerts 60 000t (40 000m3)
Landfill for inerts 1.6+0.3Mt (1.2 Mm3)
Inert Landfill capacity 1.2 Mm3
External off-take / Storage 132 000t (88 000m3)
External off-take / Storage 3.5 Mt 2.4 Mm3
External off-take Storage capacity 0.3 Mm3
Internal use at New Lanfills 29 400t (19 600m3)
Internal use at New Lanfills 0,86 Mt (570 Km3)
Metal market 4 300t
4,3Kt
Leachate reuse Stabilisation 6 000t
6,0 Kt
85 Km3
490 Km3
Contract RMW 510 Kt/y
340 Kt/y
Energy from Waste 340 Kt/y
IBA 91,4 Kt
Maturation / Metal recovery
Fly ash, FGT Residues 13,6Kt
Stabilization
Cement 3,4 Kt
Water 10,2 Kt
Blast furnace 6,8 Kt
55,6 kt (37.0Km3)
10% 32.6 Kt (21,7Km3)
Landfill for Treatment Residues 88 200t (58 800m3)
Landfill for Treatment Residues 2.2 Mt (1,47 Mm3)
Landfill for Treatment Residues capacity (1.5+0.09 = 1.59 Mm3)
Buffer : + 1.41 Mm3 (including operation materials
170 Kt/y
(NB : 510kt/y during interim period : first 22 months)
Landfill for RMW Unprocessed 170 000t (160 300m3)
Landfill for RMW Unprocessed 5.2 Mt (4.8 Mm3)
Landfill for Unprocessed capacity (4.8+0.49 = 5.29 Mm3)
The excess balance to be added to final covers
Balance Excavation / Backilling from contruction Works 0.69 Mm3
Final cover for Existing Landfill 0.45 Mm3
Final cover for Surplus Waste & Treatment residues 0.24 Mm3

Form T.2.4.2 General Site Layout

The general Layout Plans for the New Landfills and the Existing Landfill are provided in the Schedule of Maps and Drawings under the following references. As required, a detail of the boundary between the New Landfill and the Existing Landfill is also provided.

Number	Version	Designation
WDP 01	**I**	Existing landfill reshaping
WDP 04	**K**	General plan of new landfill
WDP 06	**G**	Landfill and inert cover with CDW stock
WDP 19	**B**	Details between new and existing landfill

Form T.2.4.3 Calculation of Masses and Volumes

Background calculations for the voidspace available at the New Landfills are presented below and demonstrate that the New Landfills will have a capacity exceeding by 1.4 million m3 the requirement calculated in the Base Case Waste Flow Model.

VINCA LANDFILL
LANDFILL VOLUMES
INPUT DATA

1. Input data

COVER THICKNESS (m)	Top soil	Inert Materials	Fine Material above liner	Fine Material below liner	Other	Total
Interim Landfill	0.10	0.70	0.20	0.10	0.10	1.20
Unprocessed 1	0.10	0.70	0.20	0.10	0.10	1.20
Residues 1	0.10	0.70	0.20	0.10	0.10	1.20
Unprocessed 2	0.10	0.70	0.20	0.10	0.10	1.20
Residues 2	0.10	0.70	0.20	0.10	0.10	1.20
Buffer	0.10	0.70	0.20	0.10	0.10	1.20

COVERING SURFACES OF EXTENSION (m)		RUNNING TOTAL
Interim Landfill	32 100	32 100
Unprocessed 1	27 500	59 600
Residues 1	15 200	74 800
Unprocessed 2	81 800	156 600
Residues 2	65 400	222 000
Buffer	70 000	292 000

DRAINAGE LAYER THICKNESS (m)	
Interim Landfill	0.50
Unprocessed 1	0.50
Residues 1	0.50
Unprocessed 2	0.50
Residues 2	0.50
Buffer	0.50

DRAINAGE LAYER SURFACES (m²)		RUNNING TOTAL
Interim Landfill	27 800	27 800
Unprocessed 1	35 500	63 300
Residues 1	12 500	75 800
Unprocessed 2	78 000	153 800
Residues 2	19 000	172 800
Buffer	1 100	173 900

EXPLOITATION NEEDS (%)	
Interim Landfill	10%
Unprocessed 1	10%
Residues 1	6%
Unprocessed 2	10%
Residues 2	6%
Buffer	10%

1. Landfill volumes

	Gross volume (m3)	Drainage layer volume (m3)	Cover Volume (m3)	Net Volume 1 (m3)	Exploitation needs (m3)	Net Volume 2 (m^3)
Landfill volumes						
Interim Landfill	854 000	13 900	38 520	801 580	80 158	721 422
Unprocessed 1	587 000	17 750	33 000	536 250	53 625	482 625
Unprocessed 2	4 044 000	39 000	98 160	3 906 840	390 684	3 516 156
Residues 1	211 000	6 250	18 240	186 510	11 191	175 319
Residues 2	1 445 000	9 500	78 480	1 357 020	81 421	1 275 599
Buffer	1 408 000	550	84 000	1 323 450	132 345	1 191 105
Total Landfill volume (with buffer)	8 549 000	86 950	350 400	8 111 650	749 424	7 362 226
Total Landfill volume (without buffer)	7 141 000	86 400	266 400	6 788 200	617 079	6 171 121

Waste diposal (tonnes)	Density	Waste diposal (m3) *
765 000	1.06	721 698
510 000	1.06	481 132
3 740 000	1.06	3 528 302
264 600	1.50	176 400
1 940 400	1.50	1 293 600
7 220 000		6 201 132

****NOTE :*** *the slight difference between the waste disposal volume and the calculated landfill capacity is not restraining, considering the "low" accuracy of the input hypothesis on density and exploitation needs*

Form T.2.4.4 Drawings

Additional drawings are provided in the Schedule of Maps and Drawings under the following references:

Number	Version	Designation
WDP 02	**I**	Existing Landfill Remediation Works - waste cut and fill plan
WDP 03	**I**	Existing Landfill Remediation Works - cross sections
WDP 04	**K**	General Plan of New Landfills
WDP 05	**D**	Cut and fill of New Landfills
WDP 07	**A**	General cross sections
WDP 08	**D**	Cross sections of CDW storage and Inert Landfill
WDP 09	**C**	Cross section of New Landfills for stability calculations
WDP 10.1 to WDP 10.6	**B**	3D views of Existing / New Landfills
WDP 11	**D**	New Landfills cover and bottom details, ponds details
WDP 12	**D**	Details of Peripheral dyke
WDP 13	**G**	Biogas collection system
WDP 14	**H**	Leachate collection system
WDP 15	**K**	Runoff collection system
WDP 16	**B**	Runoff drainage surfaces
WDP 17	**D**	Traffic flow
WDP 18	**B**	Peripheral dyke and protection dam connection detail
WDP 20	**D**	Weighbridges area details
WDP 21.1 to WDP 21.5	**A**	Phasing 2021 to 2046
WDP22.1 to WDP 22.3	**B**	Platforms details

Form T.2.4.5 Static Calculations

The stability of a slope can be apprehended by calculating the safety coefficient Γ of the slope. This coefficient is the ratio between the sum of the resistive forces and the sum of the driving forces. Thus, if the safety coefficient is below 1 ($\Gamma < 1$), the driving forces are greater than the resistive forces and the waste mass of the landfill is unbalanced. If the safety coefficient is above 1 ($\Gamma > 1$), it means that the resistive forces are greater than the driving forces and so that the waste mass is in a state of equilibrium.

In order to compensate for the various uncertainties, it is usually admitted that the stability of a slope is assured on short or medium term when $\Gamma > 1.3$, and on long term when $\Gamma > 1.5$. For all these reasons, we can consider that the calculation will be carried out by considering a set of maximalist hypotheses (increasing the risk).

In the case of the general stability of the considered slopes, stability calculations were carried out using the "GEO5 Slope Stability" software. Its stability valuation method consists in finding the sliding surface with a minimum safety coefficient: the software uses the method of Bishop, which is one of the most used slopes stability calculation method.

The stability studies have been carried out on the following zones of the project:

- On the Existing Landfill, according to those 2 stages of operation:
  - 1st stage : after the Existing Landfill Remediation Works and before the storage of Recycled CDW on the Recycled CDW Storage area;
  - 2nd stage : after the storage of up to 420,000 tons / 300,000 m^3 of Recycled CDW on the Recycled CDW Storage area
- On the New Landfills (for Treatment Residues and Unprocessed Waste)

(ii) **Assumptions**

Geometry

The design of the landfills has been made considering the following slopes (see the drawings and cross sections on **in schedule of maps and-drawings**):

- Recycled CDW Storage area - maximum slope : 30%
- Landfill covers maximum slopes :
  - Existing landfill : up to 25% (with 2% on berms)
  - New Landfills : 33% (plus 2% on berms)
  - Landfill for Inert Waste : 30%

The peripheral embankments of the Existing Landfill and the Dam (to be designed and built by City) are not taken into account in the stability calculations in order to check if the waste masses (on the Existing and the New Landfills) are self-stable.

Shear stress characteristics

The shear stress characteristics taken for the stability calculations follow:

Table: Shear stress characteristics

	Density kN/m3	Cohesion c' kPa	Internal friction angle ϕ' °
Natural soil	18	20	15
Cover soil	18	20	15
MSW	10	25	5
CDW and inerts	15	30	5

Those characteristics can fluctuate according to the nature and the age of the backfilling materials.

(i) Outputs

Existing Landfill Remediation Works

Two cross sections have been tested:

- Cross section CS1 ;
- Cross section CS3.

For cross each section, the stability has been analyzed on the 2 opposing slopes and for each stage of operation.

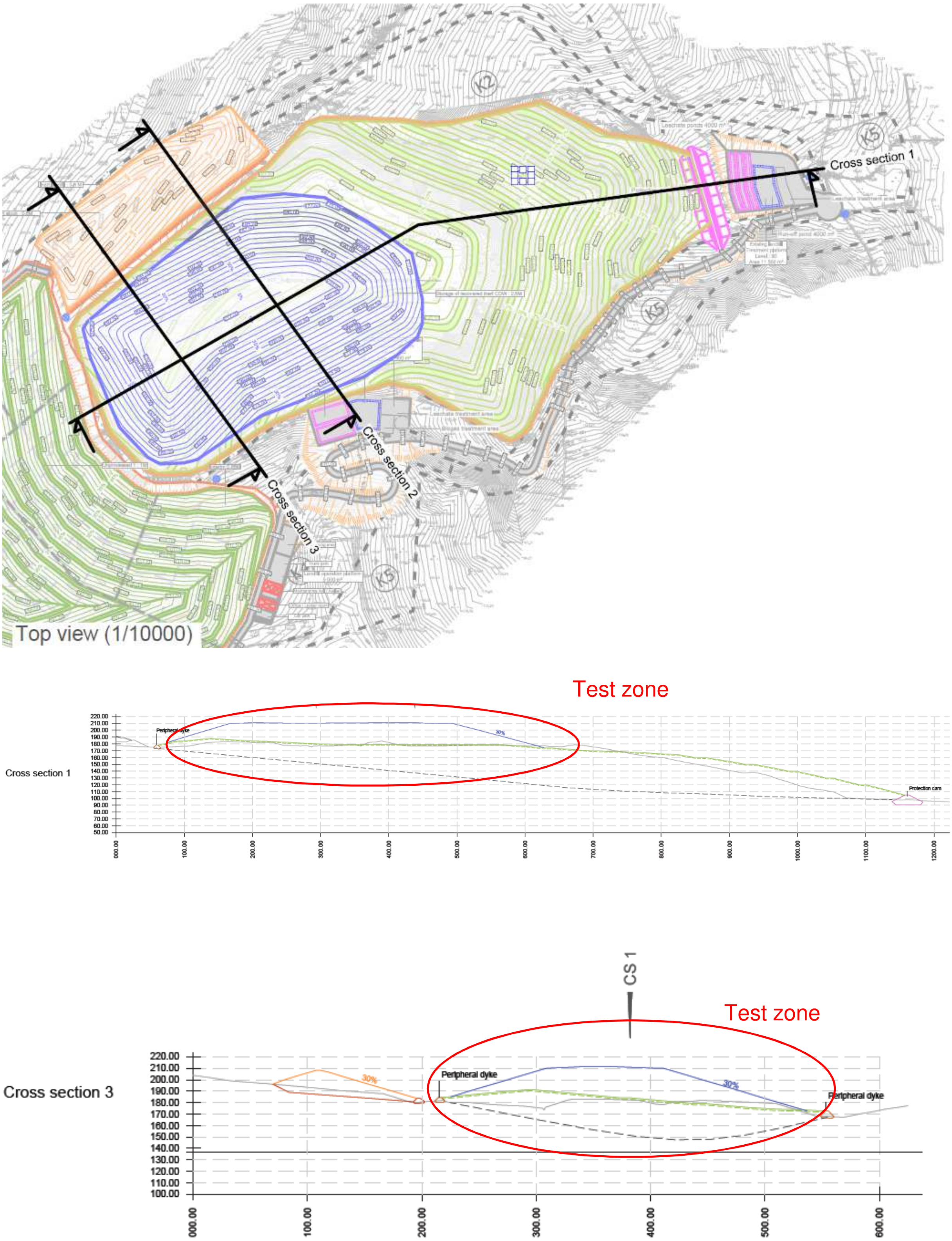


Illustration: tested cross sections of the Exisiting Landfill Remediation Works

The results indicate that the whole waste mass is stable on the cross sections CS1 and CS3, for the 2 stages of operation, with safety coefficient values □>1,50 as shown on the following table.

Table: Stability calculations results for the Existing Landfill Remediation Works

Cross section	Stage of operation	Safety coefficient □	
		West slope	East slope
CS1	Before Recycled CDW Storage	3,26	2,10
	After CDW refilling	1,84	2,17
Cross section	**Stage of operation**	**North slope**	**South slope**
CS3	Before Recycled CDW Storage	4,22	6,13
	After Recycled CDW Storage	1,95	1,93

<u>Note:</u> the cross section CS1 includes a water level.

<u>NOTE:</u>
*The stability calculations have been made considering a volume of Recycled CDW Storage Tonnage of 2.5 Mm³., while the Consortium wishes to not exceed a Recycled CDW Storage **of 0.3 Mm³** (see drawings in appendix 1). The hypothesis taken for the calculations are therefore highly conservative..*

Landfill for Inert Waste

The stability of the Landfill for Inert Waste has been studied on its 2 opposing slopes of the cross section CS3.

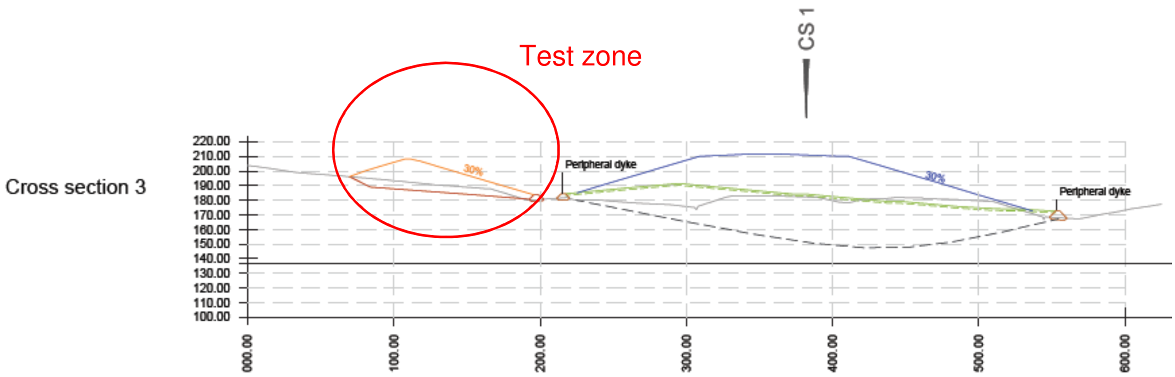


Illustration: tested cross sections on the Landfill for Inert Waste

The results indicate that the whole inert waste mass is stable on the cross section CS3, with safety coefficient values □>1,50 as shown on the following table.

Table: Stability calculations results for the Landfill for Inert Waste

	Safety coefficient	
	North slope	South slope
CS3	**2,31**	**2,02**

New Landfill

The stability of the New Landfill has been studied on its 2 opposing slopes of the cross sections CS1 and CS4 as follows.

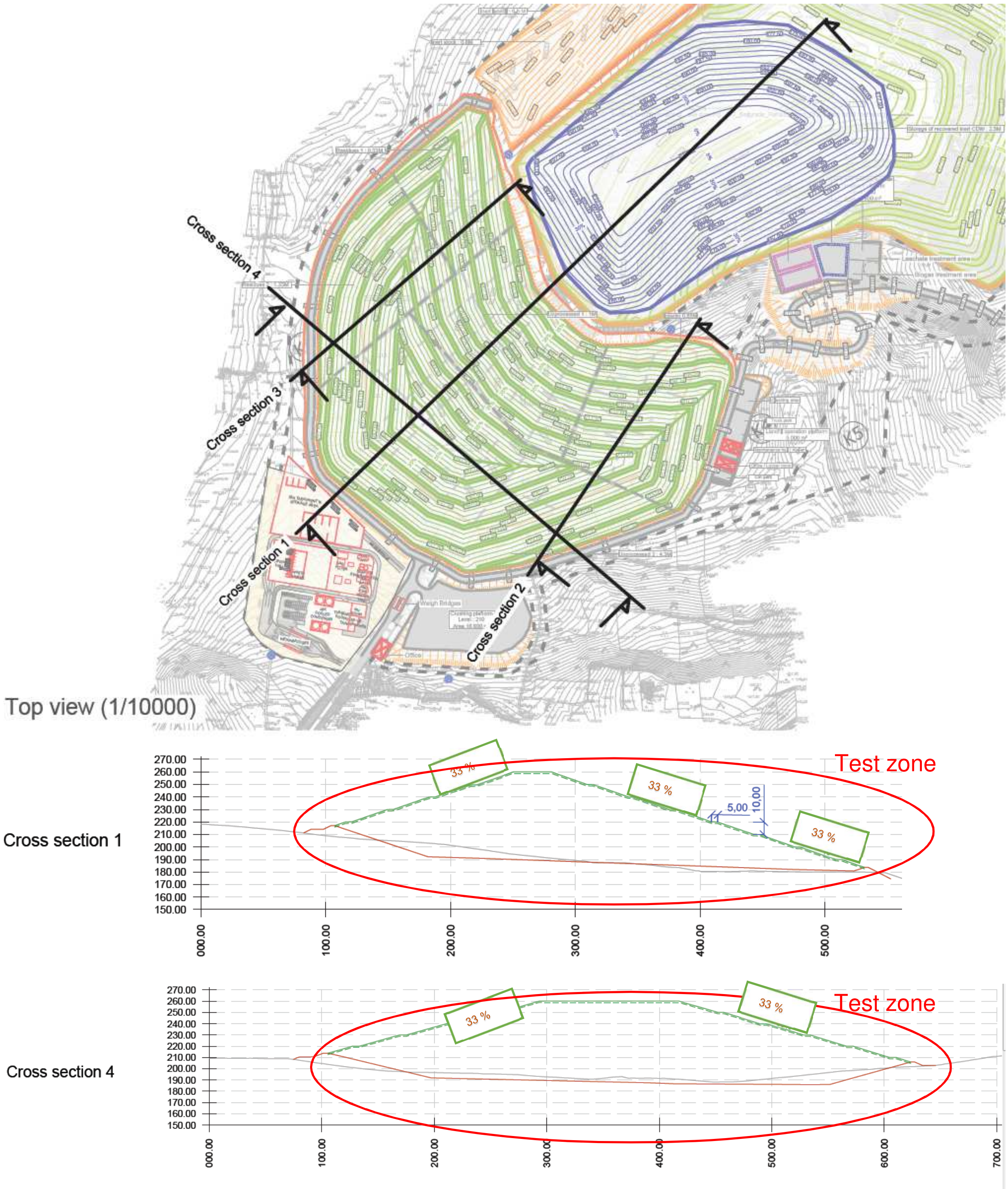


Illustration: tested cross sections on the New Landfill

The results indicate that the waste mass is stable on the cross section CS1 and CS4, with safety coefficient values □>1,50 as shown on the following table.

Table: Stability calculations results for the New Landfill

Cross section	Safety coefficient	
	West slope	East slope
CS1	1,82	1,74
	West slope	East slope
CS4	2,18	2,03

Form T.2.5 **References of Construction Sub-Contractor(s) for the RMW Treatment Facility and Operating Sub-Contractor(s)**

Form T.2.5.1 List of Construction Sub-Contractor(s) and Operating Sub-Contractor(s)

Table 1: Works Period

Name of Construction Sub-Contractor and its role in the Bidder's solution		Name of the Project	Project type **)	Location of the reference project City / State / Country	Role of the Construction Sub-Contractor in the reference project ***)	Employer or benefitting public Authority
RTC1 – not used						
RTC2 Construction Sub-Contractor for RMW Treatment Facility						
RTC2.1 Pre-Treatment Facility, if applicable	N/A	1. N/A	N/A	N/A	N/A	N/A
		2. N/A	N/A	N/A	N/A	N/A

Name of Construction Sub-Contractor and its role in the Bidder's solution		Name of the Project	Project type **)	Location of the reference project City / State / Country	Role of the Construction Sub-Contractor in the reference project ***)	Employer or benefitting public Authority
RTC 2.2 EfW Facility	*CNIM S.A - 35, rue de Bassano, 75008 Paris, France*	Merseyside Energy Recovery Project	*Engineering Procurement and Construction (EPC)*	Wilton Merseyside UK	*Leader in a joint venture company*	Merseyside Energy Recovery Ltd.
	EPC Contractor	Suffolk Energy from Waste Facility	*Engineering Procurement and Construction (EPC)*	Suffolk UK	*Leader in a joint venture company*	Suez Recycling & Recovery Suffolk, Suffolk County Council
RTC3 – not used						

Table 2: ***Services Period***

Name of Operating Sub-Contractor and its role in the Bidder's solution		**Name of the Project**	**Project type **)**	**Location of the reference project** **City / State / Country**	**Role of the Operating Sub-Contractor in the reference project ***)**	**Employer or benefitting public Authority**
RTC4 Operating Sub-Contractors						
RTC 4.1 Pre-Treatment Facility O&M (if applicable)	N/A	1.N/A	N/A	N/A	N/A	N/A
		2. N/A	N/A	N/A	N/A	N/A
RTC 4.2 Main Facility O&M	SITA ReEnergy Roosendaal B.V	1.Baviro	DBOO	Roosendaal Netherlands	Owner and O&M Contractor	Suez ReEnergy Roosendaal
	SITA Tees Valley Limited	2.STV 1&2	O&M	Billingham United Kingdom	O&M Contractor	Middlesbrough Council
RTC 4.3 Landfill O&M	SITA Waste Services Ltd	1.Went	DBO	New Territories Hong Kong	O&M Contractor	Government of Hong Kong
	Suez Recyclage et Valorisation Nord Est	2.Hersin Coupigny	DBOO	Hersin Coupigny France	O&M Contractor	SUEZ RV Nord Est

NOTE: ***SITA ReEnergy Roosendaal BV, SITA Tees Valley Limited, SITA Waste Services Limited, Suez Recyclage et Valorisation Nord-Est*** **are all Affiliates of SUEZ Groupe, the intended 100% Parent Company of the O&M Contractor of Belgrade EfW.**

Form T.2.5.2 Reference Project Data Sheet

Instructions: Complete this 0 (Reference Project data sheet) for each Sub-Contractor identified in 0.

<table>
<tr><td colspan="4">RTC No 2.2 – EfW Facility EPC
Sub-Contractor: CNIM
Experience 1: Merseyside Energy Recovery</td></tr>
<tr><td></td><td colspan="3">Information</td></tr>
<tr><td>Project location (city, state, country)</td><td colspan="3">Wilton International, Wilton, Middlesbrough, TS90 8WS Cleveland, UK</td></tr>
<tr><td>Brief description of the project,</td><td colspan="3">Turnkey Engineering Procurement and Construction (EPC) for an EfW facility</td></tr>
<tr><td>Description of the Sub-Contractor's scope of responsibility</td><td colspan="3">Member in a joint venture or consortium as leader
Process Works Sub-Contractor of the EPC Contractor, CNIM was in charge of the design of the plant, the supply and erection of all the equipment and the commissioning</td></tr>
<tr><td>Employer</td><td colspan="3">Merseyside Energy Recovery Ltd.</td></tr>
<tr><td>Completion date of the project facility</td><td colspan="3">Take over date : 23/12/2016</td></tr>
<tr><td>Period of operation of the reference facility</td><td colspan="3">From end 2016</td></tr>
<tr><td>For Operating Sub-Contractor's reference project lifetime and expiry date of contract:</td><td colspan="3"></td></tr>
<tr><td>Role in Contract
[Check the appropriate box]</td><td>Contractor
■</td><td>Consortium Member
■</td><td>Subcontractor
☐</td></tr>
<tr><td>Characteristic indicators of project -

Waste Treatment Facilities
(if project comprises more than one facility, add info for each additional facility)
• Type of facility :
• Capacity of facility (t/a of MSW):
• Actual annual throughput (t/a of MSW) for each operating year in the past five years :
• Technology of plant:
No. of Units
Design waste characteristics
Purchaser of electricity output (if any)
Flue gas cleaning standards applied
Other areas
Specify characteristic data</td><td colspan="3">Energy from Waste facility
444 000 t/y of MSW
184,000 t from start of operation end of 2016

2 lines of 29.2 t/h at LHV 9,800 kJ/kg
LHV range: 7,800 kJ/kg - 12,500 kJ/kg
One turbine-generator set (net power 50 MWe)

Steam cycle : 60b/410°C
FGT : Vapolab (dry system), Dry DeDiox with adsorbent, Residues recycling , SNCR deNOx (ammonia water)
Grate : reverse acting grate (Vario)</td></tr>
</table>

RTC No 2.2 – EfW Facility EPC Sub-Contractor: CNIM Experience 1: Merseyside Energy Recovery	
	Information
	Boiler type : natural circulation, horizontal type, one drum, bottom supported type
Characteristic indicators of non-hazardous landfill projects (if project comprises more than one landfill, add info for each additional landfill) • Type of landfill: • Type of waste landfilled (residual waste, treated waste, bottom ash, etc.) • Total landfill capacity by cells (tonnes) • Actual annual throughput (t/a of RMW) for all operating years in the past five years: • Technology of plant (if any) • Landfill construction standards Bottom liner design Leachate treatment design Gas treatment emplacement methodology area of landfill (m²) • Purchaser of electricity output (if any) Other areas *Specify characteristic data*	N/A
• Name of manufacturers of main equipment/major subcontractors	CNIM, MARTIN GmbH, LAB,
Employer's Name: Address: Telephone/fax number E-mail:	Merseyside Energy Recovery Ltd Grenfell Road, Maidenhead, Berkshire, SL6 1ES, UK. Ian SEXTON : +33 5 6346 1680 ian.sexton@ambialet.com
Public Authority benefitting from the Project: Address: Telephone/fax number E-mail:	Merseyside Recycling and Waste Disposal Authority 7th floor, No. 1 Mann Island, Liverpool L3IBP, UK Carl Beer : +44 7703 222 177 carlbeer@merseysidewda.gov.uk

RTC No. 2.2 – EfW Facility EPC
Sub-Contractor: CNIM
Experience 2: Suffolk

	Information		
Project location (city, state, country)	Lodge Lane, Great Blakenham, Suffolk IP6 0JE, UK		
Brief description of the project,	Turnkey Engineering Procurement and Construction (EPC) for a EfW plant		
Description of the Sub-Contractor's scope of responsibility	Member in a joint venture or consortium as leader Process Works Sub-Contractor of the EPC Contractor, CNIM was in charge of the design of the plant, the supply and erection of all the equipment and the commissioning		
Employer	Suez Recycling and Recovery Suffolk – Suffolk County Council		
Completion date of the project facility	Take over date : 30/11/2014		
Period of operation of the reference facility	Since 12/2014		
For Operating Sub-Contractor's reference project lifetime and expiry date of contract:			
Role in Contract *[Check the appropriate box]*	Contractor ■	Consortium Member ■	Subcontractor ☐
Characteristic indicators of project - **Waste Treatment Facilities** (if project comprises more than one facility, add info for each additional facility) • Type of facility : • Capacity of facility (t/a of MSW): • Actual annual throughput (t/a of MSW) for each operating year in the past five years : Technology of plant: No. of Units Design waste characteristics Purchaser of electricity output (if any) Flue gas cleaning standards applied Other areas *Specify characteristic data*	Energy from Waste Facility 246,680 t/y of MSW 2014: 23 111 tons 2015 : 258 975 tons 2016: 266 539 tons 2 lines of 15.8 t/h at LHV 9800kJ/kg LHV range: 7,800 kJ/kg - 12,500 kJ/kg One turbine-generator set (Guarantied Net Power Output 19,59 MW_e) with a provision for heat export 15MW_{th} Steam cycle : 60b/400°C FGT : Secolab (dry system), Dry DeDiox with adsorbent, Residues recycling , SNCR deNOx (solid urea) Grate : reverse acting grate Boiler type : natural circulation, vertical type, one drum, bottom supported type		
Characteristic indicators of non-hazardous landfill projects	N/A		

RTC No. 2.2 – EfW Facility EPC **Sub-Contractor: CNIM** **Experience 2: Suffolk**	
	Information
(if project comprises more than one landfill, add info for each additional landfill) • Type of landfill: • Type of waste landfilled (residual waste, treated waste, bottom ash, etc.) • Total landfill capacity by cells (tonnes) • Actual annual throughput (t/a of RMW) for all operating years in the past five years: • Technology of plant (if any) • Landfill construction standards Bottom liner design Leachate treatment design Gas treatment emplacement methodology area of landfill (m^2) Purchaser of electricity output (if any) Other areas *Specify characteristic data*	
Name of manufacturers of main equipment/major subcontractors	CNIM, MARTIN GmbH, LAB,
Employer's Name: Address: Telephone/fax number E-mail:	Suez Recycling & Recovery Suffolk Grenfell Road, Maidenhead, Berkshire, SL6 1ES, UK. Paul LEIGHTON: +44 1473 836 810 Paul.leighton@suez.com
Public Authority benefitting from the Project: Address: Telephone/fax number E-mail:	Suffolk County Council Endeavour house, 8 Russel Road, Ipswich, Suffolk, IP12BX, UK Steve Palfrey: +44.1473 264787 Steve.palfrey@suffolk.gov.uk

RTC No. 4.2 – EfW Facility O&M Sub-Contractor No 1: SUEZ ReEnergy Roosendaal (an Affiliate of SUEZ Groupe, 100% Parent of O&M Contractor for Belgrade EfW) Experience No 1: Baviro EfW facility			
	Information		
Project location (city, state, country)	Potendreef 2, NL – 4703RK Roosendaal, Netherlands		
Brief description of the project,	The Baviro ReEnergy plant is fully owned and financed by Suez ReEnergy Roosendaal, 100% Suez Netherlands BV, itself 100% owned by SUEZ. The Energy from Waste plant, with a capacity of 291 000 tpa, is based on leading principle of sustainability with the combined heat and power generation. ReEnergy supplies electricity to the electrical network. It also supplies heat to the greenhouses located near the plant, thereby saving some 3.5 million cubic meters of natural gas ReEnergy is one of the most efficient waste to energy plant in Europe.		
Description of the Sub-Contractor's scope of responsibility	Financing, Design, Construction, Operation		
Employer	Suez ReEnergy Roosendaal (100% Suez Netherlands BV)		
Completion date of the project facility	June 2011		
Period of operation of the reference facility	Since 2011		
For Operating Sub-Contractor's reference project lifetime and expiry date of contract:	6 years - No end : owner of the plant		
Role in Contract *[Check the appropriate box]*	Contractor ☐	Owner ☒	Operator ☒

Characteristic indicators of project -
 	
Waste Treatment Facilities
(if project comprises more than one facility, add info for each additional facility)
• Type of facility :
• Capacity of facility (t/a of MSW):
• Actual annual throughput (t/a of MSW) for each operating year in the past five years :
• Technology of plant:
  • No. of Units
  • Design waste characteristics
  • Purchaser of electricity output (if any)
  • Flue gas cleaning standards applied
	Energy from Waste
	291 000 tpa
	2012= 331 000 tpa / 2013=332 000 tpa / 2014= 336 000 tpa / 2015= 351 000 tpa / 2016= 344 000 tpa
	
	Moving grate incineration technology
	2 X 19.1 t/h
	11.7 MJ/kg
	Turbine 32 MW
	Meeting the requirements of the Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste with respect to the		

RTC No. 4.2 – EfW Facility O&M Sub-Contractor No 1: SUEZ ReEnergy Roosendaal (an Affiliate of SUEZ Groupe, 100% Parent of O&M Contractor for Belgrade EfW) Experience No 1: Baviro EfW facility	
	Information
• Other areas • *Specify characteristic data*	permissible emissions of the flue gases from waste incineration. N/A

Characteristic indicators of non-hazardous landfill projects
(if project comprises more than one landfill, add info for each additional landfill)
• Type of landfill:
• Type of waste landfilled (residual waste, treated waste, bottom ash, etc.)
• Total landfill capacity by cells (tonnes)
• Actual annual throughput (t/a of RMW) for all operating years in the past five years:
• Technology of plant (if any)
• Landfill construction standards
  • Bottom liner design
  • Leachate treatment design
  • Gas treatment
  • emplacement methodology
  • area of landfill (m²)
• Purchaser of electricity output (if any)
• Other areas
  • *Specify characteristic data*	

• Name of manufacturers of main equipment/major subcontractors	Grate : HZI / Boiler : Duro Dakovic / Flue gas cleaning : HZI / Turbine : Thermodyn
Employer's Name: Address: Telephone/fax number E-mail:	Suez ReEnergy Roosendaal Potendreef 2,NL – 4703RK Roosendaal, Netherlands +31 (0)165 534 492 / +31 (0)165 559 270 marc.das@suez.com
Public Authority benefitting from the Project: Address: Telephone/fax number E-mail:	N/A

RTC No. 4.2 EfW Facility O&M **Sub-Contractor No 1: SITA Tees Valley Limited (an Affiliate of SUEZ Groupe, 100% Parent of O&M Contractor for Belgrade EfW)** **Experience No 2: STV 1&2 EfW facility**			
	Information		
Project location (city, state, country)	Haverton Hill Road TS23 1PY Billingham, UK		
Brief description of the project,	22-year PFI Contract between Middlesbrough Council and Suez Recycling & Recovery Tees Valley Ltd: 80% Suez Recycling & Recovery UK (itself owned by SUEZ) / 20% Cleveland Authority. Suez Recycling & Recovery Tees Valley Ltd managed the development, the construction and the operation of a dedicated energy from waste plant with a capacity of 250, 000 tonnes per annum. The facility has been in operation since its commissioning in 1998.		
Description of the Sub-Contractor's scope of responsibility	Operation and Maintenance		
Employer	Middlesbrough Council		
Completion date of the project facility	1998		
Period of operation of the reference facility	Since 1998		
For Operating Sub-Contractor's reference project lifetime and expiry date of contract:	22 years – 2020		
Role in Contract *[Check the appropriate box]*	Contractor ☒	Consortium Member ☐	Subcontractor ☐

Characteristic indicators of project -
 	
Waste Treatment Facilities
(if project comprises more than one facility, add info for each additional facility)
• Type of facility :
• Capacity of facility (t/a of MSW):
• Actual annual throughput (t/a of MSW) for each operating year in the past five years :
• Technology of plant:
  • No. of Units
  • Design waste characteristics
  • Purchaser of electricity output (if any)
  • Flue gas cleaning standards applied
	Energy from Waste
	250 000 tpa
	2012= 198 000 tpa / 2013= 225 000 tpa / 2014= 206 000 tpa / 2015= 201 000 tpa : 2016=200 000 tpa
	
	Moving grate incineration technology
	2 X 15 t/h
	9.3MJ/kg
	Turbine 20 MW
	Meeting the requirements of the Directive 2000/76/EC of the European Parliament and of the council of 4 December 2000 on the incineration of waste with respect to the permissible emissions of the flue gases from waste incineration.		

RTC No. 4.2 EfW Facility O&M Sub-Contractor No 1: SITA Tees Valley Limited (an Affiliate of SUEZ Groupe, 100% Parent of O&M Contractor for Belgrade EfW) Experience No 2: STV 1&2 EfW facility	
	Information
• Other areas • *Specify characteristic data*	N/A

Characteristic indicators of non-hazardous landfill projects
(if project comprises more than one landfill, add info for each additional landfill)
• Type of landfill:
• Type of waste landfilled (residual waste, treated waste, bottom ash, etc.)
• Total landfill capacity by cells (tonnes)
• Actual annual throughput (t/a of RMW) for all operating years in the past five years:
• Technology of plant (if any)
• Landfill construction standards
  • Bottom liner design
  • Leachate treatment design
  • Gas treatment
  • emplacement methodology
  • area of landfill (m^2)
• Purchaser of electricity output (if any)
• Other areas
  • *Specify characteristic data*	

• Name of manufacturers of main equipment/major subcontractors	Grate : Volund / Boiler : Volund / Flue gas cleaning : FLS Miljo / Turbine : Ansaldo
Employer's Name: Address: Telephone/fax number E-mail:	Middlesbrough Council PO Box 502 Vancouver House Gurney Street TS1 9FW Middlesbrough, United Kingdom +44 1642 728514 ken.sherwwood@middlesbrough.gov.uk
Public Authority benefitting from the Project: Address: Telephone/fax number E-mail:	Middlesbrough Council PO Box 502 Vancouver House Gurney Street TS1 9FW Middlesbrough, United Kingdom +44 1642 728514 ken.sherwwood@middlesbrough.gov.uk

RTC No. 4.3 Landfill O&M Sub-Contractor No 1: SITA Waste Services Limited (an Affiliate of SUEZ Groupe, 100% Parent of O&M Contractor for Belgrade EfW) Experience No 1: HK Went Landfill O&M			
	Information		
Project location (city, state, country)	Lung Kwu Tan Road, Nim Wan, Tuen Mun, New Territories, Hong Kong		
Brief description of the project,	Development and operation of the WENT landfill since 1993 by SITA Waste Services Ltd (100% owned by SUEZ) which manages the development and the operation of 2 strategic landfills and treats 63% of Hong Kong's solid waste.		
Description of the Sub-Contractor's scope of responsibility	Design, Construction, Operation, Restoration and Aftercare		
Employer	Environmental Protection Department, Government of the Hong Kong Special Administrative Region		
Completion date of the project facility	Nov 1993		
Period of operation of the reference facility	Since 1993		
For Operating Sub-Contractor's reference project lifetime and expiry date of contract:	55 years - 2048		
Role in Contract *[Check the appropriate box]*	Contractor ☒	Consortium Member ☐	Subcontractor ☐

Characteristic indicators of project -
 	
Waste Treatment Facilities
(if project comprises more than one facility, add info for each additional facility)
• Type of facility :
• Capacity of facility (t/a of MSW):
• Actual annual throughput (t/a of MSW) for each operating year in the past five years :
• Technology of plant:
  • No. of Units
  • Design waste characteristics
  • Purchaser of electricity output (if any)
  • Flue gas cleaning standards applied
 	
• Other areas
  • *Specify characteristic data*			

RTC No. 4.3 Landfill O&M Sub-Contractor No 1: SITA Waste Services Limited (an Affiliate of SUEZ Groupe, 100% Parent of O&M Contractor for Belgrade EfW) Experience No 1: HK Went Landfill O&M	
	Information
Characteristic indicators of non-hazardous landfill projects (if project comprises more than one landfill, add info for each additional landfill)	
• Type of landfill:	MSW landfill
• Type of waste landfilled (residual waste, treated waste, bottom ash, etc.)	Municipal, commercial, industrial and construction waste, incinerator bottom ash.
• Total landfill capacity ~~by cells~~ (tonnes)	2.5 Mtpa
• Actual annual throughput (t/a of RMW) for all operating years in the past five years:	2012= 2.327 Mtpa / 2013= 2.427 Mtpa / 2014= 2.647 Mtpa / 2015= 2.769 Mtpa / 2016= 3.222 Mtpa
• Technology of plant (if any)	N/A
• Landfill construction standards	
• Bottom liner design	Composed of two major barriers, the primary barrier is a layer of 2mm thick HDPE geo-membrane. The secondary barrier is a layer of 6mm thick geosynthetic clay liner with a permeability not higher than 1 x 10-9m/sec. There is a bottom groundwater drainage layer that is either a groundwater stone layer or a layer of geocomposite, as well as a top cushion geotextile layer that is a 1000g/m2 geotextile.
• Leachate treatment design	Raw leachate is first treated by Ammonia Stripping Plant to remove ammonia. The stripped leachate then undergo biological treatment to remove other contaminants in the Sequential Batch Reactors (SBR). The stripped leachate undergo de-nitrification and aeration process whilst in the SBR, the treated leachate is then discharged to municipal sewage network.
• Gas treatment	Landfill gas is collected through the gas collection grid and is used/treated in 3 ways: (i) electrical power generation: landfill gas is used to fuel the landfill gas generators to generate electricity to be used in the landfill; (ii) Ammonia Stripping Plant: landfill gas is used as fuel to treat the ammoniated air after ammonia stripping by heating it up to 850°C in the flare; (iii) Flare: excessive landfill gas is burnt in the flare under controlled environment
• emplacement methodology	

RTC No. 4.3 Landfill O&M **Sub-Contractor No 1: SITA Waste Services Limited (an Affiliate of SUEZ Groupe, 100% Parent of O&M Contractor for Belgrade EfW)** **Experience No 1: HK Went Landfill O&M**	
	Information
• area of landfill (m^2) • Purchaser of electricity output (if any) • Other areas • *Specify characteristic data*	The waste are placed in waste strip of about 60m wide and 10m height, dozers are used to spread the waste, and landfill compactor is used to compact the waste. 1 100 000 m^2 N/A N/A
• Name of manufacturers of main equipment/major subcontractors	1. Caterpillar (manufacturers of landfill equipment such as dozer, compactor, excavator, articulator truck) 2. The China Engineers Limited (dealer of Caterpillar in Hong Kong) - for provision of plant after sales and maintenance services) 3. Wong Yiu Man & Son Construction Engineering & Transportation Company Limited – for provision of civil construaction works, earth works and base liner system installation works
Employer's Name: Address: Telephone/fax number E-mail:	HKEPD, Environmental Infrastructure Division, 88 Victoria Road, Hong Kong. Mr. C.F. Wong (Principal Environmental Protection Officer) Tel: +852 2872 1750
Public Authority benefitting from the Project: Address: Telephone/fax number E-mail:	HKEPD, Environmental Infrastructure Division, 88 Victoria Road, Hong Kong. Mr. C.F. Wong (Principal Environmental Protection Officer) Tel: +852 2872 1750

RTC No. 4.3 - Landfill O&M
Sub-Contractor No 1: SUEZ Recyclage et Valorisation Nord Est (an Affiliate of SUEZ Groupe, 100% Parent of O&M Contractor for Belgrade EfW)

Experience No 2 : Hersin Coupigny Non-Hazardous Waste Landfill

	Information		
Project location (city, state, country)	Rue de la Loisne, 62530 Hersin Coupigny, France		
Brief description of the project,	Suez Recyclage & Valorisation Nord Est (100% Suez RV France, itself 100% owned by SUEZ) manages the development and the operation of the Hersin Coupigny Landfill since 1977. By receiving every year about 300,000 tons of waste from the entire northern region of France, Hersin is one of largest landfills managed by SUEZ (via Suez RV France) in the country.		
Description of the Sub-Contractor's scope of responsibility	Design, Construction, Operation, Restoration and Aftercare		
Employer	Suez Recyclage & Valorisation Nord Est		
Completion date of the project facility	1977		
Period of operation of the reference facility	Since 1977		
For Operating Sub-Contractor's reference project lifetime and expiry date of contract:	100 years - 2077		
Role in Contract *[Check the appropriate box]*	Contractor ☒	Consortium Member ☐	Subcontractor ☐

Characteristic indicators of project -
 	
Waste Treatment Facilities
(if project comprises more than one facility, add info for each additional facility)
• Type of facility :
• Capacity of facility (t/a of MSW):
• Actual annual throughput (t/a of MSW) for each operating year in the past five years :
• Technology of plant:
  • No. of Units
  • Design waste characteristics
  • Purchaser of electricity output (if any)
  • Flue gas cleaning standards applied			

RTC No. 4.3 - Landfill O&M Sub-Contractor No 1: SUEZ Recyclage et Valorisation Nord Est (an Affiliate of SUEZ Groupe, 100% Parent of O&M Contractor for Belgrade EfW) Experience No 2 : Hersin Coupigny Non-Hazardous Waste Landfill	
	Information
• Other areas • *Specify characteristic data*	

Characteristic indicators of non-hazardous landfill projects
(if project comprises more than one landfill, add info for each additional landfill)
• Type of landfill:
• Type of waste landfilled (residual waste, treated waste, bottom ash, etc.)
• Total landfill capacity ~~by cells~~ (tonnes)
• Actual annual throughput (t/a of RMW) for all operating years in the past five years:
 	
• Technology of plant (if any)
• Landfill construction standards
  • Bottom liner design
 	
  • Leachate treatment design
 	
  • Gas treatment
 	
  • emplacement methodology
 	
  • area of landfill (m²)
• Purchaser of electricity output (if any)
• Other areas
  • *Specify characteristic data*
	Landfill for non-hazardous waste
	MSW, commercial, industrial and construction waste, incinerator bottom ash
	
	Authorized for 500,000 tpa
	2012= 355 000 tpa / 2013= 321 000 tpa / 2014= 329 000 tpa / 2015= 308 000 tpa / 2016= 297 000 tpa
	
	N/A
	Bottom and sides of cells lined with waterproof material K < 1x10-9 m/s (clay for example) reinforced with a HDPE geomembrane 2mm and a protective geotextile. Draining system to collect storm and leachate drains.
	
	Vacuum evapo-concentration before storage of concentrates in dedicated cells.
	
	Landfill gas is collected through the gas collection grid and is used/treated in 2 ways:
	(i) electrical power generation: landfill gas is used to fuel the landfill gas generators to generate electricity to be used in the landfill;
	(ii) Flare: excessive landfill gas will be burnt in the flare under controlled environment
	
	Storage in cells.
	
	1 600 000 m²
	4 turbines of 1.2 MWe
	
	N/A

RTC No. 4.3 - Landfill O&M
Sub-Contractor No 1: SUEZ Recyclage et Valorisation Nord Est (an Affiliate of SUEZ Groupe, 100% Parent of O&M Contractor for Belgrade EfW)

Experience No 2 : Hersin Coupigny Non-Hazardous Waste Landfill

	Information
• Name of manufacturers of main equipment/major subcontractors	Turbine : DEUTZ
Employer's Name: Address: Telephone/fax number E-mail:	Suez Recyclage & Valorisation Nord Est 1 rue Malfidano, 62950 Noyelles Godault, France Tel: +33 810 029 039 thierry.delineau@suez.fr
Public Authority benefitting from the Project: Address: Telephone/fax number E-mail:	N/A

Form T.2.5.3 Confirmation of References

Form T.2.6 Overall Project Time Schedule

Form T.2.7 Project Organisation and Management System

Form T.2.7.1 Project Organisation Chart for the Works Period

The overall Project Organization Chart for the Works period is attached in the following page. The design and construction of the Project Facilities will be primarily organized under the 2 main Construction Sub-Contracts for the Energy-from-Waste Facility (with CNIM SA) and for the New Landfills, the CDW Facility and the Existing Landfill Remediation Works (with Energoprojekt Niskogradnja). In addition, the O&M Contractor (as a separate part of its obligations structured in accordance with the requirements for Construction Sub-Contracts) will design and install (during the Works Period) the Leachate Treatment Facility and the Landfill Gas Facility. Finally, the construction of the Electricity Transmission Infrastructure will be entrusted in due time to a specialized contractor (under a design-build responsibility).

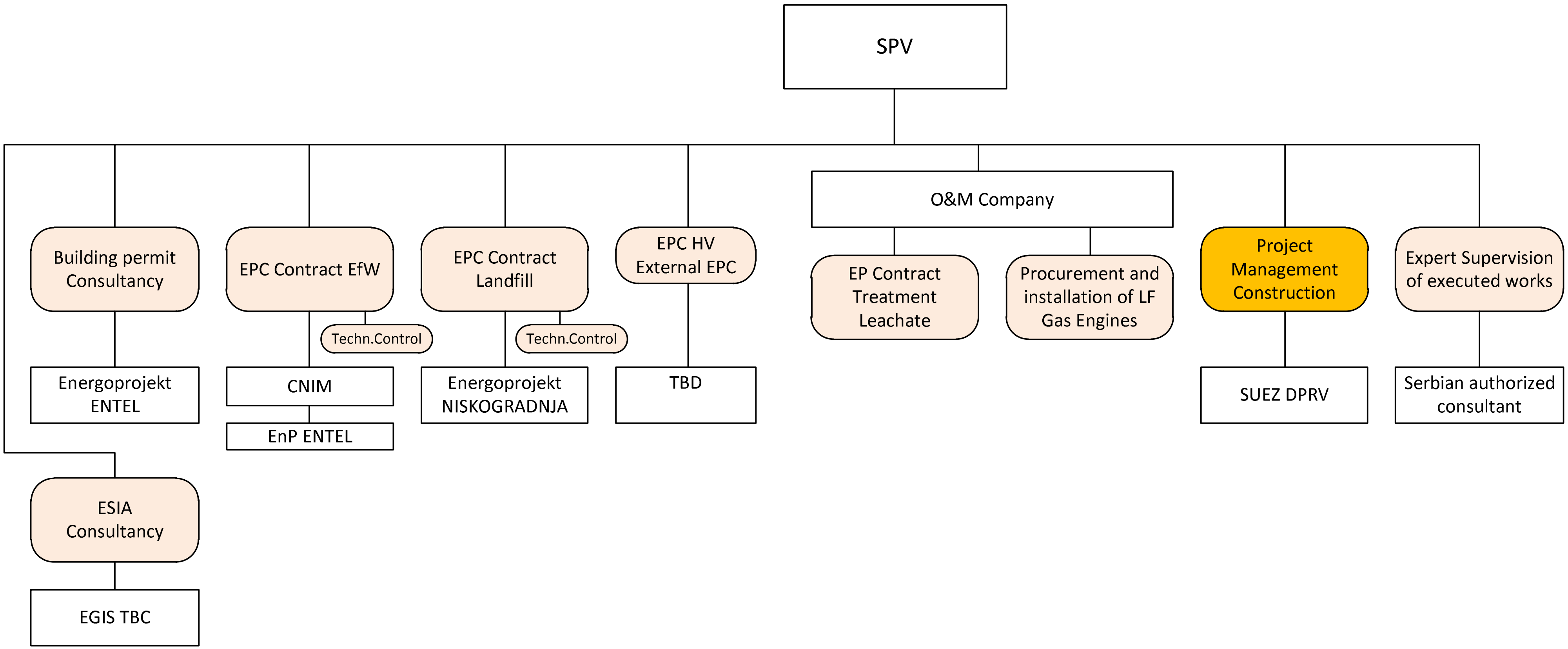
During the initial design and permitting phase of the Project, the SPV will contract with a specialized consultant for the purpose of developing the Environmental Impact Assessment study (in compliance with Serbian regulations) and the Environmental and Social Impact Assessment study (in accordance with the requirements of Senior Lenders). The SPV has pre-selected EGIS, a specialized company with a significant track record in the field of environmental permitting to undertake the necessary studies. In addition, an overall coordination for the permitting activities in Serbia will be carried out by Energoprojekt Entel, a specialized engineering company being part of the Energoprojekt group.

The overall coordination during the design and construction phase will be ensured by Suez Groupe under a Project Management Agreement, in order to make sure that:

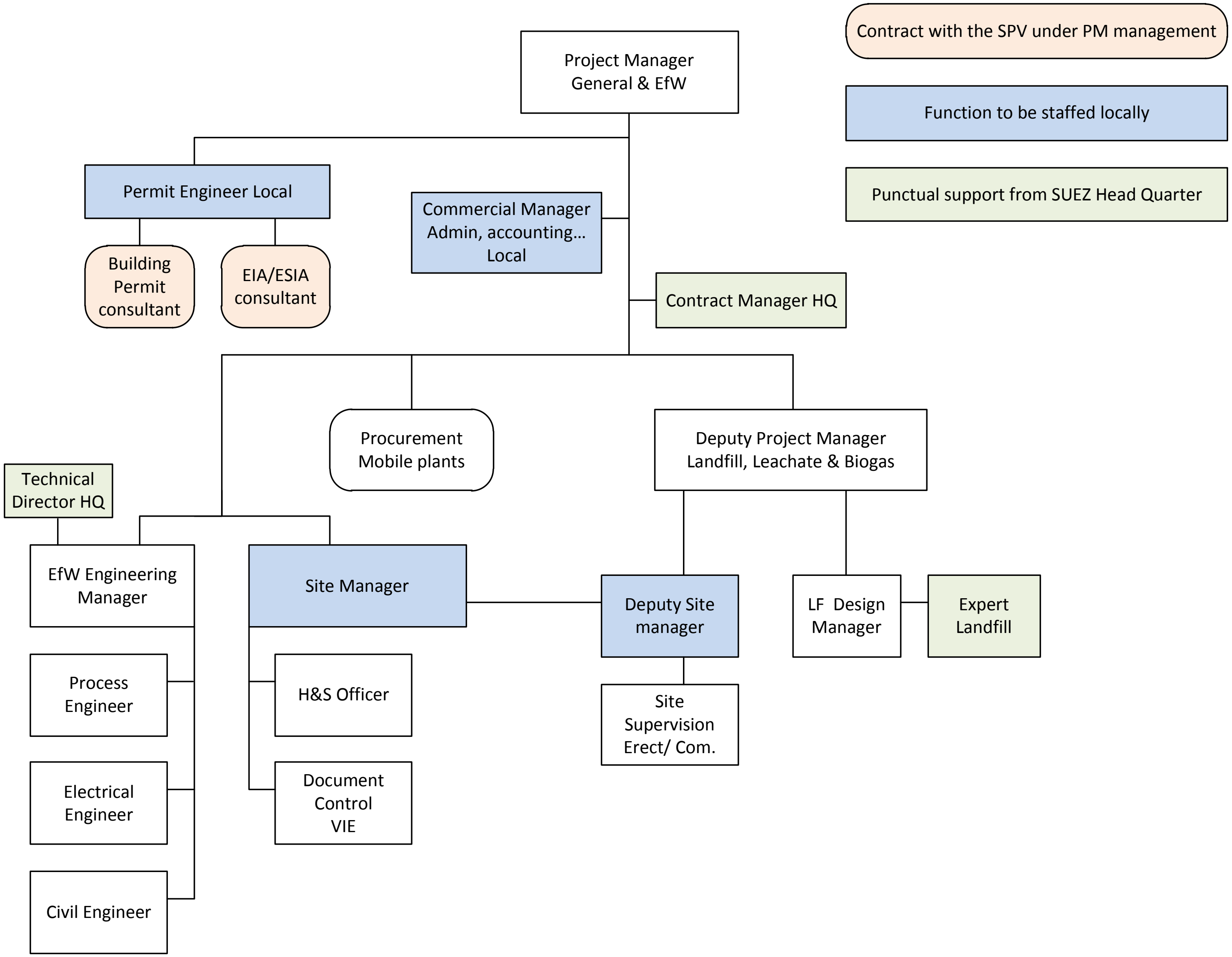
- all Construction Sub-Contractors timely provide their design inputs for review and approval by the Project Manager (and if necessary, the City);
- the progress and quality of the works is monitored and all notices, payment milestones, claims and variations are properly administered;
- Health and Safety conditions on-site are constantly monitored and any arising issue is properly addressed;
- an appropriate interface is managed between the SPV, the Construction Sub-Contractors, the O&M Contractor, the expert supervision prescribed by Serbian Law and other stakeholders throughout the construction and commissioning phases.
- The defect notification period and warranty obligations of the Construction Sub-Contractors are correctly enforced.

The following pages present the respective organization and resources during the Works Period of the Construction Sub-Contractors and the Project Manager.

Project Management for the Works period



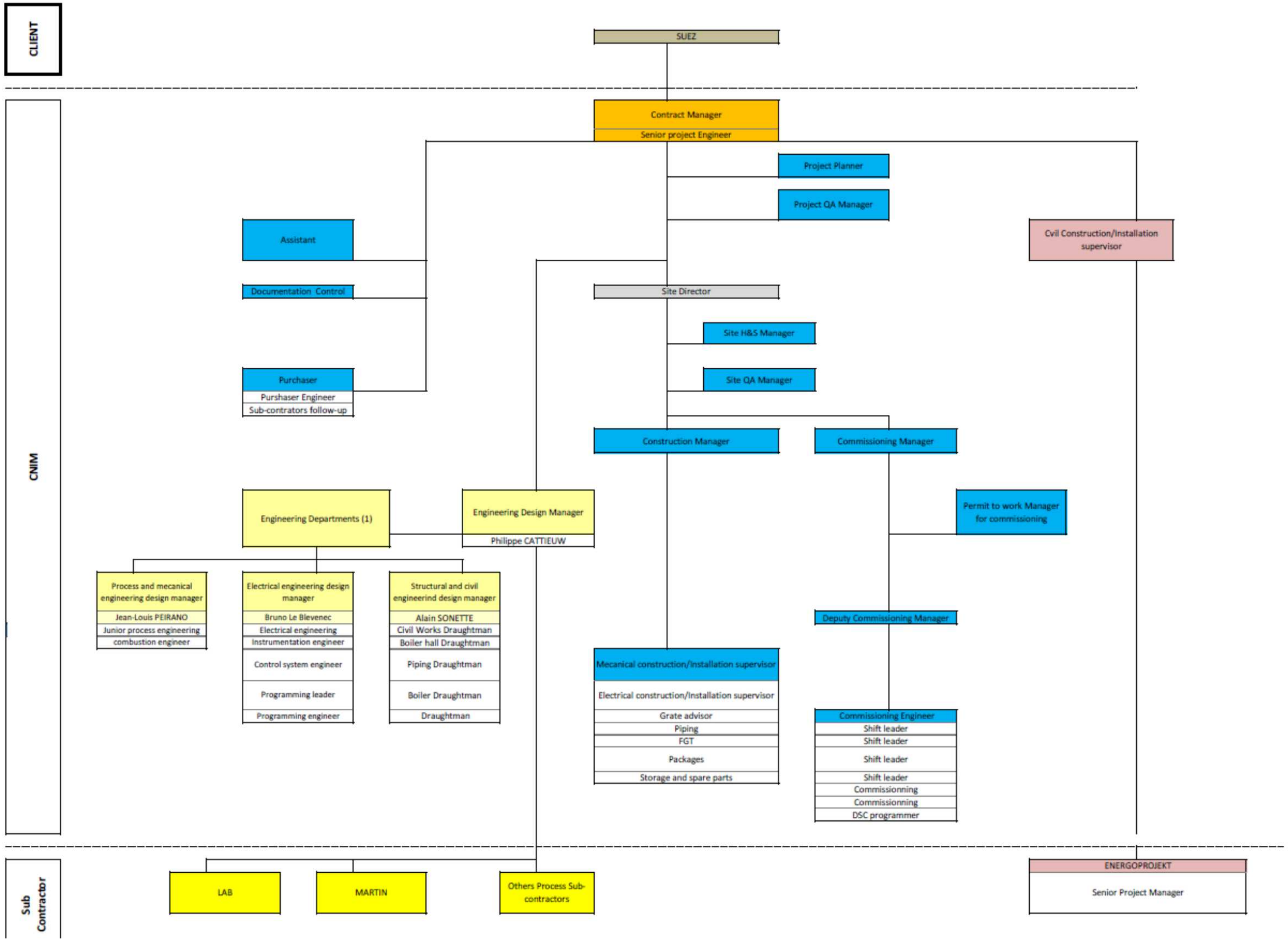
Project Management Contract SPV-SUEZ
Key Staff



EfW Construction Sub-Contractor - CNIM

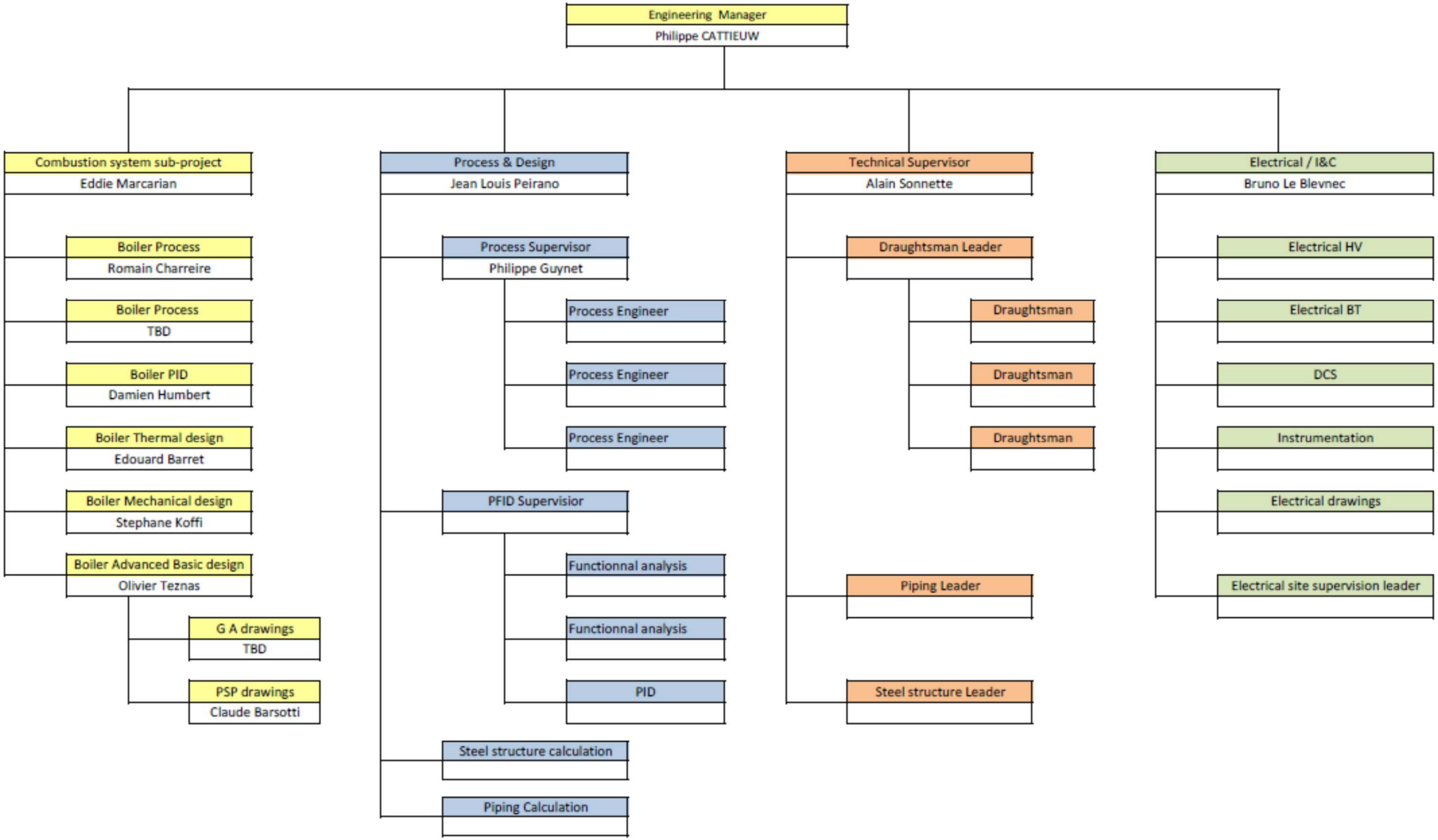
The organisation chart of the EfW Construction Sub-Contractor is presented in the following pages.

