

# BHOPAL MUNICIPAL SOLID WASTE PRIVATE LIMITED

Regd Office: 20<sup>th</sup> Floor, A Wing, Marathon Futurex, N. M Joshi Marg, Lower Parel, Mumbai-400013,  
Tel No: 022 71084444, Fax No. 71084500

Ref: BHOPAL/MSW/EC/24112018

Date: 24<sup>th</sup> November 2018

To,  
Dr. S. Kerketta, Director, IA.I  
New Delhi

**Subject: Proposed 23 MW Municipal Solid Waste based Power Plant at Villages Kolua Khurd, Adampur Chhavani, Phanda Block, Huzur Tehsil, Bhopal District by M/s Bhopal Municipal Solid Waste Private Limited. – reg. Environment Clearance**

**Ref:**

1. Letter No J-13012/16/2017-IA.II (T)

Respected Sir,

We thank you for your support and cooperation so far for Environment Clearance for Bhopal project. Please find our response as follows:

**Point 5i – Quantity of unsegregated MSW and waste for feeding to the boiler and characteristics of MSW:**

We wish to confirm that the proposed Waste to Energy power plant is designed to fire processed waste and not unsegregated waste. The plant is designed with an installed capacity to fire 1050TPD of processed waste of 1650 kcal/kg Net Calorific Value (NCV) to produce 21MW of gross electric power by firing processed waste.

Since, it's difficult to provide a single boiler capable of firing 1050TPD of processed waste, we shall be providing two lines/numbers of boilers with an installed capacity of 750TPD (15MW) and 300TPD (6MW). The steam from both the boilers shall be combined together and same shall be fed to a common 21MW steam turbine. Generator also shall be of 21MW capacity.

Please see details of waste projection from Bhopal city and adjoining cluster areas as given by Bhopal Corporation in the Project Information document (PIM), in the table attached below. Please also see the summary table based on the waste generation attached below.

Year	Bhopal	Mandidep	Obaidullahganj	Berasia	Sehore	Ichhawar	Kothri	Ashta	Total mixed	Total processed	Old legacy waste fired	Total Waste Fired	Gross power generated, MW
	TPD	TPD	TPD	TPD	TPD	TPD	TPD	TPD	TPD	TPD	TPD	TPD	@1650kcal/kg NCV
2018	1033	19	7	9	38	4	3	16	1129	790	0	0	Plant yet to be commissioned
2019	1055	19	7	9	40	4	3	17	1154	808	0	0	Plant yet to be commissioned
2020	1077	20	7	10	41	5	3	18	1181	827	223	1050	21
2021	1100	21	7	10	42	5	4	19	1208	846	204	1050	21
2022	1123	22	8	10	44	5	4	19	1235	865	185	1050	21
2023	1147	22	8	11	45	5	4	20	1262	883	167	1050	21
2024	1171	23	8	11	47	5	4	21	1290	903	147	1050	21
2025	1195	24	8	11	48	5	4	22	1317	922	128	1050	21
2026	1220	25	9	12	50	5	4	23	1348	944	106	1050	21
2027	1246	26	9	12	52	6	4	24	1379	965	85	1050	21
2028	1272	27	9	12	53	6	5	25	1409	986	64	1050	21

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2029	1299	28	9	13	55	6	5	26	1441	1009	41	1050	21
2030	1326	29	10	13	57	6	5	27	1473	1031	19	1050	21
2031	1354	30	10	13	58	6	5	29	1505	1054	0	1054	21
2032	1382	30	10	14	61	6	5	30	1538	1077	0	1077	21
2033	1411	31	11	14	63	6	5	31	1572	1100	0	1100	22
2034	1441	32	11	14	65	7	6	33	1609	1126	0	1126	22
2035	1471	34	11	15	67	7	6	34	1645	1152	0	1152	23

Table 9: Waste Generation Forecast from the Project Area

Year	Bhopal		Mandideep		Obaidullaganj		Berasia		Sehore		Ichhawar		Kothri		Ashfa	
	Population	Waste Generation (TPD)	Population	Waste Generation (TPD)	Population	Waste Generation (TPD)	Population	Waste Generation (TPD)	Population	Waste Generation (TPD)	Population	Waste Generation (TPD)	Population	Waste Generation (TPD)	Population	Waste Generation (TPD)
2014	207455	851	65643	16	24310	6	33002	8	116435	35	16012	4	11403	3	57501	14
2015	2362362	971	67640	17	24798	6	33686	8	118944	36	16275	4	11695	3	59394	15
2016	2411972	991	69636	17	25286	6	34370	9	121453	36	16539	4	11988	3	61286	15
2017	2462623	1012	71632	18	25774	6	35054	9	123962	37	16802	4	12280	3	63178	16
2018	2514338	1033	73629	19	26262	7	35738	9	126471	38	17066	4	12572	3	65071	16
2019	2567139	1055	75625	19	26751	7	36421	9	128979	40	17329	4	12864	3	66963	17
2020	2621049	1077	77622	20	27239	7	37105	10	131488	41	17593	5	13157	3	68856	18
2021	2676091	1100	79618	21	27727	7	37789	10	133997	42	17856	5	13449	4	70748	19
2022	2732289	1123	81618	22	28320	8	38511	10	137084	44	18140	5	13823	4	73331	19
2023	2789667	1147	83618	22	28912	8	39232	11	140170	45	18424	5	14196	4	75915	20
2024	2848250	1171	85708	23	29505	8	39954	11	143257	47	18708	5	14570	4	78498	21
2025	2908063	1195	87738	24	30097	8	40675	11	146344	48	18992	5	14943	4	81081	22
2026	2969133	1220	89768	25	30690	9	41397	12	149431	50	19277	5	15317	4	83665	23
2027	3031485	1246	91798	26	31283	9	42119	12	152517	52	19561	6	15691	4	86248	24
2028	3095146	1272	93828	27	31875	9	42840	12	155604	53	19845	6	16064	5	88831	25
2029	3160144	1299	95858	28	32468	9	43562	13	158691	55	20129	6	16438	5	91414	26
2030	3226507	1326	97888	29	33060	10	44283	13	161777	57	20413	6	16811	5	93998	27
2031	3294263	1354	99918	30	33653	10	45005	13	164864	58	20697	6	17185	5	96581	29
2032	3363443	1382	101982	30	34372	10	45764	14	168662	61	21002	6	17662	5	100108	30
2033	3434075	1411	104046	31	35092	11	46524	14	172460	63	21306	6	18140	5	103634	31
2034	3506191	1441	106109	32	35811	11	47283	14	176257	65	21611	7	18617	6	107161	33
2035	3579821	1471	108173	34	36530	11	48043	15	180055	67	21916	7	19094	6	110688	34

The attached tables above indicate the total unsegregated waste expected to be generated in Bhopal city and the cluster cities and towns. We will pre-process this waste to produce processed waste and quantities of the same are



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mentioned in the table. The unsegregated waste available is expected to increase from 1129TPD in 2018 to 1645TPD in 2035.

Currently, about 700TPD to 800TPD is collected from Bhopal city alone. The Waste to energy power plant will take about two years to be commissioned and the waste will be stored and will be available for firing in the boilers. Bhopal Corporation is currently collecting this waste and in due course, we will be doing the same.

This legacy waste collected for two years is expected to be about 511000 tons to 584000 tons. In the initial years when the daily processed waste available is less than 1050TPD, we will be using part of this old legacy waste daily to generate 21MW power as shown in the table above and will completely use the same over a period of time till fresh waste available itself is sufficient to produce 1050TPD processed waste.

The characteristics of MSW as given in the Project information document is mentioned in the table below.

### Physical composition

Table no. 4.2 Summary of Physical composition of waste

Date of Sampling	11-03-17	11-03-17	12-03-17	12-03-17	12-03-17	12-03-17	12-03-17		
Name of Sample Collection Points	AIMS Zone (%)	Kolar Road (%)	DIG- Bunglow (%)	Bhanpura Kunti (%)	Sehore Road- Beraghat (%)	Badbada (%)	Danapani (%)	Average (%)	
Plastic	12.65	11.35	14.88	14.31	9.39	12.09	15.14	12.83	84.94
Paper	11.97	6.46	7.31	5.62	5.44	7.28	4.49	6.94	
Wood	0.83	2.45	2.30	0.93	1.11	1.79	2.55	1.71	
Cotton	0.23	1.36	6.04	17.49	7.23	7.84	3.08	6.18	
Rubber	0.08	0.07	1.70	0.67	1.49	0.00	7.04	1.58	
Leather	1.88	0.00	1.79	1.09	1.93	1.12	1.67	1.35	
Organic	57.83	67.10	51.79	47.91	55.59	53.42	46.83	54.35	
Metal	0.68	0.00	1.87	0.74	0.77	1.23	2.38	1.10	15.06
Glass	1.66	1.70	0.77	1.35	4.34	1.68	3.35	2.12	
E-waste	0.98	0.95	0.85	0.61	0.43	1.01	1.06	0.84	
Inert	11.22	8.57	10.71	9.27	12.28	12.54	12.41	11.00	
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

The waste analysis based on the physical waste characteristics is given below.

Waste component	Average %	Corrected % without E-waste %	Waste qty based on 1180TPD (TPD)	Calorific value (kcal/kg)	Total Heat Value Kcal	Moisture content %	Moisture content tons
Organic	54.35	54.81%	647	457	295571	45%	291
Plastic	12.83	12.94%	153	4815	735137	2%	3
Paper	6.94	7.00%	83	2500	206464	6%	5
Wood	1.71	1.72%	20	2225	45276	35%	7
Cotton/Textiles	6.18	6.23%	74	2818	207241	33%	24
Rubber	1.58	1.59%	19	3495	65713	11%	2
Leather	1.35	1.36%	16	3495	56147	11%	2
Metal	1.1	1.11%	13	-35	-458	6%	1
Glass	2.12	2.14%	25	-17	-429	3%	1
Inert	11	11.09%	131	-58.6	-7671	10%	13
E-waste	0.84						
<b>Total</b>	<b>100</b>	<b>100%</b>	<b>1180</b>		<b>1602991</b>		<b>349</b>
<b>Actual calorific value of mixed waste</b>	<b>1358</b>	<b>kcal/kg</b>					
<b>Moisture content of mixed waste</b>	<b>30%</b>						

The calorific value of mixed/unsegregated waste as calculated based on physical composition is 1358kcal/kg. However, by storing the waste in pit for 5 to 6 days and allowing leachate to drain out, we can reduce overall moisture in waste and improve its calorific value as explained below.

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### **Point 5ii – Details of preprocessing/processing for reduction of inert materials, moisture and composting**

**material:** The entire unsegregated/mixed waste received shall be discharged by trucks into the Waste pit and shall be stored there for about 5 to 6 days before any pre-processing is done. The waste pit has sections. The waste received in one day is stored in one section and it is stacked vertically in the pit. This vertical sacking i.e. piling of waste increases the density of waste and forces leachate to drain out of the waste. This leachate is taken to and treated in the Effluent treatment plant (ETP) to produce treated water which is then used as process water for power plant.

