VOLUME 3

EMPLOYER'S REQUIREMENTS

Section 2 - Particular Design & Process Requirements

B

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2 Particular Design and Process Requirements

The Contracting Authority Process Requirements presented hereinafter are to be read in conjunction with Section 1 of Volume III, of these Tender Documents, comprising the General Provisions for the tendered Works in accordance with the Conditions of Contract.

Tenderers design proposals shall be in line with the standards prescribed herein or equivalent internationally accepted standards for the construction of landfills, and shall in particular consider the following design requirements for the main process units of the RLF.

The RLF shall fulfil the following general criteria:

- The plants and processes shall be operated with a high level of safety and hygiene, in order to reduce dangers to operators and other personnel;
- The waste transport, treatment and disposal processes will be conducted with the minimum possible damage to the environment;
- The process shall have a high level of stability and be "forgiving" for operator mistakes;
- The number of process steps and related equipment shall be reduced to the minimum necessary for reliable operation.

The Tenderer shall design the RWMC to fit within the site boundary. The dimensions, arrangement and layout/positioning of the structures shown on the drawings included in Volume V are indicative only and reflect the outline design proposed by the Beneficiary. Within the limits of the existing RWMC site boundary, the Tenderer is free to design, position and size the various elements of the RWMC as the Tenderer considers optimal but only to the extent that they comply with the requirements set out in the Beneficiary's Requirements and Specifications.

2.1 Location

The Subotica area, which is the area served by the project, covers seven municipalities in an overall area of 3102 km^2 and has a population of 256.128.It consists of the whole North Bačka district and the municipalities of Kanjiža, Senta, Čoka and Novi Kneževac from the North Banat. The map of the project area is shown in the figure below:

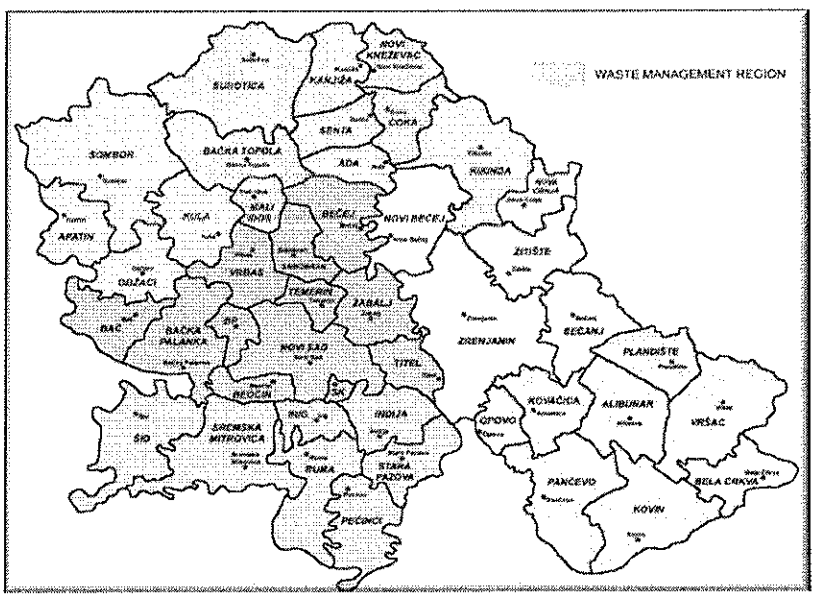

Figure 2.1: Vojvodina and the Subotica management region

The main spatial characteristics of the region are the flat relief, very good soil structure, relatively favourable climatic conditions, and a relatively extensive network of good quality asphalt roads.

The footprint of the regional landfill occupies an area of 46 ha, out of which 31.6 ha is planned for waste disposal, while it encompasses the whole parcel No. 2635 of cadastral municipality of Bikovo which is property of City of Subotica.

The chosen location of regional landfill is situated on the territory of the City of Subotica, while it is 19.7 km south-east from Subotica, i.e. east from main road, E-75, highway, and between the settlements of Bikovo, Orom and Novo Selo.

The location is surrounded by agricultural land that is in use. At present, the area does not have any constructions, and there is neither a formed traffic network nor any other infrastructure.

Figure 2.2: Subotica and regional landfill location – satellite image

Site conditions

For the purpose of this tender the site conditions shall be assumed as follows:

Location	North Bačka district and Kanjiža, Senta, Čoka and Novi Kneževac from the North Banat
Location elevation (existing condition)	Between 80 and 119 m.a.s.l.[1]
Geomorphology	Characterized by alluvial deposits and neogenous complex of sands and clay [1]
Hydrogeology	Water permeable loess interrupted by impermeable dark clay layers[1]
Seismicity	7 MCS[1]
Climate	Temperate continental[1]
Mean max. monthly air temperature – January	3.7 °C[1]
Mean max. monthly air temperature – July	28.6 °C[1]
Mean min. monthly air temperature – January	-2.9 °C[1]
Mean min. monthly air temperature – July	16.6 °C[1]
Average absolute max. temperature	35.2 °C[1]
Average absolute min. temperature	-12,2 °C[1]
Average annual rainfall	558 mm[1]

Minimum annual rainfall	247 mm[1]
Maximum annual rainfall	814 mm[1]
Maximum recorded 24-hours rainfall	94.3 mm[1]
Months with frequently rainfalls	June[1]
Humidity, max., December	87%
Humidity, min., July	66%
Reference Period	1991-2009
Wind directions	North, North-west[1]

[1] According to Environmental Impact Assessment Study

Above provided data are given for information only and therefore the Tenderer shall not demand any extra payment in case of deviations from them, unless it is a matter of unforeseeable extreme natural events.

2.2 Design Criteria

2.2.1 Waste generation and collection in the region

General

The region, which is composed of the city of Subotica and six municipalities (Backa Topola, Mali Idjos, Kanjiza, Novi Knezevac, Senta and Coka) lacks a proper sanitary landfill. The existing landfills in each municipality can have a negative impact on the environment and also on the general public health. Waste management in the 7 municipalities of Subotica district is handled by the 5 Public Utility Companies (PUC), two LUCs and one PPP.

Table 2-1 Companies providing waste management services in the Region

No.	Municipality/City	Companies authorized for waste management
1	Subotica	PUC 'Čistoća i zelenilo'
2	Senta	PUHC 'Senta'
3	Čoka	PUC 'Čoka'
4	Mali Iđoš	"Еко Komunal" Ltd. and "Kiš komunal" Ltd.
5	Bačka Topola	PC 'Komgrad'
6	Kanjiža	'Bratner otpadna privreda' Ltd.
7	Novi Kneževac	PUC '7. oktobar'

These companies are responsible for collection, transport and disposal and they directly and indirectly charge the population for these services.

The current condition in the municipalities of Subotica region is characterized by unreliable and incomplete data on the quantity of municipal waste generation, especially in terms of determining the quantity of communal waste and its morphological composition. Official data gathered from PUCs cannot be taken as fully reliable as PUCs are actually not measuring the total waste collected but rather calculate the waste transported by the number of garbage trucks per month multiplied by the total capacity of the waste.

The PUC Subotica has obtained a weighbridge in July 2011, which has been placed at the local landfill, and has started using it in September 2011.

Waste has been disposed at the landfills without being treated. Primary selection and recycling are still at an early stage, although the PUC Subotica has established a process that shows initial positive results in collecting Plastic and Paper. Aside from the PUC Subotica, the other official landfills in the region are not equipped with a weighbridge. The

large number of illegal dumping sites makes the determination of waste quantity more difficult.

Municipality	Population in 2011	kg/person/ day	t/day	t/week	t/month	t/year
Subotica	140.358	1,04	145,80	1020,61	4434,81	53,217,73
Bačka Topola	33.268	0,74	24,73	173,08	752,06	9.024,77
Mali Iđoš	11.926	0,70	8,35	58,44	253,92	3.047,09
Kanjiža	24.995	0,74	18,58	130,09	565,28	6.783,42
Senta	22.961	0,84	19,3	135,07	586,91	7.042,93
Čoka	11.388	0,70	8,00	56,03	243,48	2.921,72
Novi Kneževac	11.232	0,78	8,74	61,20	265,93	3.191,20
Region	**256.128**	**0,91**	**233,50**	**1.634,53**	**7.102,40**	**85.228,85**

***Table 2-2 Region* – Basic data on population and generated waste quantities, in 2012**

According to the calculation in the table, the total quantity of generated waste by the population in the municipalities in the Region, in 2012, was 85.228,85 tonnes. This figure is close to data from the NSWM, 2010, as well as to data collected in the municipalities and increased to 100% coverage of the territory.

Waste Composition

The situation with the morphological composition of the waste in the region is also not 100% certain: without precise measurement over a long period of time, all assumptions on the composition are based on the best guess that people from local PUCs can give. The municipalities do not have a good indication of the composition of their collected waste. In the Regional Waste Management Plan for Subotica region (version 2012), waste composition in seven municipalities is given based on their investigations on the existing municipal landfills. The average waste composition for Subotica landfill was estimated as follows:

Table 2-3: Estimated average morphology (in mass proportion) generated in the municipalities in the Region Subotica in 2012.

Type of Waste	Mass proportion* %
Total organic waste (%)	50,03
Paper (%)	4,92
Cardboard (%)	4,92
Glass (%)	3,92
Metals (%)	1,67
Plastics (%)	12,33
Textile (%)	3,93
Leather (%)	0,44
Diaper (%)	3,7

Fine components (sand, ash, earth, etc) (%)	12,94
Other (%)	1,2

**Information data – source of information:* Regional Waste Management Plan for city Subotica and municipality Backa Topola, Mali Idjos, Kanjiza, Senta, Coka, and Novi Knezevac (2013-2022).

Waste Collection

In the Region of Subotica (i.e. the region in terms of waste management), primary sellection has currently been organized mainly in the urban settlements, while in other settlements it almost does not exist. The situation varies in the municipalities, hence one can not speak about an organized system of separation and recycling. Besides the PUCs, there are private companies and informal (individual) collectors. There is no central database on waste generated or collected quantities, collectors, final users of secondary raw materials and market prices.

The main problem is that municipalities do not have enough funds in the budgets for procurement of additional equipment and recruitment of more workers for waste selection and recycling. In adition to this, there are cosl of education and public information, very important for improvement and preservation of environment.

The list of the most important and most frequent problems, stated by the PUCs in answers to the questionnaire distributed by the consultant, includes:

- Insufficient number of trucks,
- Lack of funds for equipment maintenance and procurement,
- Obsolescence of equipment,
- Lack of adequate equipment for waste collection (in the municipality of Mali Iđoš and some local communities in the municipality of Bačka Topola, collection and transportation are still carried by tractors with trailers),
- Insufficient number of containers,
- Low price (due to administrative regulation) for services.

Furthermore there are problems in the collection coverage of the rural population, most pronounced in municipalites Bačka Topola, Čoka, Novi Kneževac and Mali Iđoš. The rural population, usually, individualy transport the waste to the illegal dumpsites. The population even open new illegal sites following closure and restoration of old sites at the same location. The municipalities of the Region, year by year, put a lot of effort to increase the collection coverage of the population. The goal is to achieve full coverage before construction of the new regional landfill.

Waste that is collected in standard containers, 5m^3 and 7 m^3, is transported by truck-lifters. Waste collection and removal from standard bins, capacity of 80, 120 and 240 l, as well as 1.1 m^3 containers is carried out with special vehicles equiped for loading, compacting and unloading devices (i.e. so-called collection compactor vehicles).

2.2.2 Projections for the future

Waste Generation

Taking the above estimation of the total quantity of communal waste that is being currently created and collected in the region, the consultants have gone through the process of preparing an estimate of the total quantities of communal waste that will be created and collected in the future period of 30 years. To enable the making of the best estimate, the following factors were taken into account:

- Population projections (stated above)
- Estimated quantities of created waste in 2009 (presented above) and

- The estimate of created waste per capita in the targeted municipalities

Based on the results of such measurements, it can be assumed that in 2012 the population in urban areas on average generates 1 kg of municipal waste per capita per day (adopted for the whole city of Subotica population), while the population in rural areas generates around 0.85 kg per day (adopted for all other 6 municipalities in the coming period). It should be mentioned that the rural population often use organic waste (food etc.) for feeding the animals, therefore, the percentage of organic waste on average is lower than expected.

The next table 4 summarizes the total waste created by the population and by the businesses over the observed project period:

Table2-4: Total created waste (Population + the commercial and industrial sector) (tons/year)

Region	2016	2020	2025	2030	2035	2041
Subotica – Urban	57,256	62,946	63,230	66,086	68,113	69,764
Bačka Topola	11,054	11,276	10,909	11,189	11,253	11,186
Mali Iđoš	3,942	4,022	3,891	3,990	4,013	3,989
Kanjiža	8,575	8,925	8,801	9,109	9,180	9,125
Novi Kneževac	3,535	3,571	3,420	3,483	3,485	3,443
Senta	7,794	8,048	7,880	8,115	8,161	8,113
Čoka	3,674	3,681	3,511	3,576	3,578	3,535
TOTAL REGION	**95,829**	**102,468**	**101,641**	**105,547**	**107,784**	**109,155**

A total of about 95,829 tons of waste is estimated to be generated in 2016 in all municipalities. This is in accordance with the calculation, based on projected average weight (kg) per capita per day as set out in the National Waste Management Strategy 2010, as well as in accordance with the data obtained from the municipalities and from the Regional Waste Management Plan. Since the collected waste is not measured, waste amount is calculated as the best approximation and by comparison with similar areas.

The effects of the population trends combined with the trends in waste generation per capita (caused by the expected economic growth in the region) will influence the increase in the total quantities of waste generated, which will peak at the end of the observed period, in 2041, reaching the level of 109,155 tons/year.

The total cumulative amount of waste generated (i.e. combining population and the commercial and industrial sector) over the period 2016-2041 will be: 2,705,097 tons.

Waste Collection

An assessment of immediate needs in new collection vehicles and equipment was made for the area, and a parallel investment on such vehicles and equipment was approved.

Transfer Stations

Taking into account current situation and according to the RWMP 4 transfer stations (TS) are foreseen to be constructed in the Region:

1. TS Subotica (covers the City of Subotica)
2. TS Bačka Topola (covers municipalities of Bačka Topola and Mali Iđoš)
3. TS Senta (covers municipalities of Senta and Čoka)
4. TS Kanjiža (covers municipalities of Kanjiža and Novi Kneževac).

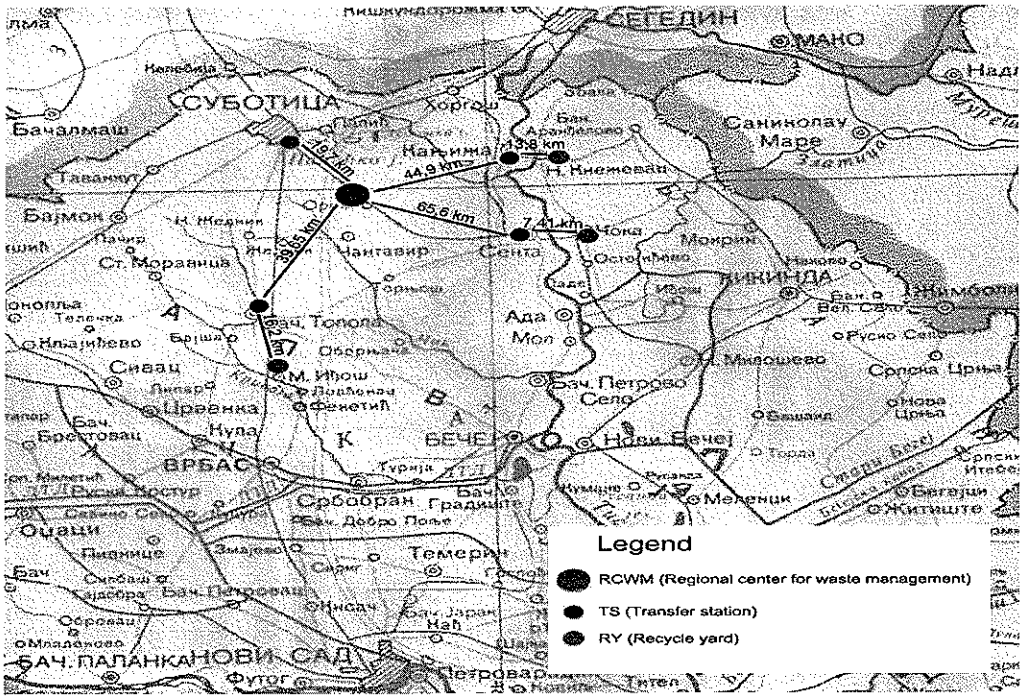

Figure 2.3 Locations of the proposed transfer stations and recycling yards in the region of Subotica, and their distance from the regional landfill site

Recycling yards

There will be recycling yards in each transfer stations and in the municipalities of Mali Iđoš, Čoka and Novi Kneževac. After separation at the source and the recycling yards, the waste quantities expected to reach the RWMC during the project's reference period are as follows:

Table 2-5: Quantities of waste from TS and directly from settlements to Regional landfill

Category	2016	2020	2025	2030	2035	2041	TOTAL for the project [t]
TS Subotica [t/y]	46,234	47,839	50,584	52,869	54,491	55,812	**1,343,917**
TS Backa Topola [t/y]	12,821	13,080	13,320	13,661	13,739	13,657	**349,631**
TS Senta [t/y]	9,805	10,028	10,252	10,522	10,566	10,483	**268,677**
TS Kanjiza [t/y]	10,354	10,684	10,998	11,332	11,398	11,311	**288,354**
TOTAL [t/y]	**79,214**	**81,631**	**85,154**	**88,384**	**90,194**	**91,263**	**2,250,580**
Option: Waste directly to the RWMC [t/y]	**4,855**	**5,340**	**5,621**	**5,805**	**5,877**	**5,877**	**146,497**

Note: If the presented quantities of waste from the stated three settlements (Cantavir, Bikovo and Visnjevac) will be brought directly to the landfill, then the TS Subotica will have less waste to transport.

All waste shall be brought to the RWMC un-compacted and will pass through the Materials Recovery Facility (MRF) except for special types of waste brought separately, like Construction and Demolition Waste which will be deposited separately, either for further

processing or individual disposal, and yard trimmings, which will go directly to the composting facility.

The design of the RWMC facilities shall be based on the figures of Table 5.

2.2.3 Basic RWMC Characteristics and Functions

The RWMC will accept municipal waste, domestic type industrial and commercial waste and recyclable waste material.

Mixed municipal waste will be collected in an organised way by companies licensed for municipal waste collection (current waste collection companies) that will transport collected un-compacted waste to Transfer Stations (TSs) or directly to the Regional Waste Managament Center (RWMC). Municipal waste will be treated in the mechanical separation plant (MRF) and the separated fractions will go to recycling, whereas the biodegradable fraction will be aerobically treated in the composting plant. Part of the compost will be used as landfill cover material and part will be upgraded for agricultural use. The remainder will be disposed in the landfill.

Outputs of the MRF plant will be: reusable waste fraction and biodegradable fraction of municipal waste. The biodegradable fraction of the waste will be aerobically treated in the composting plant.

Special regulations for specific waste categories (packaging waste, waste tyres, electrical and electronic waste, etc.) have been in force in Serbia and part of the municipal waste will be collected through a separate collection system and may be conveyed directly or via recycling yards at transfer stations (TS) or to the MRF plant at the RWMC.

Separately collected recyclable waste material will be received at the recycling yard in the RWMC. Recyclable waste materials will be shipped for treatment outside the centre.

The RWMC will be built on an area of 46 hectares and will include the following development areas:

- Preparatory works such as improvement of access road, potable water supply, power supply and transformer stations;
- Entry/exit area with guardhouse and gates, weighbridge, meter house, recycling island, and wheel wash area;
- Administrative building and parking lot;
- Service area with workshops, garage and staff premises;
- Internal roads and plateaux
- Materials Separation and Recovery Facility (MRF);
- Organic matter composting and curing facilities;
- Non-hazardous waste landfill;
- Landfill gas flare;
- Wastewater treatment and leachate pre-treatment and storage facilities;
- Green belt;
- Other infrastructure within the RWMC.

The landfill capacity has been estimated at approximately 50 years.

2.3 Process Requirements

The sizing of the structures and equipment within the RWMC complex shall be designed based on ultimate (Year 2042) capacities. The present Contract for the construction of the RWMC will be executed in a single phase.

2.3.1 Preparatory works

The location of the RWMC is without any infrastructure utility (it is not connected to the water supply, to the power, the sewage system, gas supply network, etc.), and it is necessary to bring all the necessary installations. Potable water will be obtained by connecting the water supply system of the landfill to the water network of Bikovo settlement (The length of the connection line should be 2.4 km or with be supplied from drilled well where needed quantity will be taken as technical water and the rest will be properly treated and used as potable water for the needs of the RWMC. Connection of the location to the telecommunication network and electrical power network has to be done. Electrical cable of 20kV length 2,800 m, via a 1,000 KV transformer station will connect the site with the network. There is no sewage system in the vicinity of the site.

In addition, the existing 5.5 m wide access road, over a length of 1 Km, needs widening to 7.0 m width and upgrading.

2.3.2 Entry/Exit area

Within the entry/exit area the following facilities will be designed, according to the descriptions below:

Guard House with Entrance Gates

A guardroom building is placed next to the entrance gate. It can be of the metal container type with minimum area 7.5 m^2, height of 2.65 m. It will have an office and toilet, equipped with electricity, water supply, electrical heating, air conditioning, sewerage. Data about arriving collection vehicles and accepted waste will be registered in logbooks in electronic form.

Two gates, the first being a vehicle gate (double door) with minimum width of 2 x 3.0 m and height of 3.0 m, for vehicle entry, and the second one with width of 1 m and height of 3.0 m, for pedestrian entry, are to be designed. The gates will be of galvanised wire net with mesh dimensions of 50 x 50 mm. Over this wire net barbed wire will be installed. The thickness of wire will be 4 mm. In front of the gates there will be a billboard with data of the landfill (landfill name, working time, and other basic information).

Parking lots for vehicles for visitors

Next to both entrances parking lots with 4 parking spaces, measuring 4.60 m x 2.30 m, for the vehicles of visitors will be constructed. The internal asphalt roads for heavy traffic from the gate to the landfill body, to the waste water treatment plant and to the infrastructural and service structures will be designed and constructed. The minimum width of new internal roads will be 6m, with road shoulders of 0.5m.

Check-in and Weight house

A weight house will be placed next to a weighbridge, of the same size and structure as the guardhouse mentioned above. It will have an office and toilet, equipped with electricity, water supply, sewerage, electrical heating and airconditioner. All weight measurement instruments will be placed in this house. Weights and other important data about arriving collection vehicles and accepted waste will be registered in logbooks in electronic form. The weight house is connected with the check-in lodge, next to weighbridge. All weight measurement instruments will be placed in this house.

- *Equipment*

Office desk + Chair + Office bookcase for files 100.00 x 46.00 cm, height 85.00 cm + PC + printer (A4)

Weighbridge

All waste collection vehicles that arrive, pass over a weigh bridge, with dimensions of 18 m x 3 m, near the entrance gate. Also all emptied vehicles will be weighed. The weighbridge is designed as an electronic weighbridge, suitable for loads up to a maximum 60 tonnes. It has a pit underneath. Weights and other important data about arriving collection vehicles and accepted waste will be registered in logbooks in electronic form in weight house. Total weight of the loaded truck/vehicle is measured on the weighbridge and registered. The weight of the unloaded truck/vehicle is also measured and registered. The receipt of the transferred quantity is generated and given to the client. All data related to the client are registered: name, place, date, vehicle plate number, time of both weightings, type and quantity of the waste, driver's name. Data are stored in the central database at the regional landfill. In this way the billing system generates periodical bills for the services of the RWMC Subotica, for the regular clients, or bills payable at the site for individual clients.

Design Requirements:
- The weigh bridge shall be suitable for 24 hrs. of operation per day.
- The weigh bridge shall be suitable for operation during rainy season.
- The weigh bridge shall be capable of withstanding dynamic load imparted by the vehicle movement and braking.
- The weigh bridge shall calibrate automatically the variation due to rains and other errors.
- The weigh bridge equipment shall be electronic load cell with micro processor based type.
- Approximately 100 weighments per day are expected to be made using the weigh bridge.

Weighbridge canopy

A metal canopy will be placed over the weighbridge, with dimensions of 18 m x 9 m. Useful height of structure to the lower part of main truss is min 4.30 m. The canopy will be constructed of stainless steel profiles and aluminium panels.

Recycling yard

Close to the entrance a recycling yard will be provided, for deposition of solid waste brought by individuals. Two separate steel canopies will be constructed:

- dimensions 18.00 m x 7.00 m, h=4,30m and
- 59.00 m x 7.00 m, h=4,14m

This zone is designed as two independent construction units in a covered form. The designed construction are canopies with overall dimensions 18.00 x 7.00m, in the form of three fields 5.0м long; and 59.0 x 7.00 m in the form of thirteen fields 4.243m long.

Recycling yard space is level to the access roads. Therefore, the smaller unit is at the same level, while the central part is designed to be on two levels in order to facilitate the deposit of waste in the containers, which are placed on lower plateaus. Therefore, in order to ensure the stability of the central part of the recycling island the canopy over this space is designed as the supporting wall. The mentioned is shaped in the form of a 'saw', in order to provide for better access and circulation of vehicles and containers at the weight unloading area.

The canopy's construction is of the same type as the one over the weighbridge;

The roof is double pitch with a 4° slope, completely symmetrical in regards to the facility longitudinal medium, while the slope is designed towards the central axis.

System for wheels washing, disinfection tubs – barrier

After their waste disposal, vehicles wheels will be washed (outdoors) and disinfected before leaving the landfill.

The washing process is activated automatically; once the truck passes through a light beam and without the driver getting out of the vehicle, the wheels washing starts. The vehicle passes slowly through a small bath facility. The profile of the tyres is washed by water coming from nozzles from the bottom and from the sides. The water then runs into a side-mounted collection pit for treatment. Impurities are deposited in the pit while clean water flows over the separating wall into the pump zone to be reused again for washing tyres.

The wheel washing system comprises:

- system for washing, which is equipped with: a system for monitoring vehicle movement (activates the washing process and the operation of the system), jets-nozzles for washing, pump, filter, piping with necessary valves, drain for waste water collection; and
- water recycling system and sludge removal, equipped with: tank with clean water and solids separation, pipeline for sludge removal with isolation valve and pump. The compact separator is located in a reinforced concrete structure.