ORGANISATION CHART - GENERAL VIEW



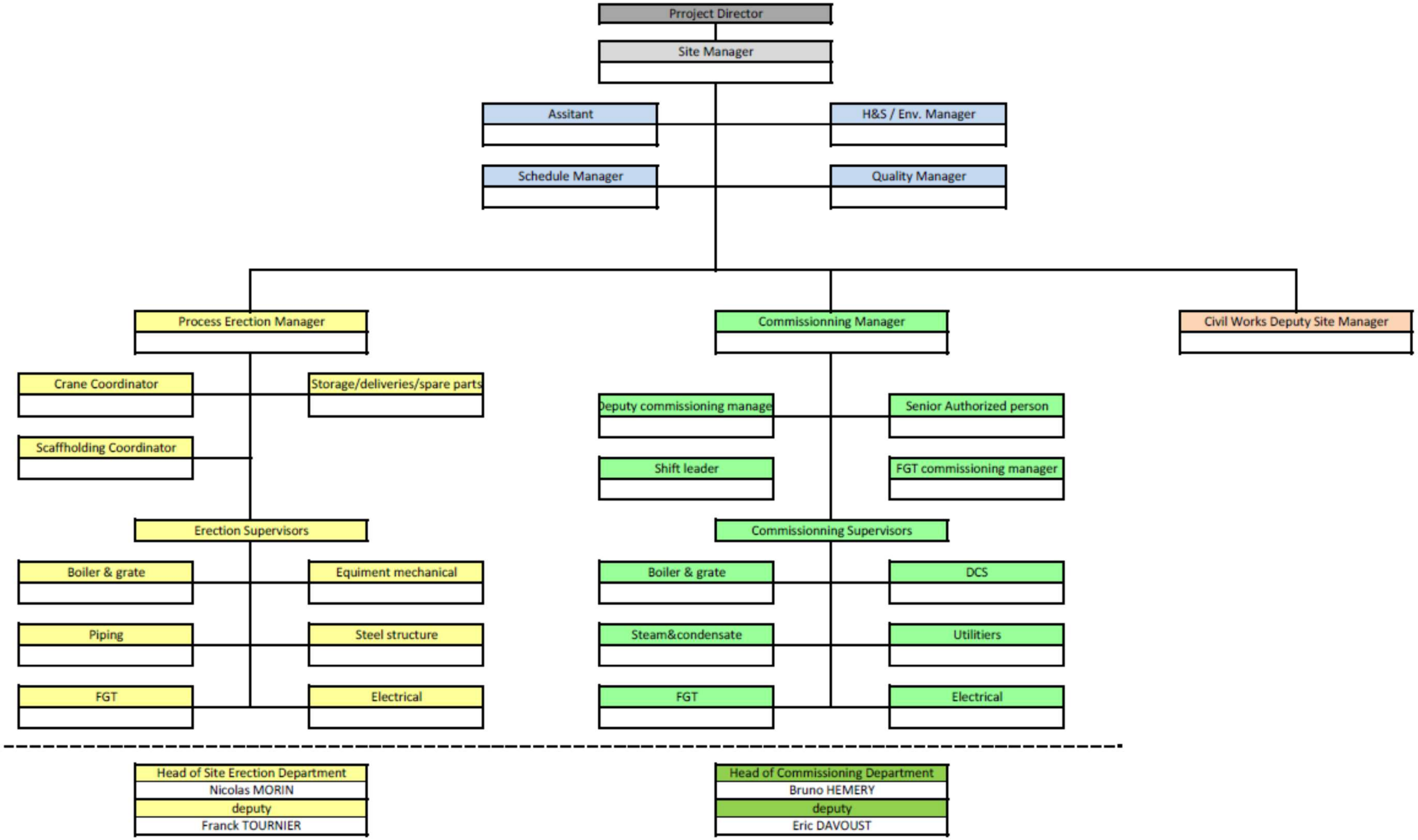
BELGRADE

ENGINEERING ORGANISATION CHART



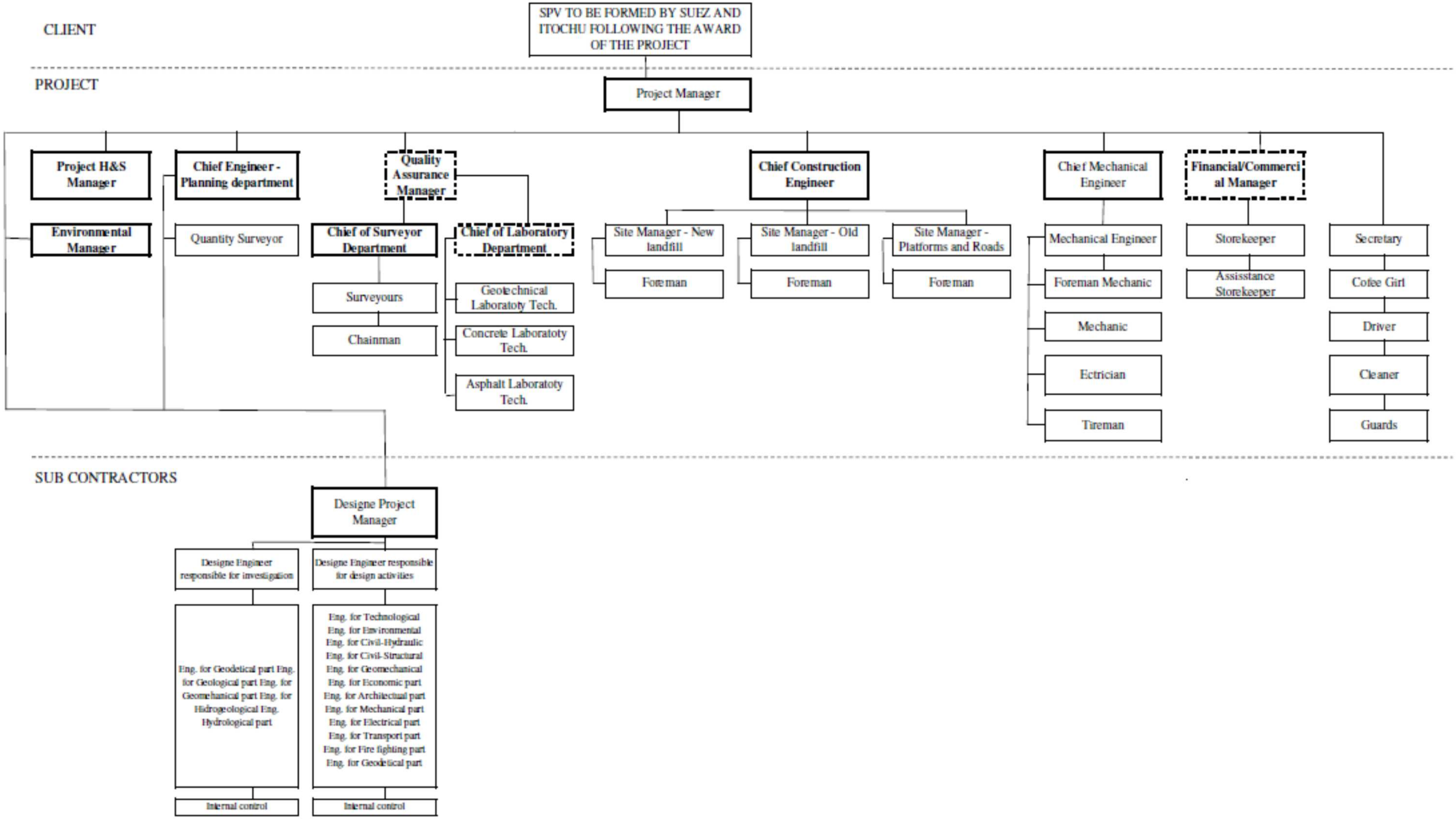
BELGRADE

SITE ORGANISATION CHART



Landfill Construction Sub-Contractor– Energoprojekt Niskogradnja

The organisation chart of the Energoprojekt Niskogradnja is presented in the following page:


CLIENT
SPV TO BE FORMED BY SUEZ AND ITOCHU FOLLOWING THE AWARD OF THE PROJECT
PROJECT
Project Manager
Project H&S Manager
Environmental Manager
Chief Engineer - Planning department
Quantity Surveyor
Quality Assurance Manager
Chief of Surveyor Department
Surveyours
Chainman
Chief of Laboratory Department
Geotechnical Laboratoty Tech.
Concrete Laboratoty Tech.
Asphalt Laboratoty Tech.
Chief Construction Engineer
Site Manager - New landfill
Foreman
Site Manager - Old landfill
Foreman
Site Manager - Platforms and Roads
Foreman
Chief Mechanical Engineer
Mechanical Engineer
Foreman Mechanic
Mechanic
Ectrician
Tireman
Financial/Commercial Manager
Storekeeper
Assisstance Storekeeper
Secretary
Cofee Girl
Driver
Cleaner
Guards
SUB CONTRACTORS
Designe Project Manager
Designe Engineer responsible for investigation
Designe Engineer responsible for design activities
Eng. for Geodetical part Eng. for Geological part Eng. for Geomehanical part Eng. for Hidrogeological Eng. Hydrological part
Eng. for Technological
Eng. for Environmental
Eng. for Civil-Hydraulic
Eng. for Civil-Structural
Eng. for Geomechanical
Eng. for Economic part
Eng. for Architectual part
Eng. for Mechanical part
Eng. for Electrical part
Eng. for Transport part
Eng. for Fire fighting part
Eng. for Geodetical part
Internal control
Internal control

Form T.2.7.2 List of Indicative Key Staff (Works Period)

Name of the Company: SPV (through SUEZ as Project Manager)

Information on Indicative Key Staff Members	
Functions in the Project (*please specify*)	**Responsibilities in the Project (*please* specify)**
Bidder	
Project Manager General & EfW	Manages the overall construction of the project with a duty of care for the Project Company. Ensures the reporting of the construction to the EPV. Specialized in Energy from Waste contract management, is directly in charge of the management of this part of the project.
Deputy Project Manager Landfill	Manages the construction of the Landfills, the Leachate Treatment plant, the Landfill Gas. Is accountable to the project manager. Manages the reporting of construction on his perimeter.
Permitting Engineer	Manages the interface between the Permitting Consultant and the EPC contractors to achieve a timely completion of the design for building permit. Is accountable to the Project Manager of the proper delivery of the engineering documents and of the compilation of all documents for the SPV in view of permit application.
EfW Engineering Manager	Supervises and controls the conformity of the design to the Employer's requirement, the contract and the regulations.
Site Manager	Supervises construction on Site. Facilitate the interfaces between the various Construction sub-contractors. Monitors works implementation. Is specifically in charge of EfW Site construction.
Deputy Site Manager	Supervises construction on Site. Facilitate the interfaces between the various Construction sub-contractors. Monitors works implementation. Is specifically in charge of Landfill Site construction.
HSE manager	Manages the implementation of security on Site. Procures that all companies staff working on Site is properly trained and knows the Site regulation associated to the relevant construction Site.

Name of the Company: CNIM (EfW Construction Sub-Contractor)

Information on Indicative Key Staff Members	
Functions in the Project (*please specify*)	**Responsibilities in the Project (*please* specify)**
Construction Sub-Contractor 1 for EfW plant : CNIM	
Project manager (or Contract Manager)	Represent CNIM under the Contract, manage the project internally and externally.
Deputy Project manager	On behalf of the project director, ensure technical coordination inside the project delivery team and/or manage interfaces with specific project stakeholders.
Civil Works/Installation Supervisor	The Civil work supervisor check all civil work on site including site interface coordination with process erection, civil work progress and works quality .
Civil Works manager	Under the responsibility of the Project Director, he is managing all Civil Work activities.
Site Manager	Responsible for HSE, Quality and on time delivery of construction works. Lead the team and represent CNIM locally.
Engineering design Manager	The Engineering design Manager designates Design Engineers, Drafters and an Electrical and C & I Engineer. They are a member of the project team.
Process Project manager	The Process Project manager, participate in periodic internal project advancement meetings, coordinate periodic technical meetings and coordinate studies within the entities concerned. In particular, ensure that the applicable change requests have been taken into account. They ensure the distribution to the personnel of their entity the information and documents Project (Management plan, contract, CR meeting ..) They take part, according to the agenda, in meetings organized by the Client or his representative or with the partners and subcontractors.
Electrical and I&C manager	The Electrical and I&C manager, participate in periodic internal project advancement meetings, coordinate periodic technical meetings and coordinate studies within the entities concerned. In particular, ensure that the applicable change requests have been taken into account. They ensure the distribution to the personnel of their entity the information and documents Project (Management plan, contract, CR meeting ..) They take part, according to the agenda, in meetings organized by the Client or his representative or with the partners and subcontractors
Structural and cvil engineering design Manager	The Structural and civil engineering design Manager, participate in periodic internal project advancement meetings, coordinate periodic technical meetings and coordinate studies within the entities concerned. In particular, ensure that the applicable change requests have been taken into account. They ensure the distribution to the personnel of their entity the information and documents Project (Management plan, contract, CR meeting ..) They take part, according to the agenda, in meetings

Information on Indicative Key Staff Members	
Functions in the Project (*please specify*)	**Responsibilities in the Project (*please* specify)**
	organized by the Client or his representative or with the partners and subcontractors
Project Planner	Manage and update the project programme, i.e measure progress and forecast the project activities. Integrate subcontractors schedules.
Project H&S Manager	Ensure project compliance with H&S regulations and industry good practise
Environmental Manager	Ensure project compliance with relevant environmental regulations
Project QA Manager	Take into account contractual quality and regulation requirements. Implement then through the Project Inspection & Test plan. Assess/audit the permanence of compliance with project quality requirements. Ensure quality animation project. Participate in the treatment of anomalies
Commissioning Manager	Ensure the Commissioning of all systems and sub-system under the responsibility of the commissioning Director, Project Director and Site Director. Precommissioning, cold commissioning, Hot commissioining, Specific tests, training, acceptance tests and Reliability tests up to take over.

Name of the Company: ENERGOPROJEKT NISKOGRADNJA (Landfill Construction Sub-Contractor)

Information on Indicative Key Staff Members	
Functions in the Project (*please specify*)	**Responsibilities in the Project (*please* specify)**
Construction Sub-Contractor 2 for Landfill Construction	
Project manager	Represent Energoprojekt Niskogradnja under the Contract, manage the project internally and externally.
Chief Construction Engineer	The Civil work supervisor check all civil work on site including site interface coordination with process erection, civil work progress and works quality .
Chief Engineer - Planning department	Manage and update the project programme, i.e measure progress and forecast the project activities. Integrate subcontractors schedules.
Project QA Manager	Take into account contractual quality and regulation requirements. Implement then through the Project Inspection & Test plan. Assess/audit the permanence of compliance with project quality requirements. Ensure quality animation project. Participate in the treatment of anomalies
Project H&S Manager	Ensure project compliance with H&S regulations and industry good practise
Environmental Manager	Ensure project compliance with relevant environmental regulations

WORKS DELIVERY PLAN 0

WEIGHBRIDGE FACILITY

Form T.2.8 Technical Description

Form T.2.8.1 Overall Design Concept

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	0 0
Facility No. Name of the Facility	0 Weighbridge Facility

Overall Design Concept

Weighbridges

The following weighbridges and associated facilities will be installed at the Site, as part of the Landfill Construction Sub-Contractor's scope of works:

- 2 (two) weighbridges for incoming trucks
- 2 (two) weighbridges for outgoing trucks,
- 1 (one) weighbridge for the CDW platform
- 1 (one) weighbridge for the maturated IBA and
- 1 (one) weighbridge for stabilized APCR to be landfilled

Each weighbridge will be able to weight in both directions in case of problem incurred with one weighbridge.

The dimension of the weighbridge at the entrance of the Site shall be 18 m long, with a maximum capacity of 60 tons. In front of each of the two incoming trucks weighbridges, a radioactivity detector, with alarm system and dedicated software will be installed.

The weighbridge facilities will include the entrance building and computer control system, The weighbridge facility will also include a room/building (ca.25m²) dedicated to the truck drivers and operators fitted with the necessary amenities.

Form T.2.8.2.1 Data Sheet for Registration/Weighing

REGISTRATION/WEIGHING	
	Page 1 of 1
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	N° 0 N°0
Facility No. Name of the Facility Location of the Facility	N°0 Registration and Weighing See Lay-out - Form 2.2.3.1
Operating hours and days	0 .h a.m. to 12 h p.m. (24h/24h) days: 365d / 365d
Number of shifts	3
Operating days	365 d/a
List of associated facility components	For Site entrance and exit : 2 weighbridges in 2 weighbridges out Registration building Welfare facilities for staff [Note: additional weighbridges will be available at the following facilities for the Contractor's internal operations: 1 weighbridge for the CDW platform 1 weighbridge for the maturated IBA and 1 weighbridge for stabilized APCR to be landfilled]
Required area of Facility (total)	Around 1500 m²

Form T.2.8.3 List of Buildings and Architectural Conceptual Design

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	0 0
Facility No. Name of the Facility	0 Weighbridge Facility

List of Buildings and Architectural Conceptual Design

Entrance and Weighing area

The site entrance contains control area and weighbridges. It has been designed with a maximum slope of 6 % admissible for the traffic of operation and security vehicles.

A crossing gate will be installed at the site entrance, allowing for separate entrance of pedestrians and vehicles. The gate will be made of steel profiles filled by steel sheets. The vehicle gate will have 2wings, each 3.75 m long. Height of the gate is 2.50 m.

All weighbridges shall be elevated installation above ground.

Weighbridge Gatehouse

Dimensions of building will be 25 x 6 m and with a height of 3 m. Windows to be provided to give good all round vision. The opening windows shall be provided such that direct hand-to-hand exchange with waste vehicle drivers is possible.

The Weighbridge gatehouse will include:

- ✓ Control desk and window/hatch to weighbridge
- ✓ Control/Office area
- ✓ Toilet facilities to include single WC with extract fan and wash basin
- ✓ Vehicle management system
- ✓ CCTV Controls

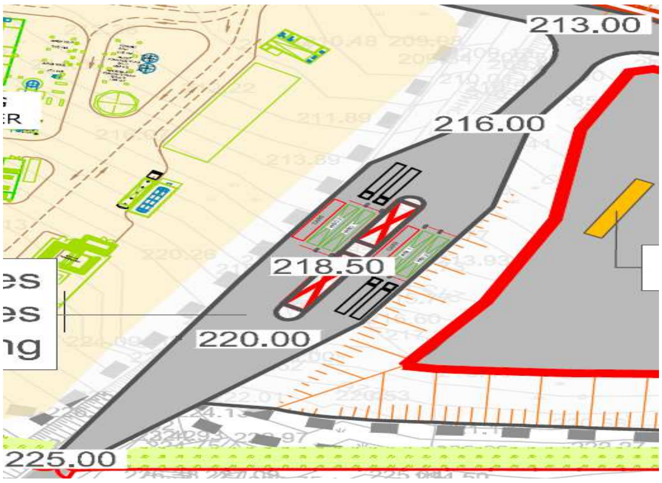
Welfare building at the entrance

A dedicated building will be foreseen apart from the weighbridge gatehouse, with dimensions 19 x 6 m and with a height of 3 m, in order to offer welfare facilities to the waste trucks staff.

Form T.2.8.6 Roads, Paved Areas and Parking

1. Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	0 0
Facility No. Name of the Facility	0 Entrance and Weighing

Roads, Paved Areas and Parking



location of site entrance

Entrance control area will include 4 weighbridges, supervisory station, parking, waiting zone

The road structure is preliminarily designed as follows:

- sub-base course: 30cm layer with 0/60mm crushed stone, including lower geotextile;
- Base course: 20cm layer with 0/31.5mm crushed stone;
- Surface course: tack coat and 6 cm bituminous macadam.

Form T.2.8.7 Infrastructure connections

1. Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	0 0
Facility No. Name of the Facility	0 Entrance and Weighing

Infrastructure Connections

Underground Ducts

Underground ducts will be required to carry CCTV and computer cabling from gatehouse to main building. It will be procured under the Landfill EPC Contract.

External Lighting

The lighting of walkways and roads shall be provided by pole-mounted lights and at the building with wall-mounted lights.

The mean minimum lighting intensity at working level will be 20 lux and 150 lux in front of gates and doors.

All along the peripheral fence of the site, and on the platforms, street lighting shall be installed in such a way that CCTV cameras are not blind at night.

WORKS DELIVERY PLAN 1

MAIN (EFW) FACILITY

Form T.2.8 Technical Description

Form T.2.8.1 Overall Design Concept

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	1 1
Facility No. Name of the Facility	1 EfW FACILITY

Overall Design Concept

1. INTRODUCTION

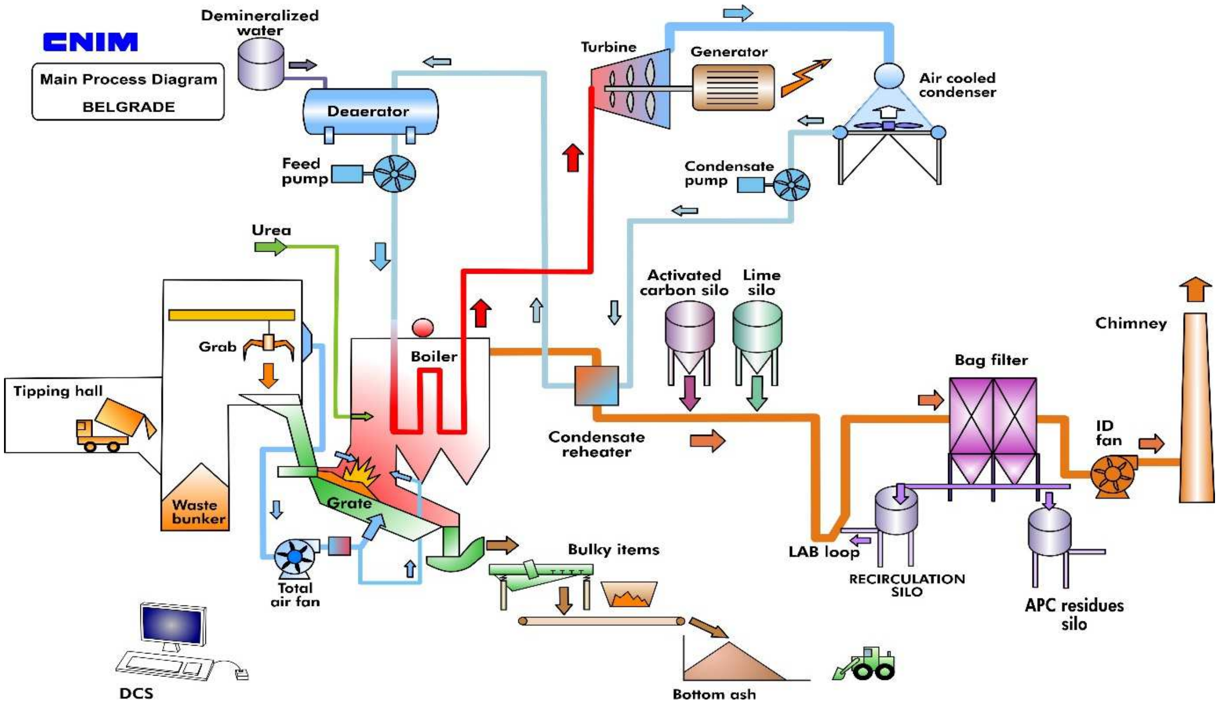
The aim of CNIM technical specification is to give a full understanding of the processes, technology and the design of the plant proposed.

The project consists of supply of one Incineration line with a Maximum Continuous capacity MCR+ of 49.4 T/h of Municipal solid Waste (MSW) with a Lower Calorific Value of 7500 kJ/kg and a Design point MCR at 43.6 t/h of MSW at a LCV of 8500kJ/kg.

The proposed technology includes the following main areas :

- a Martin Vario reverse acting grate
- a boiler designed according to our latest experiences : CNIM vertical heat recovery boiler suspended (due to the capacity)
- A ""SECOLAB"dry flue gas treatment with residue recirculation and re-activation by maturation.
- Steam cycle optimised 60bars / 400°C to achieve maximum power output
- Non catalytic NOx reduction (SNCR) will be achieved by liquid urea solution injection.
- APCR and fly ash solidification
- IBA treatment to maximise resource recovery from bottom ash.

The plant will be compliant with the Waste Incineration Directive.



The aim of this chapter is to give an overview of the process offered in our tender.

A detailed description of each part will be given in the following sections.

2. RECEPTION AND WASTE HANDLING

Collection vehicles arriving at the plant are weighed on an automatic weighbridge.

2.1 WASTE TIPPING HALL

The tipping hall will be enclosed on a limited surface at the level of the unloading bays and the bunker and provided with louvres for natural air ventilation.

A dust suppression system will prevent or capture airborne dust issued from bunker area. It includes automated spray and radio control system operated from control room.

Air for combustion will be drawn through the tipping hall, creating under pressure conditions to prevent the escape of dust and odours. Two hours rated system for penetration of openings in fire barriers between tipping hall and boiler hall will be considered. A motorised fire damper will be closed at fans aspiration box after stopping primary air fans suction, operated from control room.

Seven (7) unloading bays are foreseen to provide access to collection vehicles, with red/green lights in a location visible by truck drivers reversing into unloading bays, to indicate which bays are operational. This active traffic management allows to control traffic flow from the central control room.

One (1) back loading hopper is provided to backload waste into trucks in the event that this may be required. It is similar in construction to the boiler feed hopper, with a design robust enough to support a full crane grab weight and with an inlet size in accordance with the grab diameter.

2.2 WASTE BUNKER

The bunker has been sized taking into account the quantity of waste delivered par day.

The volume of the bunker will allow for 3 days storage capacity plus 2 days additional stacking at MCR operating condition.

The bunker will be made of reinforced, waterproof concrete with smooth surface.

Main dimensions of the bunker are:

- Length 37.30 m
- Width 18.00 m
- Depth - 10.0 m (from tipping hall level)

2.3 WASTE CRANES AND GRABS

The plant is fitted with two (2) travelling cranes equipped with mechanical grabs, each of which being capable of picking up waste from any point within the waste bunker. During plant opening time, only one crane will be used for feeding the grate hoppers and for mixing waste, to ensure that the waste loaded in the hopper has a constant calorific value.

Travelling cranes will be operated from a pulpit (1 per crane) located in the control room. This location will make the operation easier thanks to a clear view of any part of the waste residual storage.

Each travelling crane will be fitted with a waste grab and Remote Control Systems to allow the operation from the Control Room in manual, semi-automatic or fully automatic mode. In the semi-automatic mode, the waste is manually gripped by the crane operator, then directed and dropped automatically into the feed hopper.

One travelling crane will be on duty with the other on standby. Having both travelling cranes operating at the same time is not possible in automatic or semi-automatic mode and devices will be provided for a safe operation.

In full automatic operation wastes cranes are equipped with a three axes permanent positioning system connected to the main DCS of the plant. Waste bunker operations are controlled and completely managed with appropriate SCADA system able to operate on full automatic mode.

1/ feed boiler hopper

2/ clear bunker area allocated to different bays

3/ mix waste

A specific tipping hall traffic management is therefore necessary.

Each crane and grab will be designed to transfer the delivered daily waste capacity into the feed hopper in a 12 hour period. In addition, the crane and grab will be capable of further continuous operation for the remaining 12 hours of the day for lifting, moving, mixing, casting and stacking waste in the storage bunker.

- Grab and crane capacity 12 m^3, 16.5 Tons (to be confirmed during detail design)

The travelling crane in operation is used to mix the waste in the bunker, to ensure that the waste loaded in the hopper has a constant calorific value, as much as possible, and may be used also to load the waste in the back loading hopper to reload trucks with waste.

The crane and grab will be capable of simultaneous operation in two directions in the horizontal plane whilst raising and lowering the grab in the vertical plane with appropriate design features to minimise grab swing.

The travelling cranes will be of the double beam type, resting on 4 wheels, two of which are driven. Each driven wheel is actuated by one geared motor-brake unit. The frame of the crane is made of mechanically adjusted, welded and shaped sections. It supports the traversing and lifting mechanisms.

The hoisting trolley rests on 4 wheels, two of which are driven by a single geared motor-brake unit. The lifting mechanism is of a 4 strands x 2 ropes type. The lifting beam is fitted with two rolling return/pulleys and the grab suspension.

The power supply is provided by means of festoons for the crane and by means of flexible cables for the grab.

A maintenance hoisting point will be provided on each crane.

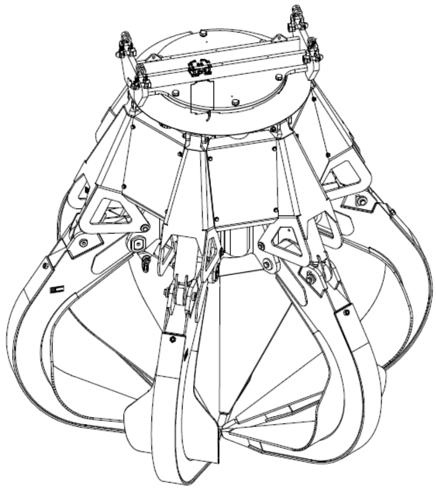
One video camera per feed hopper will display the waste level in the hopper in the control room at the crane operator station.

2.4 WASTE GRAB

Waste grabs fitted to the travelling cranes will be of orange peel type and hydraulically powered.

A load cell based weighing device will be fitted to enable to record in the DCS the weight of each grab load before discharge into the feed chute.

Two (2) grabs will be provided in total; one per crane.



The waste feed chute below the hopper is shaped to ensure the waste forms an air-tight seal with the combustion chamber in order to prevent air ingress and escape of gases from the furnace. At the bottom of the feed chute, the feeder ram pushes the waste over the feeding edge on to the front end of the grate.

3. BOILER AND POWER GENERATION

Based on the anticipated throughput and Net Calorific Value (NCV) of the waste (also called LCV Lower Calorific Value or LHV Lower Heating Value), we have elected for a 6 runs grate and vertical boiler arrangement. The grate and boiler will be from a CNIM/MARTIN standard range of equipment, with optimised energy recovery and reduced Nox level in the raw gas.

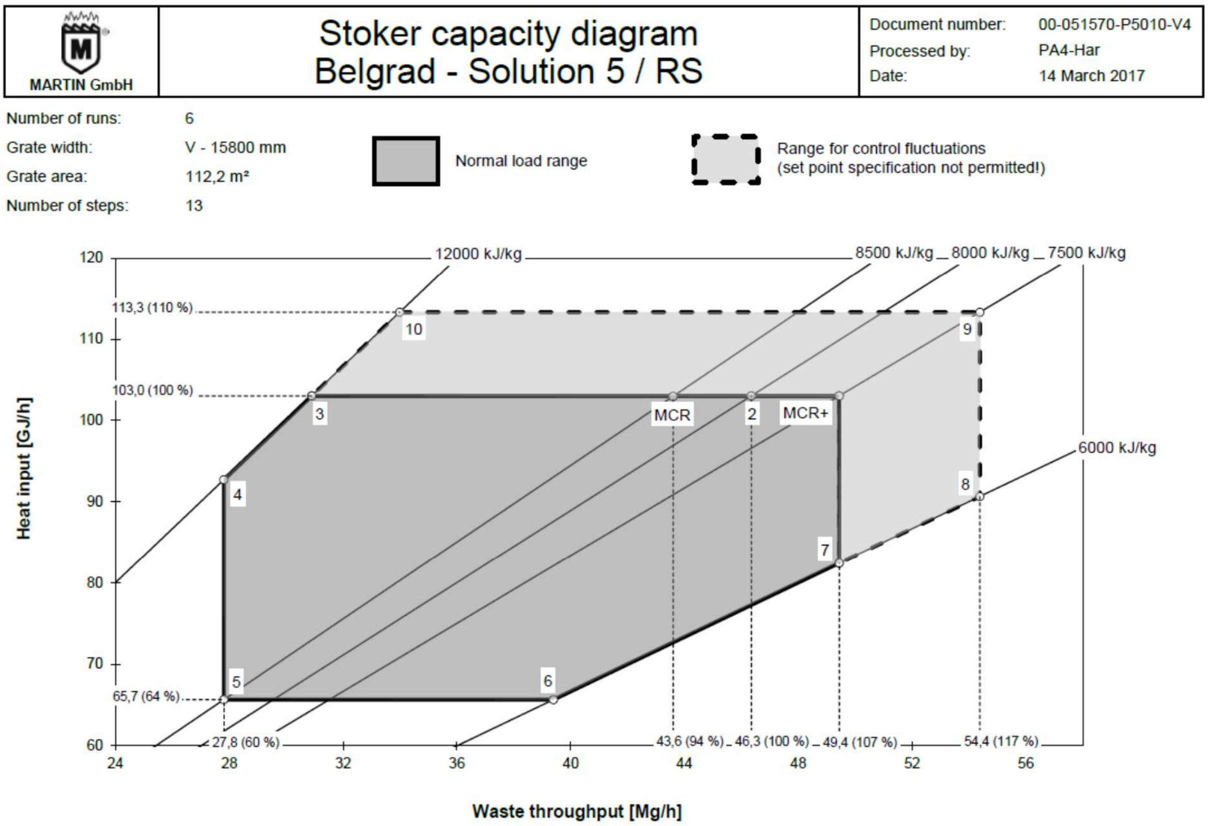
The ERF facility includes one combustion line and heat recovery boiler designed to incinerate in safe and environmentally sound manner Acceptable Waste

3.1 FIRING CAPACITY

The grate is designed to operate continuously with LCV's ranging from 6000 kJ/kg (Minimum LCV) to 12000 kJ/kg (Maximum LCV) which suits a very broad range of wastes.

The maximum (hourly) waste throughput, determined as being the tonnage of waste incinerated by the line, would be 49.4 tph for waste having a LCV between 6000 kJ/kg (MCR+) and 7500 kJ/kg and 43.6 tph at 8500 kJ/kg (MCR) which is the Design LCV.

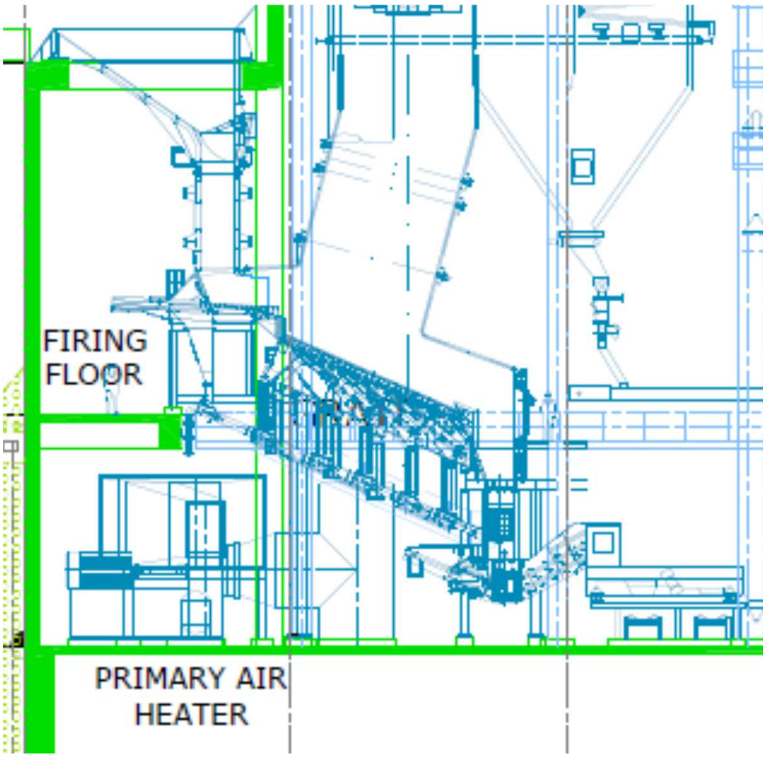
This (hourly) waste throughput shall be reduced according to the LCV for waste having a LCV between 8500 kJ/kg and 12000 kJ/k according to the following diagram.



3.2 COMBUSTION PLANT

The EfW Facility includes the following main components:

- Waste loading system
- Refuse transfer system
- Refuse feeder
- MARTIN Reverse Acting grate system, Vario type
- Grate sifting handling system
- Bottom ash discharger
- Hydraulic power system
- Combustion air distribution system
- Combustion control
- Combustion air supply system
- Auxiliary fuel firing equipment (burners)
- Ash disposal

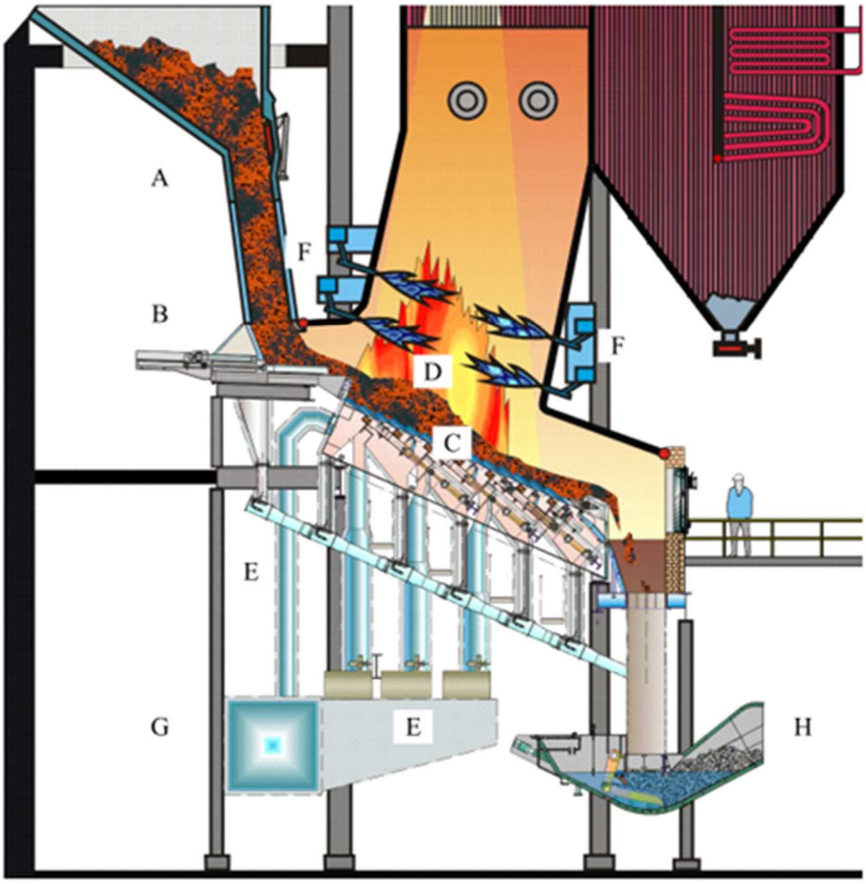


MARTIN combustion PRELIMINARY drawing

3.3 COMBUSTION SYSTEM

3.3.1 Introduction

The MARTIN reverse-acting grate is eminently suitable for the combustion of household waste and comparable commercial waste. Approximately 700 waste combustion systems in over 350 plants have been implemented worldwide using this grate system since 1959.



A	feed hopper feed chute	B	feeder	C	reverse-acting grate Vario
D	furnace	E	underfire air	F	overfire air
G	air preheater	H	discharger		

Fig. 1 MARTIN waste combustion system

The MARTIN reverse-acting grate Vario is a further development of the MARTIN reverse-acting grate.

When combusting fuel on the MARTIN reverse-acting grate, the following essential requirements are met:

- Wide heating value range with capacities for handling fluctuations in waste composition

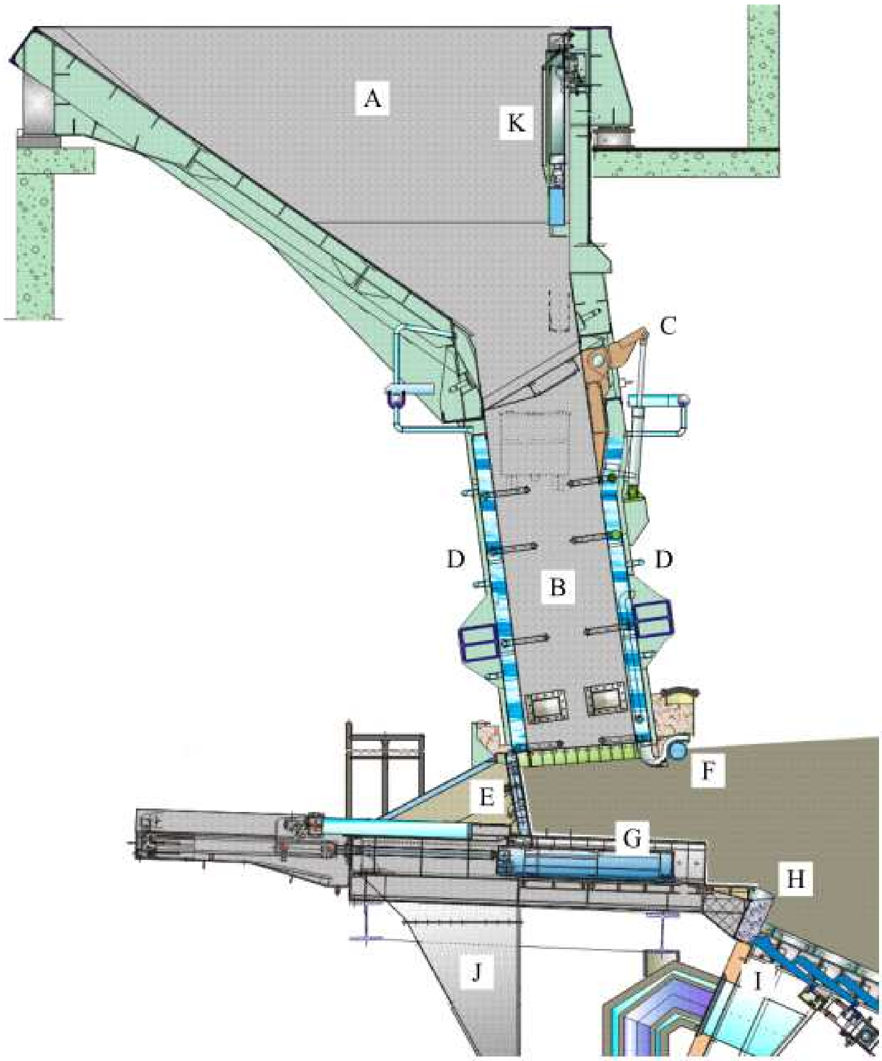
- Rapid transition of the fuel from a cold state into the combustion phase in order to prevent smouldering which adversely affects emissions
- High and uniform fuel bed temperature
- Intense and continual agitation of the fuel bed
- Grate speed can be individually set per run and zone
- Clear delimitation between combustion zone and burned-out bottom ash over the entire grate width
- Good bottom ash burnout by adjusting the grate speed in the various zones in response to varying waste quality
- Uniform covering of the grate surface
- Low thermal load on grate bars
- No air supply due to mechanical requirements (e.g. cooling of cast-steel parts)
- Easily controlled supply of combustion air as required
- Small amounts of grate siftings
- Low fly ash discharge from the combustion system
- Direct response to control operations
- Rapid start-up and shutdown of the grate
- Easy replacement of grate bars
- Modular design

This results in the following advantages for combustion system operation: high levels of availability, long grate surface service lives, recyclable residues and consistent compliance with emission requirements while at the same time maintaining high efficiency.

3.3.2 Waste feeding

An automatically operated feeder supplies the waste to the grate. Above the feeder there is a feed chute which consists of a feed hopper and a chute shaft. When the combustion line is in operation, the feed chute is filled with waste which is drawn downwards by gravity.

The waste column creates an air-tight seal between the furnace and the waste bunker. This prevents both false air inleakage, which could adversely affect combustion conditions, and fires in the chute.



A	feed hopper	B	chute shaft	C	feed chute damper
D	cooling water jacket	E	transition piece	F	front wall header
G	feed rams	H	feed edge	I	front grate step
J	feeder siftings hopper	K	bridge breaker		

Fig. 2 Waste feeding

The waste column also serves as a reserve supply for the waste being fed by individual grapple loads. The holding capacity of the feed hopper is such that the hopper remains sufficiently full throughout the entire feeder cycle. The waste level in the feed hopper is monitored by the crane operator.

Feed hopper

The feed hopper is dimensioned in such a way that when the grapple is open, the entire grapple contents can be unloaded without waste spilling over the sides. Removable wear plates are welded on the hopper where necessary.

The feed hopper is accessible from the charging floor so that work can be performed manually. The upper edge of the feed hopper is situated about 1 m above the charging floor so that there is no danger of falling in while work is being carried out.

Feed chute

The feed chute, which extends over the entire width of the grate, consists of steel plates reinforced with steel sections.

The level in the chute is monitored by microwave level detectors. When the minimum level is not reached, an alarm signal is sent to the control room and the crane control cabin.

A shut-off damper extending across the entire width of the feed chute is installed beneath the feed hopper. This damper provides an air-tight seal during start-up and shutdown of the combustion system when there is no waste in the chute. The entire hydraulic drive for the feed chute damper is located outside the chute shaft.

The chute shaft located under the shut-off damper is enclosed in a water jacket as protection against excessive thermal load. The water flows constantly through the warm and cold zones by means of natural circulation, thereby preventing overheating. There is no additional water consumption. When cooling water temperatures become too high, cooling water is supplied by means of a thermostat valve.

A safe system of removing blockages from the feed chute is foreseen with a fishing grab on a crane and a man rescue basket.

Feeder

The waste is fed by means of a ram-type feeding device. The waste compressed by gravity in the chute shaft is loosened by the rams, and uniform distribution of fuel on the grate is achieved. Uncontrolled sliding of the waste column through the chute shaft is not possible as the waste's vertical downward movement becomes a horizontal movement.

Each grate run has its own hydraulically driven feed ram. The number of strokes, stroke length and stroke speed can be set individually. The feeding cycle is integrated in the combustion control system; manual control is possible locally, if necessary.

The surfaces of the feed rams and feed table, which are exposed to heat irradiation from the furnace, consist of heat-resistant cast chromium steel. Vee guides and maintenance-free support and guide rollers ensure that the feed rams do not jam. The robust design of the entire structure essentially rules out the possibility of damage caused by heavy items falling out of the feed chute.

Waste passes from the feed table over a feed edge onto the grate. Good ignition and combustion behaviour is achieved as a result of this additional breaking up of the compacted waste, even in the case of low heating values.

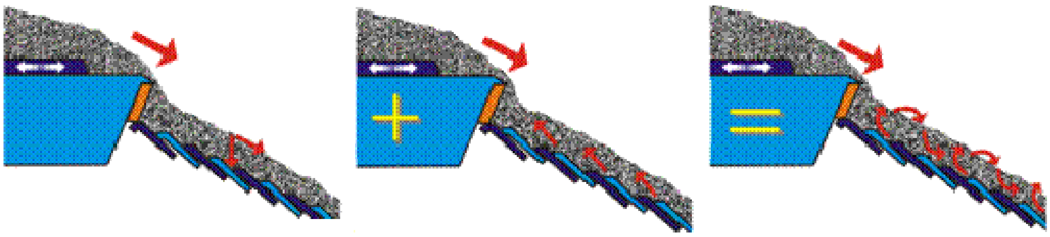
3.3.3 Reverse-acting grate

Waste combustion

The MARTIN reverse-acting grate Vario is horizontally inclined at an angle of 24° from the feeder to the discharger and comprises stationary and moving steps in alternating order.

By means of the reverse-acting motion of the moving grate steps directed against the natural downward movement of the fuel bed on the grate, the fuel is first mixed through an upward and then through a downward movement. Continual mixing of the waste layers at the front end of the grate and in the vicinity of the grate surface with red hot particles from the main combustion zone is thereby ensured.

A vigorous, stable fire, in which all the combustion phases (drying, gasification, ignition and combustion) occur simultaneously and consecutively, develops at the front end of the grate. The constant stoking motion effects a uniform heat release and ensures excellent burnout values.



weight of waste — reverse-action caused by moving grate steps — mixing of waste layer

Fig. 3 Stoking motion

The moving grate steps perform approx. 15 – 25 strokes per hour in the direction of the front end of the grate. The number of strokes, i.e. the grate speed, agitates the fuel bed. The speed has only a minimal influence on throughput. The residence time of the waste on the grate is approx. 60 - 70 minutes. Rapid clearance of the grate takes approx. 30 - 45 minutes.

Secondary combustion, i.e. oxidation of unburned gases, takes place in the flame body forming above the main combustion zone. Virtually complete gas burnout is achieved by adapting the overfire air supply to the waste conditions prevailing at any time.

The formation of carbon monoxide and halogenated hydrocarbons is essentially prevented by the intensive agitation and mixing of the gases emitted by the flames immediately above the main combustion zone using a targeted supply of overfire air.

Basic structure

The grate consists of one or more parallel grate runs. The width of the runs can be selected in small steps. The length of the grate is determined by the number of grate steps and is also variable.

Thanks to this modular system, the grate can be dimensioned to suit the precise throughput requirement and the special properties of the waste to be combusted.

The grate run structure consists of the side longitudinal frames connected by the carrier beams and the compartment walls. Carrier beams made of T-sections are inserted between the side longitudinal frames and support the grate bars of the stationary steps. Plates divide each grate run into five zones along its length. Underfire air is directed into each zone individually. Hoppers of seal-welded steel plates extend the zones. They serve to connect the zones to the underfire air plenums and to collect ash falling through the grate surface.

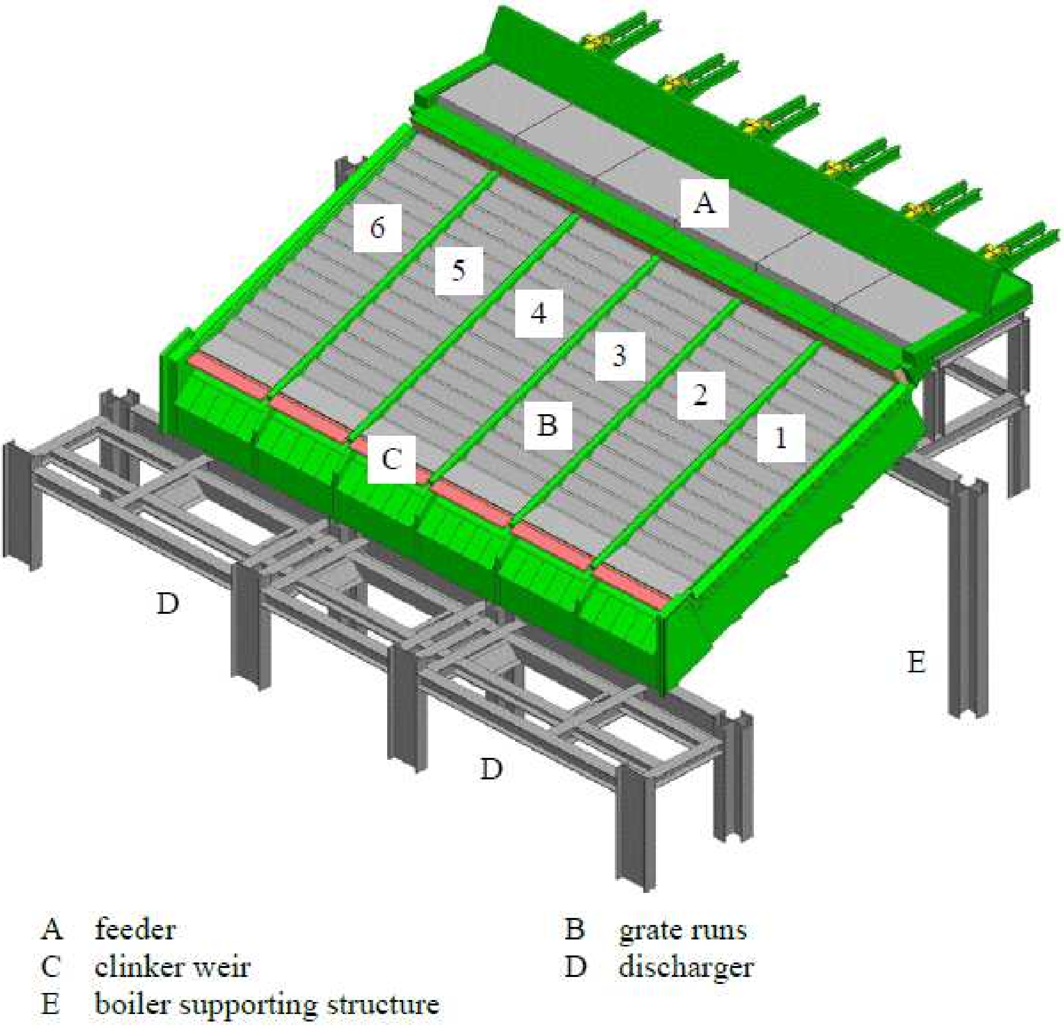


Fig. 4 MARTIN reverse-acting grate principle

Grate drive

Each grate run has its own separate drives that are independent of the other runs. Each grate run is divided into three drive zones in which the grate speed can be set to varying values.

The moving rows of grate bars in a drive zone are attached to a hydraulically driven moving grate support. The cylinders are situated underneath the grate runs and are easily accessible from the outside. Replacement is possible while the combustion system is in operation.

Support rollers ensure free movement and minimal wear. Replaceable wear strips serve as bearing surfaces. Guide rollers prevent lateral displacement of the driving beams. Sealing air protects the maintenance-free support and guide rollers against fouling.

The hydraulic drives are equipped with check valves to prevent the moving grate steps from travelling downwards due to their own weight between stroke movements.

Grate surface

The grate surface of the MARTIN reverse-acting grate consists of individual grate bars arranged in rows that are alternately stationary and moving. The grate bars are made of 18 % cast chromium steel which is highly wear and heat resistant. The grate bars are surface ground on the sides and lie flush.

All grate bars have the same basic structure. Varying end bar widths mean that the gaps between the bars are offset from one grate step to another. Interlock spigots on the sides of the bars project into the slot on the side of the adjacent grate bar. These measures prevent individual grate bars from lifting. Pyramid-shaped raking or pushing noses are attached to the head of some grate bars to assist the agitating motion.

The sturdy box-type grate bar has cooling ribs along the length of its underside. The underfire air first flows through the grate bars and then into the fuel bed through approximately 2 mm-wide air gaps at the head of the grate bars. The air gaps make up about 0.5 % of the total grate surface. This provides the high flow resistance necessary for uniform air supply to the fuel bed and at the same time cools the grate bar.

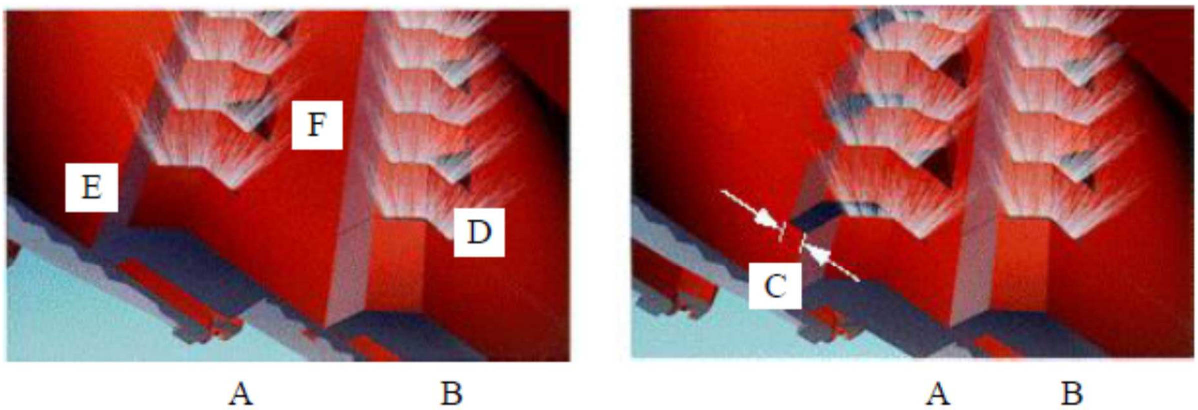
The reverse-acting motion of the moving grate steps produces a closed layer of waste and/or bottom ash over the entire grate surface. As a result, the grate bars are ideally protected against thermal irradiation from the furnace. The average operating temperature of the grate bars even in the main combustion zone is only slightly above the set underfire air temperature.

The grate surface consequently does not need to be cooled with water - not even when combusting waste with a high heating value. This provides a high level of safety with respect to thermal overloading and contributes to a long service life, which depends almost exclusively on mechanical wear. Thermocouples for measuring the temperature of the grate bars are installed in selected bars in the main combustion zone.

Mechanical wear and the influence of heat cause changes in the total width of the grate run during operation. Adjusting bars in the grate surface and moving plates on the side elements of the grate runs compensate for these changes. By exerting uniform pressure, they facilitate precise guidance of the grate bars and a tight grate surface, also during long service periods. Uneven underfire air distribution and blockages caused by foreign objects entering the gap between the grate bars are thus largely prevented.

When the moving grate steps reach their upper end position during a working stroke, every second grate bar in a stationary step is moved relative to its adjacent bars. When the moving grate steps retract to the lower end position, the same relative movement of the grate bars occurs in the moving grate steps.

The air gap is self-cleaned by means of this relative stroke. The jagged edges of the contact sides of adjacent grate bars grind any foreign objects that may be present. They are disposed of through the undergrate hopper. The relative stroke ensures uniform underfire air distribution over the entire grate surface, also during long service periods.



A	moving grate step	B	stationary step	C	relative stroke
D	air gap	E	pushing nose	F	raking nose

Fig. 5 Relative stroke of the grate bars

3.3.4 Combustion residues

Grate siftings

The grate surface of the MARTIN reverse-acting grate is on the whole very tight. Nevertheless, it is unavoidable that small quantities of fine ash particles fall through the air gaps and the gaps between the grate bars.

The grate siftings collect in hoppers underneath the grate. Beneath each of these hoppers there is a grate siftings flap. The ash that falls through the feeder is collected in the same manner. Each grate run has a separate hopper for the feeder siftings under which the feeder siftings flap is situated.

The flaps for the feeder and grate siftings of each grate run lead to a common siftings discharge duct through which the grate siftings are pneumatically conveyed to the discharger connecting piece. The air admission flap is at the air inlet. All flaps are actuated by pneumatic cylinders. The flap position (open or closed) is monitored by 2 limit switches which generate feedback signals.

The removal of ash from the grate runs occurs consecutively at intervals of approx. 5 minutes. The siftings discharge air needed for this purpose is drawn off from the underfire air. Since no supplementary air is used, the air balance for combustion remains unaffected. After the ash-discharge cycle has been completed for all grate runs, an idle time which can be set from 20 - 30 minutes follows. Thereafter the ash-discharge cycle begins again.

Clinker weir

Complete burnout of the bottom ash takes place at the rear end of the grate. At the end of the grate there is an electrically adjustable clinker weir which enables the height of the bottom ash layer and the residence time of the ash in the burnout zone to be regulated independently of the grate drive to ensure sufficient coverage of the grate surface as protection against heat irradiation from the furnace.

Discharger

The combustion system is equipped with the MARTIN discharger with extended stroke.

The hot bottom ash falls through the ash pit into the discharger water bath. Complete quenching and cooling to approx. 80 - 90 °C make it possible to safely remove the bottom ash without dust or odour nuisance.

The water bath provides an air-tight seal between the furnace and the boiler house; it is not possible for false air to enter via the discharger.

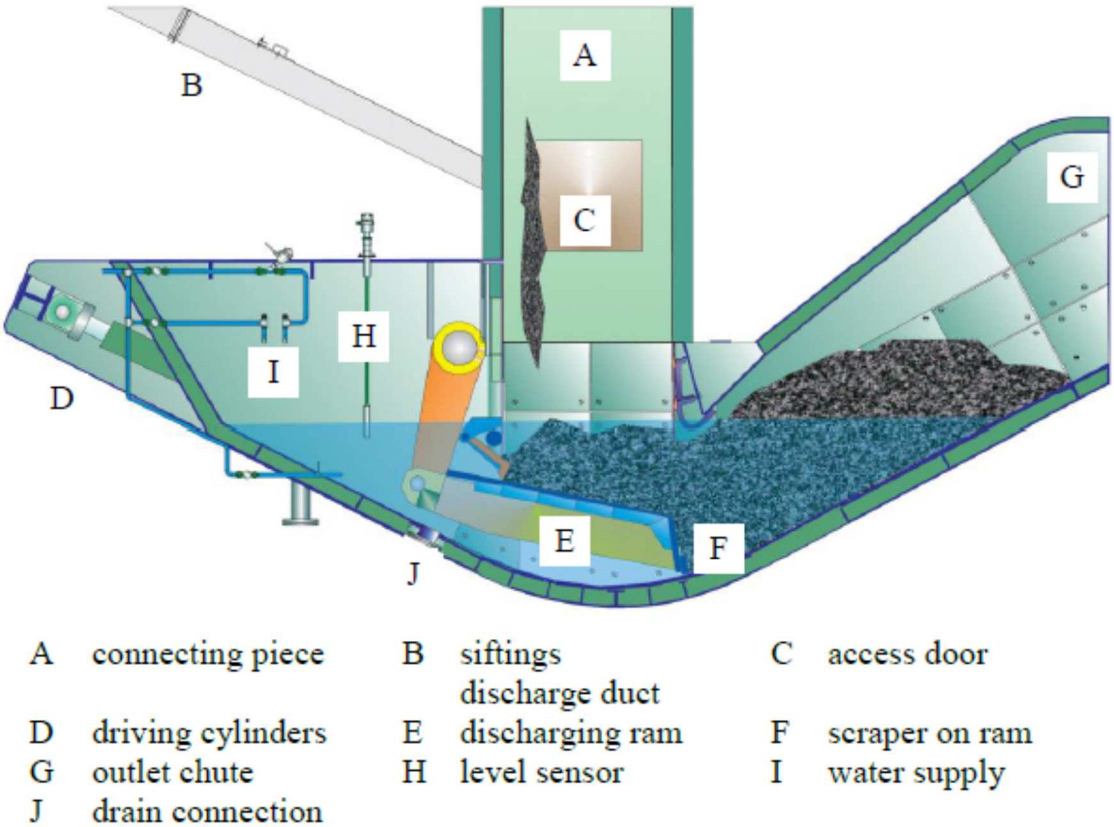


Fig. 6 MARTIN discharger principle

The water level in the discharger is kept constant with an automatic supply via float valves. The MARTIN discharger has no water overflow, i.e. only the small amount of water which evaporates and the water absorbed by the bottom ash is replaced. An outlet connection DN 100 is provided for rapid draining.