During storage, Enzymes containing bacteria are also sprayed into the stored waste to expedite decomposition of waste. These enzymes i.e. bacteria start aerobic reaction within the biodegradable waste in presence of oxygen. This is an exothermic reaction in which the bacteria breakdown the biodegradable to produce Methane (CH<sub>4</sub>) and heat. The heat produced increases the temperature of the waste mix to about 55 deg.C to 60 deg.C and this causes the inherent and leftover surface moisture in the waste to evaporate.

The primary combustion air for boiler is sucked continuously from the waste pit and due to this reason, the hot air containing methane and moisture is continuously sucked by the primary combustion air fan and is delivered to the boiler where methane gets combusted to produce heat and thereby steam. The continuous sucking of air from the waste mix continuously makes fresh oxygen available for keeping the exothermic aerobic reaction going on and the waste keeps on getting dry.

**After 5 to 6 days of this process going on in the waste pit, considerable amount of water is removed from the waste mix, which increases its net calorific value to 1650kcal/kg.**

### **Pre-processing – Please see the attached Process Flow Diagram (PFD) and Mass Balance Diagram (MBD) for 1180TPD unsegregated/mixed waste receipt:**

The unsegregated/mixed waste received is first weighed on the weighbridge and the quantity of waste received is recorded. Then this mixed waste is unloaded into the RCC waste pit and is stored there for 5 to 6 days.

Then this dried waste is loaded by grab crane into a feed hopper which in turn feeds the same into a Trommel with (-) 80mm sized holes. Trommel screens out (-) 80mm size organic food waste which is now dry and a belt conveyor takes this dry organic waste back to the waste pit.

The oversized inerts and paper, plastics, cardboard, clothes, leather etc which is collectively called RDF is discharged by trommel into another belt conveyor. This oversized inerts and RDF is then fed into a Ballistic separator, which segregates inerts and RDF. Inerts are taken to the landfill and RDF is taken to the waste pit.

Thus now dry and high NCV organic waste and RDF are now available in the waste pit. The waste grab crane operator now mixes the high NCV organic waste and RDF by lifting and dropping with crane grab and then feeds the high NCV processed waste into the boiler to produce steam. The steam in turn is expanded in the steam turbine to generate electric power.

### **Point 5iii – Details of design of Waste to Energy Power Plant which includes design parameters of boiler, turbine and generator:**

The details of WTE plant design are as follows.

**Grate type** – Reciprocating inclined grate (hydraulically operated). This is the most proven and widely used technology worldwide.

**Total Grate and Boiler processed waste firing capacity** – 1050TPD of processed waste.

**Number of lines** – Two - one line of 750TPD (processed waste) capable of generating 15MW and second of 300TPD (processed) capable of generating 6MW.



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### Boiler steam generation capacity –

Boiler no. 1 – Net 75 TPH going to turbine at 100% MCR (750TPD)

Boiler no. 2 – Net 28.5TPH going to turbine at 100% MCR (300TPD).

Total about 103.5TPH steam going to a common steam turbine of 21MW capacity at 100% MCR. Turbine performance parameters shall be finalized later after discussion with turbine vendor. We may go for a LP Heater to increase turbine cycle efficiency. ACC also shall be designed for 21MW output.

Generator of 21MW capacity shall be one number and coupled to the common steam turbine. The generator rating and its other performance parameters shall be confirmed later after the turbine power cycle is finalized with turbine vendor.

The calorific value of waste is not one and the only factor determining power generation possible from waste. The power plant process parameters, type of FGT technology, quality and method of waste pre-processing, Turbine power cycle configuration, Turbine specific steam consumption, Turbine exhaust pressure, ACC design parameters etc also play a major role.

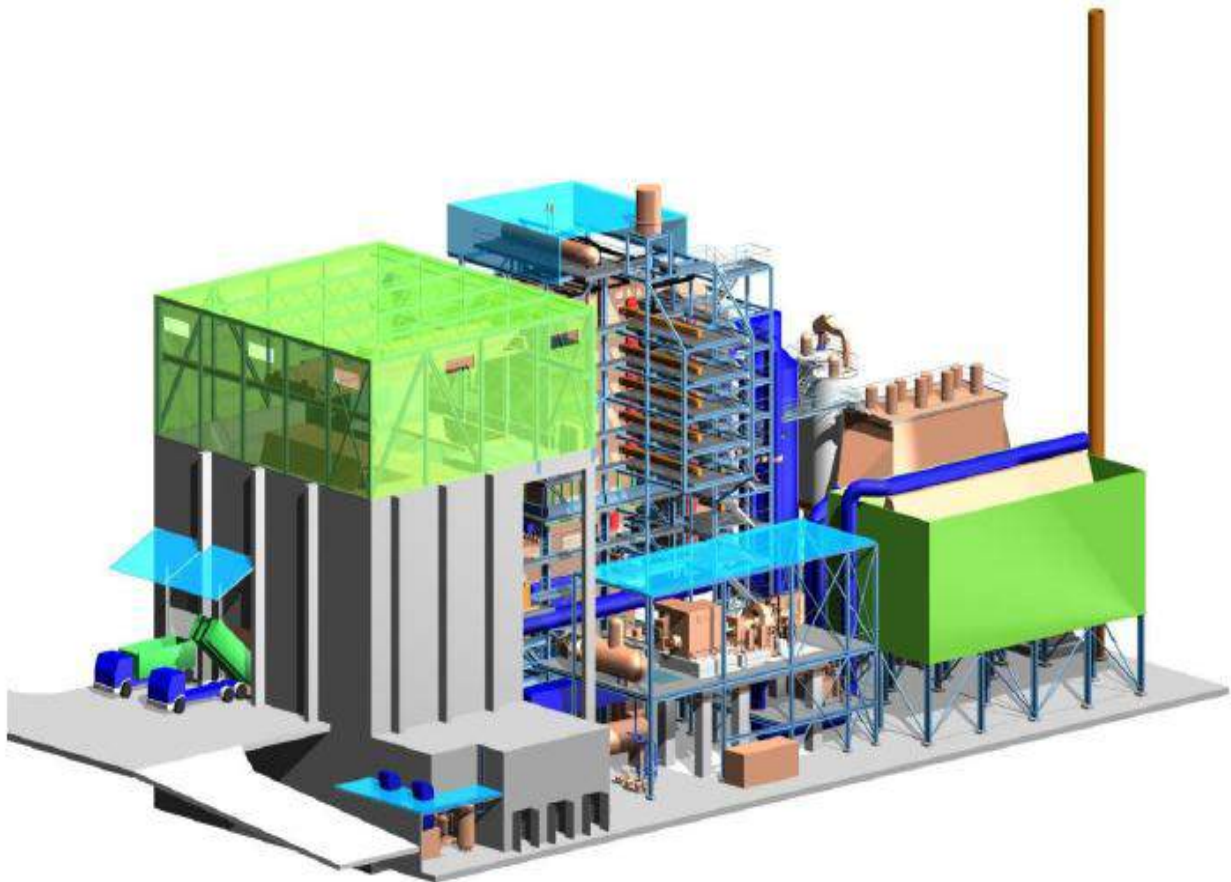
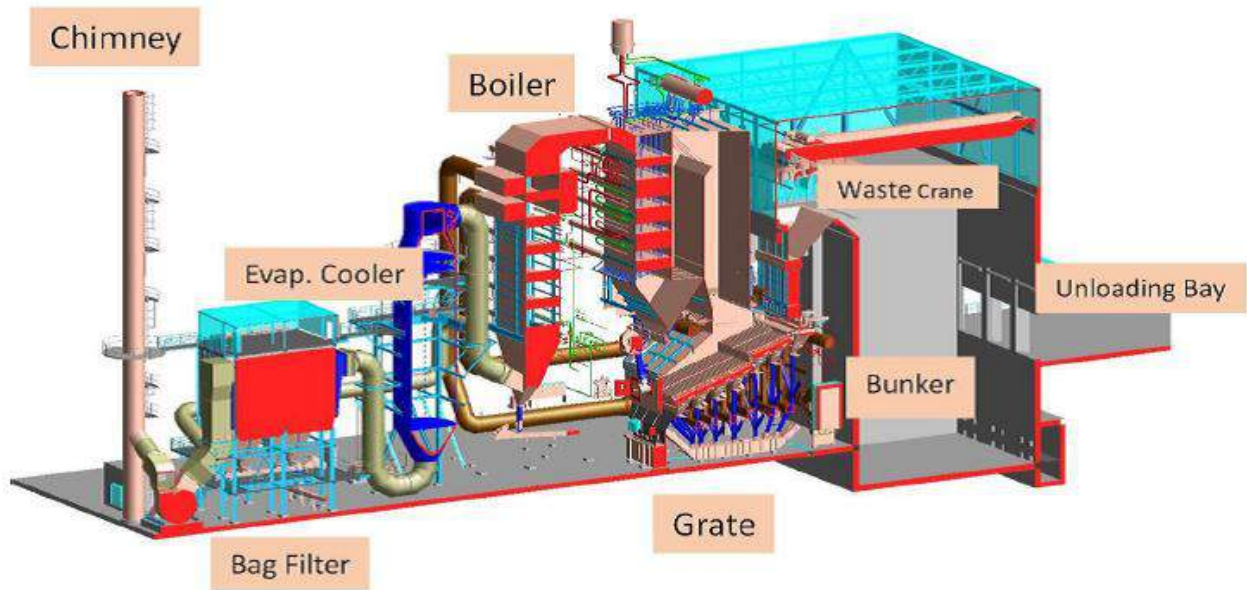
By burning the waste, a certain quantity of heat is released in the boiler furnace. How efficiently this heat is utilized and used to generate maximum amount of steam and how efficiently this steam is used in turbine to generate more power from the same is what determines the total gross power output. We have selected the best possible parameters, which distinguish our plant design from existing plants, and some of them are listed below.

Sr. no.	Description	Bhopal design	Existing plants Chinese design	Remarks
<b>A Boiler parameters</b>				
1	Steam pressure	46 bar (a)	44 bar (a)	Higher enthalpy for Bhopal
2	Steam temperature	410 deg.C	400 deg.C	Higher enthalpy for Bhopal
3	Boiler flue gas exit temperature	160 deg.C	190 deg.C	Higher steam generation
4	Secondary air temperature	220 deg.C	Ambient	More air pre-heating
5	Superheat temperature control range	60% to 100%	75% to 100%	Better part load performance
<b>B Steam Turbine &amp; power cycle</b>				
	Turbine specific steam consumption	4.7TPH/MW	5.0TPH/MW	More power generated from same steam flow
	Turbine exhaust pressure at 36 deg.C	0.135 bar (a)	0.15 to 0.18 bar (a)	More power generated from same steam flow
	One no. HP/LP heater	Considered	Not considered	Higher efficiency
<b>C Overall Power plant efficiency</b>				
		25%	22%	Better and efficient design

The 3D cut model of our boiler and complete WTE plant is as shown below.

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**Point 5iv – Detailed Project Report prepared by the Technical Consultant:** It is being submitted for your review.



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**Point 5v – Characteristics of leachate and its treatment method:** The water retention characteristics of MSW can be expressed in terms of a single parameter called **Field Capacity**. Field capacity is defined as the maximum moisture that is retained in the waste against the force of gravity in a porous waste matrix without producing downward percolation i.e. leachate. When the moisture content in waste exceeds its Field capacity, this excess moisture above the field capacity percolates out of the waste matrix as leachate.