The disinfection barrier is in a form of a reinforced concrete channel ('bath') with dimensions of 7.0 m x 3.5 m and a depth of 30 cm and slope of 15% (1%) towards the mid of the channel. The channel is filled with disinfectant.

The purpose of the tyre washing system is to prevent the spreading of mud not only in the operation zone, but also in the external traffic routes. It is situated on the extension of the internal road - plateau, in the direction of exiting the landfill body.

The truck activates the washing process by passing through the light beams in a totally automatic way without the drivers leaving the vehicle. The trucks pass through the smaller plant tub, and through the spray nozzle which washes the tyre from above and from the side and subsequently draines into the site sedimentation tank.

Impurities are collected in the tank and the clean water discharges over the wall which divides the space with the pump guide rails to the pump which again uses the same water for tyre washing. The floating valve controls the addition of missing water.

The tyre washing system consists of two sub-systems:

- Sub-system for washing which is equipped with the vehicles tracking system (initiates the system operation), spray nozzles, pump, filter, pipeline with necessary valves, cascade for collection of waste water; and
- Sub-system for water recycling and removal of the excess mud, which has: clean water tank and hard substances separation, pipeline for excess mud removal with the isolation valve and hydraulic equipment.

Compact plant is placed in the reinforced concrete construction which is made of two connected tanks. Bigger tank with the dimensions of 8.0 x 3.0 x 2.0 m and smaller tank – so called tub for vehicles passing with dimensions of 4.1 x 3.2 x 0.5 m.

Concrete has to be waterproofed, acid and frost resistant;

Parking lots for non-washed vehicles

A parking area of 100 m^2 for parking of non-washed collection vehicles will be provided, next to the washing facilities.

Sheltered plateau for washing vehicles

Indoor and outdoor spaces of total 150 m^2, 20 m x 7.5 m, designed for washing of collection vehicles, long haul trucks, compactor, loader and other mechanical mobile equipment. It is designed as a prefabricated building with dimensions 15m x 12.2m with a channel for discharge of waste water. Parking lots for un-washed vehicles are on the one side of the washing service, parking lots for washed vehicles are on the opposite side.

3

For washing transportation vehicles, bulldozers, loaders and fork lift trucks, the vehicles washing plateau will be designed, with dimensions of 15 x 12.2 m, with the waste water drainage channel.

Within the vehicles washing plateau, vehicle wash facility is designed and it represents the covered part of this plateau, with the useful basis of 11.70x7.50m and useful height for entrance of 4.2 m.

2.3.3 Administrative Building Area

Administrative building

Description

The facility is placed immediately next to the official entrance to the landfill complex, i.e. access road. Useful basis is 11.3x10.3 m and number of floors is S+P+1, and the highest point is 9.28m.

Solution for the administration building is functional –based on its exploitation requirements. Following rooms are needed:

- basement: shelter, boiler room and accompanying basement premises
- ground floor: offices for employees, archive premises, laboratory for conduction of elementary chemical analyses, toilettes – for men and women.
- floor: hall for meetings or presentations, director's office, offices for bookkeepers, kitchenette, toilettes – for men and women.

The facility is envisaged to have water supply and sewerage installations, thermal and mechanical installations, air-conditioners, high and low current, earthling rods in line with corresponding technical, sanitary and fire protection regulations.

Construction

The administrative building has the floor level 40 cm higher from the sidewalk level at the entrance, while the useful height of the floor is 3.20m.

Facility finishes

The external facade is to be of bavalit, while the interior surfaces are plastered, skimmed and painted with dispersion paints. In the toilet, the walls are covered with ceramic tiles from floor to ceiling, while in the kitchen they are from the floor to a height of 180 cm height, and the remaining surface to the ceiling is painted with dispersion paint.

Floors are of equal layers in the complete facility a surface finish of ceramic tiles. Doors and windows in the facility will be made of PVC profiles, except for the facade – entrance door which is to be of aluminium profiles, fitted with insulation glass.

In the facility, water supply and sewage installations are planned, together with heating and air-conditioning installations, low voltage and high voltage electricity, lightning rod in compliance with technical, sanitary and fire protection regulations.

Laboratory

The laboratory within the administrative building shall comprise of all furniture and equipment necessary for successful sample preparation and keeping, analysis and measurement and storing of analysis results.

Laboratory is foreseen for analysis of various streams of waste, water and the effluent before and after the treatment within the WWTP and leachate treatment plant.

Laboratory shall be equipped minimum with:

- Analytical balance with capacity up to 300g and resolution of 0,1mg, with a LCD display
- Laboratory scale with capacity up to 3,000 g and resolution of 0.5 g, with a LCD display
- Drying oven range from 0 to 250 °C
- Autoclave
- Electric Muffle furnace range 0 to 600 °C
- Calorimeter
- Incubator range 0 to 20°C
- Waterbath
- Filtering system
- Spectrophotometer - UV/VIS
- Photometar
- Conductivity Meter
- Temperature transmitters (liquid in glass thermometers, 2x; RTD temperature probe with LCD display, 2x)
- pH meter probe with glass electrode and meter with LCD display
- Jar test equipment (compact laboratory mixer for 4 samples that includes jar support base, mixer drive system, mixer paddles, light, cooling fan, tachometer and controls)
- Turbidity meter with LCD display maintenance kit
- Multiparameter - measurements (pH / pH FET / ORP / Ion / Conductivity / TDS / Salinity / Resistivity / Dissolved Oxygen / BOD (OUR, SOUR) / Temperature)
- Dissolved Oxygen analyzer with LCD display
- Equipment for measurement of COD, BOD5
- Equipment for measurement of mineral oils, total oils and fats
- Water Purification Equipment: Ione exchange and reverse osmosis
- Automatic sampler
- Total organic carbon analyzer
- ORP analyzer with LCD display
- Digestion Apparatus (Spectroquant thermoreactor)
- Heavy metals analyzer with a connection to a personal computer
- Ammonia analyzer with LCD display
- Turbidity meter with LCD display maintenance kit
- Volumetric Glassware
- Thermometer range 0 to 100 °C
- Refrigerator approx. 120 l
- Set f laboratory sowftware

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All of the equipment shall be delivered with operation and maintenance manuals and where applicable, with maintenance kits, calibration equipment, solutions and weights. The contractor shall supply at least two additional (reserve) electrodes for all analyzes that use electrodes.

All devices with connection to a personal computer shall be delivered with data acquisition software that shall be installed on two personal computers within the laboratory.

Combined devices (for measurement of multiple parameters) are allowed.

The Contractor shall supply one top-performance personal computers ready for the installation of aforementioned equipment (with preinstalled operating system MS Windows of the latest generation, MS Office Professional of the latest generation). The computer shall be equipped with 24-inch monitor and uninterruptible power supply device. All software licenses shall be registered in the name of the End Recipient and shall be delivered to the Beneficiary.

The Tenderers shall offer only equipment of reputable manufacturers with proven track records, traceable to national or international standards. All of the equipment shall be approved by the Engineer.

The laboratory have to be equipped with furniture resistant to influences in laboratory.

Office furniture

General remarks

The office furniture and equipment for utilization for Service centre, Entrance building and all other offices has to be indicated in Drawings of Main Designs. The type, style, colour, size, number and placement of furniture and equipment are subject to consent of Engineer. Contractor is required to prepare three variant solutions/samples of each specified element of furniture and equipment and submit to Engineer.

The furniture consists of: office desks of various sizes, cabinets, bookcases, office chairs, reception desks, wardrobe, closets and lockers, conference tables, conference chairs, kitchenette, fully equipped kitchen, kitchen tables and chairs, etc.

Special care must be taken for equipment for laboratory which should be resistant to chemical substances including digestors, lab tables, working tables, closets, sinks and pipes etc.

For particular rooms within the buildings it is assumed that Interior Design must be made within the scope of the Detailed Design. It is assumed that Interior Design is necessary for entry hall (Reception) of Administrative building. Interior Design for the furniture must be in accordance with architecture and overall environment of the room into which it is placed (halftones colouring of walls, ceilings and floors, doors/windows and other equipment), illumination bodies and the character of lighting.

All furniture within one room should be made with mutually harmonised colours and style in maximum 2-3 colours (or halftones). Halftones shall be determined in the Detailed Design, and approved by the Engineer.

Within one room it is necessary to insure furniture of the same styling, preferably of one manufacturer/provider (colour of the plates, colour and style of handles, table footings etc.).

Visual signs (evacuation routes), room signs with names of employers or name and number of room shall be made of stainless steel frame and glass of appropriate size.

The fire extinguishers placed in the buildings will be placed in required dimension cabinets according to extinguisher's size. The cabinets are made of wood (solid wood or Medium-density fibreboard (MDF) with external panels coated) with a lock (with three keys minimum)

and on the front side shall be glass window (the mat finish glass) with the required label (fire signs etc.). Cabinets shall be mounted in/on the wall. If necessary, cabinets can be made of staleness steel with glass window. Colour, finish, materials, dimension and location of cabinets shall be proposed by Designer and confirmed by Engineer.

Fire extinguishers type, size and position shall be define in Contractor's designs and in the necessary elaborates.

Indoor fire hydrant cabinets shall be made of staleness steal frame, glass window (mat finish glass) with required label (fire signs etc.) and lock. Indoor fire hydrant cabinets shall be wall mounted, a recess-mounted (build-in type) if possible. Colour, materials, dimension and location of cabinets shall be proposed by Designer and confirmed by Engineer.

The fire hydrant cabinet size, equipment and position shall be define in Contractor's designs and in the necessary elaborates.

Indoor fire hydrant cabinets and fire extinguishers shall be designed according to the Law on Fire Protection, and other relevant legislation.

The envisaged cables for the distribution and connectors for the sound system and TV antenna port shell be provided in the conference room.

The possibility of dimming the lights for the projections shall be provided in the conference room.

The halls shall be provided with connections ensuring potable water and electricity (placed in wall-mounted cabinet). Locations of connections shall be approved by Engineer.

The administration buildings standard electricity cabinet (for electrical equipment) shall be within the special thin cabinet with a frame made of wood (solid wood or Medium-density fibreboard), with mat finish glass window, lock and stainless steel hinges. Materials and design of electricity cabinets shall comply with the fire extinguisher cabinets. Dimension, colour and design shall be proposed by Designer and approved by Engineer.

Specifications for furniture

Manger's office should have working table, chair, telephone and computer and has to be connected with meeting room where conference table with chairs for minimum 12 persons is placed.

On the ground floor there are three offices. Two of them with two working places and one with three working places. Laboratory with the equipment defined and archive room are needed too. Shelves, table and chair will be placed in the archive room too..

On the first floor there is one office more, equipped with working table and chair and kitchen with the kitchen equipment. All rooms are equipped with telephone and computers.

- *Office Tables-desks*

Table has to be made with metal frame painted in black or metal grey with wooden working plate from massive wood, or with veneer cover or plasticised surface. Style and surface shall be determined by the Main Designer in interior design and approved by Engineer. The colours and styling shall be in accordance with overall styling of the room into the tables shall be placed.

Table legs must have the possibility for fine elevation adjustment for working surface levelling. It has to be assumed that there shall be electrical devices connected on the working surface (Personal computer (PC), lamps etc.) for which sockets must be provided. The electric cables should be hidden.

Tables which are facing the door, or face connected tables for two working places must have visual protection (approx. 40 cm above the table) on required bearing – vertical plate from

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sand blasted glass or similar transparent modesty panels. Besides working tables it is necessary to assure computer case holder on wheels (PC holder). Minimum twelve (12) pieces shall be provided.

- *Representative office table*

Representative style office tables are to be placed in offices in administrative building first floor. Minimum two (2)

- *Mobile cabinet with three trays*

Mobile cabinet has to be made of wood or metal, colour and style must be in accordance with office tables. For the purpose of mobility it has to be placed on adequate wheels. Trays must have possibility for locking (two keys complete). Trays are on sleds. Minimum twelve (12) pieces shall be provided.

- *Representative Mobile cabinet with three trays*

. Beside representative office tables. Minimum two (2) pieces shall be provided

- *Office chairs on wheels*

Chair with total height 100 cm minimum, ergonomic, steel base with polypropylene guard, metal structure with a seat and back with cover made of transpirant synthetic leather (polyurethane and more than 60% cotton), transpiring polypropylene net back, metal net, fireproof fabric or upholster textile placed on wheels with possibility of adjusting height and back inclination and with hand placement (metal structure with polyurethane arm). Chair has to be of standard dimensions fulfilling safety at works regulations. Style, colour and surface shall be determined by the Main Designer in interior design. Colour of structure and covering must be accommodated to other furniture in the room. Minimum twenty (20) pieces of office chairs on wheels shall be provided.

- *Representative office chairs on wheels*

Beside representative office tables. These chairs shall be ergonomic, total height 120 cm minimum in accordance with representative purpose of these rooms and in accordance with other furniture in these rooms and with seat and backs covered with genuine leather (Administrative building) or artificial leather/microfiber, die-cast aluminium base. Minimum two (2)

- *Reception desk "L" shaped*

To be placed in entrance hall in Administrative building in representative style (according to supplier's catalogue or by order). Materials, colours and shapes are to be made as proposed by the hall interior Designer. It is necessary to give overall solution for the corner in which it is placed (for instance special arrangement or cover of walls, light open shelves, additional lighting if required, mirrors or similar), approved by the Engineer.

In conformance with Engineer consent, it is possible to envisage advertisement signs on walls, desk, company logo or similar. Minimum one (1) piece shall be provided

- *Conference table*

Conference table is to be put into meeting room near the Manager's office. Table is predicted for 12 seating places. It has to be made with metal frame painted in black or metal grey with wooden working plate from massive wood, or with veneer cover or plasticised surface. Style, colour and surface shall be determined by the Main Designer in interior design. The colours and styling shall be in accordance with overall styling of the room into the tables shall be placed.

Table legs must have the possibility for fine elevation adjustment for working surface levelling. It has to be assumed that there shall be electrical devices and to IT network connected on the working surface (Laptop computer, for each seating places) for which

sockets must be provided. The electric cables should be hidden. Minimum one (1) piece shall be provided.

- *Conference chair*

Conference chair (total height 120 cm minimum) with metal structure with a seat and back with cover made of genuine leather (all chair in conference room), metal net, or upholster textile placed on wheels with possibility of adjusting height and back inclination, die-cast aluminium base and with or without hand placement (metal structure with padded arm). Chair has to be of standard dimensions fulfilling safety at works regulations. Style, colour and surface shall be determined by the Designer. Colour of structure and covering must be accommodated to other furniture in the room. Minimum twelve (12) pieces shall be provided.

- *Dining table*

For tea kitchen (kitchenette) in Administrative building shall be for four persons

- *Kitchen chair*

Metal structure chair with seat and back with textile or artificial leather cover are to be placed. Chair is of standard dimensions, fulfilling safety at work requirements. Colour and style of structure and other materials should be accommodated to other furniture in the room. Minimum four (4) pieces shall be provided.

- *Kitchen set,*

Kitchen is consisting of next kitchen elements: stillness steel sink 120x60 cm, refrigerator (integrated type, fridge capacity 210 l minimum, freezer capacity 20 l minimum, energy class "A+" minimum, minimum 4 safety glass shelves of which 3 adjustable fridge shelves minimum, lighting, noise level 40 dB maximum, door hinged convertible, electronic control for temperature settings, alarm), and combined cooking stove 60x60 cm (according to Conceptual design, stainless steel, electric hot plate, gas banner with electric ignition by using push-and-turn knob, integrated safety valves shut off the gas flow automatically in case the flame goes out, removable pot support for easy cleaning, control panel placed for easy access and use), with aspirator (stainless steel, 3 speed, 60 cm width minimum, stainless baffle grease filters, minimum 2x20 W halogen lamp, stainless steel chimney cover, well mount, appropriate engine power, guarantee period 2 years minimum) and kitchen wooden (solid wood or Medium-density fibreboard (MDF), 18 mm thickness minimum, painted/varnished) cabinets and panels and hanging elements (30 cm depth minimum, 90 cm height minimum/60 cm high minimum above sink/aspirator), stainless steel handle, worktop (moisture resistant, heat resistant, scratch resistant, laminate, 4 cm minimum, easy to cline), soft door and tray closing mechanism with self-closing the last few centimetres, adjustable shelves (wood, MDF, template glass, etc.), legs (adjustable, reinforced polyamide with plinth or stainless steel), boiler (capacity 10 l minimum, regulation and safety thermostat, heating indicator light, power minimum 3 kW, maximum working temperature less than 80° C), lighting (wall/ceiling fixtures, adequate electrical safety measures, LED/energy saving lamps, the Designer shall determine the shape, type, style, colour, level of illumination). All connected to installations (water supply, electricity, discharge of sanitary wastewater, gas from underground liquefied petroleum gas storage tank, hot water supply, etc.). Colour, dimension and style of kitchen elements shall be according to interior design. Colour of structure and covering must be accommodated to other furniture in the room

- *Bookcases for paper archive*

Open bookcases (shelves), metal (Administrative building) or wooden structure width 40 cm, approx. 30 cm between shelves and other dimensions according to interior design for archive in Administrative building.

Colour, style of structure and other materials should be accommodated to other furniture in the room.

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Structures of bookshelves are to be made according to folder dimensions which are to be archived, with prefabricated elements or by order. Bookcases shall be log 10 meters minimum.

Technical specification for hardware and software

The detailed computer technology (LAN) shall be prescribed in the Detailed design and additional hardware components might be needed as servers, work stations; connections cables, accessories etc. The supply of up-to-date hardware and software shall be delivered at the time of installation. The minimum specifications are given bellow.

Contractor shall deliver hardware for the RWMC Subotica:

- Two types of desktop computers on the basis of as Intel processors for the purpose of last versions of operating systems as Windows and as MS Office Professional, and other software suitable for the equipment to be delivered according to contract;
- Work stations on the basis of as Intel processors for the purpose of last versions of operating systems as Windows and as MS Office Professional, and other software suitable for the equipment to be delivered according to contract;
- Business laptop computers on the basis of as Intel processors for the purpose of last versions of operating systems as Windows and as MS Office Professional, and other software suitable for the equipment to be delivered according to contract;
- Server for all computers, equipment and management systems predicted in Contract on the basis of as Intel processors for the purpose of last versions of operating systems as Windows and as MS Office Professional, and other software suitable for the equipment to be delivered according to contract. The case is also to be delivered.
- Tape driver for backup;
- UPS;
- Office Multifunctional Colour Printer A4/A3;
- Colour Printer A3/A4r;
- Printer A4;
- Multifunctional Printer A4;
- IP telephone;
- Telephone central station;
- Outdoor network camera;
- Projector with screen.

The equipment to be delivered and installed at RWMC Subotica has to be according to technology and standards at the time of delivery with minimum same class and quality valid 30 days before takeover of the building (around 2 years from the signing of Contract).

Software

The Contractor shall for every delivered computer, laptop and server deliver operating system (as Windows) in Serbian language, Office suite (as MS Office) in Serbian language,

antivirus protection program updated to 30 days before the takeover of works. For each installed software the Contractor must deliver licence without time limit on the name of "Regionalna deponija" Ltd with the software delivered for every copy installed.

Besides above mentioned the Contractor shall deliver software in Serbian language for equipment and facilities mentioned in Contract and which is compatible with named software and hardware, all licensed on the name "Regionalna deponija" Ltd without time limit.

Other

In case that accessories, equipment and facilities mentioned in Contract predicted for centralized monitoring and managing of processes and normal operating work, need additional (different or with additional accessories) hardware or software the Contractor shall deliver it at the same price.

For management and control of work of facilities within RWMC Subotica the prescribed hardware type 3 with accompanying software shall be used if not predicted otherwise.

Computers and laptops must be connected to one phase of electricity while other sockets are marked with other colour (red) for other power supply lines.

According to needs the computers shall be connected to UPS. The connections to UPS is prescribed for minimum server and computers used for management. The number of UPS devices shall be determined by the design.

Distribution by armoured copper cables STP/FTP of category 7 or higher shall be used for shorter routes (e.g. within Service Centre itself), whereas distribution within facilities, from Communication cabinet to TK/LAN connectors shall be made by copper STP/FTP cables of category 7or higher.

Telephone central station:

Telephone central station (back-up memory durability min 7 years, application for mobile phone support as office unit, centralized management and possibility for upgrading, port for music while on hold, messages on hold, adopted to telephone equipment on CWMC, connected to uninterrupted power supply, adopted to public network with case and adequate protection if could be placed together with server).

Telephone Type 1 (min 10 pieces)

1) Expandable IP Business Telephone, 6-Line/min 24 characters Backlit LCD, Speakerphone, Headset Jack, Message Waiting LED, Digital Speakerphone, 100 Personal Speed Dial, Alphanumeric Directory Search, PC LAN Port, Bluetooth Module, Self Labeling, Navigator Key, Wall Mountable Capability, Incoming and Outgoing Call Log, Keys with LEDs.

Telephone Type 2

2) IP Telephone, 6-Line/min 24 characters Backlit LCD, Digital Speakerphone, Headset Jack, Message Waiting LED, Personal Speed Dial 100, PC LAN Port, Navigator Key, Wall Mountable Capability, Incoming and Outgoing Call Log, Keys with LEDs.

TECHNICAL REQUIREMENTS FOR HEATING AND COOLING EQUIPMENT

Combined device for central heating and equipment for hot water preparation based on electric power

Wall mounted combined device with microprocessor technology must be in constant connection to probes in device that allows full automated work according to prescribed parameters. In case of any disruption, the device has to autonomously recognize new state and block all functions.

LC display gives the consumer the actual information's about status of device and in case of any disruption shows code of mistake. Device has to have the possibility for programmed work for a week.

Device has to fulfil next requirements:

- work with minimal flow of 1.5 l/min;
- integrated smoke detectors;
- microprocessor technology with eBUS communication;
- burner with automatic modulation (40-100%);
- freezing protection; protection from pump blockade;
- low noise work;
- integrated digital pressure measurement with constant control of pressure in heating system;
- integrated two level manual pump.

Radiators

Type: panel radiator

General requirements: design in accordance with architecture (in finish and styling with overall styling of the room in which they are placed), maximal efficiency and state of art performance technology that enables long lifetime and resistance to corrosion. Radiators must have sufficient number of convection slices that allow quality heat transfer. Contractor is required to prepare three variant solutions/samples of radiators and submit to Engineer.

Specific requirements:

- material: cold flatting steel plate;
- test pressure: 13 bars, maximum working pressure: 10 bars;
- working temperature: 50°C;
- maximum working temperature 120°C;
- connections: 1.77 cm (½");
- heat efficiency according to HRN EN 442;
- anticorrosion protection: Zn phosphating:
- painting: cathode base painting + electrostatic cover layer (RAL 9010);
- guarantee period: 10 years:

All radiators must be equipped with thermostatic valves.

Piping installation for heating

All installations have to be performed with quality thermo isolation under mortar.

Cooling units

All cooling units have to be implemented as inverter devices („Hybrid Inverter") in split performance with one outer unit and more inside units.

Compressors with constant rotation speed are not acceptable.

Location of outer units locations: recommended on left or right side of attic level (view from the entrance).

All installations inside the building should be placed in required heat isolation under mortar.

Efficiency level of devices must be in energetic class "A".

Parking lots for employees' cars

A parking area with 23 parking lots for employees' cars, dimensions 4.60 m x 2.30 m, will be designed and constructed.

2.3.4 Workshop

Description

A workshop building is planned for maintenance of the vehicles and equipment on the landfill.
Facility is defined with all requested contents, while spatially and functionally following units are separated:

- operating part
- work part: workshop, vehicle wash and warehouse, premises for workers, that is, in terms of rooms:
  1. VEHICLE WASH
  2. WORKSHOP
  3. WAREHOUSE
  4. CONTROL ROOM
  5. WORKROOM
  6. DINING ROOM
  7. KITCHENETTE
  8. LADIES CHANGING ROOMS AND SHOWERS
  9. MEN CHANGING ROOMS AND SHOWERS
  10. TOILETTE FOR LADIES
  11. TOILETTE FOR MEN
  12. PANTRY FOR CLEANING LADIES
  13. HALL
  14. ENTRANCE
  15. PLATEAU FOR VEHICLE WASH

The useful floor area of the building will be a minimum of 270 m^2, with a minimum clear height of 3.15 m in the offices area and 4.95 m in the garage where trucks should be able to enter. The base of facility is ≈ 29.00x10.00 m.

The workshop shall be equipped with work benches, a full set of standard hand tools and electric tools to carry out regular maintenance and repair. The workshop shall include a storage room for larger spare parts and cupboards for repair materials and smaller spare parts and consumables.

Toilets, showers and dressing rooms shall be designed and equipped so that the flow of users will be unidirectional, either from the clean side outdoors clothing cloakroom to the wet

area and finally the work clothing cloak room when coming to work, or vice versa, when leaving work.

For the proper functioning of the landfill a maintenance facility is designated – suited for the needs of the users, current laws, regulations and standards in the field of construction.

The facility is envisaged to have water supply and sewerage installations, thermal and mechanical installations, high and low current, earthing rods in line with corresponding technical, sanitary and fire protection regulations. Heating and air conditioning will be of the same kind as in the administrative building.

The finish of the external surfaces is of two kinds. The facility is constructionally and functionally divided into two parts, which consequently defines the choice of materials for surface finishes. The lower part of the facility will have a thermally insulating facade, while the inner surfaces are plastered, leveled and finally painted.

It is designed that the facade of the remaining part of construction – the part with a higher floor (i.e. the workshop), is made of aluminum "sandwich" panels. The facility is completely covered with these panels, while the water is drained from the roof by galvanized sheet metal gutters painted in the appropriate color.

Floor finishing is ceramics in the administrative part, while in the workshop the floor finish is concrete slab. Ceramic tiles have to be non-slippery and resistant to wear.

Tools

The workshop shall be supplied by a standard set of tools including:

2 general purpose toolboxes;

2 heavy duty hand drills;

1 air compressor, min 1.1 KW motor;

Compressed air supply network with a minimum of 6 connection points;

1 welding machine;

1 portable grinding wheel;

1 set of wire cutters;

1 table dual head grinding wheel;

1 vertical table drill;

2.3.5 Internal roads and plateaux

Manoeuvring and traffic plateau

Internal asphalt roads and plateaux will be designed to connect the entrance gates with the landfill body, the facilities for waste water treatment, the infrastructure facilities and the service facilities. It should be designed for heavy load transport.

Plateau for temporary disposal of construction and demolition waste

A plateau will be provided for the temporary disposal of construction and demolition waste, in quantities less than 1 m^3, that is collected by PUCs or deposited by individuals. The area available will be 1,000 m^2. Construction and demolition waste (C & D waste) will be distributed to construction companies for further processing. One mobile unit for processing of C & D waste can be placed on this plateau, but it is not necessary at the moment. Processed C & D waste can be used for some of the landfill needs.