Hydraulic cylinders installed on both sides of the discharger move the discharging ram. Each stroke gradually pushes the bottom ash through the slightly inclined discharger outlet chute. The bottom ash is slightly compacted during this process, but there is no danger of clogging. Water drains from the bottom ash in the discharger outlet chute, thereby reducing water loss in the discharger. The moisture retained by the bottom ash at the discharger outlet is low, amounting to approx. 15 - 20 %.

The whole area under the connecting piece is cleared by the extended stroke of the discharger during each working stroke. Thus also larger particles are safely cleared and the danger of clogging is significantly reduced. Bulky items, in as far as they can be deformed, are compressed and removed by means of rapid to-and-fro movements of the discharging ram (known as the "boxer function").

Generously dimensioned access doors are provided on both sides of the connecting piece and the discharger for maintenance and clearance work.

The discharger housing is warp resistant and made of welded steel plates. Replaceable HARDOX wear plates are applied to the inner surface of the floor and side walls. The discharging ram is equipped with replaceable scrapers.

3.3.5 Auxiliary equipment

Hydraulic system

The main drives of the MARTIN combustion system (feed rams, grate runs and dischargers) are actuated via individual pumps that can be regulated steplessly by means of frequency converters. This concept is very efficient and reliable. Each pump generates only the pressure actually required for the associated drive. There is no need for proportional control valves which are expensive and prone to failure. If a pump fails, it can be replaced in a short time without shutting down the combustion system.

A feed pump designed with a backup supplies the required pressure for the pumps of the main drives. It also supplies the required oil flow and requisite pressure for actuating the auxiliary drives.

The auxiliary drive control valves (e.g. for the feed chute damper) are located in the hydraulic/pneumatic system control cabinet. The cabinet includes valves for controlling the pneumatically driven flaps for removing grate siftings.

The pumps and the hydraulic oil tank and all associated filters and fittings are installed on a frame. The heat produced in the hydraulic system is minimal and radiates off the walls of the hydraulic oil tank; an additional oil cooler is not necessary.

Lubrication system

A grease lubricator and distributor automatically serve the lubrication points at the grate drive and discharger.

Tapered lubricating nipples are provided at bearings that are to be lubricated manually.

3.3.6 Combustion air system

The combustion air is distributed as underfire air beneath the grate and is injected into the furnace above the grate as overfire air via the nozzle rows

Underfire air

The preheated underfire air is supplied in 5 separate air zones along each grate run. The air flow to each undergrate air zone is measured and can be set individually, with the exception of zones #5, to which air is supplied from zones #4.

The underfire air fan control system keeps the pressure in the underfire air plenums constant at approx. 40 hPa. In this way, the underfire air dampers can be used to set the required underfire air flow in each zone without influencing the remaining zones. The pressure difference between the underfire air plenum and the air zones beneath the grate serves as a measure of the underfire air flow in the respective zone.

The aerodynamic resistance of the grate surface is approx. 10 hPa and is significantly higher than the air resistance of the fuel bed above it (usually about 1 - 3 hPa). Therefore the air admission through the fuel bed is uniform even if the waste is distributed unevenly on the grate.

Overfire air

Most of the still unburned gases released from the fuel bed oxidize at once at high temperatures when they mix with the residual underfire air in the furnace.

This effect is enhanced by the overfire air which is supplied over the entire furnace section. It provides the oxygen required for complete oxidation and ensures thorough agitation of the gases.

As a result, a uniform temperature and flow profile, and optimal mixing of the gases in the furnace is achieved. The residence time of the gases in the high temperature area is increased, the gas burnout improved and the formation of nitrogen oxides in the furnace reduced.

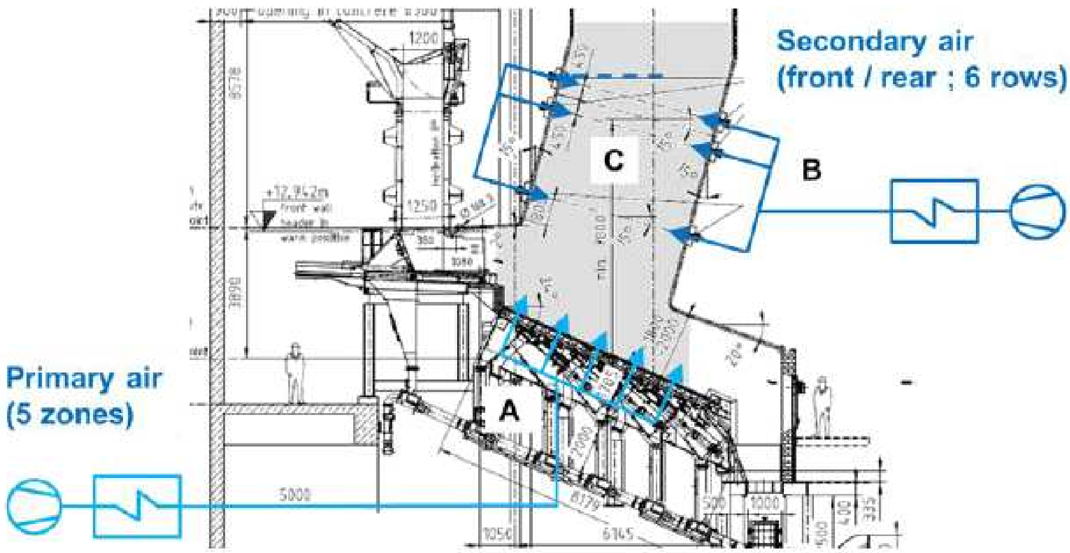
Advanced Staged Combustion process (ASC)

MARTIN GmbH für Umwelt- und Energietechnik's ASC process makes it possible to reduce NOx formation and excess air in waste combustion systems. In combination with SNCR systems, this leads to drastically reduced NOx and ammonia emissions.

The technology is based on a combustion process in which secondary air is injected via several (staged) air levels. The headers and the nozzles for the supply of the secondary air are arranged in rows opposite each other in order to ensure that furnace is completely permeated, thereby achieving thorough mixing of the flue gases and efficient secondary combustion.

The staged combustion promotes, amongst other things, the chemical reactions required to convert NOx emitted during waste combustion on the grate back to nitrogen.

MARTIN's ASC process achieves favourable combustion results, such as reduced excess O2 levels, reduced NOx emission levels, reduced NH3 consumption, increased boiler efficiency, reduction in size of the boiler and downstream flue gas cleaning components.



A underfire air distribution
B overfire air injection
C furnace (T > 1000 °C)

Fig. 7 Combustion air supply – ASC process

3.3.7 Combustion control

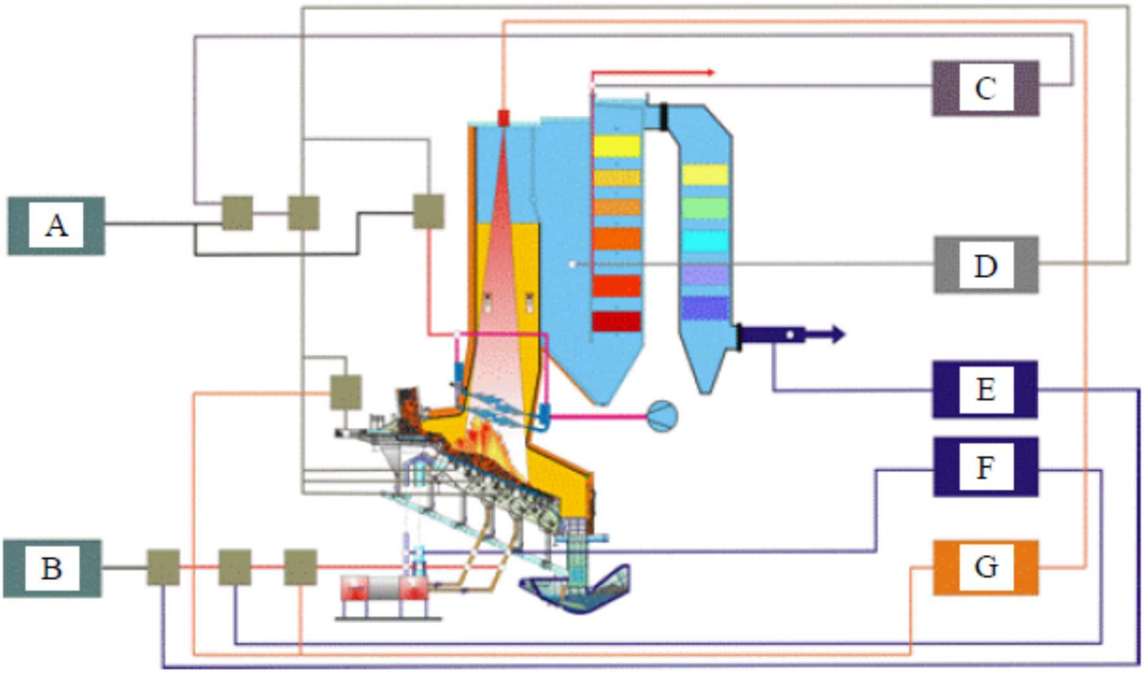
The MARTIN combustion control system is based on many years of experience and the knowhow obtained in this time. The control strategies developed and implemented by MARTIN have been optimized over the years and are constantly undergoing further development.

The combustion control system includes the fuel controller, which controls feeding of fuel to the grate. It also includes the O2 controller, which determines / corrects the combustion air flow. In addition, the overfire air flow, overfire air distribution and grate speed are controlled.

Changes in the flue gas temperature are recorded by an infrared pyrometer in the second boiler pass. Changes in the heat release from the furnace are identified promptly and reliably. This results in a very short steam flow control response time. Temperature fluctuations in the furnace and the boiler as well as steam flow fluctuations are reduced by these measures.

There is a choice of three control modes: "steam flow", "furnace temperature" or "steam flow/IR pyrometer temperature". The actuating variables calculated by the combustion control system are transmitted to the superordinate control system, where they are further processed.

Additional controllers for which signals are obtained from an IR camera system mainly influence the underfire air distribution as a function of the position of the main combustion zone, the feeder speed and grate movement. The quality of "steam flow"/"IR pyrometer temperature" control is significantly improved by the IR camera controller.



A set point for steam flow
B O_2 set point
C steam flow
D gas temperature (IR pyrometer)
E O_2 content (dry)
F underfire air flow (per zone)
G fuel bed temperature (IR camera)

Fig. 8 MARTIN combustion control principle

Technical implementation

The MICC (MARTIN Infrared Combustion Control) system has been developed by MARTIN for use in the field of combustion control as a flexible, extensible and independent system, and can be integrated in conventional superordinate control systems. Due to its innovative, modular architecture, the system can be expanded to include functionalities beyond those associated with classical combustion control.

Moreover, additional customer requirements can be easily incorporated, ideally without having to intervene in the superordinate control system. The hardware and software concept developed by MARTIN appears to the outside environment as an independent component with a clearly defined interface. All field devices are connected to the superordinate control system to ensure end-to-end visibility between the operator stations and the field.

The hardware is based on a high-end industrial PC that is available internationally over the long term. The industrial PC is installed in a control cabinet.

The software comprises various functional modules:

- Infrared camera including image analysis for process optimization
- Combustion control system with fuzzy controllers
- Operational data logging and visualization (CITECT)

The term "combustion control" normally includes both the open loop and closed loop control functions for the combustion system and grate. MARTIN-specific closed-loop control system knowhow is implemented in the industrial PC. The functions of the open loop control system and a semi-automatic control system (steam flow control) are programmed in the superordinate control system.

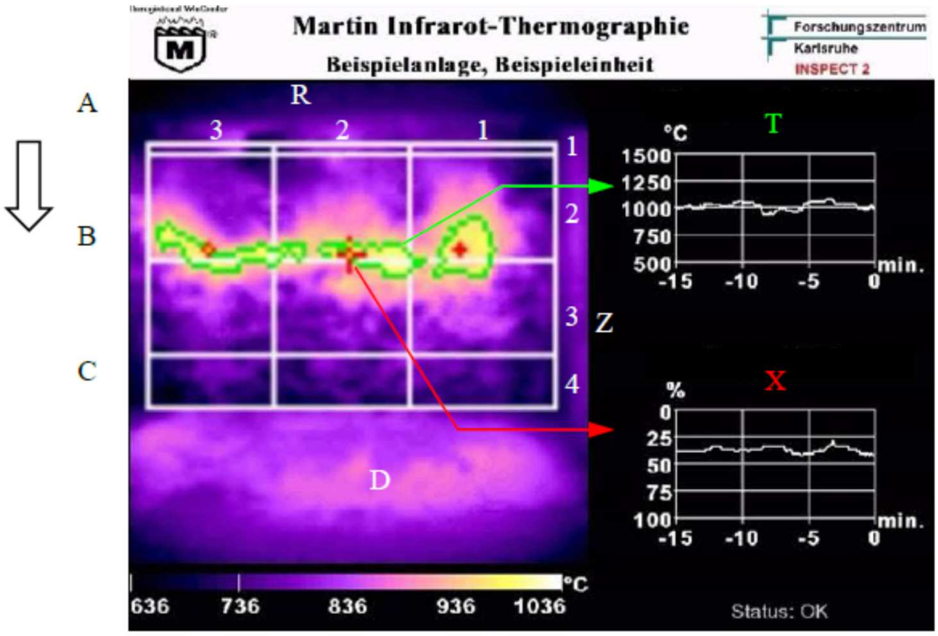
Consequently, plant operation can be sustained even while maintenance or optimization work is being performed on the industrial PC. The standardized interface and screens generated in the superordinate control system mean that the closed loop system can be adjusted from the operator consoles in the main control room, without requiring expertise in the programming language.

IR camera, image analysis and signal generation

An infrared camera system that records the intensity distribution of the thermal radiation on the fuel bed surface from the boiler roof is used to obtain additional information from the combustion process to achieve even better combustion results.

The image information delivered by the infrared camera is processed in an image analysis program developed to meet MARTIN specifications. Values are then calculated almost in real time for the combustion control system. Operating staff can also see the temporal and spatial distribution of the fuel bed surface temperatures on a separate monitor in the control room.

In addition to the supplementary controllers, the staff can also see the feeding behaviour status, which type of waste (quality, heating value, bulky items, landfill waste, …) is currently being combusted, etc. and can intervene if necessary (crane operator, manual control intervention). The fouling of boiler walls and overfire air nozzles can also be observed.



A	drying and ignition	B	main combustion area
C	burnout area	D	back reflection of the boiler wall
R	grate runs	Z	undergrate air zones
T	fuel bed surface temperature	X	position of main combustion

Fig.9 Infrared image (example 3-run grate)

The combustion parameter fluctuation range can be reduced even further by this expansion of the combustion control system and the visual information that is made available to the operating staff. The additional controllers influence feeding behaviour, grate movement and combustion air distribution.

Fuzzy control

Fuzzy control is an interesting alternative to the classical control system. The basic advantage of fuzzy control is its ability to find the "best compromise". When combusting residues in particular, the process produces partly contradictory or inexact information for the control system. Fuzzy control processes such information and finds the best solution. Manual intervention is significantly reduced and control is more stable overall. The "if … then" formulation of control behaviour allows every conceivable control case to be formulated simply, which is not possible to the same extent with classical control. The control logic programming is less complex in comparison with that of classical control, but more complex logical connections can be implemented.

Operational data logging and visualization

This module captures and displays all operating data relevant to the combustion system. If malfunctions occur or damage is noted, the captured data helps identify and eliminate the cause.

The connected remote data transmission (RDT) unit enables MARTIN to provide immediate support. Travelling expenses are thereby reduced and solutions are reached much more rapidly.

3.4 COMBUSTION AIR SUPPLY

3.4.1 Combustion air plant

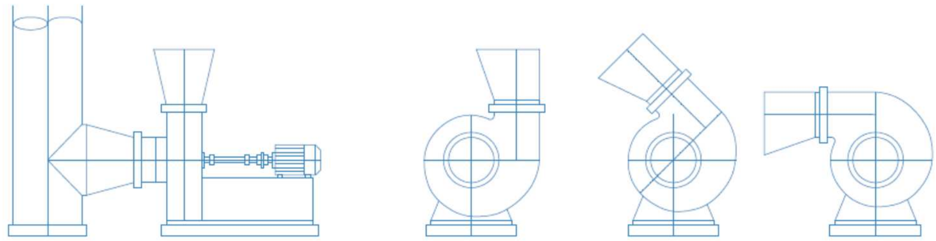
The combustion air is drawn from the Tipping hall, so that odours and airborne dust are drawn from the Tipping hall and the bunker into the incineration line. The air velocity is kept low (<4 m/s) in order to minimise clogging by paper, plastic sheets and other debris.

A duct is run from the air intake down to the forced draught fan. The forced draught fans discharge into the air heater. Necessary silencer is provided on the air inlet duct for noise attenuation. The two hours rated system for penetration of openings in fire barriers must be considered. A motorized fire damper with maintenance access and fire resistant protection cladding will be added on aspiration box of the total air fans suctions. Operator in control room will have the possibility to close dampers when necessary.

3.4.2 Air Fan

One air fan is provided to supply combustion and overfire air to the furnace (a total air fan for primary and secondary air).

The combustion fan drawn air from above the municipal waste storage bunker and tipping hall. The air is then heated into an air heater. One part of this air is used as secondary air and distributed into the combustion chamber. The other part, at the outlet of the air heater is used as primary air which will be distributed into the separate air zone compartment fitted to the underside of the grate.



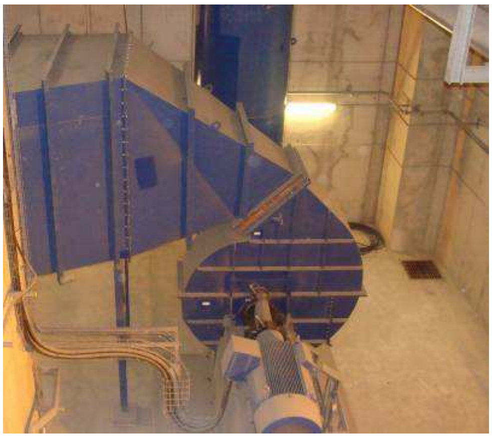
The fan is of centrifugal type with axial air inlet. Housing is of welded steel construction, braced and stiffened to prevent vibration and warping.

The fan shaft is of one piece forged and heat treated steel construction, machined, ground and polished to fit the bearings. The fan rotor will be statically and dynamically balanced to eliminate vibrations.

The fan is equipped with grease lubricated bearings supported by heavy pedestals resting on suitable soleplates. The fan is coupled to the electric motor by means of a heavy duty flexible coupling.

Combustion air fan is designed for proper combustion of the waste fuels at the worst operating conditions.

Necessary silencer on the air inlet duct is provided for noise attenuation.



3.4.3 Air Heater

A steam air heater is provided to heat the primary and secondary combustion air. The steam air pre-heater is made of 4 stages ; MP, LP, biogas engine heat and condensate sub cooling.

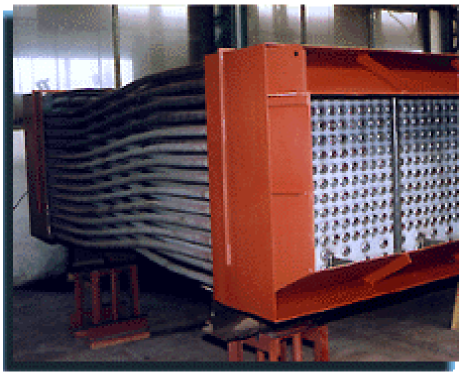
MP and LP stages will be fed with steam from the first two turbine bleeds.

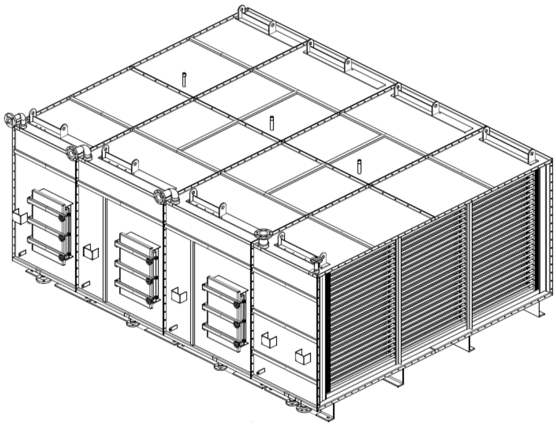
The "bioags stage" will be fed with the heat from Biogas engines.

During start-up, for low LHV, or low heat input and emergency periods heating steam will be taken from the boiler drum. The air heater will be equipped with a condensate tank where condensates will be redirected to Sub cooling stage and then to Condensate tank.

The air preheater is equipped with bypass for maintenance operations.

The air heater is made of carbon steel bare tubes banks arranged in a steel casing.



3.4.4 Air ducts

All main air ducts are made of carbon steel. Ducts are properly stiffened and reinforced to prevent vibration and to withstand the operating pressures. They are of welded construction, except at connections to equipment (Silencers, dampers, fans…).

The ducts are complete with access doors, dampers, expansion joints, instrument connections, and duct hangers as required. Expansion joints are provided where necessary in ducts exposed to high temperatures. Measurement of air flow will be provided as shown on P&ID diagram. Clean-out and access doors are provided. The doors are of fabricated steel construction and gas tight.

3.4.5 Auxiliary burners

The combustion chamber/boiler is provided with two (2) auxiliary burners, designed to:

- Raise the temperature in the combustion chamber prior to starting up from cold and during shutting down of the plant,

- Ignite the waste at the start-up of the plant following shut down periods,
- Comply with the EC Directive ("IED") on flue gas emissions. This requires that; whenever the temperature falls below 850°C a stand-by burner starts operating automatically to maintain the temperature so long as there is waste on the grate.

The FOD burners will be supplied complete with electric ignition, flame safeguard equipment, and a valve train, which contains control valves, instrumentation, isolation valves and a local control panel. The system will be pre-piped and pre-wired to the maximum extent possible to minimise the amount of field installation.

The flame detection system for the burners is a flame detector with a self-checking feature. The flame intensity is converted to an electrical signal, which is used to indicate flame status and initiate the appropriate response.

The equipment includes local control panel as well as a dedicated safety PLC installed in the PLC room. The local control panel is capable of starting and stopping the burner sequencing through the PLC. The local control panel functions as a termination panel for the burner and valve train electrical devices and instruments.

Each burner will be equipped with a dedicated fan.

3.5 HEAT RECOVERY BOILER

3.5.1 Main Concept of the CNIM Boiler

Heat is recovered from the flue gases by means of an integral water tube boiler. The boiler and associated equipment are of the type and quality suitable for municipal waste incineration plant service and will meet the steam requirements of the turbine generator as well as all other steam requirements of the plant.

The CNIM boiler is specially designed for the combustion of municipal waste and is of a well proven technology. The design is the outcome of CNIM's long standing expertise in this field which began in 1965, with the plant in the PARIS suburb of Issy-les-Moulineaux. Since this time, CNIM have continuously constructed or are in the process of constructing many refuse incineration plants.

The boiler is of the natural circulation, vertical, one drum, top supported type, with 4 passes and water walls integral to the furnace:

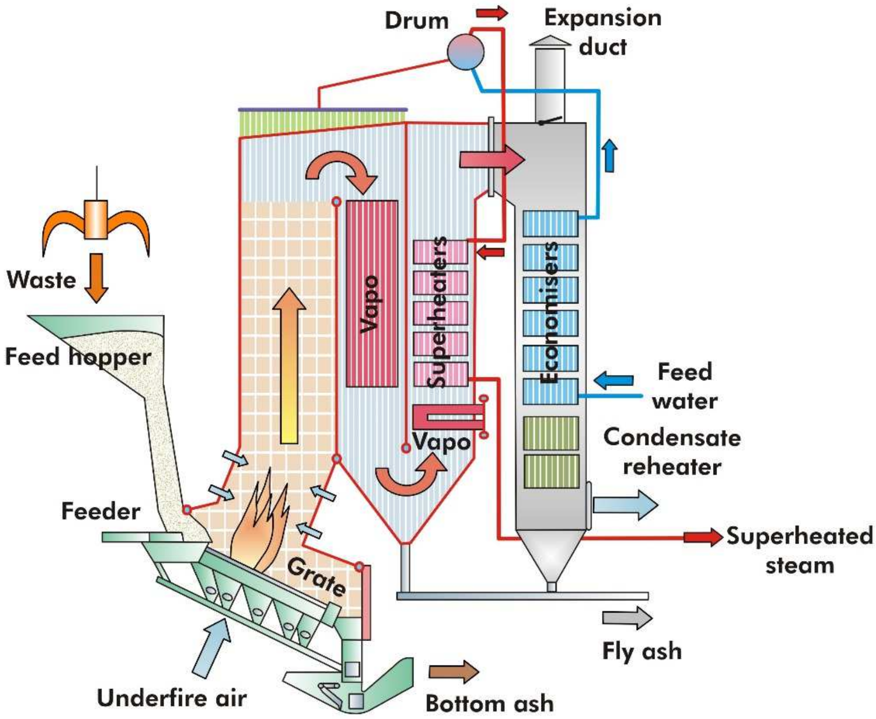
- Furnace: radiant combustion chamber, empty vertical pass
- 2nd pass: vertical pass, with evaporator panels
- 3rdnd pass: vertical pass, with evaporator bank and superheaters
- 4th pass: vertical pass with economisers
- External economiser: located downstream the boiler

The passes are enclosed in water wall panels (except 4th pass). These air tight walls are composed of finned tubes welded lengthwise.

The first pass is protected by Inconel and refractory up to the central screen header.

In order to optimise efficiency particularly suitable for waste incineration, and to prevent fouling, erosion and corrosion, the design was governed by the following main criteria:

- A combustion chamber of correct width and adequate height
- Low velocity of the flue gas in the combustion chamber in order to reduce ash carry-over
- Long residence time
- Refractory protection of combustion chamber water walls in the flame zone designed to achieve good heat transfer without high hot face temperatures
- Low gas velocities and long residence time before entering the first convective surfaces
- Large tube spacing in the convective banks
- Convective superheater design for high flue gas temperature and steady steam temperature
- Easy access for inspection and maintenance of all pressure parts
- On-line cleaning systems based on water injection in the second pass, and sootblowers devices on others passes.



Typical vertical boiler scheme

(for detail design please refer to drawings included in the tender)

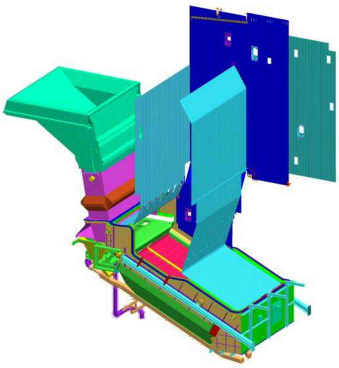
At the outlet of the steam boiler, a final economizer (External economizer) is provided to cool down the combustion gas to 140°C before it enters the dry reactor (LABloop). A recirculation and by-pass system is provided to control the condensate temperature entering this economiser.

3.5.2 Water walls

All the evaporating tube panel elements have the same profile.

Since all enclosure walls are at a uniform temperature, all expansion is uniform, and there are no possibilities of gas leaks causing damage to insulation or resulting in corrosion attack on the outer metal sheeting.

Within the constraints of shipping and handling on the erection site, shop fabrication and testing are maximised.

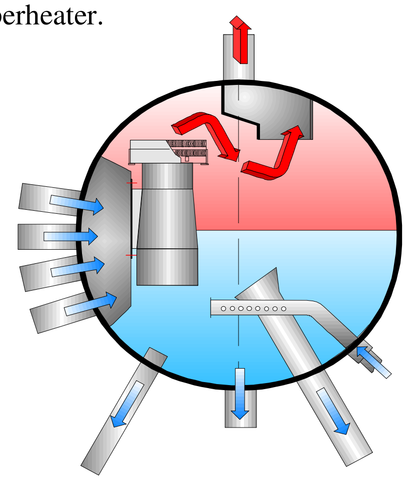


3.5.3 Drum

The drum is of a transverse arrangement. It will be of fusion welded construction, X-ray tested, stress relieved fabricated from steel plate according to the requirements of the relevant and standards.

Steam drum internals mainly includes:

- Internal feed water pipe and supports.
- Continuous blow-down and chemical feed pipes and supports.
- Separators and devices to limit solids carry over to the superheater.
- Sufficient nozzles for each of the following are provided:
- Safety valves
- Feed water
- Continuous blow-down
- Vents and sampling valves
- Water columns and level transmitter
- Drains and miscellaneous

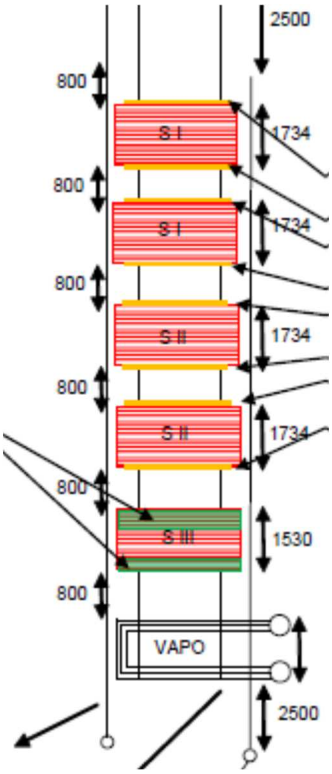


3.5.4 Superheater

The convective superheater bundles are installed in the vertical pass after the evaporator bank .

Each of them consists on horizontal tubes arrangement. They operate only on the convective mode. Intermediate water injections between superheater are provided for de-superheating purposes.

Individual tubes are perpendicular to the main flue gas flow and heat transfer is mainly performed by convection between the flue gas and the tube metal. The flue gas velocity will be high enough to ensure a sufficient convective heat transfer coefficient. They will be located in areas where temperature values are lower to 600 °C, to limit corrosive attack.



3.5.5 Evaporator

The natural circulation evaporator panels are installed in the second and in the third passes.

3.5.6 Economiser

The economizer is located in the 4th pass and is provided to preheat the feed water prior to entering the boiler steam drum.

The economiser consists of several banks of plain tubes supported by water-cooled tubes or bars according to flue gas temperature. The economiser is completely drainable and ventable. The economiser is enclosed in a steel welded casing.

3.5.7 Safety valves

The boiler is fitted with:

- One main safety valve fitted on the drum and sized to release a minimum of 75 % of the boiler steam rate.
- One safety valve fitted on the superheater at its outlet and sized for releasing a minimum of 25% of the boiler steam rate.

This safety valve is set to open before the main safety valves fitted on the drum, to ensure a permanent flow through the superheater.

3.5.8 Protection against corrosion

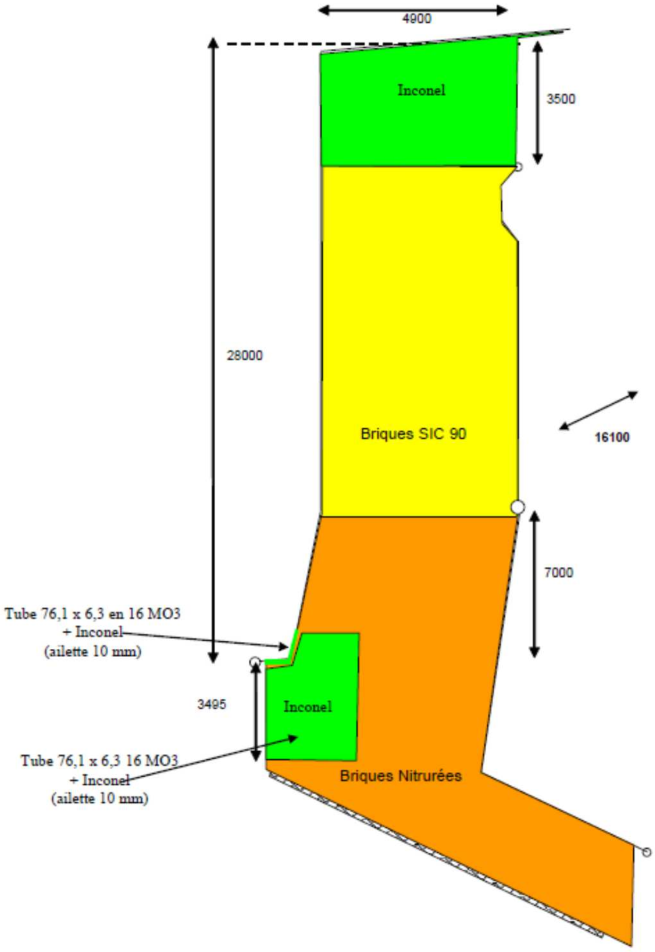
Inconel 625

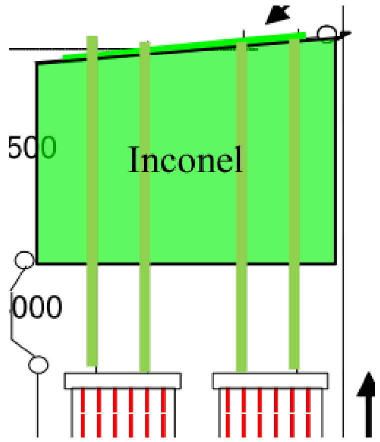
CNIM incineration boilers protection against HT corrosion is achieved by means of a combination of refractory lining and Inconel platting.

More than 590m² of Inconel is used in specific areas of high potential risk of corrosion.

- Roof, front, and side walls of the furnace above the refractory
- Roof, rear, and side walls of the second pass above the refractory furnace level
- Rising grid between 1st and 2nd pass
- Vaporizer panels hanging tubes
- 2 first rows and 4 last raw (flue gas direction) of superheater SHT (SIII)
- Side walls in the lower part of the furnace (fire place)
- Feeder roof

The combustion chamber and second pass have been zoned as shown on the sketches below.





Refractory

Two kind of refractory are used:

- Refractory on casing:

  In these areas we use refractory bricks ,SIC bricks, nitrite bonded bricks, insulating concrete or refractory concrete

- Refractory on tubes:

  In these areas we use CNIM patented refractory bricks with high SIC contents

3.5.9 Access Doors, Inspection Holes

Access doors and inspection holes provide access to the convective passes and allow the boiler to be inspected.

3.5.10 Ash Hoppers

In order to collect the fly ashes under the gas circuits, the boiler is equipped with hoppers.

Fly ash collection hoppers are provided at the bottom of any pass. They are formed by fabricated steel. The hoppers in the high temperature section of the boiler are refractory-lined or water cooled while the hoppers in the low temperature section of the boiler are of casing type with thermal insulation externally only.

3.5.11 Cleaning Equipment

Satisfactory cleanliness of the convective heat transfer surfaces is insured by a combination of sootblowing devices and online water sprays as follows:

2nd Vertical pass:

On line water spray on second vertical pass : each cleaning module will clean the boiler walls, the roof of the radiant chamber and evaporator panels. For this purpose, water will be sprayed by special nozzle lances onto heating surfaces.

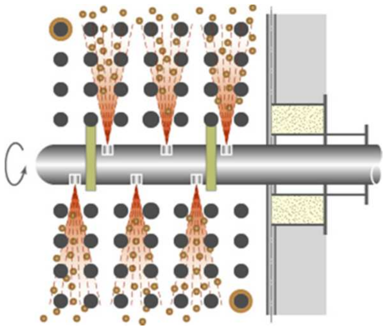
3rd Vertical pass:

The 3rd pass is cleaning by retractable (at the entering of the evaporator panel and the SIII, semi -retractable (for SIII and SII) and rotary sootblower system (for SI).

Retractable sootblower

4th Vertical pass:

The 4th pass is cleaning by rotary sootblower system (for economiser).



3.5.12 Steam and water piping

The feedwater is heated up in the economiser in counter-current flow to the flue gas to a temperature somewhat lower than the evaporation temperature.

From the boiler drum the water flows down through the unheated downcomers and supplier tubes to the lower headers of the evaporator system and thereafter is partly evaporated in the heated evaporator tubes (walls and bundles). The resulting water/steam mixture flows over the riser tubes back to the drum, where the water steam mixture is separated.

The saturated steam from the drum is heated up in the primary and secondary superheaters bundles in counter-current flow and in the final superheater bundles in co-current flow.

The live steam temperature is kept constant by spray type attemperator located between the primary and secondary superheater bundles. The attemperator is equipped with variable, orifice type spray valve.

All boiler-heating surfaces can be completely drained and vented.

The high pressure, low pressure, steam and feed water pipework will be designed and manufactured in accordance with relevant National Standard or equivalent.

All steam and feed water pipework will be adequately supported with provision for accommodating any expansion encountered by the inclusion of suitable spring supports and expansion joints.

All steam and feed water pipework operating at high temperature will be insulated as indicated below.

Flanged joints in the steam and feed water systems will be kept to the minimum number possible.

Turbine isolation (for maintenance purposes) at the exhaust will be through a blind flange. A bypass valve will be provided to allow for functional checking at reduced load prior to returning to normal operation.

3.5.13 Blowdown system

One blowdown system will be supplied for the drainage and the blowdown of the boiler.

This blowdown system consists of one flash tank and one atmospheric blowdown tank which will receive all continuous and intermittent drains.

Expanded steam from atmospheric blowdown tank is vented to the atmosphere, while the liquid phase is routed to and recovered in the bottom ash coolers.

3.5.14 Final Economizer

At the outlet of the steam boiler, a final economizer (External economizer) is provided to cool down the combustion gas to 140°C before it enters the dry reactor (LABloop). A feed water injection is provided to control the condensate temperature entering this economiser and a by-pass system is provided to control the outlet flue gas temperature.

3.5.15 Boiler water treatment

Demineralised water

The boiler feed water is produced by a demineralised water plant by reverse osmosis, one duty and one standby..

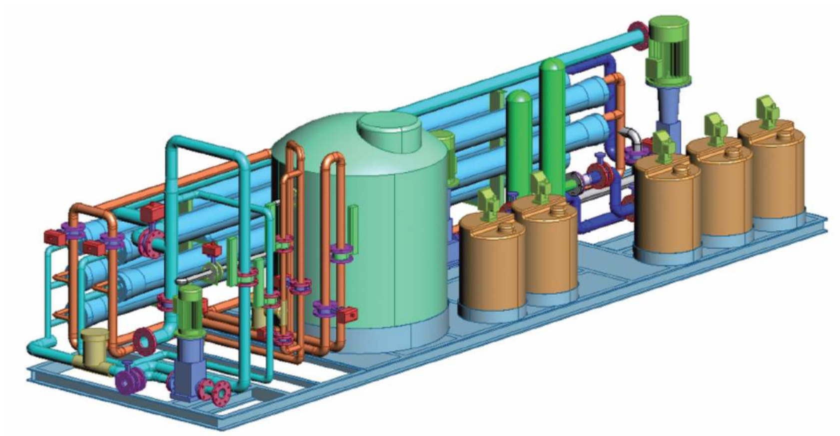
The treated water will be used to fill up the boiler and water network and then for the make-up of the same.

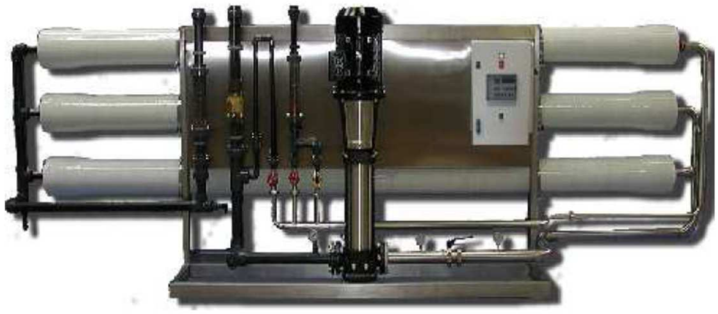
The plant is automatically controlled by the levels in the demineralised water tank.

Water to be treated is drinking water quality.

The purpose of the reverse osmosis unit is to decrease the water conductivity by concentrating molecules and ionic particles using selective thin membranes.

This membrane separation technique allows the reduction in concentration of water dissolved particles. The advantage of this process is that it avoids the use of chemical regeneration (acid and base).





Necessity of a pretreatment **:**

To be able to work properly, the reverse osmosis unit must be operated with treated inlet water (softened water) :

The parameters which must be avoided are:

- Particles which could clog the membranes : rare in town water; stopped by filtering

- Bacteria which could clog the membranes : rare in town water; some big bacteria could be stopped by filtering. No risk of bacteria development in the membranes when RO is running; the periodic flushings when RO unit is stopped allows to avoid bacteria proliferation in the membranes during outages.

- High hardness could clog the membranes with Ca and Mg carbonates : hardness is eliminated by upstream water softener.

- Chlorine and oxidizing agents which could cause membranes failure. This is achieved by bisulfite injection.

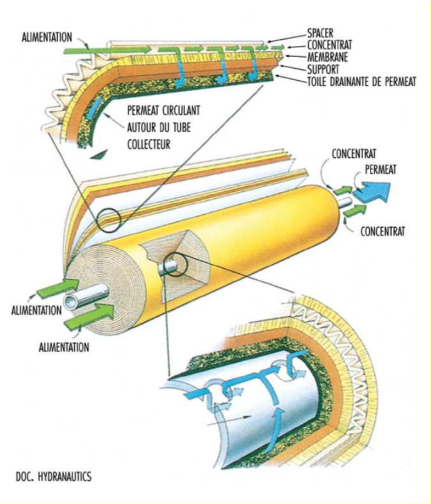
Principal of the reverses Omosis :

Reverse osmosis (RO) is a membrane-technology filtration method that removes many types of molecules and ionic particles from inlet softened water by applying pressure to the solution when it is on one side of a selective membrane. The result is that most of the molecules and ionic particles are retained on the pressurized side (concentrates) of the membrane and the purified water is allowed to pass to the other side (permeates).

To be "selective," this membrane should not allow large molecules or ions through the pores (holes), but should allow smaller components of the solution (such as the water) to pass freely.

In the normal osmosis process, the water naturally moves from an area of low concentration (High Water Potential), through a membrane, to an area of high concentration (Low Water Potential). The movement of a water to equalize concentrations on each side of a membrane generates osmotic pressure.

Applying an external pressure to reverse the natural flow of water, thus, is reverse osmosis.



Functioning
A microprocessor controls the automat isms, the safety and alarms, the user has however the possibility to set the operational parameters.

The functions of control and safety are performed by:

- An automatic valve for admission with pressostat,
- An regulation valve, a flow-meter and a pressure gauge mounted on the concentrate circuit;
- An flow-meter and a conductivity-meter mounted on the permeate circuit;
- An automatic valve for rinsing.

Advantages

- Very ecological because of the absence of reagent chemical;
- High quality of the produced water;
- Continuous production;
- Reduce overall dimensions;
- Easy to maintenance

Demineralised Water Tank

Demineralised water is stored in a water tank that:

- Acts as a buffer tank to ensure that demineralised water is continuously available.
- Stores demineralised water during any planned shut-down and/or emptying operations
- Demineralised water storage capacity is the volume of 1.5 boiler.

Boiler Water Conditioning

A combined unit suitable for both Phosphate and oxygen scavenger dosing will be fitted. A dosing pump will inject the oxygen scavenger at the feed water pump suction. A dosing pump will inject the Phosphate in the drum.

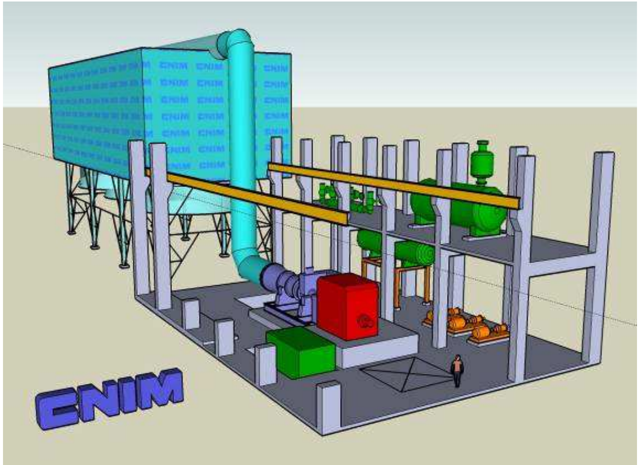
Make-Up Water Pumps

Water from the demineralised water tank is transferred to the deaerator by two controlled make-up water pumps (one on standby) of the horizontal single stage type.

3.6 POWER GENERATION

The 'Power Generation Plant and Auxiliaries'' include the following main components:

- ✓ Steam turbine and auxiliary equipment
- ✓ Power generator
- ✓ Air condenser
- ✓ Condensed steam heater(s)
- ✓ Boiler feed water system
- ✓ Miscellaneous equipment



3.6.1 Steam turbine and auxiliary equipment

General

The total steam quantity generated by the heat recovery boiler is used in a common condensing / bled turbine to generate electricity and steam export for CHP. The steam turbine will be used in full condensing mode when there is no CHP use.

The condensing steam turbo generator is designed for continuous operation. After subtraction of the power required for internal use, the electrical net production will be discharged to the grid system via a step-up transformer.

Upon loss of the main export connection whilst the turbine generator is running, the turbine output shall automatically reduce in a stable manner to island mode without tripping.

CHP :

The plant will be connected to Konjarnik heating Network. The City of Belgrade will be in charge of the design and construction of the District heating network up to 2 heat exchangers located at the site boundaries of the EfW site.

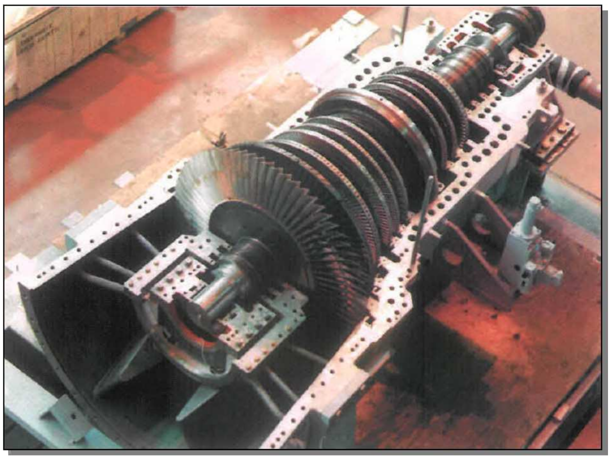
Refer to Chapter 2.16 "Process flow diagram".

Turbine

The turbine is designed to accept the total steam flow produced by the incineration train under any anticipated ambient conditions.

It will accept the full boiler operating range in conjunction with Acceptable Waste within the stoker capability diagram.

A gland steam exhauster system consisting of a condenser and fan exhauster recovers heat and condensate to the feedwater system, while non-condensable gases are exhausted to atmosphere outside the building.



Upstream steam pressure is regulated through the turbine by the governor-controlled steam admission valves. The governor valves operate sequentially to provide maximum efficiency corresponding to the design rating of the boiler at rated capacity. The governor programmable microprocessor control unit controls the turbine speed and accepts an external control signal generated from the boiler outlet steam pressure and provides all the control functions required to maintain safe operation of the turbine. The control unit will be fully interfaced with the SCADA and the boiler control system.

The turbine is protected with a mechanical over speed trip device and an electronic over speed unit using speed sensors.

The subsequent loss of oil pressure causes the stop valves to rapidly close and the governing valves to close.

Turbine isolation (for maintenance purposes) at the exhaust will be through a blind flange. A bypass valve will be provided to allow functional checking at reduced load prior to returning to normal operation. An isolation valve will also be provided.

Gearbox

The reduction gear is of parallel axis reduction type.

The gearbox is fitted with the necessary equipment for turbine operation and safety including but not limited to:

- AC motor and manual engagement (hand barring facilities)
- Bearing temperature indicators and transmitters
- Bearing vibration sensors

Lubricating oil system

A common remote mounted lube oil system is provided to lubricate the turbine, gearbox and the generator main and subsidiary bearings.

A separate system will supply oil for the high pressure hydraulic operation and servo control of the control and emergency shutoff valves.

The main oil pump will be either AC electric motor driven, or driven directly from the low speed gearwheel of the gearbox, and will supply oil to the complete assembly for both lubrication and power control purposes. An AC starting and stand-by pump is provided to start in the event of failure of the main pump. An AC UPS supplied rundown/cooling pump is provided for safe stoppage in case of failure of the main pump.

The emergency AC UPS driven pump which operates on low pressure in the event of both the main pumps being unavailable for maintaining bearing lubrication will maintain effective cooling for a sufficient length of time, while the unit coasts to a halt and is mechanically or hand driven.

Lubrication oil passes through one of two 100% heat exchangers and a duplex filter for removing particles. A lube oil centrifuge is provided for lube oil conditioning together with fan extraction vented to the outside. The oil tank is fitted with a visible level indicator and high and low level switches.

Generator

The generator consists of a synchronous 1500 rpm 4 pole totally enclosed water-to-air cooled (TEWAC) machine excited by rotating diodes with no brushes or rings.

The generator will be supplied with appropriate excitation cabinet containing:

- Auto excitation controller for voltage control, power factor
- Neutral point cabinet with current transformers, earth resistor with a homopolar detection core and connection terminals
- Monitoring panel containing the following: line voltage meter, excitation ammeter, wattmeter, phase meter, frequency meter, duplex voltage meter, duplex frequency meter, a synchroscope, emergency stop switch, power factor control, voltage and current excitation control, automatic or manual control, control for turbine speed, generator voltage, generator power factor.

3.6.2 Air cooled condenser

An air cooled condenser is provided. The air cooled condenser is designed to condense a total amount of exhaust steam

- The proposed solution refers to an anti-freezing steam condenser arranged in a direct roof A-frame type, air cooled, mounted on a steel structure.
- The steam condenser is designed to condensate the whole of the steam from the turbine and/or from the bypass of the turbine.
- The proposed air cooled solution allows for maximum flexibility against variations in thermal load and/or ambient condition.

3.6.3 Condensate system

Condensate tank

Condensed steam will be collected and stored in a single condensate tank arranged at level +4.50m. The condensate tank is of a cylindrical shape arranged horizontally. It will be made of carbon steel plates.

Condensate transfer pumps

Two x 100% condensate pumps are provided to transfer condensate to the deaerator via condensate heater(s). Pumps are of centrifugal single stage type driven by an AC constant speed electric motor.

Condensed steam heater(s)

Condensed steam heater is used to improve the Rankin cycle efficiency by heating the condensed steam from the condenser using extraction steam from the turbine. The condensed steam from turbine is returned back to the main condensed steam tank. In addition, the condensate is heated in the external economiser before entering the deaerator.

To improve performances, CNIM install one stage of condensate heater fed with steam from the third turbine bleed.

Refer to Chapter 2.16 “Process flow diagram”.

Deaerator and feed water tank

Condensate is returned to the deaerator for suitable heating and degassing.

3.6.4 Feed Water Pumps

The boiler is fed with water from the deaerator by multistage, centrifugal, horizontal feed water pumps.

3.6.5 Plant performance optimisation

This optimisation improves the plant performance during partial load operation.

To achieve this, an interconnect between R1 bleed (highest pressure) and R2 bleed (middle pressure) is installed. When at low load (i.e. 1 x 60% MCR), the R1 bleed is used to maintain pressure in the R2 bleed line, so that the internal steam demand can be met from turbine bleeds instead of the HP let down station.

As a consequence, more steam is sent to the turbine which increases power production for partial load operation.

4. AIR POLLUTION CONTROL EQUIPMENT

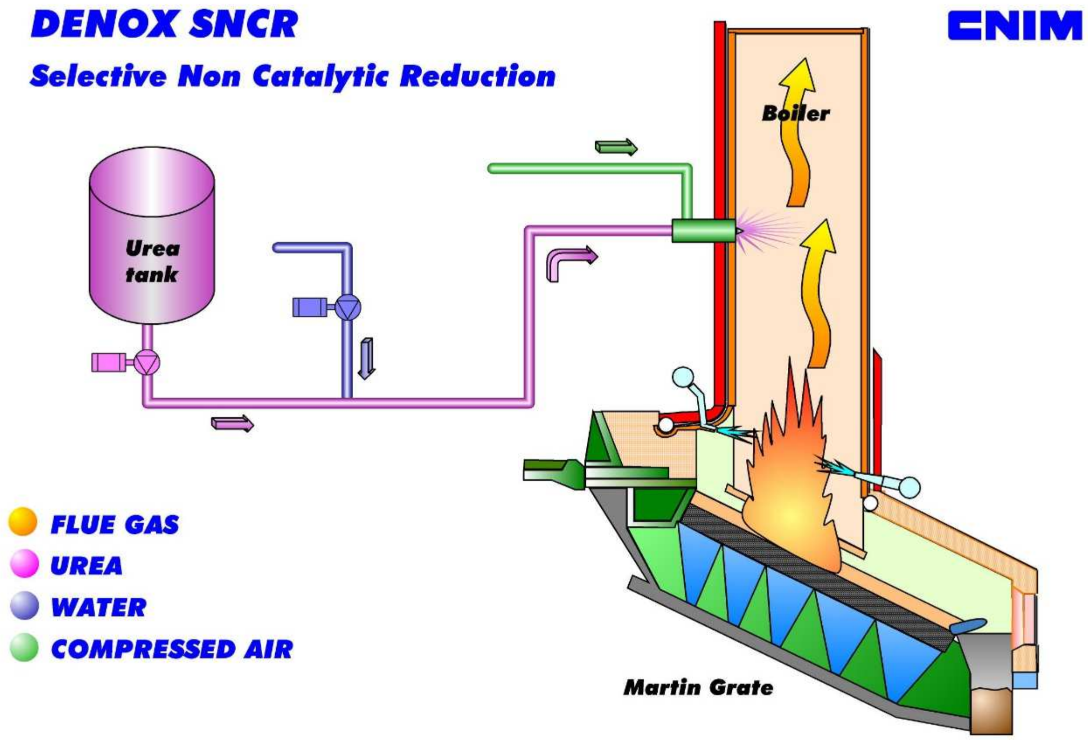
4.1 FLUE GAS EMISSION LIMIT

The flue gas emissions will remain within the applicable limit values which fully comply with the EU directive 2010/75/EC on Industrial emissions (IED).

To reach the limit values fixed by the EU directive we have elected an SNCR with liquid urea solution injection and a CNIM/LAB "SECOLAB" dry process.

4.2 NOX REDUCTION SYSTEM

Emissions of nitrogen oxides are controlled by an Selective Non Catalytic Reduction (SNCR) DeNOx system. The system uses liquid urea solution injection into the combustion chamber. The storage of the liquid urea solution will be done in a tank.



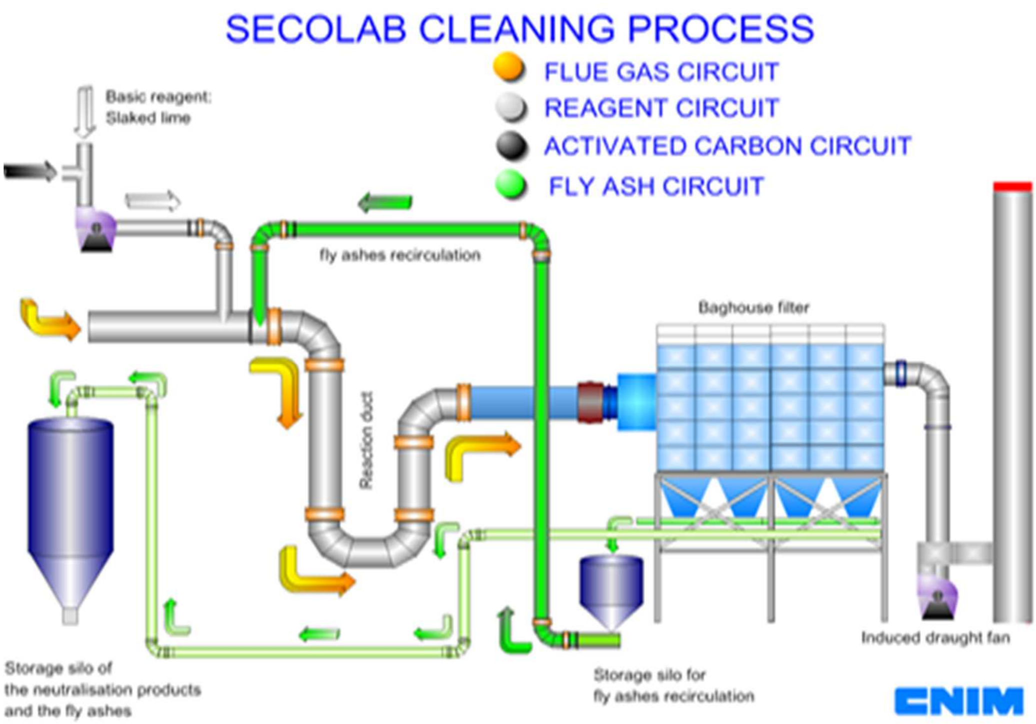
4.3 SECOLAB PROCESS

The Flue Gas Cleaning plant consists of the following equipment elements:

- A reacting duct for mixing the absorbents into the flue gas system upstream the bag house filter,
- A bag house filter with P84/PTFE bags,
- An induced draft fan, gas ducts and silencer,
- A self-supporting double wall stack to discharge the treated flue gas into the atmosphere.
- Hydrated lime storage and injection system
- Activated carbon storage and injection system
- Residue maturation and recirculation system,
- Final residue collecting / storage system

The CNIM SECOLAB™ dry process utilises injection of a hydrated lime as reagent into the flue gases. The reagent is injected by a pneumatic conveying system, and is then turbulently mixed with the re-circulated residues coming from the fabric filter.

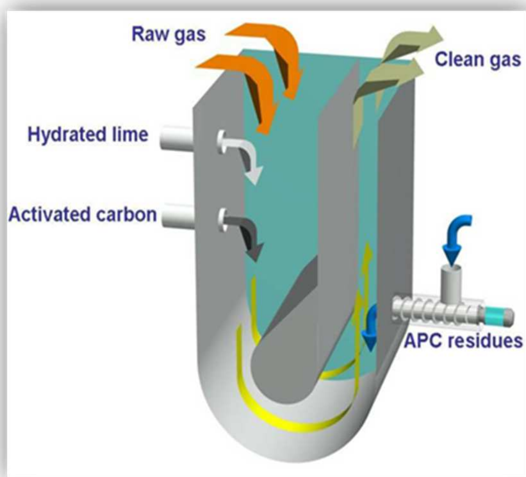
The gases flow through the reacting duct and the fabric filter and are then discharged via the induced draught fan to the chimney.



4.3.1 Reaction duct (LABloop)

The LABloop reaction duct is used to optimise the mass transfer between the flue gases and the dry absorbents. It is designed in form of an area of intensive mass transfer. The reactor actively participates in:

- high-performing separation of the pollutants contained in the flue gas under the actual operating conditions of the combustion plant
- reduction of the generated pollutant peaks by optimal reaction with absorbents,
- increase of the operational flexibility
- strong minimization of the generated quantity of residues to manage



High turbulence is produced by the turbulent flow created by carefully calculated flue gas speed.

Its active zone is produced by adding reactivated recycled residues coming from the fabric filter, fresh and powdery hydrated lime and activated carbon.

4.3.2 Fabric filter

The bag filter is used for the major separation of particle pollutants from the flue gas. These pollutants mainly consist of entrained dust, dried reaction salts and used up absorbents.

Description

The bag filter is a high-performing filter with compressed air de-dusting mainly composed of the housing of chamber-type design with vertically arranged cylindrical bags, the bag bottom, the raw gas inlet duct, the clean gas discharge duct and the dust collection hoppers.

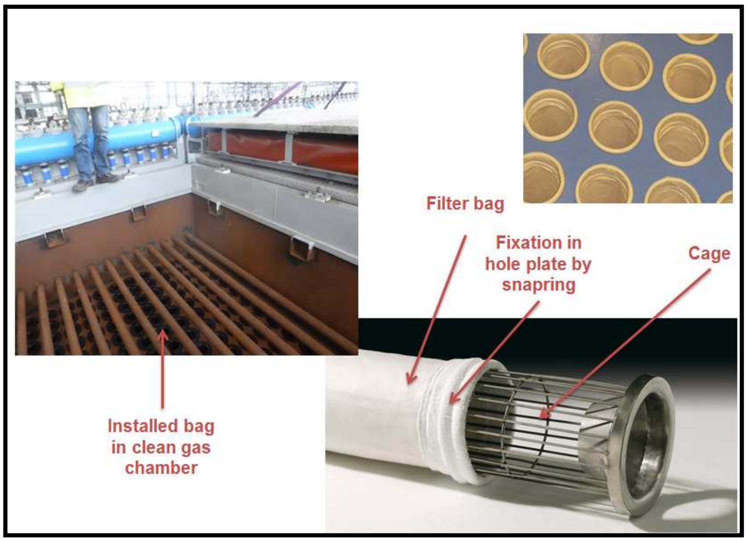
The design of the different chambers consists of a welded gas-proof steel structure with reinforced steel profiles. The welded-in bag bottom separates the raw gas room from the pure gas room. The pyramidal dust collection hoppers are implemented below the raw gas room.

The dust-carrying flue gas is introduced into the bag filter housing through the raw gas duct. The housing is a chamber-type design allowing for the separation, inspection and maintenance of parts of the unit involved in the flue gas process during plant operation thanks to the shut-off valves between the raw gas and pure gas room.

The fabric filter is designed with sufficient number of compartments so that any compartment can be safely isolated whilst the associated boiler is operating at MCR within guaranteed emission limits.

The raw gas related interlock is ensured through shut-off valves between the raw gas duct and the filter chamber and the clean gas related interlock through shut-off valves.

The filter bags are arranged inside the filter chambers. The flow runs through the filter bags from outside to inside. During the passage through the filter bags, the dust proportion of the flue gases is retained for a major part and deposited as a filter cake on the surface of the bags. Filter baskets inside the bags prevent the filter bag from collapsing.