Typical Field capacity values of MSW landfills reported in literature is as given in the table below.

*Table 4.2 Field capacity of MSW reported in the literature*

Reference	Reported field capacity v/v
Remson et al. (1968)	0.29
Straub and Lynch (1982)	0.30 - 0.40
Korfiatis et al. (1984)	0.20 - 0.30
Oweis et al (1990)	0.20 - 0.30
Zeiss and Major (1993)	0.12-0.14
Schroeder et al. (1994)	0.29
Yuen et al. (2001)	0.34

The variation above is due to differences in composition, density and porosity of stored waste. The above values are for landfill waste which is heavily compacted and exposed to rain, sun etc. Waste stored in waste pit is compacted, but not to the extent as landfill waste.

The Field capacity of un-compacted MSW is about 50%. The difference of 10% will percolate as leachate”.

In the physical analysis of waste given in the table above, the moisture content worked out was 349 tons for 1180TPD mixed waste received in plant. The 10% excess moisture above 40% compacted Field capacity i.e. 34.9TPD (10% of 349TPD moisture), will drain out as leachate.

**If we consider average 1500TPD of mixed waste for design, the leachate quantity drained out would be 45TPD i.e. 45m<sup>3</sup>/day (Total moisture 30% of 1500TPD i.e. 450TPD and leachate 10% of 450TPD i.e. 45TPD).**

**This will happen only in monsoon season when the waste is wet whereas in summer and winter season the moisture content of waste received is below the compacted Field capacity and practically no leachate will be generated in summer and winter seasons.**

Please see attached treated water test reports from our Jabalpur WTE plant.

The leachate drained out from the waste stored in the waste pit is collected in a tank from where it is pumped to the Effluent Treatment Plant (ETP) for further treatment. The quantity of leachate generated from MSW varies from season to season. It will be higher in rainy season and minimum in winter and summer.

The typical characteristics of leachate from waste pit is as follows.



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### Input characteristics

**Table 72: Leachate Characteristics<sup>26</sup>**

Parameter	UOM	Values
<b>Chemical Analysis</b>		
pH Value at 25 °C	-	6.82
Phenols	mg/L	0.8
Arsenic (as As)	mg/L	ND (<0.01)
Lead (as Pb)	mg/L	0.5
Cadmium (as Cd)	mg/L	0.03
Copper (as Cu)	mg/L	0.2
Mercury (as Hg)	mg/L	ND (<0.005)
Zinc (as Zn)	mg/L	0.7
Fluoride (as F)	mg/L	3
Ammonia (as NH <sub>3</sub> )	mg/L	546
Cyanide (as CN)	mg/L	ND (<0.01)
Oil & Grease	mg/L	227
Solids Dissolved (TDS)	mg/L	14075
BOD 3 days at 27°C	mg/L	13761

Parameter	UOM	Values
CCO (as O <sub>2</sub> )	mg/L	34402
*Cobalt (as Co)	mg/L	0.3
*Specific gravity	g/cm <sup>3</sup>	2.16
<b>General Parameters</b>		
Chromium Total (as Cr)	mg/L	0.7
Hexavalent Chromium (as Cr <sub>6+</sub> )	mg/L	ND (<0.01)
Nickel (as Ni)	mg/L	0.8
Nitrate (as N)	mg/L	95
Solids Suspended (TSS)	mg/L	1690
Odour		Objectionable
Total Kjeldahl Nitrogen (as N)	mg/L	2152
Ammonical Nitrogen (as N)	mg/L	1832

**Leachate Treatment scheme** – The leachate treatment includes reduction of BOD and COD. TSS is removed by settlement and sludge; BOD and COD is controlled by the treatment. The cakes are prepared from the sludge water. The sludge water is re-circulated to the channel and cakes are fed into the boiler for combustion. As the leachate generated during monsoon is more, the TDS will be low in monsoon and higher in other seasons.

The treated water is then used for gardening and for process cooling water for Bottom ash.

Since, the Bhopal WTE Plant is a zero discharge plant, all the waste water generated in the plant is treated and re-used for plant purposes.

The Process Flow Diagram of the Leachate/Effluent Treatment Plant is as shown below.

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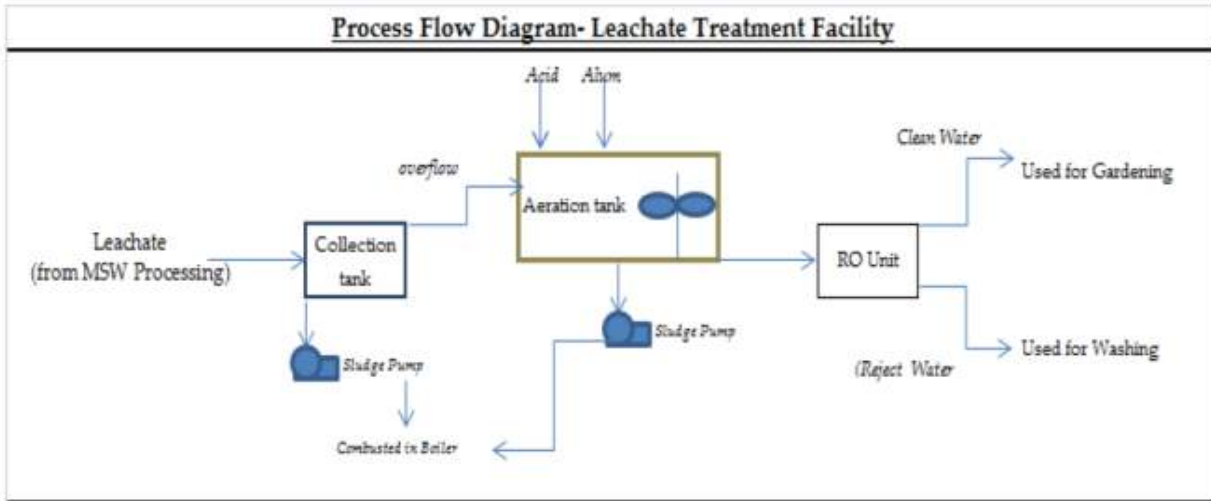


Figure 13: Process flow diagram of leachate treatment plant

The treated leachate for disposal shall meet the standards as prescribed in MSW Rules 2016.

Table 36: Standards for leachate disposal as per SWM Rule 2016

S. No.	Parameters	Inland Surface Water	Public Sewers	Land Disposal
1	Suspended solid (mg/l)	100	600	200
2	Dissolved solid (inorganic) (mg/l)	2,100	2,100	2,100
3	pH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
4	Ammonical Nitrogen (as N) (mg/l)	50	50	-
5	Total Kjeldal Nitrogen (mg/l)	100	-	-
6	Biochemical Oxygen Demand (BOD) 3 days @ 270C (mg/l)	30	350	100
7	Chemical Oxygen Demand (COD) mg/l	250	-	-
8	Arsenic (as As) mg/l	0.2	0.2	0.2
9	Mercury (as Mg) (mg/l)	0.01	0.01	-
10	Lead (as Pb) (mg/l)	0.1	1	-
11	Cadmium (as Cd) (mg/l)	2	1	-
12	Total Chromium (as Cr) (mg/l)	2	2	-
13	Copper (Cu) (mg/l)	3	3	-
14	Zinc (Zn) (mg/l)	5	15	-
15	Nickel (as Ni) (mg/l)	3	3	-
16	Cyanide (as CN) (mg/l)	0.2	2	0.2
17	Chloride (as Cl) (mg/l)	1,000	1,000	600
18	Fluoride (as F) (mg/l)	2	1.5	-
19	Phenolic Compounds(as C6H5OH) (mg/l)	1	5	-

**Point 5vi – Source of water requirement and permission for water withdrawal 50KLD during construction and 500KLD during operation phase:** For 50 KLD application is submitted to CGWA for NOC vide letter no. BPL MSW/CGWA/231018 dated 23.10.2018 for bore well permission.

For 500 KLD the primary source of water shall be from adjoining Ghodapachad dam BMC has provided assurance letter vide BMC/SWM/SBM/BPL/2018/6615 dated 3.11.2018 as enclosed

We would like to inform you that the Bhopal Municipal Authority already agreed to provide water as per Concession Agreement Article 6 -Authority Obligation clause no. 6.1 j where it has been mentioned that Water supply of ISWM (Integrated Solid Waste Management) facility be provided by authority (BMC).

Meanwhile Irrigation dept. has taken necessary action vide letter no 861/2018/820/Bhopal dated 29.9.2018 to supply water from Ghoda Pachhad dam and BMC also submitted formal application to irrigation dept. to supply water from Ghoda Pachhad dam vide letter no BMC /2018 /6581-6582 dated 18.10.2018. Copy of correspondence is enclosed.

**Point 5vii – Details and responsibility of transportation of the unsegregated Municipal Solid waste from source to the power plant site:** Our MSW collection operations in Bhopal city will start much before the



## BHOPAL MUNICIPAL SOLID WASTE PRIVATE LIMITED

Regd Office: 20<sup>th</sup> Floor, A Wing, Marathon Futurex, N. M Joshi Marg, Lower Parel, Mumbai-400013,  
Tel No: 022 71084444, Fax No. 71084500

commissioning of power plant and we will be transporting the same to power plant site. The Details of transportation of MSW is given in attached DPR.

### Other details –

Our consumption of Hydrated lime and Activated carbon for both the boilers together shall be as follows.

**Hydrated Lime** – 350kg/hr of minimum 92% purity.

**Activated Carbon** – 10kg/hr

**Inerts** removed during pre-processing shall be about 15% to 20% of the as received mixed waste and that shall be in the range of 177TPD (15% of 1180TPD total waste in 2018) to about 300TPD (20% of 1500TPD in 2031). This quantity will increase as the quantity of as received waste increases.

**Stack** height shall be 45m.

In addition, during detail design and engineering phase, we will be providing 10% additional margin over actual quantities.

Detailed specification of **Turbine and Generator** is attached separately. This is a typical specification for 300TPD plant.

### Part load operation philosophy of plant –

We maintain boiler exit gas temperature of 160 deg.C at all times and at all load conditions. At part loads, we have bypass part of the water going to economizer. The flue gas temperature at economizer inlet is less at part loads. If we allow 100% water to go to economizer, the boiler exit gas temperature can fall below 140 deg.C, which is the acid dew point temperature, where acids like dilute H<sub>2</sub>SO<sub>4</sub> and HCl can form and attack boiler and FGT components and cause failure. To avoid this problem, we bypass part of the water going to economizer and maintain 160 deg.C boiler exit temperature at all load conditions.

We hope above information are in line with your requirement, You are requested kindly issue the EC letter.

Thanking and assuring Authority of its best attention at all times.

Yours Faithfully

For **Bhopal MSW Pvt Ltd**

Authorised Signatory

**Copy: 1.** The Additional Principal Chief Conservator of Forests (C), Minister of Environment, Forest and Climate Change, Regional Office (WZ), E-5, Kendriya Parayavaran Bhawan, E-5 Arera Colony, Link Road-3, Ravishankar Nagar, Bhopal – 462016.