Plateau for the temporary disposal of the parts of used tyres

It is designed for the temporary disposal of used tyres. An area of 1000 m^2 is available, next to the weighbridge. The used tyres should be delivered to cement plants, but tyres can be also used for some of the landfill needs (fixing and temporary protection of landfill body sides).

Disel station
Inside the RWMC, a diesel station for the supply of vehicles shall be built.

Parts of diesel station are:

- steel fuel tank
- reinforced concrete plateau for access to the pour-out equipment and to the opening of the underground fuel tank
- device for pouring out of motor fuel
- steel roof of the pour-out equipment area

Steel fuel tank
Steel two-sheathed tank of cylinder form with the capacity about 25 m3.

For the purpose of fuel flow between the tank and the equipment, there shall be underground and above-ground pipelines made of corrosion-protected steel pipes.

Reinforced concrete plateau
Reinforced concrete plateau consists of two reinforced concrete slabs. One plateau shall have ground plan size of around 4.35 m x 1.60 m. The other slab shall have ground plan size of around 4.37 m x 1.60 m and shall be used for the access to the entrance shaft of the tank. Slabs shall be separated and edged with concrete kerbs.

Pedestrian access to the de-aeration valve from the plateau shall be constructed too.

Fuel pour-out device
Fuel shall be poured out by means of a self-service device, without charge. The device shall be fixed on the fundamental formwork, which will be fixed with screws to the reinforced concrete slab of the plateau. Corrosion protection of the fundamental formwork is factory-made.

Steel roof
Roof structure shall consist of steel cantilever and two steel columns. Ground plan size of the roof shall be around 5.50 m x 3.60 m, with total height of about 5.0 m.

Under the roof structure, lighting fixtures shall be installed in order to illuminate the handling area. In the centre of the dripping edge of the roof, a hanging gutter shall be installed for discharge of precipitations.

Diesel station shall also have auxiliary fire-fighting equipment, warning and ban signs, as well as horizontal and vertical signalling for vehicles.

Fire safety
The facility has to fulfil all fire protection requirements and to be part of integral fire protection system of the landfill.. For the minimum requirements, near the diesel station fire

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extinguishers shall be placed (manual powder filled devices). Sandbox shall be placed next to the pouring device that will enable covering of spilled diesel fuel with sand.

2.3.6 Materials Separation and Recovery Facility (MRF)

MRF plant

In the first phase, a MRF plant will be provided, for the separation of mixed waste, which will operate in combination with a Composting Plant and gradually through the development of the primary selection it will be finally used for the separation of the waste after primary selection .

The proposed Waste separation line is based on:

- Manual sorting out of paper and cardboard, PET, plastic, foil
- Mechanical separation of ferrous metals and non-ferrous metals, such as aluminium;
- Main activities take place in an enclosed industrial building;
- Simple (no complex machinery), sturdy & proven separation line.

The separation line is intended only for treatment of municipal solid waste with specific weight of up to 0.3 - 0.4 t/m^3 and for waste fractions ranging from 0 - 500 mm. The plant capacity should be minimum 70,000 tons/yr.

The separation process basically will consist of:

- First selection and sorting of bulky waste **> 500 mm** (wood, bulky construction waste material, etc.) The non-recyclables are taken directly to the landfill cell and recyclable materials are further processed;
- Bag opening and treatment in the rotating drum screen with 55-100 mm openings, which separates the waste in two main fractions:
  - coarse fraction **> 100 mm** (dominantly recyclable materials), and
  - fine fraction **< 100 mm** (mostly organic waste);
- Waste **< 100 mm** goes through the magnetic and Eddy-current separators for separating the ferrous and non-ferrous fractions, while the remaining, mostly organic waste goes to the Composting process;
- Waste **> 100 mm** goes to sorting cabin where recyclable materials are handpicked:
  - light waste fraction (paper, cardboard, light plastics, PET),
  - heavy fraction (heavy plastics, metallic materials).

  The handpicking process ends with the sorting of recyclable materials in separate storage boxes for paper/cardboard, PET, plastics, metals and glass;
- Recyclables as plastics, PET and paper/cardboard, go to appropriate hydraulic presses installed at the end of the separation line, where these recyclables are baled and transported to the recycled materials storage plateau.

The MRF provides the following technological operations:

- Entrance and logistics of arriving waste collection vehicles;
- Waste unloading in a pit at the unloading platform;
- Waste transfer from the pit onto the conveyor belt;
- Waste transferred from the platform with a grab crane;
- Removal of bulky material;
- Bag shredding in a bag shredder and fed onto a conveyor to take to the Rotating Drum Screen;
- Mechanical waste separation in a rotary drum screen with integrated waste bag opener (knives) and 55-100 mm openings;
- Magnetic recovery and Eddy-current separators;
- Sorting lines for fine and coarse waste fractions;
- Manual waste separation in a indoor air-conditioned cabin with separating the waste in several boxes;

- Transport of useful separated waste to a press and baling machine (i.e. waste baling machines for the recyclables), and transport to the temporary storage area for sales or further transport to specialised recycling companies, whereas the non-useful waste will be pressed in a separate press, before disposal;
- Transport of organics, together with yard waste and trimmings, to the composting facility;
- Transport of non-useful waste to the active landfill cell for disposal.

The capacity of the separation line is calculated as the total waste quantity collected at the 7 municipalities in the project area, reduced by 10% for the waste already separated at source (in the municipalities, the four Transfer Stations (TSs) and the three Recycling Yards).

A further 10 % of the remaining waste will be separated by first handpicking and sorting of waste fractions > 500 mm, and an additionally 10 % will be separated at the rotary screen as fine particles less than 100 mm which will be transported directly to the compost plant or to the landfill.

The expected quantity of municipal waste to be processed at the separation line is calculated at a minimum 20 t/h, based on approximately 70.000 tons a year, i.e. 280 tons daily in the first (2016) year of landfill operation. Basing the calculation on 250 working days/year, it follows that about 10 shifts/week (2x5) and approximately 7.0 working hours/shift, with a minimum of 30 minutes per shift are foreseen for the separation line and building cleaning and washing per shift at the beginning. The total expected quantity of municipal waste to be proceeded at the separation line will increase during the landfill lifetime, but with waste quantity increasing non-linearly because separation activities at source will also increase.

The MRF indicative building dimensions are 29 m x 78 x, height 13 m, and minimum area 2,200 m^2. It will be specifically designed for the installation of the proposed MRF waste separation line. The waste separation line will be installed in this building.

The hall floor is elevated from the surrounding plateau by 0.05 m to 0.20 m, which allows the entire vehicular traffic and manipulation of materials, receipt and dispatch, to be performed at the same level, while the transportation is done by trucks and forklifts.

The collection trucks from the Municipalities within the Region and the hook trucks hauling un-compacted waste from the Transfer Stations (TS), after passing the weighbridge and control area, will head for the waste unloading area in the MRF.

Unloading and pre-sorting platform

The unloading operations shall be carried out onto the waste unloading platform located near the sorting line. The platform has a designed capacity of one work day of waste production. The facility shall include a minimum of six bulky waste sorting posts on both sides of the platform, for sorting big pieces of paper, cardboard, plastics, non-ferrous materials, etc., which may interfere with the sorting process that follows. The bulky waste shall be hand-picked and put into reversible conveyor belts through a series of hoppers located beside the sorting posts. The conveyor belts shall later take the useful materials to the related press.

The sorting line hopper feeding from the waste platform shall be effected by means of a mechanical shovel type machine. The waste shall be taken to the process line by means of plate conveyors of variable speed in order to allow metering of feeding waste.

Waste from the platform can also be picked by an overhead crane travelling on rails, using a grab, and transferred either to the bag shredder or directly to the rotating drum sieve, or anywhere else inside the hall.

The sorting platform characteristics will be as follows:

SORTING PLANT: **UNLOADING AND PRE-SORTING PLATFORM**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Minimum number of workplaces and bins	-	4

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

SORTING PLANT SORTING PLANT: **UNLOADING AND PRE-SORTING PLATFORM**	TENDERER/CONTRACTOR	
DESIGN DATA	UNIT	DATA
Overall dimensions -- total length, external -- total width, external -- total height, external	 m m m	 ....
Number and dimensions of drop chutes -- Number of chutes -- drop cross section -- height above floor	 No m^2 m	 ....

Overhead crane

An overhead bridge crane, provided with an electro hydraulic orange peel motor grab, will also be taking waste from the sorting platform to the bag shredder, the drum screen or directly to the sorting conveyors. The characteristics of the crane and grab will be as follows:

SORTING PLANT: **OVERHEAD CRANE AND GRAB HOOK**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Minimum number of units	Pieces	1
Minimum bridge span	M	8.00
Minimum load capacity	T	3
Type of grab	-	Orange peel
Grab minimum volumetric capacity	m3	2
Grab minimum load capacity	T	1.5
Maximum power	kW	4

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

SORTING PLANT: **OVERHEAD CRANE AND GRAB HOOK**	TENDERER/CONTRACTOR	
DESIGN DATA	UNIT	DATA
Make/type/model	-	.....
Bridge span	M	.....
Total bridge and grab weight		
Load capacity	T	.....

Grab maximum vertical travel	M	.....
Grab volumetric capacity	m^3	.....
Grab load capacity	Litre	.....
Open grab height	T	.....
Closed grab height	M	.....
Open grab width	M	.....
Closed grab width	M	.....
Maximum power	kW	.....

Mechanical shovels

Two mechanical shovels (bobcat type) will be necessary for the operation of the MRF. The one shall feed the bag shredder and the other the conveyor belts after pre-sorting and the conveyor belt delivering useful materials to the baling press.

The shovels will have the following characteristics:

SORTING PLANT: **MECHANICAL SHOVEL**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Minimum number of units	Pieces	2
Rubber wheels	-	Yes
Stacker equipped facility	-	Yes
Convenience cabin with air-filter	-	Yes
Shovel minimum load capacity	T	0.75
Shovel minimum volume	m^3	0.4
Tipping load	T	1.5
Minimum height of shovel pin	M	2.0

The filled in data sheet shall be annexed to the questionnaire in Volume I, Section 4, Form 6.10

SORTING PLANT: **MECHANICAL SHOVEL**	TENDERER/CONTRACTOR	
DESIGN DATA	UNIT	DATA
Make/type/model	-	.....
Bucket capacity	m^3	.....
Operating weight	T	.....
Engine rated power	kW	.....
Emission standard	EUROMOT	.....
Fuel tank	Litre	.....
Length	M	.....
Height top of cabin	M	.....
Width over tires	M	.....
Bucket width	M	.....
Turning radius	M	.....
Operating height	M	.....

Conveyor belts

Within the limits of the civil engineering specifications and the described erection conditions, the Tenderer is free to configure the equipment in the Sorting Plant such that, in line with his experience, an optimum arrangement will be obtained. As a result of his design the Tenderer shall secure enough room for the vehicles unloading waste and the waste storage as described before. Also he shall arrange the machinery so that he will get a good transfer point into the sorting area.

For all Tenderer's designs, particular attention should be paid to the characteristics of the waste to be treated and the media to be discharged.

Only smooth-surfaced belt conveyors guided by pulleys are permissible, to allow complete lateral material guidance with generously sized belt width (if other systems, such as drag link conveyors or apron conveyors are offered, this shall be justified in detail).

Belts shall be of sufficient width, so that no conveyed material will spill sideways from them.

The conveying devices shall be of robust design in order to cope with the anticipated difficult operating conditions.

The following minimum number of conveyors will be necessary, namely:

- Conveyor from unloading platform to bag shredder;
- Sloped conveyor belt from the bag shredder to the rotary screen;
- Sloped conveyor belt which transports the waste to the manual waste sorting cabin;
- Conveyor belt in the sorting cabin;
- Conveyor belt that transports separated waste to the separated waste press;
- Conveyor belt that transports non-separated waste to the non-separated waste press
- Slope conveyor belt for waste from primary separation, which transports the waste to the manual waste sorting cabin
- Spare conveyor

The data sheets are to be completely filled in by the Tenderer. The design data submitted from the Tenderer with his offer must be in compliance with the given minimum requirements and they are treated as guaranteed data.

SORTING PLANT: **CONVEYORS**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Belt speeds	m/s	max. 0.25
Belt width	Mm	min 1.400
Distances between idlers		
• in charging section	mm	max. 300
• other section	mm	max. 1,000
• lower stand idlers	mm	max. 3,000
Power consumption, continuous operation	kWh	max 5,5

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

DATA SHEET	
SORTING PLANT: **CONVEYORS**	TENDERER/CONTRACTOR
The Tenderer shall fill out a separate data sheet for each conveyor!	
Conveyor Unit Nr., location and purpose	.....

Make/type/model	.....	
Belt quality	.....	
DESIGN DATA	UNIT	DATA
Conveying capacity -- average -- maximum	 m^3/h t/h m^3/h t/h	 ....
Belt speed from to	m/s m/s	....
Stepwise variable belt speed	yes/no	....
Belt length	M	.....
Belt width	Mm	.....
Drive power	kW	.....
Power consumption, continuous operation	kWh	.....

Bag Shredder

A bag shredder of minimum capacity of 20 t/h of waste shall be installed, prior to the rotary drum screen, with the following characteristics:

SORTING PLANT: **BAG SHREDDER**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Minimum capacity	t/h	20
Maximum power	kW	12

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

DATA SHEET		
SORTING PLANT: **BAG SHREDDER**	TENDERER/CONTRACTOR	
Make/type/model	.....	
DESIGN DATA	UNIT	DATA
Capacity	t/h	.....
Weight	Kg	.....
Installed Power	KW	.....
Length	Mm	.....
Width	Mm	.....
Height	Mm	.....
Loading Height	Mm	.....
Discharge Height	Mm	.....

Rotary screen

After bag shredding the waste shall reach the rotary sieving in order to sieve, separate and fluff up the waste and make the later operations easier. The sieving mesh is 55-100 mm which ensures a proper extraction of concentrated organic matter.

The small fraction < 100 mm, passes under an overband electromagnet and then is taken by conveyor belt to the compostable material collection bin. The gross fraction > 100 mm, formed mostly by useful materials shall be taken to the sorting zone.

SORTING PLANT: **ROTARY SCREEN**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Minimum capacity	t/h	20
Minimum slope	%	4
Maximum sieving mesh in the front	Mm	55
Maximum sieving mesh at the end	Mm	100
Maximum power	kW	22

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

DATA SHEET		
SORTING PLANT: **ROTARY SCREEN**	TENDERER/CONTRACTOR	
Make/type/model	.....	
DESIGN DATA	UNIT	DATA
Capacity	t/h	.....
Slope	%	.....
Sieving mesh in the front	Mm	.....
Sieving mesh at the end	Mm	.....
Weight	Kg	.....
Installed Power	KW	.....
Power consumption	KWH/t	.....
Noise emission (1m from source)	dbA	.....
Length	Mm	.....
Width	Mm	.....
Height	Mm	.....
Loading Height	Mm	.....
Discharge Height	Mm	.....

Sorting Zone

The sorting zone shall include a minimum of twelve workplaces (picking stations) both sides of the line in order to facilitate the hand picking and sorting of the gross fraction. At the rotary sieve outlet there is a vacuum system for removal of plastic film.

The valuable material fraction shall be composed of:

High density polyethylene (HDPE).

Polyethylene Terephtalate (PET).

Cardboard and papers.

Plastic film

The workplaces are located within a cabin on the sorting platform and with stair access according to the relevant labour Health and Safety regulations. The cabin shall be properly lighted, soundproofed and air-conditioned in order to ensure suitable work conditions for workers. An air exchange/renewal system shall be designed in order to generate a lower pressure in the sorting hoppers and avoid unpleasant smells.

The sorted products shall be put into the different hoppers to conveyor belts which take each of them according to its nature toward the valuable materials press. Pressing shall be done sequentially according to the type and quantity of each of the different valuable materials in order to produce bales of each one of the different types of valuable materials: Plastic film, HDPE, PET, cardboard, etc.

Indicative dimensions of the cabin are: width 5000mm; length 21000mm; height 3500mm. The cabin is elevated to a height of 3-4m.

SORTING PLANT: **SORTING CABIN**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Minimum number of workplaces (equally distributed on either side of the conveyor belt)	-	12
Clearance height to bottom of steel support structure (container support surface)	M	3
Proportion of windows		
- referred to total wall area	%	min. 60
- referred to total floor area	%	min. 10
Insulation		
- noise level inside	dB(A)	max. 65
- temperature range inside	°C	17-26
Air exchange rate	Per hour	10

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

DATA SHEET		
SORTING PLANT: SORING CABIN	**TENDERER/CONTRACTOR**	
Make/type/model	.....	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Overall dimensions		
-- total length, external	m	.....
-- total width, external	m	.....
-- total height, external	m	.....
Dimensions of drop chutes		
-- drop cross section	m^2	.....
-- height above floor	m	.....
Total window area	m^2	.....
-- window area, referred to total wall area	%	.....
-- window area, referred to total floor area	%	.....
Total weight	T	.....
Overall dimensions		
-- total length, external	M	.....
-- total width, external	m	.....
-- total height, external	m	.....

Telehandler forklift

Two telehandler forkifts are necessary for stacking baled recyclables on piles or shelves.

SORTING PLANT: **TELEHANDLER FORKLIFT**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Rubber wheels	-	Yes
Stacker equipped facility	-	Yes
Convenience cabin with air-filter	-	Yes
Forklift capacity minimum	m^3	1
Minimum lift capacity	t	3
Lift height minimum	m	8
Forward reach minimum	m	5

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

SORTING PLANT: **TELEHANDLER FORKLIFT**	TENDERER/CONTRACTOR	
Make/type/model	.....	
DESIGN DATA	UNIT	DATA
Forklift capacity	m^3	.....
Operating weight	T	.....
Maximum lift capacity	T	.....
Engine rated power	kW	.....
Emission standard	EUROMOT	.....
Fuel tank	Litre	.....
Length	M	.....
Height top of cabin	M	.....
Width over tires	M	.....
Distance between forks • Maximum • Minimum	 mm mm	 ....
Length of forks • Maximum • Minimum	 mm mm	 ....
Turning radius	M	.....
Maximum operating height	M	.....
Maximum horizontal reach	M	.....

Magnetic separators for ferrous metals

The ferrous materials separation shall be carried out after the sorting cabin and at the outlet of the organic matter from the rotary sieving, by means of electromagnet over bands. The minimum features of the two electro magnets, one for the organic matter fraction and another for the reject stream from the sorting line are summarized below:

SORTING PLANT: **MAGNETIC SEPARATOR FOR ORGANIC STREAM**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Minimum capacity of feed	t/h	6
Maximum power	kW	4

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

DATA SHEET		
SORTING PLANT: **MAGNETIC SEPARATOR FOR ORGANIC STREAM**	TENDERER/CONTRACTOR	
Quantity	.....	
Make/type/model	.....	
DESIGN DATA	UNIT	DATA
Capacity	t/h	.....
Weight	Kg	.....
Installed Power	KW	.....
Power consumption	KWH/t	.....
Noise emission (1m from source)	dbA	.....
Length	Mm	.....
Width	Mm	.....
Height	Mm	.....
Loading Height	Mm	.....
Discharge Height	Mm	.....

A larger unit will be required for the sorting line

SORTING PLANT: **MAGNETIC SEPARATOR AFTER SORTING**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Minimum capacity of feed	t/h	18

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

DATA SHEET		
SORTING PLANT: **MAGNETIC SEPARATOR AFTER SORTING**	TENDERER/CONTRACTOR	
Quantity	.....	
Make/type/model	.....	
DESIGN DATA	UNIT	DATA
Capacity	t/h	.....
Weight	Kg	.....
Installed Power	KW	.....
Power consumption	KWH/t	.....
Noise emission (1m from source)	dbA	.....
Length	Mm	.....
Width	Mm	.....
Height	Mm	.....
Loading Height	Mm	.....
Discharge Height	Mm	.....

Eddy current separators

For the recovery of non-ferrous metals after the removal of ferrous metals, eddy current separators will be used, both after the sorting lines and at the outlet of the organic matter from the rotary sieve. The separators will be of the concentric type and can also be provided as one unit, together with the ferrous metal magnetic separator.

SORTING PLANT: **EDDY CURRENT SEPARATOR FOR ORGANICS STREAM**	MINIMUM REQUIREMENTS	
Type	Concentric	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Minimum capacity of feed	t/h	6

The filled in data sheet shall be annexed to the questionnaire in Volume I, Section 6, Form 4.10

DATA SHEET		
SORTING PLANT: **EDDY CURRENT SEPARATOR FOR ORGANICS STREAM**	TENDERER/CONTRACTOR	
Make/type/model		
DESIGN DATA	UNIT	DATA
Capacity	t/h	.....
Weight	Kg	.....
Installed Power	KW	.....
Power consumption	KWH/t	.....
Noise emission (1m from source)	dbA	.....
Length	Mm	.....
Width	Mm	.....
Height	Mm	.....
Loading Height	Mm	.....
Discharge Height	Mm	.....

A larger unit will be required for the sorting line

SORTING PLANT: **EDDY CURRENT SEPARATOR AFTER SORTING**	MINIMUM REQUIREMENTS	
Type	Concentric	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Minimum capacity of feed	t/h	18

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

DATA SHEET		
SORTING PLANT: **EDDY CURRENT SEPARATOR AFTER SORTING**	TENDERER/CONTRACTOR	
Make/type/model		
DESIGN DATA	UNIT	DATA
Capacity	t/h	.....
Weight	Kg	.....
Installed Power	KW	.....
Power consumption	KWH/t	.....
Noise emission (1m from source)	dbA	.....
Length	Mm	.....
Width	Mm	.....
Height	Mm	.....
Loading Height	Mm	.....
Discharge Height	Mm	.....

PET Shredder

A small PET shredder shall be installed before the baler press, in order to shred and squash PET bottles before they are pressed. As most PET is collected before waste gets to the landfill, a 600 Kg/hr shredder will be more than adequate.

Separated waste bale press

The bale press serves to compact the sorted out plastic materials, paper or cardboard. The minimum throughput capacity of this press shall be at minimum 5 t/h.

SORTING PLANT: **SEPARATED WASTE BALE PRESS**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Throughput	t/h	min. 5
Pressure	Bar	min. 250
Fastening to floor	--	Anchorage
Channel around the press	--	Not necessary
Maximum power	kW	25

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

SORTING PLANT: **SEPARATED WASTE BALE PRESS**	TENDERER/CONTRACTOR	
Make/type/model		
DESIGN DATA	UNIT	DATA
Capacity	t/h	----------
Output	bales/h	----------
Total installed power	kW	----------
Pressure	Bar	----------
Compaction time (including return stroke)	Sec	----------
Bale weight	Kg	----------
Bale density	t/m³	----------
Number of binding wires	No.	----------
Baling chamber dimensions (wxdxh)	mm x mm x mm	----------
Max. bale size (wxdxh)	mm x mm x mm	----------
Size of charging port (wxd)	mm x mm	----------
Exterior dimensions (wxdxh)	mm x mm x mm	----------
Charging height	M	----------
Total weight of bale press	T	----------
Noise emissions (at a distance of 1 m)	dB(A)	----------

Not separated waste press

This press is used to compact the useless material that remains after sorting, before they are transported to the landfill.

SORTING PLANT: **NON SEPARATED WASTE BALE PRESS**	MINIMUM REQUIREMENTS

PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Throughput	t/h	min. 5
Pressure	Bar	min. 250
Fastening to floor	--	Anchorage
Channel around the press	--	Necessary
Maximum power	kW	25

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

SORTING PLANT: **NON SEPARATED WASTE BALE PRESS**	TENDERER/CONTRACTOR	
Make/type/model		
DESIGN DATA	UNIT	DATA
Capacity	t/h	----------
Total installed power	kW	----------
Pressure	Bar	----------
Compaction time (including return stroke)	Sec	----------
Size of charging port (wxd)	mm x mm	----------
Exterior dimensions (wxdxh)	mm x mm x mm	----------
Charging height	M	----------
Total weight of press	T	----------
Noise emissions (at a distance of 1 m)	dB(A)	----------

Ventilation, heating and cooling of the separation cabin

A unit for air heating and ventilation shall be provided next to the separation cabin.

Ventilation of the separation cabin

The air shall be taken from outside the hall by ventilators which are in the unit for heating and ventilation, and it is directed to the cabin through a disposable filter and channel and distributed within the cabin by a diffuser system. The air is under small pressure which prevents the air from the hall from coming into the cabin. It is necessary to provide ten changes of air per hour. The air from the cabin is removed through the separation shuts. Filter changes are determined by differential pressures.

Air channels are made of zinc plated tin sheets.

Heating of the separation cabin

Electrical heaters, used for air heating, are installed in the unit for air heating and ventilation. A thermostat is located in the separation cabin and it controls the switching on and off of the electric heaters at the unit for air heating.

Cooling of the separation cabin

Split air coolers of 3.5 kW in power are used for cooling the air in summer. There should be at least four units, two on each side of the cabin length, symmetrically positioned.

Ventilation, heating and cooling of the waste separation and baling facility

Ventilation of the waste separation and baling facility

- Hall ventilation is conducted naturally and forcedly.
- Natural ventilation is carried out through a ventilation shutter 160mm wide, positioned along the hall in the top horizontal line of the roof.

- Forced ventilation is conducted by axial ventilators installed into both longitudinal walls of the hall (five ventilators in the longitudinal wall with the doors, and six on the longitudinal wall without doors) and both side walls (two for each). Shutters for the installation of the ventilators are installed with the fixed bars on the outside of the building. The location of ventilators is adjusted to the according to the places where dust from unloading the waste from the trucks and exhaust gases of trucks and vehicles occur.
- Fresh air supply in the hall is coming through the door (if open) or through louvres in the facade.

The selection of the ventilators is based on one air change per hour considering that the hall space is large. Turning on the ventilators is done manually, when it is necessary.

Heating and cooling of waste separation and baling facility

Considering that there is no need for the hall to be heated or cooled, the temperature inside the hall will mostly be equal to the air temperature outside.

Separation Hall construction

In the central part of the entrance exit zone there is a waste separation hall. Unique closed space of total net surface minimum 2.200 m^2 provides conditions for following technological operations:
- Entrance and traffic area for vehicles that deliver waste,
- Unloading and taking the waste to the conveyors,
- Mechanical separation of waste and extraction of iron waste,
- Manual separation of waste in the cabin and extraction of secondary raw materials in the boxes,
- Transportation of non separated waste to the press, baling and transportation to temporary disposal area,
- Transportation of secondary raw material to the press, baling, transportation and further storage.