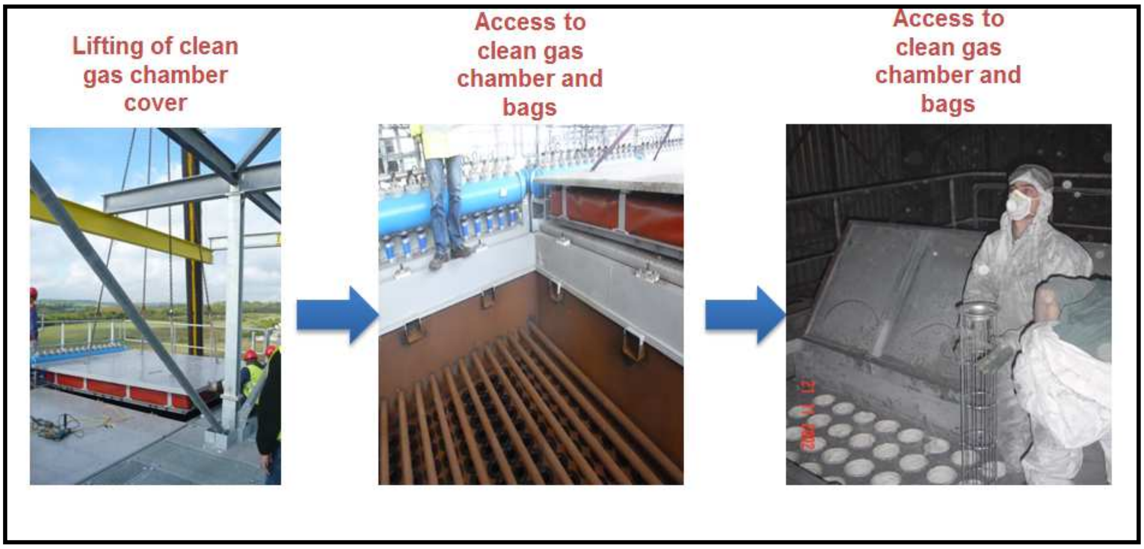


The filtered flue gas is directed inside the filter bags and from there to the pure gas chambers and the consecutive pure gas duct. The filter medium perfectly matches the application as far is concerned the flue gas parameters and dust properties, so as to ensure high operation safety with extended shutdown times.

Roof access on each compartment is designed for complete closure and tightness. The inner face (hot face) is separated from the external face (cold face) by heat insulation. Doors are provided with lugs.

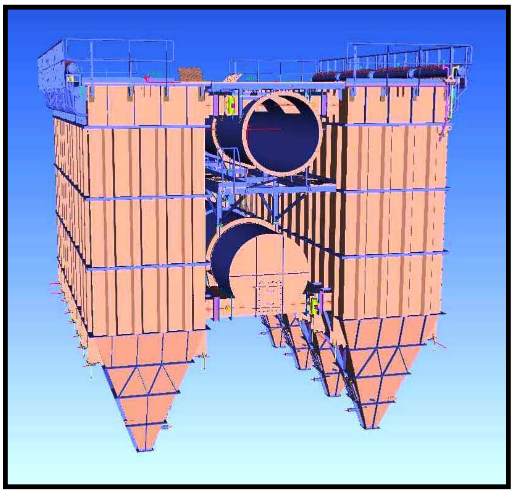
See on the below picture the detail of our principle for separation of cold and hot roof.

The following pictures show the maintenance facilities for handling the doors at top of the Bag Filter.



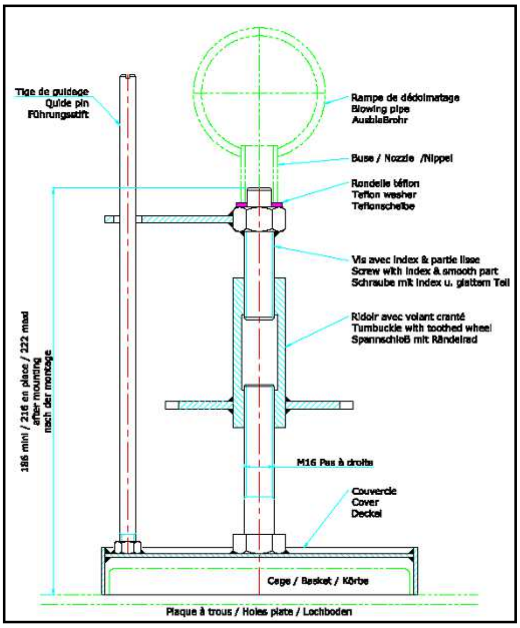
Main characteristics:

- 8 independent cells,
- on line air pulse cleaning of bags,
- P84/ PTFE membrane bags, with stainless steel cages in 2 pieces each,
- 8 independent hoppers with high level detection, isolating gate valves, temperature measurement and connection to the inert gas station,
- preheating using the reinforced trace heating system of the filter,
- pre-coating system using main lime injection circuit: lime is injected during start-up of the line to protect the bags, as soon as the flue gas flow is sufficient to carry the lime to the filter.



Typical view of CNIM/LAB design bag filter

In case of leakage on filter bag, it is possible to plug it by means of a special tool.



The tool allows to close the bag without the need to replace the bag out from the filter. The tool is placed between the blow nozzle in the compressed air cleaning pipe and the bag inlet. The repair is a temporary solution that allows filtering to continue until the bag filter is completely shut down, for the punctured bags to be replaced. Some plugs are included in our scope.

After identifying a potential leak on a bag, 30 minutes is necessary to locate the leak through the DCS curves (dust measurement combined compressed air vessels pressure) and plug the leaking bag.

If filter bags have to be replaced in a plant stop this will be done by following step sequence.

- Open of filter roof cover by using the hoist
- Replacing of compressed air blowing tube to get access to the bags
- Pull out filter cage
- Push the snap ring on bag top and push the bag into the chamber
- The bag falls into the hopper and can be taken away by opening the hopper man hole.

Control logic

In order to control the pressure drop caused by the filter, the filter bags are de-dusted through compressed air pulses in intervals controlled by a differential pressure-control. This is done fully automatically through the short opening of a diaphragm valve, in order to direct the compressed air from the compressed air tank via the nozzles to the relevant filter bag rows. Other relevant process signals, such as actual flue gas volume flow, current inlet and outlet pollutant concentrations can be considered during the cleaning sequence.

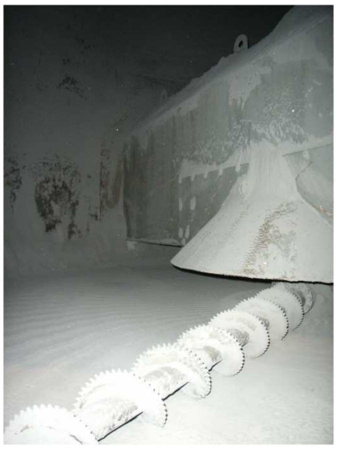
Compressed air pulses from the nozzles are sent inside the filter bags thus generating a pressure wave passing throughout the bag and leading to the short expansion of the filter bag. This phenomenon causes the filter cake to be detached and to fall into the collection hoppers, directly arranged under the filter chamber.

From there, the residues are extracted via the conveyors and transported to the residue silo or re-circulation system.

4.3.3 Recycling of fabric filter residues

The residues removed by the fabric filter still contain a certain portion of un-reacted lime. In order to make best use of that, a part of the residues coming from the fabric filter is recycled back to the reaction duct.

For this purpose, a mechanical fully proven self-controlled re-circulation equipment developed by LAB is implemented. The residues are first collected from the filter hoppers by means of screw conveyors. A part of the residues is then led into the re-circulation maturation buffer silo with a pneumatic transport system, while remaining residues are automatically transported to the final residue storage silos (APCR silos). The maturation silo is of a flat bottom type, to ensure a correct extraction and to accurately control the residence time of residues. The extraction system is a purpose built heavy duty system with planetary extraction unit, with a special design to take into account a continuous operation of the system. The buffer silo is calculated to allow the correct maturation time for reactivation of the residues, to make optimum use of the recycled material in the reaction duct.



Inside view of the recycling silo extracting system

Without any treatment of the residues, only a part of the recycled excess of reagent is available at the surface of the particles and can react with acid gases. Activation consists in increasing the part of the reagent that will be available for reaction. Maturation is a safe way of activation. It produces calcium hydroxichloride (CaClOH) through a diffusion process of hydroxide into the calcium chloride crust that covers the particles. Efficiency mainly depends on residence time and appropriate mixing into the maturation silo.

Residues are extracted from the silo and re-injected to the reaction duct by mechanical conveyors.

After being injected to the reaction duct, the recycled material is conveyed by the flue gas flow to the fabric filter and will be returned to the reacting duct again.

This type of re-circulation design allows for automatically expelling the part of residues from the system corresponding to the sum of fresh absorbents and fly ash taken in without implementing sophisticated and failure-causing control and measurement systems and intermediate tanks. This system further excludes overloads of the reactor/bag filter unit as well as an unnecessarily high absorbent consumption.

Heat insulation and trace heating, as well as the heavy duty design matching the properties of bulk material ensure the operation of this simple, self-controlled and reliable re-circulation system.

4.3.4 Dry Injection of hydrated lime and activated carbon

Hydrated lime and activated carbon are injected upstream the LABloop reaction section.

Hydrated lime and activated carbon are taken from their respective silos making use of mechanical extraction devices. They are transported to the feeding point of a pneumatic conveying pipe by means of speed-controlled dosing screws.

2 radial fans (one in service, one in stand-by) produce the required volume flow and ensure the pneumatic conveying of the absorbent-air mixture to the reacting duct. There it is intensively mixed with the flue gases and entrained under continuous reaction with the flue gas pollutants.

4.3.5 Induced Draft Fan and silencer

The induced draft fan is used for the compensation of plant pressure drops, the flue gas conveying throughout the upstream plant components and the depression control in the combustion room.

This is a radial speed-controlled fan single-flow design. The flue gas enters the welded sheet steel casing via the flue gas duct on the intake side, where it is accelerated through the rotor and fed to the discharge end. The rotor is equipped with profile blades and is electro-dynamically balanced out in two levels.

The coupling to up- or downstream flue gas ducts is ensured using compensators. The rotor is located on a shaft with greased or lubricated dust-proof roller bearings and is driven by one three-phase frequency converter controlled motor by means of elastic coupling.

There are one single main motor and one jockey motor.

The whole unit is located on a common vibration-free frame housing both the ID- fan and the drive. The drive and bearings are controlled for the monitoring of over-temperature, vibration and winding temperature of the motor. Once certain limit values are reached, the ID fan is automatically stopped.

In addition to that, because the ID fan motor is a major noise source for the plant, the main motor is equipped with an acoustic hood.

4.3.6 Chimney

The chimney is of a steel self-standing double wall type.

The stack is equipped with:

- An external access ladder with a safety hoop or safety rail + belt
- Lightning protection

The internal flue is in carbon steel and thermally insulated.

4.4 PERIPHERAL EQUIPMENT

4.4.1 Lime storage & injection system

Hydrated lime ($Ca(OH)_2$) is supplied to the plant as dry powdered absorbent using silo trucks and stored in bulk material silo. When the minimum level in the lime silo is reached, the operator staff shall order the required lime quantity from the supplier.

The lime is then fed from the silo truck pneumatically into the buffer silo. To do so, the extraction coupling of the silo truck is coupled to the pneumatic filling pipe of the buffer silo using a flexible hose and fed into the silo by means of the truck compressor dedicated to this purpose.

The feeding operation is accomplished after the full emptying of the silo truck or once the maximum filling level is reached in the silo. The exhaust air generated during the feeding operation is de-dusted by means of a fabric filter located on the silo top and sent to the atmosphere.

From the silo, the hydrated lime is discharged for injection in the reaction ducts as described above.

The extraction system consists of a mechanical dosing screw with its electric driving, together with an injection of dry instrument air in the conical hopper to avoid bridging phenomena.

4.4.2 Activated carbon storage & injection system

For the adsorption of the volatile heavy metals (i.e. mercury Hg) and organic components (i.e. PCDD/F) to separate, powdered activated carbon (PAC) is added to the flue gas together with lime.

The absorbent is supplied by silo trucks as dry powder and stored in a bulk material silo. When the minimum level in the silo is reached, the operator staff shall order the required quantity from the supplier.

The PAC is then fed from the silo truck pneumatically into the bulk material silo. To do so, the extraction coupling of the silo truck is coupled to the pneumatic filling pipe of the buffer silo using a flexible hose and fed into the PAC silo by means of the truck compressor dedicated to this purpose.

The feeding operation is accomplished after the full emptying of the silo truck or once the maximum filling level is reached in the silo. The exhaust air generated during the feeding operation is de-dusted by means of a fabric filter located on the silo top and sent to the atmosphere.

The absorbent silo is equipped with a continuous filling level monitoring, a maximum filling level sensor, an overflow sensor, a temperature sensor to detect hot spots, an overpressure and depression safety valve, connections for nitrogen inertizing and a fabric filter on top of silo. Continuous dry instrument air injection is performed in the conical hopper to ease the extraction of activated carbon.

The complete bottom of the silo is enclosed to protect the equipment dedicated to the PAC transportation.

4.4.3 Conveying and storage of FGT residues

The residues generated in the flue gas treatment plant are a mixture of fly ash, dried reaction salts ($CaCl_2 \times 2H_2O$, $CaSO_4 \times 2H_2O$, $CaSO_3 \times ½H_2O$, $CaF_2 \times 2H_2O$, u. a.) and excess absorbents. They are collected in the hoppers of the bag filter, from where they are carried out to the recirculation and to the storage silo, with a possibility to be loaded in a big-bag in case of necessity.

The residues from the fabric filter are conveyed to the buffer silo using mechanical equipment: screw conveyors and/or chain conveyors and final pneumatic transport with switch towards the final storage silos and the re-activation maturation silo.

The residues are falling from the buffer tank into the pneumatic conveying vessel until the maximum level is reached. The inlet valve is closing. The pneumatic valve opens, the pressure in the vessel increase and the transport of the residue through the conveying pipe into the maturation silo or to the residues silo starts. When the pressure decreases again in the vessel the complete filling is transported to the corresponding silo.

After a certain cleaning time of the transport pipe with air the valve in the compressed air supply closes again and the vessel can be filled again with residues.

In addition, the Boiler fly ashes are sent by mechanical conveyors to the APCR silos.

Each of the 2 residues silos has conical bottom with a mechanical vibrating cage inside. Under each silo's outlet flange, we have 2 possibilities: 1 is to fill in the solidification process and the other is to fill in residues mixed with fly ashes from boiler into the trucks via a telescopic spool if necessary.

The residue silos are entirely heat insulated, and electrically heat traced in its lower part.

A third storage silo is foreseen which can be filled in with APCR in necessary or with blast furnace.

4.5 PROCESS CONTROL

The flue gas cleaning system is equipped with some independent Programmable Logic Controllers (PLC) for some local functions as indicated hereafter, which are monitored by the client's Master Programmable Controller (MPC) of the plant. MPC provides automatic and selected manual control and operation of the system. Graphic displays, alarms and report generation are derived from the MPC.

Local control panels are provided for the following:

- Fabric filter cleaning sequencer
- Filter hoppers and conveyors heaters
- Lime / Activated carbon silos filling stations

4.5.1 Dry lime injection

The lime flow rate is controlled by the upstream and stack acid pollutants values, and the flue gas flow.

4.5.2 Activated carbon injection

Activated carbon injection is controlled by the flue gas flow; the injection rate is constant, and may be adjusted by the operator.

4.5.3 Silos filling stations

The reagents storage silos are provided with externally mounted silo filling panels that monitor and coordinate the silo filling operation, including the roof mounted silo vent filter and the silo level indicators (weighing cells). The panels are of standard construction utilising selector switch lights, etc., with signals taken to the local interface station located at silo for control and monitoring of the silo filling activity.

4.5.4 Fabric filter

The fabric filter pulse jet cleaning sequence and damper operation are controlled from the local interface station.

When the pressure drop across the collector reaches a pre-determined set point, the cleaning cycle will be initiated. This cycle will clean compartments in sequence until the collector differential pressure is below the pre-determined set point. The controller also includes a timer to clean the compartments in sequence when the collector has operated for a relatively long period of time and a cleaning cycle has not been initiated by an increased pressure drop.

4.5.5 Hopper heaters

A control panel is provided to monitor and control the operation of the hopper heaters. The local panel will house all the heater contactor units together with a remote I/O rack. The heater panels will be equipped with panel mounted switches and lights. The remote I/O rack will be wired to the fabric filter local interface station by means of communication cable to allow monitoring, control, and display both at the local and central station in the central control room.

4.5.6 Emissions monitoring

Continuous Emissions Monitoring Systems (CEMS) are provided to monitor the full range of pollutants stipulated by the Waste Incineration Directive. The systems are arranged in a duty and standby configuration to ensure the continuity of operation in the event of a fault on one of the systems.

A PC based data storage system fully equipped with necessary software, monitor, keyboard and printer is dedicated to monitoring the emissions, providing reporting data in the format required by the Environment Agency. Dioxins continuous sampling systems are also provided, 1 in service, 1 as redundancy.

5. ASH AND BOTTOM ASH DISPOSAL

5.1 ASH DISPOSAL

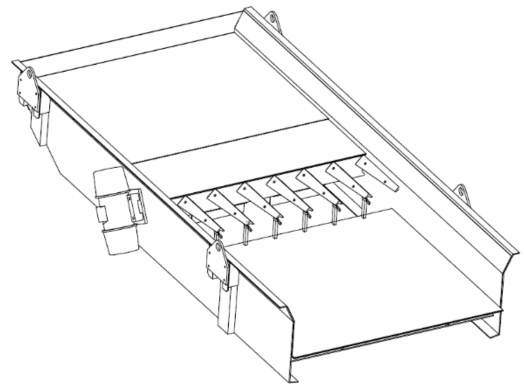
Fly ash under boiler :

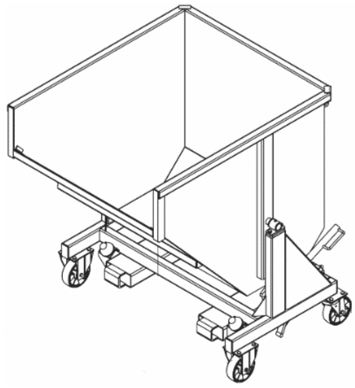
The fly ash collected from the boiler and economisers hoppers will be mechanically routed to the APCR and boiler ash silos.

5.2 BOTTOM ASH DIPOSAL

The bottom ash from the Martin grate goes to the ash dischargers (3). It will be conveyed to the bottom ash pre- treatment area by means of a vibrating conveyor and belt conveyors.

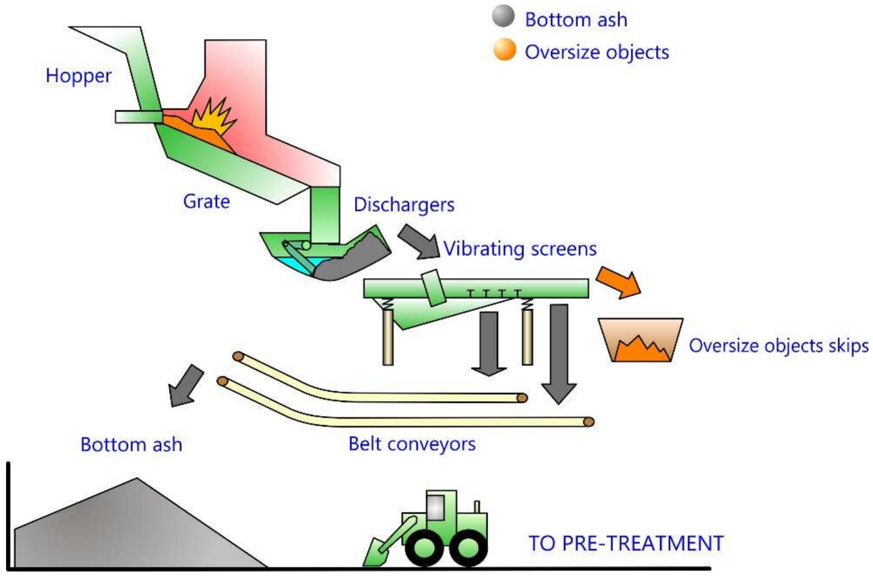
- The bottom ash is first collected from the ash dischargers by means of a vibrating conveyor (1 per discharger) with a 300mm grid which removes the oversized objects. Those oversized objects are stored in a 2m3 skip which can be handled by forklift.





Vibrating Grid 300 mm & oversize objects skip

- The passing fraction of bottom ash is then conveyed to the bottom ash treatment area by means of a succession of conveyors belts (two enclosed lines of conveyors will convey the bottom ash to the storage area : 1 + 1 in stand-by). A switching device system is foreseen to enable ash to be directed from the boiler to the stand-by conveyors system.
- In case of conveying belt failure of the line, the above system will allows the bottom ash to be sent to the conveyors of the by-pass line.
- At the end of the belts the bottom ash is driven to the IBA treatment process where it will be treated.



The bottom ash will then be treated on the site.

6. CONTROL AND SUPERVISION SYSTEM

The purpose of this Chapter is to introduce the automatic control system of the Energy-from-Waste facility. The plant is designed to operate continuously 24 hours per day, all year round except for planned outages.

The safety of all personnel against coming into contact with live parts of equipment is ensured as the installation is designed according to existing safety standards. Electrical or electronic equipment is provided with integral protective devices and trip-off facilities in case of failure.

CNIM's proposal includes mainly:

- Control and printers desks to be installed in the Control Room,
- Input/Output card gathering cubicles with racks, terminals…(that can be placed in the vicinity of the necessary equipment),
- Special power supplies,
- Communication buses (including field buses for remote I/O),
- Following redundancies:
  - DCS power supplies,
  - DCS high speed communication cards,
  - DCS controllers.

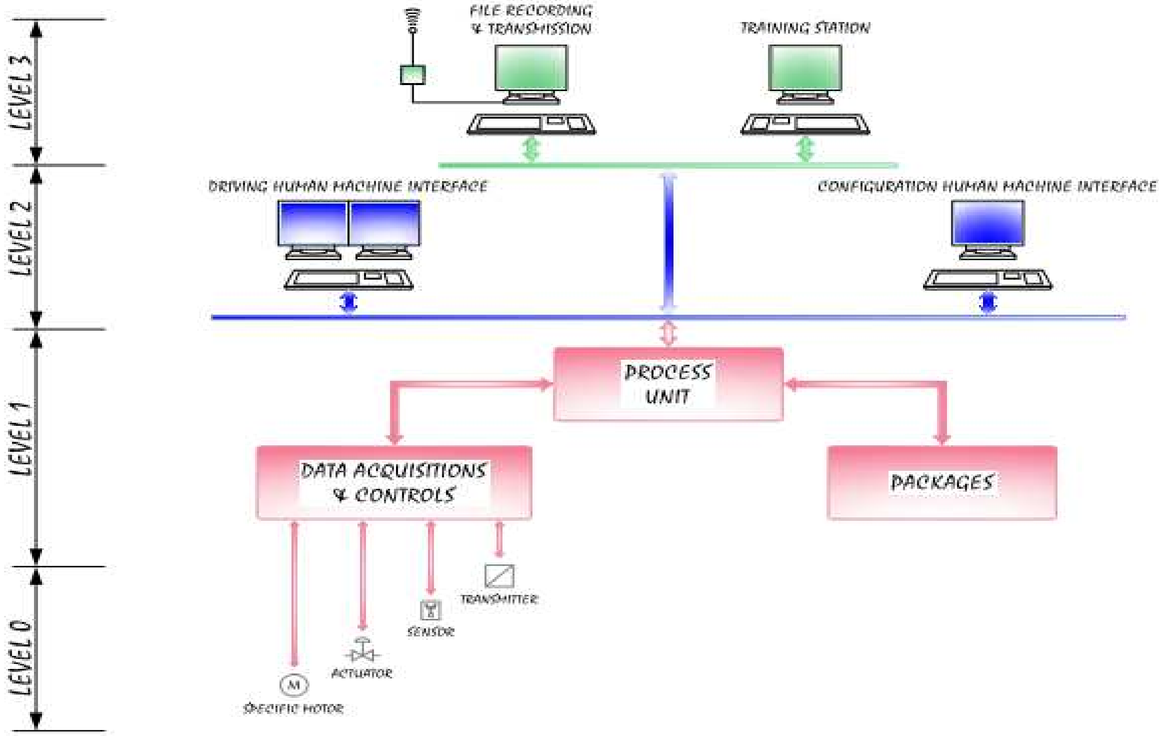
The system shall be designed with sufficient redundancy to enable any one controller to fail with no effect on the rest of the system. All control systems shall be designed to operate within the manufacturer's recommended computer loading capacity and in any case at no capacity greater than 30%. The distributed control system shall have the provision for 20% expansion.

For more details see documents :

Titles	N°
Control system architecture	0A1401 1610/62G.0001

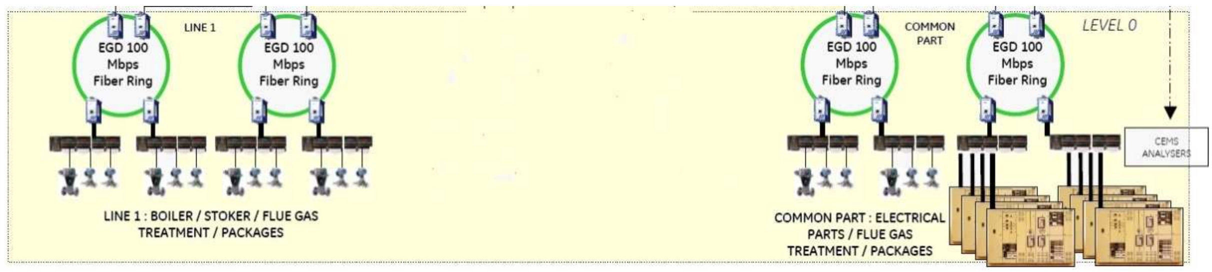
6.1 CONTROL SYSTEM ARCHITECTURE

The proposed main control and supervision system consists of a Distributed Digital Control System (DCS) organised on several levels:



6.1.1 Level 0: Process level

This level ensures logical and analogical signals conditioning: inputs and outputs from and towards local instrumentation and cabinets.



6.1.2 Level 1: Control level

This level ensures:

- Data processing (including logical sequences, closed control loops, mathematic functions...) related to the main process,
- Data exchanges with local PLC's by communication on serial bus,
- Alarms processing.

This level is composed of:

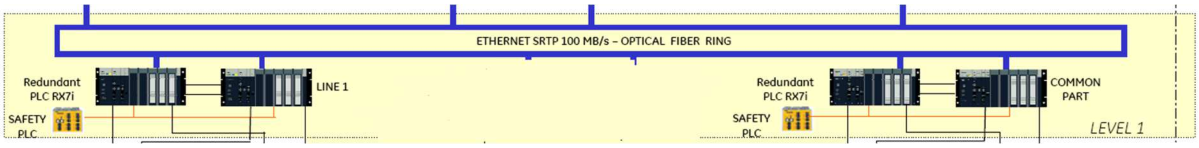
- Part 1: Two redundant controllers unit

Each controller can control the "Incineration stream" consisting of the furnace, boiler and Flue Gas Treatment, and the "Common parts" controlling the common equipment, miscellaneous equipment and electrical installation. In the case of failure of one controller the second controller will operate the plant with immediate effect.

- Part 2: Specific sub-systems

Various other PLCs are associated with complex equipment which represents independent functional systems. This mainly concerns:

- Waste cranes,
- Burners,
- Boilers water spraying,
- Turbo-Generator,
- Water treatment,
- Bag-filters,
- Diesel generator.
- Biogas generators



6.1.3 Level 2: Supervision level

This level ensures:

- Operator interface,
- Data storage and display,
- Alarm processing.

This level is composed of:

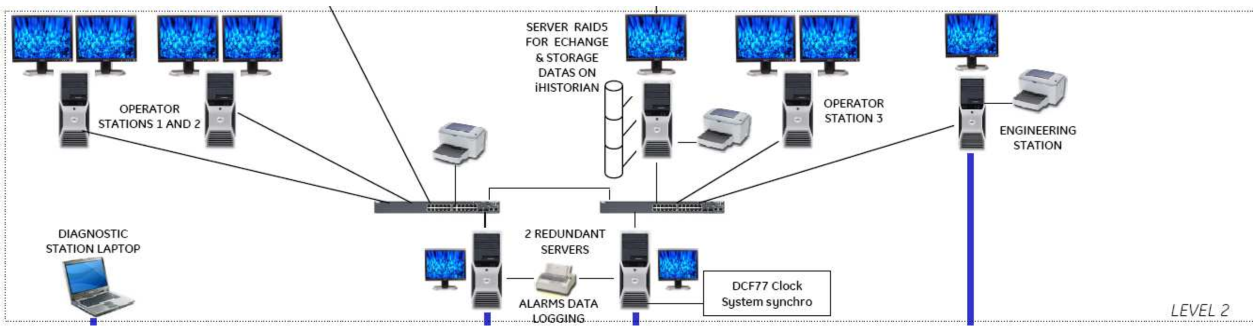
- 2 operator stations (PC-type) fitted with two 27" monitor +2 large screens 60”, keyboard and mouse,
- 1 engineer station (PC-type) fitted with two 27" monitor+ 1 large screen 60”, keyboard and mouse,
- 1 PCMS (PC-type) fitted with two 24" monitor, keyboard and mouse,
- 1 laptop for diagnostic station,
- GPS clock to synchronise the clock of the PLCs or protection relay with the main controller,
- 2 Fire wall VPN
- 1 colour printer for trends, mimic views and reports printing,
- 1 historic data station for long term data storage (60 months).

This level 2 enables the supervision of the whole Energy-from-Waste facility and provides detailed information about main processes. It also provides grouped information for remote and secondary equipment as well as data storage on a short term (week) and a medium term (month) basis. Long term storage is assumed to be recorded on an optical disk or equivalent (via the streamer).

The information are made available through different views - mimic views for monitoring, controllers' views for tuning, alarm views, trends and historical curves.

Moreover, the redundant operator stations ensure a server function for:

- Communication between levels 1, 2 and 3 throughout the fire wall,
- Software support for monitoring,
- Database updating and storage,
- Operating continuity by automatic backup in case of server failure,
- Data disposal for level 3.



6.1.4 Level 3: Administrative and technical management level

The level 3 mainly provides the following functions:

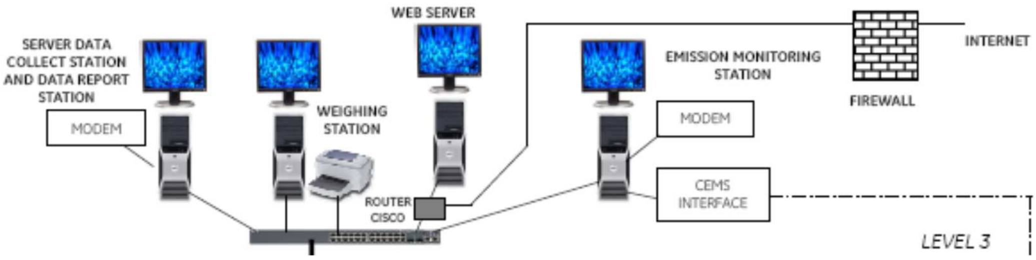
- Data analysis,
- Recording of long term data,
- Data display on screen (tables, trends),
- Report printing,
- Remote consulting of the operating values.

In the present case, this level consists in:

- 1 "Weighing" station: stand-alone and only connected to the level 3 bus to allow the operator to recover data relating to material entries and outgoings,
- 2 "Atmospheric Emissions Monitoring" stations fitted with a colour monitor, keyboard and mouse,
- 1 OPC server station (PC-type) that can be used as operator station fitted with one 24" monitor and keyboard and mouse,
- 1 " CNIM data collect" station fitted with a colour monitor, keyboard, mouse and VPN/ADSL modem, used for plant performance calculation and remote access for maintenance from CNIM's office,
- 1 training station (PC-type) that can be used as operator station fitted with one 24" monitor and large screen 55", keyboard and mouse,

- 1 TGU station (PC-type) that can be used as operator station fitted with two 24" monitors , keyboard and mouse,
- 1 CMMS (PC-type) that can be used as operator station fitted with two 24" monitors , keyboard and mouse,
- 1 remote MARTIN monitor 24” for the MICCs, keyboard and mouse for MICC,
- 3 colour printer for trends, mimic views and reports printing,
- 1 link with router VPN and fire wall to communicate with the internal plant network.
-

The "open" structure of this level 3 allows the eventual addition of other stations for plant commissioning, operating, office and maintenance (additional stations out of scope).



6.1.5 Data Exchange

Throughout the different levels of DCS, data will be exchanged by means of several buses:

- Field bus for communication between levels 0 and 1,
- Main redundant bus for communication between levels 1 and 2,
- Ethernet bus for communication between levels 2 and 3.

Several electrical and control cabinets are associated with equipment representing independent functional systems. Corresponding automations are carried out within these cabinets by means of conventional relaying or PLC, depending on the level of automation.

Examples:

- Conventional relaying: phosphate injection, doors, turbine crane...
- PLC: Turbo-Generator, waste cranes, water treatment...

According to the quantity levels, data will be exchanged either through input/output cards (possibly remote close to grouping areas), or by means of serial links (e.g. Modbus).

6.2 SUPERVISION STATIONS (LEVEL 2)

6.2.1 Operator station

The operator station will supply the following functions:

- Users passwords on several levels,
- Screen views summary,
- Mimic views including logical controls (on/off, working mode selection...) and analogical controls (set-points adjustments, valves controls...),
- Trends,

- Alarms reporting views,
- Controllers views,
- Logical sequences status views,
- DCS status views (CPU, inputs/outputs cards, communication cards, power supplies...),

Proper hardware requirements:

- 2 sets of 24" high resolution colour flat screens
- For two operator stations, an additional large screen (55"), (to install on wall)
- 1 communication cards with two ports for connection to the appropriate networks
- Sound card and speakers (alarms management)
- Operation software licence
- Video card with 4 driving

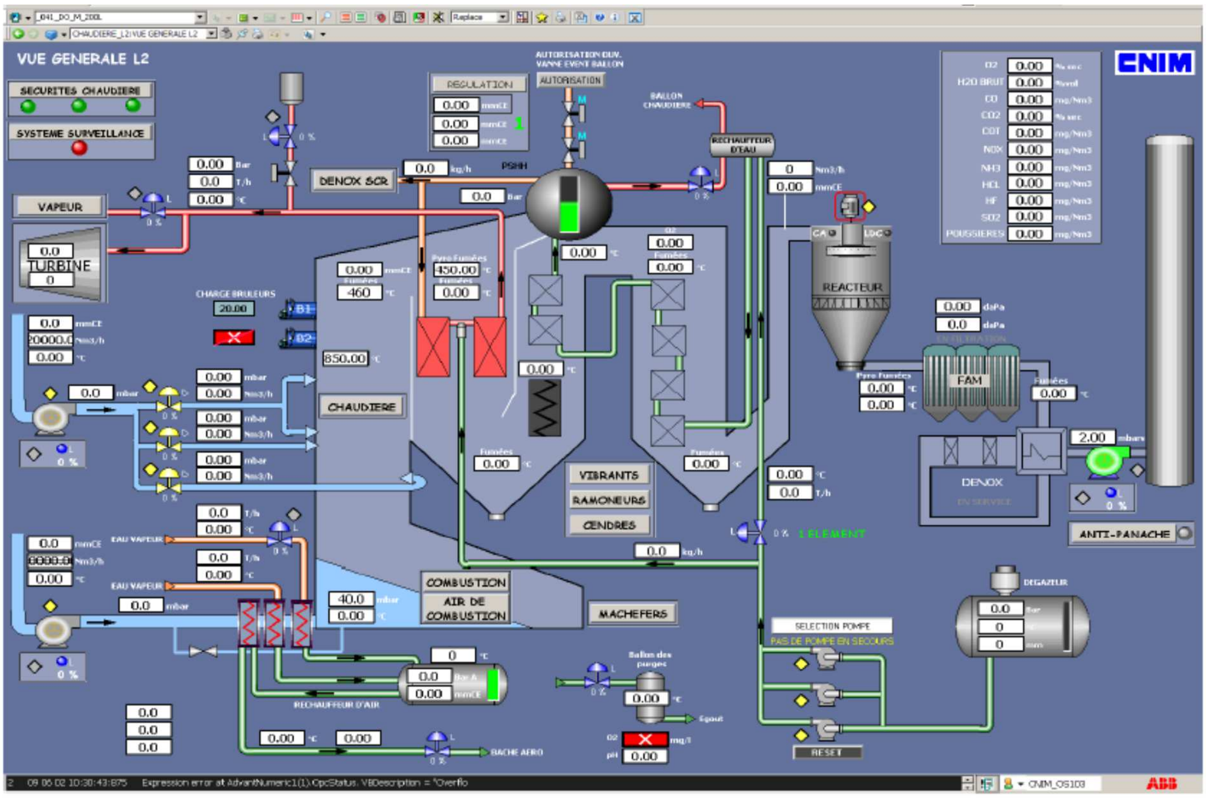


Fig. 10 - Example of Operator Control View

6.2.2 Engineer station

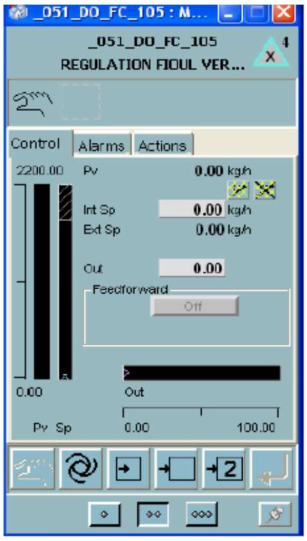
The configuration (or engineer) station will carry out the following functions:

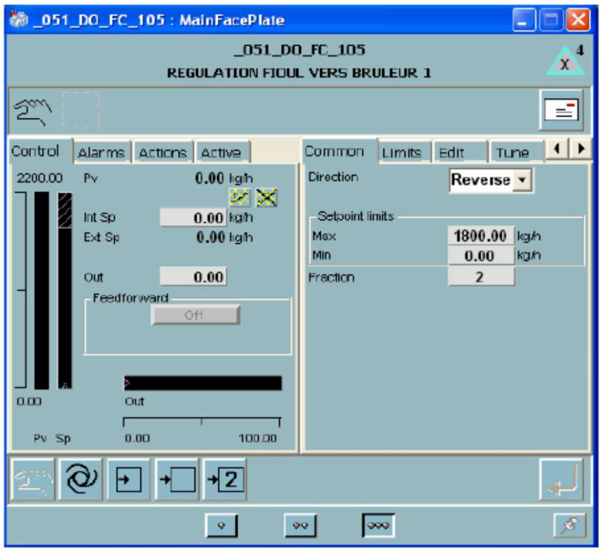
- users passwords management
- database realisation
- screen views summary realisation

- mimic views configuration
- input/output and communication cards configuration
- trends and reports configuration
- alarms configuration (groups, labels, emergency levels)
- controllers and logical sequence programming
- fixed set-points, delays, thresholds, controllers parameters adjustments

Proper hardware requirements:

- 2 sets of 24" high resolution colour flat screens
- For two operator stations, an additional large screen (55"), (to install on wall)
- 1 communication cards with two ports for connection to the appropriate networks
- Sound card and speakers (alarms management)
- Operation and programming software licence
- Video card with 2 driving





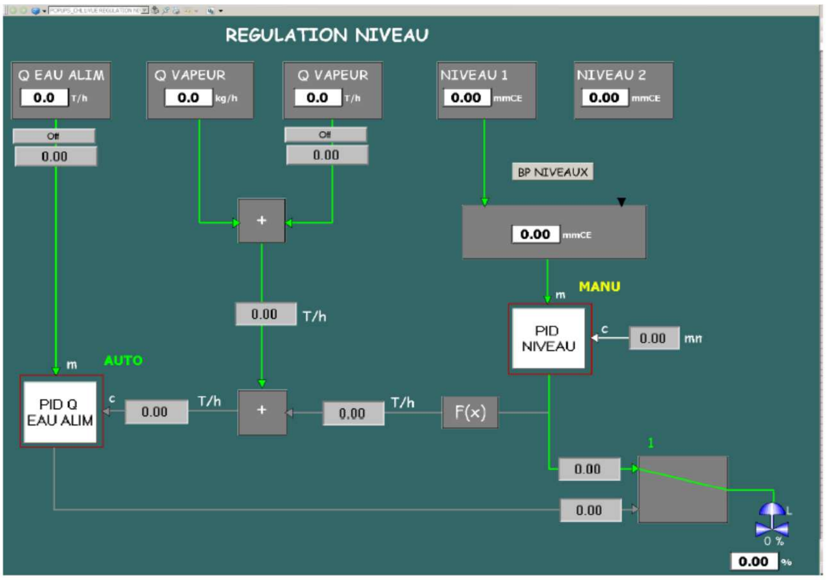


Fig. 9 - Example of Engineer Control View

6.2.3 Historic data station

Main tasks:

- Acquisition and storage of data,
- To expand, modify and load processing programs,
- To access and modify the different parameter values,
- To store database and program.

It is connected between Level 2 and level 3, and composed of:

- PC-type central unit, rack version with USB boot available,
- 1 colour flat screen high resolution 24“,
- Hot redundant power supply,
- Hot unplug RAID 5 hard disk SATA-type (500 Go) redundant server with hard disk,
- One trackball or mouse,
- 1 QWERTY IP20 Keyboard,
- Redundant Ethernet card for connection to level 3,
- 1 communication cards with two ports for connection to level 2,
- 1 fire wall to secure the level 2 from the level 3,
- Anti-virus,
- Ghost tools

6.2.4 Lap Tops

The laptops will be dedicated to commissioning and service interventions and shall have the same functions as the Engineering station.

The laptop will have to accept the software for PLC'S packages configuration and shall allow configuration in stand-alone mode, when it's not connected to the DCS.

Characteristics of the laptop:

- high resolution colour flat screen (17" minimum)
- 1 serial port
- Microsoft windows Office pack professional latest version
- All the necessary software for commissioning and maintenance facilities.
- Operation and Programming software licence
- Operating in Stand Alone

In addition with a suitable controller this laptop must allow following tests:

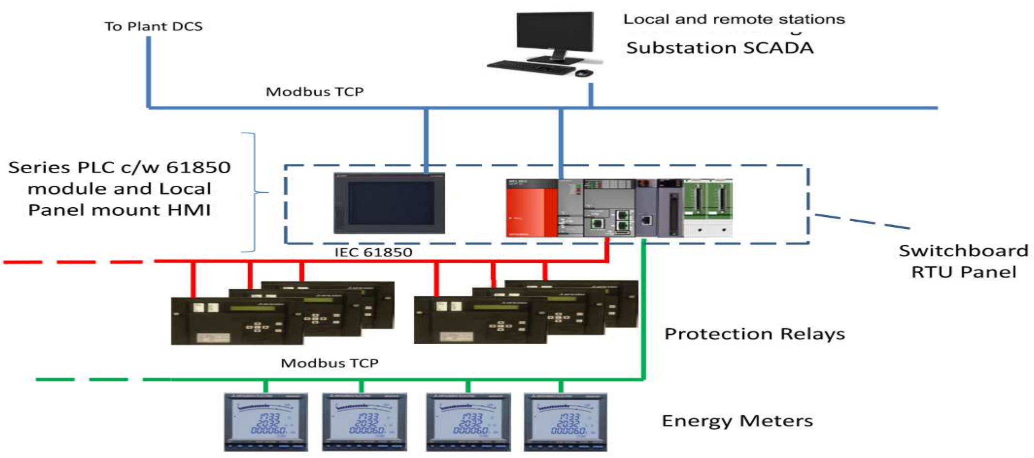
- IO tests in the LV or grate Contractor workshop
- Communication tests with PLC supplied by package contractor

6.2.5 Power Management and Control System (PMCS)

A dedicated local power management and control system (PMCS) complying with IEC61850 - communication networks and systems in substation with redundancy will be provided for the management of the plant MV power system, at 11kV AC will include all major switchboard components (all circuit breakers, auto transfer switch, etc.), warning and alarm annunciation, power quality monitoring, parasitic consumption monitoring, Surplus Electricity export monitoring.

Integration with the STG and biogas generator synchronization device etcLV system will be managed through the DCS and the PMCS will be connected to the DCS .

One station will be installed into the control room and the second will be installed into the 11kv Substation.



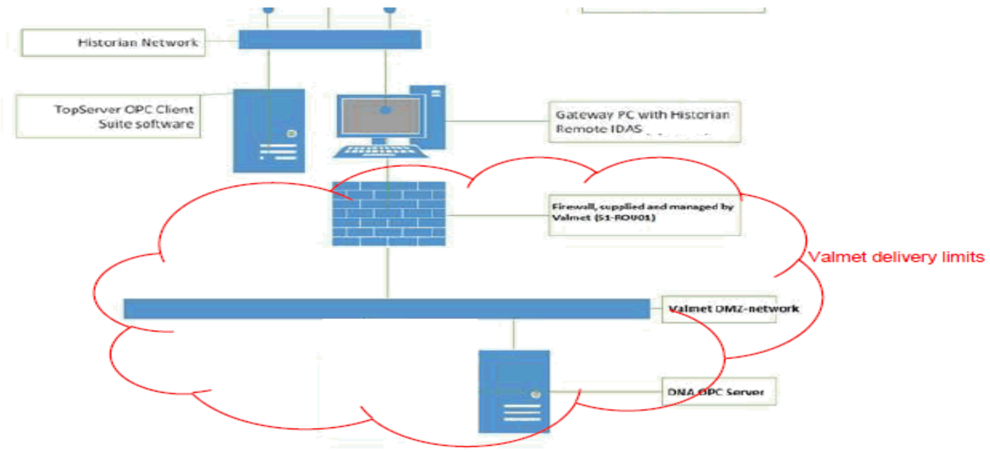
6.3 ADMINISTRATIVE STATIONS (LEVEL 3)

6.3.1 CMMS station

CNIM supplies a CMMS station for maintenance operation. The software application and configuration will be done by the customer.

6.3.2 OPC Server station client

The main process view as well as the views available within the main control system (DCS) can be displayed as a live diagram on a large screen by using a dedicated PC and connected to the supervisory control system.



6.3.3 CNIM data collect station

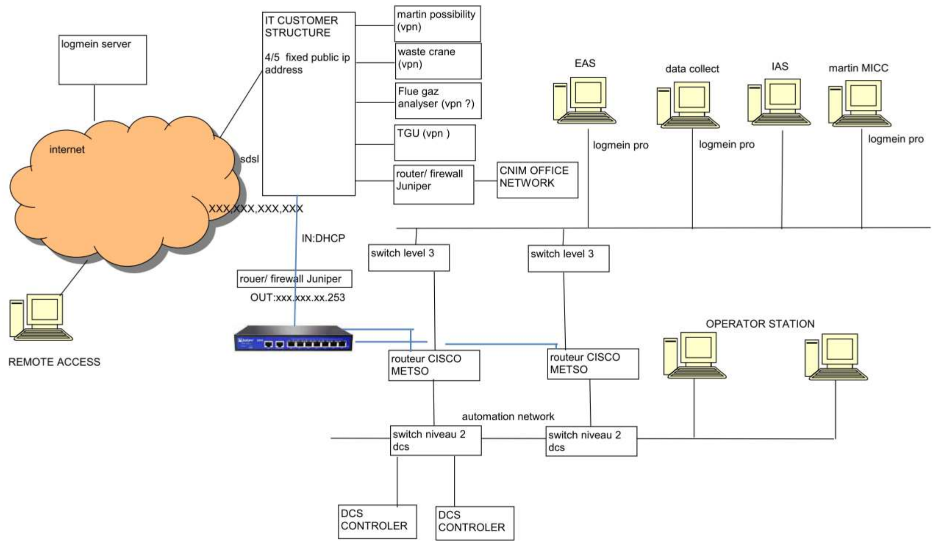
The data collect Server will be dedicated to collect the necessary historical data to allow CNIM's remote diagnostic from France.

It will be connected to the DCS level 3 for data recovery (Historical data base) and process views displaying.

This station (SLAVE) will allow an access from a remote station (MASTER) to ensure the files transfer to its hard drive disk and the mimic view visualisation (Without any control facilities) through a client Viewer of the operation software.

The MASTER Station is out of the scope of supply.

Access will be protected by Login and Password. This remote acess will be via the main VPN firewall router.



6.3.4 OPC server station

It is included to install TopServer OPC Client Suite software on the DCS network. This would interface with the DCS system to obtain the required data using the OPC protocol, and uses DCOM for data exchange.

6.3.5 Training station

The main process view as well as the views available within the main control system (DCS) can be displayed as a live diagram on a large screen by using a dedicated PC and connected to the supervisory control system.

6.3.6 Other equipments

Printers

reports laser colour printers:

- 1 A3/A4 colour and B/W laser jet printer connected to the DCS plant management level
- 2 A3/A4 colour and B/W laser jet printer connected to the DCS centralized operation level, dedicated to the printing of reports, event history, and alarms and located in the control room.

Switches

All the switches necessary to operate the DCS are included in the scope of supply, including those for MODBUS TCP/IP or PROFIBUS DP communications with external equipments. These switches or repeaters will be industrial type, monitored and, when applicable, remotely manageable. The management software will be provided and installed by the DCS Contractor in the DCS and the Laptop.

GPS clock

This clock will realize the time stamping of the DCS (Date/time). The IRIG B (modulated or none modulated) or SNTP protocols will be used to dispatch the time. This device has at least 3 outputs available for external systems (3 NTP); for each output, the LAN or VLAN domains must be adjustable independently.

This device will be compliant to 19" standard to be racked in IT bay.

A modular system using backplane and modules is used to allow extension and improve adaptability of this function.

Modem and VPN Router accesses

The DCS and stations of the architecture may be remotely accessible from external networks, including Internet access, with respect of the security policies rules.

KVM

All the PC or station have to be installed in cubicles or bays; therefore every display, mouse or keyboard installed in the operator control room will be taken in charge by KVM.

6.3.7 Acquisition and control

The system resources shall enable minimum 20% increase of the control logic and loops, without decreasing the processing time.

Processing units

The redundant processing units work, with reference to a data base, and manage the process digital and closed loop control functions. Unit will be able to manage all the boiler, flue gas treatment and common functions.

They will respect the following requirements:

- The communications are based on redundant optical fibre/ Ethernet networks. It concerns the following functional components:
  - Operator station
  - Application server
  - Controllers and/or acquisition devices
  - ...
- They communicate with the remote I/O modules via redundant suitable fieldbus.
- They are each functionally independent from the others. The failure of one unit does not involve the failure or shut-down of any another one.
- With the redundant power supply installed, the processing units will allow automatic change over to the safe source without shutdown.
- Each unit will have access to all the information managed by the DCS whatever its physical location.
- The processing units will be able to perform all the processing functions carried out by the DCS.

- The processing units will be able to carry out auto-test functions. The supervision will grant the processing units access to all the necessary information needed in order to run checking and maintenance (Load rate, type and localisation of faults…)
- Each unit will be able to detect the assigned faulty I/O cards (With alarm facilities available on the operator stations),
- Each unit will detect each faulty Analogical input (Link broken, Out of scale signal, loss of supply, etc…).
- Each unit will be time stamped by the GPS clock through time adjustment protocol (NTP or equivalent).
- Back up functions will be available.

Networks and bus

- The networks and bus allow communication between the DCS components and allow to reach the DCS overall reliability and performance requirements.
- Plant management Network level: optical fibre Ethernet TCP/IP communication between the computers of this level, gateways to IT network or external lines
- Suitable gateways between different designed networks.
- Operation and monitoring Network level: redundant optical fibre/Ethernet bus between the application servers, station and gateways of this level.
- Automation Network level: redundant optical fibre/Ethernet TCP/IP communication between processing units and gateways of this level. The redundant I/O fieldbus for communication between the processing units and the I/O modules (included in the I/O cabinets and LV switchboards

Note: In case where the IO fieldbus is star-shaped, the node switches which will be housed in local boxes installed in process area or electrical room throughout the plant.

- The communication bus between the processing units and the communicating devices/PLC out of the DCS
  - PROFIBUS DP standard where DCS is master
  - MODBUS TCP/IP communications will be bidirectional, on Ethernet standard and the DCS is Master

Input/Output modules

The I/O cards will be chosen and affected in order to minimise the different types of I/O modules.

The I/O willl be defined in accordance with CNIM standard,

The I/O cards changing could be achieved under voltage and without any risk (hot swap)

In the case of changing of an I/O-card or in case of partial power failure of the system for maintenance during operation, no changes to the previous conditions of the controlled system willl be made. In general, the replacement of failed components willl be possible when the system is in operation. The systems allow the identification on HMI of malfunctions at least at module level

Each module willl be fitted with I/O testing facility.

The proposed technologies will support redundant fieldbus, I/O status monitoring, and other features, etc

The analog inputs willl be of the 4...20mA type, with current limitation channel by channel (Max 30mA). Depending on the measurement instrument, the input channel will be connected in order to accept either a 24VDC loop powering by the PLC input module (2 wires or passive equipment) or a loop powering by the field instrument (4 wires or active equipment). They willl be compliant with "HART" transmitters.

A configurable filter is further required on each analogical input channel. A cut (<3.8mA) or an overload (>20.5mA) detection will be effective and an alarm will be raised. In such a case, the concerned measure will be frozen at its last value.

The analogical outputs are of the 4...20mA (load impedance = 50Ω), with current limitation channel by channel (Max 30mA).

The digital inputs willl be 24VDC type with current limitation channel by channel. They will be Opto-electrically insulated from the system. The inputs number per module willl be 16 as a maximum. A configurable filter is further required for bounce suppression.

The DI will accept indifferently 2 or 3 wires technologies

The Pulse inputs for the metering will have quick acquisition facilities. The other requirements are the same as the Digital inputs.

The outputs number per module willl be 16 as a maximum. In case of failure, the output can be put in a safe position configurable channel by channel during the commissioning. The Digital outputs willl deliver dry contacts, insulated, free of potential and able to withstand a making current of 4A and breaking current of 2A (minimum) under 240VAC and/or 110VDC.

Safety PLC (SRS)

The safety treatments willl carried out by a combination of the DCS and an independent Redundant Safety PLC (SRS) which takes into account the origin of the safety (Analogical or logical sensors) and the concerned equipment to ensure a direct boiler and main auxiliaries tripping by wired circuits actuated by safety sensors.

Safety PLC will meet SIL 3 performance requirements.

The design, construction, inspection and testing of the Safety PLC will comply with the relevant requirements :

- SIL requirements are based on the standards current at the time of construction.
- Communication with the DCS by a redundant ETHERNET TCP/IP bus
- Safety PLC will have a maximum PLC cycle time under 200 ms, which is necessary for processing the signals from the I/O modules, executing the user logic, and setting the outputs.
- Safety PLC will provide internal diagnostics and system testing.

- The internal architecture of the Safety CPU will provide two shutdown paths and allow double code generation and execution to detect systematic faults in the code generation and execution and random faults in the CPU and the RAM.
- The double code execution is controlled by 2 different processors integrated into the CPU.

The internal architecture of the Safety I/O modules will:

- Provide redundancy,
- Detect systematic faults in the code execution, and random faults in the I/O modules.
- In addition, the Safety I/O modules provide diagnostics, which check:
- The communication between the I/O modules and the CPU,
- The status and the health of the I/O modules.

By having a fully redundant configuration, it will be possible to maintain SIL3 even when the followings occur:

- Input failures, CPU failures,
- Output failures.
- DCS or DCS Communication failure

For programming functions and function blocks will be certified for use in Safety logic.

Safety relays of category 4 according to EN 13849-1 such as Pilz, Preventa or equivalent will be provided if the outputs of the SRS will not be able to stop directly the equipment in their command chains or if they are in negative logic (Closed circuit trips) without continuity checking device. They will be wired with "positive safety" (Open circuit trips the motor).

They will have the following characteristics:

- 24VDC coil.
- Automatic reset
- Plug in relays mounted on bases.
- Visual indication of relay status.
- Redundant supplies 24VDC

6.3.8 Plant Management Applications – Introduction

This section describes the Plant Management Applications (PMAs) that are modular solutions to fulfill the reporting and monitoring needs of power plants.

Plant Management Applications are built on top of the Information System. The Information System consists of data warehousing and Reporting and Analyzing Tools that are used to report, display and analyse these data.

The Process calculation applications are realised in the Central unit calculation environment and the results of the calculations are displayed in trends, reports and graphic displays with Reporting and Analysing Tools.

The PMA applications which are included in the scope of supply are described in the next sections.

6.3.9 Valmet DNA Plant Operation Monitoring

The purpose of this application is to monitor power plant heat balance and performance, as well as to report the main production and consumption figures.

The application can be applied for

- conventional power plants utilising solid fuel boilers and waste incinerators
- combined cycle plants
- CHP plants.

User interface

The results are displayed in delivered reports and display. Below are some examples:

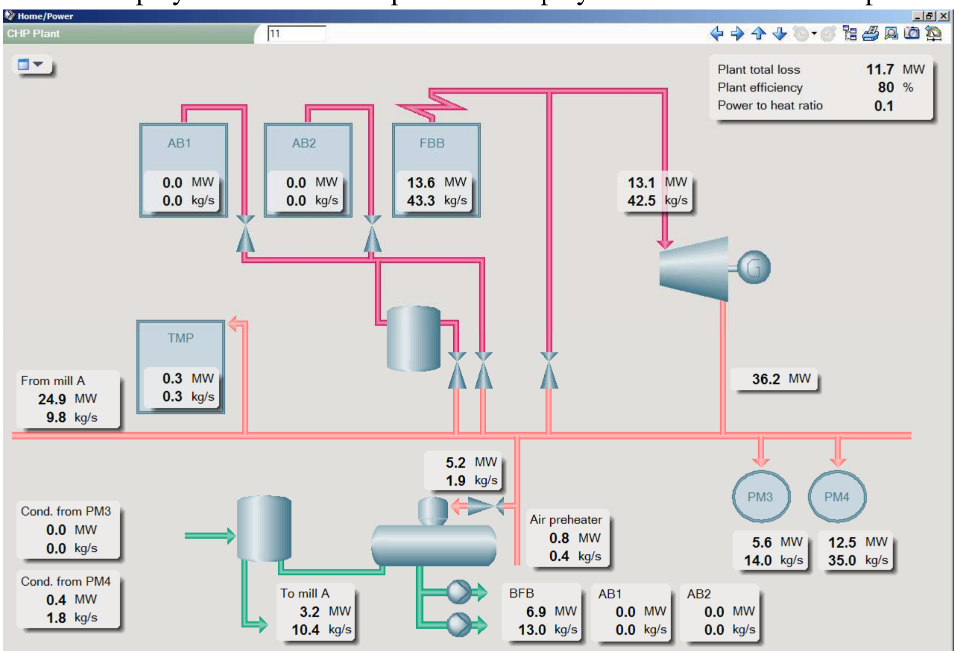


Fig. 12 - Power plant overall display

6.3.10 Operation Point Deviation Monitoring

The purpose of this application is to monitor power plants' controllable losses that arise when the actual operating parameters deviate from expected ones. The application is applicable to conventional cycle power plants.

The target values are calculated from correction curves obtained from the manufacturer or are set as constants (in the latter case they can be maintained by the end-user with the Manual Entry tool).

The application compares the actual parameters with expected ones and calculates the change in plant efficiency (and optionally fuel cost) due to the deviations. The effect on efficiency and fuel cost are calculated using manufacturer data (where applicable).

User interface example

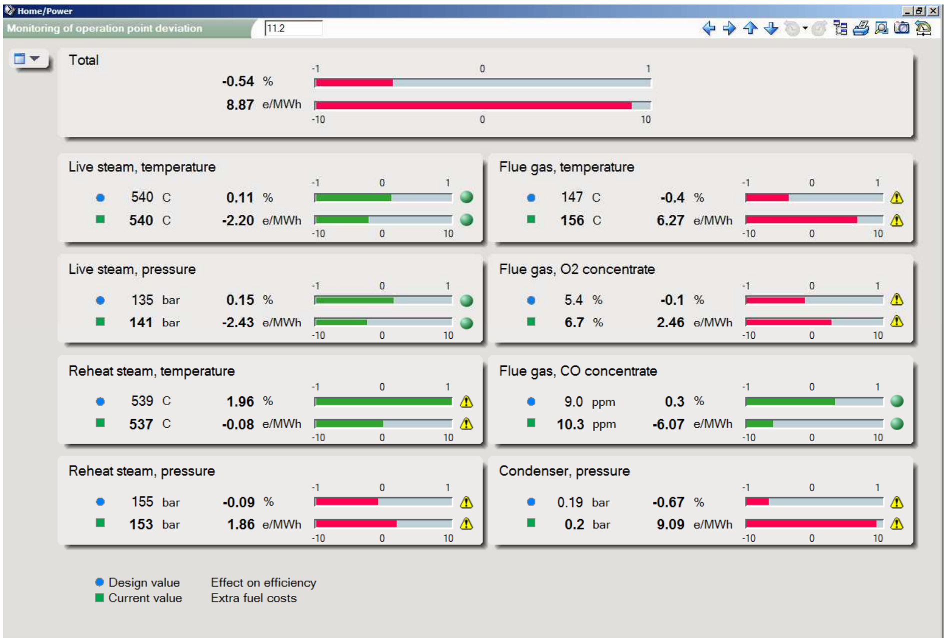


Fig. 13- Operation point display

6.4 ATMOSPHERIC EMISSIONS MONITORING

6.4.1 Emissions measurement

The following pollutants are continuously monitored and recorded:

- Total dust,
- HCl (Hydrogen chloride),
- CO (Carbon monoxide),
- SO2 (Sulphur dioxide),
- HF (Hydrogen fluoride)
- NOx (Nitrogen oxides, NO & NO2 expressed as NO2),
- NH3 (Ammonia),
- VOC (Volatile organic compounds expressed as TOC: Total Organic Carbon)
- Oxygen (O2),
- Water vapour (H2O)

With associated parameters:

- Pressure,
- Temperature,
- Volume flow.

According to the selected equipment, some parameters are measured directly or evaluated from another measurement which allows calculation.

2 continuous automatic sampling systems are installed for dioxins, 1 in service, 1 in stand-by.

The pressure measurement is not necessary because it has a negligible influence on the accuracy of analysis results. The filtering to be implemented on this variable measurement and the response time could even have a negative influence on the quality of results.

Equally, the system allows the data logging of the Flue Gas Treatment status (operation/fault condition information) as well as data logging and recording of some parameters issued from the combustion/boiler units, which are representative of the process status, such as:

- Combustion unit on/off,
- Combustion temperature,
- Oxygen content after boiler,
- Steam flow,
- Auxiliary burner(s) on/off.

6.4.2 Emissions monitoring station

This computer station is supplied in order to perform the data storage and calculations concerning emissions and performances of the Energy-from-Waste facility.

This dedicated equipment consists of the following:

- 2 stations (PC-type) fitted with 15" monitor, keyboard and pointing device,
- 1 long term data storage device.

This system will issue all reports requested by the Public Authorities with regards to pollutant emissions. All the data will be expressed in the standard format required and published in daily, weekly and monthly reports.

As emission values and associated parameters are necessary for the control of the process, primary correction calculations are made directly by the main control system (DCS).

Auxiliary calculations (averages on diverse time bases, peak values, etc.) are made by the administrative stations. All the information from combustion unit, boiler and Flue Gas Treatment are then available from the administrative station which allows on-screen monitoring and reports to be printed.