2. Shri Avinash Lavania Ji, Commissioner, Municipal Corporation, Bhopal

3. Guard File/Monitoring file

4. Website of MoEF&CC

### Enclosure:

1. Waste generation forecast
2. Detailed Project Report
3. CA water obligation extract
4. Water Assurance Letter from BMC
5. Correspondence with Irrigation department and BMC on water

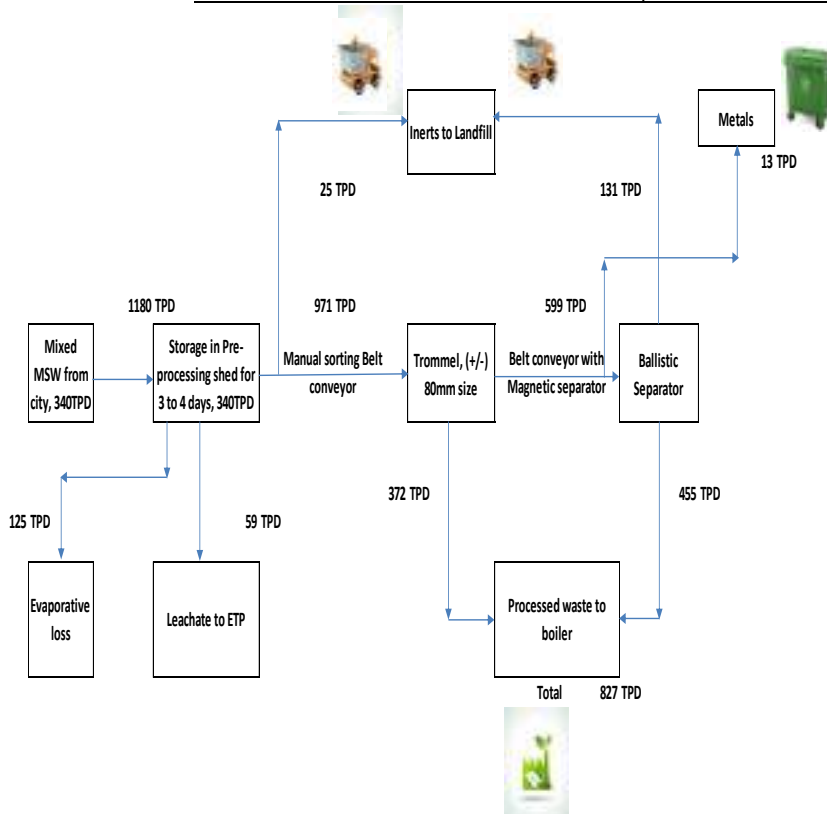


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U40100MH2016PTC287576

# BHOPAL MUNICIPAL SOLID WASTE PRIVATE LIMITED

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Tel No: 022 71084444, Fax No. 71084500

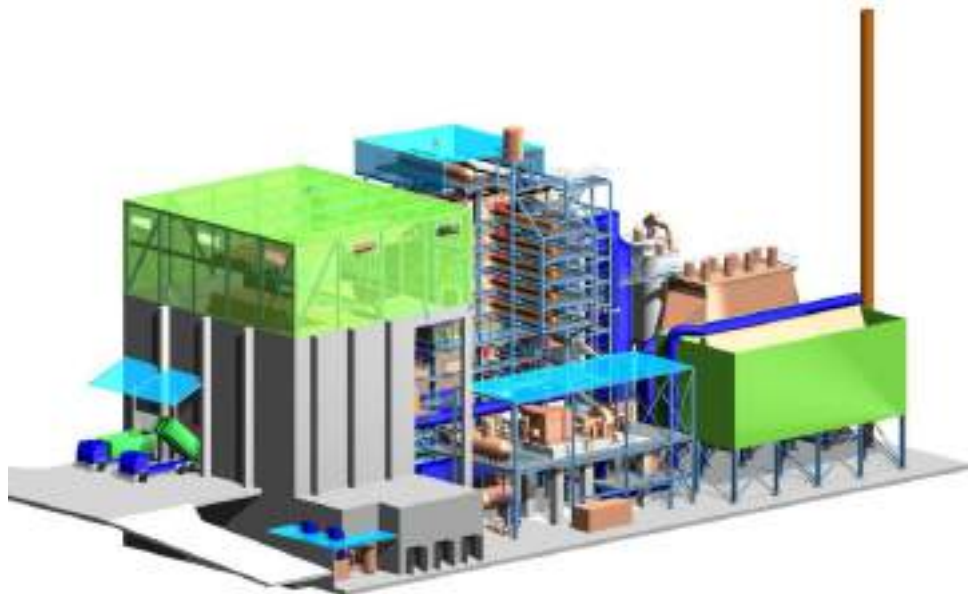
**PROCESS FLOW DIAGRAM FOR PRE-PROCESSING OF 1180 TPD MIXED/UNSEGREGATED WASTE FOR BHOPAL WTE PLANT**



Power Generation Calculation		
Quantity (Processed waste)	827	TPD
Calorific value	1650.00	kcal/kg
Overall Efficiency	24.00	%
Gross Power	16	MW
Auxiliary consumption	13%	
Auxiliary Consumption	2	MW
Export Power	14	MW

# **Annexure-I**

**Detail Project Report**  
**For**  
**PROPOSED 23 MW WASTE TO ENERGY POWER PLANT FOR BHOPAL, MP**



**PREPARED FOR**

**M/S Bhopal Municipal Solid Waste Private Limited**

Essel House, B-10, Essel House, Industrial Area, Lawrence Road,  
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**PREPARED BY**



**MITCON CONSULTANCY & ENGINEERING SERVICES LTD.**

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EME/SWM/BMSWPL /2016-17/116: R1 Date: 19/03/2017

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## CHAPTER NO. 1 INTRODUCTION

### 1.1. Background:

Municipal solid waste management is an important as it impacts health, Environment and aesthetic society if it is not managed properly. Hence to improve quality and standard of living, the Bhopal Municipal Corporation (BMC) has proposed to strengthen the covering collection, segregation, recycling, transportation, processing and disposal with option for composting, waste to energy, disposal in 8 Urban Local Bodies (ULBs) in Bhopal. The BMC intends to institutionalize a holistic Integrated, sustainable environment and eco-friendly Municipal Solid waste Management System in the urban local bodies (ULBs).

Rapid industrialization and population explosion in India has led to the migration of people from villages to cities, which generate thousands MT of municipal solid waste daily, which is one of the important contributors for environmental degradation at national level. Improper management of municipal solid waste (MSW) causes hazards to inhabitants.

Therefore, BMC has initiated the project that involves setting up an Integrated Solid Waste Management System (ISWM) for a cluster comprising of 8 ULBs within a radius of 80 km of Bhopal. The Bhopal cluster comprises of 8 ULBs from 3 districts namely Bhopal District (Bhopal and Berasia), Raisen District (Mandideep, Obaidullaganj) and Sehore District (Sehore, Ashta, Ichhawar, Kothri).

### 1.2. Problems associated with Solid Waste Management System:

With the 74th Constitutional Amendment specifying powers of ULBs and responsibilities of Local Self Govt. and PIL filed in Supreme Court of India in 1996 alleging GOI, State Governments, and Union Territories & ULBs failing to discharge obligatory duties regarding MSW management. In March 1999, Expert Committee set up by Supreme Court, submitted detailed recommendations for all Class I cities and various stakeholders for

implementation. Municipal Solid Waste Management and Handling Rules 2000 - 2016 also specifies solid waste management as an obligatory function of urban local bodies, but in actual practice the solid waste management is given the last priority and the duties are either not performed or poorly performed, the city has to face numerous problems related to environment and sanitation.

The major deficiencies associated with the system are:

- Rapidly urbanization, increase in population leads to increase in per capita waste generation rate.
- Inadequate resources like finance, absence of suitable trained staff.
- Inappropriate technology.
- Major portion of manpower is utilized in collection, so the cost of collection increases considerably.
- Social status of solid waste is low, therefore lack in participation of citizens in SWM services.
- Low efficiency of system because of unspecified norms of work, poor maintenance of vehicles, lack of co-ordination.

### 1.3. Status of Solid Waste Management:

Bhopal alone contributes to about 86% of the total MSW from all the other ULB collectively. The population of Bhopal as per Census 2011 was 1922130. As of 2016 the total population of the town is 2411972 therefore considering average 300gm/capita/day of solid waste for domestic & 2Kg/unit/day for commercial the total waste generation in year 2016 of Bhopal city & ULBs accounts to be 1000 TPD.

It should be noted that the waste generation rates calculated/assumed for the 8 ULBs includes waste from all the sources (residential, Commercial, institutional etc.).

Table 1.1: ULB wise waste generation at source (2016)

ULB	Wards	Population 2016	Total waste generation(TPD)
Bhopal	85	2411972	909
Mandideep	26	87676	17
Obaidullaganj	15	25286	8
Berasia	18	34370	10
Sehore	35	121453	32
Ichhawar	15	16539	4
Kothri	15	11988	4
Ashta	18	61286	16
<b>Total</b>			<b>1000</b>

#### 1.4. Present Project Details:

The proposed project area comprises Bhopal city & other 7 ULBs around the city. The Bhopal cluster comprises of 8 ULBs from 3 districts namely Bhopal District (Bhopal and Berasia), Raisen District (Mandideep, Obaidullaganj) and Sehore District (Sehore, Ashta, Ichhawar, Kothri). Bhopal is the major town among the Cluster of ULBS comprising of Sehore, Ashta, Kothri, Ichhawar, Berasia, Mandideep and Obaidullaganj. The existing solid waste management system of the region needs significant improvement. The region does not have any scientific methods of waste treatment and disposal.



### 1.5. Objectives:

The objective of the project is to prepare a holistic, integrated, sustainable, environment friendly and executable municipal solid waste management system and to meet the following requirements to implement the Solid Waste Management in the ULB's of Bhopal, MP.

- Analyze the quantity and types of Municipal solid waste generated per capita per day, in the ULB's for different sources and types of waste generated.
- Appraise the current mechanism for Primary and Secondary collection of solid waste, including details of physical infrastructure such as Waste bins, Collection points, Road length covered, number of sanitary workers employed and type of vehicles used, etc.
- Study the adequacy of existing infrastructure facilities for collection, transportation and disposal of solid waste and list and quantify the deficiency based on the various available normative standards.

- Appraise the daily collection at various stages, number of Shifts & trips made by Vehicles, Carrying capacity, distance travelled to transfer stations treatment and disposal site.
- Optimization of transport routes and location of transfer stations for cost effective transportation of waste. Existing tie up and arrangements of the Council, with Private operators, for collection, transportation, treatment and disposal of solid waste.
- Details of existing dumping yards/compost yard such as area, facilities available.
- Evaluation of solid waste management system I terms of cost per ton of waste, cost per capita & other operating parameters.
- Feasibility & Evaluation of the proposed landfill sites
- Suggestions for Institutional strengthening, staff requirement and training

#### 1.6. Scope of Work:

The project has two broad components i.e. physical infrastructure creating & efficient service delivery. However while designing the project scope adequate care has been taken so that the cost of service delivery without compromising the quality of service should be affordable.