Hall has to have the control room for controlling the operation of the system, control of the process, visual supervision of the working area through installed cameras.

Hall space is defined in the technological design and equipment elements regarding their dimensions, but also regarding construction elements which are important for equipment transportation and mounting. Industrial door is installed according to the requirements conditioned by the main traffic routes of material and staff. Cabin for manual separation of waste is part of the technological equipment. Hall floor is lifted from the surrounding plateaus 0.05 m to 0.20 m, which enables the complete vehicle traffic and material manipulation, delivery and dispatch, to be performed at the same level, and the transportation is done by transportation vehicles and fork lift trucks.

Sanitary units for the workers working on separation line have to be constructed too.

Surface area (according to JUS UC2 100/2002.):
Non-transparent parts are light construction panels, made of galvanized and painted steel sheet metal.The planned panels are resistant to fire (2000/556/EC) and do not spread flame.

The facility is levelled in the surrounding manipulative space. These surfaces are concreted and adjoined with the facility floor construction in such a way that prevents occurrence of fractures and differences in the levels at in the entrance to the facility.

Artificial ventilation of the space is done by the ventilator installed in the wall liner of the hall.

Covered Area for storage of separated waste

This is a covered area with minimum canopy dimensions 25m x 40 m, total of 1,000 m^2, located next to the hall for waste separation, for disposal of separated bulky household waste, recyclable materials and baled separated waste. The floor of the building has been levelled and incorporated into the surrounding plateau, thus allowing the entire vehicular traffic and manipulation of materials, to be performed at the same level, and transportation to be done by trucks and forklifts. Canopies will be constructed of stainless profiles and aluminium panels.

Hangar for baled waste, secondary raw materials and hazardous waste

Hangar design to be a ground floor, partly open steel structure intended for storage of baled waste, secondary raw materials and hazardous waste. The layout of facility is in accordance with its functional – operational requirements. Dimensions of the facility are 52.00x18.00 m height 5.00 m, with average elevation point of the slab at 106.92 alt. The facility is divided into two units: hangar for baled waste and recyclables, 41.60x18.00 and hangar for hazardous waste 10.40x18.00.

Roof cover is single layer aluminium sheet metal with roof pitch of 12.8%. Wall liner is aluminium sheet metal, hanged on the facade beams on three sides of the facility, while one longitudinal side in hangar for baled waste and recyclables and mainly open. The face side of hangar is open, without wall lining. The openings on the left are for vehicles' access and natural light and ventilation in the facility.

Drainage of atmospheric water from the roof is achieved by horizontal and vertical gutters made of galvanized sheet metal.

Thermo insulation of the facility is not necessary due to the nature of its purpose

2.3.7 Organic matter composting and curing facilities

2.3.7.1 General

An open windrow type composting plant will be designed to handle yard trimmings – green waste (leaves, grass clippings, tree trimmings, and brush from parks and gardens, wood waste, sawdust and tree pruning) and the compostable portion of a mixed waste stream (e.g. yard trimmings, food scraps, scrap paper products, and other decomposable organics). Sledge from the town Waste Water Treatment Plant is planned to be treated in the composting facilities and it is going to improve the quality of the produced compost. These materials are the feedstock or "find" for the composting process.

The composting process, designed as part of regional landfill complex "Subotica", is based on using the compostable portion of a mixed waste stream as a feedstock (app. 30% of the total MSW quantity), having in mind that food scraps includes fruit and vegetable trimmings and leftover food, waxed corrugated boxes, napkins, and other soiled paper, but excludes meat, fish, bones, fat, oils, eggs, and animal food waste. Also, if the incoming fresh waste contains lots of inorganic pollution the quality of the maturated compost will be lower and less suitable for fertilising purposes. Green/organic waste separation at source or at the regional landfill complex "Subotica" is of high priority for composting.

The composting plant for treatment of green and organic waste and mixed municipal waste (after being separated in the Separation plant), will be built as part of the Works Contract (i.e. in the first phase of the landfills' exploitation life).

In this way from the beginning of landfill complex operation, the composting plant will be used for compost production that can be sold as commercial product or in case of mixed municipal waste; this compost would be disposed on the landfill as cover material.

The composting plant should have a total capacity of 20,000 ton per year (incoming raw material). The development of the composting plant at the Subotica RWMC is based on the following main design criteria:

- the facility will be open for 6 days a week resulting in 300 days/yr;
- operating times: 300 days per year, 1 shift with 7 effective hours per day; the input of organic waste is estimated at 65 tons raw material per day;
- constant supply, no peak deliveries etc;
- the waste originates from separately collected organic waste, compostables from the separation plant and waste water treatment sludge;
- humidity of delivered materials is 50-60%;
- the process consists of a composting and maturing phase;
- a place for storage of the material;
- a weight reduction of 45%;
- an area of 1.5 to 2,0 ha is required.

2.3.7.2 Process description:

- delivery of materials (waste) during the day time;
- material is transported in the reception area by means of front end loaders;
- composting process in two stages: composting followed by maturing;
- The first stage of the composting process will take place under a roofed area, while the maturing area is in the open air;
- use of static pile system;
- use a compost turning machine to regularly turn the organic material
- concrete or asphalt hard surface is provided with a drainage system;
- mechanical processing at reception (shredding, after composting and sieving after maturing);
- moistening with water (recirculation system).
- Maximum consumption of the electrical energy is limited to 6 kWh/m^3 of the raw materials.

Reception area

The material is discharged on a platform. On the unloading area there will always be an employee present to check that no cargoes are discharged of which the waste composition deviates too much from the aimed composition. In particular, the amount of organic waste material and unacceptable pollutants will be checked.

The waste material on the reception platform is moved by means of a front-end loader.

Large, bulky material must be removed from the waste. First the waste will be manually screened and large objects will be removed, secondly the larger organic material waste will be shredded. The waste stream will be brought to the composting pile.

In the reception area a space capable of receiving and sieving 65 ton per day is required. With a density of 500 kg/m^3 a total daily volume of 130 m^3 is predicted. When the waste is stored for a duration of one day at a height of 2 m, approximately 200 m^2 is required. The pre-treatment line (shredder) also requires this area and for logistics another 500 m^2 is anticipated. It is therefore estimated that the reception area should be at least 1000 m^2.

Composting

<u>Set up composting fields</u>

Composting includes pulverizing /grinding of material in order to bring it in contact with air and water as much as possible: after grinding, the particle size in a pile is 5 to 6 mm. At the composting field the material is mixed with a quantity of oversized material to guarantee a porous mixture. During the grinding process, different components are mixed in order for the composting mass to be mixed well enough.

The following steps consist of mixing different kinds of organic waste in order to improve the C/N ratio and the porosity.

Porosity

Bacteria that are encouraged to grow in a compost pile are aerobic (require oxygen). Open spaces must be maintained to provide oxygen and allow air to penetrate and move through the pile. Ideally 35 to 50% of the pile volume would be small open spaces to allow air through the pile.

C/N ratio

The proper compost mix requires both carbon (C) and nitrogen (N) at the proper C/N ratio. The proper C/N ratio will result in a composting process that generates little odour, yet offers an environment where microorganisms can flourish. Generally, a C/N ratio that is higher than 25:1 is satisfactory. Most waste materials have a C/N ratio that is too low to compost. In order to compost these materials, additives that contain a high C/N ratio must be added.

Mixture produced will be transported by loader and tunnel will be filled. Walls are 1.2m high, and in the middle the pile is about 3m high. The size of the tunnel is 8,0m x25,0 m .

Volume of the mass for composting per tunnel is 420m3, so each tunnel receives mass for composting that was collected for about 4 days. (consistency of the material is 700kg/m3).

If composting lasts two months, total volume of the tunnels should be about 6000 m3- 14 tunnels. Construction of the tunnels will be done in two phases.

The decomposing processes start in the pile which consequently increases in temperature. Piles are stacked by loader and they need to be moistened in order to maintain an optimal humidity level of 50 to 65%. The highest water demand is in the first and the third phase when the processes are most intense. They can be covered with foil in order to maintain the temperature.

After formation of the composting piles and the start of decomposition, microorganisms quickly use all the oxygen, especially because the pile is compacted under its own weight which makes it difficult for new amount of air to reach inside the pile. Therefore the piles are regularly turned with a windrow-turning machine and air from below is blown into the piles. The most favourable oxygen amount is between 10 and 15%. The time and number of turnings are most often defined by temperature monitoring, but they also depend on the size of the pile, material composition and type of turner. The piles are at first turned over every three to five days, and every 15 days in the curing period.

Leachate collected from the composting piles will be collected, stored and reused for recirculation of the compost moisture because of high nutrient content and necessary microorganisms. Excess leachate can be discharged into the sewage network for further treatment.

The composting plant is situated in a large industrial building to protect rain infiltration and lower the required water treatment system capacity. The height of the covering construction is estimated at 6 m.

Maturing step

Post processing stage – shredding and screening

Post processing is normally performed to refine the compost product to meet end-use specifications or market requirements. Sorting and removal operations can be conducted to remove any remaining large or inorganic particles that could lower the quality of the compost, or be aesthetically displeasing. The same equipment can be used in both pre-processing and post-processing. After curing, the compost is transferred to a hammer mill for further size reduction. An additional stationary rotary drum screening device (mesh of 5 mm), placed in composting facility, or mobile drum screens/air separator/wind shifter, is then used to separate non-degraded materials from this compost. This equipment allows effective cleaning and removing of impurities and over-sized screened particles, the screen size has to be 50-80 mm. The undersize material is the readily-usable product and is transferred to the storage area. Oversized particles undergo additional shredding and screening. Material which is inorganic or cannot be shredded is disposed of at the landfill cell. Compost is transported with a shovel/wheel loader within compost storage area.

The composted material is further sieved (<40 mm) and at the end of the rotary drum the oversized material is discharged. A hand picker may be positioned to remove small contaminants or components that are not suitable for composting. The remaining oversized waste is brought by truck to the composting area to be used there as covering material when setting up the extended static piles.

The static piles for maturing are set up in the same manner as the composting area. They are also provided with forced aeration. The static pile is not covered with the oversized material as this material has already reached a sufficient stage of stabilisation.

During the setting up of the maturing fields the material is moistened. The undersized material of the composted fraction usually has a dry substance of approximately 65% and this should be brought back for the maturing step up to approximately 50%. Using irrigation pumps, water is transported by means of a hose from the water basin to the maturing field.

The maturing stage will take some 1.5 months resulting in a total windrow of approximately 600 m. It is anticipated to make 4 to 8 windrow lines.

The material is aerated during approximately 42 days. As with the composting process the organic waste is decreasing (-40 vol%) therefore less surface is required during this phase than in the composting process. It is estimated that only 4800 m^2 are required.

This part of the process takes place in open air. Therefore no covering is required.

At the end of the curing process, when about 50% of the volatile organic matter will have decomposed and the moisture content of the compost will be around 30%, the volume of the compost will be around 25 m^3 with a bulk density of around 1,100 Kg/m^3, or 27.5 tons of compost daily. A non-cured product will have a moisture content of about 40% and will be about 30 tons/day. During the curing process the loss in organic matter is minimal.

After 3 months the compost dries i.e. matures. Cured compost is subject to analysis during which chemical composition, moisture, pH value, pathogens content, etc., are determined.

Excavating and screening the matured material

The excavated material is brought into the mobile rotary drum screening device (mesh of 8 mm), positioned at the end of the maturing area. The undersized material is the finished product and is transported to the compost storage area.

The finished product undergoes a final processing step which may be a ballistic separation or a grinding step to remove small stones and glass particles. Afterwards it is stored in bulk waiting for transportation. The compost can be used on agricultural fields or as a material for landfill closure.

Product storage.

For storage of the compost a space of about 1,000 m^2 is required. It is expected that the product will be stored to a height of 3 m.

Miscellaneous

Residues

In the reception hall, the sorted pollutants and compost resistant materials are dumped into roll containers. When full the contents of these roll containers are emptied at the landfill.

Infrastructure

The facility will be provided with a hardened concrete base. A gutter will be constructed to intercept and drain off the possible leachate water.

Mass balance

The input of the process is 20,000 ton/year. The incoming organic waste from the waste separation collection is estimated at 100%. It is expected that the final yield of compost is approximately 45% of the total organic waste input and that the compost has a 70 % dry fraction of which approximately 30% is organic.

2.3.7.3 Total are area requirement

The total area is expected at least 1000 m^2 reception area; an area of 3260 m^2 for composting, 4,800 m^2 for maturing, and 1,000 m^2 for storage. Furthermore an area for treatment (sieving, shredding) of 500 m^2 is assumed. Including logistics it is expected that the site needs 1.5 - 2 ha. Offices and other facilities are not included as they are included in the waste management site.

Bagging or baling of final product is not foreseen because it is relatively labour intensive and therefore costly.

In order to improve the quality of the compost and produce a more valuable commercially product, the composting plant should be designed so that it can be expanded in the future, to receive the domestic wastewater treatment low metal content dewatered sludges from the Subotica Waste water treatment Plant.

2.3.7.4 Air blowers

The aerated windrow method takes the piped aeration system a step further, using blowers to supply air to the composting materials. The blowers provide direct control of the process and allow larger piles. No turning or agitation of the materials occurs once the pile is formed. When the pile has been formed properly and where the air supply is sufficient and the distribution uniform, the active composting period is completed in about three to five weeks.

With the aerated windrow technique, the raw material mixture is piled over a concrete base which is criss-crossed by trenches, in which wood chips, chopped straw or other very porous material is placed. The porous base material contains a perforated aeration pipe. The pipe is connected to a blower, which either pulls or pushes air through the pile.

The initial height of the windrows should be about 1.5-2.5 m, depending on: material porosity, weather conditions, and the reach of the equipment used to build the pile. Extra height is advantageous in the wintertime as it helps retain heat. It may be necessary to top off the pile with 15 cm of finished compost or bulking agent. The layer of finished compost protects the surface of the pile from drying, insulates it from heat loss, discourages flies, and filters ammonia and potential odours generated within the pile.

The required air flow rates and the choice of blowers and aeration pipe depend on how aeration is managed, i.e. how the blower is controlled. The blower can be run continuously or intermittently. In the latter case, the control mechanism can be a programmed time clock or a temperature sensor.

Positive pressure aeration shall be applied. In this case, the exhaust air leaves the compost pile over the entire pile surface. Therefore, it is difficult to collect the air for odour treatment. Where better odour control is desired, a thicker outer layer of compost can be used. Pressure aeration provides better air flow than suction aeration, largely because of the lack of an odour filter. The lower pressure loss results in greater air flow at the same blower power. Therefore, pressure systems can be more effective at cooling the pile and they are preferred where temperature control is the overriding concern.

Based on the mass balance of the process, the contractor will calculate the number, the size, the capacity and the working pressure of the blowers. There will always be a standby blower provided. The blowers shall be housed in a weatherproof enclosure.

2.3.7.5 Shredder

An organics shredder has to precede the composting process, in order to reduce the size of the compostable material, to levels small enough to enhance the process. It is best for the shredder to be mobile. In order to achieve maximum operational flexibility it is foreseen that the shredder shall be a movable shredder type, capable of both shredding bulky garden and park waste (branches, etc.) and performing mixing of structural and soft materials. Alternative options may be proposed by the Tenderer.

The minimum features of the organic waste shredder/mixer are summarised as follows:

COMPOSTING PLANT: ***SHREDDER***	*MINIMUM REQUIREMENTS*	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Specific weight of input materials -- organic waste -- bulky green waste	 t/m³ t/m³	 0.6 (0.5-0.8) 0.3 (0.1-0.4)
Throughput capacity Shredding action -- diameter of cross-sectional area -- max. edge length	t/h mm mm	>20 50 250

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

COMPOSTING PLANT: **SHREDDER**	TENDERER/CONTRACTOR	
DESIGN DATA	UNIT	DATA
Make/type/model	.....	
Throughput capacity: -- maximum	 t/h m³/h	 ....
Overall dimensions: overall height overall length overall width	 m m m	 ....
Total weight	T	.....

Power supply (diesel)	-	.....
Power rating	KW	.....
Power consumption per tonnes	kWh or litre/t	.....
Capacity of charging hopper	m^3	.....
Height of charging hopper loading edge	M	.....
Dimensions of charging opening	m x m	.....
Noise emissions	dB(A)	.....
Durability of the shredding parts	hours	.....
	tonnes	.....

2.3.7.6 Windrow turner, straddle type

A windrow turner is necessary to periodically turn the windrows in order to improve the post composting process. The basic characteristics of the windrow turner will be as follows:

COMPOSTING PLANT: **WINDROW TURNER**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Convenience cabin with air-filter	-	Yes
Windrow width	m	min. 5
Windrow height	m	min. 2.5
Capacity	m^3/h	min. 2,000

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

COMPOSTING PLANT: **WINDROW TURNER**	TENDERER/CONTRACTOR	
DESIGN DATA	UNIT	DATA
Make/type/model	-	.....
Capacity, maximum	m^3/h	.....
Overall dimensions:		
overall height	m	.....
overall length	m	.....
overall width	m	.....
Total weight	T	.....
Windrow height	m	.....
Windrow width	m	.....
Power supply (diesel)	yes/no	.....
Power rating	KW	.....
Power consumption (diesel) per m^3	Litre/m^3	.....
Integrated watering system	yes/no	.....
Noise emissions	dB(A)	.....

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2.3.7.7 Post screening

Post screening is necessary to create a material useful for other than landfilling uses. Post screening can take place before final curing and at times after final curing. Thus, it is best for the screen to be movable or self mobile:

COMPOSTING PLANT: **DRUM OR VIBRATING SIEVE**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Rubber wheels	-	Yes
Easy exchangeable screens	-	Yes
Integrated conveyors for discharge	-	Yes
In-put material, specific weight Capacity	t/m^3 t/h	0.4-0.6 Min. 10
Mesh size	mm	40

The filled in data sheet shall be annexed to the questionnaire in Volume I, Section 6, Form6.10

COMPOSTING PLANT: **DRUM OR VIBRATING SIEVE**	TENDERER/CONTRACTOR	
DESIGN DATA	UNIT	DATA
Make/type/model	-	.....
Capacity, maximum	t/h m^3/h	....
Overall dimensions: overall height overall length overall width	 m m m	 ....
Total weight	T	.....
Range of speeds min. max.	 1/min 1/min	 ....
Power supply (diesel)	-	.....
Power rating	kW	.....
Power consumption per tonnes	kW/t	.....
Noise emissions	dB(A)	.....

2.3.7.8 Front end loader

The front end loader is the basic tool for moving materials around the composting plant, moving windrows and loading final product. The basic characteristics of the loader will be as follows:

COMPOSTING PLANT: **FRONT END LOADER**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
• Rubber wheels • Stacker equipped facility • Convenience cabin with air-filter	- - -	Yes Yes Yes

•	Front shovel minimum	m^3	1.5
•	Lift height minimum	m	3

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

COMPOSTING PLANT: **FRONT END LOADER**	TENDERER/CONTRACTOR	
DESIGN DATA	UNIT	DATA
Make/type/model	-	.....
Bucket capacity	m^3	.....
Operating weight	T	.....
Maximum load	T	.....
Engine rated power	Kw	.....
Emission standard	EUROMOT	.....
Fuel tank	Litre	.....
Overall dimensions:		
Length	M	.....
Height top of cabin	M	.....
Width over tires	M	.....
Bucket width	M	.....
Turning radius	M	.....
Operating height	M	.....

2.3.7.9 Loading Conveyor

Large trucks will be loaded with compost by the front end loader. A loading conveyor at an angle to the horizontal will be necessary for loading composting material to smaller trucks. This can be either a belt or a shaftless screw conveyor

COMPOSTING PLANT: **CONVEYORS**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Belt speeds	m/s	max. 1
Angle to the horizontal		
• Minimum	o	30
• Maximum	o	45
Distances between idlers		
• in charging section	mm	max. 300
• other section	mm	max. 1,000
• lower stand idlers	mm	max. 3,000

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

DATA SHEET	
COMPOSTING PLANT: **CONVEYORS**	TENDERER/CONTRACTOR
Please fill out a separate data sheet for each conveyor!	

Conveyor Unit Nr., location and purpose	.....	
Make/type/model	.....	
Belt quality	.....	
DESIGN DATA	UNIT	DATA
Conveying capacity -- average -- maximum	 m^3/h t/h m^3/h t/h	 ....
Belt speed from to	m/s m/s	....
Stepwise variable belt speed	yes/no	....
Belt length	m	.....
Belt width	mm	.....
Drive power	kW	.....
Power consumption, continuous operation	kWh/h	

2.3.8 Non-hazardous waste landfill

2.3.8.1 General

The area of the proposed plot for waste disposal is 34.33 ha. The area available for the cells for waste disposal is 31.60 ha.

The total area of 31.60 ha, is divided into 10 cells that will be built in 5 successive phases, each phase consisting of 2 cells.

Design of the cells for waste disposal assumes that after the cell is filled and closed, waste is disposed of in next cell which rests on the already completed section. The estimated density of disposed and compacted waste, based on the technical details of the selected compactor, is 800 kg/m^3.

The first phase of the regional landfill complex comprises the construction of the first and second cell for waste disposal and all auxiliary facilities, while other phases of construction of the landfill each include the construction of two new cells (i.e. each phase consists of two cells). The landfill body will be surrounded by dikes.

2.3.8.2 Dikes, channels and movable fence

Surrounding dikes are designed to support the stability of the cells and anchoring of the protective membrane at the top of the landfill body. Filling of the cells can start only when the retaining dike is constructed. Dikes are of trapezoidal shape of average height 2 m, with a crown width of 4.0 m and slopes on the outside of maximum inclination 1:1.5 (towards the peripheral canal), and 1:1.5 internal (toward the body of the landfill).

In the corridor around landfill body, gravel roads-5 m width should be designed. They are made of materials excavated on the site. Disposal of waste in the cells will be transported from the manipulative – service area to the cells by this road. Trucks with waste will drive down into the cells by ramps. One ramp is designed per cell. These temporary ramps will have width of 5 m at the top and slopes of maximum 10%.

Partitioned dikes are the dikes in-between the waste disposal cells and are minimum 4 m wide at the top. These dikes have slopes of 1:1.5. They are compacted in layers of 20-30 cm by bulldozer and vibrating rollers, up to 100 % (Proctor procedure) until the final height is

reached. Dikes have to be constructed from the soil with density of 1.55 t/m^3 (dry soil) and humidity less than 2 % (by Proctor standard).

Temporary internal gravel roads over the landfill body and over the dikes will be constructed in all phases in relation to the active and filled-up cells. That means that in the first phase of construction, only the roads around the first 2 cells shall be completed.

The internal road around the landfill body will have width of 5 m (in the corridor around ladfill body) and a slope of 2%.

Boundary channels

Boundary channels for atmospheric waters (i.e. rainwater and surface water) are positioned within the corridor around the landfill body. The channels are dimensioned so that they could receive a 10-minute long rain event with a two year return period without causing overflowing (i=148 l/s by the conditions of Republic Hydro-meteorological Service of Serbia). Not poluted rain water from the empty landfill cells has to be collected into the channel for the rain water and discharged.

Surface water is not supposed to be collected and taken to the tank for treated water. It is collected in the soak channels.

Channel bottom is b=0.5m wide, with slope inclination 1:1 .Channel depth is h=0.75m. Excavated material from the surface water channels is transported to the temporary landfill of inert soil and used for covering.

Movable fence

A movable fence is designed with dimensions 15 m long and 3 m high. Mesh fences are made of extruded polymer of high strength. The supporting structure is made of aluminium profiles. This fence will be used during waste disposal in order to prevent dispersal of the waste due to wind.

2.3.9 Landfill bottom liners and drainage layer

The work includes the following:

delivery, placement and compacting of a layer of 0.5 m of non-permeable layer, with permeability coefficient of k≤1.0x10^{-9} m/s, placed over the levelled and compacted natural soil.

delivery and installation of high-density polyethylene (HDPE) liner on top of the non-permeable layer in the landfill cells;

delivery and installation of a protective geotextile of minimum 800 g/m^2, thickness of 7.5 mm, laid above the HDPE geomembrane in order to prevent any damage of the geomembrane by sharp or course particles in the drainage layer;

delivery and installation of a leachate drainage layer of 0.5 m, placed above the geotextile, with an integrated drainage pipe system for collection and transport of leachate towards the leachate treatment facility.

2.3.9.1 Materials and material requirements

Clay

General

Clayey soil is widely used for lining non-hazardous waste landfills. Clay can be defined as the soil fraction that has particles equal to or finer than 0.002 mm or as the soil fraction that has particles equal to or finer than 0.005 mm.

Clay-rich soil is placed in layers and compacted with heavy equipment to form a barrier to movement of liquids and gases. The soil liner is typically designed to have a hydraulic conductivity ≤ 1 x 10^{-9} m/s. Compacted clay liners are constructed either from natural soil materials that contain sufficient clay to attain the required low hydraulic conductivity or, if suitable soils are not available near the site, from a blend of commercially processed clay (almost always bentonite) and native soils obtained on or near a site.

For compacted clay liners, Construction Quality Assurance focuses on three crucial components: (1) ensuring that proper materials are used in constructing the liner; (2) ensuring that materials are placed and compacted properly; and (3) confirming that the liner is adequately protected from damage.

Clay liner is compacted with minimum modulus of compressibility of 20 MN/m2. Clay liner thickness should be at least 50.0 cm after compaction.

Clay liner must be well compacted and the surface of liner must be smooth and plain so that the next layer can be easily applied.

Substitution materials can be used instead of pure clay liner, provided that they ensure the same characteristics as the compacted clay liner.

HDPE liner

The liner must be a minimum 2.0 mm thick HDPE liner, smooth on both sides, UV resistant. The brand of liner offered must be stated clearly in the bid, including the supplier and possible sub-contractor for installation of the liner.

With the bid, documentation for fulfilment of the requirements listed in the Table below must be provided by the Tenderer. Furthermore, other information required must be attached.

Requirements for the HDPE liner are given in the following table:

Characteristics	Requirements	Testing Method
Appearance	Smooth on both sides with no visible defects.	Visual examination.
Thickness	Minimum 2.0 mm	EN 1849-2 or corresponding applicable standard.
Tensile Strength longitudinal/transvers e	30/30 N/mm2	EN ISO 527-1 or corresponding applicable standard.
Elongation at break	Elongation at break shall be >50 %	ISO 527-1 or corresponding applicable standard.
Tear strength	140 N/mm^2	ISO 34-1or corresponding applicable standard.
Puncture resistance	> 5.5 KN	DIN 12236 or corresponding applicable standard.
Fluid leakage	1.66 x 10^{-6} $m^3/m^2.d$	EN 14150 or corresponding applicable standard.