6.5 INSTRUMENTATION

Important note: unless otherwise stated, all signals are 4/20 Ma and IP65

The proposed control equipment main features are as follows:

6.5.1 Temperature

- Primary element:
  - T < 400 °C resistance probe PT100 type
  - T > 400 °C thermocouple K type

- Sensor and thermowell material:
  - T < 1,000 °C stainless steel 316 L
  - T > 1,000 °C refractory stainless steel (NS 30 or equivalent)
- Thermowells manufacture:
  - Water & steam circuits drilled thermowells
  - Air & flue gas circuits welded thermowells
- Power supply 10/36 Vcc two wires
- Accuracy class +/- 1 %

6.5.2 Pressure and differential pressure

- Transmitter SMART-type
- Power supply 10/36 Vcc two wires
- Accuracy class +/- 0,25 %

6.5.3 Flow

- Venturi nozzle with differential pressure transmitter for air and flue gas,
- Orifice plates with differential pressure transmitter for water and steam,
- Flow meter adapted to the fluid to be measured (e.g. electromagnetic flow meter).

If an extractive-type dust content analyser is used, the flue gas flow measurement will be issued from this apparatus (using a "Pitot" tube).

6.5.4 Level

- Gauge pressure measurement for tanks under atmospheric pressure,
- Differential pressure measurement for pressurised tanks,
- Capacity probe, hydrostatic pressure sensor, ultrasonic transmitter or micro-waves (Radar) measurements according to the fluid to be measured.
- Power supply 10/36 Vcc or 220 Vca

6.5.5 Flue gas analysers

- Combustion O2 analyser
  - Type Zirconium probe
  - Power supply 230 Vca, 50 Hz
- Dust content analyser
  - Type Light diffusion
  - Power supply 230 Vca, 50 Hz
- Multi-gas content analysers set for emissions measurement
  - Power supply 230 Vca, 50 Hz
  - Accuracy class 3 % of the full scale

This set allows the measurement of the pollutants on the following principles:

- HCl, CO, SO_2: wet or dry gas extractive or in-situ infrared spectroscopy,
- NOx, NH_3: wet or dry gas extractive or in-situ infrared spectroscopy or ultraviolet spectroscopy,

- Water content (% H_2O) is determined as follows:
  - IR spectroscopy measurement, in case of a wet gas extraction type multi-gas analyser or in-situ type multi-gas analyser,
  - Calculation based on the measurement of wet O_2 by a dedicated Zirconium cell probe type analyser compared with dry O_2, in case of dry gas extraction type multi-gas analyser.

6.6 MAIN CONTROL LOOPS

The Energy-from-Waste facility main process control loops are the following:

- Combustion Control loops,
- Combustion air temperature,
- Underfire air pressure,
- Overfire air flow,
- Auxiliary burner control,
- Combustion chamber under-pressure,
- Steam drum level-control,
- HP-steam temperature,
- HP-steam pressure,
- MP-steam header pressure,
- HP-steam de-superheating control,
- Condensate tank level-control,
- Feed-water tank level-control,
- FGT-inlet flue gas temperature,
- Hydrated lime injection.

6.7 AUTOMATISMS & SAFETIES

The automatisms and safety systems allow for at the same time the protection of personnel and equipment against eventual faults or malfunctions, and follow the recommendations and regulations in force.

The automatisms and safety systems are based and designed on the "FAIL-SAFE" principles, i.e. in normal operation, all safety circuits are energised and in "closed contact" position. The fault or opening of any circuit, leads to a safe and stable position.

6.7.1 Automatisms

The automatisms take into account the safeties and status reports (on/off feedback signals) in order to manage the start-up, shutdown and falling back sequences of the diverse discontinuous systems.

The automatisms are executed either by hardwired logics, by dedicated PLC or by the main control system (DCS) according to:

- the required level of automation,
- the degree of independence of the treated function versus the main process.

6.7.2 Safeties

The safeties are elaborated by on/off sensors or by thresholds on analogue measurements. They are selective and have an action on the relevant equipment, either simple (e.g. pumps, fans...) or complex (e.g. burners, grates...).

For the incineration streams and the steam/water circuit, safeties are processed at the same time in DCS and in the specific safety system (fail-safe PLC).

6.8 INSTALLATION AND CABLING

6.8.1 Installation

Generally, transmitters are installed on a steel support, with manifold (2 or 3 ways depending on measurement).

Pipes are of the seamless carbon-steel type. Fittings are from ANSI B16.104 class 3,000. The line length between process pipe and manifold shall be as short as possible. Screwed connections are of the NPT-type.

Power air supply pipe is with isolating valve fitted nearby the instrument to feed. From the isolating valve to the instrument, the line is 8mm-copper tube.

6.8.2 Cabling

All signal cables are twisted pair, polyethylene insulated, collective screen, LSZH sheathed, unarmoured, minimum conductor size 0.9 mm^2, manufactured according to IEC requirements. However, where manufacturers' equipment recommendations for signal/data transmission cables are in conflict, the manufacturers recommendations shall apply.

- Compensating iron/copper-nickel cables are used with iron/copper-nickel type J thermocouples.
- Compensating nickel-chromium/nickel-aluminium cables are used with type K thermocouples.

There will be 10 % spare core in all control and signal cables.

Instrumentation cables are segregated from the power cables.

6.8.3 Labelling

All control equipment, including distribution boards, are provided with labels suitably engraved with indelible characters indicating purpose and use of the equipment together with the voltage and current rating.

7. ELECTRICAL INSTALLATION

All equipment and materials are of the quality best suited for the purpose specified and comply with the IEC standard.

Electrical engineering and design will be done following the EPC Contract's Employer's Requirements, Networks Distribution Code, and the Grid Code

Electrical calculations/studies include:

- Total system voltage drop, load flow, motor starting analysis, harmonic study and short circuit studies
- Arc flash hazard analysis, including:
  - Design phase analysis, prior to equipment selection, to limit hazard to 40 cal/cm2 using conservative estimates for times and short circuit levels.
  - Final analysis using available short circuit values and actual relay settings.
  - Arc Flash equipment warning label information.
- Facility load study (see description above)
- Electrical equipment sizing calculations including system grounding equipment and sizing of transformers, switchgear, motor control centres, etc.
- Substation and Facility ground grid calculations per DNO Distribution Code and Grid Code requirements
- Diesel generator load study and sizing calculation (including sequencing and/or shedding of loads and black start)
- Battery and charger load study and sizing calculation
- Battery Hydrogen Evolution Calculation, where required
- UPS load study and sizing calculation
- Lighting system calculations
- Cable sizing criteria and calculations
- Specialty relay studies (e.g., ground overvoltage, differential current, under/over voltage, under/over frequency, reverse power, negative sequence, loss of excitation, volts/hertz, distance, loss of synchronization/out-of-step, and any settings required by DNO, including calculations, curves, relay settings, etc.
- Protective relay studies, including relay settings and phase and ground overcurrent coordination curves, calculations, etc.
- Protective relay communications configuration(s) required to initiate event reports in upstream or downstream relays.
- Protective relay data register assignments for transmitting metering or other data information over a data link to the DCS, or DNO. Communications protocol to be determined during detailed design.
- Hazardous area classification study

- Corrosive area classification study

The plant is connected to the National Grid from a 110kv supply, through a 110kv substation and one 110 kV /11 kV step-up transformer.

The Turbo-Generator generates electrical energy at 11 kV and is connected onto the plant 11 kV main power distribution system through the both 11 kV / 110 kV step-up transformers

The plant auxiliaries are supplied from the 11 kV main distribution network through an another 11kv power subdistribution system who supplies four (4) auxiliaries MV/LV transformers with neutral three-phase 50 Hz alternating current:

- Two 11 kV / 0,6 kV (TR 11 & 12) for stream 1 and common part,
- Two 11 kV / 0,4 kV (TR 13 & 14) for stream 1 and common part,

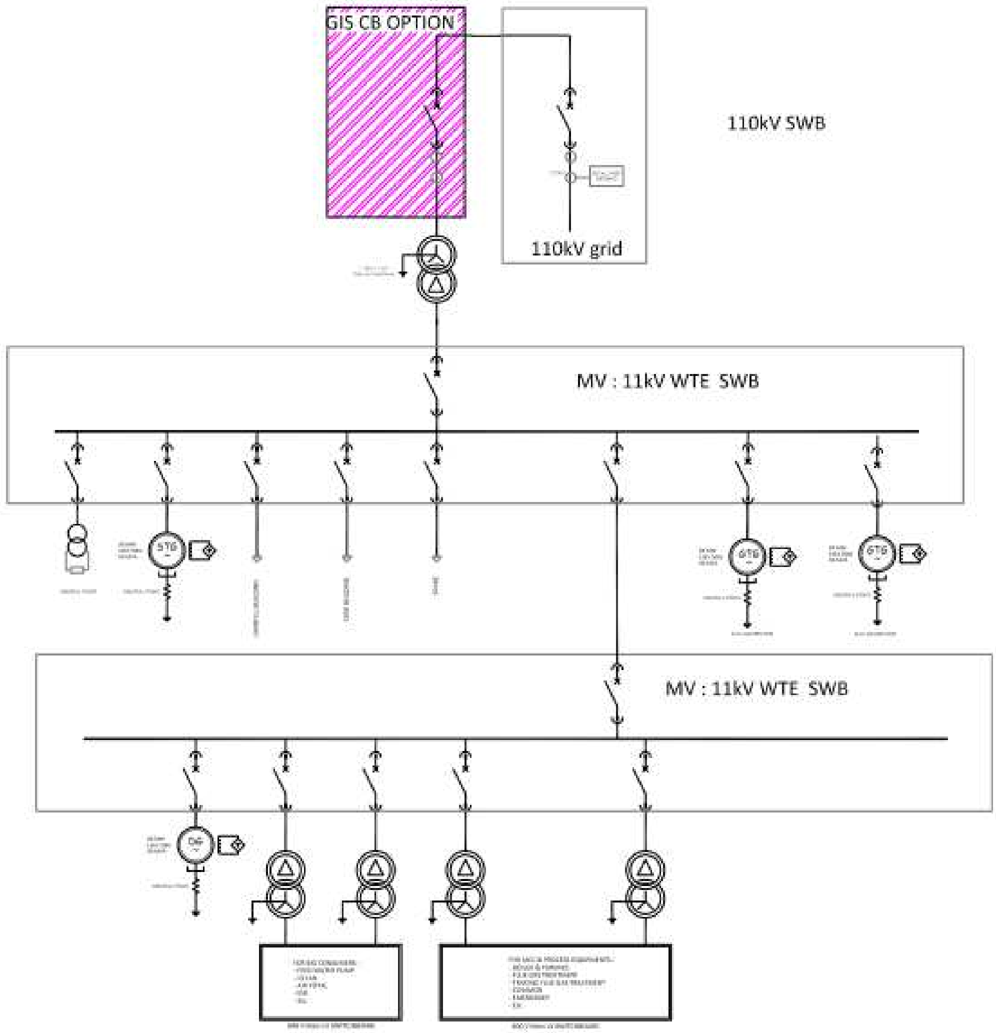


Fig. 14 - Electrical Distribution Principle

In normal operating conditions, the power requirements of the Energy-from-Waste facility are supplied by the Turbo-Generator and the balance is exported to the National Grid.

In the event of a breakdown of the Turbo-Generator, the power will be supplied from the National Grid through the main line. Or bio gas motors

Should the main line become unavailable whilst in normal operation, the Turbo-Generator will switch automatically to Island Mode so as to allow continued incineration of waste without electrical export to the National Grid.

Should the main line become unavailable together with the Turbo-Generator while in normal operation, emergency power will be supplied from a emergency diesel generator to prioritise circuits allowing the Energy-from-Waste facility to shut down in full safety conditions.

Necessary interlocks and switching are provided in order to ensure that appropriate changeovers can be made accordingly.

For more details see documents :

Titles	N°
110KV MV DISTRIBUTION SLD	0A1401 1702/62G011
11KV MV DISTRIBUTION SLD	0A1401 1702/62G012

The electrical installations comprise the following:

- Cable from the plant 110 kV sub-station to DNO 110KV sub-station and connection (Out of CNIM scope)
- Plant 110 kV sub-station (Out of CNIM scope)
- 110KV metering circuit breaker (Out of CNIM scope)
- 110KV metering circuit breaker (Out of CNIM scope)
- Tariff quality metering (Out of CNIM scope)
- Cable from the plant 110 kV sub-station to 110kv GIS CB (CNIM scope)
- 110kV GIS CB (OPTION)
- 11 kV / 110 kV step-up transformers (CNIM scope)
- 11 kV medium voltage main power distribution system (CNIM scope)
- 11 kV medium voltage main power subdistribution system (CNIM scope)
- Bio gas generator and cabling (Out of CNIM scope)
- Diesel generator (CNIM scope)
- 690 V power distribution system (CNIM- scope)
- 415 V power distribution system (CNIM- scope)
- 230 V power distribution system (CNIM- scope)
- 110 V DC distribution system (CNIM- scope)

7.1 HV-DISTRIBUTION SYSTEM

7.1.1 110 kV sub-station DNO (out of CNIM scope)

7.1.2 110 kV- power distribution plant (OPTION)

The bay is GIS type for indoor installation

- Double bus bar system
- Rated fault level - 12KA, 3 Sec /200A
- Metal clad SF6 switch gears

The minimum requirement for this sub-station is:

- 1 circuit breaker line
- CT's and VT's
- Measuring panel
- LV-distribution
- DC system and distribution
- Specific protections
- SCADA system
- Gantry of connection

Operating and safety instructions will be displayed on the front of each bay.

7.1.3 110 kV / 11 kV step-up transformer ONAN/ONAF

The step-up transformer is fitted with:

- 1 automatic on-load tap-changer +/-4x2.5% (on HV-windings),
- 1 alarm thermostat and tripping device,
- 1 Buchholz alarm relay and tripping device (gas emission).
- 1 locking system between the access door and the MV-bay

7.1.4 Main 11kV-power distribution

The bays are of a prefabricated-type for indoor installation. Withdraw units

Operating and safety instructions will be displayed on the front of each bay.

The distribution system comprises 11 kV switchgears which ensure:

- 1 incoming protection bay (circuit breaker)+ TP measures cell
- 1 measure cell

- 3 protection bay (circuit breaker) for the sub-distribution + 1 spare.
- 1 protection bays (circuit breaker) for steam generator
- 1 protection bays (circuit breaker) for neutral point
- 2 protection bays & measures (circuit breaker) for biogas generators
- 1 protection bays (circuit breaker) for 11kv power subdistribution system

7.1.5 MV/LV transformers ANAN

Each transformer is fitted with:

- 1 off-load tap-changer,
- 1 thermal protection,
- 1 earthing connector,
- 1 locking system between the access door and the MV-bay.

7.2 LV-DISTRIBUTION

7.2.1 LV-power distribution

For more details see documents :

Titles	N°
690V MLV DISTRIBUTION SLD	0A1401 1702/62G.0013
400V MLV DISTRIBUTION SLD	0A1401 1702/62G.0014

The power distribution system is designed using protective devices, each of which is capable of making and breaking any over-current up to and including the prospective short-circuit current at the point of installation.

Characteristics of the protective devices are chosen so that full discrimination is maintained for any over-current up to short-circuit between devices directly upstream or directly downstream each other.

All circuits have lockable isolating facilities so that they can be disconnected and worked upon in complete safety.

All circuit control devices are de-rated as required according to their method of enclosure and to power factor and frequency of operation where appropriate.

Single phase load is balanced across the phases of supply.

7.2.2 Cubicle construction

Cubicle construction consists of a free standing dust and damp proof construction, manufactured from cold reduced sheet steel, folded and welded to provide a rigid cubicle enclosure with each compartment being separated from adjacent compartments.

With any open cubicle door, protection against live parts is provided in accordance with standard IEC code

Each cell or bay is equipped with an anti-condensation heater and thermostat and also mounted with a common or individual base to end at floor level.

The cubicles protection degree is:

- IP 55 for on-site cubicles and boxes,
- IP 31 for cubicles and boxes located in electrical rooms.

7.2.3 Busbars system

Main busbars comprise a triple pole fully rated phase of adequate cross section for specified ratings. Suitable rated secondary busbars are provided at the rear of each tier with connections to individual compartments by flexible or solid copper insulated connections.

The busbars system is designed to ensure adequate current rating, clearances, mechanical strength and complete reliability and is fully enclosed to prevent accidental contact and to withstand the short-circuit current associated strength.

The cells segregation are form 3 (www).

7.2.4 Main LV-switchboards 400Vac

The purpose of the main LV-switchboard is to carry out the distribution of the 400 V low voltage supply to the MCC's, auxiliary and secondary switchboards. The busbars system is splited in two sections, being fed by three transformers through a circuit breaker.

The busbars system is sized for the apparent power of one transformer. An interlock is provided between the three incoming feeders and the connecting switch in order to avoid the feeding of the busbars by the two transformers at the same time.

One transformer has been sized for two sections.

The cells segregation are form 3 (www).

7.2.5 Main LV-switchboards 690Vac

The purpose of the main LV-switchboard is to carry out the distribution of the 690 V low voltage supply to the MCC's, auxiliary and secondary switchboards. The busbars system is splited in two sections, being fed by three transformers through a circuit breaker.

The busbars system is sized for the apparent power of one transformer. An interlock is provided between the three incoming feeders and the connecting switch in order to avoid the feeding of the busbars by the two transformers at the same time.

One transformer has been sized for two sections.

The cells segregation are form 3 (www).

7.2.6 Motor Control Centre (MCC)

The purpose of the MCC is to carry out the distribution of 415 V supply to the auxiliary and secondary switchboards and LV-motors. The busbars is made of one section, being fed from the Main LV- switchboard through a circuit breaker.

The busbars system is sized following the rating of the outgoing circuit breaker of the Main LV-switchboard. The cells segregation are form 3 .

Standard MCCB will be provided.

7.2.7 Secondary distribution boards

These distribution boards carry out the power distribution and the eventual hardwired automatisms for the various auxiliaries. The switchboard is fitted with necessary instruments, control switches and operating devices mounted on a front panel. The Control power inside cubicle is made by an internal transformer.

The secondary distribution board is complete in every respect and suitable for satisfactory operation.

A free-standing dust and damp-proof construction, manufactured from cold reduced sheet steel, folded and welded, provides a rigid cubicle enclosure with fixed mounted part (form 2B).

7.2.8 Uninterrupted Distribution Board (UPS)

This distribution board carries out the distribution of uninterrupted supply via two redundant charger/inverter units. In normal operating conditions, UPS is carried out through a charger rectifier and inverter. In the event of overloading or malfunctioning, a static switch automatically switches onto the normal system. In addition, both units are equipped with a manual change-over system.

This device is designed to ensure the constant supply to various consumers during a 60 minutes interval.

7.2.9 110Vdc charger battery

Redundant 110Vdc charger battery will be provided to supply the MV Switchboards components in normal operating conditions.

This device is designed to ensure 60 hours continuous quiescent supply with the battery voltage remaining above 85% of its nominal value.

Batteries will be sealed for life and maintenance free arranged in series/parallel banks to provide the following minimum capacity;

7.2.10 Earthing System in LV-distribution

Earthing system is of the TN-S type.

7.3 CABLE SUPPORT SYSTEM

All cabling is supported on heavy duty galvanised steel cable trays, or ladder systems. Cables and cable trays are installed according to the best industrial practices. Cables are segregated as per voltage and nature of carried information, according to IEC requirements.

It is provided:

- 1 tray for power cables,
- 1 tray for instrumentation cables.

Cable route is horizontal or vertical except where some obvious feature of the building renders a sloped run appropriate. Minimum clearance between cables and steam and other services is 150 mm.

Cable routes are chosen in order to:

- minimise the number of changes in direction,
- minimise the overall route length,

- ensure accessibility of cables.

The cable support system is designed such that 25 % extra cables of a similar size and spacing can be installed in the future.

In areas where a cable tray/ladder system is not feasible, special support systems are employed using heavy duty hot dipped galvanised channel sections bolted into a robust structure.

7.4 CABLING

All cables are suitable for their place of installation and fully resistant to all the expected environmental features, such as ambient temperature, UV exposure, chemical attack, physical damage, etc. either by virtue of their special construction or because of the protective features of installation.

7.4.1 MV-cables

Cable single core copper or aluminum with MDPE over sheath. Cables rated at 10/33 kV with XLPE/LSZH insulated conductors, unarmoured.

7.4.2 LV-cables

Cable 600/1000 V with XLPE/LSZH insulated conductors, unarmoured.

Cables used for wiring in conduit trunking are LSZH insulated of 600/1000 V grade.

7.4.3 Sizing of cables

The requirement loadings for cables are determined, making due allowance for a diversity power factor.

De-rating factors for ambient temperature and method of installation are applied in accordance with the manufacturer's recommendations and Standards. The ratings of cables, after applying all de-rating factors, are not less than the ratings of their respective circuit protection devices. Cables are of sufficient size to withstand the let-through energy of their respective circuit protective devices without harm.

7.5 EARTHING CIRCUIT

The main earthing system is composed of a set of cables, rods and connection intended to drain to the earth all the faults occurring on the metallic parts of the plant structure and equipment.

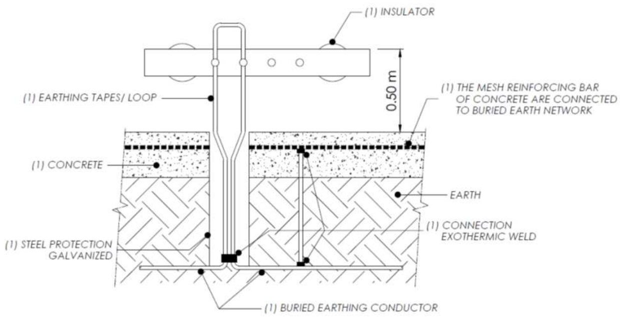
The main earthing system where concrete foundations are provided is carried out by means of a bare copper cable, buried in the ground and connected to the existing earthing system. The buried cable is accessible in several points of its route for bonding to steel structure.

All steel structures, equipment mounted on frames, transformers, electrical enclosures, cables trays and large metal parts of the installation are bonded to the main earth system in accordance with IEC requirements.

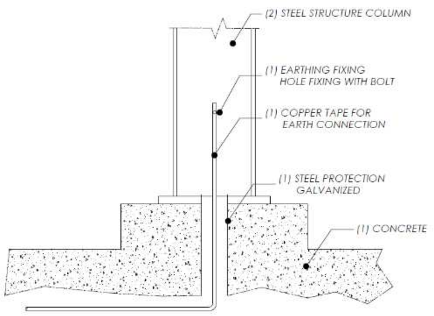
Another circuit is intended to earth any sensitive equipment such as electronic devices and control systems. This circuit is mainly composed of specific bars installed in electrical rooms connected to the main earth bars, who themselves are connected to earth rods.

Clean earth will be not provided.

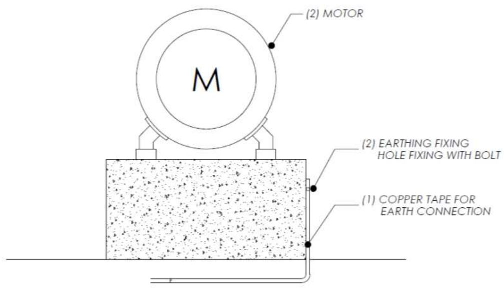
Example Earth arrangement for earthing tapes/loop from buried earth conductor to earth bar



Example Steel structure earthing



Example Equipment earthing



7.6 AUXILIARY DIESEL GENERATOR

The emergency Diesel Generator fully fitted will be designed to stop properly the stream.

The emergency generator will be designed for emergency operation (<500h/year). In addition to providing emergency power supplies to essential users, the generators shall be designed for operation when:

(1) synchronised to the grid;

(2) synchronisation of the diesel generation set with the Site distribution system for testing purposes; and

(3) automatic switching of the diesel generation set to the Site electrical connection so that the Site supply can be restored without disruption of the essential services.

The noise will be conform with the regulation. The emergency generator shall be sized with 10% extra capacity to allow for future additional loads.

7.7 ELECTRICAL MOTORS

The electrical motors have the following characteristics:

- Protection and insulation:
  - Protection in defined areas, insulation class F, temperature class B.
- Number of successive starts:
  - The motors designed for a continuous operation are able to sustain three starts per hour from the cold state, uniformly distributed.
  - Others: according to service specification
- Temperature probes:
  - Type IPSOTHERME (temperature switch) on windings for installed motor powers greater than 75 kW
  - Type PT100 (temperature measurements) on windings and bearings for installed motor powers greater than 100 kW
- Type of starter:
  - Direct on-line starter or frequency drive or soft starter according to motor power and service
- Efficiency:
  - Class : IEC 60034

7.8 ANCILLARY AMENITIES

The plant incorporates the necessary ancillary services required for its operation such as:

- The high voltage switchgear for connection onto the grid for electric power export or import.
- Instrument and service compressed air units and distribution network.
- Control room
- Workshops
- Stores
- Administration and amenity facilities
- Conference room
- Visitor center

Form T.2.8.2.3 **Main Facility**

EFW FACILITY	
	Page 1 of 2
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	1 1
Facility No. Name of the Facility Location of the Facility	1 Main Facility – Energy from Waste facility See Lay-out - Form 2.2.3.1
Type of combustion system	Incineration with a reverse acting grate
Number of combustion lines	1
Input type (RMW Unprocessed, RDF, others)	RMW Unprocessed
Design LHV	8, 500 kJ/kg
Heat input at 100% MCR (according to the combustion diagram set out in 0)	103 MW
Nominal [RMW Unprocessed/RDF] capacity at 100% MCR and selected LHV	43,6 t/h @ 8500 kJ/kg 340,000 t/a @ 8500 kJ/kg
Peak [RMW Unprocessed/RDF] capacity	49,4 t/h
Number of working shifts	3
Operating time	333 d/a 7,800 h/a
Availability time ratio	89%
Full load operating hours	7,800 h/a

EFW FACILITY	
	Page 2 of 2
Nominal capacity of main Facility components: • bunker • offgas treatment • flue gas residues treatment including boiler ash (APCR and boiler ash solidification) • Bottom ash treatment	 • 7000 m³ equivalent to a storage capacity of 3. days of average daily input quantity • 191,734 Nm³/h • 18.5 t/h • 75 t/h
Facility outputs (e.g. bottom ash, FGT residues, waste water, etc.) (*please specify*) 1. Bottom Ash Aggregate 2. Bottom Ash Aggregate . 3. Ferrous Metal from Bottom Ash 4. Leachate from Bottom Ash maturation 5. Stabilized APCRs	*Specify quantity and destination (e.g. to landfill type, treatment facility, recycling market, etc.)* 1. 25 000 t/a to recovery on New Landfill 2. 56 000 t/a to New Landfill for Residues 3. 4 000 t/a to External off-take 4. 6 000 t/a to recovery in APCR stabilization 5. 33 000 t/a to New Landfill for Residues
Required area for the Facility (total)	40 000 m²
Energy output for sale (after deduction of own consumption of the Main facility): Electricity Heat	168 000 MWh/year 175 000 MWh/year

Form T.2.8.3 List of Buildings and Architectural Conceptual Design

Instructions: Complete this form for each Facility as required according to the number and type of Facilities for the proposed solution

Reference No. of the corresponding Works Delivery Plan	1
Reference No. of the corresponding Services Delivery Plan	1
Facility No.	1
Name of the Facility	EfW Facility

List of Buildings and Architectural Concept Design

1 CIVIL STRUCTURES

1.1 General assumptions

- Natural ground can be used for backfilling around foundations and for compaction of subbase. Where required grater subbase compaction, sandy-gravel layer shall be used.
- Auxiliary consumption transformers in Electrical building are dry transformers, hence there are no oil collecting pits.
- Primary leveling shall be done according to CNIM drawing GENERAL ARRANGEMENT –SITE PLOT PLAN, No 0A 1401-0202/62G605. Most of the plot area shall be in cut due to big difference between natural ground level and designed ground elevation. Hence, retaining walls are planned (for greater differences in elevations - diaphragms, for smaller - standard retaining walls).
- Proposal covers reinforced concrete slab on grade in IBA area, catch pit and lagoon, access and internal roads to suit renewed PDR.
- Sanitary water supply is directly from Municipality network.
- Separate Oil tank for collecting leakage from Step up Transformer is taken, as per Serbian practice/requirements.
- Fence is planned around the plot plan according to drawing No 0A 1401-0202/62G605. which is reduced with comparison to drawing - Unit KP4 defined in “Detailed plan for Vinča” - drawing No 04_SPROVODJENJE_2500.DWG.

1.2 Description Waste Tipping Area (outdoor area except access to the tipping bay)

Superstructure:	Steel structure.
Ground floor slab:	R/C slab at +219.00 level, lied over compacted layer of sandy-gravel soil, 1m deep.
Roof:	Roof metal sandwich panels, clad on both sides with corrugated steel sheet, polymer-coated, with rock wool core, thickness 200 mm; light panels (20 % of roof area). Roof drainage through external rainwater downpipes
Facade:	No facade.
Facade doors:	Steel, fire rated (P090), solid leaf with rock wool, finish painted, single leaf doors with dimensions 930/2050 mm (1 pcs).
Facade roller shutter doors:	Steel, with core, finish painted, door (T 500) dimensions 5000/5000 mm, doors (T400) dimensions 4000/5000 mm .
Floors finish:	Concrete with surface hardener.
Walls – finish:	Without finish
Ceilings – finish:	Without finish.

1.3 Waste Bunker Hall

Superstructure:	Reinforced concrete structure up to level +235.90 and steel structure above this level.
Substructure:	Reinforced concrete bunker walls, Peripheral R/C walls below level +219.00 along façade walls in grid 1 to close the interior of the building because the road passing nearby changes level from +215.00 to +218.50.
Foundations:	Foundation slab below bunker and isolated footings below peripheral walls, connected by peripheral walls or beams. Columns of waste bunker hall in grid "D" are founded on the common pile raft with boiler steel structure.
Ground floor slab:	R/C slab at +219.00 level, lied over compacted layer of sandy-gravel soil, 1m deep.
Roof:	Roof metal sandwich panels, clad on both sides with corrugated steel sheet, polymer-coated, with rock wool core, thickness 200 mm. Roof drainage through external rainwater downpipes.
Facade:	Facade metal sandwich panels, clad on both sides with shallow corrugated steel sheet laid in horizontal grid, polymer-coated, with rock wool core, thickness 200 mm.
Facade roller shutter doors:	Door (V 250) dimensions 2500/3000 mm
Facade doors:	Steel fire rated (P090), solid leaf with rock wool core, finish painted, single leaf door with dimensions 930/2050 mm (2 pc).
Floors finish:	Concrete with surface hardener
Walls – finish:	Without finish.
Ceilings – finish:	Without finish (roof metal steel coated sandwich panels on internal side)
Insulation of slab on grade:	Elastomeric bituminous waterproofing membrane over a concrete base (blinding layer), underneath RC floor slab. painted. Steel fire resistant door, solid leaf, with rock wool core, finish painted: Double leaf door (90 min fire resistance). Single leaf doors (90 min fire resistance).

1.4 Administrative Building

Internal partition walls:	Masonry, clay block 190 mm, 120 mm, 70 mm, plastered on both sides, Light weight drywall partitions, thickness 100 mm, with mineral wool core (control of ground floor entrance).
Internal partition with platform and railing:	Partition in control room, glazed, fire resistant (90 min), dimensions 3800/2000 mm, steel partition, finish painted, glazed with fire resistant tempered glass, with platform and railing dim 5680/700/3900 mm, in a steel tube and flat steel structure with galvanized steel net, covered with steel sheet, aluminium glazed office acoustic partitions with doors.
Floors finish:	Vinyl floor cladding (offices); ceramics, non-slip, tile dimensions 300/300 mm, over cement screed, with waterproofing coating (sanitary facilities, pump station); PVC antistatic; porcelain stoneware, tile dimensions 600/600 mm, over cement screed (entrance hall, corridors, staircase); parquet floor in managers offices.
Walls – finish:	Emulsion paint and ceramic tiles in sanitary facilities, height up to suspended ceiling, over masonry/plastered and concrete surfaces.
Ceilings – finish:	Suspended ceilings – flat, of plasterboard tiles, moisture resistant, emulsion paint finish (sanitary facilities), emulsion paint over concrete surfaces (all other areas).
Acoustic insulation	Acoustic insulation of floors, walls and ceiling.
Insulation of slab on grade:	Elastomeric bituminous waterproofing membrane over a concrete base (blinding layer), underneath RC floor slab

1.5 Boiler Hall

Facade:	Facade metal sandwich panels, cladded on both sides with shallow corrugated steel sheet laid in horizontal grid, polymer-coated, with rock wool core, thickness 200 mm.
Facade windows:	Aluminium profiles with thermal break, anodized, with double insulated glazing unit.
Facade doors:	Steel fire resistant (P090), solid leaf with rock wool core, finish painted, single leaf doors. Facade roller shutter doors: Steel doors with core, finish painted, door (M 400) dimensions 4000/5000 mm Door (V 300) dimensions 3000/3000 mm.
Floors finish:	Concrete with surface hardener.
Walls – finish:	Without finish (facade steel coated sandwich panels on internal side).
Ceilings – finish:	Without finish (roof steel coated sandwich panels on internal side),
Insulation of slab on grade:	Elastomeric bituminous waterproofing membrane over a concrete base (blinding layer), underneath RC floor slab.

1.6 Flue Gas Treatment Area & Residue Stabilization Area

Foundations:	• Bag filters are founded over two rafts. • Freestanding Chimney is founded over pile rafts supported by drilled piles Ø 1000 mm, L=16 m. • Other equipment is founded either on isolated footings /rafts or over plinths at slab on grade. Top of raft and footings is at -1.5m below ground level to enable laying trenches and other installation above them. R/C Stacking wall is founded over strip at foundation depth 1.0m below ground level.

1.7 Analyzers Shelter

Superstructure:	Masonry walls with r/c piers and roof slab.
Foundations:	Strip foundation below walls.
Ground floor slab:	R/C slab at +215.00 level, lied over compacted layer of sandy-gravel soil. Separate foundations and plinths for equipment supporting.
Roof:	Flat inaccessible roof consisting of: concrete slab, sloping layer, vapour barrier, waterproofing roof membrane, thermal insulation with rock wool t=150mm, Geotextile, protection with gravel, course thickness 75-100 mm. Roof drainage through external rainwater downpipes.

1.8 Flue Gas Treatment Area & Residue Stabilization Area

Facade:	Masonry thermally insulated sandwich wall consisting of: mortar, clay block 190 mm, thermal insulation with rock wool 150 mm, solid brick 120 mm, mortar, acrylic facade paint.
Facade windows:	Aluminium profiles with thermal break, anodized, with double insulating glazing unit (two glass panels in a unit) dimensions 2000 x 2000 mm.
Facade doors:	Steel, solid leaf, with rock wool core, finish painted, double leaf door dimensions 2000/2500 mm.
Floors finish:	Epoxy flooring, thickness 3-5 mm.
Walls – finish:	Acrylic paint, over masonry/plastered and concrete surfaces.
Ceilings – finish:	Acrylic paint, over concrete surfaces.
Insulation of slab on grade:	Elastomeric bituminous waterproofing membrane, over concrete base (blinding), underneath RC floor slab.

1.9 DENOX Building

Superstructure:	Steel structure with roof steel truss.
Foundations:	Isolated footings, connected by peripheral beams.
Ground floor slab:	R/C slab at +215.00 level, lied over compacted layer of sandy-gravel soil. Separate foundations and plinths for equipment supporting. Drainage trench and manhole, covered with grill.
Roof:	Roof metal sandwich panels, cladded on both sides with corrugated steel sheet, polymer-coated, with rock wool core, thickness 150 mm. Roof drainage through external rainwater downpipes.
Facade:	Facade metal sandwich panels, cladded on both sides with shallow corrugated steel sheet laid in horizontal grid, polymer-coated, with rock wool core, thickness 150 mm.
Facade windows:	Aluminium profiles with thermal break, anodized, with double insulated glazing unit (two glass panels in a unit), dimensions: 3800/2000 mm.
Facade louvers:	Aluminum, fixed, anodized, of extruded aluminum profiles, with slats and protective mesh, dimensions 6000/7000 mm.
Facade doors:	Steel, fire resistant (P0 100), solid leaf, with rock wool core, finish painted, single leaf door, dimensions 1030/2050 mm.
Floors finish:	Epoxy flooring, thickness 3-5 mm.
Walls – finish:	Without finish (facade steel coated sandwich panels on internal side).
Ceilings – finish:	Without finish (roof metal steel coated sandwich panels on internal side).
Insulation of slab on grade:	Elastomeric bituminous waterproofing membrane over a concrete base (blinding layer), underneath RC floor slab.

1.10 Water Treatment Building

Superstructure:	Reinforced concrete structure.

Foundations:	Isolated footings below building columns connected by ground floor beams below façade masonry walls. Row & Demin. Water reservoirs are founded at separate rafts. Below these rafts and adjacent isolated footings (four pcs.) soil compaction should be done. Other equipment is set over plinths on ground floor slab. Ground floor slab is R/C slab at +215.20 level, lied over compacted layer of sandy-gravel soil. Drainage trench is covered by grill. Around NaOH & HCl reservoirs is planned enclosed area by r/c upstands 0.5m high, to eliminate eventual acid leakage to remaining part of building.
Ground floor slab:	R/C slab at +215.20 level, lied over compacted layer of sandy-gravel soil. Separate foundations and plinths for equipment supporting.
Roof:	Flat inaccessible roof consisting of: concrete slab, sloping layer, vapour barrier, waterproofing roof membrane, thermal insulation with rock wool thickness 150mm, Geotextile, protection with gravel, course thickness 75-100 mm. Roof drainage through external rainwater downpipes.
Facade:	Masonry thermally insulated sandwich consisting of: mortar, clay block 190 mm, thermal insulation with rock wool 150 mm, solid brick 120 mm, mortar, acrylic facade paint.
Facade windows:	Aluminium profiles with thermal break, anodized, with double insulating glazing unit (two glass panels in a unit) dimensions 5600 x 800 mm, 3000 x 800 mm.
Facade louvers:	Steel, fixed finish painted, dimensions 2500 / 2000 mm.
Facade doors:	Steel, solid leaf, with rock wool core, finish painted, double leaf door dimensions 3000/4000, single leaf door 930 x 2050 mm.
Floors finish:	Epoxy flooring, thickness 3-5 mm, with skirting, height 150 mm, in laboratory ceramics, acid-resistant, non-slip, tile dimensions 300/300 mm, over cement screed, with waterproofing coating.
Walls – finish:	Acrylic paint, over masonry/plastered and concrete surfaces, ceramic tiles in laboratory.
Ceilings – finish:	Acrylic paint, over concrete surfaces, suspended ceiling in laboratory, flat, of plasterboard tiles, acrylic paint finish.
Insulation of slab on grade:	Elastomeric bituminous waterproofing membrane, over concrete base (blinding), underneath RC floor slab.

1.11 Turbo generator Hall

Superstructure:	Reinforced concrete structure.
Foundations:	Isolated footings below building columns connected by ground floor beams below façade masonry walls. Turbo generator foundation is thick raft isolated from other foundations by peripheral joint.
Ground floor slab:	R/C slab at +215.00 level, lied over compacted layer of sandy-gravel soil. Cable trenches are covered with steel plates.
Roof:	Flat inaccessible roof consisting of: concrete slab, sloping layer, vapour barrier, waterproofing roof membrane, thermal insulation with rock wool of 150mm thickness, Geotextile, protection with gravel, course thickness 75-100 mm. Roof drainage through external rainwater downpipes.
Facade:	Reinforced concrete and/or masonry thermally insulated sandwich wall consisting of: mortar, clay block 190 mm, thermal insulation with rock wool 150 mm, solid brick 120 mm, mortar, acrylic facade paint.
Facade louvers:	Aluminum, fixed, anodized, of extruded aluminum profiles, with slats and protective mesh, dimensions 2000/20000 mm.
Facade doors:	Steel, solid leaf, thermally insulated, finish painted, double leaf door, dimensions 1800/2100 m and single leaf door 830/2050 mm, 930/2050mm.
Facade sectional door:	Steel with core, finish painted, dimensions 4200/5200 mm.
Floors finish:	Concrete with surface hardener, steel gratings over floor channels, finish painted.
Walls – finish:	Without finishes
Ceilings – finish:	Without finishes.
Insulation of slab on grade:	Elastomeric bituminous waterproofing membrane, over concrete base (blinding), underneath RC floor slab.
Internal railings:	Steel, finish painted.

1.12 AAC (Air Cooled Condenser)

Foundation:	Isolated foundations below equipment supporting structure.
Ground slab:	R/C slab at +217.00 level, lied over compacted layer of sandy-gravel soil.

1.13 Electrical Building

Superstructure:	Reinforced concrete structure.
Foundations:	Isolated footings connected by ground floor beams below façade and internal masonry walls.
Ground floor slab:	R/C slab at +215.00 level, lied over compacted layer of sandy-gravel soil. *Cable trenches* are covered with steel plates.
Roof:	Flat inaccessible roof consisting of: concrete slab, sloping layer, vapour barrier, waterproofing roof membrane, thermal insulation with rock wool of 150mm thickness, Geotextile, protection with gravel, course thickness 75-100 mm. Roof drainage through external rainwater downpipes
Facade:	Reinforced concrete and/or masonry thermally insulated sandwich wall consisting of: mortar, clay block 190 mm, thermal insulation with rock wool 100 mm, facade brick 120 mm,
Facade doors:	Steel, solid leaf, with rock wool core, finish painted, double leaf door dimensions 2000/3050 mm, single leaf door dimensions 1000/2050 mm.
Internal doors:	Steel, solid leaf, with rock wool core, finish painted, double leaf door dimensions 1400/2500 mm, single leaf door dimensions 1000/2200 mm.
Internal partition walls:	Masonry, clay block 190 mm, plastered on both sides.
Floors finish:	Epoxy antistatic flooring, thickness 3 - 5 mm Raised floor of metal panels over substructure, raised to height of 1000 mm.
Walls – finish:	Acrylic paint, over masonry/plastered and concrete surfaces.
Ceilings – finish:	Acrylic paint, over concrete surfaces
Insulation of slab on grade:	Elastomeric bituminous waterproofing membrane, over concrete base (blinding), underneath RC floor slab.

1.14 Step-up Transformer & Oil Tank

Step up transformer is founded over r/c beams inside oil retention sump, enclosed by fence 2.6m high. Besides, oil pit at enough safety distance is planned to collect all 17m3 of oil from transformer retention. Oil pit is underground reinforced concrete structure with inspection manholes.

1.15 Workshop & Warehouse

Superstructure:	Steel structure with roof steel truss.
Foundations:	Isolated footings, connected by peripheral beams.
Ground floor slab:	R/C slab at +215.00 level, lied over compacted layer of sandy-gravel soil. Separate foundations and plinths for equipment supporting. Drainage trench covered with grill.
Roof:	Roof metal sandwich panels, cladded on both sides with corrugated steel sheet, factory polymer-coated, with rock wool core, thickness 150 mm. Roof drainage through external rainwater downpipes.
Facade:	Facade metal sandwich panels, clad on both sides with shallow corrugated steel sheet laid in horizontal grid, factory polymer-coated, with rock wool core, thickness 150 mm.
Facade windows:	Aluminum profiles with thermal break, anodized, with double insulating glazing unit (two glass panels in a unit)
Facade doors:	aluminum single leaf door with overlights,
Facade roller shutter door:	Steel, with core, finish painted, dimensions 4600/5000 mm Internal doors: 1. Standard wooden, cladded on both sides with MDF, finish painted, single leaf door, 2. Steel, fire resistant, solid leaf, with rock wool core, finish painted, single leaf door and double leaf.
Internal partition walls:	Masonry, clay block 200 mm, plastered on both sides and lightweight plasterboard partitions, thickness 100 mm, with mineral wool core
Floors finish:	Epoxy flooring, thickness 3-5 mm, with skirting, height 150 mm, in sanitary facility ceramics, non-slip, tile dimensions 300/300 mm, over cement screed, with waterproofing coating.
Walls – finish:	Acrylic paint and ceramic tiles in sanitary facility, height up to ceiling, over masonry/plastered and concrete surfaces, interior finish of facade wall – without finish (facade metal sandwich panels on internal side).
Ceilings – finish:	Without finish (roof steel coated sandwich panels on internal side).
Insulation of slab on grade:	Elastomeric bituminous waterproofing membrane, over concrete base (blinding), underneath RC floor slab.

1.16 Auxiliary Fuel Storage Area (Civil part only)

Fuel oil tank is located in retention basin, formed by foundation slab and peripheral r/c walls. Tank itself is set over plinths laid over foundation slab. It is planned retention zone under truck unloading area surrounded by drainage channels. Filling station is planned to be “kiosk” type over r/c slab on grade. Between fuel tank and boiler hall are planed r/c pipe trenches as well as cable trenches.

1.17 Fire Water Pumps Room

Dimensions:	10.0 x 10.0m. Roof parapet high 6.05m.
Superstructure:	Masonry walls with r/c piers and roof slab for Fire Water Pump Room.
Foundations:	Strip foundation below building walls.
Ground floor slab:	R/C slab at +215.00 level, lied over compacted layer of sandy-gravel soil. Separate foundations and plinths for equipment supporting. Drainage trench covered with grill. Fire water reservoir is supported on cylindrical foundation wall below reservoir walls, 2m deep. Inside the cylinder compacted soil should be provided. Below 2m (foundation level), layer of 0.5m should be improved and compacted. Depth of 2m is caused by adjacent road level (2m below ground level around reservoir plateau level).
Roof:	Flat inaccessible roof consisting of: concrete slab, sloping layer, vapour barrier, waterproofing roof membrane, thermal insulation with rock wool of 150mm thickness, Geotextile, protection with gravel, course thickness 75-100 mm. Roof drainage through external rainwater downpipes.
Facade:	Masonry thermally insulated sandwich wall consisting of: mortar, clay block 190 mm, thermal insulation with rock wool 150 mm, solid brick 120 mm, mortar, acrylic facade paint.
Facade doors:	Steel, solid leaf, with rock wool core, finish painted, double leaf door,
Facade louvers:	Aluminium, fixed, anodized, of extruded aluminium profiles, with slats and protective mesh.
Floors finish:	Epoxy flooring, thickness 3-5 mm, with skirting, height 150 mm.
Walls – finish:	Acrylic paint, over masonry/plastered and concrete surfaces.
Ceilings – finish:	Acrylic paint, over concrete surfaces.
Insulation of slab on grade:	Elastomeric bituminous waterproofing membrane, over concrete base (blinding), underneath RC floor slab.

1.18 Gate House

Dimensions:	16.80 x 8.90m. Roof parapet high 9.40m.
Superstructure:	Masonry walls with r/c piers and roof slab.
Foundations:	Strip foundation below walls.
Ground floor slab:	R/C slab at +220.00 level, lied over compacted layer of sandy-gravel soil.
Roof:	Flat inaccessible roof consisting of: concrete slab, sloping layer, vapour barrier, waterproofing roof membrane, thermal insulation with rock wool t=150mm, Geotextile, protection with gravel, course thickness 75-100 mm. Roof drainage through external rainwater downpipes.
Facade:	Masonry thermally insulated sandwich wall consisting of: mortar, clay block 190 mm, thermal insulation with rock wool 150 mm, facade brick 120 mm.
Facade windows:	Aluminium profiles with thermal break, anodized, with double insulating glazing unit (two glass panels in a unit).
Facade doors:	Aluminium profiles with thermal break, anodized, door on sanitary facility - solid door, aluminium sheet on both sides and mineral wool core, door at entrance to the building glazed with double insulated glazing unit, tempered glass, entrance door single leaf door, door on sanitary facility single leaf door.
Internal doors:	Standard wooden, clad on both sides with MDF, finish painted, single leaf door with dimensions 800/2100 mm.
Internal partition walls:	Masonry, solid brick 120 mm, plastered on both sides and lightweight drywall partitions, thickness 100 mm, with mineral wool core.
Floors finish:	Floor finish of porcelain stoneware, tile dimensions 300/300 mm, over cement screed, in sanitary facilities with ceramics, non-slip, tile dimensions 300/300 mm, over cement screed, with waterproofing coating.
Walls – finish:	Emulsion paint and ceramic tiles in sanitary facilities, height up to suspended ceiling, over masonry/plastered and concrete surfaces.
Ceilings – finish:	Ceilings – finish: Suspended ceilings – flat, of plasterboard tiles, emulsion paint.
Insulation of slab on grade:	Insulation of slab on grade: Elastomeric bituminous waterproofing membrane, over concrete base (blinding), underneath floor RC slab.

1.19 Waste Water Treatment Area

Substructure:	R/C structure
Superstructure:	R/C structure

1.20 Auxiliary Boiler Room

Dimensions:	6.40 x 4.00m.
Superstructure:	Masonry walls with r/c piers and roof slab.
Foundations:	Strip foundation below walls.
Ground floor slab:	R/C slab at +215.00 level, lied over compacted layer of sandy-gravel soil. Separate foundations and plinths for equipment supporting. Drainage trench covered with grill.
Facade:	Masonry thermally insulated sandwich wall consisting of: mortar, clay block 190 mm, thermal insulation with rock wool 150 mm, solid brick 120 mm, mortar, acrylic facade paint.
Facade windows:	Aluminium profiles with thermal break, anodized, glazed with double insulating glazing unit (two glass panels in a unit).
Facade louvers:	Aluminium, fixed, anodized, of drawn aluminium profiles, with slats and protective mesh.
Facade doors:	Steel, solid leaf, with rock wool core, finish painted, double leaf door.
Floors finish:	Epoxy flooring, thickness 3-5 mm, with skirting, height 150 mm.
Walls – finish:	Acrylic paint, over masonry/plastered and concrete surfaces.
Ceilings – finish:	Ceilings – finish: Acrylic paint, over concrete surfaces.
Insulation of slab on grade:	Elastomeric bituminous waterproofing membrane, over concrete base (blinding), underneath RC floor slab.

1.21 Diesel Generator & Compressed Air Shelters

Superstructure:	Open steel structure with roof steel truss.
Foundations:	Isolated footings for shelter structure and mas foundations for equipment.
Ground floor slab:	RC slab at +215.00 level, lied over compacted layer of sandy-gravel soil.
Compressed Air	
Dimensions:	16.40 x 4.80m. Roof level 5.20m.

1.22 Plant Preparation & Leveling

Plant leveling is done based on CNIM drawing GENERAL ARRANGEMENT –SITE PLOT PLAN, drawing No 0A1401-0202/62G605.

1.23 Internal Roads and Ramps

Pavement of Internal Roads and Ramps is designed on the basis of the following parameters:
- Traffic over the operation period (heavy trucks),
- Sub ground at which the Pavement Structure shall be constructed,
- Road drainage.

1.24 Traffic Signing

Traffic signing comprise traffic lights, traffic signs and lines to enable safe traffic inside the plant, as well as at checking and unloading points.

1.25 Car Parks

Car parks are done based on CNIM drawing GENERAL ARRANGEMENT –SITE PLOT PLAN

1.26 Retaining Walls

Necessity to provide retaining walls is described in: General assumptions, item 3 of this section. Several cases are treated regarding difference in ground levels: 8m, 3m, 3.50m and cases between noted values. Diaphragms are planned in case of 8m, from 8m to 3m-3.50m where classical retaining walls construction might affect planned time frame as time consuming activity.

1.27 Landscaping, Vegetation, Perimeter Fence, Gates

Landscaping comprise top soiling at areas free of buildings and other facilities. Fence around ERF project is estimated as per General assumption No. 7 of this section.

Form T.2.8.4 Earth Works

Instructions: Complete this form for each Facility as required according to the number and type of Facilities for the proposed solution

Reference No. of the corresponding Works Delivery Plan	1
Reference No. of the corresponding Services Delivery Plan	1
Facility No.	1
Name of the Facility	EfW Facility

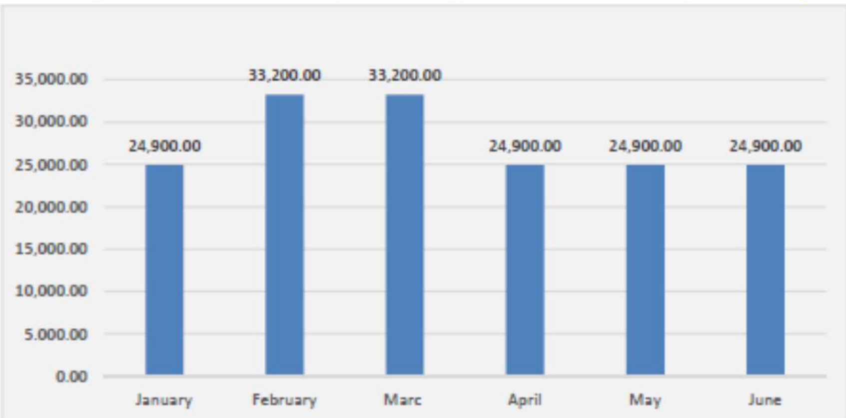
Earthworks

The preliminary estimate of earthworks for the EfW plant are given hereafter for the first months of the contract.

Energy from Waste Facility in Belgrade - EXCAVATION Histogram **10.07.2017**

EXCAVATION (m3)

	2019						
	January	February	Marc	April	May	June	∑=
	24,900.00	33,200.00	33,200.00	24,900.00	24,900.00	24,900.00	**166,000 m3**



daily average(m3)	958	1277	1277	958	958	958	**m3/dan**

Form T.2.8.5 Description of foundations

Reference No. of the corresponding Works Delivery Plan	1
Reference No. of the corresponding Services Delivery Plan	1
Facility No.	1
Name of the Facility	EfW Facility

Foundations

Waste Bunker Hall

Foundation slab below bunker and isolated footings below peripheral walls, connected by peripheral walls or beams. Columns of waste bunker hall in grid "D" are founded on the common pile raft with boiler steel structure.

Administrative Building

Administrative building is structurally part of Waste Bunker Hall structure and foundations.

Boiler Hall

Steel structure is founded on three separated pile rafts (each approximately 35mx20m) supported by drilled pipes Ø 1000 mm, L=19,5 m. Top of raft is at -1.5m below ground level to enable laying equipment foundations/plinths and trenches.

Flue Gas Treatment Area & Residue Stabilization Area

- Bag filters are founded over two rafts.
- Freestanding Chimney is founded over pile rafts supported by drilled piles Ø 1000 mm, L=16 m.
- Other equipment is founded either on isolated footings /rafts or over plinths at slab on grade.

Top of raft and footings is at -1.5m below ground level to enable laying trenches and other installation above them.

R/C Stacking wall is founded over strip at foundation depth 1.0m below ground level.

DENOX Building

Foundations: : Isolated footings, connected by peripheral beams

Ground floor slab: : R/C slab at +215.00 level, lied over compacted layer of sandy-gravel soil. Separate foundations and plinths for equipment supporting. Drainage trench and manhole, covered with grill.

Water Treatment Building

Foundations: Isolated footings below building columns connected by ground floor beams below façade masonry walls. Row & Demin. Water reservoirs are founded at separate rafts. Below these rafts and adjacent isolated footings (four pcs.) soil compaction should be done.

Other equipment is set over plinths on ground floor slab. Ground floor slab is R/C slab at +215.20 level, lied over compacted layer of sandy-gravel soil. Drainage trench is covered by grill. Around NaOH & HCl reservoirs is planned enclosed area by r/c upstands 0.5m high, to eliminate eventual acid leakage to remaining part of building.

Ground floor slab: R/C slab at +215.20 level, lied over compacted layer of sandy-gravel soil. Separate foundations and plinths for equipment supporting

Turbo generator Hall

Foundations : Isolated footings below building columns connected by ground floor beams below façade masonry walls. Turbo generator foundation is thick raft isolated from other foundations by peripheral joint.

Ground floor slab: R/C slab at +215.00 level, lied over compacted layer of sandy-gravel soil. Cable trenches are covered with steel plates.

AAC (Air Cooled Condenser)
Foundation: Isolated foundations below equipment supporting structure.

Electrical Building

Foundation : Isolated footings connected by ground floor beams below façade and internal masonry walls.

Workshop & Warehouse
Foundations : Isolated footings, connected by peripheral beams.

Ground floor slab : R/C slab at +215.00 level, lied over compacted layer of sandy-gravel soil. Separate foundations and plinths for equipment supporting. Drainage trench covered with grill.

Form T.2.8.6 Internal roads and paved areas

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	1 1
Facility No. Name of the Facility	1 EfW Facility

Internal roads

Asphalt Roads (85% of internal roads area)

- Layer of crushed stone dia.0-63 mm, t=25 cm
- Lower load-bearing layer of crushed stone dia.0-31.5 mm, t=15 cm
- Upper load-bearing layer of bituminous material t=10cm
- Wearing layer made of asphalt t=5 cm

Concrete Roads (15% of internal roads area)

- Layer of crushed stone dia.0-63 mm, t=20 cm
- Lower load-bearing layer of cement and crushed stone dia.0-31.5 mm mixture, t=15 cm
- Wearing layer made as concrete slab MB 35t=15 cm

Parking areas

- Layer of crushed stone dia.0-63 mm, t=20 cm
- Lower load-bearing layer of crushed stone dia.0-31.5 mm, t=10 cm
- Layer of crushed stone dia.4-8 mm, t=4 cm
- Precast concrete paving t=8 cm

Installation of concrete curbs on concrete bedding is priced for entire internal roads area

Sidewalks around buildings

- Layer of crushed stone dia.0-31.5 mm, t=10-15 cm
- Concrete slab t=10 cm

Form T.2.8.7 Infrastructure connections

Reference No. of the corresponding Works Delivery Plan	1
Reference No. of the corresponding Services Delivery Plan	1
Facility No.	1
Name of the Facility	EfW Facility

Infrastructure Connections

1.1 Outdoor Hydro technical Installations

- Water supply (potable and FF)
- Storm water drainage
- Sewage
- Industrial Waste Water.

For all listed systems pipes and manholes are included. Besides septic tanks are planned with regard to position of buildings facilities.

Water Supply System

The Complex shall be fed from external water supply system over newly designed connection point and HDPE supply pipeline. A manhole with water meters and suitable valves for shutting off the entire water supply system is provided at the point of entry of water pipe into the EfW plot.

Supply pipelines for potable water supply of the building consist of HDPE water pipes (PE100), of suitable diameter with permanent watertight joints executed with butt fusion welding. All supply pipeline junctions are of cast iron fittings with PE pipes over polyethylene joints (flange adapters) with loose flange.

Piping material for external firefighting – hydrant system, is the same as for domestic water supply system.

Sewage System

Drainage i.e. collection and removal of sanitary water, oily water and storm water from the building and from the entire plot shall be realized by way of gravity, through separate systems.

Sanitary sewage system provides for collection of sanitary water from all buildings and its efficient removal through discharge pipeline and cleanouts to septic tank which shall be emptied in specified time periods.

Storm water shall be led over drains and linear drainage channels into storm sewer led into oil separator and then discharged into the existing channel at the perimeter of the plot.

Removal of oily water and emergency discharge water shall be realized through pipelines leading collected water into industrial waste water pit, wherefrom water shall be discharged into the existing perimeter channel.

Piping material for external sections of the sewer shall be PVC sewer pipes and fittings installed in a trench.

Cleanouts with internal diameter of 1000 mm, with cast iron covers of suitable load-bearing capacity and clear opening of Ø600 mm, are provided at all horizontal and vertical setoffs of external water supply system.

1.2 Indoor Hydro technical Installations
(Potable water supply, sewage & storm drainage inside buildings)
Waste Bunker Hall
• Ground and above pipeline for potable water including all necessary fittings, insulation, valves and installation material
• Ground and above pipeline for sewage water including all necessary fittings, drains and installation material,
• Ground and above pipeline for storm water including all necessary fittings, drains and installation material,
• Drainage pump station including all necessary fittings, pipeline and accessories.

Administrative Building
• Ground and above pipeline for potable water including all necessary fittings, insulation, valves and installation material
• Ground and above pipeline for sewage water including all necessary fittings, drains and installation material,
• Ground and above pipeline for storm water including all necessary fittings, drains and installation material, sanitary fixtures.

SNCR DENOX Building
• Ground and above pipeline for potable water including all necessary fittings, insulation, valves and installation material,
• Ground and above pipeline for sewage water including all necessary fittings, drains and installation material,
• Ground and above pipeline for storm water including all necessary fittings, drains and installation material,
• Sanitary fixtures.

Water Treatment Building
• Ground and above pipeline for potable water including all necessary fittings, insulation, valves and installation material,
• Ground and above pipeline for sewage water including all necessary fittings, drains and installation material,
• Ground and above pipeline for storm water including all necessary fittings, drains and installation material, sanitary fixtures.

Turbo Generator Hall
• Sewage high temperature resistant pipeline including all necessary fittings and installation material.

Workshop
• Ground and above pipeline for potable water including all necessary fittings, insulation, valves and installation material,
• Ground and above pipeline for sewage water including all necessary fittings, drains and installation material,
Ground and above pipeline for storm water including all necessary fittings, drains and installation material, sanitary fixtures.

Gate house

• Ground and above pipeline for potable water including all necessary fitting, insulation, valves and installation material,
• Ground and above pipeline for sewage water including all necessary fittings, drains and installation material,
• Ground and above pipeline for storm water including all necessary fittings, drains and installation material, sanitary fixtures.

1.3 Fire-fighting Systems
Mechanical firefighting equipment included in this Proposal is as follows:
Bunker hall: Protected with automatic sprinkler, hose reels station cabinets and fire extinguishers Protected with 2(two) remote controlled monitors and one hose reel cabinet.
Administrative Building: Protected with automatic sprinkler, hose reels station cabinets and fire extinguishers Equipped with firefighting extinguishers, except the control room with fire suppression systems.
Boiler hall: Protected with automatic sprinkler, hose reels station cabinets and fire extinguishers
Flue gas treatment area: Covered with one hose reel cabinet and with firefighting extinguishers located on main walkways.
Bottom ash Zone: Covered with one hose reel cabinet.
Turbo generator room: Protected with automatic sprinkler, hose reels station cabinets and fire extinguishers
Step up Transformers: Served by deluge system.
HV/LV Transformers: Served by firefighting extinguishers.
HV/LV Switchboard: Protected with automatic gaseouse fire suppression systems
Workshops and Storages: Covered with firefighting extinguishers and hose reels station cabinets.
Auxiliary Fuel tank: Covered with firefighting extinguishers and hose reels station cabinets.
Fire Pumps Room: Equipped with firefighting extinguishers.

Main Firefighting Equipment: Consist of fire above ground steel tank (2 x 600 m3), two diesel fire pumps (2 x 11355 l/min) and one jockey pump. Ground connection pipelines from pump station to all consumers will be made of HDPE. **Investor need to provide water for testing**

2. Heating, Ventilation and Air Conditioning (HVAC)
The following buildings (premises) will be provided with HVAC systems:
- Waste Bunker Hall
- Administrative building
- Boiler hall
- Analyzers shelter
- DENOX Building
- Water Treatment Building (WTB)
- Turbo Generator Hall
- Electrical building
- DNO building
- Workshop and storage
- Fire water pump building and compressed air building
- Gate house
- Auxiliary boiler building

Note: Bio Gas engine building not included in scope.