The project entails provisioning of physical infrastructure components appended as follows:

#### **A. Equipment for Collection, Transportation & Disposal:**

1. Equipment for collection & transportation: This includes;
  - a. Movable bins of varying capacities,
  - b. Primary collection vehicles for all the ULBs – Rickshaw (Tricycles) with twin bins system, motorized 3 & 4 wheelers with GPS trackers
  - c. Secondary collection vehicles: Refuse compactors of various capacity (with GPS trackers) required for collecting the waste from primary collection vehicles/storage points & satellite segregation unit

- (MRFs) & transporting the waste to landfill site
- d. Other ancillary equipment required to support collection & transportation activities
  - e. Animal carcass carriers for the dead animals
2. Equipment for intermediate storage & disposal
    - a. Segregation units at processing plant
    - b. Loader, compactors, back hoe, weigh bridges etc. to support the functioning of activities at landfill site
  3. Waste processing unit: The processing unit, comprising of waste to energy unit, which will be developed by private operator/concessionaire to process the waste of 8 beneficiary towns of this project.
  4. Ancillary Equipment: These include, but not limited to safety equipment, uniforms for sanitary workers, stand by vehicles for collection, transportation & disposal activities.

## **B. Infrastructure to be created:**

### 1. Integrated Solid Waste Management facility (ISWM):

This involves the development of sanitary landfill site as well as the various support infrastructure required at landfill site. The landfill will comprise of central facility for the management & oversight of project functioning. Apart from sanitary landfill, the proposed ISWM facility will also have waste processing facility, weigh bridge, storage sheds, workshops, parking area for the transportation fleet, etc.

### 2. Satellite Units:

In order to reduce the transportation cost, a Satellite Segregation Station, is to be established near Sehore for selected ULBs, i.e. Sehore, Icchawar, Ashta&Kothri. The ISWM Facility at Adampur Chhawani which will act as intermediate storage cum segregation points.

## CHAPTER NO. 2 PROFILE OF ULBS-BHOPAL CITY

### 2.1. Introduction:

Bhopal is the capital of Indian state of Madhya Pradesh and administrative headquarters of the Bhopal District & Bhopal Division. Bhopal is known as City of Lake. It is the 17<sup>th</sup> largest city in the country and 131<sup>st</sup> in the world. The city is located in the central part of India within North Latitude of 23°16' & East Longitude 77°36'. The administration of Bhopal city is handled by Bhopal Municipal Council (BMC) & the area under BMC is 413 sqkm. The city is basically divided into two parts – old Bhopal & New Bhopal. Average population density of Bhopal city is around 6956 persons per sqkm, however the population in the city is not evenly distributed.

The major industries in the old city are electrical goods, medicinal, cotton, chemicals and jewelry. Other industries include cotton and flour milling, cloth weaving and painting, as well as making matches, sealing wax, and sporting equipment. The residents of Bhopal also engage in large retail businesses. Handicrafts, like zardozi and batua are some of the products of the Old City.

### 2.2. Historical Background of Bhopal City:

Bhopal was founded in 11th century by the Paramara king Bhoja, who ruled from his capital at Dhar. This theory states that Bhopal was originally known as Bhopal after a dam constructed by the king's minister. Bhopal became a princely state after signing a treaty with the British East India Company in 1818. Between 1819 and 1926, the state was ruled by four women, Begums unique in the royalty of those days under British suzerainty. Qudsia Begum was the first woman ruler, who was succeeded by her only daughter Sikandar Begum, who in turn was succeeded by her only daughter, Shahjehan Begum. Sultan Jahan Begum was the last woman ruler who, after 25 years of rule, abdicated in favor of her son, Hamidullah Khan. The rule of Begums gave the city its waterworks, railways, a postal system, and a municipality constituted in 1907.

Bhopal State was the second-largest Muslim-ruled princely state: the first being Hyderabad. After the independence of India in 1947, the last Nawab expressed his wish to retain Bhopal as a separate unit. Agitations against the Nawab broke out in December 1948, leading to the arrest of prominent leaders including Shankar Dayal Sharma. Later, the political detainees were released, and the Nawab signed the agreement for Bhopal's merger with the Union of India on 30 April 1949.[20] The Bhopal state was taken over by the Union Government of India on 1 June 1949.

### 2.3. Geographical conditions of Bhopal City:

Bhopal has an average elevation of 500 meters (1401 ft.). Bhopal is located in the central part of India, and is just north of the upper limit of the Vindhya mountain ranges. Located on the Malwa plateau, it is higher than the north Indian plains and the land rises towards the Vindhya Range to the south. The city has uneven elevation and has small hills within its boundaries. The prominent hills in Bhopal are Idgah hills and Shyamala hills in the northern region, Katara hills in southern region. City's geography has in it two lakes namely upper lake and lower lake.

#### 2.3.1 Climate

Bhopal has a humid subtropical climate, with cool, dry winters, a hot summer and a humid monsoon season. Summers start in late March and go on till mid-June, the average temperature being around 30 °C (86 °F), with the peak of summer in May, when the highs regularly exceed 40 °C (104 °F). The monsoon starts in late June and ends in late September. These months see about 40 inches (1020 mm) of precipitation, frequent thunderstorms and flooding. The average temperature is around 25 °C (77 °F) and the humidity is quite high. Temperatures rise again up to late October when winter starts, which lasts up to early March. Winters in Bhopal are cool, and not very much comfortable like summers, with average daily temperatures around 16 °C (61 °F) and little or no

rain. The winter peaks in January when temperatures may drop close to freezing on some nights. Lowest temperature ever recorded was 0.3C. Total annual rainfall is about 1146 mm (46 inches).

### 2.3.2 Humidity

Comparatively the humidity goes higher during the south-west monsoon period. Rest of the year the air seems to be dry. During the summer season the humidity goes down to less than 20%.

### 2.3.3 Geology and Soil

The top portions of the hillocks generally consist of hard red soil, mixed with basaltic boulders. Black cotton soil is seen at various depths from 1 to 3m. The soil in and around is alluvial land. The soil is conducive for agriculture & is appropriate for Rabi &Kharif crop harvesting.The geological formations underlying the Bhopal area – at the eastern edge of the Malwa Plateau – are largely red sandstone strata, with the depth of the rock varying according to the slopes.

### 2.4. Land use patterns:

In terms of land use, predominant use is residential and sizable undeveloped land is available in all these cities, which to a large extent, is responsible for increasing overhead cost of providing infrastructure. Bhopal has higher percentage of land under traffic i.e. 14.86 %.

Table no. 2.1 Land use Distribution in Bhopal

Particulars	Percentage (%)
Residential	46.80 %
Industrial	7.94 %
Commercial	3.71 %
Recreational	16.71%

Particulars	Percentage (%)
Transportation	14.86 %
Public & semi public	7.19%
Others	2.79%

## 2.5. Participating ULBs:

The project's geographical coverage is providing MSW Management services to a cluster comprising of 8 ULBs within a radius of 80 km of Bhopal. The Bhopal cluster comprises of 8 ULBs from 3 districts namely Bhopal District (Bhopal and Berasia), Raisen District (Mandideep, Obaidullaganj) and Sehore District (Sehore, Ashta, Ichhawar, Kothri).

Following are the ULBs which are considering in Solid waste management system-

Figure 2.1 maps of ULBS

### 1. Sehore:

Sehore is the headquarter town of the district which is 39km away from Bhopal. It is part of Bhopal division & is bound by the districts Rajgarh, Shajapur (NW), Guna (N), Bhopal, Raisen (NE) and Hoshangabad, Dewas (S). Sehore has been divided into five tehsils, ie. Sehore, Ashta, Ichhawar, Budni & nasrullaganj. The district is likewise composed of urban town's viz. Ashta (M), Budni (NP), Ichhawar (NP), Jawar (NP), Nasrullaganj (NP), Rehti (NP) & Sehore (M). The town has an area of 18.59sqkm & road length 73 km. Sehore is divided into 35 wards.



## 2. Ichhawar:

Ichhawar is located at 23.02 N & 77.02 E. It is at a distance of 19kms from District headquarter, Sehore & 60kms from Bhopal city. It is a tehsil headquarter in the Sehore District. The town has an area of 13.49sqkm & road length 10km. Ichhawar is divided into 15wards.



## 3. Mandideep

Mandideep is located at 23.5' North latitude & 77.31 East longitudes. Mandideep is 23km from Bhopal. It is a Nagar Palika Parishad in district of Raisen M.P. The town has an area of 12.88 sq. km & road length 18km. Mandideep is divided into 18 wards.



## 4. Ashta

Ashta is located at 23.02 N 76.72E. The town has an area of 15.38 sqkm & road length 47km. Ashta is divided into 18wards. Ashta is a Nagar Palika Parishad in a district of Sehore, M.P



## 5. Berasia

It is located at 23.43' North latitude & 77.26' East longitudes. Berasia is Municipal headquarter towns in Bhopal district of M.P. The town has an area of 16.58 sqkm & road length 41km. Berasia is divided into 18 wards



## 6. Kothri

It is located between the north latitude 22 31' to 23 40' and east longitude 76 22' to 78 08' in Sehore district of M.P. Kothri is located at a distance of 30kms from district headquarters, Sehore & 60 kms from Bhopal City. This town has an area of 29.43sqkm & road length 7km. Kothri is divided into 15 wards.



## 7. Obaidullaganj

Obaidullaganj is located at 23.1' N 77.35' east. The town has an area of 29sqkm & road length 52km. Obaidullaganj is divided into 15wards. It is a Nagar Parishad.



## 2.6. Population:

Bhopal city accounts for about 87% of the total project population out of other ULBs. The socio economics factor as per census 2011 of Bhopal city & ULBs is shown in below table

Table No. 2.2 Socio economics factors.

Name	Area (sq.km)	No. of wards	Households (2011)	Population (2011)	Sex ratio	Literacy rate (%)
Bhopal	413	85	382690	1922130	918	88.9
Sehore	15.1	35	20314	109118	918	70.06
Mandideep	12.88	26	14330	59564	842	83.76
Ashta	15.38	18	10006	51824	928	79.41
Berasia	16.58	15	6257	30951	905	76.57
Obaidullaganj	10.12	15	4391	22845	904	80.57
Ichhawar	13.49	15	2735	15221	913	76.77
Kothri	29.43	15	1952	10526	938	73.6

The Bhopal city has large no. of wards so they are distributed in Zones. There are total 19 zones considering 85 wards. As per the data received by BMC the total no. of households & commercial properties present in wards of Bhopal city of year 2016 are shown in below table.

Table no. 2.3 Population of Bhopal city & ULBs of 2016

Name	No. of wards	Zones	Residential Population
Bhopal	85	19	2411972
Sehore	35	-	121453
Mandideep	26	-	87676
Ashta	18	-	61286
Berasia	18	-	34370
Obaidullaganj	15	-	25286
Ichhawar	15	-	16539

Name	No. of wards	Zones	Residential Population
Kothri	15	-	11988

### 2.7. Slum Population:

According to City Development Plan, there are about 380 slums settlements. A large number of slums are on, or close to, nallah or riverbanks. Many slums have steep slopes, rock outcrops and high water table. The main location of slums in Bhopal is Rahul Nagar & Shanti Nagar. Out of other ULBs, Berasia, sehore & Ashta has slum population.

## CHAPTER NO. 3 ASSESSMENT OF EXISTING SOLID WASTE MANAGEMENT SYSTEM

### 3.1. Introduction:

The solid waste is heterogeneous & commingled. The trends seen are the proportion of putrescible organic matter is greater in low income countries than those of high income. The proportion of paper and plastic waste is more with increasing national income, which shows that waste density is a function of national income. Moisture content is also higher in low income countries. The factors influencing the waste quantities are income, population, social behavior, climate, industrial production, consumer behavior and high standard of living. Forecasting waste quantities in the future is as difficult as it is in predicting changes of waste composition.