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Characteristics	Requirements	Testing Method
Gas leakage	3.29 x 10^{-3} $m^3/m^2.d$	ASTM D 1434 or corresponding applicable standard.
Linear coefficient of thermal expansion	1.76 x 10^{-4}	ASTM D 696 or corresponding applicable standard.
Permeability	> 1 x 10^{-14} m/s	ISO 11058 or corresponding applicable standard.

The bid must have enclosed a description of the guarantee given for the HDPE liner which is offered. The description must be in English and fully describe the characteristics, producer's data and locations where it was installed in the period of last 5 years..

Protection geotextiles

Material

Quality assured geotextile protection layers are required, one below the HDPE membrane and one above. The geotextiles should be of non-woven construction, manufactured from approved polymeric fibres such as polyethylene (PE) or polypropylene (PP)) and not produced of the secondary row materials.

Geotextile below HDPE membrane

The geotextile should have a minimum density of 300 g/m^2. Requirements for the geotextile are given in the following table:

Characteristics	Requirements	Testing Method
Thickness at pressure of 2kPA	2.7 mm	ISO 964-1/2001 or corresponding applicable standard.
Mass (Mass per surface)	> 300 g/m^2	ISO 965/2001 or corresponding applicable standard.
Strip Tensile strength (long./trans)	> 14/24 kN/m	ISO 10319 or corresponding applicable standard.
Elongation at break (long./trans)	95/80 %	ISO 10319 or corresponding applicable standard.
CBR static puncture resistance	> 3,000 N	ISO 12236/2001 or corresponding applicable standard.

Above HDPE membrane

The geotextile should have a minimum density of 800 g/m^2. Requirements for the geotextile are given in the following table:

Characteristics	Requirements	Testing Method
Thickness at pressure of 2kPA	5.2 mm	ISO 964-1/2001 or corresponding applicable standard.

Mass (Mass per surface)	> 800 g/m^2	ISO 965/2001 or corresponding applicable standard.
Strip Tensile strength (long./trans)	> 35/58 kN/m	ISO 10319 or corresponding applicable standard.
Elongation at break (longitudinal/transverse)	100/75 %	ISO 10319 or corresponding applicable standard.
CBR static puncture resistance	> 8,000 N	ISO 12236/2001 or corresponding applicable standard.

Installation

The geotextile shall be played directly on the HDPE geomembrane. All objects must be removed from the surface.

During the rolling out into position of the geotextile, sufficient allowance shall be made in order to provide an overlap at least 200 mm between adjacent sheets. Installation of geotextile, the edges shall be joined by either sewing, loistering or welding. This will prevent the material becoming displaced when the drainage blanket is placed and also prevent wind lifting of the geotextile if the edges are not connected.

The geotextile shall be anchored at the top of slopes, also to prevent wind lifting of the geotextile over time.

Once the geotextile is laid it shall not be trafficked until an adequate layer of drainage material is placed over it. Blades or buckets of construction plant must not be allowed to come into contact with the fabric during filling operations.The edges of the fabric shall be laid on the ground at the edges of the surface to be covered by adequate loading (e.g. sand bags or similar items that will not damage the bottom layer materials) to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimise risk of wind flow under the panels).

During the filling process, no attempt shall be made to restrain the top of the fabric.

Control

The Tenderer shall supply a compliance certificate from an independent testing laboratory to the effect that the geotextile supplied complies with the specifications.

Aggregate drainage layer

The aggregate material for the drainage layer surrounding the drainage pipes must be clean and must not contain fine particles. The content of organic material must be less than 1% ignition loss. The aggregate material must have good drainage properties.

Drainage properties: $k > 1x10^{-1}$ cm/s

Control shall as a minimum include one sample per 1,000 m^3.

Maximum content of carbonate 10 m wide around drainage pipes must be less than 5 %.

2.3.9.2 Execution of the works

Installation of HDPE liners must take its departure from the lowest point (i.e. at the leachate collection well).

Control of the liner base

Before installation, the Contractor should carefully check the surface of the liner base, including level survey and compaction properties.

It must be proven that the final surface has been compacted to at least 95 % Standard Proctor. Furthermore, the surface must fulfil the following requirements:

The surface must be smooth and free of stones larger than 50 mm.

Deviation from design levels: +/- 0.05 m.

Maximum deviation on a 3 m long straight edge: 0.02 m.

The installation must commence as soon as possible after control of the liner base.

Delivery and storage of the HDPE liner

The rolls of HDPE liner must be delivered and stored in such a way, that they are not exposed to unnecessary risk of damage, and they must be covered as protection against dirt and sunshine.

Liner material must not be stored directly on the ground. It should be placed on pallets or similar constructions.

Installation of the HDPE liner

Installation of the HDPE liner must take place in accordance with the instructions of the supplier, the design and with the approval of the Engineer.

The Contractor must prepare a plan drawing for the installation of the liner. The plan shall set out all sections of liner and clearly indicate the lengths to be welded. The plan must be approved by the Engineer before commencement of the installation work.

The installation must be carried out only in dry weather conditions. On slopes the orientation of panels shall be parallel to the slope. The panels shall be secured in an anchor trench at the top of the slope.

On the liner, the name of the welder, the roll number and the welding temperature must be marked. Further, it must be marked on each liner length, whether the liner is approved and tested for the sake of installation of drainage material on the liner.

The HDPE liner shall be anchored at the top of slopes, also to prevent wind lifting the HDPE liner over time.

During installation, the liner must be kept in place by adequate loading (e.g. sand bags or similar items that will not damage the liner) to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimise risk of wind flow under the panels).

The Contractor carries the full responsibility for the keeping in place and for storm damages. Sand bags must be removed in time with the installation of drainage material on the liner.

At his choice of working method and equipment, the Contractor must make sure that the liner is not damaged or exposed to traction. Prior to commencement the Engineer must be informed on the planned working method etc. for commenting.

Welding of the HDPE liner

All welding joints must be made by hot air welding equipment or contact heat welding equipment, and where this is not possible by use of automatic extrusion welding.

The liner must be clean and dry before welding is commenced.

Welding is performed with an overlap of minimum 10 cm.

Installation of drainage layer

The surface of the HDPE liner at the side areas for drainage installation must be clean from soil and other items.

The geotextile (see specification above) is installed on top of the HDPE liner.

The HDPE drainage pipe sections are installed on the geotextile and connected to the installations at the leachate collection shaft at the lowest point of the disposal unit. Leachate collection shafts are to be placed outside perimeter embankment and equipped with inspection lids (see paragraph 2.3.17 below).

Upon installation of the drainage pipes, silicate aggregate drainage material is installed in the 10 m wide geotextile covered areas. Other areas then covered.

Driving on the HDPE liner or the geotextile layer by means of any vehicle is strictly forbidden! Before driving on the drainage layer, elevated interim roads consisting of a minimum 0.70 m thick drainage fill layer (above the HDPE liner) must be established. After final installation of the aggregate drainage layer, surplus material used for interim roads must be removed.

Driving directly on the 0.50 m thick aggregate drainage layer is only allowed with equipment with limited contact load, i.e. tracked vehicles.

The aggregate fill layer must not be installed by bulldozing, but must be installed by a front end loader (Bob-Cat) or similar, in order to ensure that no folds or tensions are introduced at the liner.

Blades or buckets of construction plant must not be allowed to come in to contact with the fabric during filling operations.

2.3.9.3 Quality control

HDPE liner works

Performance Report for HDPE liner works

For each working day, the Contractor must prepare a performance report for the Engineer. The report must include information on:

Weather conditions (temperature and rainfall).

Installation plan with specification of roll number, location, welding equipment, welding operator, welding temperature, welding speed etc.

Tests carried out (see below).

Special conditions (repairs, rejected welding etc.)

Quality control on HDPE liner works

Tests include:

Area	Item	Test Method	Extent	Acceptance Criteria
Delivery control	Data sheets	Test certificates.	Per each roll	
	Welding made at factory	Tightness [2].	1 per 100 m	Tight
Receiving	Liner	Visual appearance.	1 per 1,000 m^2	Faultless

control		Thickness.	1 per 1,000 m^2	As specified
		Strength parameters (Elongation at yield and Elongation at break).	1 per 5,000 m^2	As specified
	Welding made at factory	Tightness [2].	1 per 1,000 m^2	As specified
		Shear mode test.	1 per 5,000 m^2	As specified
		Peel mode test [1].	1 per 5,000 m^2	As specified
Tests at commen-cement of works	Joints	Tightness [2], shear mode test and peel mode test [1].	1 per each welding equipment/welding operator	Tight
Tests during liner installation	Liner	Visual examination.		Faultless
	Joints	Tightness [2].	100 %	Tight
	Joints	Cut out sample with shear mode test, peel mode test [1] and tightness [2].	1 test per 5,000 m^2	Tight joint. Seam strength maximum negative deviation: 10 % at shear mode tests and 25 % at peel mode tests.

[1] Peel mode tests are performed both for upper liner/under lap and lower liner/over lap.
[2] Tightness tests are performed by vacuum test, pressure test or by spark test.

Description of Control and Tests of HDPE liner works:

Delivery Control:	The Engineer must approve the sub-contractor that performs the installation and welding of the liner. The welding operators must provide references on relevant experience from similar works. Lining Team Manager The Lining Team Manager will be an engineer or technologist with not less than 5 years experience in the installation of HDPE geomembrane liners. Master Welder The Master Welder will be responsible for the installation of the panels and will have installed not less than 100,000 m^2 of HDPE geomembrane using the same welding equipment to be used on this Contract. The Master Welder will be present at the works area whenever welding works are in progress. Welders

	Welders will be experienced in the installation and seaming of HDPE and will have installed not less than 25,000 m^2 of HDPE geomembrane using the same seaming equipment to be used on this Contract. The above mentioned must be documented by means of a reference list or similar which is attached to the Subcontractor's bid.
Receiving Control:	A programme of testing will be carried out by a laboratory of the Contractor's choosing, and at the Geosynthetics Subcontractor's cost, to confirm that the geomembrane supplied to the site comply with the manufacturers' specification. The Engineer will approve the choice of laboratory, and thus details of the laboratory should be attached to the Geosynthetics Subcontractor's bid, and if possible, be discussed at the pre-bid meeting. A 1m wide sample will be removed from rolls chosen randomly by the Engineer or his representative for each 5,000 m^2 of liner to be installed. For each liner roll delivered, a laboratory certificate from the factory must be available, in which, at a minimum, the product, type, tensile strength, elongation at break and the thickness is stated. No rolls of HDPE liner should be accepted with welds. Costs for carrying out of the tests must be included in the unit price for installation of the liner.
Control at Commencement of Installation:	Before commencement of the installation works, each welding operator must perform a test welding with all welding equipment foreseen to be used during the installation. The Engineer must be present at the test weldings. The weldings shall be tested on Site by the Contractor in the presence of the Engineer. A welding operator/welding equipment must not commence welding on the HDPE liner before approval from the test institute is available.
Control and Tests during Installation of the HDPE Liner:	At daily commencement of the welding works and at possible technical interruptions, welding tests for all welding equipment in use must be undertaken. The Contractor performs the tests on his own and the results are documented and handed over to the Engineer (all documentations must be provided in English). On a daily basis, the surface of the installed HDPE liner is inspected in cooperation with the Engineer. The inspection may also be conducted periodically in time with the installation of drainage material on the liner. The result of the inspection is noted on a form and by clear marking on the liner, where the welding has been approved. Possible suspected areas are tested by vacuum tests and it is marked on the liner when possible failures have been

	repaired. The Contractor must test all weldings either by vacuum tests, by compressed air where weldings are made as double weldings or by spark tests with inserted copper wire.
Control Forms:	The controls performed must be noted on forms and be handed over to the Engineer continuously as part of the work report. Control forms must include all data from the tests performed in accordance with the table above. The following forms must be prepared with a statement of the data mentioned: Delivery control form: Roll number. Data sheet per each roll (certificate from the manufacturer). Tightness of possible weldings made at factory. Receiving control form: Roll number. Each roll is checked for possible transport damages. Liner control (visual appearance, thickness, yield strength/break strength). Possible weldings made at factory (tightness, shear mode strength and peel mode strength). Form for test of weldings: Test of joint prior to commencement of the installation (tightness, shear mode test and peel mode test). Test of each joint for each start-up of welding equipment. Form for control of installed liner: Visual inspection of liner surface. Test of joints (tightness). Sample taking at joint (a sample cut out is tested for shear mode strength, peel mode strength and tightness). Control form for work status: Statement of finished liner area.

2.3.10 Other Mobile equipment for Landfill operation

Bulldozer

Bulldozers are the main piece of equipment used for pushing the waste materials into the active landfill cells. The instrument used for pushing is a metal blade attached to the front of the bulldozer. The same blade is used to trim excess material in order to achieve a level site. Tracked bulldozers are preferred for landfill operations as they provide a better degree of compaction. A backhoe attachment for excavation is also necessary. The characteristics of the required equipment are as follows.

LANDFILL OPERATION: **BULLDOZER**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Tracks	-	Yes
Convenience cabin with air-filter	-	Yes
Type of blade	-	Universal
Minimum engine power	KW	160
Minimum weight	T	22

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

LANDFILL OPERATION: **BULLDOZER**	TENDERER/CONTRACTOR	
Make/type/model	-	.....
DESIGN DATA	UNIT	DATA
Blade type	-	.....
Operating weight	T	.....
Engine rated power	kW	.....
Emission standard	EUROMOT	.....
Fuel tank	Litre	.....
Length	M	.....
Height top of cabin	M	.....
Width over tracks	M	.....
Blade width	M	.....
Blade height	M	.....
Turning radius	M	.....

Compactor

Waste compaction is literally crushing the material to reduce the total area it occupies. Bulldozers and compactors can do this because of their heavy weight. They move around on tracks or specially designed wheels, which helps to disperse their weight on the material. The waste is compacted by repeatedly driving the vehicles over the active dumping area. The compactor will have the following characteristics:

LANDFILL OPERATION: **COMPACTOR**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Tipped wheels	-	Yes
Blade type	-	Straight
Convenience cabin with air-filter	-	Yes
Minimum engine power	KW	170
Minimum weight	T	26

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

LANDFILL OPERATION: **COMPACTOR**	TENDERER/CONTRACTOR	
Make/type/model	-	.....
DESIGN DATA	UNIT	DATA
Wheel spike legth	Mm	.....
Wheel spike diameter	Mm	.....
Operating weight	T	.....
Engine rated power	kW	.....
Emission standard	EUROMOT	.....
Fuel tank	Litre	.....

Overall dimensions:		
Length	M	.....
Height top of cabin	M	.....
Width over wheels	M	.....
Turning radius	M	.....

Tipper truck

The tipper truck is to be used for the internal transport and tipping of waste and the transport of earth for landfill cover. The basic characteristics are as follows:

LANDFILL OPERATION: **TIPPER TRUCK**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Minimum useful volume	m3	8
Minimum load	t	7
Convenience cabin with air-filter	-	Yes
Brakes	-	ABS
Lifting ram	-	Hydraulic
Gearbox	-	Manual

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS

LANDFILL OPERATION: **TIPPER TRUCK**	TENDERER/CONTRACTOR	
Make/type/model	.....	
DESIGN DATA	UNIT	DATA
Bucket capacity	m^3	.....
Operating weight	t	.....
Engine rated power	kW	.....
Emission standard	EUROMOT	.....
Fuel tank	litre	.....
Length	m	.....
Height top of cabin	m	.....
Height of bottom of dumper body	m	.....
Width over tires	m	.....
Payload	t	.....
Useful volume	m^3	.....
Turning radius	m	.....

Truck lifter

The truck lifter shall be suitable for lifting the 7 m^3 open containers, filled mainly with organics for the composting plant, or non-separated material for landfilling. Basic characteristics are as follows:

LANDFILL OPERATION: **TRUCK LIFTER**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
• Rubber wheels	-	Yes
• Stacker equipped facility	-	Yes
• Convenience cabin with air-filter	-	Yes
• Container size	m^3	7

The filled in data sheet shall be annexed to the questionnaire in Volume I, Section 6, Form 610

LANDFILL OPERATION: **TRUCK LIFTER**	TENDERER/CONTRACTOR	
Make/type/model	.....	
DESIGN DATA	UNIT	DATA
Container capacity	m^3	.....
Operating weight	t	.....
Engine rated power	kW	.....
Emission standard	EUROMOT	.....
Fuel tank	litre	.....
Overall dimensions:		
Length	m	.....
Height top of cabin	m	.....
Width over tires	m	.....
Turning radius	m	.....
Operating height	m	.....

Roll arm tipper

This truck is suitable for lifting with a roll arm and positioning on its platform recyclables in containers, of all types, from 1.1 m^3 to 8 m^3, to transport outside the RLF. Basic characteristics are as follows:

LANDFILL OPERATION: **ROLL ARM TIPPER**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
• Rubber wheels	-	Yes
• Stacker equipped facility	-	Yes
• Convenience cabin with air-filter	-	Yes
• Maximum container size	m^3	8

The filled in data sheet shall be annexed to the questionnaire in Volume I, SECTION 6 : DATA SHEETS)

LANDFILL OPERATION: **ROLL ARM TIPPER**	TENDERER/CONTRACTOR	
Make/type/model	.....	
DESIGN DATA	UNIT	DATA
Container capacity	m^3	.....
Operating weight	t	.....
Length of roll arm	m	.....
Maximum load roll arm can lift	t	.....
Engine rated power	kW	.....
Emission standard	EUROMOT	.....
Fuel tank	litre	.....
Overall dimensions:		
Length	m	.....
Height top of cabin	m	.....
Width over tires	m	.....
Turning radius	m	.....
Operating height	m	.....

Mechanical shovels

The mechanical shovel will be necessary for moving materials around the composting plant and the landfill in general

LANDFILL OPERATION: **MECHANICAL SHOVEL**	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Minimum number of units	Pieces	1
Rubber wheels	-	Yes
Stacker equipped facility	-	Yes
Convenience cabin with air-filter	-	Yes
Shovel minimum load capacity	T	
Shovel minimum volume	m^3	2
Tipping load	T	8
Minimum height of shovel pin	M	2.5

The filled in data sheet shall be annexed to the questionnaire in Volume I, Section 6, Form 6.10

LANDFILL OPERATION: **MECHANICAL SHOVEL**	TENDERER/CONTRACTOR	
DESIGN DATA	UNIT	DATA
Make/type/model	-	.....
Bucket capacity	m^3	.....

Operating weight	T	.....
Engine rated power	kW	.....
Emission standard	EUROMOT	.....
Fuel tank	Litre	.....
Length	M	.....
Height top of cabin	M	.....
Width over tires	M	.....
Bucket width	M	.....
Turning radius	M	.....
Operating height	M	.....

Caravan car

2 piece 4 seats caravan or pickup truck with collapsible back seats for fast transport of personnel and small pieces of equipment and personnel in and out of the landfill shall be provided.

2.3.11 Auxiliary equipment for general processing plant and landfill use

Weighing scales

One set of industrial scales, platform type, minimum capacity 1,000 Kg, sensitivity 200 g, with digital display, made of steel, installed in the storage hall.

Containers

A full set of containers of various types and sizes shall be provided for the temporary storage and transport of waste inside and outside the landfill. There will be containers for the storage and transport of recyclable materials and the storage and transport of organic and non-organic residuals

Metal containers 1.1 m^3

A minimum of 12 steel Waste Containers of typical waste collection type shall be supplied, capacity 1.1 m^3, body thickness 2 mm, suitable for waste containment and lifting by roll arm tipper truck, with lifting mechanism of the truck. Manufactured according to international standards EN 840-3. Approx. empty weight: 150Kg. 3) The whole container (body and cover) shall be thermo-galvanized (by hot dip) with pure thermal zinc of purity 98.5% with an average thickness 80 micron, according to J.S DIN-1550. The container shall have a curved shape lid (cover) manufacture of high quality moulded metal plates with two springs for easy use. The cover slip automatically during discharge of the garbage. The cover shall be supplied with rubber strap to protect the hands of the users. The cover should have three stages of movements for opening and closing. The cover and the arm shall be welded by CO_2. Wheels: Each container shall have four heavy-duty solid wheels of (200) mm diameter, rotated 360 for easy movement according to DIN 30700 ISO 1284; two of them have foot break. Drainage hole: Provision of Drainage hole at the bottom of the container for liquid draining and cleaning; the hole shall be covered by plastic removable cap. All the container parts should be assembled through welding MIG system CO_2 including the lifting handles lever arms, to provide the container with sufficient strength and resistance.

The plate used should be according to DIN 1541. Body thickness : 2.00 mm. Cover thickness : 1.25 mm. Lid arms thickness : 3.00 mm. Wheel base thickness : 4.00 mm

Plastic Containers 1.1 m^3

A minimum of 12 plastic containers, similar to the above described metal containers, for the storage and transport of recyclable materials shall be provided.

Wire containers

A minimum of 20 wire mesh containers shall be provided, suitable for the storage of medium and large size recyclable materials shall be provided. They will be large wire mesh containers, minimum wire thickness 6 mm, electrogalvanised after welding, They will have a minimum volume of 600 litres and a load capacity of at least 800 kg. They will have collapsible sides and a reinforced bottom, with at least 4 swivel wheels of which 2 will have brakes.

Open 7 m^3 Containers

A minimum of 12 public waste containers of capacity 7 m^3 each shall be provided, suitable for the corresponding truck lifter. The basic construction of the public waste containers shall be of steel plates 3 mm in thickness, and reinforced for rigidity by steel plates 4 and 5 mm in thickness. All rigid parts are welded along which eliminates the possibility of inner corrosion. Covers are suspended by springs, and may be closed by the use of stainless steel butterfly screws. Surface protection will be achieved by the use of paint, while inner surfaces will protected by a paint resistant to salts, acids and bases.

Containers 8 m^3 for transport of recycled waste

A minimum of 4 containers of capacity 8 m3 each shall be provided, suitable for the corresponding lifting arm truck.

Emergency diesel generator

Emergency diesel generator for operation of the RWMC in case of electric cut with capacity to cover the minimum operation requirements of RWMC.

2.3.12 Landfill gas collection and flare system

The landfill gas collection and treatment system comprises two systems: LFG extraction system and LFG utilization system. Current LFG-extraction techniques make it possible to start LFG extraction during the active phase of the landfill.

LFG Extraction System

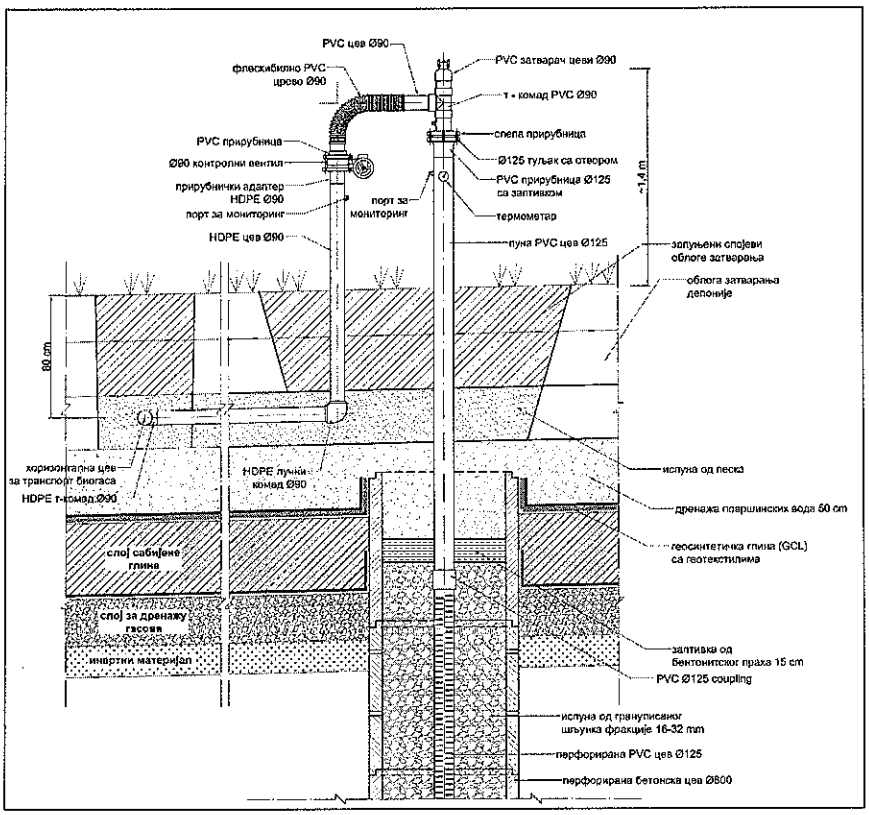
The proposed landfill gas extraction (i.e. until the blower/flare units) system consists of:

- Landfill gas vertical extraction wells (extendable build-up wells);
- Landfill gas collection headers;
- Landfill gas collection and horizontal piping system.
- Equipment for connection of the extraction wells to the horizontal piping system

The plateau area 100 m^2 has been designed for the installation of the flare. The flare is connected to the main landfill gas collecting pipe. Planned area should be sufficient to accommodate the co-generating facilities, in case the beneficiary decides to install such facilities during operation of the landfill.

The total number of extraction wells proposed is an average of 40 wells per phase. In the first part 10 vertical extraction wells will be installed during construction of cell 1 - phase I of the regional landfill; the second part of the vertical extraction wells (12 pcs) will be installed during construction of cell 2 - phase I. All other wells will be installed during construction of the subsequent cells in the future.

Vertical wells (bio-thorns) consist of perforated, concrete, pipes that enable gas flow. Pipes have a diameter of 800 mm. They are mounted over a monolith, concrete, flanged bed of 1.2 x 1.2 m enabling tight fitting. Beds are installed over the flat drainage layer before commencement of waste disposal. The concrete pipe is initially installed to a height of 2.4 m from the bottom. As the waste deposit grows, the wells are extended accordingly.



Sample of. extraction well and connection to the horizontal pipe system

From 2016 onwards the first cell of the new regional landfill will be filled up with waste. Vertical gas extraction wells will be installed from the start of filling. The vertical extraction wells will "grow" with the height of waste. As soon as cell 1 volume is filled, it is temporarily closed and covered with a (temporary) soil layer after which it is expected that some 70% of the gas produced will be captured. After settling (up to 2 years) a final cover shall be placed, increasing the recovery rate to at least 80-85%. The same technique should be applied till the end of the subsequent phases of the landfill. During filling-up it is possible to capture some of the gas that is produced. In practice some of the gas is (will be) released to the atmosphere in a controlled way (using the wells for venting / controlled release).