3. Electrical Installations
Scope of work
The following electrical systems within building services are covered by this Proposal:
• Power supply for all buildings & structures within the site,

• Indoor normal lighting system,
• Indoor emergency lighting system,
• Service power outlets,
• Small power socket outlet system,
• Outdoor normal lighting system,
• Outdoor emergency lighting system,
• Access road lighting,
• Fence lighting,
• Earthing and lightning protection system.

Hence, building services i.e. the lighting and small power system shall include design and installation works for:
• Distribution boards,
• Cables,
• Cable trays & trunkings,
• Socket outlets and plugs,
• Lighting fittings,
• Lighting switches,
• Earthing and bonding,
• Complete detail labeling of all installations,
• Complete documentation necessary for obtaining technical conditions and permits from relevant state/municipality authorities.

Limit of supply is fence of EfW plant.

4. Telecommunication and Extra Low Voltage Systems
General
The following Telecommunication, ELV, Security and Fire Alarm and Detection Systems have been proposed for Belgrade EfW Plant:
a) Local Area Networks (LANs).
b) Telephone System.
c) Building Management System (BMS).
d) Video Wall.
e) Traffic Light Signals System (on hold to be defined later -not included in a budget price).
f) Weighing System equipment (on hold to be defined later- not included in a budget price).
g) Access Control Systems and Time Attendance System.
h) CCTV System.
i) Fire Detection & Alarm System.
j) Gas Detection System (on hold to be defined later, not included in a budget price).
k) Public Address and General Alarm (PA/GA) System.
l) Miscellaneous systems:
- Emission Monitoring Station
- Operator Stations equipment
- Crane Operators equipment
- Audio-video equipment for visitor center and conference rooms

Local Area Networks (LANs)
Structured cabling system will consist of passive network and accessories and will provide flexible cabling infrastructure for transferring data, voice and video services within local area network of EfW Plant buildings. Structured cabling system shall be comprised of the following:
• Telecommunication room with cable concentration point and core network node,

• Fibre optic cables and termination boxes for backbone connections,
• Unshielded twisted pairs (UTP) CAT 6 cables for horizontal distribution,
• Patch panels, jumpers, patch cords,
• Switches and routers, optical patch cords, UPS and power cables,
• Telecommunication outlets,
• Trays, vertical risers, conduits and associate passive equipment.

Two separate LANs shall be arranged and to be used for:
• Telephone System, Plant Data Network and BMS,
• Security systems (Perimeter Security System, Access Control System and Time Attendance System and CCTV System).

LAN switches will be connected in common fibre optic cable loop network connecting concerned plant buildings.

Telephone System
Call manager to run as IP PABX for up to 50 telephone extensions with direct inward dial (DID) and in plant dialing with four digits shall be provided. All telephone apparatus will be IP telephones, for offices they will be standard office type but for other rooms will be of industrial type. LAN network and switches shall be used as telephone installation. Call manager will be supplied from dedicated 230 VAC UPS and autonomy of 2 hrs.
Limit of supply is connection box at plant border for connection of external telecommunication cable to be provided by local telecom company. Plant owner/plant company will provide PSTN and internet services from local company/internet providers.

Form T.2.8.9 Main Facility Design

Form T.2.8.9.1 List of Equipment and Components

MAIN FACILITY LIST OF EQUIPMENT AND COMPONENTS	
	Page 1 of 3
Bidder	
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	1 1
Facility No. Name of the Facility Location of the Facility	1 Energy From Waste Facility See Lay-out - Form 2.2.3
List of the equipment and components of the Main Facility	

No	Equipment and components / construction activity	Responsible key Sub-Contractor
	Reception and Feeding	
	Bunker (deep)	CNIM (to be supplied / built by Energoprojekt as Cnim Subcontractor)
	Bridge crane	CNIM
	Feeding hopper	CNIM
	Bulky waste shredder (if applicable)	N A
	Furnace - boiler	
	Incineration unit (including grate or fluidized bed system),	CNIM
	Combustion air system	CNIM
	Total air system primary and secondary (including fan and other components)	CNIM
	Steam air preheater	CNIM
	Boiler (including boiler accessories)	CNIM
	Convection heat surfaces	CNIM
	Superheater	CNIM
	Slag / bottom ash extraction	CNIM
	Magnetic separator and scrap conveyor (if not part of a	CNIM

	separate bottom ash treatment facility)		
	Flue Gas Treatment (FGT)		
	Flue gas ducts (including lime injection, if applicable)	CNIM	
	Fabric filter	CNIM	
	Dust hoppers	CNIM	
	Steel casings flue gas treatment	CNIM	
	All components of the reagents and reaction product handling systems (including reagents / reaction product silos, lime slurry preparation (if applicable), feeding, discharging and transportation equipment)	CNIM	
	DeNOx System	CNIM	
	Silencer	CNIM	
	Induced draft (ID) fan	CNIM	
	Chimney	CNIM	
	Wastewater collection and treatment plant (including treatment (*please specify*), pipes, pumps, storage, discharge equipment)	CNIM	
	Turbine- generator-cooling system		
	Steam turbine (including turbine steam path, turbine accessories, etc.)	CNIM	
	Generator (including main components, *please specify*)	CNIM	
	Air-cooled condenser system (including main components, *please specify*)	CNIM	
	Heat exchanger	CNIM	
	Emergency genset	CNIM	
	Auxiliary systems		
	Feed water system (including main components, e.g. feed water pump, deareator, feed water tank)	CNIM	
	Demin water plant and boiler feed water conditioning (with components according to technology applied)	CNIM	
	Compressed air system	CNIM	

	Fuel oil start-up and auxiliary firing system	CNIM
	Air conditioning and general ventilation system	CNIM
	Firefighting and protection equipment	CNIM
	Maintenance cranes and hoists	CNIM
	Electrical and I&C systems	
	110kV Electrical substation *(DNO part+ metering + building)*	tbd
	110kV GIS Electrical substation (plant part)	CNIM
	Step up transformer (for grid connection)	CNIM
	11kV MV system	CNIM
	Auxiliary transformers	CNIM
	11kV LV system	CNIM
	Distributed control system (DCS) except CMMS	CNIM
	CMMS system	Tbd
	Electrical works MV/V, including I&C and communication	CNIM
	Monitoring equipment	
	Continuous emissions monitoring system (CEMS)	CNIM
	Others *(please specify)*	
	Vehicles	SPV
	Containers	SPV
	Civil works (*please specify if split to various contractors*)	CNIM
	IBA treatment equipment	CNIM
	APCR and fly ash solidification equipment	CNIM

Form 2.8.9.2 Justification of Design LHV

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	1 1
Facility No. Name of the Facility	1 EfW Facility

Justification of Design LHV for the Main Facility

As noted during the Competitive Dialogue, the Consortium believes that the average LHV of Municipal Solid Waste collected in Belgrade may range from 7 through 9 MJ/kg.

The combustion diagram allows for a full flexibility to operate at the maximum thermal load for waste LHV ranging from 7,5 to 8,5 MJ/kg.

The EfW Facility has been designed to be always able to process the Treatable Tonnage Limit at the maximum expected LHV of 8,5 MJ/kg.

The Consortium expects that if the average LHV exceeds the [7.5 – 8.5 MJ/kg] range, the Contractor will be able to select waste of appropriate characteristics from the deliveries to achieve the right waste mix.

Form T.2.8.15 Description of Solidification of Fly Ash and Flue Gas Cleaning Residues

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	1 1
Facility No. Name of the Facility	1 EfW Facility

Description of solidification of fly ash and flue gas cleaning residues

The solidification process planned to be used at at the EfW Facility is based on a proven technology of Flue Gas Treatment (FGT) residues and boiler fly ash from waste –to-energy plants. This technology has been successfully applied in several reference plants, including Suez-operated Poznan Energy from waste Facility in Poland.

The basic idea of this process is to take advantage of the fact that the APC residues, also called here filter residues, contain salts and free lime, and that mixed with blast furnace slag they will induce solidification.

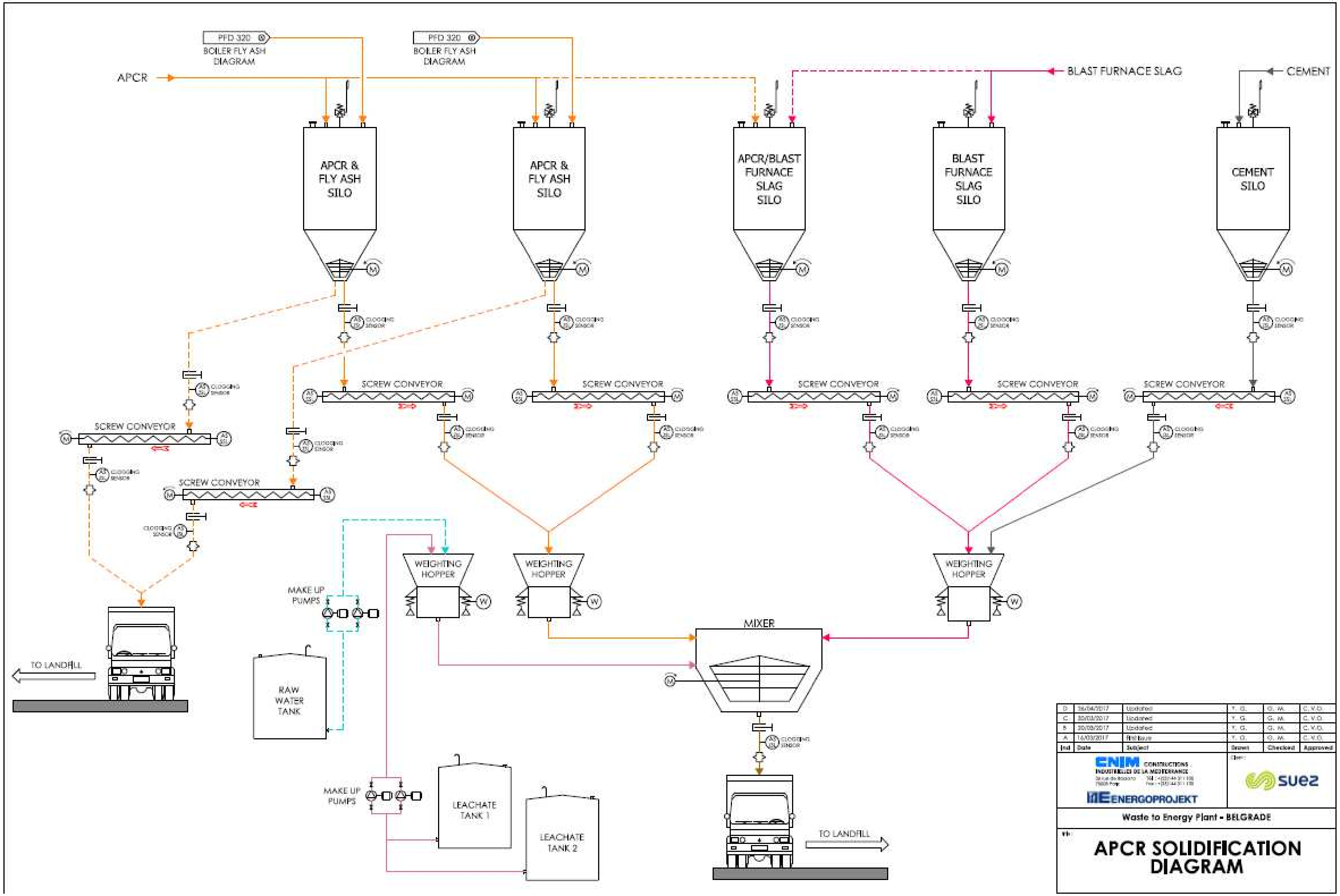
Mixing both streams together with leachate (and/or recycled water) and cement allows to capture pollutants into a dust-free solid mixture with an overall volume reduced. The mix and quantity of additives will be determined so that the end-product meet the criteria of non-hazardous waste, in order to allow its landfilling at the Site.

The mix is easy to handle and can be discharged and spread in layers that support vehicle load after curing.

Description of proposed equipment and components:

FGT and boiler fly ashes residues collected in 2 silos are transported by mechanic conveyors or screw up to a weighting hopper. The cement and blast furnace slag are introduced through a second weighting hopper. The leachates or recycled water (stored in tanks) are pumped into a third weighting hopper.

All products are then introduced by gravity from the hoppers into to a continuous mixer, from where the produced mixture is dumped into a truck and carried to landfill. The system operates by batch.


PFD 320
BOILER FLY ASH DIAGRAM
PFD 320
BOILER FLY ASH DIAGRAM
APCR
BLAST FURNACE SLAG
CEMENT
APCR & FLY ASH SILO
APCR & FLY ASH SILO
APCR/BLAST FURNACE SLAG SILO
BLAST FURNACE SLAG SILO
CEMENT SILO
SCREW CONVEYOR
SCREW CONVEYOR
SCREW CONVEYOR
SCREW CONVEYOR
SCREW CONVEYOR
SCREW CONVEYOR
SCREW CONVEYOR
WEIGHTING HOPPER
WEIGHTING HOPPER
WEIGHTING HOPPER
MIXER
MAKE UP PUMPS
RAW WATER TANK
MAKE UP PUMPS
LEACHATE TANK 1
LEACHATE TANK 2
TO LANDFILL
TO LANDFILL
Ind Date Subject Drawn Checked Approved
D Updated Y. G. G. M. C. V. O.
C Updated Y. G. G. M. C. V. O.
B Updated Y. G. G. M. C. V. O.
A 16/03/2017 First Issue Y. G. G. M. C. V. O.
CNIM CONSTRUCTIONS INDUSTRIELLES DE LA MEDITERRANEE
ENERGOPROJEKT
Client:
suez
Waste to Energy Plant - BELGRADE
APCR SOLIDIFICATION DIAGRAM

Form T.2.8.16 Description of Bottom Ash Treatment Plant

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	1 1
Facility No. Name of the Facility	1 EfW Facility

Description of bottom ash treatment plant for the purpose of material recycling

The Incineration Bottom Ash (IBA) treatment will be done according to the following process:

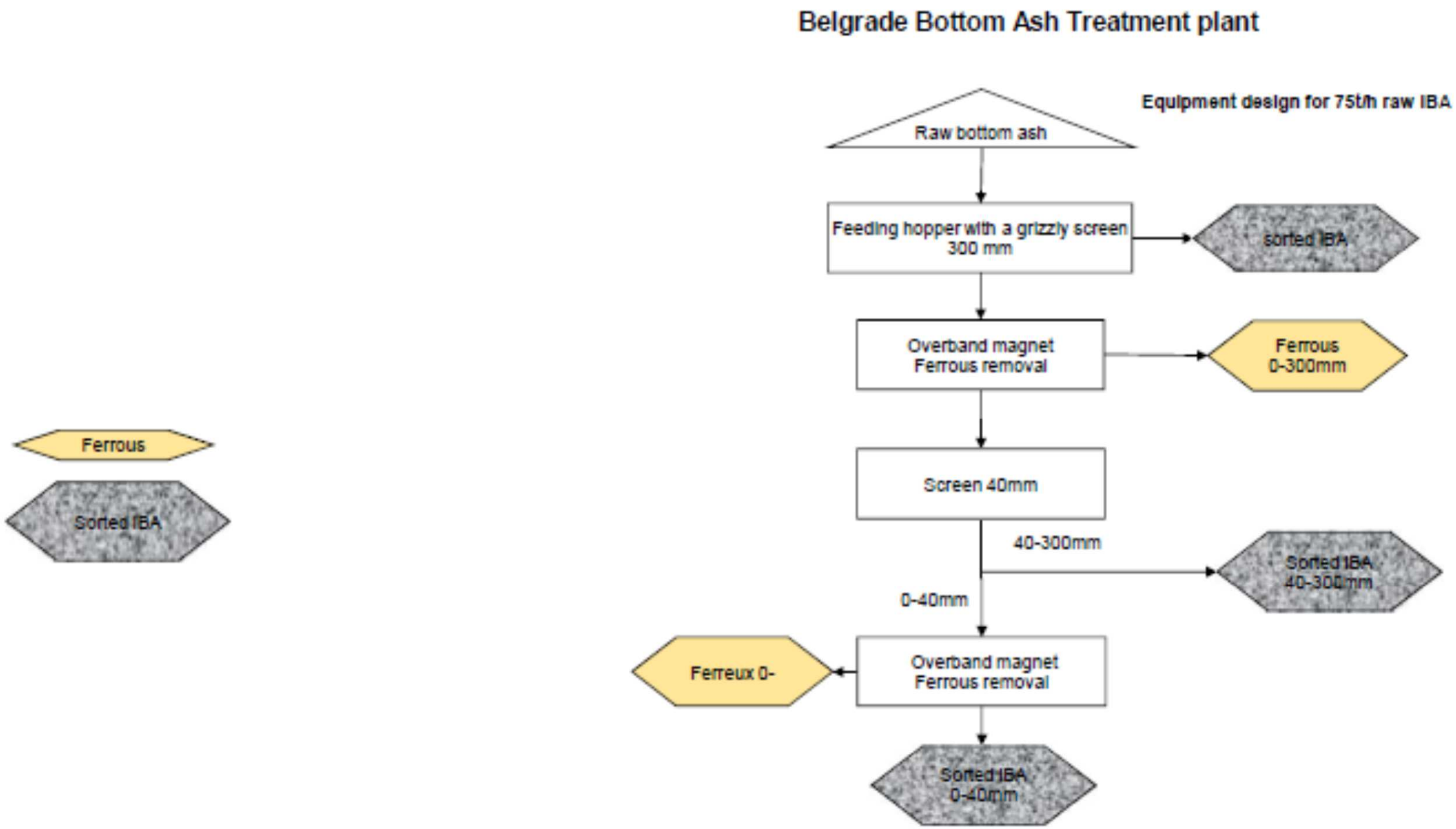
IBA coming from the ash extractors of the grate will be transported by a succession of conveyor belts to allow a continuous process.

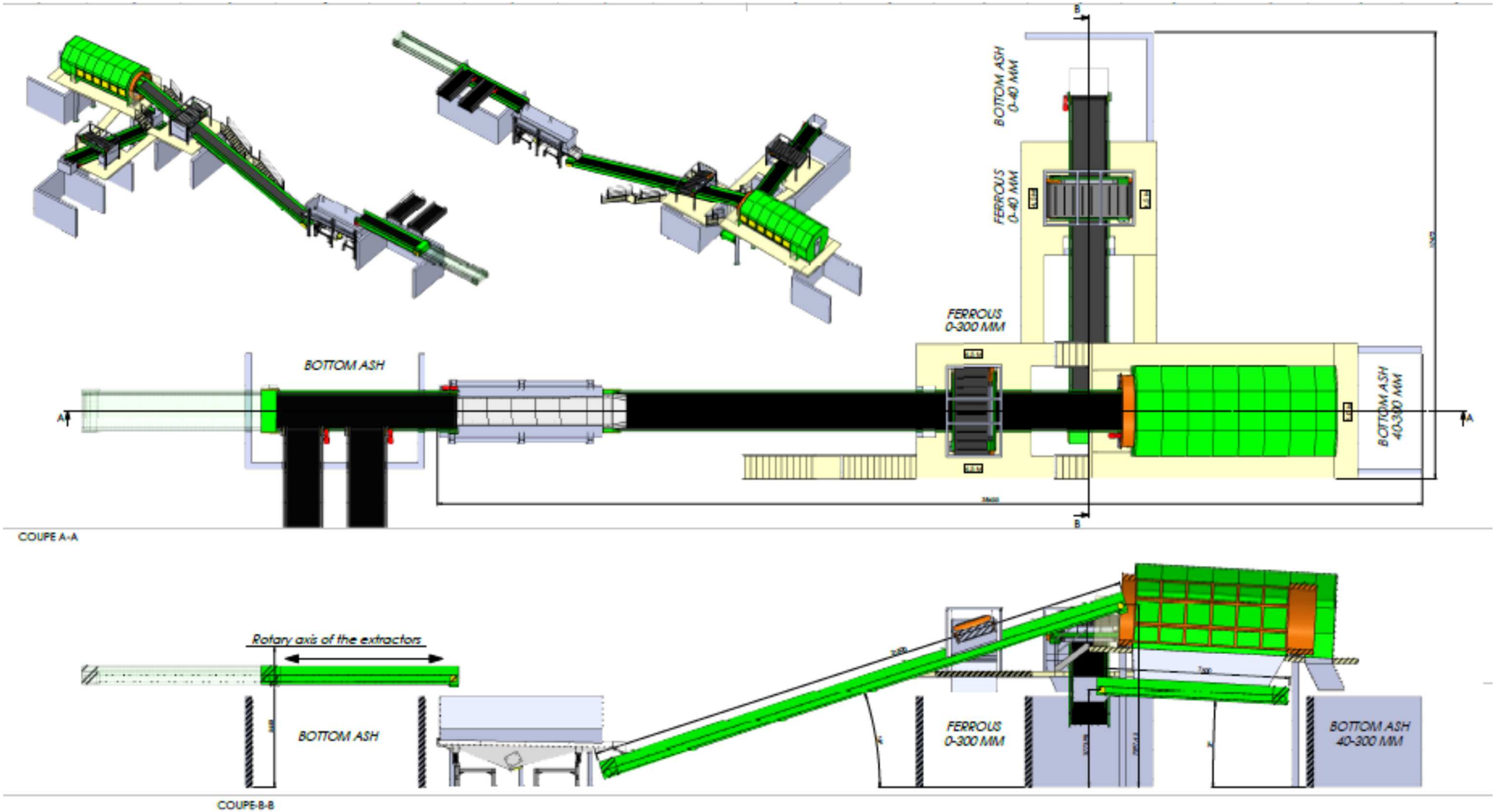
IBAs will fall on a mobile conveyor belt to feed a grizzly hopper (removing any large pieces > 300mm).

From thereon, a magnet overband will remove the ferrous on the passing fraction before its separation in two fractions 0-40mm and 40-300mm by a drum screen. Extracted ferrous metals will be stored in a dedicated area in containers.

Another magnet overband will extract ferrous metals from the 0-40mm fraction. The fraction > 40 mm will be stored in a dedicated area and the resulting ferrous will be stored in containers.

Following metal removal IBAs will be transported onto a storage area for maturation before their offt-take, reuse in landfill covers, or disposal at the New Landfills.


Belgrade Bottom Ash Treatment plant
Equipment design for 75t/h raw IBA
Raw bottom ash
Feeding hopper with a grizzly screen 300 mm
sorted IBA
Overband magnet Ferrous removal
Ferrous 0-300mm
Screen 40mm
40-300mm
Sorted IBA 40-300mm
0-40mm
Overband magnet Ferrous removal
Ferreux 0-
Sorted IBA 0-40mm
Ferrous
Sorted IBA


BOTTOM ASH
0-40 MM
FERROUS
0-40 MM
FERROUS
0-300 MM
BOTTOM ASH
BOTTOM ASH
40-300 MM
COUPE A-A
Rotary axis of the extractors
BOTTOM ASH
FERROUS
0-300 MM
BOTTOM ASH
40-300 MM
COUPE-B-B

Form T.2.8.17 Description of Flexibility with regard to production of Electricity / Heat

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	1 1
Facility No. Name of the Facility	1 EfW Facility

Description of Flexibility with regard to production of Electricity / Heat

The Waste to Energy plant will be able to produce :

- In Combined Heat and Power mode : up to 56,5 MWth to the District Heating, associated to an electricity production of 20,6 MWe.
- In full electricity mode : up to 29,15 MWe.

The Heat production can be adapted from 56,5 MW, its maximum value in CHP mode, down to 0 MW and the electricity varies according to the table given in the Form T.1.4 Heat Load Levels, and Electricity Load Levels.

Design diagram of the water steam cycle

Please see in the following page :

- Steam water cycle diagram
- Heat and Mass Balance Diagram without district heating
- Heat and Mass Balance Diagram with district heating

Form T.2.9 Construction Programme and Commissioning Plan

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	1 1
Facility No. Name of the Facility	1 EfW Facility

Construction Programme and Commissioning Plan

Please refer to Form T.2.6 Overall Project Time Schedule for the view on the EfW Construction Programme

Form T.2.10 Process Flow Diagram with Mass and Energy Balance

Reference No. of the corresponding Works Delivery Plan	1
Reference No. of the corresponding Services Delivery Plan	1
Facility No.	1
Name of the Facility	EfW Facility

Process flow diagram with mass and energy balance

Please see in the following pages:

EFW - PROCESS DRAWINGS		
		EfW HMBD BELGRADE 06-2017 Maxi DH 60-102 + Biogas.pdf
		Form T.2.10 EfW HMBD BELGRADE 06-2017 Summer + Biogas v3.pdf
		Form T.2.10 EfW MCR_Mass flow diagram.pdf

Form T.2.11 Drawings

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	1 1
Facility No. Name of the Facility	1 EfW Facility

Drawings

To address the **points (i) to (iv), (vi) and (vii)** please refer to the following drawings of EfW Lay outs and cross sections.

EFW DRAWINGS - LAY OUT AND CROSS SECTIONS		
		0A1401-0202-62G503-M-Site Plot Plan Ground Levels.pdf
		0A1401-0202-62G505-M-Site plot plan.pdf
		0A1401-0202-62G605-D-Site plot plan final access.pdf
		0A1401-0202-62G506-M-Plan view Level 0.00.pdf
		0A1401-0202-62G507-M-Plan view intermediate level.pdf
		0A1401-0202-62G508-M-Plan view upper level+.pdf
		0A1401-0202-62G509-B-Footprint possible extentions.pdf
		0A1401-0202-62G520-M-Boiler section.pdf
		0A1401-0202-62G521-M-Waste bunker cross section.pdf
		0A1401-0202-62G522-M-Turbine sections.pdf

To address the **point (v) preliminary design of each building**, please refer to the full set of drawings compiled in

EFW DRAWINGS - ARCHITECTURAL DRAWINGS		
		Full set of Architectural drawings **BELGRADE EFW PLANT ARCH rev1.pdf**

To address the point (viii) SCADA system, please refer to :

EFW - PROCESS DRAWINGS		
		SCADA - CONTROL SYSTEM ARCHITECTURE.pdf

WORKS DELIVERY PLAN 2

CDW FACILITY

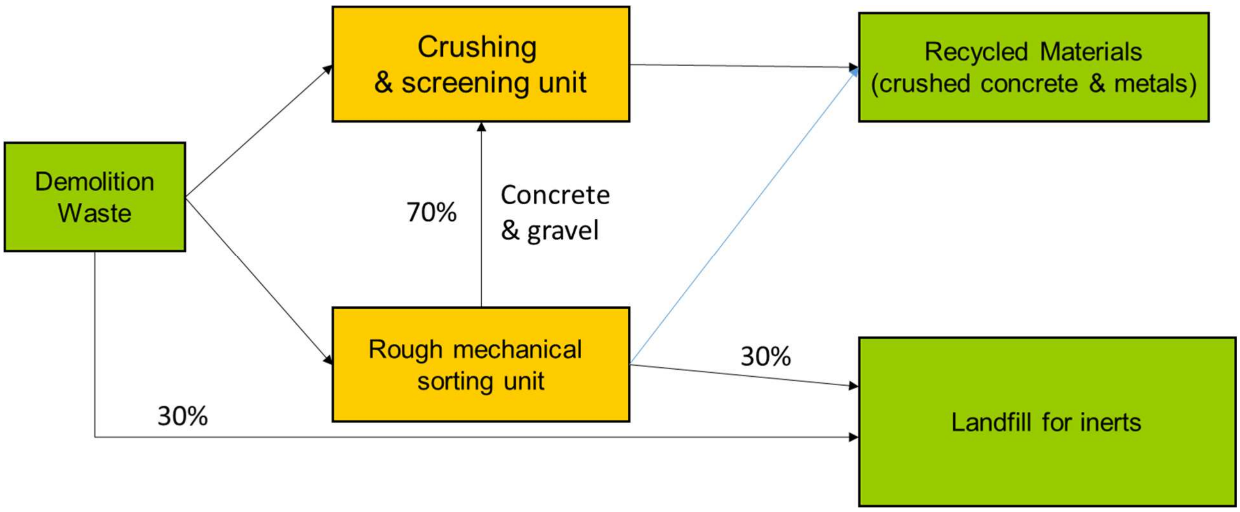
Form T.2.8.1 **Overall concept design**

Reference No. of the corresponding Works Delivery Plan	2
Reference No. of the corresponding Services Delivery Plan	2
Facility No.	2
Name of the Facility	CDW FACILITY

Overall Concept Design

I) CDW Facilities – Overview

The CDW Facility will be designed to extract/process recoverable material from mixed CDW. It is expected that approx. 30% of the input will not qualify for recovery and will be dispoed of at the Inert Waste Landfill.



The Facility will include:

- a mechanical pre-sorting unit with excavator and dedicated fittings (basic sorting of demolition waste)
- a crushing and screening facility to classify concrete & gravel materials into different size ranges and produce :

- aggregates for road sub-layer (unbound base courses) of various sizes to best adapt to any off-take requirement
- backfill materials, etc.

0/31^{5}

40/80

80/150

Adaptable production range

II) Process

IV.1) Sorting process

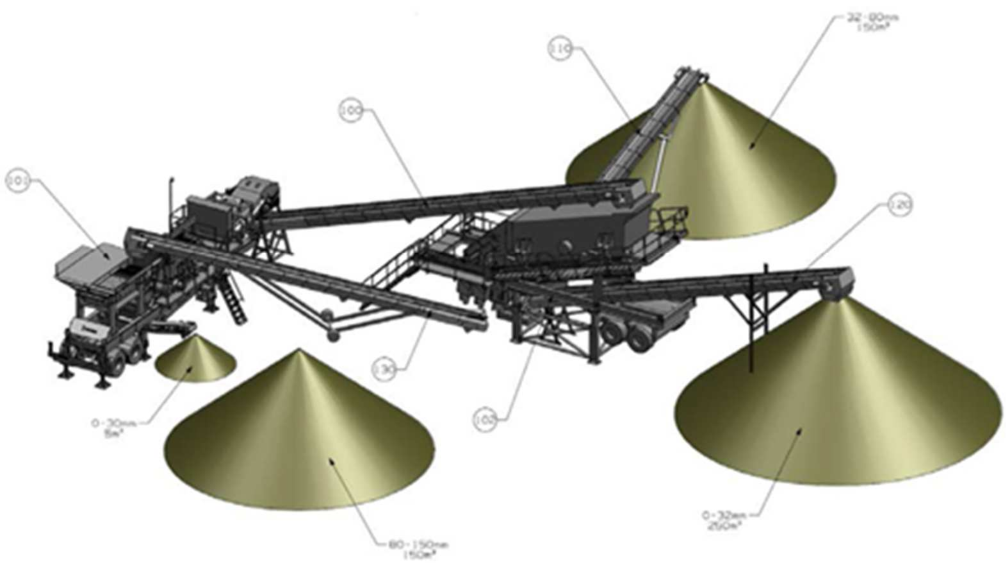
CDW accepted at the Facility will be sorted using a digger fitted with a bucket.

The sorted materials which will be crushed. Unrecoverable inert waste will be separated and disposed of at the inert waste landfill.

Large concrete items will first be reduced in size using a hydraulic hammer and a multi-functional crusher. The metal parts inside reinforced concrete will be separated.

IV.2) Crushing and screening process

Process capacity: up to 300 t/h capacity



In case of lack of off-taker, the sorted materials will be stored on the Recycled CDW Storage Area to be located at the Existing Landfill post Remediation Works.

Form T.2.8.2.4 **CDW Treatment and Storage Facility**

CDW TREATMENT AND STORAGE FACILITY	
	Page 1 of 2
Bidder	
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	2 2
Facility No. Name of the Facility Location of the Facility	2 CDW Treatment facility … See Lay-out - Form 2.2.3.
Nominal capacity [*specify type of CDW*]	250 t/h Min 200,000 t/a
Design capacity (peak) [*specify type of CDW*]	250 t/h
Number of lines (*specify the capacity per line, if total capacity set out above is not evenly distributed*)	1
Number of working shifts	1
Operating time	260 d/a 2080 h/a
Availability time ratio	18 %
Full load operating hours	400 h/a
Nominal capacity of main Facility components: • reception area • Pre-sorting • Crushing	• 10 000 m³ equivalent to a storage capacity of 55 days of average daily CDW quantity • 300 t/h • 250 t/h

CDW TREATMENT AND STORAGE FACILITY	
	Page 1 of 2
Facility outputs (e.g. soil, secondary aggregate, residues) *:* 1. Crushed concrete 0/32.. 2. Crushed concrete 32/80 3. Crushed concrete 80/150……….. 4. Residues	*Specify quantity and destination (e.g. to landfill type, recycling market)* Indicative figure based on 100 000t processed : 1. 20 000 t/a to recovered CDW storage area 2. 30 000 t/a to recovered CDW storage area 3. 20 000 t/a to recovered CDW storage area 4. 30 000 t/a to Inert landfill
Required area for the Facility (total)	17 000 m²

Form T.2.8.3 **List of buildings and architectural conceptual design**

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	2 2
Facility No. Name of the Facility	2 CDW FACILITY

Operational building on CDW platform

The operational building consists of an office for weighbridge, premises for employees and a store room. The building consists of three connected containers with dimensions 3x6m and with a height of 3 m, on reinforced concrete slab with a thickness of 10 cm. Finishing floor coat in sanitary facilities are of ceramic tiles, whereas in the other two premises is of PVH floor finish. Wall finishing is specified of prefabricated plasticized steel panels at the exterior and interior side. Windows and doors are specified in the drawing within container walls (please refer to the drawing ARH-001 CDW ops building.pdf).

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Net area=49.05 m², gross area=54.00 m²

Form T.2.8.4 Earthworks

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	2 2
Facility No. Name of the Facility	2 CDW FACILITY

The CDW Facility will have an overall footprint of 16.100 m^2 (Please refer to CDW platform layout.pdf).

After that, necessary mechanical scraping shall be carried out. Scrapped surface layer should be taken to the site landfill for later necessary sodding of free surfaces.

Excavation of the 3rd category soil will be carried out in exhausted wide space 80% by equipment and 20 % using hand operating with removal to the site landfill for later filling if so allowed in detailed geological investigation report.

Before backfilling it is necessary to carry out rolling of that surface to provide the required extent of the soil compaction.

For necessary backfilling, material from excavation will be used.

Form T.2.8.5 Foundations

Reference No. of the corresponding Works Delivery Plan	2
Reference No. of the corresponding Services Delivery Plan	2
Facility No.	2
Name of the Facility	CDW Facility

Foundations

CDW operation building

For the CDW operation building, the foundation of bungalows is provided on a reinforced concrete slab on ground with reinforcement along the perimeter. A lean concrete layer is provided under the foundation. The quality of materials (concrete, reinforcement) will be defined at later design stages.

Weighbridge :

For CDW weighbridges, the foundation is provided on a reinforced concrete slab and strips on ground. A lean concrete layer is provided under the foundation. The quality of materials (concrete, reinforcement) will be defined at later design stages.

Crushing facility

A reinforced concrete structure for foundation will be provided (foundation slabs, spot footings...). Within Screening/Crushing area (A=16.100 m^2) for needs of crushing facilities on the area of ~3.000 m^2 The quality of materials (concrete, reinforcement) will be defined in the project.

Form T.2.8.5 List of Equipment and Components

CDW-TREATMENT AND STORAGE FACILITY LIST OF EQUIPMENT AND COMPONENTS	
	Page 1 of 2
Bidder	
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	2 2
Facility No. Name of the Facility Location of the Facility	2 CDW Facility
List of the equipment and components of the CDW Facility	

No	**Equipment and components / construction activity**	**Responsible key Sub-Contractor**
	Reception and Feeding	
	Bunker (flat or deep),	
	Crane, if applicable	SPV
	Feeding hopper	
	Mechanical treatment (as applicable)	
	Shredder / crusher	SPV
	Screen(s)	SPV
	Air classifier(s)	
	Ballistic separator(s)	
	Magnet separator (ferrous material)	SPV
	Eddy current separator (non-ferrous material)	
	Others (*please specify*)	
	Conveying systems	SPV
	Steel structure, platforms, steel chairs	
	Storage areas	ENERGOPROJEKT NISKOGRADNJA
	Auxiliary systems	
	Rainwater / wastewater collection and treatment plant (including treatment (*please specify*), pipes, pumps, storage, discharge equipment)	ENERGOPROJEKT NISKOGRADNJA
	Firefighting and protection equipment	
	Electrical and I&C systems	
	Transformers (if applicable)	ENERGOPROJEKT NISKOGRADNJA

CDW-TREATMENT AND STORAGE FACILITY LIST OF EQUIPMENT AND COMPONENTS		
		Page 1 of 2
	SCADA / DCS system	SPV
	Electrical works MV/LV, including I&C and communication	ENERGOPROJEKT NISKOGRADNJA
	Vehicles	
	Loader	SPV
	Excavator	N/A
	Truck	SPV
	Containers	SPV
	Civil works (*please specify if split to various contractors*)	ENERGOPROJEKT NISKOGRADNJA
	Others *(please list further as required)*	

Form T.2.9 Construction Programme and Commissioning Plan

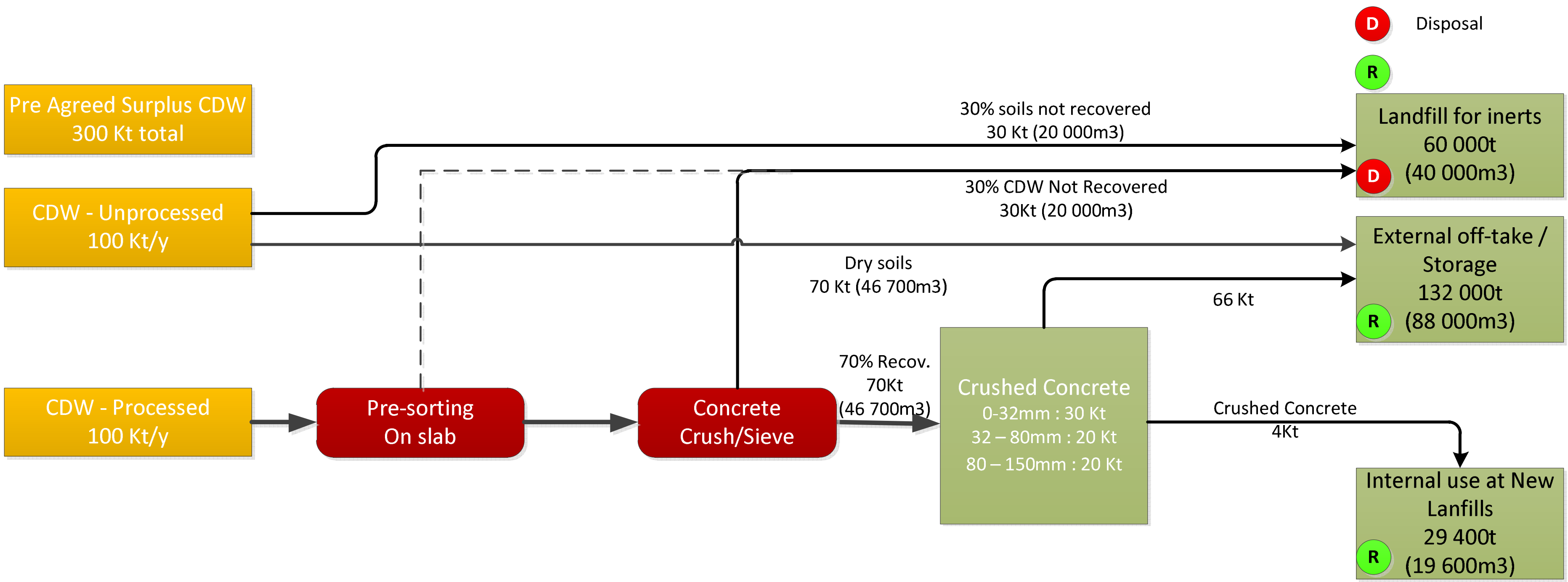
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	2 2
Facility No. Name of the Facility	2 CDW FACILITY

Construction Programme and Commissioning Plan

Please refer to Form T.2.6 Overall Project Time Schedule for the view on the EfW Construction Programme. The CDW Facility will be ready by the Interim Services Commencement Date.

Form T.2.10 Process Flow Diagram with Mass and Energy Balance

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	2 2
Facility No. Name of the Facility	2 CDW FACILITY



Form T.2.11 Drawings

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	2 2
Facility No. Name of the Facility	2 CDW FACILITY

Drawings

WORKS DELIVERY PLAN 3

NEW LANDFILLS

Form T.2.8.1 **Overall concept design**

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3 3
Facility No. Name of the Facility	3 New Landfills

The overall scope of the New Landfills include the following facilities

- Landfill for inert materials;
- Landfill for Unprocessed Waste and Treatment residues;
- Runoff water, leachate and biogas drainage and collection networks;
- Runoff water and leachate ponds;
- Leachate and biogas treatment platforms ;
- Access and internal roads.
- Operating buildings and facilities, of which :
    - Entrance control area including : weighbridges, supervisory station and parking;
    - Internal weighbridges (to be adapted regarding the material flows);
    - Landfill operation platform including cleaning area and parking for operating engines, parking for light-duty vehicles, maintenance building, offices and locker room building.

See **WDP 04 "General plan of new landfill" in Schedule of Maps and Drawings**

The New landfills and the Existing Landfill will be markedly separated by an access road (see details on **WDP 19 "Details between new and existing landfill" in Schedule of Maps and Drawings**).

As per Form T 2.4 Final Disposal Plan, and in relation with the Base Case Waste Flow in form T.2.3, the volumes required for the New Landfills over the contract lifetime are as follows:

	Tons	m^3
New Landfill for RMW Landfilled Unprocessed	**5 141 452**	4 850 426
Intermediate covers + final capping	*989 487*	659 658
New Landfill for Treatment Residues - IBAs not recovered	**1 389 758**	926 505
Intermediate covers + final capping	148 704	99 136
New Landfill for Treatment Residues - stabilized APCRs	**816 000**	544 000
Intermediate covers + final capping	87 312	58 208
Total	*8 572 713*	***7 137 933***

New Landfill for Inert Waste	**1 928 877**	1 285 918

Form T.2.4.3 provides a detailed calculation of masses and volumes showing that the total combined voidspace available at the New Landfills for RMW Unprocessed and Treatment Residues will be 8.5 million m^3, thus exceeding by 20% the required voidspace of 7.1 million m3 calculated in the Base Case Waste Flow Model.

Notes:

- the need for intermediate covers / capping materials has been stimated to 10% of the gross waste volume for Landfills for Unprocessed Waste and 6% for Landfills for Treatment Residues.
- considering the average height of the waste mass (more than 10m), waste settlement can reduce the gross waste volume by a factor up to 10%;
- approximately 25 500 tonnes per year of IBAs, produced by the EFW facility, will also be used as operation needs material.

The New Landfills for Waste Unprocessed and Treatment Residues will be developed according to the following design (from top to bottom):

Bottom and internal slope design
The bottom and internal slopes of the New Landfill will be designed as follows (from the top to the bottom):

- Waste ;
- 50cm of drainage gravel ;
- Geotextile ;
- HDPE liner (permeability K≤1.0E^{-11} m/s ;)
- Clay liner ;
- 50cm of clay-like material with a maximum permeability value of K≤1.0E^{-09} m/s;
- Natural soil.

This solution is equivalent (hydraulic equivalence) to a 1m thick clay-like material with a permeability K≤1.0E-09 m/s and will be adopted only in the case where the natural ground does not meet the hydrogeological requirements (min 1m natural ground layer with a permeability K≤1.0E-09 m/s). An investigation campaign will be conducted during the construction works in order to determine the permeability of the natural soil at the bottom of the landfill.

The internal slopes of the cells (3H/1V) will be designed as follows:

- Extension of the 0.50ml clay-like material (1.10^{-9} $m.s^{-1}$) up to 2m from the bottom
- Full covering of the leachate drainage liner, HDPE Liner and 1cm thick clay liner up to the cell top.

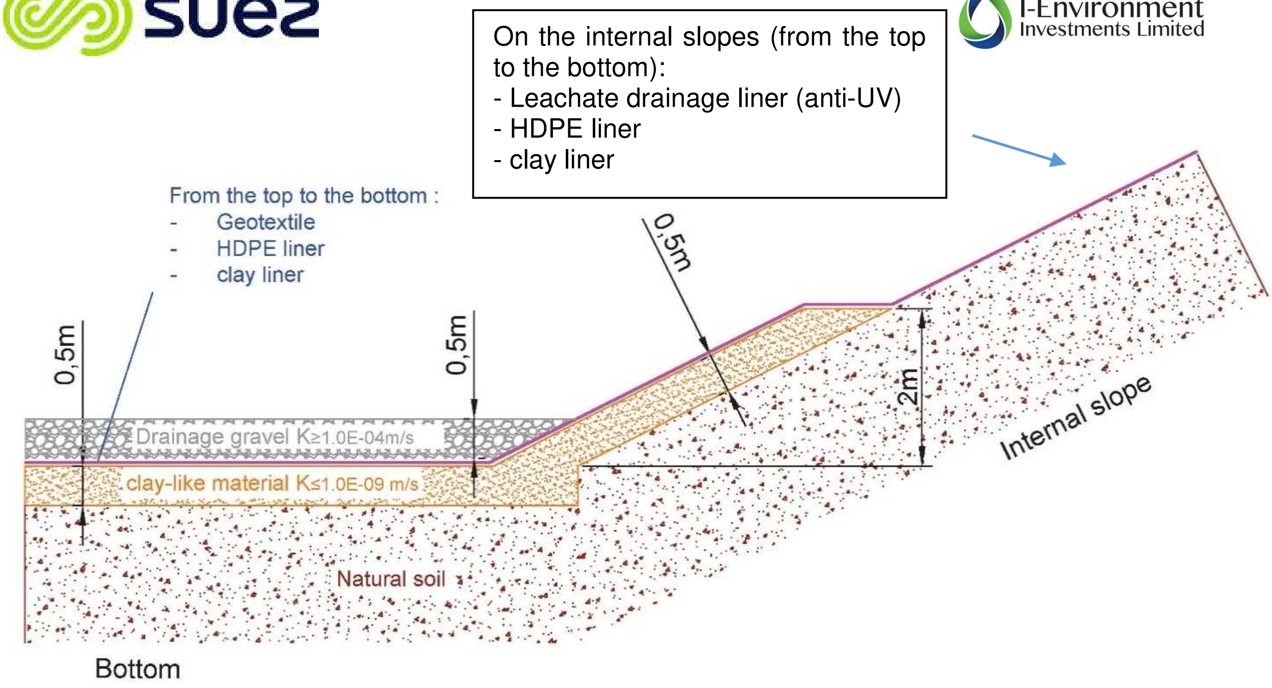


Illustration: Cells bottom and internal slopes design

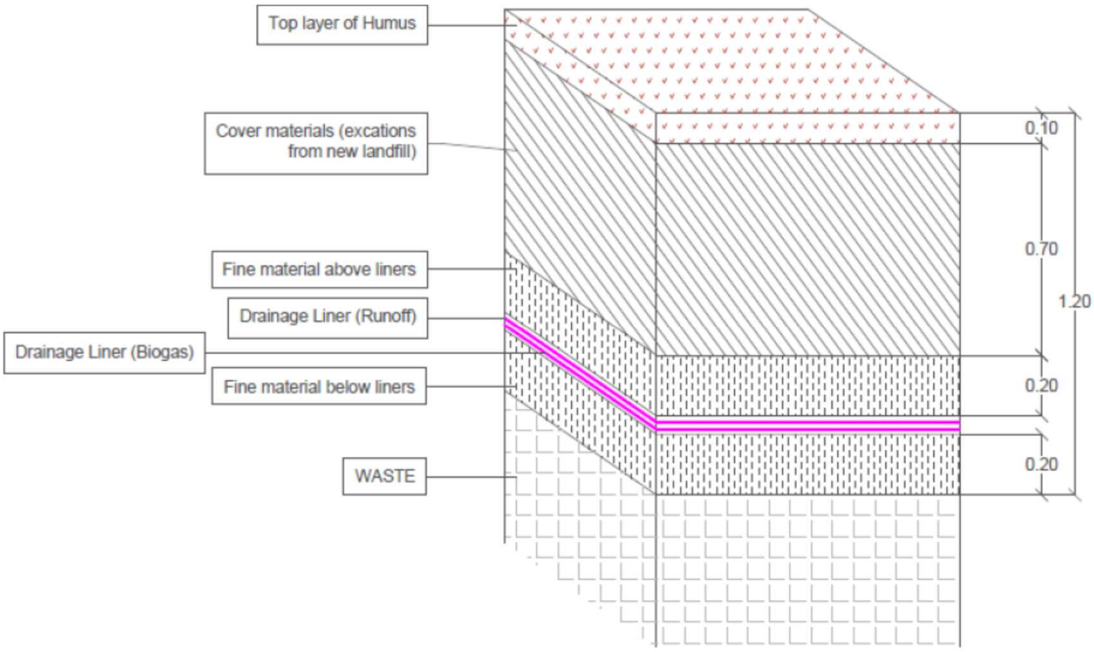
See drawing WDP 11: "Landfills cover and bottom details, ponds details_Rev D-PLAN" on **appendix xx (drawings)**.

Design of landfill cover

The cover of the New Landfills will be realized by the O&M Contractor as per the progress of operations according to the following design (from top to bottom):

- 10cm of topsoil (including seeding) coming from excavated materials generated by new landfill earthworks ;
- 70cm of excavated materials generated by new landfill earthworks ;
- 20cm of fine materials coming from excavated materials;
- Run off water drainage liner ;
- Biogas drainage liner ;
- 20cm of fine materials below liners (waste transition layer) coming from excavated materials generated by new landfill earthworks.

The main benefit of this solution will be to re-use the materials generated by the excavations of the New Landfills.



New landfill cells cover design

The cover will have an initial maximum slope of 33.3% (1V:3H) according to the requirements of Output Specifications. This slope angle is however expected to slightly fade overtime due to the effect of waste settlement following biodegradation.

The design of the cover will be in line with the recommendations of the European Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste:

Layer	Landfill category : non hazardous	Suez-IEI solution
Gas drainage layer	Required	Above the transition layer (fine materials below liner), will be installed a gas drainage liner which can drain the biogas under the runoff drainage liner.
Artificial sealing liner	not required	N/A
Impermeable mineral liner	Required	Both requirements (impermeable mineral layer and 0,5m thickness drainage layer) are performed by a run-off drainage liner. **Notes :** • The liner needs to be quasi watertight because, in the cases of the Existing and the New landfills, a fraction of rainwater needs to infiltrate into the landfill cells in order to maintain the biodegradation of the waste (the process needs the waste to be continuously moist). It is considered that the drainange liner will still allow approximately 5% of the rainwater to infiltrate into the cells.
Drainage layer > 0,5 m	Required	

		• The drainage liner offers the same flow rates as a 0,5m thickness gravel drainage layer (with a permeability above 1.E-04 m/s).
Top soil cover > 1 m	Required	Our design includes a 1m top soil cover comprised of: • 0.20m of fine materials above liner • 0,70m of cover materials • 0,10m of humus top layer These materials will come from the excavation of the New Landfills.

Biogas collection system

The treatment area (on the EFW platform) will collect the biogas generated by the New Landfills and the Existing Landfill (including the part located under the Recycled Pre-Agreed CDW Storage area.

The design of the biogas collection system is based on the following principles:

- from the New Landfills: the biogas wells will be connected to the EfW platform treatment area through a tertiary , a secondary and a primary network. The primary network is peripheral to the landfill. The tertiary and secondary networks have been designed with a "fishbone" shape in order to redirect a portion of biogas condensates flow into the wells; a condensate separator will be located at the lowest point of the primary network in order to avoid the clogging of the biogas network.
- from the Existing Landfill: the same solution as above is implemented, however on the part of the landfill located under the Pre-Agreed CDW Storage area, the biogas wells and the tertiary and secondary networks will be buried under the landfill cover within a layer of fine materials ;

See drawing **WDP 13: "Biogas collection system"** in **Schedule of Maps and Drawings**.

Leachate collection system

The gravity collection systems have been divided within 3 areas:

- the Existing Landfill: peripheral leachate drains located at the base of the peripheral embankments (See drawing **WDP 12: "Peripheral dyke detail" in Schedule of Maps and Drawings**) and at the base of the Dam, all connected by gravity to the downhill leachate reservoir.
- the New Landfills for Unprocessed Waste: the leachate drains located in the drainage layer (gravels) at the lowest level of each cell. They are connected by gravity to leachate collectors and to the first leachate reservoir at the uphill treatment area.
- the New Landfill for Treatment Residues: the leachates are conducted to the second leachate reservoir of the uphill treatment platform.

See drawing **WDP 14: "Leachate collection system" in Schedule of Maps and Drawings**.

Runoff water collection system

The runoff water system includes:

- the construction of trapezoidal ditches on the edges of access roads;
- the installation of reinforced concrete or PVC pipes;
- the installation of precasted or field-poured concrete drainage channels.

A peripheral ditch collects the landfill cover runoff water. The ditch will have a 0.30 m minimum depth and a 0.70m minimum width at the top. The network slopes are ≥ 0.5%.

The gully of the ditch will be sealed with a drainage liner installed on the axis of the ditch. A PVC drainage pipe will be set on the bottom of the ditch to collect the runoff water. The ditch will be filled with drainage gravel.

The cover runoff water will be conducted to the bottom peripheral network via buried PVC pipes and intermediate peripheral ditches (with manholes on the connection between pipes and ditches).

A concrete structure (precasted of field-poured) will be installed at the outlet of each down pipe in order to protect the network against erosion.

See drawing **WDP 15 and 16: "Runoff collection system" and "Runoff drainage surfaces " in Schedule of Maps and Drawings**.

Underground water collection

In order to avoid risk of uplift by infiltration of underground water below the bottom HDPE liner of the New Landfills, underground water will be collected through HDPE drain pipe laid in a gravel layer, protected by an anti-clogging geotextile and installed at the bottom of ditches. The ditches will be excavated around the lowest point of each landfill cell, leachate reservoir and run-off water reservoir.

This underground water collection network will be connected by gravity to the runoff water network in order to ensure the evacuation of underground water.

Access and internal roads

The 10m wide (sidewalk included) internal roads will provide access to:

- the downhill and uphill treatment platforms, for service vehicles;
- the Pre-Agreed Recycled CDW Storage area, for dumpers and operations machinery;
- the New Landfills, for dumpers and operations machinery.

The maximum admissible slope for the traffic of maintenance and operation plant is 10% (6% on the entrance area).

See drawing **WDP 04 and 19: "General plan of new landfill" and "Detail between new and existing landfill** " in **Schedule of Maps and Drawings**.

Landfill operation facilities

Landfill operation platform

A 5,000 m^2 operation platform will be located East of the New Landfill and contain the following facilities:

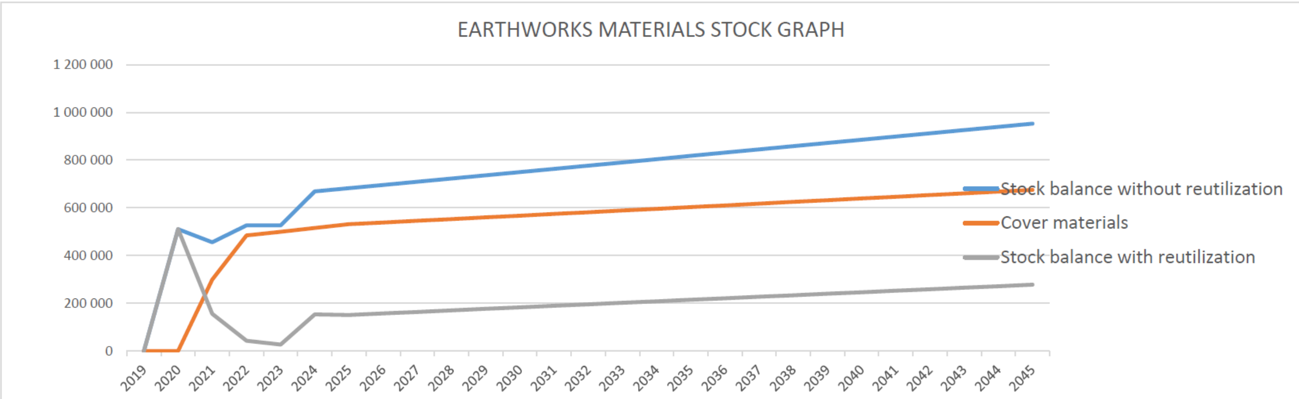
- 1 heavy duty asphalted parking for approx. 12 trucks, 4 RoRo skips, 3 plant (under repair/maintenance) and 25 LVs;
- 1 office building for approx. 60 operation staff including
  - Managers/technical staff offices
  - Lockers room
  - Restrooms / shower facilities
  - Lunch room (capacity 20)
  - 2 meeting rooms (each capacity : 6 and 20)
- 1 washing area for heavy duty trucks and light vehicles, including:
  - 1 room for high pressure washing device
  - 1 concrete slab size 16x6m
  - sludge and oil separators vessels
- 1 fuel station, including:
  - 1 fuel tank for machines, capacity 20m3, with one fuel pump
  - 1 fuel tank for light vehicles and trucks, capacity 20m3, with one fuel pump
  - 1 concrete slab, size 16x6m
  - sludge and oil separators vessels
- 1 workshop shelter (size 12x10m, 8m high), open on 1 side with 2 roller shutters suitable for wheel loader CAT 966 and excavator CAT 320, including:
  - air and water networks
  - heavy duty concrete slab with retention
  - tyre washing devices, 14m long, for heavy duty trucks located near the roundabout (full cleaning of tyres and beneath chassis)
  - an on-site waste water treatment micro-station.

Balance of materials

Earthwork material balance

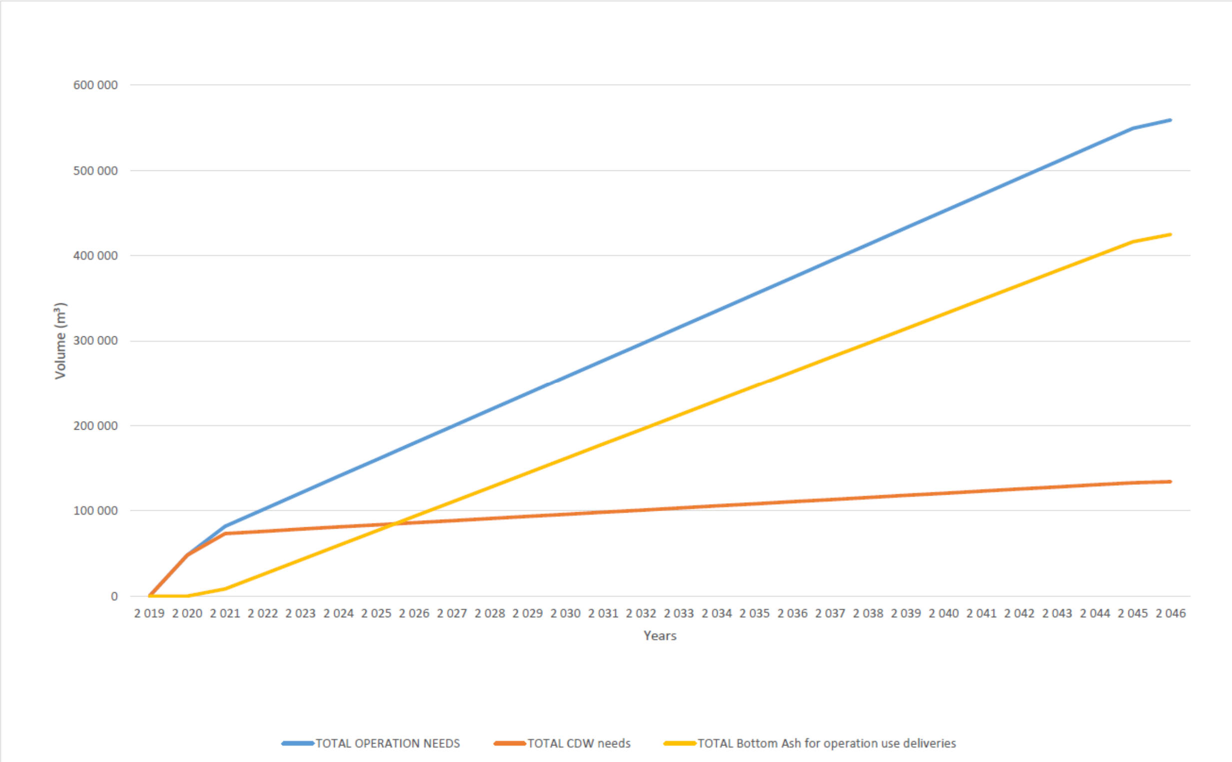
The purpose of the earthworks balance is to re-use the materials generated by the New Landfill excavations over the project lifetime for the purpose of capping the Existing and the New Landfills.

Projections indicate a final balance of **254 590 m^3** of excavations by the end of the Project, which will allow for a buffer of capping materials for subsequent landfill operations after the end of the Project.



IBA/CDW reuse balance

The purpose of the IBA/CDW reuse balance is to compare the production of IBA/CDW with the demand for intermediate covers at the New Landfills, estimated to 10% of the gross waste volume for Unprocessed waste and 6% for Treatment Residues.



The demand for operation materials (21 300 m^3 per year on average) will be satisfied by:

- 17 000 m^3 per year of IBAs;
- 48 000 m^3 in 2020, 25 000 m3 in 2021, then an average of 2 400 m^3 per year of CDW until mid-2026

An overall volume of 3.5 Mm^3 of CDW (134,000 m^3 per year on average) will be produced in excess of the internal reuse capacity, to be either offtaken by third parties or the City or stored at the Pre-Agreed Recycled CDW Storage Facility.