### 3.2. Sources of Solid Waste:

Sources of Municipal Solid Waste (MSW) may be broadly classified as:

- Domestic Origin: Kitchen waste (left over/rejected food materials), human waste, paper, plastic, rags, metal, rubber, glass, cardboard, expired medicine, containers of medicine/disinfectants, etc.

- Street/Kerb side Waste: Street/ sweepings comprising dust, grit, dry leaves, papers, plastic, rubber, glass, cardboard, metal containers, carcass of animals and so on.
- Market Origin: Paper, plastics, cardboard, packaging materials, etc.
- Industrial Solid waste: Scrap metals, alloys, ores, glass, paper, plastic, chemicals and other industry specific items.
- Hospitals/Medical solid waste: Hospital wastes include used bandages, infected linen, Plaster of Paris, injection vials, medicine bottles and containers disinfectants, diseased organs etc. apart from common solid waste items (Paper, plastic and food materials etc.)
- Commercial Institutional Origin: Paper, plastic, cardboard, packaging materials, etc. from shops and offices, leftover food from hotel and miscellaneous items.
- Agricultural and Animal Waste; these also find their way into the urban area through the agricultural marketing complexes, dairy & poultry farms.
- Zoological & botanical gardens, etc.

### 3.3. Waste quantification details:

Waste quantification has been carried out for Bhopal city & other ULBs from the following sources:

- Residential /Individual houses
- Slums
- Market yards
- Road /Street sweepings
- Hotels & Restaurants
- Shops/Office/Institutions
- Hospitals/Nursing Homes/Pathological Laboratories
- Marriage/Function halls

- Construction waste

### Residential area:

The residential and commercial areas are major sources of generation of solid waste. In the following table, Per capita waste generation rates as per CPHEEO manual are identified.

Table no. 3.1 Per Capita waste generation rates by Population range

Population range (in million)	Average per capita value(kg/capita/day)
01 to 0.5	0.21
0.5 to 1.0	0.25
1.0 to 2.0	0.27
2.0 to 5.0	0.35
>5.0	0.50

Also following are the municipal waste generation rates: Residential waste : 0.3 to 0.6 kg/capita/day

Following table shows the no. of residential households present in the Bhopal city with the waste generation rate & calculation.

Table no.3.2 Waste generation from residential of Bhopal city

Wards	Zones	Waste generation residential (TPD)
85	19	740
	<b>TOTAL</b>	<b>740</b>

### Slums

There are more than 380 slums in the Bhopal city & other ULBs. The quality of life in each of the slums is appalling with low level of municipal facilities. In the slum areas door step waste collection is not possible, therefore, large size wheeled community dustbin is placed on the outer boundary of each slum.

## Market waste:

Next to household waste, one of the major contributors of municipal solid waste quantity is the market waste. There are total 147 markets in city. The waste generation factor for markets is considered to be 0.3kg/unit. Table below shows the waste generation from these markets-

Table no. 3.3 Waste generation from markets

S. No.	Zones	Wards	Total No. of markets	Waste generated per day(0.3 kg/unit)
1	19	85	147	44.1
Total waste generation in TPD				0.04

## Street sweepings and Drain cleaning

Daily sweeping of public roads, streets, lanes and by-lanes is a routine activity where there is habitation of commercial activity on one or both sides of the streets isolated pockets or roads. Street sweeping waste is mainly inert waste comprising of dust, sand and stones.

Street sweeping:

- High density roads-1 person per 300 -350m road length
- Medium density roads- 1 person per 500 m road length
- Low density roads- 1 person per 750-1000 m road length

## Hotels & restaurants

There are around 6177 hotels, star hotels, Bar and restaurants in Bhopal city& other ULBs. The waste generation factor for hotels and restaurants is 1.5/kg/day. All of them are storing their waste on site in plastic containers. Dry and wet waste may be stored separately. In case of restaurants, waste may be stored in smaller containers or plastic bags. The total waste generation from hotels & restaurants is 9.2 MT/day.

## **Hospitals/Health centers**

About 346 hospitals and nursing homes are present in different areas of Bhopal city & other ULBs. Two types of waste are generated from these establishments, one is municipal refuse & other is bio medical waste. About 0.1 MT of waste is generated by the Hospitals.

## **Construction waste**

Construction and demolition waste is generated whenever any construction/demolition activity takes place, such as, building roads, remodeling etc. It consists mostly of inert and non-biodegradable material such as concrete, plaster, metal, wood, plastics etc.

## **Marriage Halls:**

These are places where large quantity of waste is generated but only occasionally these are places where large quantity of waste. The Bhopal city & other ULBs has more than 70 bouquet halls. A quantity of about 0.01 MT of waste is generated.

## **Commercial Establishments (Shops, Offices, Institutions):**

The waste from the commercial establishments like shops and offices, whole sale and retail stores, Paint shops, Jeweler shops and general stores have been considered in this category. The numbers of shops are 39075, offices 2201 & schools are 832 respectively. Therefore the waste generation from this commercial establishment is 8.42 MT/day.

## **Temples & gardens:**

There are about 1014 religious places & 467 gardens in city. The waste generation is considered to be about 0.14 MT.

## Summary of Waste Generation

Following table gives the breakdown of waste generation & percentage of waste generated.

Table No. 3.4 Total Waste generation in Bhopal city.

S. No.	Type of waste	Waste generated(TPD)	% of waste generation
1	Domestic households	740	81.40
2	Commercial properties	98	10.78
3	Street sweeping	71	7.8
	<b>Total</b>	<b>909</b>	

### 3.4. Storage of Waste:

Storage of waste at the source is the first important step of solid waste management. Every household, shops establishments, market yards etc., generate solid waste on day-to to-day basis. The waste should normally be stored at the source of waste generation till collected for disposal. Generally it is observed that no bins for storage of waste at source are kept. As a result most of the waste from the domestic places, institutions and even from hospitals comes on to the street.

The situation in Bhopal city & ULBS is no different and more over with open drainage system it is observed that the surface drains are clogged with wastes especially plastic bags etc. The situation in slum areas is further worse, the drains filled with waste.

Following factors need to be considered for source segregation and various options available to implement the system.

### Individual Houses

Mixed waste is stored in various containers like plastic bins, cartons, plastic carry bags etc. by households. Source segregation is not in practice in city &

ULBs. Domestic waste will be collected by push carts followed by streets bins. In most of the wards door to door collection is in practice, some types of receptacles presently used for storage by households are Buckets, Plastic bags, plastic bins.

### **Slums**

The solid waste generated is stored in on the street/roadside or thrown in the surface drains or in the backyard of the house.

### **Street/road sweeping**

Street sweepings comprise of natural wastes, road traffic wastes, behavioral waste and silt from open drainages. The sweepers are allotted certain stretches of the roads. Two sweepers are located one side of the road; hence six (6) to Eight (8) sweepers are involved for each stretch of road.

### **Hotels & restaurants**

The Hotels & Restaurants are not having the facilities to store their waste onsite in large steel/plastic containers and dispose them accordingly. Proper segregation of dry and wet waste is not being met by the generator.

### **Markets yards**

The vegetable and fruit waste from Market need to store their waste in the bins. In addition to these there are small daily, by weekly and weekly markets in different residential areas of the town apart from the door to door fruit & vegetable vendors. These markets produce wastes, which are ideal for production of compost.

Figure No.3.1 Site photographs of existing storage condition



### 3.5. Existing Collection and Transportation system by BMC:

#### **1. Primary Collection System: Door to Door Collection**

Transportation of waste from secondary collection points at regular intervals is one of the essential jobs in MSW Management. Presently Door to-Door garbage collection is being carried out in all 85 wards of Bhopal city & areas of other ULBs. Bhopal city itself contributes to about 86 % of total MSW. The total 85 wards of Bhopal city are divided into total 19 zones & the other ULBs are considered 1 zone 1 ULB particularly. Waste bins of size 1.1 cum are provided in 85 wards & 4.5 cum are provided in 19 zones for waste collection. Detailed ward & zone wise are shown in below table.

Table no.3.5 Existing No. of bins provided in wards &amp; zones

Sr. No.	Zones.	Wards	1.1 cum bins	4.5 cum bins
1	1	1 to 5	77	11
2	2	6 to 8, 10, 21	0	0
3	3	9, 11 to 14	90	12
4	4	15 to 18, 20	65	19
5	5	19,22,23,24	75	26
6	6	25 to 28	0	0
7	7	30,31,32,46,51	60	53
8	8	33,34,35,42,47	0	0
9	9	43,45,48,49,50	0	0
10	10	36,37,38,71	36	12
11	11	39,40,41,70	38	11
12	12	44,58,59,69	59	42
13	13	52 to 55	42	12
14	14	56,57,60,61	0	18
15	15	62,63,64,66,67	62	16
16	16	65,68,72,73,74	0	0
17	17	75 to 79	220	15
18	18	29,80,82,83	33	0
19	19	81,84,85	49	0
<b>TOTAL</b>		<b>85 wards</b>	<b>906</b>	<b>247</b>

Figure No. 3.2 Solid waste bins 1.1 cum & 4.5 cum



## 2. Secondary waste Collection System

The collection and transportation of waste is practiced on all the days of the year including the public holidays by BMC & other ULBs. Waste stored in open spaces is either loaded manually or with the help of loaders in trucks. The vehicles involved in the solid waste transportation include tractor trolley, TATA Magic, Aappe, Dumper, refuge compactors, truck 407, & 709.

## 3. Transportation

There are total 220 vehicles transport the garbage from storage point to transfer station. & from transfer station to landfill site.

The total no. of vehicles engaged is as follows:

1.	TATA magic-	239 nos.
2.	Refuge compactors-	28 nos.
3.	Truck 709 –	06 nos
4.	Truck 407 –	16 nos.
5.	Tripper –	34 nos.
6.	Dumper -	41 nos.
7.	Tractor Trolley-	16 nos.

8.	JCB	19 nos.
9.	Skid Stear	7 nos
10.	Excavator	3 nos
11.	J S 200	2 nos
12.	J S 80	1 no
13.	Tata 410/31 Truck	1 no
14.	Road Sweeper	2 nos
15.	Loader	2 nos
16.	Buldozer	1 no
17.	Truck 1210	12 nos

(For details see annexure 17)

#### 4. Man power

There are total 2940 Workers are involved for door to door collection of waste. The zone & wards wise list of workers is shown below table. Also the detailed data of no. of workers engaged in door to door collection with their place or colony of work is attached as Annexure.