LFG Combustion

The proposed landfill gas combustion system is in line with safety standards prescribed by EN 60079-ff concerning fire protection. It consists of:

- Landfill gas filtration on pre-filter and ceramic filter;
- Condensate water siphons with simple leachate treatment installation with re-injection;

- Flare;
- The blower unit with engine resistant to EEx;
- Combustion chamber;
- Central unit for electrical control of resistance to climate change and whole system safety parameters;
- Mobile analyzer of the concentration of CH_4, O_2, and CO_2 (and monitoring wells).

Flare / Combustion Chambers

A flare is needed to burn landfill gas. The flare is a means of reducing the impact of landfill gas but it also introduces additional hazards or nuisances that need to be considered holistically within a proper assessment before designing and siting a flare. The areas that should be covered in any assessment include:

- Local and global air quality and the effect of undesirable reaction products;
- Visual impact;
- Noise impact;
- Odour nuisance;
- Explosion, fire and asphyxiation.

Burning landfill gas burns a waste – methane that would otherwise be released into the atmosphere. Combustion of biogas is done in dedicated combustion systems for biogas. The plant will be designed to meet strict criteria and requirements related to safe emissions and prevention of air pollution. In order to minimize the quantities of undesirable products within the flare, the biogas is burnt at high temperatures (more than 850 °C, less than 1,200 °C) or special filters are installed on the combustion plant. The maximum capacity of the flare shall be equivalent to the maximum capacity of the blower. Where flaring is the only method of biogas treatment at the landfill, the capacity should be in the range of 100m3 to the maximum 1000 m^3/h.

An enclosed, noiseless flare is proposed with a combustion temperature of 1,200°C and a minimum residence time of 0.3 seconds. This means that the flame shall burn silently and only inside the flare (invisible). An enclosed flare with a minimum capacity of 1000 m^3/h is to be provided and installed as part of the Works Contract.

Enclosed Flares:

- Meet performance and emission standards;
- Permanent – 10-15m high;
- Capable of operation over a wide range of combustion conditions;

Blower, Pre-filter and Condense Water Siphon

A pressure gradient in the extraction system has to be effected in order to extract landfill gas. To create this pressure gradient a blower shall be installed. The capacity of the blower is based on the expected amount of biogas. A blower with a maximum capacity of 1000 Nm^3/hr and maximum sub-pressure of 60 mbars should be provided and installed as part of the Works Contract. The engine should be resistant to EEx. Before the blower there is a pre-filter and ceramic filter for removal of the particles over 40 µ from LFG. The temperature of the biogas decreases during movement upwards. This leads to condensation and liquid generation that can be harmful for the pipeline. Therefore liquid is collected at the lowest parts of the horizontal pipeline in "traps" i.e. siphons (condensate separators) with perforated reservoirs enabling condensate to be recycled back to the leachate collection system.

2.3.13 Waste Water Treatment Plant / SBR

All treated waste water, before being discharged must fulfil quality requirements defined by RS regulations, specially the requirements stated in the document:
"Regulations on the limit values of pollutants in water and time to reach those limits ("Official Gazette RS"No. 67/2011 and 48/2012.); and Regulations on the limit values of pollutants in surface and groundwaters and sediments and time to reach those limits ("Official Gazette RS"No. 50/2012); and " Regulations on dangerous substances in water ('Official Gazette of RS'; No. 31/82).":

The proposed WWTP plant is based on Sequencing Batch Reactor technology (SBR in the further text), consisting of biological treatment of waste water in enclosed reactors. It is designed for treatment of technical waste water generated during washing of equipment, vehicles, working and service area, plateaux and roads of working and clean zone within the manipulative – service area and for treatment of sewage from administrative building and other buildings. This waste water will be transported to the SBR plant through a sewerage network. The SBR plant is foreseen to be placed between the manipulative – service area and the surrounding channel, providing the shortest transport route for excess treated water from SBR to the channel and further to the nearby final recipient. The SBR comprises of two reactors, sand filter, clean water storage tank, pumps, piping, etc. Treated water can be reused in a closed circuit for technical water supply, for washing of service areas and roads or spraying the grass and trees. The sledge can be composted or deposit on the landfill. The dimensions are 4.5 m x 4.6 m, height 3.0 m. The designed hydraulic load is 30 m^3/day. A detailed description of SBR technology is provided below.

SBR technology is widely applied in the treatment of all municipal waste waters (sanitary-faecal and technical). It is based on the activated sludge process within the SBR. This is a modified and sophisticated waste water treatment method, suitable for municipal and industrial waste water.

Compared to conventional wastewater treatment systems where each phase takes part in separated and dedicated basins with a defined sequence, SBR systems combine all phases in a single reactor.

The operation cycle of the SBR plant will consist of five steps as follows:

- Filling;
- Aeration;
- Sedimentation;
- Decanting of purified water;
- Sludge discharging.

The basic characteristics of the plant should be as follows:

SBR WASTEWATER TREATMENT PLANT	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Type of treatment plant	-	SBR
Hydraulic load	m^3/d	> 30
Minimum guaranteed effluent quality		
• BOD_5	mg/l	25
• COD	mg/l	125
• TSS	mg/l	30
• $N\text{-}NH_4$	mg/l	15
Maximum consumption	kWh/m^3	3

The filled in data sheet shall be annexed to the questionnaire in Volume I, Section 6, Form 6.10

WASTEWATER TREATMENT PLANT (SBR)	TENDERER/CONTRACTOR	
Make/type/model	.....	
DESIGN DATA	**UNIT**	**DATA**
Installed aeration power	KW	.....
Type of aeration (diffused/mechanical/induced?)		.....
Type of diffusers, if any		.....
Number of diffusers, if any		.....
Overall inside dimensions:		
Length	m	.....
Width	m	.....
Depth of water	m	.....

2.3.14 Separator

Storm water will be led to an oil-water separator. The separator will receive waters from 'dirty' parts of the manipulative-service plateau, such as waste storage plateaux, and internal roads used by vehicles from the gate to the plateau for vehicles washing. These waters may be contaminated with water from oil, oil products and grease, and possibly bulk waste. The separator is a water-tight reservoir, which consists of a sedimentation chamber, with bypass, coalescent cartridge (filter for fine mechanical impurities), absorption sleeve (active charcoal), which floats on the surface, (sorption) filter and relief shaft. Maximum concentration of oil in the discharged water is 2mg/l

The design capacity is 400 l/s, on the basis of the maximum 15-minute rain event. Oil, which is separated in this device, is stored in plastic barrels and delivered to companies authorised to treat hazardous waste. Treated, purified, water is transported into the purified water tank.

The separator's characteristics shall be as follows:

OIL-WATER SEPARATOR	MINIMUM REQUIREMENTS	
PERFORMANCE AND DESIGN CRITERIA	UNIT	DATA
Maximum Hydraulic load	l/s	400

The filled in data sheet shall be annexed to the questionnaire in Volume 1, Section 6, Form 6.10

OIL-WATER SEPARATOR	TENDERER/CONTRACTOR	
Make/type/model	.....	
DESIGN DATA	**UNIT**	**DATA**
Maximum hydraulic load	l/s	.....
Overall inside dimensions:		
Length	m	.....
Width	m	.....
Depth of water	m	.....

2.3.15 Leachate pre-treatment facility

General

According to the Leachate treatment option analysis, the proposed solution of Pre-treatment on-site with disposal on the landfill body has been adopted.

After collecting the leachate through the leachate collection system, it will be transferred to the leachate treatment plant, where it will be treated in order to remove unpleasant smells, partially remove organic load and iron and manganese by oxidation. Thus, the leachate will be subjected to intensive aeration in the aerated lagoon, using aerators.

The most common biological treatment is in the aerated lagoons, which is a suspended-growth process that uses aerobic microorganisms to biodegrade the organic contaminants in leachate. The concept of naturally aerated ponds was rejected as it would require large areas and could produce noxious smells at times.

Lagoons are aerated by surface aerators, diffuser-ejectors or diffused air. Air (oxygen) is needed for biological oxidation. Diffusers, which are installed at the bottom of the lagoon, are more convenient for colder climates and provide a continuous treatment effect in the winter months. Due to lagoon geometry it is best to use diffuser-ejector technology. Aerated lagoons are similar to treatment with activated sludge with extended aeration, without recirculation. The difference is a lower ratio of activated sludge concentrations, as well as a higher sensitivity to environmental temperature changes. Activity of the micro flora and treatment efficiency depends heavily on the water temperature.

An Aeration lagoon or 2,800 m^3 and a Sedimentation lagoon of 300 m^3 will be constructed in this area. Instead of a sedimentation lagoon, it is also possible to construct an equivalent size concrete sedimentation tank. Estimated quantity of the leachate is 100m3/day. The system for collection has following components: drainage (perforated pipes layed on the bottom of the landfill over the membrane where water is by gravitation collected in the manholes), collection and treatment components.

Lagoon bottom construction

Aeration lagoons

Drainage

Membrane at the bottom protects that leachate gets into the soil and underground water. For drainage gravel layer is used. HDPE pipes are placed on the bottom and collect the water. Each pipe is connected to the collection perforated pipe that takes water to the treatment. If perforation on the pipe is Ø 1-2 *mm* mechanical treatment is not needed.

Aeration

In order to avoid unpleasant smells, removal of the organic components and oxidation of Ferro and Mange water is aerated in lagoons by aerators.

The air is taken into the lagoon by the diffusions that are placed close to the bottom due to the climatic conditions.

Two lagoons should be constructed with the capacity of V=850m3 and dimension about 20.0m x 15,0m and 3,5m deep.

Each lagoon should have two aerators 7,8 kW with input of oxigen of 12kgO2/h.

Sedimentation of the aerated waste water

Sedimentation should be done in two concrete sedimentation lagoons (16,0m x10,0m and 2,5m deep) located behind aeration lagoons. Water is directed into the sedimentation lagoon with system of veils where the sledge is partly stabilised. Sledge is from time to time taken out from the lagoons and taken to the landfill.

This water is partly pumped back into the landfill and partly taken to the WWTP

Recirculation

system starts from the manhole where pumps are located. Water is spayed along the landfill and over left is taken to the WWTP.

WWTP

Beside aeration lagoons and recirculation of the leachate it is necessary to introduce plant for waste water treatment. The best foreseen method for waste water treatment is reverse osmoses The treatment can be designed as compact unit placed in the container. Quality of the treated water has to be according to RS standards and requirements. Water is discharged into the recipient located nearby (Orom – Čik – Krivaj canal 1600 m fare away) . Part of leachate not used for recirculation will be treated, The capacity of the WWTP should be sufficient to be able to treat these leachate in the period of the next ten years taking into consideration average precipitation of the location and predicted content of the waste.

Maximum capacity of the Waste Water Treatment Plant is $4m^3/h$. Maximum 30% of treated water can be concentrate and treated water at the exit has to be minimum 70%. Maximum energy consumption is limited to 15 kWh/m^3 of the treated waste water , .

2.3.16 Leachate management system

General

The tenderer will submit, together with his offer, a draft leachate management plan, based on the method of leachate pre-treatment and recirculation to the landfill body. Water that is not going to be used will be treated and discharged into the recipient that is 1 600 m fare away.This plan will be prepared by the Contractor in its final form during the final design of the project. The plan shall enhance upon the proposed minimum recirculation plan by pointing out monitoring spots, possible pockets of dry waste and methods of minimisation of leachate production (working on minimum exposed front, quick sealing of fully filled areas, use of covers, reducing rainwater infiltration, etc.). It will also propose improvements in the system and possible contingency measures, like temporary storage lagoons, to cater for an extended rainy period.

Leachate recirculation

Leachate recirculation system is introduced in order for the stabilization of organic waste to be as effective as possible, for the improvement of conditions for biogas production and maintenance of landfill moisture. The adopted methodology is subsurface infiltration by horizontal perforated pipes distributed in the landfill body. The installation of perforated pipes is foreseen to be in two levels. The first level will be at about 7m from the landfill bottom, and the second one at approximately 16m from the landfill bottom. Gravitational infiltration system will be used.

Until the height of 7m of disposed waste is reached, the treated leachate will be sprayed over the landfill body by mobile irrigation pump and firefighting hose for water transport from the surface hydrant to the sprayer. This system will also be used in wet periods, to distribute leachate to known dry pockets of waste.

The water is pumped from the leachate treatment plant to the manhole in cassette 1. The diameter of HDPE supply pipe is 100mm. Surface hydrants ∅80 are placed between the pump station and mentioned manholes and distribution supply pipes for the first and second levels of infiltration can be connected to these hydrants. When the second level is reached it means that the first one has become inactive. Irrigation pump is also connected to these

hydrants until the disposed waste reaches the 7m height where the first level pipes for subsurface infiltration are installed.

Leachate runs from the distribution manhole through PVC pipe which is 150mm in diameter, and to the perforated PVC pipes for infiltration which diameter is 75mm. In order to ensure more efficient infiltration and leachate distribution the supply pipe ∅150 is connected to the ring. Supply pipes and pipes for infiltration have an inclination of 0.2%. The pipes for infiltration are placed at the distance of 20m and in the layer of sandy-gravel material, thus enabling more efficient process of infiltration.

The distribution system shall be of the multizone type, where it will be possible to isolate parts leading to areas rich in leachate, and direct leachate in semi-covered dry, partly aerobic, or fully covered anaerobic and methanogenic areas, where leachate will reduce in quantity and/or strength.

2.3.17 Monitoring

2.3.17.1 Monitoring of landfill body stability

Monitoring of landfill body stability is performed by analyzing the data on landfill body and sensor monitoring of the sealing liner - foil. The landfill stability is checked once a year.

2.3.17.2 Leachate monitoring

Leachate quality monitoring is performed by, (a) analyzing the samples taken before leachate is discharged into the aerated lagoon, and (b) from the pump station used for recirculation of treated leachate.

Leachate quantity monitoring around the landfill will be done through a series of monitoring shafts, strategically positioned, where the level of leachate in will be carefully monitored from the pump station, weekly during dry periods and daily during wet periods. In this way it will be possible to detect any inordinate increase of leachate levels within the landfill, before it becomes dangerous for landfill sustainability and take immediate corrective action.

Leachate monitoring shafts

Leachate monitoring shafts, if proposed, shall be constructed in peripheral embankment of the landfill cells to be constructed in Phase 1 Eight (8) monitoring shafts shall be constructed, in which leachate will be collected from the drainage pipes. Shafts shall be linked with HDPE collection pipes, which will lead the leachate to the pumping shaft and finally to the leachate treatment plant.

Monitoring shafts shall be made of HDPE pipes SN8, diameter 2,500 mm. The bottom of the shaft shall be made from HDPE plates 2.5 cm thick.

A single pipe is connected on each shaft for the supply of leachate from landfill cell, where pipe bottom shall be at a height of a least 80 cm from the bottom of the shaft. Every leachate collection pipe shall be closed at the end with the blind flange. Before pipe end there shall be connection for rainwater led off and leachate water led off.

Connection of these pipes to leachate collection pipes shall be done by welding.

2.3.17.3 Ground water monitoring

Monitoring of ground waters located under the landfill bottom and landfill zone of influence provides the information on the ground waters that can be polluted as a consequence of landfill operation.

The reference values for ground water monitoring are the samples taken before landfill commissioning and they are marked as the "initial condition". The samples will be taken according to the ISO 5667-2 standard, part 11, 1993.

The ground water samples are taken from hydrogeological objects (piezometers, piezometric batteries and wells for monitoring) from at least three points which follow the ground water flow. The system comprises a network of 9 piezometers (6 existing, and 3 additional needs to be placed)

The ground water samples are tested with the aim of determining potential risk in the protective layers of the landfill, that is, pollution of ground waters. Besides determining the ground water composition, permanent measuring of water table is also performed.

2.3.17.4 Gas emission monitoring

Gas emission monitoring is based on a representative number of samples regulated by permit. Measuring of emission and concentration of gases CH_4, CO_2 and O_2 is performed once a month during the exploitation phase of the landfill. After the landfill exploitation phase these measurings are also conducted every six months in the first ten years, and then every two years until the landfill ceases to exist. Other landfill gases (H_2S, H_2 and other) are analyzed depending on the composition of disposed waste and in accordance with the permit.

Mobile analyzer equipped with sensors and measuring device is used for determining the landfill gas quantity and composition. The measuring device registers data and transfers it to the PC. The measuring is performed on the valves installed on horizontal pipes for gas extraction, before the blower and flare, and in the wells for gas monitoring. Six monitoring wells are foreseen (3 in the First phase) to be constructed at the distance of 300 m around the entire landfill body. Each well will be up to 6 m deep and above the level of ground waters. At least one well will be dug near the entrance to the manipulative-service area.

2.3.18 Green belt

Two sectors of greenbelt was planned. One around the manipulative –service area and additional which is surrounding the entire area.

A cultivated green zone is planned around the manipulative – service area (i.e. plateau) as protection in relation to rodents and flies, noise, unpleasant smells, views, etc. It is designed for about 250 pcs of coniferous trees or deciduous trees to be planted between the clean and dirty zone of the manipulative – service area, and between the manipulative – service area and the landfill body area, as a kind of dividing green belt.

An additional greenbelt surrounding the entire area of the landfill complex is also included in the Works Contract. This green belt surrounds the access road and the landfill complex. It has a protective (noise, smell), and aesthetic role. The Contractor shall plant 600 pcs of coniferous trees or deciduous trees at the area surrounding the landfill complex and access road, to provide a surrounding protective green belt.

The total number of trees in two zones mentioned above is about 850 pcs (250+600).

Excavated soil has to be changed with fertile soil and humus, and sprinkled with water.

2.3.19 Other infrastructure within the RLF

Surrounding Channel (Internal Channel)

A surrounding channel (Internal Channel) is designed to accept rainwater and un-contaminated surface water around the landfill which can be discharged to the nearby final recipient channel. Un-contaminated surface water is flowing from the top of the surrounding dikes into the surrounding channel by downstream channels. The surrounding channel is distributed along the dikes of the landfill body at a distance up to approximately 3.50 m to the base of the dikes. The channel bottom width is 1 m. The channel has slopes of 1:1 and a depth of 1.0 m. The length of the channel is approximately 2,400 m. The volume of

surrounding channel is designed to accept all surface water in the raining period, particularly it is capable of accepting 15 minutes of heavy rain associated with a two year return period.

Fence

A wire fence surrounding the landfill complex, with a length of 2,360 m and a height of 3.0 m, is planned. The fence will prevent the animals entering the landfill and will protect the environment from windblown waste from the landfill. There should be two types offence - one on the entrance sections and the other surrounding the area. The entrance section is metal fence 2,3m high while the surrounding part is wire galvanized net with mesh dimension 50x50mm.

Water Supply System

Technical solution

Technical solutions for water supply of the regional landfill in Subotica foresee the construction of two separate water supply systems:

- Construction of potable water supply system;
- Construction of technical water supply system with fire protection;

Potable water supply system

The preliminary design foresees construction of a potable water supply system within the regional landfill in Subotica (parcel number 2635, cadastral municipality Bikovo). The connection with the existing water supply system will be performed in the direction of Bikovo by constructing a water supply pipe of polyethylene pipelines PE-100 Ø110 mm over a distance of around 2308 m. Option is to use the water from the well that is going to be made for the purpose of the technical water. If this is the option, water has to be treated and quality of the water according to regulations of RS for potable water.

Pipe distribution and connections of the facilities are mainly carried out underground using reinforced-concrete manholes except for special cases.

The entire potable water supply system will be.

Total maximum estimated amount of potable water required for all facilities within the inlet – outlet zone is Q = 2.30 l/s.

Technical water supply network with fire protection

The need for technical water supply of regional landfill, as well as the required amount of water for fire extinguishing is proposed by developing a special source.

The design includes construction of a drilled well (diameter of drilled hole is Ø450 mm) that is 100 m deep. The well is equipped with appropriate hydromechanical equipment placed in reinforced-concrete manhole with inner dimensions of 160/245 cm.

For the construction of this design no hydrogeological terrain research was conducted at the source location. Therefore, in order to provide necessary amount of water for fire protection purpose (72m^3 of water is required for two hour long fire extinguishing), which is in accordance with the regulation book of technical norms for outdoor and indoor hydrant network, the design specifies construction of a 130m^3 reservoir for technical water and fire protection purpose.

Technical water tank construction

Technical water tank is situated in the green zone, immediately next to the well for water supply. Facility is conceived as two connected spaces: tank of the useful volume cca 130 m^3 for storing the well water, and separate room for hydro mechanical equipment.

The facility is completely made of reinforced concrete. ank dimensions are 4.0x10.0 m depth 4.0m, while the dimensions of the hydrophor room and room to house the other hydro mechanical equipment are 4.10x4.65m and height 4.0m.

Around the tank chamber, earth material is covered to the height of 2.25m. Access to the facility – equipment room, is from the local road, i.e. access road to the approach stairs. Inspection access to the tank chamber is over the dyke, around the tank, in the form of concrete stairs and later fixed ladder.

The reservoir includes space intended for the pumps with the following indicative characteristics:

Q=300 l/min
H=50 m
N=6.0 kW

All other necessary hydromechanical equipment will be included. The first pump (frequently regulated) provides 5 l/s, while the second pump is put into use in case of maximal fire protection requirements, and it provides 10 l/s.

A 10 l/s diesel pump will also be provided, to operate in cases of power failure. In case of fire, there will be a suitable network to draw water from the treated wastewater reservoir, in order to provide additional fire fighting capacity.

The above mentioned pump characteristics are the minimum acceptable, and the final sizing and characteristics will be determined by the Contractor in his detailed design. This holds for the pumping stations in the RWMC.

Outdoor distribution of technical water supply network is made of polyethylene pipes of suitable size.

Fire fighting water supply network shall be constructed from PE100 piping underground and of heavy type galvanised steel pipe above ground and inside buildings.

Over-ground fire hydrants that are 80mm in diameter and at prescribed distance, are designed in accordance with the regulation book of technical norms for outdoor hydrant network. A minimum of 31 hydrants will be situated around the landfill body: The construction of fire protection network around the landfill is carried out in phases. The construction of rings is divided into 5 phases that are synchronized with the landfill construction phases. In the first phase 14 hydrants are construted.

Two branches of water supply network are intended for the entrance- exit zone and they have:

- a minimum of 4 overground fire hydrants;
- a minimum of 10 underground fire hydrants.

Eight underground hydrants are intended for the delivered waste separation hall, and one is to be positioned in front of the baled waste hangar. All hydrants are 80mm in diameter and at prescribed distances. The tenth hydrant is intended for the covered plateau for vehicle wash.

Indoor hydrant network in the Administration building (2 piece), Workshop (1 piece) and Hall for the classification of delivered waste (4 pieces) should be designed.. There will also be wall hydrants with diameter of DN 50 mm with all accompanying equipment.

According to the regulation book of technical norms for the hydrant network intended for fire extinguishing, the amount of water required for the outdoor network is Q = 10 l/s, and Q = 5 l/s for the indoor network. The pressure at the outflow point is minimally 2.5 bars.

Distribution of indoor installations for fire protection in the facilities (administration building, workshop and waste separation hall) has t obe designed and constructed after all fire protection approvals are obtained..

The accompanying equipment for fire protection of the facilities within the entrance- exit zone is:

- Two portable fire extinguishers of 25 kg in the waste separation hall;
- Two portable fire extinguishers of 6 kg in the administration building;
- Two portable fire extinguishers of 6 kg in the workshop;
- One portable fire extinguisher of 6 kg in the doorman's booth;

Well pump

The minimum characteristics of the well pump shall be:

Q=400 l/min
H=23 m
N=3,0kW
The pump characteristics are to be verified by the Contractor's calculations.

Materials used and pipeline laying mode

Newly designed outdoor pipeline (sanitary and technical water supply network) is made of PE and PPR pipes of prescribed diameter with operating work pressure of 10 bars. Node connections are given in the node schemes and their position is presented. All connection elements in the nodes are made of ductile cast iron.

Anchorage blocks

In order to protect the water supply system from unpredicted deformations, concrete anchorages are designed. All node points, arcs, branching and separating are secured by anchorages of the required dimensions. The blocks are made of concrete, type MB 20, and are cast immediately. Fittings and reinforcement must be protected against corrosion prior to the contact with concrete.

Trench excavation and planks

The trench, for the water supply pipe, for the main water pipeline and facility connection is of perpendicular shape and 0.8 m wide, and has a depth which is in accordance with the grade level of the newly designed water supply pipe. Trench excavation is conducted in two ways: by machine and manually.

Trench and pit strutting is done by wooden (or metal) planks with vertically placed struts and posts. The strutting and securing of the trench is followed by excavation. Prior to trench backfilling it is necessary to provide the conditions to facilitate plank removal.

Laying of the pipes, trench backfilling and excess soil transportation

Laying of the pipes is performed onto sand bedding that is 10.00cm in depth. While laying the pipes and fittings, special attention must be paid to the slope and not to have any horizontal or vertical ruptures, except on places where predicted by the design. The pipe position during the installation should be monitored constantly by surveying instrument. Pipe joints should be installed according to the instructions of pipe and reinforcement manufacturers.

Trench backfill is carried out in two ways; with soil excavated from the trench and sand. First, sand covering of pipes up to +30cm above the pipe. Sand compaction around and above the pipe is to be performed by water or in accordance with the pipe manufacturer. Trench backfill above the sand lining is carried out in layers of 30-50 cm, along with appropriate soaking and necessary compaction. Filling with soil is done up to the ground level, and where water supply line is under the road, trench backfilling with sand is done up to the level of the lower edge of the road construction. The required compaction level must be 100% of maximum

laboratory compaction according to 'Proktor' testing. If the testing is conducted by compressibility module, the carrying capacity of the sand should be: Me=2.00 KN/cm^2

Excess soil during the excavations should be loaded onto a truck and taken to temporary landfill(s) approved by the Engineer.

Testing the watertight features of pipe joints

After the installation of pipes and fittings, water pipes and joints will be tested for the trial pressure in accordance with standards and regulations. Pipe fittings must be visible until the trial testing.

Pipeline rinsing and disinfection

Prior to putting the water supply system into operation, rinsing and disinfection must be performed in accordance with standards and regulations. Disinfectants are provided by the Beneficiary. After the testing, water sampling and chemical and bacteriological water analyses should be done.

Sewage network

Technical solution

Design solution defines drainage from plateaus and facilities in the entrance- exit zone of the regional landfill in Subotica. Technical solution specifies two independent sewage systems:

- Atmospheric sewage network;
- Sewage and technical sewage system;

The entire sewage system is intended for phase I of the regional landfill construction and is included in the Works Contract.