Form T.2.8.2 Main design parameters

Instructions: complete this form for each type of New Landfill separately (e.g. New Landfill for RMW Landfilled Unprocessed, New Landfill for MW Treatment Residues, New Landfill for Inert Waste)

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3 3
Facility No. Name of the Facility	3 New Landfills

NEW LANDFILL FOR RMW LANDFILLED UNPROCESSED	
	Page 1 of 1
Bidder	
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3.1 3.1
Facility No. Name of the Facility Location of the Facility	3.1 New Landfill for RMW Landfilled Unprocessed See Lay-out - Form 2.2.3
Annual waste delivery for the Base Case (*specific waste type(s) and origin (e.g. Main Facility, CDW Treatment Facility, etc) in accordance with the Base Case Waste Flow Summary according to 0, please add further rows, if required)* Waste type/origin: RMW collected Total:	170 000..... t/a
Total void space (excluding intermediate covers and final capping)	5 200 000 tonnes[2] .... m^3
Total landfill volume (including intermediate covers and final capping)	.... tonnes 5 500 000.......m^3[3]
Percentage of intermediate covers and final capping of total landfill volume	19,2 % by weight 13,6 % by volume
Number of working shifts	2
Operating time	365 d/a 5840 h/a
Required area for the Facility (total)	Approx 110 000 m^2
Maximum height of the landfill	260 m
Slope ratio	33%

[2] This figure must be equal or higher than the related figure set out in Form T.3-1, Table 3
[3] This figure must be equal or higher than the related figure set out in Form T.3-1, Table 3

Instructions: complete this form for each type of New Landfill separately (e.g. New Landfill for RMW Landfilled Unprocessed, New Landfill for MW Treatment Residues, New Landfill for Inert Waste)

NEW LANDFILL FOR LANDFILLED MW PROCESS RESIDUES	
	Page 1 of 1
Bidder	
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3.2 3.2
Facility No. Name of the Facility Location of the Facility	3.2 New Landfill for Treatment Residues See Lay-out - Form 2.2.3
Annual waste delivery for the Base Case Waste type/origin: Incineration Bottom Ash Aggregate not recovered from IBA treatment Waste type/origin: Solidified FGT Residues from stabilization plant Total:	 57 000 t/a 33 000 t/a 90 000 t/a
Total void space (excluding intermediate covers and final capping)	2 206 000 tonnes[4] .... m^3
Total landfill volume (including intermediate covers and final capping)	.... tonnes 1 630 000 m^3[5]
Percentage of intermediate covers and final capping of total landfill volume	10,7 % by weight 10,7 % by volume
Number of working shifts	1
Operating time	365 d/a 2920 h/a
Required area for the Facility (total)	Around 80,000 m^2
Maximum height of the landfill	245 m
Slope ratio	33%

[4] This figure must be equal or higher than the related figure set out in Form T.3-1, Table 3
[5] This figure must be equal or higher than the related figure set out in Form T.3-1, Table 3

Instructions: complete this form for each type of New Landfill separately (e.g. New Landfill for RMW Landfilled Unprocessed, New Landfill for MW Treatment Residues, New Landfill for Inert Waste)

NEW LANDFILL FOR INERT WASTE	
	Page 1 of 1
Bidder	
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3.3 3.3
Facility No. Name of the Facility Location of the Facility	3.3 New Landfill for Inert Waste see Lay-out - Form 2.2.3
Annual waste delivery for the Base Case Waste type/origin: Inert CDW not recoverable from CDW treatment plant Inert CDW not recoverable from non processed CDW Total	 30 000 t/a 30 000 t/a 60 000 t/a
Total void space (excluding intermediate covers and final capping)	1 600 000 tonnes[6] 1 060 000 m^3
Total landfill volume (including intermediate covers and final capping)	1 600 000 tonnes 1 060 000 m^3[7]
Percentage of intermediate covers and final capping of total landfill volume	0 % by weight 0 % by volume
Number of working shifts	1
Operating time	365 d/a
Required area for the Facility (total)	Approx 100 000 m^2
Maximum height of the landfill	207 m
Slope ratio	30%

[6] This figure must be equal or higher than the related figure set out in Form T.3-1, Table 3
[7] This figure must be equal or higher than the related figure set out in Form T.3-1, Table 3

Form T.2.8.3 **List of buildings**

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3 3
Facility No. Name of the Facility	3 New Landfills…

List of Buildings and Architectural Conceptual Design

Office / Locker room – Administrative building

Maintenance hall / Atelier

On-site sanitary facilities

Prohibited waste quarantine area

Office / Locker room - Administrative building

Administrative one-storey building contains a canteen and locker room for employees, specified as built of brick blocks with a thickness of 25 cm and with thermal insulation.
The roof is two-sloped over reinforced concrete slab and roof structure of steel sections, roof finish is from two-component painted steel panels with a thickness of 12 cm.
The floor is provided of reinforced concrete slab with a thickness of 15 cm, hydro-isolated, over rammed concrete and rammed gravel slab-on-grades. Floor finishing is provided of non-sliding ceramic tiles in all premises with the exception of the administrative part, where laminated floor is specified in offices and conference rooms.
Interior wall finishing is provided with rendering, finishing is provided with semi dispersive paint, walls in toilets and in the part of serving area in the canteen are specified of ceramic tiles of height 1,5 m.
Exterior walls finish is demit façade, finishing - with façade paint.
Windows and doors joinery is provided from six-chamber PVC.
Administrative building consists of the following premises:
- offices for 6 managers
- locking room for 45 persons
- sanitary facilities and showers for employees
- sanitary facilities for administration
- canteen for 20 persons
- conference rooms for 6 and 20 persons 12 m2+30 m2
- connection with the hall.

Total net area 302.73 m2, gross area – 345.83 m2.

Maintenance hall

Maintenance hall is specified with dimensions 10x12 m and a height of 8 m, of steel structure on reinforced concrete slab. The walls are of prefabricated plasticized steel trapezoidal panels with a thickness of 10 cm. Two roll-up doors 4.0x4.5 m, which contain one individual door each, 90/220 cm, opening around vertical axle. The windows are of steel locksmith and they are being open using opening mechanism. Floor finish coating is epoxy coating.
Roof covering is of prefabricated plasticized steel trapezoidal panel with a thickness of 12 cm.

net area P=125.13 m², gross area=130.21 m²

On-site sanitary facilities

Free-standing facility for toilets for employees is provided to be built from thermally isolated brick blocks with a thickness of 20 cm. Roof covering is provided from steel panels with a thickness of 12 cm, painted with two-component paints, over wooden roof structure. Floor structure bottom side is closed with combined plate with a thickness of 1.5 cm.
The floor is provided with reinforced concrete plate with a thickness of 15 cm, hydro-isolated, over rammed concrete and rammed gravel slab-on-grades. Floor finishing is provided from non-sliding ceramic tiles.
Interior wall finishing is provided with rendering, finishing is provided with semi dispersive paint, ceramic tiles of height 1,5 m are provided.
Exterior walls finish is demit façade, finishing - with façade paint.
Windows and doors joinery is provided from PVC.

Net area is 7,32 m2, gross area is 11,29 m2.

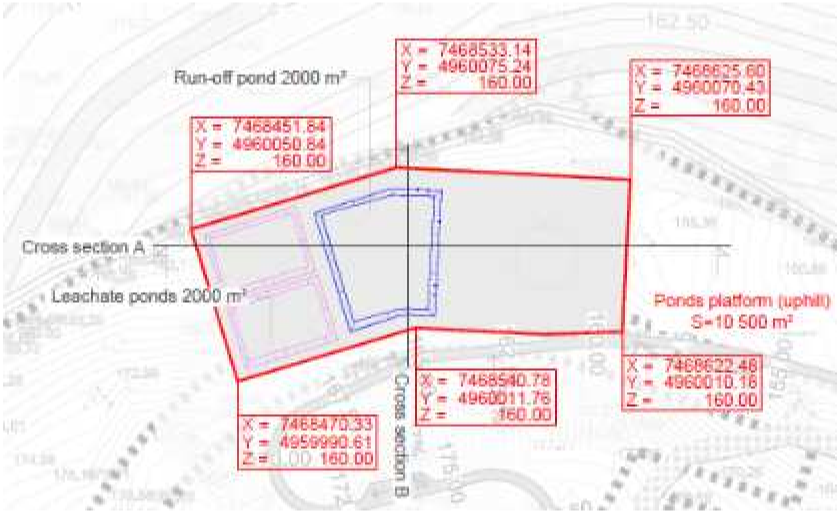
Prohibited waste quarantine area

The facility is specified with dimensions 6 x 4 m, and a height of 3.0 m, steel structures are on the reinforced concrete slab with a thickness of 10 cm. Columns and frame beams are specified from box section steel 150/150. Single slope roof. Roof covering and wall coatings: trapezoidal plasticized steel sheet 60.170….0,8 mm, over the understructure from box sections. The floor is specified from cement screed 5 cm. The door is specified as double leaf steel door.
net area=25.43 m², gross area P=26.77 m²

Uphill platform

The uphill platform will collect:

- ✓ the leachates separately from:
  - o 1st pond: the treatment residues landfill (where are stored IBAs and ACPRs)
  - o 2nd pond: the interim and unprocessed waste landfill (where are stored MSWs)
- ✓ The run-off water from:
  - o The new landfill
  - o The uphill access roads and platforms



Location of uphill platform

The uphill platform (10 500 m²) will contain :

- a 4 000 m² runoff pond;
- two leachate ponds, 2 000 m² each.

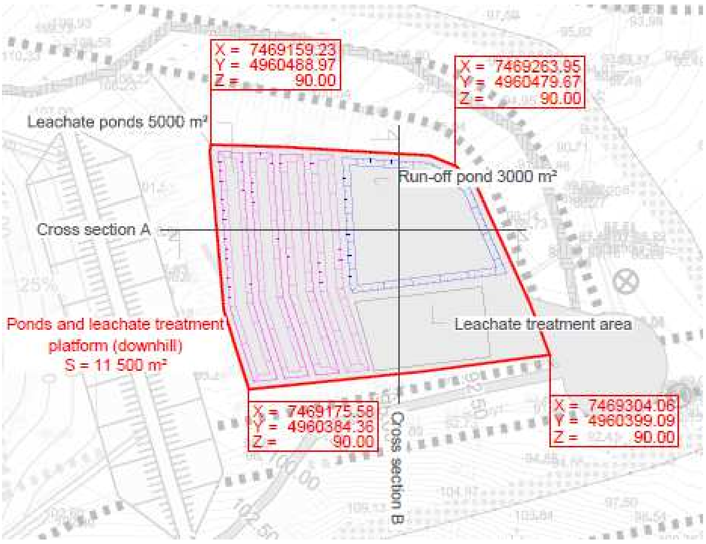
Considering the earthworks balance, the area needed and the peripheral slopes of the platform, the following parameters apply:

- 2H/1V peripheral slopes (steadiness of the slopes);
- 160m platform height, which allow a gravity discharge of runoff water and leachates from the New Landfill, and a gravity discharge until the downhill leachate treatment area;
- Available area of 10 500 square meters;
- 71 500 cubic meters of cutting and 5 000 cubic meters of backfilling.

Downhill platform

The downhill platform will collect:

- The leachates from the old landfill
- The run-off water from:
  - The old landfill
  - The downhill access road



location of downhill platform

The downhill platform (11 500 m²) will contain :

- a 4 000 m² runoff pond
- a 4 000 m² leachate pond
- a leachate treatment area

Considering the earthworks balance, the area needed and the peripheral slopes of the platform, the following parameters apply:

- 2H/1V peripheral slopes (steadiness of the slopes);
- Platform height of 90 which allow a gravity discharge of runoff water and leachates from the Existing Landfill, below the bottom of the protection dam;
- Available area of 11 500 square meters;
- 56 700 cubic meters of cutting and 300 cubic meters of backfilling.

Form T.2.8.4 Earthworks

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3 3
Facility No. Name of the Facility	3 New Landfills…

Earthworks

Landfill Operation plateform

Before the beginning of excavation it is necessary to mark the facility – Operation platform that occupies area of 5.000 m^2

After that, necessary mechanical scraping shall be carried out. Scrapped surface layer should be taken to the site landfill for later necessary sodding of free surfaces.

Excavation of the 3rd category soil shall be carried out in exhausted wide space 80% by equipment and 20 % using hand operating with removal to the site landfill for later filling if so allowed in detailed geological investigation report.

Before backfilling it is necessary to carry out rolling of that surface to provide the required extent of the soil compaction.

For necessary backfilling, material from excavation or other corresponding material from borrow pit shall be used.

Existing landfill reshaping

The existing landfill reshaping consist of leveling the landfill surfaces and decreasing the slopes to ensure the geotechnical stability of the waste mound.
Waste slopes are to be mechanically excavated up to the designed levels by hydraulic excavator. Excavated waste are to be backfilled and compacted on the dumpsite. The quantities are according to the bill of quantities. Works are to be executed according to the given cross and longitudinal sections and other relevant design data. These operation will take account the global humidity of the waste and the leachate management.

Excavation

Removing of humus

Remove humus along the route of the facility using bulldozer, according to width and depth, and the average transport length as given in the design, or according to the Supervisor’s decision. Humus removal takes place after requested marking. Removed humus to be deposited on temporary dumpsite. Works are to be executed according to the given technological schemes and cross sections.

Mechanical excavation

After humus removal, cassette bottoms or basins or platforms are to be mechanically excavated up to the designed levels by hydraulic excavator. Excavated material is to be disposed aside to a temporary dumpsite. The quantities are according to the bill of quantities. Works are to be executed according to the given cross and longitudinal sections and other relevant design data. Excavated material is to be used for construction of embankments or covers.

Mechanical excavation of trench

Do mechanical trench excavation followed by depositing of material on one side with 1m minimum distance from the trench edge or load the material into transport vehicle to be transported to temporary dumpsite. Do mechanical excavation according to the trench longitudinal and cross sections. The depth and width of the trench are according to the design. On sections where the route passes through agricultural land humus is to be removed, as given in the design, and separately deposited for later backfilling of the trench. Do trench excavation with vertical sides secured against wall material sliding. Excavation is to be done strictly according to the depth as given in the design, and excavation levels will be checked and approved of by the Supervisor in the site diary. Inadequate excavation by Contractor is not acceptable; over excavated trench is to be filled with gravel and well compacted, or in special cases with compacted concrete according to Supervisor's decision at Contractor's expense. If unexpected underground structures and lines are found during excavation, or if the ground composition is different from expected, the Contractor is to apply safety measures, inform Supervisor who is to give further directions.
Remove stones, root and bushes from the excavated material which will be later used for trench backfilling. Safety measures must be applied during excavation, and also in case of natural disaster to prevent any damage to executed works. Mechanical excavation quantities for calculation are identified by measuring of executed excavation of undisturbed ground or by changes approved by Supervisor.

Embankment works Making Embankment

Making of embankment implies laying of natural cohesive material taken from temporary dumpsites of excavated earth or of inert material coming from CDW (construction demolition waste). Embankment is made by mechanical spreading in 20-30 cm layers according to the design sections, levels and slopes with allowed difference of up to 5 cm. Embankment compaction is done by vibratory equipment, keeping optimal moisture. Requested compaction is 95% according to standard Proctor procedure. Works are to be executed according to technological schemes and cross sections.

Construction of hydro geological clay barrier

Clay barrier is to be embedded in 20-30 cm layers (up to total height of 50cm) on levelled compacted surface, preventing contact between landfill content and underground water. Layers are to be mixed and compacted by vibratory roller up to required compaction of 95% according to Proctor procedure (JUS U.B1.038). If necessary, each mixed and compacted layer is to be wetted to avoid clay drying (shrinkage) and layer cracks. Clay material is to comply with the following conditions:
- Permeability coefficient less than $\kappa = 1 \times 10^{-9}$ m/s

Embedding of drainage blanket course

Drainage blanket course of 16-32mm graded gravel is to be embedded on leveled cassette bottom in 50 cm layer for underground water and for leachate drainage. Gravel is to be transported and unloaded by trucks; gravel is spread in 20-30 cm layers by hydraulic excavator.

Trench backfilling

After leveling, trench bottom is compacted mechanically.

Trench is backfilled with sand up to bed bottom of existing pavement construction or any other traffic or pedestrian area, or to the level as given in the design. Sand is to be deposited in 20-30cm layers with concurrent compacting and wetting, followed by backfill compaction testing. It has to be 100% of maximum laboratory compaction according to standard Proctor procedure (according to JUS-4 UB1.016). If testing is done by modulus of compression (JUS.UB1.046), bearing capacity of the backfilled sand in the trench, on the bed level below traffic area is to be Me=2.5 KN/cm².
In other cases, trench is to be backfilled with grained excavated material in 20-30cm layers followed by mechanical compaction. Minimum allowed compaction is that of the surrounding ground and cannot be less than 95 % of maximum laboratory compaction according to Proctor procedure. Excavated material must be without big pieces of hard earth, stones, leaves, roots and other.

Topsoil embankment

The final, 10 cm thick, layer should be composed of topsoil, if possible "pre-sow" to facilitate revegetation of the final cover.
The implementation of this layer should be done the same way as the underneath inert material layer.

Leveling works

Levelling of cassette bottom is to be done by bulldozer with precision of ± 1 cm according to the designed levels and slopes, followed by disposing material surplus aside. Cassette bottom surface is to be compacted by roller up to required compaction. Compaction is to be minimum 15 MPa. Excavation is to be done strictly according to the designed levels; levels will be checked and approved of by the Supervisor in the site diary.

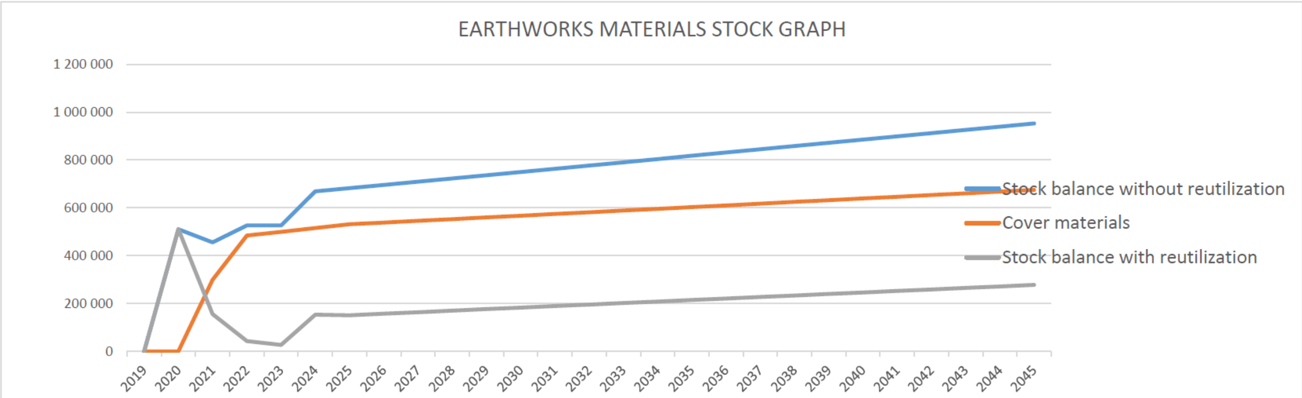
Earthwork - general conditions for objects and platforms

Earth works and excavations will be performed in accordance with the recommendations and results of geotechnical investigations for the subject locations of facilities.

Earthwork material balance

The purpose of the earthworks balance is to re-use the materials generated by the new landfill excavations from 2019 to mid-2046 on the cover of the old and the new landfills.

We reach that way a final balance of **254 590 m³** of excavations in 2046, which can be consider as a safe value regarding the potential reusability of cutting materials and the sharpness of the volume estimations and/or which can be used as operation material or cover needs for the new landfill buffer.



Earthwork balance graph

Form T.2.8.5 **Foundations**

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3 3
Facility No. Name of the Facility	3 New Landfills…

Foundation of the landfill operation buildings :

Office / Locker room – Administrative building

Maintenance hall / Atelier

On-site sanitary facilities

Dangerous waste hangar

As a general principle, after excavation for the foundation pit, it's necessary to build the base plate of the objects, and make a tampon gravel layer of thickness d=50 cm with compaction in layers d=25 cm and Me = 50.000 KN/ m2.

Above the tampon layer and below the base reinforced concrete plate, we shall install a concrete layer MB15 d=10 cm.

Foundation panels and walls will be constructed in accordance with the static calculation and results of geotechnical investigations for each object.

Office / Locker room – Landfill administrative building

Foundations are reinforced concrete strips with assumed dimensions 800x500 mm, foundationed on the level – 1,2 m with respect to the floor. Foundation strips are provided along the facility perimeter with additional longitudinal and cross strips inside the facility. A lean concrete layer is provided under the foundation. The quality of materials (concrete, reinforcement) will be defined in the project .

Maintenance hall / Atelier :

Foundations are reinforced concrete strips with assumed dimensions 1200x500 mm, foundationed on the level – 1,5 m with respect to the floor. Setting foundation is provided along the facility perimeter. A lean concrete layer is provided Under the foundationThe quality of materials (concrete, reinforcement) will be defined in the project .

On site sanitary facilities :

Foundations are reinforced concrete strips with assumed dimensions 600x400 mm, founded on the level – 1,2 m with respect to the floor. Setting foundation is provided along the facility perimeter. A lean concrete layer is provided under the foundation. The quality of materials (concrete, reinforcement) will be defined in the project.

Dangerous waste hangar

Foundation is provided on a reinforced concrete slab on ground with reinforcement along the perimeter. A lean concrete layer is provided under the foundation. The quality of materials (concrete, reinforcement) will be defined in the project .

Washing area :

A reinforced concrete slab of the containment basin, size 16x6, with a thickness of 25 cm is provided over a lean concrete layer on ground. The quality of materials (concrete, reinforcement) will be defined in the project.

Fuel pump :

A reinforced concrete slab size 16x6, with a thickness of 25 cm is provided over a lean concrete layer on ground. The quality of materials (concrete, reinforcement) will be defined in the project .

Form T.2.8.6 **Roads, paved areas and parkings**

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3 3
Facility No. Name of the Facility	3 New Landfills…

Roads, paved areas and parkings

Access and internal roads on the landfill in operation

In addition to the new facilities that are planned for construction within the landfills, it is also necessary to build an adequate network of internal traffic surfaces, which in this case represents an access road with manipulative surfaces and platforms. They need to ensure a normal technological process and access to all envisaged facilities in the construction and exploitation phases, as well as connecting with the external transport network and they also have to meet standards related to the fire protection of the facilities.
Road linear 1900 m length and width of 10 m, and a road linear length 1800 m and width of 4 m are envisaged.

The 10 meters, sidewalk included, wide internal roads have to guarantee access to:

- the downhill and uphill treatment platforms, for vehicles of maintenance;
- the long term temporary storage area for inert materials, for dumpers and operations engines;
- the new landfills (including the inert landfill), for dumpers and operations engines.

The maximum admissible slope for the traffic of maintenance and operation engines is 10%.

Preliminary design assumptions for the road structure as follows:

- sub-base course: 30cm layer with 0/60mm crushed stone, including lower geotextile;
- Base course: 20cm layer with 0/31.5mm crushed stone;
- Surface course: tack coat and
  - 6 cm asphalt for light traffic such as LV parking and road from Landfill Operation platform to downhill Leachate treatment Platform.
  - 10cm asphalt (for heavy traffic : from entrance to EfW, CDW, Inert landfill, Landfill Operation Platform.

As shown on **WDP n°20 "Weighbridges area details" in Schedule of Maps and Drawings**, traffic lights will be implemented at the EFW platform entrance, CDW platform entrance and on the crossroad between both platforms.

Access and internal roads on the landfill operation plateform

GENERAL

Landfill operation platform location is in south-east part of the landfill. The location occupies area of about 5000 m^2. The platform consists of:

1. DANGEROUS WASTE HANGAR area ~25m^2
2. RoRo containers (4 pieces)
3. On-site sanitary facilities area ~7m^2
4. MAINTENANCE HALL / ATELIER area ~125m^2
5. WASHING AREA 16x6m
6. MASHINERY PARKING (with 3 parking lots)
7. TRACK PARKING (with 12 parking lots)
8. FUEL PUMP
9. OFFICE BUILDING area ~303m^2
10. CAR PARK (with 20 parking lots)

Solution to traffic

Access of vehicles to the car park and the platform facilities realizes from the internal road with the width of 10 m, which is in the zone of the platform.

Conception of the traffic solution on the Landfill operation platform is based on separation of activities related to administrative building from the other platform facilities.

Administrative building and parking

The access to the Car park is planned independently of the access to the other platform facilities, directly from the internal road. The car park is provided for passenger vehicles of employees and visitors. On this area 20 parking lots with dimensions 2.5x5.0 m are provided with the road width of 6m. The area finishing is planned to be from asphalt-concrete on the corresponding bedding.

Car park users access to the platform, using pedestrian areas. The pedestrian areas are planned to be performed from precast concrete elements on the corresponding bedding.

Other facilities of the Landfill operation platform

Vehicular traffic across the Landfill operation platform is planned to be one-way, with the exception of the DANGEROUS WASTE HANGAR zone, where exit of vehicles which leave the platform and dangerous goods vehicles entry-exit is provided.

The access to the vehicles platform, with the exception of dangerous goods vehicles, is provided from the internal road of the complex directly behind the administrative building. The access road is 7 m wide, so that trucks are directed to the filling station or to the other platform facilities using road marking

The conception of traffic solution of the filling station, which has internal character, is provided with two fuel dispensers each with one Gasoline pump nozzle. This solution enables filling two vehicles at a time. In the framework of the pump station is one fuel tank for machines, capacity 50m3, with 2 fuel pumps (one for light duty vehicule, one for heavy duty trucks and mobiles equipment's.

Parking for trucks and mechanization is provided deeply in the complex with the dimensions 3.5x10m, i.e. 4.5x10m.

The washing area is projected as a containment basin with fouled water central drain and dimensions 16x6m.

Traffic platform areas: of the filling pump, truck and machinery parking, access to the washing area and the maintenance hall, zone where 4 RoRo containers are set and the zone around DANGEROUS WASTE HANGAR are to be performed as rigid (concrete) driving structure on the corresponding base.

All facilities on the platform are to be functionally separated by isles bordered by concrete kerbs with freeboard 12 cm.

Form T.2.8.6 **Infrastructure Connections**

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3 3
Facility No. Name of the Facility	3 New Landfills…

Infrastructure Connections

General

In this moment infrastructure connections are planned according to the existing Detailed Regulation Plan.

New Landfill Concept Design will be the main input for the New Detailed Regulation Plan, which would produce local conditions for this project.

Electric energy grid and facilities

The landfill facilities shall be fed from the planned and existing high and medium voltage overhead lines through the switchyards and pertaining transformer stations.

Each transformer shall be installed in a dedicated electrical room located within the following facilities:

- Crash demolition waste (CDW): 1000 kVA transformer
- Landfill: 600 kVA transformer
- Leachate waste treatment plant (WTP): 3000 kVA transformer
- Energy from waste (EFW): 1000 kVA transformer

Facilities consumers shall be connected directly to the switchgears and switchboards (large consumers) or through the distribution and sub-distribution boards (small consumers, process equipment).

Road infrastructure shall include the underground lines of 10 kV, 1 kV, as well as telecommunication connections.

Public road lighting is foreseen.

The installed and simultaneous landfill facilities power shall be checked and approved.

Location and the connection type on the MV and HV public grid shall be approved by PE EMS and PE EPS.

Waterworks facilities

The subject-matter location is around 2200 m away from the existing waterworks Ø200 in Smederevski put. In the traffic connection of the landfill "Vinca" there is a pipeline Ø100mm in the length of some 450 m. The connection to the city network should be executed to the waterworks Ø200 mm in Smederevski put with the minimum diameter of Ø150mm.

Considering that there is not enough pressure in the existing waterworks, a construction of the new pumping station with pumping point, planned on the north-western side of Nova 1 Street, is necessary.

From Smederevski put to the planned location of the pumping station, city waterworks Ø150mm are planned. After the construction of the waterworks Ø150mm, the existing Ø100mm should be eliminated.

For the needs of water supply to the landfill facilities, waterworks of a minimum diameter Ø150 mm should be constructed to the planned tank (at the level 247,30 masl). The planned waterworks from the pumping facility to the tank should be installed next to the access road, on the east side. An air valve should be placed at the highest point. A water gauge should be placed within the borders of the pumping facility. Within the construction complex, the waterworks should be connected in the ring system with all the necessary reinforcements.

The planned pumping station, waterworks and tank represent an internal network and are not in function of water supply to other consumers.

The existing waterworks do not contain sufficient quantities of water for sanitary, technological and fire fighting needs of the planned facilities, so it is necessary to provide the water locally, from own tanks (run-off ponds).

Sewerage and facilities

Considering that in the part where the landfill is planned there is no constructed rain and faecal sewerage, there is no possibility for connecting to the city sewerage. The draining from this territory is solved locally, which does not fall under the competence of the PUC "Beogradski vodovod i kanalizacija".

For the part that belongs to the Central Sewerage of Belgrade system, the recipient of the precipitation and used water is the Danube river, but the used sanitary water should be treated prior to their discharging. A local treatment facility planned within the K4 unit (DRP) should be constructed for the treatment of the used sanitary water of the planned users.

After the treatment, the treated waters should be discharged into the canal for clean water, next to the internal road.

For the precipitation water from the edge road, Nova 2 Street, a recipient is the road canal.

Leachate water from the new and the old landfill will treat in the leachate treatment plant under protection dam and leachate ponds (downhill platform). Clean water will be discharge to Ošljanski steam and Danube river.

Form T.2.8.11 New Landfills and Existing Landfill Remediation Works – List of equipment and components

Instructions: specify type of landfill or "overall landfill", if components are used for the entire landfills on the Site

LANDFILL NO. / ALL LIST OF EQUIPMENT AND COMPONENTS	
	Page 1 of 1
Bidder	
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3
Facility No. Name of the Facility Location of the Facility	3
List of the equipment and components for *All landfills*	

No	Equipment and components / construction activity	Responsible key Sub-Contractor
	Reception area	Energoprojekt Niskogradnja
	Basal lining system	Energoprojekt Niskogradnja
	All layers *(please specify)*	Energoprojekt Niskogradnja
	Surface capping system	Energoprojekt Niskogradnja
	Final capping - all layers *(please specify)*	Energoprojekt Niskogradnja
	Intermediate capping	Energoprojekt Niskogradnja
	Drainage system	Energoprojekt Niskogradnja
	Leachate collection (pipes, excavated trenches, pumps, manholes, leachate tank, etc.)	Energoprojekt Niskogradnja
	Surface water run-off system (pipes, ditches, manholes, etc.)	Energoprojekt Niskogradnja
	Electric installation	Energoprojekt Niskogradnja
	Landscaping	Energoprojekt Niskogradnja
	Vehicles	SPV
	Compactors	SPV
	Bulldozers	SPV
	Loaders	SPV
	Excavators	SPV
	Trucks	SPV
	Containers	SPV
	Civil works (*please specify if split to various contractors*)	Energoprojekt Niskogradnja
	Others *(please list further as required)*	

Form T.2.9 **Construction Programme and Commissioning Plan**

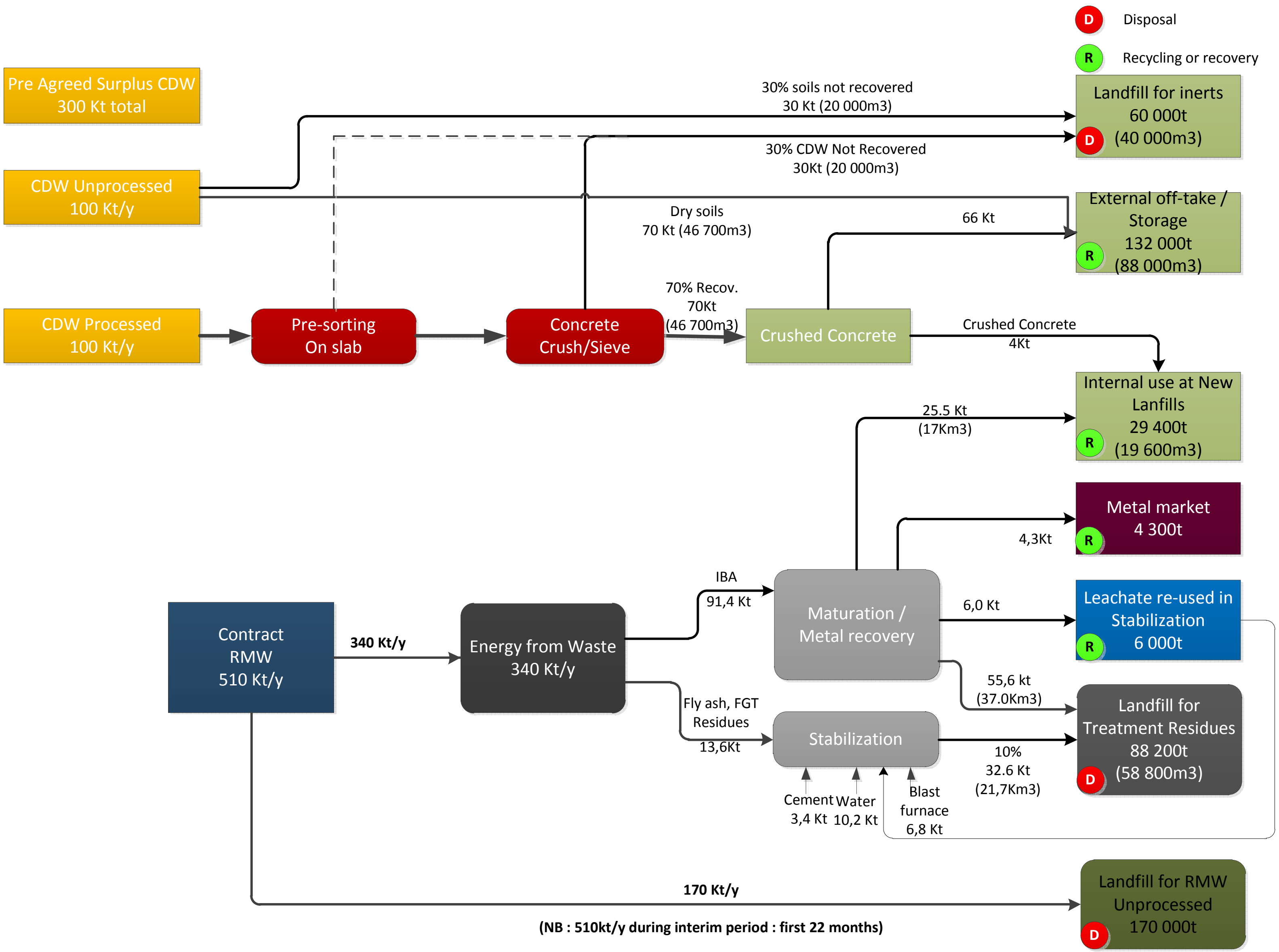
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3 3
Facility No. Name of the Facility	2 New Landfills

Construction Programme and Commissioning Plan

Please refer to Form T.2.6 Overall Project Time Schedule for the view on the New Landfills Construction Programme

Form T.2.10 Process Flow Diagram with Mass and Energy Balance

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3 3
Facility No. Name of the Facility	3 New Landfills



D Disposal
R Recycling or recovery
Pre Agreed Surplus CDW
300 Kt total
CDW Unprocessed
100 Kt/y
CDW Processed
100 Kt/y
Pre-sorting
On slab
Concrete
Crush/Sieve
70% Recov.
70Kt
(46 700m3)
Crushed Concrete
30% soils not recovered
30 Kt (20 000m3)
30% CDW Not Recovered
30Kt (20 000m3)
Dry soils
70 Kt (46 700m3)
66 Kt
Crushed Concrete
4Kt
Landfill for inerts
60 000t
(40 000m3)
External off-take / Storage
132 000t
(88 000m3)
Internal use at New Lanfills
29 400t
(19 600m3)
25.5 Kt
(17Km3)
Metal market
4 300t
4,3Kt
Leachate re-used in Stabilization
6 000t
6,0 Kt
Contract
RMW
510 Kt/y
340 Kt/y
Energy from Waste
340 Kt/y
IBA
91,4 Kt
Maturation / Metal recovery
55,6 kt
(37.0Km3)
Fly ash, FGT
Residues
13,6Kt
Stabilization
10%
32.6 Kt
(21,7Km3)
Cement
3,4 Kt
Water
10,2 Kt
Blast
furnace
6,8 Kt
Landfill for Treatment Residues
88 200t
(58 800m3)
170 Kt/y
(NB : 510kt/y during interim period : first 22 months)
Landfill for RMW Unprocessed
170 000t

Form T.2.11 Drawings

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	3 3
Facility No. Name of the Facility	3 New Landfills

Please find in Schedule of maps and drawings the following list of drawings :

LANDFILL - LAY OUT & CROSS SECTIONS		
Number	**Version**	**Designation**
WDP 00	**A**	Vinca site facilities footprints vs DPR_Rev_B-Présentation1
WDP 01	**I**	Existing landfill reshaping
WDP 02	**I**	Existing landfill reshaping - waste cut and fill plan
WDP 03	**I**	Existing landfill reshaping - cross sections
WDP 04	**K**	General plan of new landfill
WDP 05	**D**	Cut and fill of new landfill
WDP 06	**G**	Landfill and inert cover with CDW stock
WDP 07	**A**	General cross sections
WDP 08	**D**	Cross sections of CDW storage and inert stock
WDP 09	**C**	Cross section of new landfill for stability calculations
WDP 10.1 to WDP 10.18	**B**	3d views of VINCA landfill
WDP 11	**D**	Landfills cover and bottom details, ponds details
WDP 12	**D**	Peripheral dyke details
WDP 13	**G**	Biogas collection system
WDP 14	**H**	Leachate collection system
WDP 15	**K**	Runoff collection system
WDP 16	**B**	Runoff drainage surfaces
WDP 17	**D**	Traffic flow
WDP 18	**B**	Peripheral dyke and protection dam connection detail
WDP 19	**B**	Details between new and existing landfill
WDP 20	**D**	Weighbridges area details
WDP 21.1 to WDP 21.5	**A**	Phasing 2021 to 2046
WDP22.1 to WDP 22.3	**B**	Platforms details

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To address the point (ii) : WDP 00, WDP 01, WDP 4, WDP 6 and WDP 21

To address the (iii) 3D views of the planned landfill bodies : WDP 10.1 to 10.18

To address point (iv) and (v) longitudinal and cross sections : WDP 3, WDP 5, WDP 6, WDP 7, WDP 8 and WDP 9.

To address the point (vi) rainwater and surface water drainage : WDP 15 and WDP 16

To address the point (vii) details of dam penetration of leachate drainage pipe : WDP 18.

To address point (viii) details of liner system, leachate drainage and gas collection system : WDP 11, WDP 12, WDP 13, WDP 14, WDP 15.

To address the point (x), preliminary design drawings of each building please see :

LANDFILL - ARCHITECHTURAL		
		ARH-001 CDW ops building.pdf
		ARH-002 Office - Locker room.pdf
		ARH-003 Office - Locker room.pdf
		ARH-004 Maintenance hall - Atelier.pdf
		ARH-005 On site sanitary facilities.pdf
		ARH-006 Dangerous waste hangar.pdf
		USA-001 Operation platform layout.pdf
		USA-002 CDW platform layout.pdf
		Internal roads-cross sections-C5.4.1.pdf

To address the points (xi) and (xii) : WDP 4, WP 17, WDP 20, WDP 21 and WDP 22.

WORKS DELIVERY PLAN 4

LEACHATE TREATMENT FACILITY

Form T.2.8.1 **Overall concept design**

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility	4 Leachate Treatment Facility

Overall Concept Design

The Overall Concept design for the Leachate Treatment Facility is crucially dependent upon the assessment of the volume of leachate to be treated from both the Existing and the New Landfills, an area where there is hardly any data available.

The following presents the Consortium's approach to the volume of leachates to be treated from the Vinca landfills.

1. Leachate production

1.1 Water balance calculation

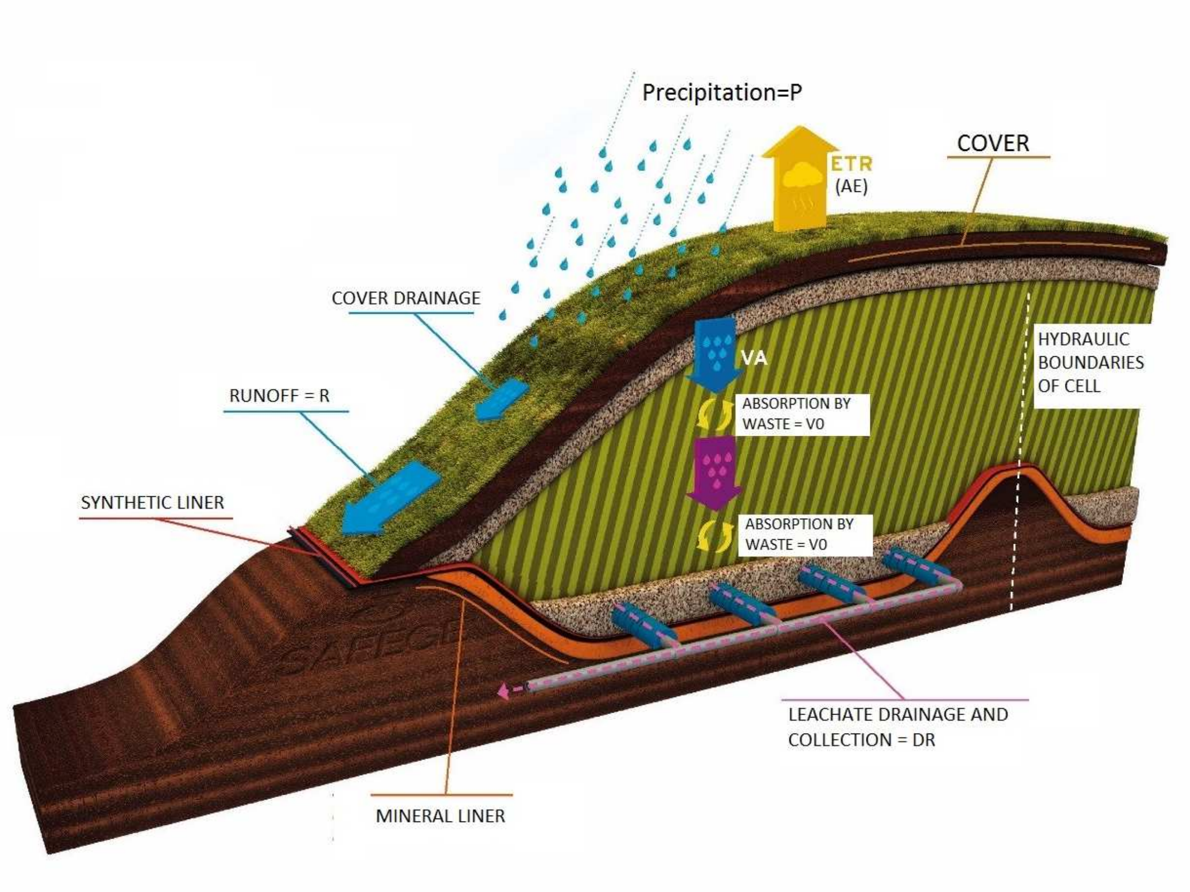
Purpose

The purpose of the water balance calculations is to assess the volume of leachate generated by the infiltration of precipitation into the waste body at different stages of landfill operation, namely:

- during the operation and extension of the New Landfills
- during the last years of operation of the Exisiting Landfill by the PUC, as well as during the Remediation Works

The model used

Software modelling tool PROLIX has been used to determine the water balance by capturing all potential sources of infiltration into the waste, as illustrated below.



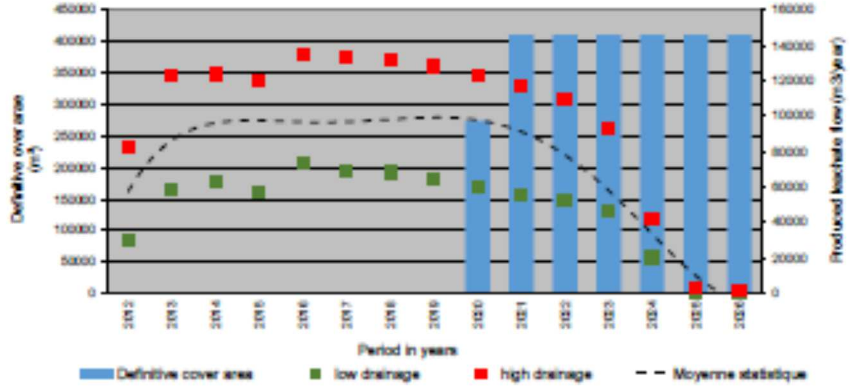
Picture: Schematic of inputs to and outputs from a landfill cell

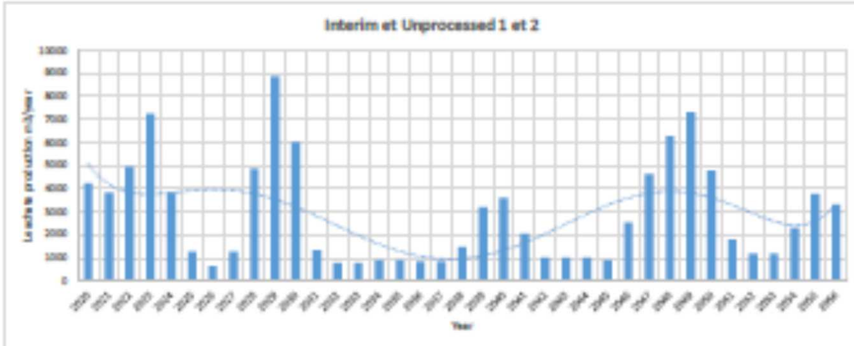
The outputs are presented in the following page. It is expected that the remediation and capping of the Exisiting Landfill will result after some years in practically stopping the production of leachates, or at least, its capture due to the lack of bottom liner. In parallel, the regular production of leachates from the New Landfills will be recovered for solidification of APCRs at the EfW Facility.

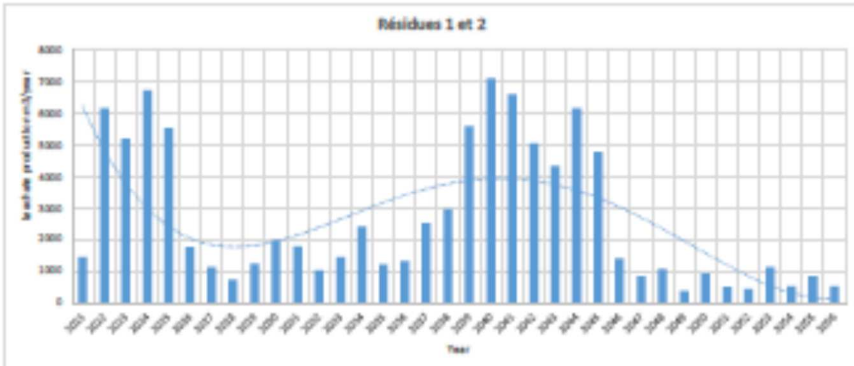
Nevertheless, a sizeable treatment facility is required to treat the volume of leachates collected in the first years of the project following the Interim Services Commencement Date, with up to 90,000 m3 of leachates collected per year.

VINCA Landfill (Serbia)
Results of the water balance calculations

Year	ANNUAL DRAINAGE FLOW RATE				
	Old Landfill			New landfill	
	High annual drainage (m3/an)	Low annual drainage (m3/an)	Average (m3/an)	Interim and Unprocessed waste landfill	Treatment residues landfill
2000	44 125	29 291	36 708		
2001	37 418	25 281	31 350		
2002	29 363	18 575	23 969		
2003	20 454	7 674	14 064		
2004	48 769	27 704	38 237		
2005	49 960	22 303	36 131		
2006	37 084	14 948	26 016		
2007	42 306	12 805	27 555		
2008	62 769	24 420	43 595		
2009	80 562	39 855	60 208		
2010	84 308	43 492	63 900		
2011	71 334	28 404	49 869		
2012	82 608	30 592	56 600		
2013	123 341	58 613	90 977		
2014	123 970	62 781	93 375		
2015	119 936	57 284	88 610		
2016	134 514	73 444	103 979		
2017	133 930	69 202	101 566		
2018	132 420	68 325	100 372		
2019	128 532	64 590	96 561		
2020	122 980	60 551	91 766	4 217	
2021	117 429	55 889	86 659	3 805	1 446
2022	109 408	52 490	80 949	4 946	6 159
2023	93 152	47 017	70 085	7 212	5 187
2024	42 415	20 293	31 354	3 811	6 717
2025	3 520	0	1 760	1 271	5 530
2026	1 619	0	810	651	1 761
2027				1 283	1 126
2028				4 840	731
2029				8 834	1 228
2030				5 973	1 959
2031				1 336	1 782
2032				776	1 029
2033				776	1 439
2034				891	2 403
2035				891	1 232
2036				856	1 306
2037				856	2 504
2038				1 461	2 954
2039				3 176	5 594
2040				3 593	7 107
2041				2 047	6 586
2042				1 003	5 046
2043				1 007	4 336
2044				1 007	6 164
2045				893	4 769
2046				2 530	1 406
2047				4 620	831
2048				6 254	1 061
2049				7 280	865
2050				4 757	918
2051				1 790	506
2052				1 191	430
2053				1 191	1 136
2054				2 303	534
2055				3 760	828
2056				3 309	535







Emission limit values of water pollutants

According to the Serbian regulation on emission limit values of water pollutants (No: 67/2011 and its updates No 48/2012 and No: 1/2016), the processed leachates (after treatment) should meet the values defined by the regulation before discharging them to the natural environment:

Table 1: Serbian regulation on emission limit values of water pollutants

Parameter	Units	Limit values
Temperature	°C	30
pH		6,5-9
Suspended solid	mg/l	35
BOD (BPK_5)	mgO_2/l	20
COD (HPK)	mgO_2/l	200
Total inorganic nitrogen (NH_4-N, NO_3-N, NO_2-N)	mg/l	70
Total phosphorus	mg/l	3
Hydrocarbon index	mg/l	10
Nitrogen from nitrates (NO_2-N)	mg/l	2
Toxicity to fish (T_F)		2

Definition of process

The choice of treatment technology is guided by the input data, SUEZ experience and the Project's conditions.

The **effluent in Vinca** presents the following characteristics:

- High Organic load (COD and BOD_5)
- High Nitrogen load in the form of ammonium
- Salt load (chlorides and conductivity)

The following observations can be made from analyzing the requirements of the applicable **discharge standards**:

- hard COD must treated by a final treatment step.
- the max allowed level of Nitrogen requires a complete Nitrogen treatment process.

The Leachate Treatment Plant will combine two technologies: a first step to concentrate leachate with Reverse Osmosis (RO) and a second step to reduce brines through a vacuum evaporator equipped with mechanical vapor compression.

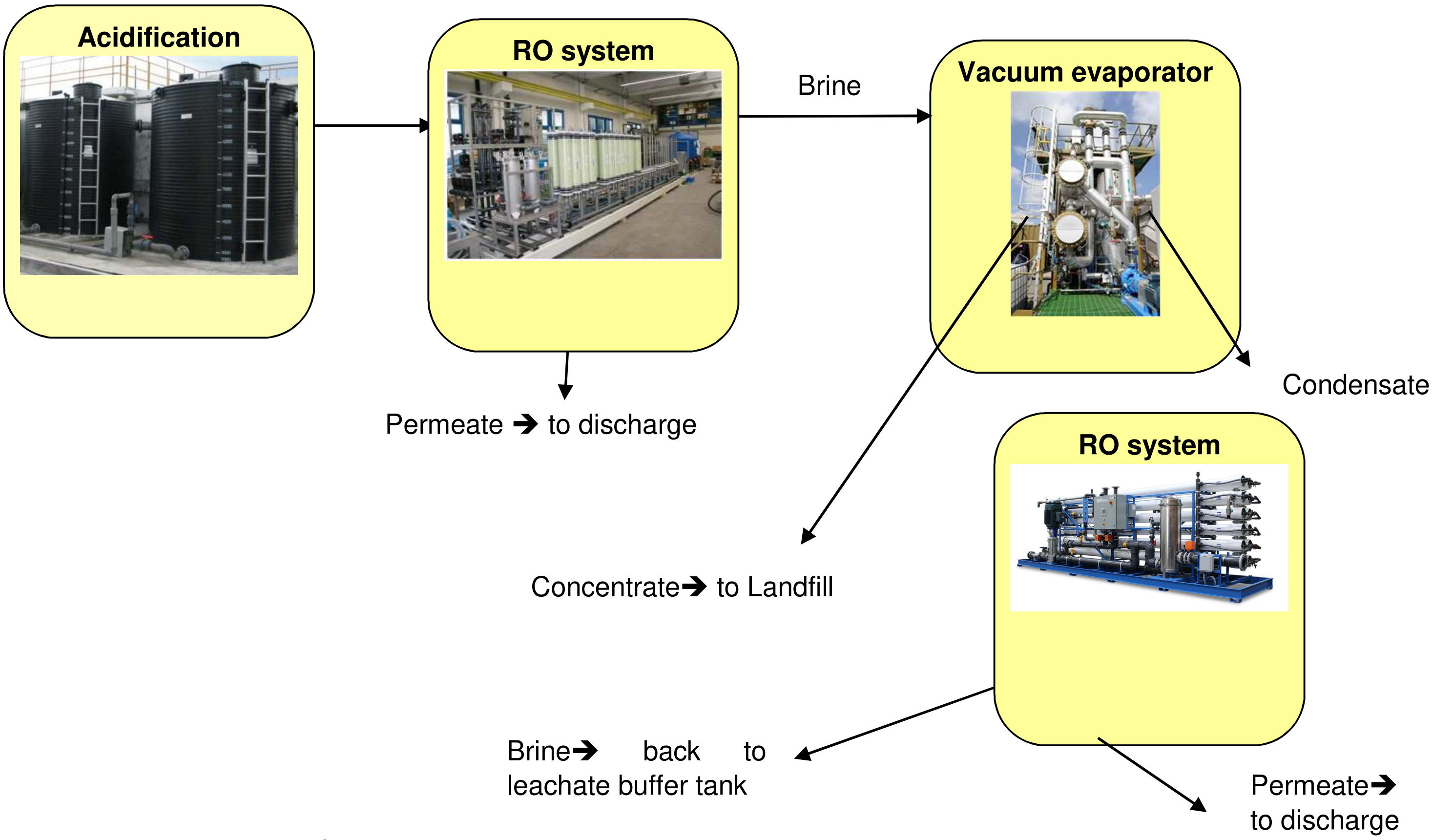
Compared with a standard biological treatment such as membrane bioreactor, the advantages of this system are :

- to ease start-up/stop on the equipment : biological treatment needs time to adapt to the site leachates quality and reach nominal flow while as RO + Evaporator configuration is based on physical separation, it can start-up and stop easily.

- to reduce by products production : RO brines are concentrated in order to have a dryness between 20 to 30 % max
- to adapt easily the unit to the decreased flowrate

Leachate is filtered and acidified to avoid membranes clogging using the reverse osmosis technology directly on leachate and ensure ammonia treatment.

The first stage RO systems will concentrate leachate to reduce the flow rate. RO permeate will be discharged to the environment. RO concentrated flow will be treated by a vacuum evaporator to increase dryness of the residue to a minimum of 20%. Evaporator condensates will be discharged to the environment while concentrates will be disposed of at the New Landfill with or without solidfication.



♦ **Reverse osmosis system - leachate**

- ♦ Reverse osmosis (RO) is a water purification technology that uses a semi-permeable membrane. In reverse osmosis, an applied pressure is used to overcome osmotic pressure. Reverse osmosis can remove many types of molecules and ions from solutions, and is used in both industrial processes and producing potable water. The result is the solute is retained on the pressurized side of the membrane and the pure solvent is allowed to pass to the other side. To be "selective", this membrane should not allow large molecules or ions through the pores (holes), but should allow smaller components of the solution (such as the solvent) to pass freely.
- ♦ Leachate is beforehand filtered to remove sand, clay and big particles.
- ♦ It is necessary to treat ammonia which is a component of leachate. Free ammonia can pass through the membrane of RO system and will be find in the permeate flow. Permeate flow goes to drain. Therefor filtered leachate is acidified with sulfuric acid convert ammonia into ammonium sulphates which remain in concentrate phase with the membrane treatment.

- Depending of the leachate quality (mainly salt and organic concentrations) recovery rate will be around 50% to 70%.

- **Vacuum evaporators**

  - The vacuum evaporator process treats leachate thermally. Mainly heat will come from hot water loop (from boiler or cogeneration loop). If no hot water loop is available, it is possible to bring energy with alternate solutions such as electric heater. The evaporator works under vacuum, that allows to decrease the water boiling point and separate steam from salts at lower temperature.
  - Nitrogen (ammonia) contained in leachate has to be treated beforehand. Otherwise, ammonia will stay in the steam phase and not in the liquid phase. Ammonia pre-treatment could either be done with biologic treatment (nitrification wwtp) or with acidification.
  - Evaporator consists in a two stages system which is composed of:
    - First stage : a falling film evaporator with mechanical vapors compression, followed by
    - a forced circulation second stage.

In the first stage, energy comes from a hot water loop (from a boiler or electrical heater) to evaporate under vacuum water contained in the leachate. As the energy available from hot water loop is not enough to provide all energy, a vapor compressor will be installed. Vapor compressor will entertain the reaction by compressing produced mists. By increasing pressure of the vapor, the blower increases the condensation temperature. Compressed mists are used to entertain first stage evaporation and to evaporate water on the second stage of the evaporator.

In the case of mechanical vapor compression, the heating loop is used to start the process. Then, energy brought by the compressor is enough to entertain the process.

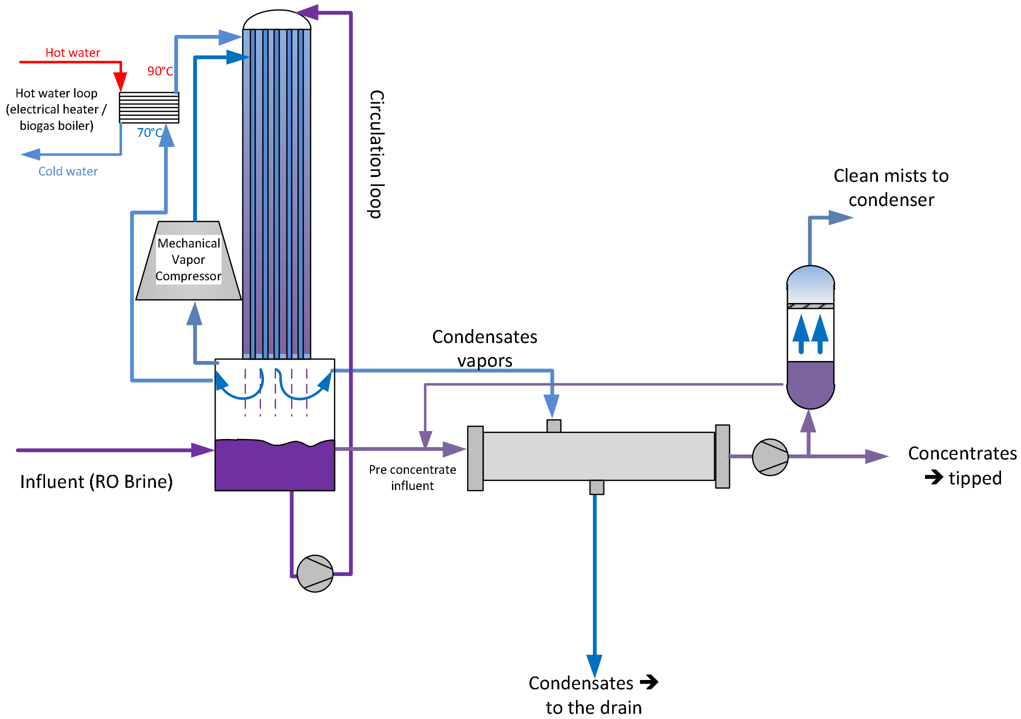
The second stage will use energy contained in the vapors produced in the first stage which will condensate to evaporate water contained in the concentrated leachate coming from the first stage. Concentrate siccity will reach max 30% at the exit of the second stage.

A two stage vacuum evaporator equipped with MVC permits to reduce drastically the energy demand to evaporate water, by using condensation energy from vapors produced on the first stage to evaporate water contained in leachate.

Vapors from the second stage are condensed with either a dry cooler, a cooling tower or other cold source

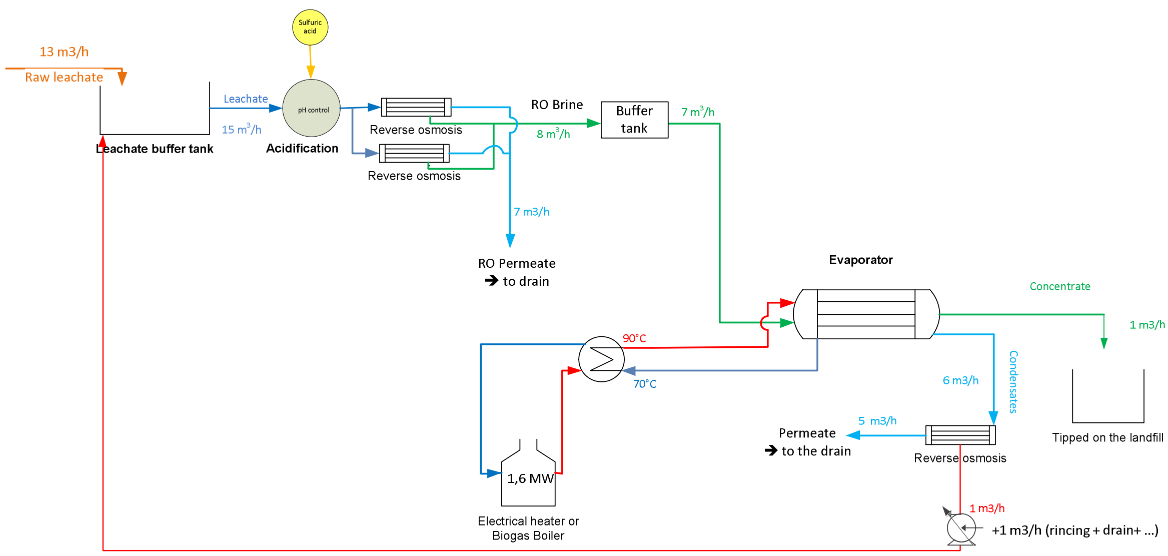
- Produced condensates are good quality water, free from most of salts and organic compounds, will easily be below discharge limits.

- Vacuum evaporator's concentrates will reach maximum 20%-30% dryness and will be composed of salts, nitrogen, organics, metals from the leachate. Concentrates will represent about 6% of the raw leachate entering in the RO systems.



- **Reverse osmosis system – clean water**
  - A Reverse osmosis system will be installed after the vacuum evaporators to treat Evaporators condensates. Evaporator condensates are clean water. However, a RO system will remove ammonia, salts, heavy metals traces and ensure at any time to be below the limits.
  - RO concentrate will be recirculated to the leachate buffer tank while RO permeate will go to the drain.
  - On clean water, the recovery ratio of the RO system can go up to 85-90%.

1.1. Detail of the solutions



The leachate treatment plant is sized to treat 90 000 m^3/y.