Table no. 3.6 No. of workers engaged in Door to door collection

Sr. No.	Zones.	Wards	No. of workers
1	1	1 to 5	150
2	2	6 to 8, 10, 21	180
3	3	9, 11 to 14	146
4	4	15 to 18, 20	138
5	5	19,22,23,24	84
6	6	25 to 28	126
7	7	30,31,32,46,51	228
8	8	33,34,35,42,47	86
9	9	43,45,48,49,50	306
10	10	36,37,38,71	270
11	11	39,40,41,70	108
12	12	44,58,59,69	106

Sr. No.	Zones.	Wards	No. of workers
13	13	52 to 55	262
14	14	56,57,60,61	186
15	15	62,63,64,66,67	128
16	16	65,68,72,73,74	42
17	17	75 to 79	92
18	18	29,80,82,83	256
19	19	81,84,85	46
<b>TOTAL</b>		<b>85 wards</b>	<b>2940</b>

### 3.6. Transfer stations:

The area of Bhopal city & other ULBs area large and the disposal site Bhanpura is far from the city & ULBs. The Bhopal city has greater area than other ULBs therefore there 12 transfer stations & the other ULBs have smaller area compared to Bhopal therefore the waste is transported from wards to direct dumping site.

The list of transfer station present in wards of Bhopal city is provided in below table.

Table no. 3.7 Transfer stations

Sr. No.	Ward No.	Transfer Place	Remark
01	01,02,03,04 and 05	Sehore Naka near Bairagarh Visarjan Ghat	Existing
02	09,11,12,13,14,15,16,17 and 18	DIG Bunglow near New Pul	Existing
03	24,25,26,27,28,29,31 and 32	Bhadbhada Square Savage Plant	Existing
04	45,48,49 and 50	Dana Pani	Existing
05	56,57,58,59,60 and 61	Near AIIMS	Existing
06	65,68,72,73,74,75,76,77,78 and 79	Bhanpur Khanti	Existing
07	80,81,82,83 and 84	Mahabadiya	Existing

Sr. No.	Ward No.	Transfer Place	Remark
08	06,07,08 and 10	Behind Bhoot Bangla, Near VIP Guest House	In progress
09	19,20,21,22,23,33,34,35,36,37,38 and 42	Yadgare-E-Shahjahani Park	In progress
10	30,46,47 and 51	Bhava Nagar, Shahpura	In progress
11	52,53,54,55 and 85	Laharpur	In progress
12	62,63,64,66 and 67	Prakash Nagar	In progress

### 3.7. Treatment & disposal of waste:

The collected waste from Households will be deposited into the bins located in respective wards. The sanitary workers lift waste from the bins, at a frequency of daily. The waste from the road side bins and street sweepings is collected regularly and transported to the transfer stations & then to the dumping site.

The waste generated from all the wards of Bhopal city is dumped at the site Bhanpura which is located approx. 12 km from the city having an area of 57.8 acres. This site is operating since 35 years. The existing waste disposal site where crude open dumping is practiced with no leachate collection and treatment system and does not meet the current requirements of MSW 2000 – 2016 rules. Open burning of waste, indiscriminate disposal, presence of stray animals & rag pickers at the disposal site and leachate migration into the subsurface are common occurrences.

Every day the Bhopal Municipal Corporation (BMC) dumps over 909 MT of solid waste at the Bhanpura village disposal site. The site has an electronic weighing bridge cum recorded room (capacity 30 MT) & a washing area for vehicles. Day to day record of waste entering the premises is maintained.

The existing landfill site, previously on the outskirts of the city, now lies within the developed areas of Bhopal. The site is surrounded by Agricultural fields & human settlements (<100m). Transportation vehicles entering the landfill site are generally found to be under loaded. Slaughtering of dead animals is also carried out at the site. Plastics, cloths and papers are scattered all around the site thereby spoiling the aesthetic appearance of the Bhanpur site has a bio-fertilizer plant of capacity 100 MT/day. This plant was set-up around 10 years ago by M/s. MP Agro Fertilizer Corporation Ltd. However this plant is not in operation due to some technical reasons.

A natural water stream runs adjoining to the existing dumping & was observed to be polluted with solid waste leachate & runoff from the dumpsite.

The waste disposal in unscientific manners causes various environmental impacts like:

- Contamination of ground water & soil
- Release of noxious gases into the atmosphere.
- Damage of agricultural fields which is downstream
- Pollutant exposure such as particulates, landfill gases, & odor & disease vectors due to rodents/birds.

National Green Tribunal ordered Bhopal Municipal Corporation (BMC) for scientific closure of the existing dump site at Bhanpura by compliance to MSW Rules 2000 - 2016.

Figure no. 3.3 Bhanpura dumpsite



The same condition is present in Other ULBs. Each ULB has their dumping site therefore the waste from the ULBs are directly transferred to the dumping site respectively.

In the below table the solid waste management system from collection to disposal of Bhopal city & ULBs for current year is summarized.

### Solid Waste Management Rules 2016

Table no. 3.8 summary of Solid waste management system of Bhopal &amp; ULBs of year 2016

ULB	Collection & Transportation	Segregation	Storage	Processing	Disposal
Bhopal	Primary Collection-DTDC service is going on in 85 wards. TATA magic-38 nos. Refuge compactors-80 nos. Truck 709 – 4 nos Truck 407 – 14 nos. Tripper – 3 nos. Dumper -43 nos. Auto Aappe- 31 nos. Tractor Trolley- 6 nos. Jeep- 1 nos. Total sanitary workers:2940	Segregated waste collection is going on in only 1 ward(ward 57)	1.1 cum bins-906 4.5 cum bins -247	No processing	Random dumping of waste in unscientific manner at 57.8 Acres land located at Bhanpur, 12 km from city boundary used as dumping ground since 35 years. Frequent waste burning observed at site. The new proposed site is Adampur Chhawani, 20 km along Raisen road.
Mandideep	Primary collection-DTDC in 18 wards- 7 magic tempos and 4 mini tractors. Collection twice a day (8 am & 3 pm) through 1 cargo, 2 auto tippers.	At source-No; At disposal point-no.	14 containers (4.5 Cum) secondary collection points	No processing	Unscientific, uncontrolled dumping at 10.78 acres of land (owner by Municipality). Used as dumping site since 20 years. Frequent waste burning observed at site.

ULB	Collection & Transportation	Segregation	Storage	Processing	Disposal
	Secondary C&T-3 tractor trolleys and 7 magic tempos (4.5 Cum). Total sanitary workers-118				
Obaidullaganj	Primary Collection-DTDC service is being carried out in all 15 wards using 1 tractor trolley and 1 Tata magic. Collection twice a day(8am & 3 pm) Secondary C&T-1 tractor trolleys. Sanitary workers-permanent 6 Daily wages-54	At source- No; At disposal point-no.	Total 100 bins	No processing	There is no land available for dumping site.
Berasia	Primary Collection-DTDC service is being carried out in 6 out of 18 wards Vehicles involved in primary collection-50 push carts. Secondary C&T-(1 tipper, 1 Tata magic & 1 tractor) Waste collection-twice a day at 7am & 2 pm	At source- No; At disposal point-no.	10 containers(1cum) & 30 containers(1.5 cum)	No processing	Landfill site allotted at Patalpurviran khasara No. 182 having area 8.63 hectares. It is located at 5 km from the center of ULB.

ULB	Collection & Transportation	Segregation	Storage	Processing	Disposal
Sehore	<p>Primary Collection-DTDC service is being carried out in 2 out of 35 wards</p> <p>Vehicles involved in primary collection-2</p> <p>Waste collection- twice a day at 8am &amp; 2 pm</p> <p>Sanitary workers-permanent 109</p> <p>Daily wages-219</p>	<p>Segregation of dry &amp; wet waste- No</p>	40 containers	No processing	Open dumping in unscientific manner on a 24 acres land located 8 km from the town.
Ichhawar	<p>Primary Collection-DTDC service is being carried out in 2 out of 15 wards using 2 Tata magic &amp; 25 pushcarts.</p> <p>Collection once a day (8am).</p> <p>Secondary C&amp;T-2 tractor trolleys.</p> <p>Sanitary workers-permanent 5</p> <p>Daily wages-44</p>	<p>At source- No;</p> <p>At disposal point-no.</p>	2 secondary bins	No processing	Landfill site is allotted but being used as a dumping ground since 8 years. It is located at 3 km from the center of ULB. Area is 2.5 acres
Kothri	<p>Primary Collection- no DTDC service</p> <p>Collection once a day (7am).</p>	<p>At source- No;</p> <p>At disposal point-no.</p>	15 secondary bins	No processing	Landfill site is allotted at ward no. 15 and Khasra No. 325. It is located at 3 km from the center of ULB.


ULB	Collection & Transportation	Segregation	Storage	Processing	Disposal
	Secondary C&T-2 tractor trolleys. Sanitary workers-permanent 1 Daily wages-18				
Ashta	Primary Collection-DTDC service is being carried out in all 18 wards Vehicles involved in primary collection-47 (36 push carts, 6 cycle rickshaws, 1 Tata magic & 3 tractor trolleys) Collection frequency-no data. Secondary C&T- no data. Sanitary workers- no data.	At source- No; At disposal point-no.	3 bin (1.1 cu m)	No processing	5 hectares of land is allotted at 8 km from the ULB



### 3.9. Observation and Deficiencies in the present system:



- There is no segregation takes place. All types of waste is in mixed form.
- The waste is dumped on site is without processing & unscientifically.
- At present, crude dumping of waste is taking place.
- Daily cover material is not spread on dumped waste. As such waste remains open to atmosphere.
- Internal roads do not exist at existing site for easy movement of transportation vehicles.
- There is no control over the dumping of inert, organic waste, electronic and ash of biomedical waste at the site.
- Apparently no studies have been carries out to determine the effect of the landfill operations on the environment and ground water. No environment impact assessment (EIA) study reports are available.
- Industrial waste and construction debris are being dumped unauthorized at the disposal site.
- Open trucks are used to transport waste to the landfill site. This causes dropping of garbage, contamination of soil, odor and nuisance problems along the transport route.
- The safety and environmental aspects as per the MSW Rules (M&H) 2000-2016 are neglected at the site.
- Basic facilities as per the requirement of MSW (Management & Handling) Rules, 2000 - 2016 are not available at existing dumping site.


The below table shows the deficiency analysis/compliance of MSW rules 2000-2016 in the MSW management system existing currently.

Table no. 3.9 Compliance of MSW Rules 2000 - 2016 in the existing SWM system of Bhopal & ULBs

Component	MSW Rules 2000 – 2016	Compliance	Photos
Generation	Prohibit littering on the streets, promote segregation of recyclable waste at source and ensure storage waste at source in two bins; one for biodegradable waste and another for recyclable material	The municipal corporation has already initiated educating the citizen to store the waste at source by offering the service of door to door collection of waste. Presently D2D garbage Collection is being carried out in all 85 wards of Bhopal city & but in ULBs is only active in some of the wards of ULBs. Total waste is collected in the bins. But still waste is found on road side.	
Segregation at source	Set up treatment facilities for biodegradable waste using composting or waste to energy technologies meeting the standards laid down in Schedule IV.	Corporation is encouraging the source segregation at door to door /primary collection. But still Segregation of waste at the source of generation absent.	