Atmospheric wastewater

Technical solution for atmospheric wastewater in the entrance- exit zone of regional landfill in Subotica defines installation of drainage elements in approximate length of

- type V 300, L= 330m;
- type V 400, L= 349m;
- type V 500, L= 148 m;
- The elements are made of polymer concrete and they are closed with a bar having the carrying capacity of 40 KN. They are placed on prepared MB 30 concrete bedding, that is 20-30 cm thick, and are concreted up to the ground level. Water collected from the asphalt plateau and facility roofs (through gutters) is drained to the oil and fat separator, after which it is directed to the treated water reservoir.

The maximum estimated amount of water collected and drained to the separator by drain channels is 420 l/s.

Sewage and technical wastewater

The design specifies a unique sewerage system that drains used water from sanitary nodes at the facilities, as well as technical water from plant and equipment wash, to a SBR treatment facility. After the treatment water is directed to the treated water reservoir.

Design requires the construction of an outdoor sewerage network consisting of PVC pipelines Ø250 and 200 mm. Along the network, there are prefabricated manholes Ø1000 mm at prescribed distances.

Total estimated amount of sewage/waste water drained by pipeline to SBR treatment facility is 3.00 l/s.

Materials and equipment

The outdoor sewerage system is constructed of hard PVC sewage pipes that are 200 and 250 mm in diameter. The pipe quality must be in accordance with the quality of UKN PVC C20.

Sewage manholes are reinforced-concrete (watertight) inspection chambers made of prefabricated elements – rings, which inner dimensions are Ø1000mm. Manhole base with channel pipe is cast on a base of gravel or concrete.

Laying of the pipes, trench backfilling and excess soil transportation

The trench for the sewerage pipe is of perpendicular shape and 1.20 m wide, and has a depth which is in accordance with the grade level of newly designed sewerage pipe. Trench excavation is conducted in two ways: by machine and manually. Machine excavation is expected to be more dominant, while manual excavation should be applied in the cases when a machine cannot be used.

Laying of the pipes is performed onto sand bedding that is 15.0 cm in depth. While laying the pipes and fittings, special attention must be paid to the slope and not to have any horizontal or vertical ruptures, except on places where predicted by the design. The pipe position during the installation should be monitored constantly by surveying instrument. Pipe joints should be installed according to the instructions of pipe and reinforcement manufacturers.

Trench backfill is carried out in two ways; with soil excavated from the trench and sand. First, by sand covering of pipes up to +30cm above pipe. Sand compaction around and above the pipe is to be performed by water or in accordance with the pipe manufacturer. Trench backfill above the sand lining is carried out in layers of 30-50 cm of excavated soil, along with appropriate soaking and necessary compaction. Filling with sand is, under the road, done up to the bedding level. The required compaction level must be 100% of maximum laboratory compaction according to 'Proktor' tests. Excess soil from the excavations is to be loaded on the truck and taken to a temporary landfill(s) approved by the Engineer.

Testing the watertight features of pipe joints

After the installation of the pipes and fittings, water pipes and joints will be tested for the trial pressure in accordance with standards and regulations.

Pump station for treated water reservoir

Sewage waste water (sewage- technical), after being treated is directed to reinforced concrete reservoir of treated water that is 850 m^3 in volume. From the above mentioned reservoir and pump station with pressure pipeline, water is transported to the nearest recipient: The Orom – Čik – Krivaj canal 1600m fare away.

The pump station is designed to stand immediately next to the treated water reservoir. Inner chamber dimensions are 200/300 cm. Within the chamber, there are two dry sewage pump assemblies with the following characteristics:

Q=minimum 22 l/s
H=16 m
N=22.0 kW
Frequency 50Hz
Exit DN 150mm

with accompanying hydro mechanical equipment. According to the design, the two pumps will operate in turn.

Beside the pump station, a pressure pipeline 1700 m long and made of polyethylene pipes PE should be designed.

2.3.20 Electrical, Control and SCADA

2.3.20.1 Electrical

Power supply

The electrical power supply system is not provided yet. The provision of the power supply for the Subotica RLF is partly in the Scope of the Delivery of this Tender. For the purpose of this Tender (both for the design and delivery) the Tenderer can assume: (a) MV power connection will be provided from the connection point to the dedicated transformer substation, (b) power supply connection will be realised from the LV Switchgear Cubicles in the dedicated transformer substation and (c) available power capacities will be sufficient for required power demands. The planned power capacity is considered sufficient for the future power demand. For all works on the power supply system, which includes works on LV connections, the Contractor shall coordinate with the local electricity supply company in order to realise the supply of electricity to the site. All costs necessary for the designing and construction (together with corresponding taxes)shall be included in the offer.

Power Supply System as planned to be built on the RLF site

The power supply system for Subotica RLF will be designed in accordance with the Urban Technical Conditions and Technical Condition of the Power Distribution Company. In accordance with those technical conditions, the Main Design will be prepared As per that documentation, the Power Supply System for the Subotica Regional Landfill (Subotica RLF) involves a 20kV overhead line from CTC 16 at Bicki's ranch, from where a 2,800 m long 20 KV cable will be connected and will run parallel to the local Subotica-Orom road, ending with a correspondent transformer station which includes: 24kV switchgear, one power transformers 24/0.4kV, 1,000 kVA and 0,4 kV switchgear, with a position for an additional future transformer

The cable will be laid directly in the ground, in an open trench 0.8m deep. When running under the road, the cables will be placed in protective PVC tube, Φ160 mm. The vertical distance between the upper edge of the cable channel and the level of the road should be at least 0.8 m. Protective tubes will be set by drilling under the road.

A double-sided power supply of MBTS 20/0, 4 kV *'Landfill'* is foreseen in the future. After the reconstruction of 10kV network in Gabric region, and moving to 20 kV, MBTS 20/0, 4 kV *'Landfill'* will be connected with the Gabric network, by constructing a 20 kV power line to the landfill. On the last pole, close to the landfill there will be a change to the underground cable line of 20 kV. The cable will run under the road, at the same place as the 20 kV cable from the CTC Bicki's ranch. For this reason, another protective PVC tube Φ160 will be previously set under the road.
The overhead supply lines are envisaged with Aluminium/Steel wire ropes, of adequate power carrying capacities for the power demands of the Subotica RLF. In Volume V, the Drawing V 4.1, representing the position of the power transformer station on RLF layout is attached, only for purpose of showing preliminary location of the power supply connection in order to enable the Contractor to plan the design of the LV supply feeders.

MV switchgear shall be composed from an adequate number of MV cubicles. The incoming cubicles shall be equipped with switch unit and earthing disconnecter, while the transformer cubicle shall be equipped with SF6 circuit breakers.

Power metering will be installed in accordance with the requirements of the local Power Authority.

Design and responsibilities

The Contractor shall design, construct and install all electrical equipment, including power supply equipment, electrical distribution boards, MCC's, control and monitoring equipment,

instrumentations, power cables, signal and control cables, indoor and outdoor lighting, small power supply equipment, HVAC, earthing and lightning system, telecommunication equipment, and all other electrical equipment necessary to operate and control the RLF. The design and instalment will be, prior to start of the works, approved by Regional Electro Distribution Company.

The general design criteria are as follows:

- The design shall be harmonized with location and size of the plant
- The design shall be consistent with the facility and building arrangement on the site
- The power supply system shall be designed to provide a reliable supply for the type of treatment plants proposed.
- Ambient temperature, conditions for installation of the equipment, and other ambient conditions
- Short circuit ratings of electrical equipment on the location
- Fire protection conditions
- Video and access control of the plant

Power supply of essential equipment

Power backup for the essential electrical equipment shall be arranged with a diesel generator. The power and the main characteristic of the diesel generator shall be designed based on the request for a minimum of process continuity in case of public power supply failure.

The energy building will be an extension of the prefabricated transformer building and will house the auxiliary generator. The auxiliary generator will have adequate power for emergency lighting, the inlet screens, one outlet pump, the scrapers of the sedimentation unit and the thickeners, and one sludge recycle pump, a total power of no more than 70 HP, which means that a 100 KVA generator will be adequate. A diesel oil tank of capacity at least 1,200 litres will be installed in an enclosure outside the generator room.

Distribution boards and MCC

Distribution boards and MCC shall be assembled as standard free standing or wall mounting cubicles with bottom or top cable's access. If PLC equipment has to be installed, it will be separated from main switches units and other disturbing units.

The switch board for outdoor installation shall be made of UV resistant PVC or of good protected metal sheets in adequate IP degree. Rain protection shadow shall be preferable also for maintenance purpose.

Motor Starters (380 V)

The way of starting different motors connected to process and mechanical equipment shall be direct start, by soft starter and start by variable speed driver.

The protection equipment chosen to protect the cable and motor, shall be active both in manual and automatic mode. Connection between soft starters or variable speed drivers with local PLC will be achieved through a communication port.

UPS Installations

The Contractor shall provide dedicated UPSs units for control system, PLCs, and for all other equipment where an uninterruptible power supply with one hour autonomy is required.

Power and Control Cabling

The complete power and control cabling installation shall be designed and installed on the plant area. The cables shall be installed in the buildings on cable trays, in cable channels, ducts, on the wall with saddles, or in the pipes.

External cables shall be laid in a cable channel or buried directly in the ground according to the local regulations or requirements.

Cable channels, ducts, service-ways, draw-pits and the like shall be arranged to facilitate installation and subsequent maintenance with minimum disruption to other services.

The Contractor shall be responsible for the correct choice of the type and size of all cables between items of plant designed by him in accordance with their duty and environment.

Protection measures and earthing system

The Contractor shall design an earthing system according to the domestic standards. It means that zinc coated tape laid in the foundation of the buildings shall be generally used. The calculation shall define additional measures for increasing protection efficiency if necessary.

The earthing schemes shall be implemented in accordance with requirements of the local Power Authority.

Power Factor Correction

The Contractor shall provide power factor correction equipment to provide a power factor of not less than 0,95 lagging under all operating conditions. The power factor correction equipment shall be distributed as individual correction or grouped on the level of main switchgear, distribution board or MCC.

Local control network

Communication between programmable logical controllers (PLCs), work stations, servers and other equipment distributed in local panels and MCC shall be performed with fibre optic Self-Healing ring. On the base of Ethernet connection, the Contractor shall provide TCP/IP protocol standard IEEE802.3

The Contractor shall lay fibre optic cable between the buildings properly protected from damages with adequate telecommunication boards and passive and active equipment inside.

The system shall be readily capable of being extended to allow for future expansion of the works and shall be capable of modification to allow for changes that may be made to the as-installed system.

CCTV

The Contractor shall design, deliver the equipment and install a CCTV system on the location of RLF. The CCTV system shall provide video monitoring of unauthorized entrance(s) and process activities along the process line.

The Contractor shall provide WEB cameras around the fence on the external lighting poles and outdoor and indoor cameras for process monitoring. Video signals will be concentrated in the control-administration building.

Fire Alarm System

A fire alarm system shall be provided according to fire fighting document.

2.3.20.2 Process control

Drive operation

Each drive shall be capable of being operated from:

- Local control unit adjacent to the drive
- From the starter compartment push buttons on the MCC

From the control centre via SCADA. Each starter compartment shall have a selector switch to give:

- Local - Control via the push buttons on the starter compartment door
- Remote - Control from the local control unit adjacent to the plant item
- Auto Control via the PLC

Each local control unit shall incorporate Stop/Start push buttons and a twist to reset a mushroom head emergency Stop button. These may be enclosed in a common enclosure.

Each MCC ICA section contains a PLC together with ancillary equipment to control and monitor the plant, which is connected to that MCC. Where interlocking of plant items from different MCC's in required this shall be achieved via the site communication system, which interconnects the PLC's, and SCADA.

2.3.20.3 SCADA system

General

The contractor shall be responsible for the design, procurement, installation, testing and commissioning of a works integrated automation and control system including the necessary SCADA interface for central despatch office located in the main administration building on the Site.

General Automation Philosophy

The control system will operate at three levels as follows:

Level 1	Manual operation using local stop start switches at equipment items or within substation.
Level 2	Local automated operation by local PLC or controller
Level 3	Remote automated operation from a remote control room in the control admin building

In a case of communication failure between levels 2 & 3, PLC will continue to operate under the last request from central control room.

On failure of local controller, unit will either continue to operate or shutdown dependent on individual requirements.

Any intervention at level 1 will override any remote or local automation. Local manual or emergency shutdown buttons will always stop equipment including any additional equipment that is integrated into the equipment's safe operation.

The Contractor will be responsible for developing an integrated approach of individual local panels managing specific items of equipment or providing a number of electrical/automation switch rooms with local stop start switches at equipment.

Central Despatch

The central despatch shall be located in the RLF plant operation building. From the central despatch the operator shall have a complete overview of the plant.

Central despatch shall be equipped with two PC's of a recognized top brand manufacturer for the SCADA control.

The PC's shall have at least the following specifications: Dual Core, 2 gHz, 2*100 Gb HD RAID, 2 gB RAM, DVD writer, USB 2.0, wireless optical mouse,

Monitor 27 inch LCD, TFT active matrix, and resolution min 1900*1200, dot pitch < 0.3 mm.

Computers shall be networked (Ethernet) and redundant.

The computers shall share one colour laser printer, 600 pix/inch, A4 / A3 size paper, network enabled, separate colour and black toner cartridges.

Matrix printer, two colour for alarm printing.

Mimics

The Contractor shall develop the SCADA system and the mimic representation. for the approval of the Engineer.

Mimics shall be developed for

- Representation of all MRF and composting plant activities and equipment and wastewater and leachate treatment facilities, including but not limited to all process units, pumps and drives
- Capacity and qualitative measurements
- Alarms status and alarm printing.
- Dynamic trending of process parameters
- Graphic representation and reports for statutory purposes
- Power consumption
- Change of set points and timer settings

2.3.20.4 Supply of Electrical Plant

The Contractor shall be responsible for the design, supply, installation, testing, commissioning of all Electrical Plant required for the works generally as described below and as may be required according to the Contractor's design:

- Medium voltage power supply line from nearest power sub station
- Medium Voltage (10 / 12 kV) switchgear and 10 / 12 kV - 0.4 kV transformer station and related cabling
- LV switchgear, Motor Control Centres, local control units, SCADA system
- All control and monitoring equipment, computers and software requirements
- Internal cabling, cabling from plant to associated control panels located on that plant or immediately adjacent to it
- Earthing and bonding
- Site communications system connecting instrumentation, equipment, local PLCs and SCADA
- Equipment for areas designated as hazardous

- Lighting and power installations to plant buildings
- Lightning protection equipment
- Emergency lighting
- Fire alarm system
- Telephone system
- Site lighting
- Entrance gate control
- Internal CCTV

The Contractor shall make due consideration in the design of the works to ensure that electrical panels may be extended to cater for future extension.

All electrical components shall be CE marked.

2.3.20.5 Electrical design

Electrical design shall be done on the basis of internationally recognized standards and in line with Serbian standards.

In general design according IEC standards is accepted:

- IEC 6364 for Electrical installations
- IEC 61024 Earthing
- IEC 60079- Explosive gas atmospheres and hazardous areas

2.3.20.6 Explosive atmosphere

The Contractor shall take note that any equipment installed in potential explosive atmosphere needs the certification of the Serbian Explosion Authority.

All localities at the treatment plant shall be classified in EX zones in accordance with the local laws, the ATEX Directive and other related directives, norms and standards. The Contractor shall have the classification approved by the relevant local authorities.

The design and the installation shall be carried out in accordance with the ATEX Directive and the approved classification. All components shall be selected in accordance with the ATEX Directive.

2.4 Inspection And Testing

2.4.1 General

The Contractor's quality assurance system shall include procedures for carrying out inspection and testing of the works both on and off site during the design and construction phase. The Contractor's project plan shall include a programme for completing such inspections and tests in a co-ordinated manner and in accordance with the requirements of the Contract.

The Contractor shall provide equipment, instruments, qualified personnel and facilities necessary to inspect the work and perform the tests required by the Project Documentation.

The Contractor shall submit to the Engineer full details of inspections and tests to be carried out at least 21 days in advance. Attendance at and acceptance of tests and inspections of the works shall not prejudice the right of the Engineer to reject any part of the works if it subsequently fails to comply with the requirements of the Contract.

The Contractor shall keep a record of all tests and inspections, irrespective of whether or not they show compliance with the Contract and shall issue this record to the Engineer on completion of each test and inspection.

The Contractor shall repeat tests and inspections after correcting non-conforming work until all work complies with the requirements. All re-testing and re-inspections shall be performed at no additional cost to the Client.

The Engineer may elect to perform additional inspections and tests at the place of the manufacture or the shipping point to verify compliance with applicable Specifications. Inspections and tests performed by the Engineer shall not relieve the Contractor of his responsibility to meet the Specifications. Inspections and tests by the Engineer shall not be considered a guarantee that materials delivered at a later time will be acceptable.

Inspections and tests conducted by persons or agencies other than the Contractor shall not in any way relieve the Contractor of his responsibility and obligation to meet all Specifications and referenced standards.

Off-site inspection and testing
All major items of plant and equipment (e.g. blowers and gas motor as appropriate) shall satisfactorily pass a factory acceptance test (FAT) to design working conditions prior to dispatch. The Contractor shall complete routine and functional works tests to ensure the item is in compliance with the specifications. The Contractor shall give the Engineer the opportunity to attend and witness such tests by giving notice in due time.

No material or item of plant and equipment shall be delivered to site without prior inspection, testing and certification, where applicable, unless the Engineer confirms, in writing, that such inspection, testing and/or certification are not required.

2.4.2 Inspections and tests

The Contractor shall prepare a section within the Workplan and Programme that describes in detail the Inspection, Testing and Commissioning Plan. The Inspection, Testing and Commissioning Plan can be modified in order to comply with the project timeline. Any modification of the Inspection, Testing and Commissioning Plan shall be submitted to the Engineer's approval. Final Inspection, Testing and Commissioning Plan shall be ready and approved by the Engineer 56 days before the start of the tests.

All inspections and tests shall be conducted in accordance with written test procedures as detailed in the Quality Assurance Plan and the Inspection, Testing and Commissioning plan that have been reviewed and approved by the Engineer.

Inspection and test procedures submitted for approval shall include, but not be limited to, the following:

inspection/test procedure reference

references to Clauses of this Specification and other standards along with applicable inspection/test levels specified therein

prerequisites for the given inspection/test

required tools, equipment

necessary environmental conditions

acceptance criteria

data to be recorded

test results reporting forms

identification of items tested.

Approved procedures and instructions shall be readily available and used by inspection and test personnel at the time of inspection or test. All revisions to these procedures and instructions shall be approved prior to being used to inspect or test the work. No deviations from the approved procedures and instructions shall be allowed without written authorization from the Engineer.

Inspection and testing work shall be performed by personnel designated by the Contractor. Such personnel shall not be the same as those performing the work.

The Contractor shall furnish the Engineer with a signed and stamped inspection report for each item of work to be inspected. The report shall indicate whether the item of work, material and/or equipment complies with all the inspection/test criteria. The Contractor shall submit inspection/test results to the Engineer prior to incorporating the item(s) into the work. Inspection/test failures shall be reported to the Engineer immediately.

The Contractor shall clearly document and identify the inspections and test status of all materials and equipment throughout construction. Identification may be by means of stamps, tags, or other control devices attached to, or accompanying, the material or equipment.

2.4.3 Measuring and test equipment

The Contractor shall establish and maintain documented procedures which conform to accepted and approved national or international standards to control, calibrate and maintain inspection, measuring and test equipment used by the Contractor to demonstrate the conformance of materials, equipment and/or construction work with the requirements of the Project Documentation.

Inspection, measuring and test equipment shall be used in a manner which ensures that the measurement uncertainty is known and is consistent with the required measurement capability.

The Contractor shall establish a unique identification number for each item of measuring and test equipment. This unique identification number shall be permanently affixed to each item of measuring and test equipment

The Contractor shall ensure that each item of inspection, measuring and test equipment is calibrated at intervals recommended by the manufacturer. Valid calibration certificates for measuring and testing equipment shall be present and available for inspection during inspections and tests.

The Contractor shall establish a log of all measuring and test equipment and record:

equipment description

identification number

date of the last calibration

date that the next calibration is due.

2.4.4 Inspection and test status

The inspection and test status of materials, equipment and construction work shall be identified by suitable means, which indicates the conformance or non-conformance of materials, equipment and construction work with regard to inspection and tests performed. The identification of inspection and test status shall be maintained, as defined in the Quality Assurance Plan and/or documented procedures, throughout the course of construction to ensure that only materials, equipment and construction work that have passed the required inspections and tests are used or installed.

2.4.5 Factory Acceptance Tests

The main equipment will be tested / inspected at Contractor's promises in accordance with the Conditions of Contract.

Tests shall include, but not be limited to:

Origin of materials and subsystems,

Functional check of control, electrical and mechanical components,

Geometrical parameters,

Electrical parameters (power absorption, cos φ),

Functional test of the software,

Noise measurement,

Fire and explosion safety properties,

Health and safety properties.

Exact conditions, test methods, rejection criteria and details for testing are must follow applicable standards and legally prescribed procedures.

2.4.6 Tests on Delivery

Tests on Delivery shall be carried out upon delivery of any Plant or material to the site and shall be done in accordance to the Conditions of Contract.

The Contractor shall give notice to start Tests on Delivery to the Engineer 15 days before delivery of any Plant or material to the Site.

Tests shall include, but not be limited to:

A. Origin of materials and subsystems;
B. Checking of a Section in regard to import permits or required licences;
C. Checking of a Section in regard to quality assurance, such as:

name of a Section,

Section's number,

Section's description,

suppliers name,

serial number or other identification (where applicable),

technical specification reference (where applicable),

verification of receipt of all required supporting documentation,

quantity of items,

location and installation of item,

test/inspection certificate,

non-conformance number (if applicable),

observations/comments;

D. Installation, operation and maintenance manuals;

E. Warranty;

F. Check of physical integrity of a package.

2.4.7 Tests on Completion

2.4.7.1 General/Personnel

The Contractor shall give the Engineer not less than twenty-one (21) days notice of his intention to commence the tests on completion.

Commissioning and performance tests shall be carried out using trained, experienced staff. The Commissioning Engineer shall have a minimum of five years experience in the commissioning and performance testing of similar plants.

All tests must be carried out in the presence of the Engineer, or such other person appointed for this purpose, unless the Engineer states otherwise in writing. Tests shall be carried out to the satisfaction of the Engineer. Certificates shall mention shortcomings to be corrected by the Contractor in a list of defects.

The Engineer may require additional tests to prove compliance with the specifications. All such tests shall be at the Contractor's expense.

During the Tests on Completion all necessary personnel required to properly run the plants and landfill will be employed by the Beneficiary. If necessary, additional staff may be hired by the Contractor who will have the sole responsibility for their salaries and expenses. Having in mind the purpose of the Tests on Completion, Beneficiary shall grant all necessary managing and controlling positions to the Contractor's personnel.

The MRF and Composting Plant and LTP and SBR operational and maintenance personnel shall have the appropriate qualifications to perform the Tests on Completion, based upon their general qualification, skills and experience and upon training that shall be provided by the Contractor prior to the completion of the construction works.

The list of necessary personnel with required general qualification, skills and experience, shall be supplied by Contractor 6 months before the completion of the construction works or at the time previously agreed between the Contractor and Beneficiary. The Beneficiary shall provide the requested number of personnel with requested qualification and skills. After the

Contractor's consent on proposed personnel, the Beneficiary will employ them, if they are not already employed by Beneficiary. If the Beneficiary does not provide the required number of personnel with the required qualifications and skills, the Contractor may propose them by himself.

In the case that during the Tests on Completion it appears that some personnel are not able to fulfil their duty, the Contractor shall be entitled to give due notice to the Beneficiary with a written explanation about the issue. The Beneficiary shall in 30 days examine the issue and find adequate replacement(s), if necessary.

2.4.7.2 Pre-commissioning Tests

Pre-commissioning tests are meant to identify the performance of each machine and equipment, individually and in sequential and adjoining sets, in the absence of external loads.

At the end of successfully finished pre-commissioning tests, the Engineer will issue the End of Assembly Statement (EAS), but only after the following has been verified:

That all civil engineering and infrastructure works meet the required specifications,

That each machine and equipment meets the required specifications and that they are duly certified when such certification is required under the Contract,

That all the alarm, stoppage and control circuits of each machine and equipment meet the required specifications,

That each machine and equipment meets legal and/or regulation requirements,

That first draft of the "as-built documentation" has been delivered as well as all preliminary versions of operating and maintenance manuals,

That the training of operating personnel has been successfully completed,

That the general cleaning of the site has been performed, in particular of the areas containing organics and/or equipment,

That the detailed testing plan for the following phases (which are not part of the Works Contract), to be submitted by the Contractor, has been approved by the Engineer.

On completion of erection of the equipment and before start-up, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Engineer and the Contractor for correctness and completeness of installation and for acceptability of start-up

After the physical installation of all systems and subsystems has been completed, the Contractor shall insure that all building services, such as electrical power, central steam supply, natural gas, water, sewer, etc., have been connected and started.

The list of pre-commissioning tests to be performed shall be as included in the Contractor's Workplan and Programme (in the Inspection, Testing and Commissioning Plan).

The Engineer shall, with help of the Contractor, perform an inspection to ensure that the system is operational and ready for testing. All subsystems shall be inspected, started by and tested by the Engineer to ensure that they function as required, and that all subsystems are operational.

The main activities that will have to be carried out during the pre-commissioning tests are:

verification of proper mechanical assembly

verification of proper tightening of bolts with torque wrenches

verification of proper machine alignment

verification of conformity of installation to the project drawings

verification of proper marking of all components, boxes and panels

verification of proper wiring

verification of as-built drawings and documents

verification of spare parts lists and special tools lists

verification of existence and application of operation and maintenance (O&M) manuals

"dry" or "cold" functional tests

balancing and adjusting.

"Dry" or "cold" functional tests imply that the complete equipment shall be operated integral with all sub-systems and supporting equipment.

The Contractor is obliged to remedy any defects discovered during the pre-commissioning tests. The contractor shall bear all costs resulting from remedying of errors. The Contractor shall make all necessary corrections to O&M manuals and procedures if errors are discovered during the commissioning process.

The Contractor shall document all tests and inspections performed on the Works or a Section during the pre-commissioning tests, record all parameters and test results, and submit them to the Engineer for review.

The Engineer will issue to the Contractor a certificate of successful pre-commissioning tests within 28 days after successful completion of tests, or a notice of any objection together with a period for remedying the failures in case of unsuccessful pre-commissioning tests.