1.1.1. Reverse osmosis

- **Acidification**
  - Transformation of the nitrogen, which is present in the leachate as ammonium, into non-volatile salts A first step of acidification will be done before RO treatment

- **Reverse osmosis – direct leachate treatment**
- Two parallel RO system of 200 m3/d treatment capacity will be installed
- RO system will have a recovery rate of about 54%. RO will produce around 50 000 m3/y of treated water which will go to the drain. Concentrate phase which represent about 40 000 m3/year will feed the vacuum evaporators.
- RO will concentrate pollutants contained in the leachate into the RO concentrate phase.
- RO system components :
  - *RO Pretreatment :*
    - Rotary sieves
    - Sand filter to eliminate particles > 30 µm diameter
    - Acidification
    - Filtration to remove suspended solids and protect membranes. Pre filtration done by :
      - 2 cartridges filter of 10 and 1 µm to protect the membranes.

  - *Membranes :*

    Each 200 m3/d RO skid will be composed of 2 stages of membranes :
    1st stage : 1337 m^2 of membrane composed of 36 membranes of 8”, followed by a
    2nd stage : around 446 m^2 of surface membrane composed of 12 membranes of 8”.

    RO systems will be equipped with 8” spiral organic membranes. These membranes have a high retention ratio.

    Stage 1 will be feed with high pressure pump of 70b and about 5 m3/h to ensure a sufficient cross flow filtration velocity (> 16 m/h) and limit membranes clogging.

  - *CIP*

    CIP equipment will be installed to allow RO membranes cleaning with acid and basic chemicals. Each stage could be cleaned independently.

1.1.2. Evaporation

Due to the diversity of the pollution in leachate, the best solution to treat leachate is to use a heat treatment such as evapo-concentration. Once nitrogen stabilized by pre-treatment, evaporation-condensation can concentrate pollutants without odor emissions.
We propose to install a double stage evapo-concentrators of 40 000 m3/y capacity.
The first stage will be composed of a falling film evaporator. Between 2020 and mid-2021, when biogas will not be available, energy to evaporate water will come from electric heaters to initiate the process. Once the evaporator warmed and the process running, energy comes from a vapor compressor which compresses mists to increase energy. After mid-2021, when biogas will be available, a 1,6 MW biogas boiler will provide hot water loop to start the unit.

This energy is used to evaporate the water contained in the leachate. Vapors are used (by condensing in the heat exchanger) to evaporate contained in concentrated leachate in the second phase.
The second stage is composed of a forced circulation evaporator. This technology allows to reach 20%-30% dryness.
Falling film and forced circulation evaporators work under vacuum; this will reduce the risk of corrosion and scaling compared to evapo-concentrator working at atmospheric pressure.

To measure the effectiveness of this treatment phase, a continuous measurement of the quality of the condensate outlet of the condenser is provided with a conductivity meter.

Leachate ponds sizing

Output Specifications define (part 2.2.3, item #16) that:

"The leachate of all landfill areas at the Site shall be collected and directed to a common leachate pond sealed with an impermeable liner. The leachate pond shall have an adequate capacity to

receive the average leachate quantity of 20 consecutive calendar days or the quantity after 3 calendar days continuous heavy rainfall – 25 year storm valid for the Site, whichever is larger."

The following table summarizes the values of leachate ponds capacities estimated with both methods and the selected value (the larger one) for each pond.

Leachate ponds capacity

	Leachate ponds capacity		
Pond	1st method: Average leachate quantity of 20 consecutive calendar days	2nd method: Quantity of leachates after 3 calendar days continuous heavy rainfall – 25 years storm (see **appendix 6.2**)	Selected value
"Existing Landfill" leachate reservoir	13 800 m^3 (max monthly production : 20 590 m^3)		13 800 m^3
"Treatment Residues Landfill" leachate reservoir	890 m^3 (max monthly production : 1 330 m^3)	For a 1 ha active area : 2 000 m^3	2 000 m^3
"Unprocessed Waste landfill" leachate reservoir	1 030 m^3 (max monthly production : 1 540 m^3)	For a 1 ha active area : 2 000 m^3	2 000 m^3

Notes:

The calculations have been made for a 100 years storm according to the available datas of the Belgrade meteorological station

The leachate reservoirs will be designed as follows (from the top to the bottom):

- HDPE liner;
- Geotextile;
- Gas drainage liner (connected to gas washout vents), which prevents the formation of gas "pockets" under the HDPE liner;
- 0,5m clay-like material (with a permeability < 1.10^{-9} m/s)
- Underground water drainage pipe (on a peripheral trench filled with drainage gravel at the bottom of the pond).

This design is illustrated on the following schematic layout.

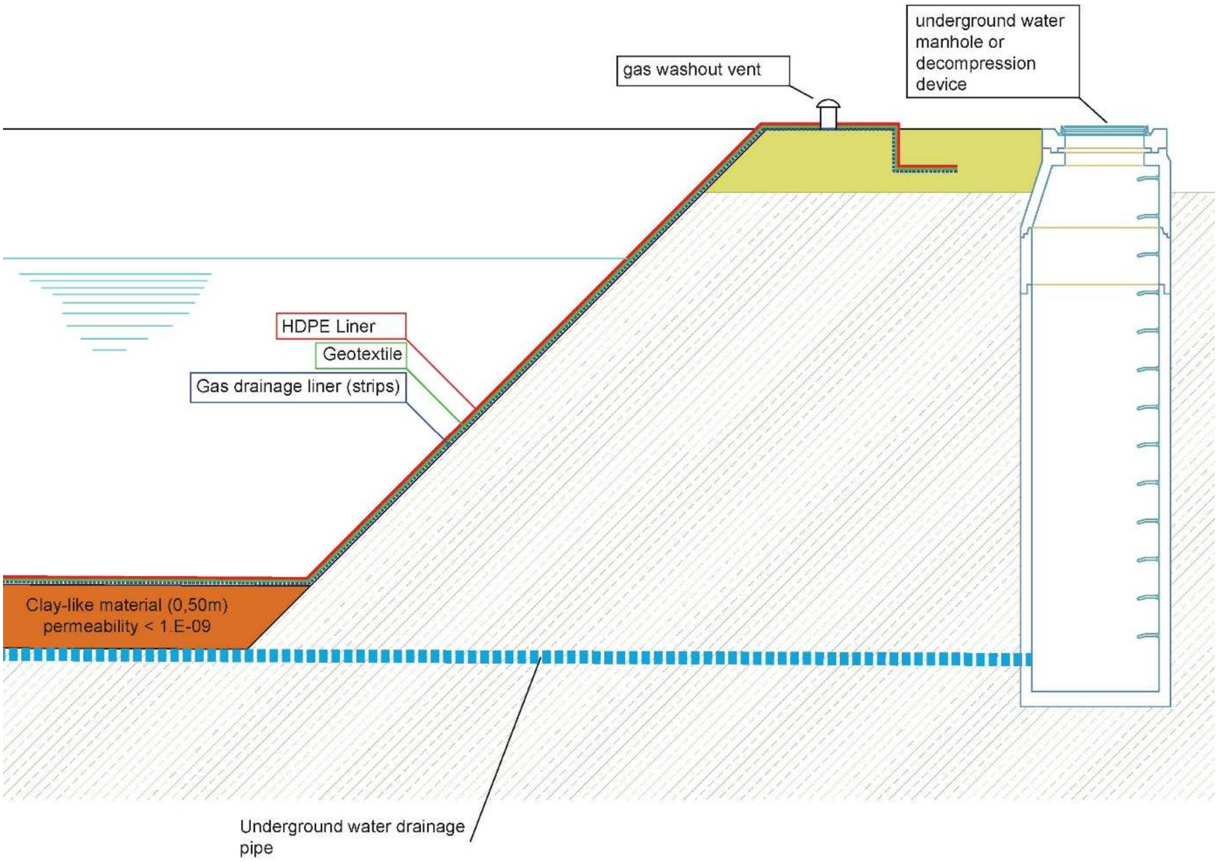


Illustration : Leachate and runoff water ponds design

Leachate treatment area

The Leachate Treatment Plant will be located at the bottom of the Existing Landfill, on a dedicated area behind the Dam built by the City.

The platform will have the following characteristics :

- 2H/1V peripheral slopes;
- Platform height of 90 which allow a gravity discharge of runoff water and leachates from the Existing Landfill, below the Dam;
- Available area of 11 500 square meters;
- 56 700 cubic meters of cutting and 300 cubic meters of backfilling.

It can be noticed that the downhill platform can be extended up to 18 000 square meters. Indeed the natural ground surrounding this area is relatively flat.

Form T.2.8.2.6 Leachate treatment facilities

LEACHATE TREATMENT FACILITY	
	Page 1 of 2
Bidder	
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility Location of the Facility	4 Leachate Treatment Facility in 2 steps : RO treatment of leachate Evaporation of RO Brine See Lay-out - Form 2.2.3
Storage pond capacity Leachate pond New Landfills Leachate pond Existing Landfill	4 000 m³ 4 000 m³
Nominal capacity	RO 15. m³/h - 105 000 m³/a Evaporation : 7,5 m3/h - 50 000 m3/an
Peak capacity	RO 15 m³/h Evaporation : 7,5 m3/h
Number of lines	RO.: 2 lines of 7,5 m3/h Evaporation : 1 line of 7,5 m3/h
Number of working shifts	1
Operating time	292 d/a 7,000 h/a
Availability time ratio	80 %
Full load operating hours	6 000 h/a
Nominal capacity of Main Facility components: • Reverse Osmosis treatment • Evaporation of brine from RO	 • 15 m³/h • 7,5 m³/h
Facility outputs (please specify) 1. Clean Water 2. Concentrates	Specify quantity and destination (e.g. landfill (section) Based on 90,000 m3: 1. 83 000 t/a to environment 2. 7 000 t/a for disposal
Required area for the Facility (total)	2 000 m²

Form T.2.8.3 List of Buildings and Architectural Concept Design

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility	4 Leachate Treatment Facility

List of Buildings and Architectural Concept Design

Not Applicable. Outdoor equipment.

Form T.2.8.4 Earthworks

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility	4 Leachate Treatment Facility

Earthworks for the Leachate Treatment Facility are included in the works conducted for the New Landfills.

Form T.2.8.5 Foundations

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility	4 Leachate Treatment Facility

Foundations

The Leachate Treatment Facility will be installed on a concrete slab which is part of the scope of works of the New Landfills executed by the Landfill EPC Contractor.

Form T.2.8.6 Roads, paved areas and parkings

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility	4 Leachate Treatment Facility

Roads, paved areas and parkings

Roads and manoeuver areas servicing the Leachate Treatment Facility are in the scope of works of the New Landfills executed by the Landfill EPC Contractor.

Form T.2.8.7 **Infrastructure Connections**

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility	4 Leachate Treatment Facility

Infrastructure Connections

Power
Water supply

Form T.2.8.12 Leachate Treatment Facility – List of Equipment and Component

LEACHATE TREATMENT FACILITY LIST OF EQUIPMENT AND COMPONENTS	
	Page 1 of 2
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility Location of the Facility	4 Leachate Treatment plant see Lay-out - Form 2.2.3
List of the equipment and components for Leachate Treatment Facility	

No	Equipment and components / construction activity	Responsible key Sub-Contractor
	Treatment technology/ies, as applied	O&M Contractor (as supplier during Works Period)
	Equipment and components according to technology/ies applied	O&M Contractor (as supplier during Works Period)
	Discharge of waste water	O&M Contractor (as supplier during Works Period)
	Electrical and I&C systems	O&M Contractor (as supplier during Works Period)
	Electricity MV to the Site	Energoprojekt Niskogradnja
	Vehicles	N/A
	Containers	O&M Contractor (as supplier during Works Period)
	Civil works (*slab*)	Energoprojekt Niskogradnja
	Others *(please list further as required)*	

Form T.2.9 Construction Programme and Commissioning Plan

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility	4 Leachate Treatment Facility

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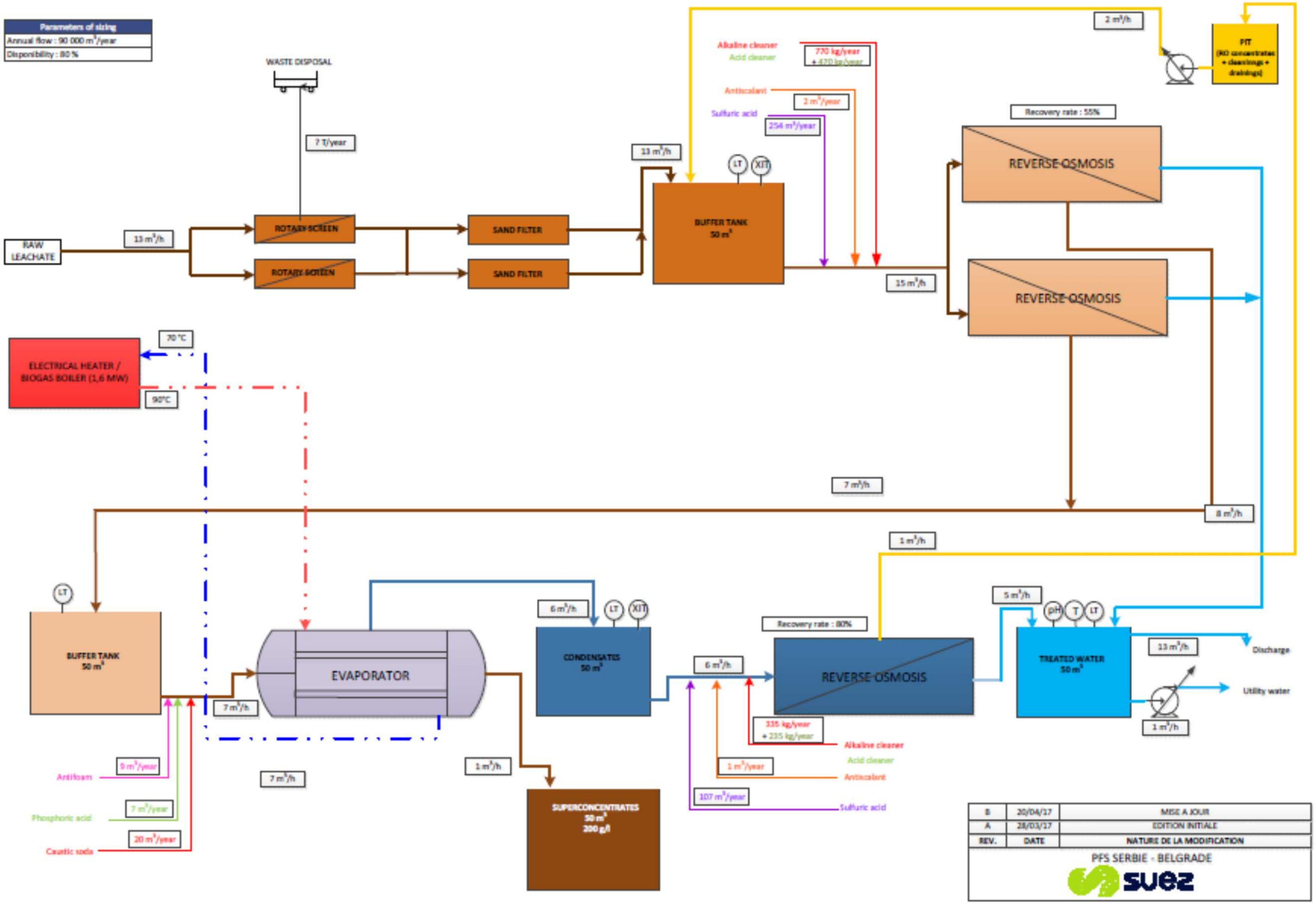
Construction Programme and Commissioning Plan

Please refer to Form T.2.6 Overall Project Time Schedule for the view on the Leachate Treatment Facility Construction Programme.

The Leachate Treatment Facility will be operational by end of 2019 for the Interim Services Commencement Date.

Form T.2.10 Process Flow Diagram with Mass and Energy Balance

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility	4 Leachate Treatment Facility

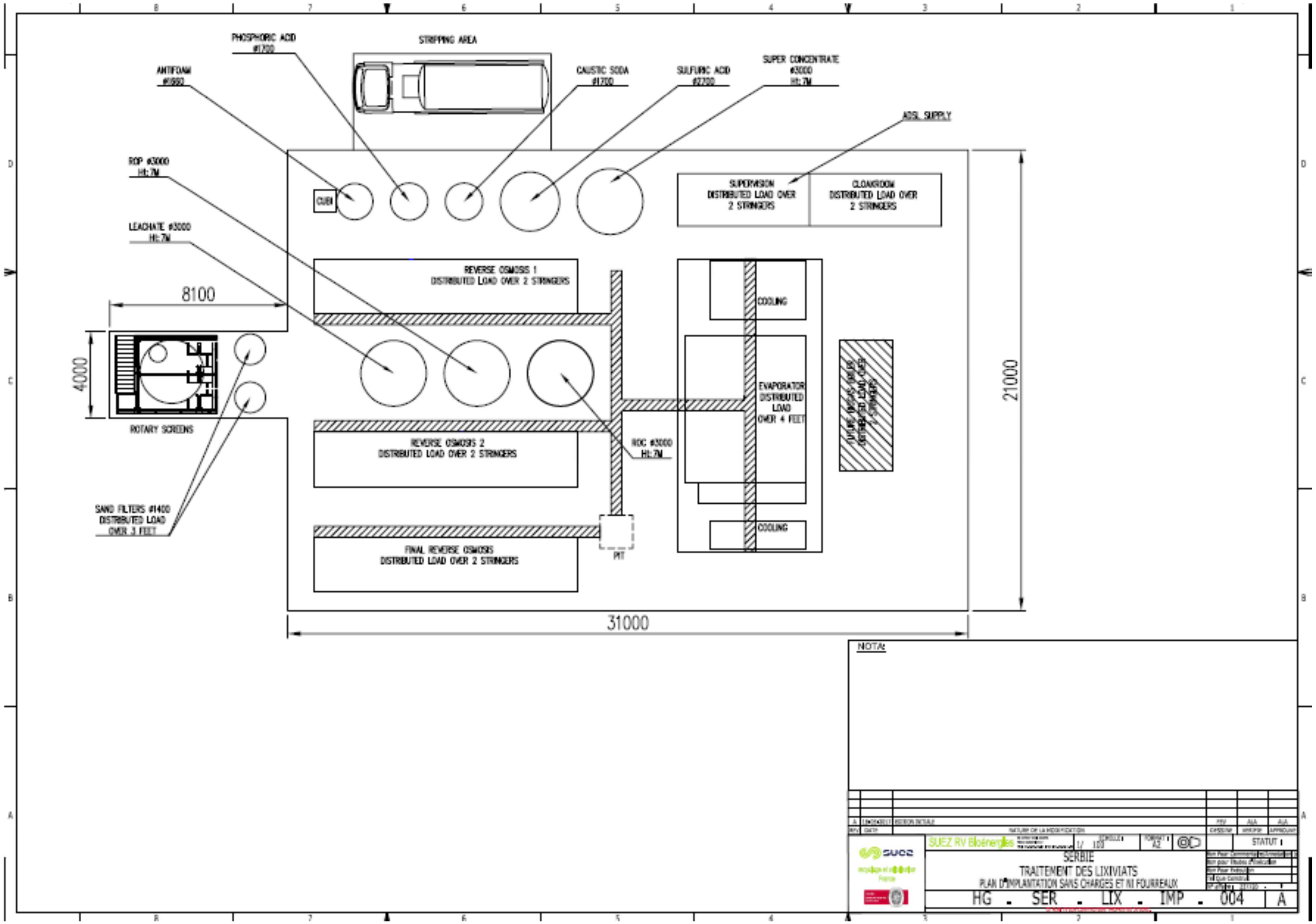


Parameters of sizing
Annual flow : 90 000 m³/year
Disponibility : 80 %
WASTE DISPOSAL
7 T/year
RAW LEACHATE
13 m³/h
ROTARY SCREEN
ROTARY SCREEN
SAND FILTER
SAND FILTER
13 m³/h
LT
XIT
BUFFER TANK
50 m³
Alkaline cleaner
Acid cleaner
770 kg/year
+ 470 kg/year
Antiscalant
2 m³/year
Sulfuric acid
254 m³/year
15 m³/h
2 m³/h
PIT
(RO concentrates + cleanings + drainings)
Recovery rate : 55%
REVERSE OSMOSIS
REVERSE OSMOSIS
70 °C
ELECTRICAL HEATER / BIOGAS BOILER (1,6 MW)
90°C
7 m³/h
8 m³/h
1 m³/h
LT
BUFFER TANK
50 m³
EVAPORATOR
6 m³/h
LT
XIT
CONDENSATES
50 m³
6 m³/h
Recovery rate : 80%
REVERSE OSMOSIS
5 m³/h
pH
T
LT
TREATED WATER
50 m³
13 m³/h
Discharge
Utility water
1 m³/h
7 m³/h
Antifoam
9 m³/year
Phosphoric acid
7 m³/year
Caustic soda
20 m³/year
7 m³/h
1 m³/h
SUPERCONCENTRATES
50 m³
200 g/l
335 kg/year
+ 235 kg/year
Alkaline cleaner
Acid cleaner
1 m³/year
Antiscalant
107 m³/year
Sulfuric acid
B | 20/04/17 | MISE A JOUR
A | 28/03/17 | EDITION INITIALE
REV. | DATE | NATURE DE LA MODIFICATION
PFS SERBIE - BELGRADE

Form T.2.11 Drawings

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility	4 Leachate Treatment Facility

LEACHATE TREATMENT PLANT- PROCESS DRAWINGS		
		Leachate Treatment - process.pdf
		Leachate Treatment Lay out.pdf
		Leachate Treatment Architectural 3D.pdf


PHOSPHORIC ACID
ø1700
STRIPPING AREA
ANTIFOAM
ø1660
CAUSTIC SODA
ø1700
SULFURIC ACID
ø2700
SUPER CONCENTRATE
ø3000
Ht: 7M
ADSL SUPPLY
ROP ø3000
Ht: 7M
CUBI
SUPERVISION
DISTRIBUTED LOAD OVER
2 STRINGERS
CLOAKROOM
DISTRIBUTED LOAD OVER
2 STRINGERS
LEACHATE ø3000
Ht: 7M
REVERSE OSMOSIS 1
DISTRIBUTED LOAD OVER 2 STRINGERS
8100
COOLING
4000
EVAPORATOR
DISTRIBUTED
LOAD
OVER 4 FEET
21000
ROTARY SCREENS
REVERSE OSMOSIS 2
DISTRIBUTED LOAD OVER 2 STRINGERS
ROC ø3000
Ht: 7M
SAND FILTERS ø1400
DISTRIBUTED LOAD
OVER 3 FEET
COOLING
FINAL REVERSE OSMOSIS
DISTRIBUTED LOAD OVER 2 STRINGERS
PIT
31000
NOTA:
SUEZ RV Bioénergies
1/ 100
A2
STATUT :
SERBIE
TRAITEMENT DES LIXIVIATS
PLAN D'IMPLANTATION SANS CHARGES ET NI FOURREAUX
HG . SER . LIX . IMP . 004
A

WORKS DELIVERY PLAN 5

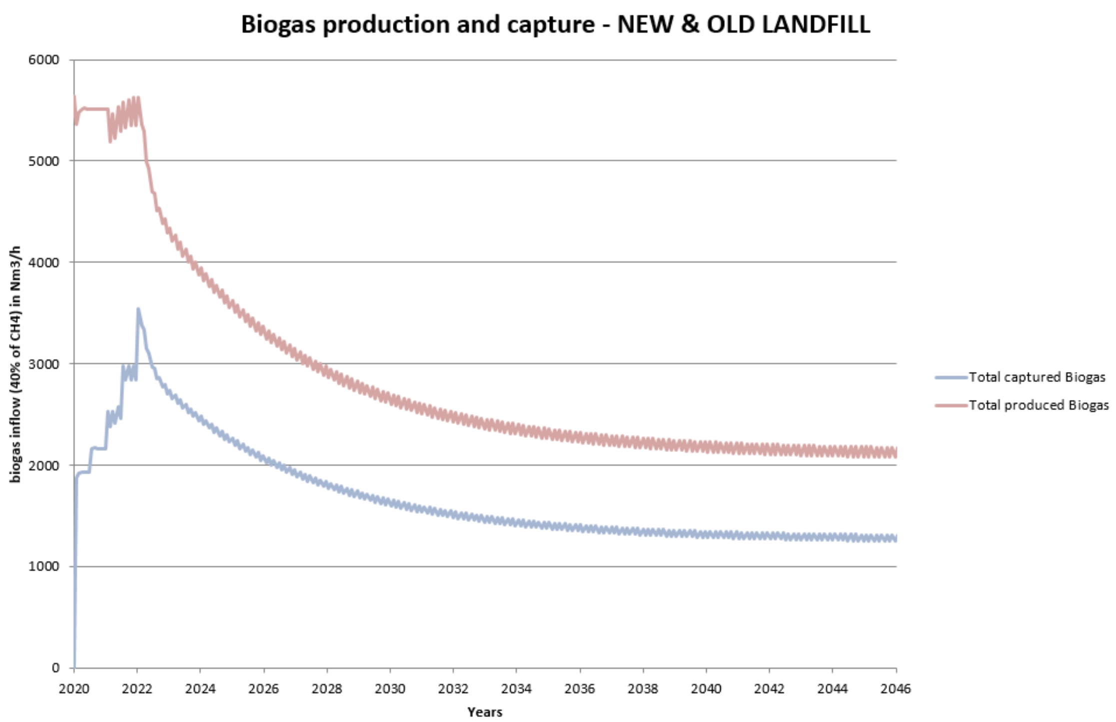
LANDFILL GAS FACILITY

Form T.2.8.1 Overall concept design

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	5 5
Facility No. Name of the Facility	5 Landfill Gas Facility

A desktop analysis has been carried out by SUEZ using its proprietary software SIMCET to assess the potential of landfill gas generation and capture from the Existing and the New Landfills, considering the type of cover and biogas drainage system envisaged for the Landfills.

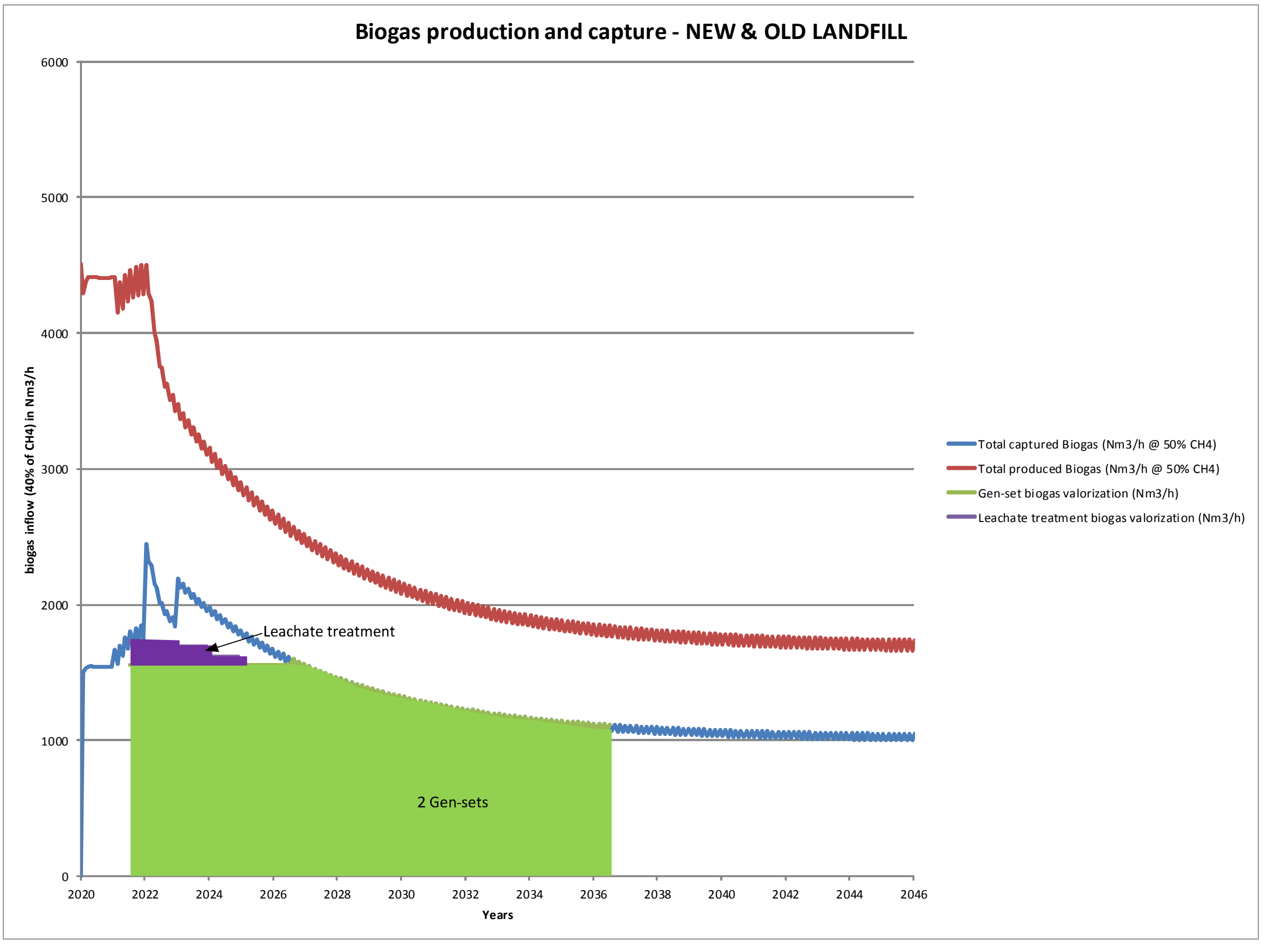
The following graphs show the estimated volume of biogas (with a 50% CH_4 content) captured from each landfill over the Project lifetime.



Based on this simulation:

- The production of biogas will reach a maximum flow of 5,600 Nm^3/h (with 50% of CH_4) in 2022, and then will logarithmically decrease to reach 2,050 Nm^3/h in 2045, with an average of 2,900 Nm3/h;
- From 2020 to 2044, the average captured flow is estimated to approx. 1,700 Nm^3/h, with a maximum of 3,500 Nm^3/h in 2022 and a minimum of 1,250 Nm^3/h in 2045.

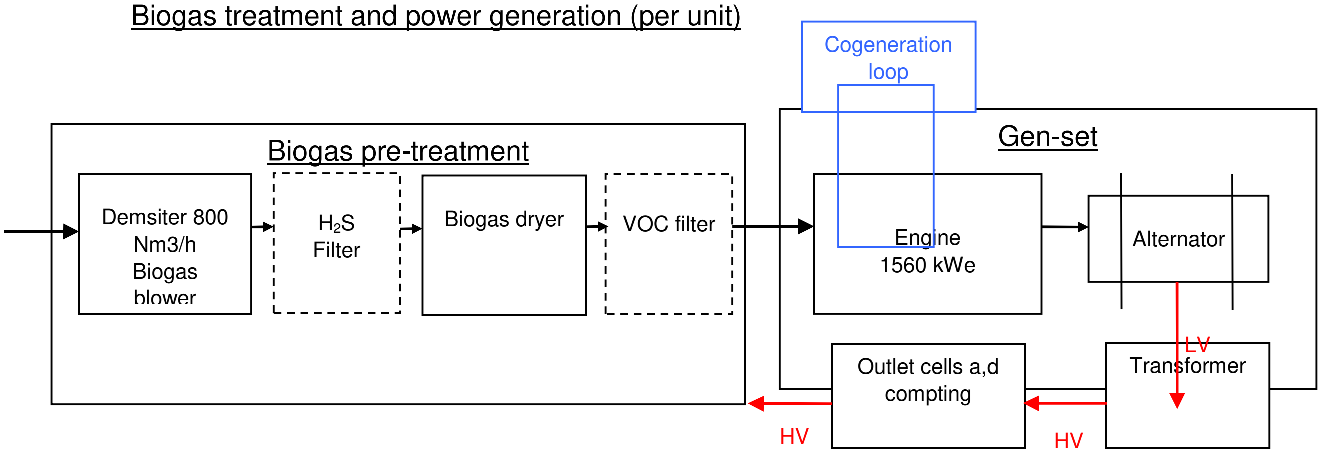
Based on this estimated potential, the Consortium plans to install 2 biogas gensets to recover up to 1 600 Nm3/h of biogas at 50% CH_4. and produce 1,560 kWe each. In addition, a hot water cogeneration loop will allow to recover additional energy from the engines, that will be used to heat primary air at the EfW Facility, thus increasing the overall energy efficiency.



Characteristics for each unit:

Electrical production	Electrical yield	Thermal production	Thermal yield	Biogas flow rate
1560 kWel +/- 8%	42% +/- 5%	1598 kWth +/- 8%	43% +/- 5%	748 Nm^3/h at 50% CH_4

Biogas treatment and power generation (per unit)



Expected availability ratio of the two gensets during the whole period is estimated to 90%.

In addition, 2 biogas flares will be installed with 2,000 Nm^3/h max capacity connected to the New Landfill biogas network and the Existing Landfill biogas network.

Biogas flares are equipped with their own biogas blower and can be controlled either by the gensets or in automatic to maintain a constant vacuum pressure in the landfill cells.

Form T.2.8.2.7 Landfill Gas Facility

LANDFILL GAS FACILITY	
	Page 1 of 1
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	5 5
Facility No. Name of the Facility Location of the Facility	5 Landfill Gas Facility At EfW Facility - see Lay-out - Form 2.2.3
Nominal capacity of main components of the Facility *Instructions: provide a landfill gas projection with description of projection formula applied and assumptions of parameters to verify the nominal capacity as given below :* see graphs above	
Gas extraction Existing Landfill	60 m^3/h - 500 000m^3/a (min) 1 900 m^3/h - 1 500 000 m^3/a (max) 530 m^3/h - 4 000 000 m^3/a (average)
Gas extraction New Landfill(s)	110 m^3/h - 880 000 m^3/a (min) 1 400m^3/h - 11 000 000 m^3/a (max) 1 100 m^3/h - 8 800 000 m^3/a (average)
Gas extraction Total (Existing Landfill and New Landfill(s))	170 m^3/h – 1 380 000 m^3/a (min) 3 300 m^3/h – 12 500 000 m^3/a (max) 1 630 m^3/h - 12 800 000 m^3/a (average)
Flare	4 000 m^3/h (with 2 units)
Utilization (e.g. CHP/gas engine, *please specify*): 2 CHPs / gas engines	1 500 m^3/h
Landfill Gas Utilization, where applicable:	
Number and size of generators for electricity production	2. x 1 500 kW_{el}
Number of working shifts	1
Operating time	365 d/a 7 900 h/a
Availability time ratio	90%
Full load operating hours	7 900 h/a
Energy output (at design capacity)	20 000.000 kWh/a electricity 20 000.000 kWh/a heat (where used)
Required area for the Facility (total)	1000 m^2

Form T.2.8.3 List of Buildings and Architectural Concept Design

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	5 5
Facility No. Name of the Facility	5 Landfill Gas Facility

List of Buildings and Architectural Concept Design

Not Applicable. Outdoor equipment.

Form T.2.8.4 Earthworks

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	5 5
Facility No. Name of the Facility	5 Landfill Gas Facility

Earthworks for the Landfill Gas Facility are included in the EfW scope of works.

Form T.2.8.5 Foundations

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility	4 Leachate Treatment Facility

Foundations

The Landfill Gas Facility will be installed on a concrete slab which is part of the scope of works of the EfW Facility executed by the EfW EPC Contractor.

Form T.2.8.6 Roads, paved areas and parkings

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility	4 Leachate Treatment Facility

Roads, paved areas and parkings

Part of EfW facility

Form T.2.8.7 **Infrastructure Connections**

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	4 4
Facility No. Name of the Facility	4 Leachate Treatment Facility

Infrastructure Connections

Connected to the 110 kV Electricity Transmission Infrastructure

Form T.2.8.13 Landfill Gas Facility – List of Equipment and Components

LANDFILL GAS FACILITY LIST OF EQUIPMENT AND COMPONENTS	
	Page 1 of 2
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	5 5
Facility No. Name of the Facility Location of the Facility	5 …Landfill Gas Facility …see Lay-out - Form 2.2.3………
List of the equipment and components for Landfill Gas Facility	

No	Equipment and components / construction activity	Responsible key Sub-Contractor
	Landfill gas collection system	Energoprojekt Niskogradnja
	Horizontal gas wells	Energoprojekt Niskogradnja
	Gas pipes	Energoprojekt Niskogradnja
	Gas collecting station	O&M Contractor (as supplier during Works Period)
	Condensate separator	O&M Contractor (as supplier during Works Period)
	Gas blower/ booster	O&M Contractor (as supplier during Works Period)
	Landfill gas treatment	O&M Contractor (as supplier during Works Period)
	Components according to technology applied	O&M Contractor (as supplier during Works Period)
	CHP unit	O&M Contractor (as supplier during Works Period)
	Gas engine	O&M Contractor (as supplier during Works Period)
	Generator	O&M Contractor (as supplier during Works Period)
	Heat exchanger	O&M Contractor (as supplier during Works Period)
	Flare	O&M Contractor (as supplier during Works Period)
	Electrical and I&C systems	O&M Contractor (as supplier during Works Period)
	Civil works (*please specify if split to various contractors*)	Energoprojekt Niskogradnja
	Electricity MV to site	Energoprojekt Niskogradnja

Form T.2.9 Construction Programme and Commissioning Plan

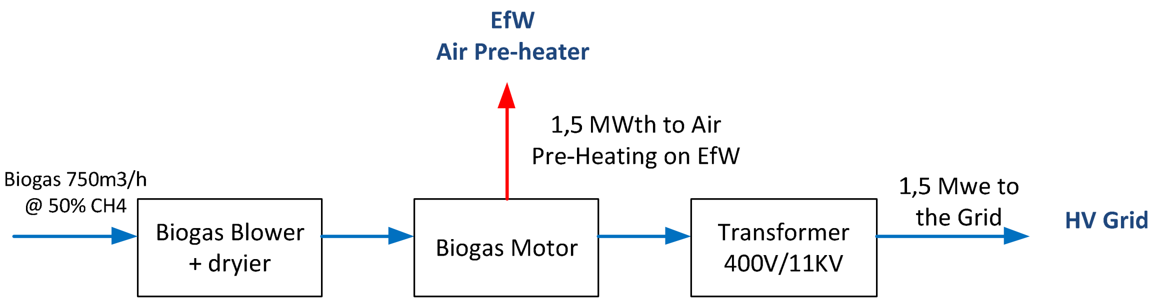
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	5 5
Facility No. Name of the Facility	4 Landfill Gas Facility

Construction Programme and Commissioning Plan

Please refer to Form T.2.6 Overall Project Time Schedule for the view on the Landfill Gas Facility Construction Programme. It is planned that the flares shall be operational by the Interim Services Commenecment date and the biogas engines by the Services Commencement Date.

Form T.2.10 Process Flow Diagram with Mass and Energy Balance

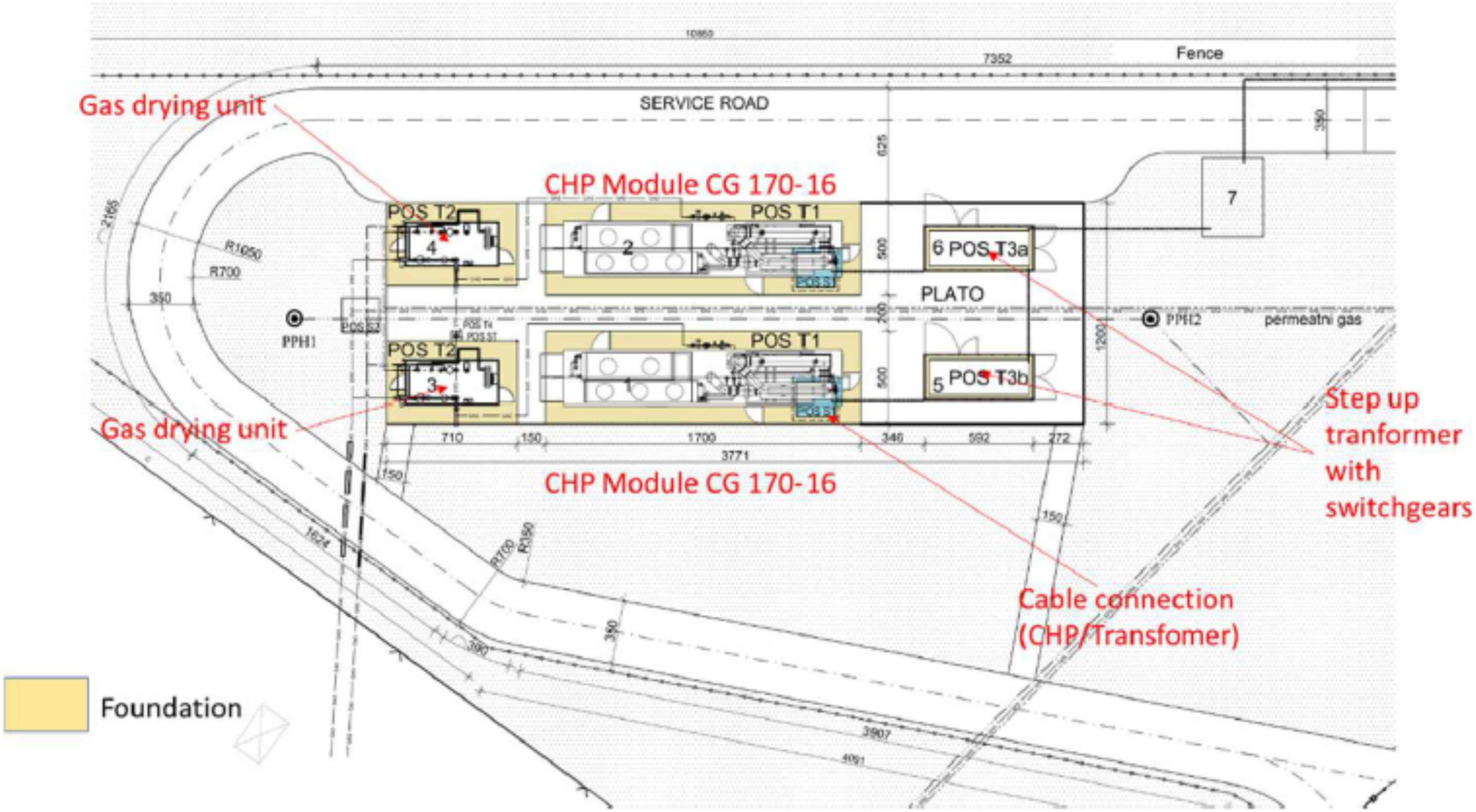
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	5 5
Facility No. Name of the Facility	5 Landfill Gas Facility



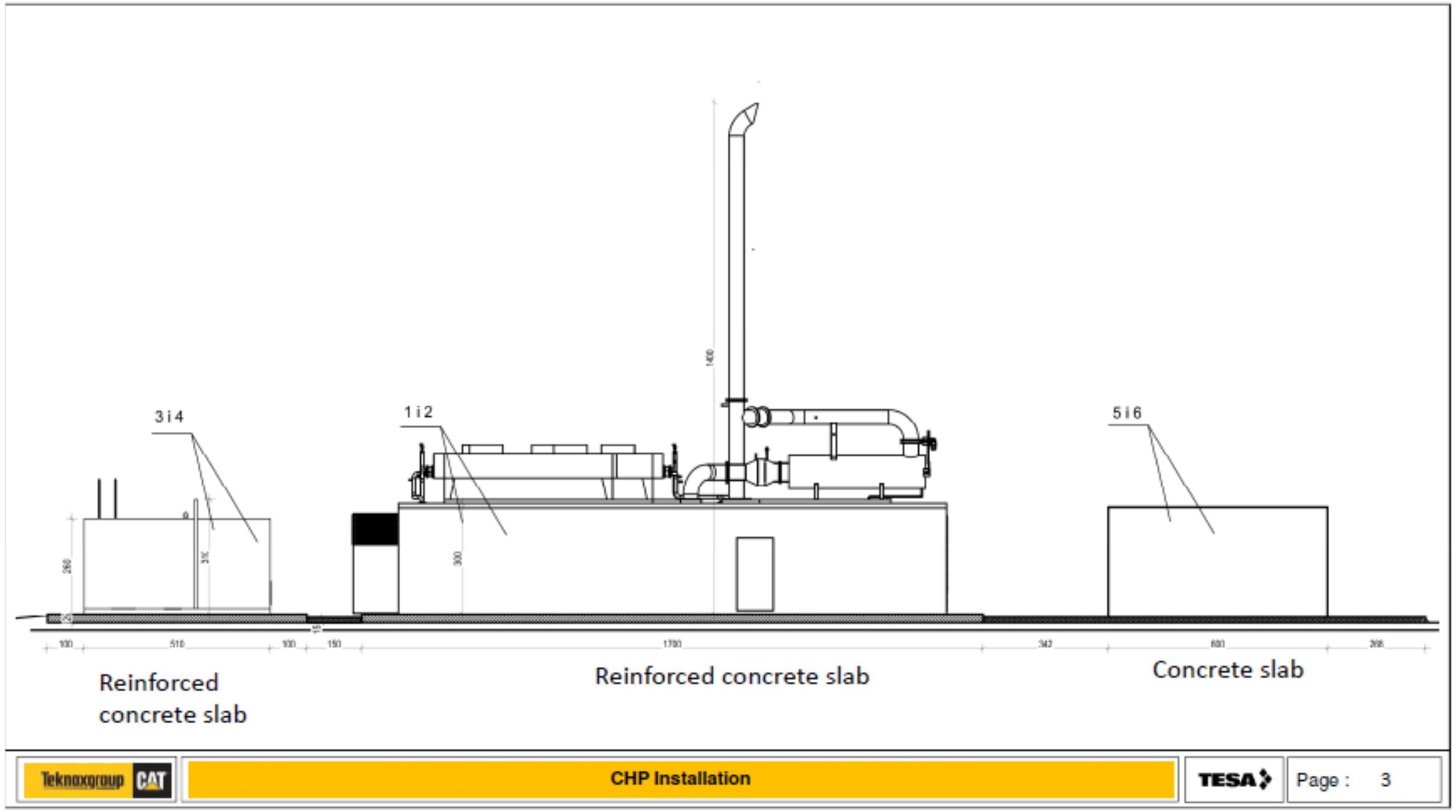
Form T.2.11 Drawings

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	5 5
Facility No. Name of the Facility	5 Landfill Gas Treatment

LANDFILL GAS TREATMENT - PROCESS DRAWINGS		
		Landfill Gas Treatment - Lay out.pdf
		Landfill gas Treatment - Archi Side vue.pdf



Fence
SERVICE ROAD
Gas drying unit
CHP Module CG 170-16
POS T2
POS T1
6 POS T3a
7
PLATO
PPH1
PPH2
permeatni gas
POS T2
POS T1
5 POS T3b
Gas drying unit
Step up
tranformer
with
switchgears
CHP Module CG 170-16
Cable connection
(CHP/Transfomer)
Foundation


3 i 4
1 i 2
5 i 6
Reinforced concrete slab
Reinforced concrete slab
Concrete slab
CHP Installation
TESA
Page : 3

WORKS DELIVERY PLAN 3

EXISTING LANDFILL REMEDIATION WORKS

Form T.2.8.1 **Overall concept design**

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	6 6
Facility No. Name of the Facility	6 Existing Landfill Remediation

Scope of works for the Existing Landfill Remediation Works includes:

- Landfill reshaping: waste cutting and backfilling (805 000 m^3), waste leveling and waste compaction. The reshaped landfill slope is between 10% and 25% with intermediate berms.
- Peripheral dyke construction (2 900 linear meters): removal and disposal of the water saturated-ground up to 1m deep, backfilling with clay-like material (including base course).

The peripheral dyke and the protection dam will be backfilled on a “waterproof” geological layer base in order to limit the pollutants discharge below the dykes.

- Landfill cover, as follows (from top to bottom, see illustration below):
  - 10cm of topsoil (including seeding) coming from excavated materials generated by new landfills and platforms earthworks,
  - 70cm of excavated materials generated by the New Landfills and Platforms Earthworks,
  - 20cm of fine materials above liners coming from excavated materials,
  - Run-off water drainage liner,
  - Biogas drainage liner,
  - 20cm of fine materials below liners (waste transition layer) coming from excavated materials.

The main purpose of this cover design is to re-use the materials generated by the new landfill excavations until the end of 2020. All the Existing Landfill cover materials will come from the New Landfills and platforms earthworks.

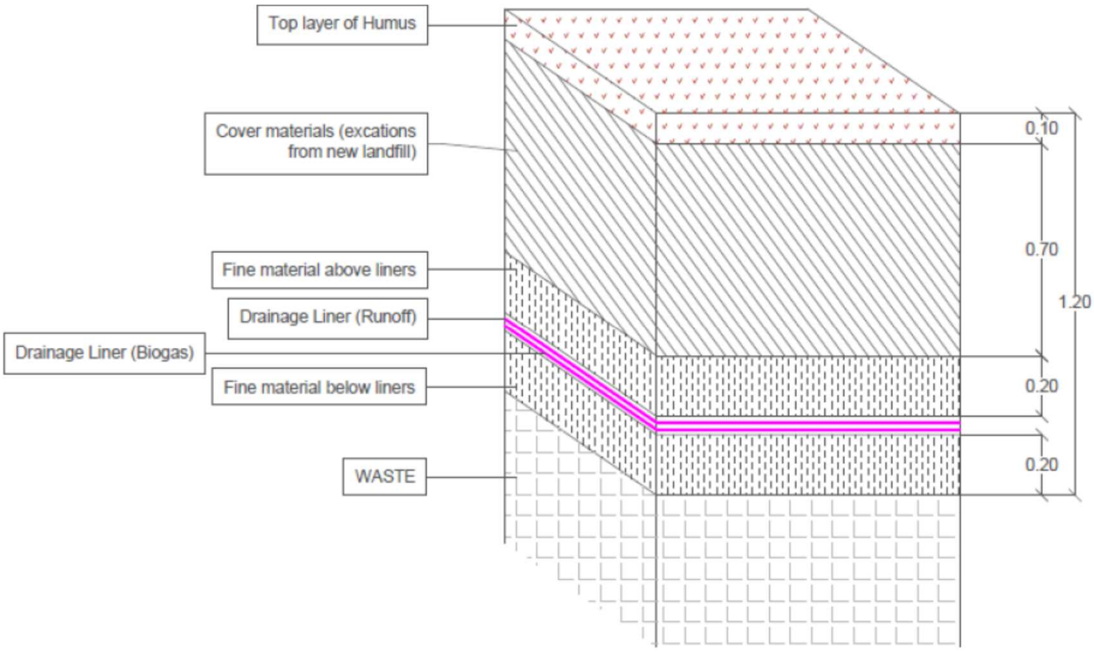


Illustration 1 : Existing landfill cover design

Drawing extracts

Reshaping of the Existing landfill (see WDP 01)

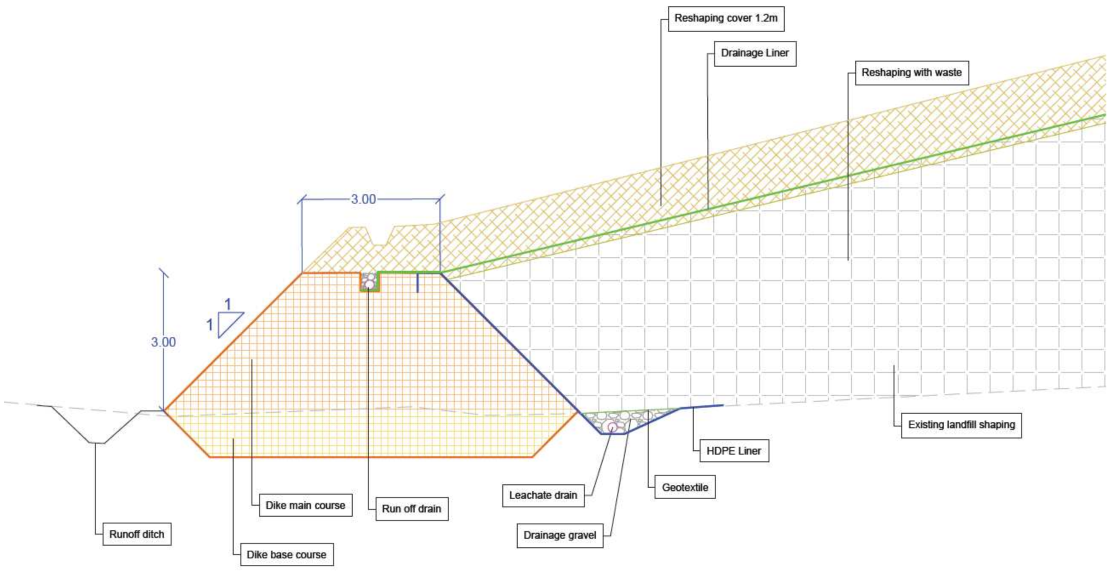
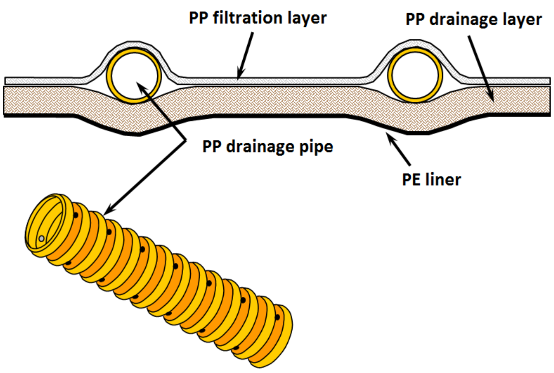


Illustration: Existing Landfill peripheral dyke (see WDP 12)

The capping will have a maximum slope of 25% (1V:4H).

The European Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste gives recommendations for the cover selling of non-hazardous landfills, as follows, from the bottom to the top:

Layer	Landfill category : non hazardous	SUEZ Consulting design
Gas drainage layer	required	1 gas drainage liner will be installed to drain the biogas under the runoff drainage liner. It is expected to use gas drainage liner made by Afitex (ALVEOGAZ) :  This is a nonwoven needled geotextile thermoformed into a cellular structure, which can be associated with a thermobonded nonwoven filter.
Artificial sealing liner	not required	N/A
Impermeable mineral liner	required	Both requirements (impermeable mineral layer and 0,5m thickness drainage layer) are achieved by a run-off drainage linerable to provide provide semi-waterproofing of the cover, such as Afitex DRAINTUBE FTP:
Drainage layer > 0,5 m	Required	

<table>
<tr><td></td><td></td><td>

Notes :

The liner needs to be quasi watertight because, in the cases of the Existing and the New landfills, a fraction of rainwater needs to infiltrate into the landfill cells in order to maintain the biodegradation of the waste (the process needs the waste to be continuously moist). It is considered that the drainange liner will still allow approximately 5% of the rainwater to infiltrate into the cells.
The drainage liner offers the same flow rates as a 0,5m thickness gravel drainage layer (with a permeability above 1.E^{-04} m/s).
</td></tr>
<tr><td>Top soil cover > 1 m</td><td>required</td><td>Cover design includes a 1m top soil cover as follows:

0.20m of fine materials above liner
0,70m of cover materials
0,10m of humus top layer

Those materials come from the excavations of the New Landfills.</td></tr>
</table>

Biogas collection system

The treatment area (on the EfW platform) will collect the biogas generated by the entire Existing Landfill.

Considering the length of the collection systems and the number of biogas well connected to them (the biogas wells collecting radius is 25 meters for the Existing Landfill), the network will be divided into a primary, a secondary and a tertiary network.

- on the part of the landfill located under the inert temporary storage, the biogas wells and the tertiary and secondary networks are buried under the landfill cover within a layer of fine materials ;
- The biogas wells are connected to the Landfill Gas Facility located on the EFW platform thought a tertiary, a secondary and a primary network. A condensate separator is located at the lowest point of the primary network in order to avoid the clogging of the biogas network.

See drawing WDP 13: “Biogaz collection system Rev G-PLAN” on **appendix xx (drawings)**.

Leachate collection system

Peripheral leachate drains located at the base of the peripheral embankments (See drawing WDP 12: “Peripheral dyke detail Rev D-PLAN” on **appendix xx**) and at the base of the Dam are connected by gravity to the downhill leachate reservoir.

See drawing WDP 14: “Leachate collection system Rev H-PLAN” on **appendix xx (drawings)**.

Runoff water collection system

The runoff water system includes:

- The construction of trapezoidal ditches on the edges of access roads;
- The installation of reinforced concrete or PVC pipes;
- The installation of precasted or field-poured concrete drainage channels.

A peripheral ditch collects the landfill cover runoff water.

The ditch have a 0.30 m minimal depth and a 0.70m minimum wide at the top. The network slopes are ≥ 0.5%.

The gully of the ditch is sealed with a drainage liner installed on the axis of the ditch. A PVC drainage pipe is laid on the bottom of the ditch to collect the runoff water. The ditch is filled with drainage gravel.

The cover runoff water is conducted to bottom peripheral network through buried PVC down pipes and intermediate peripheral ditches (with manholes on the connection between pipes and ditches).

A concrete structure (precasted of field-poured) is installed at the outlet of each down pipe in order to protect the network against erosion.

See drawing WDP 15 and 16: “Runoff collection system Rev K-PLAN” and “Runoff drainage surfaces Rev B-PLAN“ on **appendix xx (drawings)**.

Peripheral dyke and Dam

The main purpose of the peripheral dyke and the Dam at the Existing Landfill is to collect the leachates produced by the waste body.

The peripheral dike (See drawing **WDP 12: “Peripheral dyke detail**” in **Schedule of Maps and Drawings**) and the protective Dam will be equipped with drainage pipes at their base (See drawing **WDP 18: “Peripheral dyke to protection dam connection detail”** in **Schedule of Maps and Drawings**).

The peripheral dyke and the Dam will be backfilled on a “waterproof” geological layer base in order to limit the infiltration of pollutants below the dykes.

EXISTING LANDFILL REMEDIATION WORKS	
	Page 1 of 1
Bidder	
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	6 6
Facility No. Name of the Facility Location of the Facility	6 Existing Landfill Remediation Works See Lay-out - Form 2.2.3
Expected volumes of waste to be moved and replaced	800,000 m^3
Expected volumes of additional material to be used for backfilling (excluding final capping)RTC1	Inert material from surplus excavation 5 000..m^3
Expected volumes of additional material to be used for final capping (*describe the structure of the capping concept*)	fine materiel below liner . 85 200 m^3, (height:0.2m) biogas drainage geomembrane, (height:N/A) water drainage geomembrane, (height:N/A) inert material from surplus excavation 298 000 m^3, (height:0.7m) topsoil from surplus excavation 42 600 m^3, (height:0.1m) Total height: 1.20 m
Expected area for remediation (total area for capping)	426 000 m^2

Form T.2.8.2 Main design parameters

Instructions: complete this form for each type of New Landfill separately (e.g. New Landfill for RMW Landfilled Unprocessed, New Landfill for MW Treatment Residues, New Landfill for Inert Waste)

Form T.2.8.3 List of Buildings and Architectural Conceptual Design

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	6 6
Facility No. Name of the Facility	6 Existing Landfill Remediation

List of Buildings and Architectural Conceptual Design

The platforms and associated equipment are considered in the New Landfill.

No building is associated to this Works Delivery Plan.

Form T.2.8.4 **Earthworks**

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	6 6
Facility No. Name of the Facility	6 Existing Landfill Remediation

Earthworks

See concept design

Form T.2.8.5 Foundations

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	6 6
Facility No. Name of the Facility	6 Existing Landfill Remediation

The platforms and associated equipment are considered in the New Landfill.

No foundation.

Form T.2.8.6 Roads, paved areas and parkings

Internal roads will be built to access to the Existing Landfill mainly for monitoring purpose.

The access to the downhill platform is done by a long internal road passing along the lower part of the Existing Landfill.

Form T.2.8.6 Infrastructure Connections

See concept design

Form T.2.8.11 Existing Landfill Remediation Works – List of equipment and components

Instructions: specify type of landfill or "overall landfill", if components are used for the entire landfills on the Site

EXISITING LANDFILL REMEDIATION WORKS LIST OF EQUIPMENT AND COMPONENTS	
	Page 1 of 1
Bidder	
Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	6 6
Facility No. Name of the Facility Location of the Facility	6 Exisiting Landfill
List of the equipment and components for … ***Existing Landfill Remediation Works***	

No	Equipment and components / construction activity	Responsible key Sub-Contractor
	Reception area	N/A
	Basal lining system	N/A
	All layers *(please specify)*	N/A
	Surface capping system	Energoprojekt Niskogradnja
	Final capping - all layers *(please specify)*	Energoprojekt Niskogradnja
	Intermediate capping	N/A
	Drainage system	Energoprojekt Niskogradnja
	Leachate collection (pipes, excavated trenches, pumps, manholes, leachate tank, etc.)	Energoprojekt Niskogradnja
	Surface water run-off system (pipes, ditches, manholes, etc.)	Energoprojekt Niskogradnja
	Electric installation	Energoprojekt Niskogradnja
	Landscaping	Energoprojekt Niskogradnja
	Vehicles	SPV
	Compactors	SPV
	Bulldozers	SPV
	Loaders	SPV
	Excavators	SPV
	Trucks	SPV
	Containers	SPV
	Civil works (*please specify if split to various contractors*)	N/A, limited to Earth works
	Others *(please list further as required)*	

Form T.2.9 Construction Programme and Commissioning Plan

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	6 6
Facility No. Name of the Facility	6 Existing Landfill Remediation

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Construction Programme and Commissioning Plan

Please refer to Form T.2.6 Overall Project Time Schedule for the view on the New Landfills Construction Programme

Form T.2.10 Process Flow Diagram with Mass and Energy Balance

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	6 6
Facility No. Name of the Facility	6 Existing Landfill Remediation

N/A

Form T.2.11 Drawings

Reference No. of the corresponding Works Delivery Plan Reference No. of the corresponding Services Delivery Plan	6 6
Facility No. Name of the Facility	6 Existing Landfill Remediation

LANDFILL - LAY OUT & CROSS SECTIONS		
Number	**Version**	**Designation**
WDP 00	**A**	Vinca site facilities footprints vs DPR_Rev_B-Présentation1
WDP 01	**I**	Existing landfill reshaping
WDP 02	**I**	Existing landfill reshaping - waste cut and fill plan
WDP 03	**I**	Existing landfill reshaping - cross sections
WDP 04	**K**	General plan of new landfill
WDP 07	**A**	General cross sections
WDP 08	**D**	Cross sections of CDW storage and inert stock
WDP 10.1 to WDP 10.18	**B**	3d views of VINCA landfill
WDP 11	**D**	Landfills cover and bottom details, ponds details
WDP 12	**D**	Peripheral dyke details
WDP 13	**G**	Biogas collection system
WDP 14	**H**	Leachate collection system
WDP 15	**K**	Runoff collection system
WDP 16	**B**	Runoff drainage surfaces
WDP 18	**B**	Peripheral dyke and protection dam connection detail
WDP 19	**B**	Details between new and existing landfill
WDP 21.1 to WDP 21.5	**A**	Phasing 2021 to 2046