A positive outcome of the pre-commissioning activities qualifies the Works for the Final Inspection of the construction works and issuing of a Temporary Use Permit by the Ministry of Environment, Mining and SpatialPlanning.

2.4.7.3 Putting into operation (Commissioning Tests)

Commissioning of the Works or of a Section cannot be started before a valid Temporary Use Permit for the Works or a Section has been issued. Commissioning of the Works cannot be started until the final versions of the "as-build" documentation, operation and maintenance manuals have been delivered and accepted by the Engineer.

Within 7 days from issuing of the Temporary Use Permit, the Contractor shall notify the Engineer about the start of the commissioning tests of the Works. Upon receipt of the notice, the Engineer will inform the Contractor and the Beneficiary about time and location of a Commissioning Meeting. The Commissioning Meeting will be held within 7 days from the

receipt of the Contractor's notice from the Engineer. The Contractor shall attend the Commissioning Meeting.

The purpose of the meeting is to prepare for the commissioning tests, and to ensure that the Contractor and the Beneficiary are ready to begin full-scale commissioning. During the Commissioning Meeting the Contractor must present and submit an exact Commissioning Plan for conducting and completing commissioning tests. The Commissioning Plan shall be in compliance with the Contractor's Workplan and Programme and accepted and confirmed by the Engineer.

Commissioning tests shall take place within 7 days from the Commissioning Meeting.

The commissioning tests must demonstrate complete functionality and safety of every Section of the Works, in different operating conditions, i.e. under different weather conditions, input loads and dynamics etc. Detailed testing procedures and schedules shall be defined in the Contractor's Workplan and Programme. Sufficient time shall be reserved for all necessary adjustments of the equipment comprising all plants in the scope of Works.

The Beneficiary shall provide input municipal solid waste (MSW) needed for the execution of commissioning tests. Quantities and dynamics of delivery of necessary input materials shall be stated in Contractor's Workplan and Programme. Disposal of any product produced by the Works during trial operation shall be arranged by separate agreement between the Beneficiary and the Contractor.

The Contractor is obligated to remedy any defects discovered during the commissioning tests. The contractor shall bear all costs resulting from remedying of errors and all costs for the testing of the Works and operation of plants.

The Contractor shall document all tests and inspections performed on the Works as part of the commissioning process.

The Engineer shall within 7 days after successful completion of tests issue to the Contractor a certificate of successful commissioning tests, or a notice of any objections together with a period for remedying the failures in case of unsuccessful commissioning tests.

2.4.7.4 Pre-commissioning and commissioning tests

The pre-commissioning and commissioning tests under dry and wet conditions as appropriate shall include all procedures and functions, safety, emergency as well as normal procedures.

The Contractor shall set out, in his construction documentation, a full list of the pre-commissioning and commissioning tests to be carried out under the Contract to prove compliance with the Requirements. Such tests shall include, but not necessarily be limited to:

a) Test of structures and pipes

- Leakage and pressure tests
- Construction materials testing.

a) Tests of mechanical equipment

- Tests of correct direction of rotation of motors
- Tests of automatic operation

- Tests of manual operation
- Tests of capacity of all machines individually and as part of the entire plant
- Tests of quality of materials.

b) Tests of electrical equipment

- Tests of alarm systems
- Tests of the emergency switch system
- Tests of manual operation
- Tests of all interlocking systems
- Tests of indications
- Tests of all panel functions
- Tests of safety systems
- Tests of all signals to the SCADA PLC
- Tests of modifications of the control systems (new start and stop level etc)
- Full test of all signals to and from the PLCs, instruments and signal converters.

All testing under "dry" conditions shall be completed to the satisfaction of the Engineer prior to the introduction of "wet" conditions to the plant.

All necessary consumables, spare parts, tools, lubricants, etc. for the carrying out of tests shall be supplied by the Contractor as part of the Contract.

2.4.7.4 Trial Operation (running-in and process proving)

Once the pre-commissioning tests have been completed to the satisfaction of the Engineer, the Contractor shall operate and maintain the RLF in accordance with the draft operation and maintenance manuals for a trial period of approx. three months. During this period the Engineer shall have the opportunity to witness all operation and maintenance activities, the objectives of which are to optimise the function and operation of the entire RLF. All mechanical tests shall be made in this trial operation period which shall be approx. three months.

Test Equipment

The Contractor shall provide and install ready for use any equipment, materials, consumables, water, etc. necessary for execution of the functional tests at his own costs.

Any equipment used in the testing of the plant shall comply with the appropriate safety regulations and requirements in all respects. The Contractor shall ensure that all subcontractors are acquainted with the contents of these regulations.

The manufacturer shall satisfy the Engineer on the accuracy of all instruments used for tests and, if required, shall produce recent calibration test certificates, or otherwise have the instruments calibrated at his own expense by an independent authority.

KWh meters shall be checked for correct rotation and creep tests shall be carried out to ensure that the meter is inoperative with voltage alone if the secondary of the current transformer is left connected with the primary current interrupted.

Trial Operation shall be conducted for the MRF, the Composting Plant and the Leachate Treatment Plant.

Trial Operation shall be executed only after successful completion of the commissioning tests.

The duration of the Trial Operation shall be limited to maximum duration of six (6) months. During the Trial Operation there shall be continuous operation of the plants on full load (of all subsystems) for at least 1 month, during which the Performance Tests shall be carried out.

Trial Operation can, if previously agreed with the Engineer and the Beneficiary, start immediately after the successful completion of the commissioning tests. This will allow the use of material already contained in the plants and thus shorten the total time for conducting the Performance Tests.

If the Performance Tests are to be considered successful, each plant shall operate continuously at design loads (or any other loads previously accepted by the Engineer and the Beneficiary) during a period of 30 days, without major interruption or failure. Additionally, the Performance Tests shall be considered successful if each item of the equipment can operate continuously and without major interruption or failure during the aforementioned period of 30 days.

For the period of the Performance Tests, the time of operation with any load shall be counted. Minor interruptions caused during the continuous operation shall not affect the period of the Performance Tests. However, if in the opinion of the Engineer/Beneficiary, the interruption is too long, the period for the Performance Tests shall be prolonged to allow for the period of interruption.

During the period of the Performance Tests, In the event there is a failure that may not be corrected without the stoppage of entire plant, the test will be considered unsuccessful. In this case, the Contractor will undertake the repairs/corrections with all due diligence and testing will resume from the beginning. This procedure will be repeated until the continuous 30 days trouble-free operation is achieved. Up to a total of 3 (three) short stoppages during one day, due to small operating deficiencies in the equipment, not longer than 1 (one) hour, will not be considered as interruptions requiring tests to restart from the beginning.

A Trial Operation Report comprising of observations and recordings of various parameters to be measured in respect of the Trial Operation shall be prepared by the Contractor. This Report, besides recording the details of the various observations during Trial Operation, shall also include the dates of start and finish of the Trial Operation and shall be signed by the Engineer and the Beneficiary.

The Report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the trial operation. Based on the observations, necessary modifications and repairs to the equipment shall be carried out by the Contractor to the full satisfaction of the Engineer/Beneficiary. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for rejection of entire Performance Tests.

The Beneficiary shall provide input MSW needed during the Trial Operation. Quantities and dynamics of delivery of necessary input materials shall be as defined in the Beneficiary's

Requirements. Disposal of any product produced by the Works during trial operation shall be arranged by separate agreement between the Beneficiary and the Contractor. The Contractor shall bear all costs for the testing of the Works and operation of plants.

The Beneficiary shall guarantee to supply designed input quantities of MSW during the period of the Performance Tests.

The Performance Tests shall be executed by the Contractor, under the supervision of the Engineer and the Beneficiary. The Performance Tests shall include all necessary measurements to determine the following guarantees (defined in the Beneficiary's Requirements):

MRF and Composting Plant capacity guarantees

Guarantees for efficiency and quality of separated materials in the MRF Plant

Leachate Treatment Plant capacity guarantees

Leachate Treatment Plant effluent quality guarantees

Measurements of all parameters connected to the capacity shall be carried upon every arrival/input of input materials and upon every removal/output of products, or continuously if applicable. Measurements of all parameters connected to the quality of output material shall be carried out on the daily basis.

All procedures and results from the Performance Tests shall be documented and approved by the Contractor, Engineer and the Beneficiary.

After the successful conclusion of the Performance Tests and the Trial Operation, the Use Permit can be issued after which the Engineer will issue the Final Acceptance Certificate.

If the tests are unsuccessful, the Beneficiary has the right to reject the Works.

2.4.7.5 Alteration of equipment

The Contractor shall alter any equipment in order to: (i) remedy any defects and (ii) meet the values provided for in the Contract specifications. The alteration shall be performed within a reasonable period of time within the period of time set by the Engineer.

Alteration of equipment, after the Final Inspection of the construction works and issuing of the Use Permit, may require additional Final Inspection of the altered equipment and/or entire subsystem.

The Contractor shall bear all costs resulting from alteration of equipment.

Rejection of works shall apply after the Engineer concludes that the Contractor is not in a position to mend the faults or defects in question and the deviations measured.

2.4.7.6 Use of equipment in case of rejection

Notwithstanding the rejection, the Beneficiary has the right to go on using the equipment in question within its capacity until a final solution is found.

2.4.8 Tests after Completion

2.4.8.1 General

The main purpose of the Tests after Completion is verification of the guaranteed operating costs for the MRF plant, the Composting plant and Leachate Treatment Plant, specified in the Contractor's offer for the Works Contract. Secondly, the purpose of these Tests is to confirm that each operation and equipment performs correctly and with the foreseen capacity for which they were meant and that plants, taken as a whole, are operating in accordance with the planned capacity and required quality, as specified in the Beneficiary's Requirements.

The commencement of the Tests after Completion shall be immediately after the issue of the Provisioanl Acceptance Certificate for the Works Contract. Unless the Parties have mutually agreed to prolong the Tests after Completion, the obligation of the Contractor is to participate in operation and maintaining of the plants for a duration of 12 months.

The Contractor shall bear all costs for the testing of the Works and the Beneficiary shall bear all costs for operation of the plants.

All tests will be undertaken under the supervision of the Engineer (or his Representative). Whenever required by the Serbian rules, tests shall be performed by a "Serbian Authorised, independent third Party" employed and paid by the Contractor. All the necessary parameters for the tests will be recorded and evaluated by the Engineer, the Beneficiary and the Contractor.

During the Tests after Completion, the following operating capacities and quality will be measured and controlled:

Testing of each process and equipment operating up to maximum load. Integrated operating and capacity tests for sequential machine systems;

Checking the conformity of the operating conditions of the main and of the auxiliary processes with the requirements for the project;

Checking the consumption of utilities;

Checking of the capacity and quality (properties) of the output fractions from the MRF plant and the Composting Plant;

Checking of the effluent capacity and quality from the Leachate Treatment Plant;

Checking of the operating costs of the MRF plant, the Composting plant and Leachate Treatment Plant.

2.4.8.2 Organization of tests

Tests will be conducted in four consecutive periods with duration of 180 days that will comprise of two sub-periods:

(i) testing of plants under normal operating conditions in duration of 150 days

(ii) testing of plants under nominal (full) capacity in duration of 30 days - "Performance Testing Period"

Following types of verification are foreseen during the testing of plants under normal operating conditions:

performance tests regarding quality of the output fractions from the MRF plant, the Composting plant and the Leachate Treatment Plant,

checking the availability of the MRF plant and the Composting plant,

additional mechanical tests.

Following types of verification are foreseen during the Performance Testing Periods:

performance tests regarding quality of the output fractions from the MRF plant, the Composting plant and the Leachate Treatment Plant,

checking of the availability of the MRF plant and the Composting plant,

verification of operating costs.

If the performance tests are to be considered successful, each plant shall operate continuously at design loads (or any other loads previously accepted by the Engineer and the Beneficiary) during a period of 30 days (during the Performance Testing Period), without major interruption or failure. Additionally, the performance tests shall be considered successful if each item of the equipment can operate continuously and without major interruption or failure during the aforementioned period of 30 days.

Within the Performance Testing Periods, the time of operation with any load shall be counted. Minor interruptions caused during the continuous operation shall not affect the period of the performance tests. However, if in the opinion of the Engineer/Beneficiary, the interruption is too long, the period for the performance tests shall be prolonged for the period of interruption.

During the Performance Testing Period, in the event there is a failure that may not be corrected without the stoppage of entire plant, the test will be considered unsuccessful. In this case, the Contractor will undertake the repairs/corrections with all due diligence and the Performance Testing Period will resume from the beginning. This procedure will be repeated until the continuous 30 days trouble free operation is reached. Up to a total of 3 (three) short stoppages during one day, due to small operating deficiencies in the equipment, not longer than 1 (one) hour, will not be considered as interruptions requiring tests to restart from the beginning.

A Report of Performance Testing Period, comprising of observations and recordings of various parameters to be measured, shall be prepared by the Contractor. This Report, besides recording the details of the various observations during Performance Testing Period, shall also include the dates of start and finish of the Performance Testing Period and shall be signed by the Engineer and the Beneficiary.

The Report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Performance Testing Period. Based on the observations, necessary modifications repairs to the equipment shall be carried out by the Contractor to the full satisfaction of the Engineer/Beneficiary. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for rejection of the entire Performance Testing Period.

The performance tests during each Performance Testing Period shall be executed by the Contractor, under the supervision of the Engineer and the Beneficiary. The performance tests shall include all necessary measurements to determine following guarantees (defined in the Beneficiary's Requirements):

MRF plant and Composting plant operating costs

MRF plant and Composting plant capacity guarantees

Guarantee for maximum quantity of biodegradable and rejected material to be landfilled

Guarantees for efficiency and quality of separated materials in the MRF Plant

Leachate Treatment Plant operating costs

Leachate Treatment Plant capacity guarantees

Leachate Treatment Plant effluent quality guarantees

Measurements of all parameters connected to the capacity shall be carried upon every arrival/input of input materials and upon every removal/output of products, or continuously if applicable. Measurements of all parameters connected to the quality of output material shall be carried out on the daily basis.

All procedures and results from the performance tests shall be documented and approved by the Contractor, Engineer and the Beneficiary.

All required tests shall be performed according to Serbian/European standards in force by the duly certified laboratories.

In the event the values guaranteed are not being met during first three Performance Testing Periods, the Contractor will make any modifications, corrections and replacements required to meet those values. The Contractor shall bear all costs resulting from those modifications, corrections and replacements. The Contractor shall not implement any proposed modification until such modification has been reviewed by the Beneficiary, and consent to proceed has been given in writing. However, any such approval or consent, or any review shall not relieve the Contractor from any obligation or responsibility. No significant alteration to such arrangements and methods shall be made without the prior written approval of the Beneficiary

In the case of any modifications, corrections and replacements, the contractor shall update the Technical Documentation and Operating & Maintenance Manuals. The Contractor shall bear all costs for updating documentation.

All updated documentation must be approved by the Beneficiary.

The Contractor may request the Beneficiary to authorize the repetition of tests in order to improve their results. In this case, the Contractor will bear the risks and costs for additional personnel, specified equipment and laboratory services.

The Beneficiary may require additional guarantee verification tests at any time or any other tests on an 'ad hoc' basis. The Beneficiary shall bear all costs for the additional tests.

In the event the values guaranteed are not being met during last Performance Testing Period the Testing after Completion will be considered as failed. In that case the Contractor shall become liable to the Beneficiary for the payment of non-performance damages as stipulated in the Particular Conditions of Contract.

Personnel

During the Tests after Completion all necessary personnel to properly run the plants and landfill will be employed by the Beneficiary. If necessary, additional staff may be hired by the Contractor who will have the sole responsibility for their salaries and expenses. Having in mind the purpose of the Tests after Completion, Beneficiary shall grant all necessary managing and controlling positions to the Contractor's personnel.

The MRF Plant, Composting Plant and Leachate Treatment Plant operators and maintenance personnel shall have the appropriate qualification to perform the Tests after Completion, based upon their general qualification, skills and experience and upon training that shall be provided by the Contractor prior to the completion of the construction works.

During the Tests after Completion, where it appears that some personnel are not able to fulfil their duty, the Contractor shall be entitled to give due notice to the Beneficiary with a written explanation about the issue. The Beneficiary shall within 30 days examine the issue and find the appropriate replacement(s), if necessary.

2.4.8.3 Delivery of municipal solid waste

The Beneficiary shall be responsible for the supply of the municipal solid waste (MSW). No other material shall be allowed for treatment other than material delivered by the Beneficiary or person designated by the Beneficiary.

The Beneficiary shall guarantee to supply MSW during the Tests after Completion and designed input quantities of MSW during Performance Testing Periods. If those quantities cannot be supplied, the Beneficiary shall indemnify and hold the Contractor harmless against any penalties related to the operating costs and plant capacity.

2.4.8.4 Defects

The Contractor is obliged to remedy any defects discovered during the tests. The contractor shall bear all costs resulting from remedying of errors. The Contractor shall make all necessary corrections to O&M manuals and procedures if errors are discovered during the Tests after Completion.

2.4.9 Inspections by the Engineer during Defects Liability Period

The Engineer will give the Contractor due notice of his intention to carry out any inspections during the Defects Liability Period.

The Contractor shall arrange for a responsible representative to be present at the times and dates named by the Engineer.

The Contractor's representative shall render all necessary assistance and take note of all matters to which his attention is directed by the Engineer.

2.5 Non-Conformances Monitoring

2.5.1 General

The Contractor shall establish and maintain documented procedures to ensure that an item that does not conform to the requirements of the Project Documents is prevented from unintended use or installation. This control shall provide for identification, documentation, evaluation, segregation (when practical) and disposition of the non-conforming item(s).

The monitoring system shall apply to material and equipment as well as installation and construction which fails to conform to the Project Documentation.

2.5.2 Review and disposition of non-conforming items

The responsibility for review and authority for the disposition of non-conforming items shall be defined in the Quality Assurance Plan.

Non-conforming items shall be reviewed in accordance with documented procedures. Non-conforming items may be:

reworked to meet the specified requirements

accepted with or without repair if agreed in writing by the Engineer

re-graded for alternative applications

rejected or scrapped.

The proposed use or repair of an item which does not conform to the requirements of the Project Documentation shall be reported to the Engineer. The description of the non-conformity and of repairs shall be recorded to denote the actual condition.

Repaired and/or reworked products shall be inspected in accordance with the Quality Assurance Plan and/or documented procedures.

2.5.3 Corrective and preventive action

The Contractor shall establish and maintain documented procedures for implementing corrective and preventive action.

Any corrective or preventive action taken to eliminate the causes of actual or potential nonconformities shall be to a degree appropriate to the magnitude of problems and commensurate with the risks encountered.

The Contractor shall implement and record any changes to the documented procedures for implementing corrective and preventive action.

2.5.3.1 Corrective action

The Contractor shall take prompt action to identify the causes of each non-conformance and the corrective action necessary to prevent recurrence. The results of failure and discrepancy report summaries, Contractor evaluations, and any other pertinent applicable data shall be used for determining corrective action. Information developed during construction, tests, and inspections that support the implementation of required improvements and corrections shall be used to support the adequacy of corrective action taken.

2.5.3.2 Preventive action

The procedures for preventive action shall include:

the use of appropriate sources of information such as processes and work operations which affect product quality, concessions, audit results, quality records and service reports to detect, analyse and eliminate potential causes of non-conformities

determination of the steps needed to deal with any problems requiring preventive action

initiation of preventive action and application of controls to ensure that it is effective

ensuring that relevant information on actions taken is submitted for management review.

2.5.4 Identification of non-conforming items

The Contractor shall clearly identify each non-conforming item with a status tag or other distinguishing mark. The Contractor shall establish procedures for installing, monitoring and removing these status tags and identify personnel authorised to remove status tags.

2.5.5 Non-conformance records

The Contractor shall provide the Engineer with the following information for each non-conformance:

identification of non-conformance

description of non-conformance

evaluation of non-conformance to establish the cause

recommended corrective action

date non-conformance was identified

date corrective action was completed

description of final corrective action.

The Contractor shall establish and maintain a non-conformance log. The log shall contain the following information as a minimum:

sequential reference number

date issued

originator

description of item deemed to be in non-conformance

description of non-conformance

recommended and final disposition

date closed remarks, as applicable.

2.6 Training Of Staff Of Operator/Beneficiary

The Contractor shall provide training to personnel assigned by the Beneficiary (minimum two employees/workers for each workplace defined by the Contractor) , so that they are capable of operating and maintaining the MRF, the Composting Plant and the Leachate Treatment Plant in accordance with the highest internationally accepted standards. Training shall commence during the construction period and shall end prior to the Commissioning period.

In order to manage and control the installation properly it is essential to acquire the necessary know-how and knowledge. A good training programme in combination with practical experience should be the best and fastest way to give insight into the process and the applied equipment.

2.6.1 Training programme

After one-week theoretical training in Serbia, employees/workers should visit the Contractor's existing plant, where a two-week practical training will be held in the waste processing plant. This practical training relates to the information acquired during the training. The treatment process and management aspects discussed in Serbia should be gone through in practice. Employees/Workers should learn to trace down and solve possible occurring disturbances at an early stage.

Objective

The employees/workers should learn the following but not limited to:

to know and understand the process;

the effect of each component of the each sub-system process;

how to start and stop the installation;

when to operate the emergency stop;

how to operate the control cabinet;

how to intervene in the waste treatment process:

what and when to clean:

to recognize and solve occurring disturbances;

who to contact if he cannot solve it himself;

to recognize wear and tear;

when to replace parts;

when to lubricate the components;

how to run Facility safely and efficiently.

The Contractor shall submit a fully detailed training programme, based on the training programme submitted with his Tender, within four (4) months after the commencement date of the Contract. The Engineer's consent or comments will be provided to the Contractor within 21 days of submission. The final training programme shall be submitted to the Engineer within a further 14 days. Without written acceptance of the training programme by the Engineer, the Contractor cannot perform the training.

The training programme shall include at least, but not limited to, the following:

The organisational structure of the personnel required for management, operation and maintenance of the Facility;

The manpower requirements, by skills and trades, necessary for the management, operation and maintenance of each element of the Facility;

A detailed description of each element of the training programme which will show how the necessary skills will be imparted to the personnel assigned by the Engineer

A list which will identify the minimum educational levels or standards of technical skill which must have been already obtained for each position by the assigned personnel;

Reference materials and documents to be provided in the training programme.

2.6.2 Contractor's training personnel

The Contractor shall provide training supervisory personnel for each of the positions required for training in the operation and maintenance of the plant, as identified in the training programme. The duties of each of the training personnel, hereinafter referred to as Contractor's Counterpart Staff, shall be to supervise and train the staff members to operate and maintain that element or those elements of the plant appropriate to his/her position. The emphasis shall be on "hands-on" training.

The trainer (one or more), who should be a process Operator of some existing plant, and who should have years of experience in the process-oriented treatment of waste, should give appropriate training for all sub-systems at the Beneficiary's site in Serbia. During this training the process-oriented aspects of the treatment process will be explained clearly. Next to the process-oriented operation all aspects that are important for managing the installation properly will be clarified by means of video images.

2.6.3 Facilities and location for training

The Contractor shall provide all necessary facilities for training for each sub-system.

One-week training in Serbia

Theoretical part with short movies

Introduction

Safety

Process explanation

Maintenance

Cleaning

Replace wear and tear parts

Two-week practical training on existing plant

The Contractor/Operator should discuss the following aspects:

Going through and explaining the separation process.

Explain the effect of the components of the separation process.

Maintenance of the components.

Explanation of what disturbances can occur and how to solve them.

Health and Safety aspects

Four weeks training in Serbia

Training by the Contractor during the commissioning:

Start-up of the installation.

Explanation of how to operate.

Explanation of maintenance.

Wear and tear parts.

Cleaning.

Behaviour in unexpected situations

Emergency shutdown situations and procedures

Software working principles

Language for training

Training shall be carried out in Serbian language

2.7 N.A.

2.8 Spare Parts And Tools

2.8.1 Spare Parts

The Contractor shall supply spare parts as follows:

- A complete set of spare parts and consumables (other than electricity and fuel) for the Defects Liability Period of 12 month following Provisional Acceptance Certificate
- A complete set of spare parts for a period of 24 month following the Defects Liability Period -when FAC is issued

The numbers and amounts shall be in accordance with the maintenance schedules as set out in the Operation and Maintenance manuals.

The Contractor shall provide a detailed schedule in duplicate of all the spare parts to be supplied. During commissioning all spare parts shall be checked against the schedule and against the recommended maintenance programme. Any shortfall in the provision shall be provided by the Contractor.

All cases, containers or other packages are liable to be opened for such examination as may be required and packing shall be designed to facilitate opening and thereafter re-packing.

2.8.2 Tools

For general tools to be supplied see paragraph 2.3.4 of this document.

Tools for each different type of equipment shall be contained in a suitable box clearly marked or labelled with its description (e.g. 'digital multi-meter', 'pH meter'). Each tool shall be identified and a list of tools shall be affixed to the inside of the box lid.

Each set of tools shall be supplied with the equipment with which it is associated.

With the tools the Contractor shall provide:

- One fitter's portable chain block of capacity two-tonne
- One set of fitters' taps and dies
- One set of pipe fitter's dies (up to 150 mm)

- Gas blow lamp and fittings
- A supplementary and comprehensive tool kit containing such as micro-meters, rev-counters, feeler gauges, torque wrenches
- Two digital electronic multi-meters
- Frequency meter
- Two clamp-on ammeters

The Contractor shall provide a detailed schedule in duplicate of the tools and supplies.

2.8.3 Special Tools

The Contractor shall supply within this Contract all necessary special tools for dismantling, maintenance and adjustment of the supplied equipment. Tools and equipment for major inspections and measurements shall be included as well.

The tools, wrenches, etc. shall be unused. They shall be of the forged and polished chrome-vanadium type. Special tools and devices shall be provided with means for ready identification.

Suitable hardwood or steel boards arranged for wall mounting as well as tool carts and/or tool boxes shall be included in the delivery. An itemized list and description of all provided tools, auxiliary devices, storage equipment, etc. shall be included. Acceptance of any tool or device shall not take place before the Contractor has submitted the complete final detailed List of Special Tools.

A complete list of maintenance equipment and special tools included in the scope of supply shall be submitted with the Tender, to be included in the questionnaire in Volume I, Section 5, Form 5.3.1 (v). The price for the special tools shall be included in the price of relevant item in the Schedules of Prices (Volume IV).

The Contractor shall supply to the Beneficiary, along with each item of special equipment supplied, three copies of the Manufacturer's Instructions Catalogue.