Component	MSW Rules 2000 - 2016	Compliance	Photos
<p>Primary collection</p>	<p>Organize primary collection of biodegradable and non-biodegradable waste from the doorsteps including slums areas at pre informed timings on a day to day basis using containerized vehicles.</p>	<p>Waste Bins of 1.1 cum sizes are provided in each ward &amp; 4.5 cum sized bins are provided in each zone &amp; in some wards. Each push cart is handled by 1-2 workers in particular area or colony. The path/colony has decided of each workers. Unhealthy and unhygienic waste disposal practices followed by disposal in to drains and open places.</p>	
<p>Secondary collection</p>	<p>Abolish open waste storage depots and make provision of covered containers or closed body waste storage depots.</p>	<p>Poor maintenance of collection points. Separate collection points for various streams of waste absent. Mixing of drain silt at this level Manual lifting and open transfer of the waste from the collection points leading to spilling of waste. Personal protection equipment's used by the workers clearing the waste absent.</p>	

Component	MSW Rules 2000 - 2016	Compliance	Photos
Street sweeping	Organize Street sweeping covering all the residential and commercial areas on all the days of the year irrespective of Sundays and public holidays.	Street sweeping is done daily.	
Transportation	Organize transportation of waste in covered vehicles on a day to day basis avoiding multiple and manual handling of waste.	Corporation is putting efforts to dispose the waste by using 220 transport vehicles the garbage from storage point to transfer station and to dumping site. There are 12 transfer station. Vehicles transfer the waste from transfer station to Bhanpura site. But the vehicles are not covered which are highly unhygienic	
Community participation		Community participation is absent except very small initiative at one or two places	

Component	MSW Rules 2000 - 2016	Compliance	Photos
Public awareness		No significant educational programs, campaigns, NGO activities for public awareness on solid waste management, significance of recycling, reuse and segregation of MSW.	
Disposal	Minimize the waste going to the landfill and dispose of only rejects from the treatment plants and inert material at the engineered landfills.	Scientific waste processing practices as per MSW 2000 - 2016 rules absent. No scientific disposal. Unmanaged landfill site. The waste is disposed on Bhanpura site of Bhopal. & Other ULBs has disposal site separately which dumps the waste.	

## CHAPTER NO.4 WASTE QUANTIFICATION AND CHARACTERIZATION

### 4.1. Introduction:

Quantification of municipal waste generated was carried out separately for different sources of generation such as residential, commercial, institutional, street sweeping and drain cleaning, markets, slaughter houses, function halls, cinema halls, etc. Waste composition, characteristics and quantities of solid waste is essential for:

- It provides the basic data on which the management system is planned, designed and operated.
- The changes/trend in composition and quantity of waste over a period of time are known which help in future planning.
- It provides the information for the selection of equipment and appropriate technology.
- It indicates the amount and type of material suitable for processing, recovery and recycling.
- The forecast trends assist designers and manufacturers in the production of vehicles and equipment suitable for the future needs.
- The waste generation rates have been worked out on the basis of field surveys, waste sampling and discussion with the different waste generators.

### 4.2 Waste characterization & quantification

#### **4.2.1 Sources of waste generation:**

A waste characterization study for BMC & other ULBs was carried out on 11 to 12 March, 2017. To analyze the physical characteristics of waste samples. The sources of waste generation from BMC& ULBs are as follows-

- Residential/Individual houses
- Slums

- Market yards
- Road/street sweeping
- Hotels& restaurants
- Shops/offices/institutions
- Hospitals/nursing homes/pathological laboratories
- Marriage halls
- Construction waste

#### **4.2.2 Methodology of waste quantification & characterization:**

Information on the nature of wastes, its composition, physical and chemical characteristics and the quantities generated are basic requirements for devising solid waste management plans. For the purpose of solid waste management, it is important to look into the properties of the waste material apart from their origin. Accordingly, they may be classified as:

- **Biodegradable:** Organic materials, which can be degraded by biological agents, e.g., microbes are known as biodegradable. Examples are food material, fruit and vegetable waste, garden waste (plant waste) etc.
- **Recyclables:** Plastic, Paper, metal
- **Combustibles:** Relatively dry material having a high calorific value, such as paper, plastic, rags, cardboard, etc. are known as combustibles.
- **Hazardous;** certain items which are hazardous for human or animal health and detrimental for the environmental either due to their chemical or pathogenic nature are classified as hazardous waste e.g., hospital waste, certain industrial etc.
- **Inert;** Dust, cinder, grit and other debris are known as inerts.

During the collection of municipal solid waste samples the major collection sites are identified which are covering a larger size of population. Based on the type of area such as residential, commercial, industrial, market, slum etc.

sampling points are distributed uniformly all over the study area. There are 7 sampling points are considered which are listed as follows:

1. AIIMS Zone
2. Kolar road
3. DIG Bungalow
4. Bhanpura Kunti
5. Sehore road-Beraghat
6. Badbada
7. Danapani

#### 4.3 Study results

Study was conducted by MITCON team & BMC's staff in the Bhopal city during the March, 2017 with the objective of estimation of per capita waste generation rate in the city. Reason for choosing only Bhopal as the study area for quantification is the fact that Bhopal alone contributes to about 86% of the total MSW from all the other ULBs collectively.

The quantity of waste generation is estimated and considered by using the following in the city.

- Secondary sources
- Primary survey results

#### **Secondary data collection:**

As per municipal records quantity of waste generation in Bhopal & other ULBs about 1000 MT/day. The sources of waste contributing to the total tonnage are given in the following:

#### **Primary survey Procedure:**

The methodology used for calculating the per capita waste quantification for Residential, Commercial and street sweeping at below.

Following method has been adapted-

1. Take nearly 100 kg sample for analysis.
2. Spread on a clean plastic sheet.
3. Mix it thoroughly
4. Divide the sample in 4 parts.
5. Select two parts opposite to each other and discard it. And balance two sample (quarters) are considered for further quartering process.
6. Once again (2nd time) divide sample in 4 equal parts and again discard two sample opposite to each other and balance sample opposite to each other (nearly 25 Kg ) will be representative of initial 100 Kg sample.
7. Now balance 25 Kg sample will be segregated in following item wise and weighted separately

There are total 7 sampling stations were considered.

Sample Point 1: AIMS zone:

The site photograph of primary survey carried out in AIMS Zone are as follows-

Figure No. 4.1 site photographs of sampling at AIMS zone





Waste composition details of sampling point 1 AIIMS zone:

Table no.4.1 Physical composition in AIIMS zone

Sr. No.	Particulars	Average (%)
1	Plastic	12.65
2	Paper	11.97
3	Wood	0.83
4	Cotton	0.23
5	Rubber	0.08
6	Leather	1.88
7	Organic	57.83
8	Metal	0.68
9	Glass	1.66
10	E-waste	0.98
11	Inert	11.22
	<b>TOTAL</b>	<b>100 %</b>

By the survey the detailed waste composition carried at 7 locations is given in following table.

Table no. 4.2 Summary of Physical composition of waste

Date of Sampling	11-03-17	11-03-17	12-03-17	12-03-17	12-03-17	12-03-17	12-03-17		
Name of Sample Collection Points	AIMS Zone (%)	Kolar Road (%)	DIG-Bungalow (%)	Bhanpura Kunti (%)	Sehore Road-Beraghat (%)	Badbada (%)	Danapani (%)	Average (%)	
Plastic	12.65	11.35	14.88	14.31	9.39	12.09	15.14	12.83	84.94
Paper	11.97	6.46	7.31	5.62	5.44	7.28	4.49	6.94	
Wood	0.83	2.45	2.30	0.93	1.11	1.79	2.55	1.71	
Cotton	0.23	1.36	6.04	17.49	7.23	7.84	3.08	6.18	
Rubber	0.08	0.07	1.70	0.67	1.49	0.00	7.04	1.58	
Leather	1.88	0.00	1.79	1.09	1.93	1.12	1.67	1.35	
Organic	57.83	67.10	51.79	47.91	55.59	53.42	46.83	54.35	15.06
Metal	0.68	0.00	1.87	0.74	0.77	1.23	2.38	1.10	
Glass	1.66	1.70	0.77	1.35	4.34	1.68	3.35	2.12	
E-waste	0.98	0.95	0.85	0.61	0.43	1.01	1.06	0.84	
Inert	11.22	8.57	10.71	9.27	12.28	12.54	12.41	11.00	
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

#### 4.4 Collection efficiency

The necessary details were collected and the waste quantity reaching the dumpsite is found to be about 900 TPD which translate to about 0.41 to 0.6 kg/capita/day.

#### 4.5 Future Generation Trends

The Waste generation is directly proportional to the population. Therefore, population of all 8 ULBs have been projected up to the year 2035. The projected population & the projected waste generation up to the year 2035 have been given in table below.

Table no. 4.3 Waste generation forecast from the project area by decadal method.

Name of ULB	Population 2016	Waste Generation (TPD)	Population 2021	Waste Generation (TPD)	Population 2025	Waste Generation (TPD)	Population 2035	Waste Generation (TPD)
Bhopal	2411972	909	2908063	926.17	3294263	1044.99	3579821	1133.74
Sehore	87676	17	146344	51.22	164864	57.70	180055	63.02
Mandideep	25286	8	87738	30.71	99918	34.97	108173	37.86
Ashta	34370	10	81081	28.38	96581	33.80	110688	38.74
Berasia	121453	32	40675	14.24	45005	15.75	48043	16.82
Obaidullaganj	16539	4	30097	10.53	33653	11.78	36530	12.79
Ichhawar	11988	4	18992	6.65	20697	7.24	21916	7.67
Kothri	61286	16	14570	5.23	17185	6.01	19094	6.68
<b>Total</b>	<b>2770570</b>	<b>1000</b>	<b>3066076</b>	<b>1073.13</b>	<b>3463599</b>	<b>1212.26</b>	<b>3763750</b>	<b>1317.31</b>

## CHAPTER NO.5 COLLECTION AND TRANSPORTATION PLAN

### 5.1 Basis of Design of Proposed SWM Plan

Municipal Corporations are urban government bodies which are also referred as Third level of government that works for the development of a city providing necessary community services like health care, educational institutions, housing, transport etc. The Municipalities provide these services by collecting several taxes and utility charges from its citizens and the grants from the government.

The proposed project area comprises Bhopal city & other 7 ULBs around the city. The Bhopal cluster comprises of 8 ULBs from 3 districts namely Bhopal District (Bhopal and Berasia), Raisen District (Mandideep, Obaidullaganj) and Sehore District (Sehore, Ashta, Ichhawar, Kothri). Bhopal is the major town among the Cluster of ULBS comprising of Sehore, Ashta, Kothri, Ichhawar, Berasia, Mandideep and Obaidullaganj. Bhopal Municipal Corporation is having a population of approx. 1938251 as per 2011 census. The estimated number of house-holds and comm. establishment within the Municipal area is 542348 approx.

The aim of the survey is quantification of household and commercial establishments ward wise for Bhopal city under Bhopal Municipal Corporation (BMC).

#### 5.1.1 Survey Objectives

The objective of the household survey were

- a. Identify the wards and households
- b. Identify commercial establishments

- c. Identify adequate tagging location and land marks for placing waste collection carts
- d. Establish a collection and transportation map for the wards

### **5.1.2 Survey Methodology**

A comprehensive primary data collection supported by secondary data collection was undertaken by the study team

The team carried out ward wise household survey on foot and on motorbike for collecting the following data Grid wise. The Satellite image of Bhopal is divided into 450 grid of 1Km By 1 Km. There are multiple “tagging points” under each beat. Tagging points are area points/ land marks where waste carts shall be stationed for collection of waste for certain number of households and commercial establishments.

Data was collected for 85 wards under Bhopal Municipal Corporation. The information collected by surveyors is as follows:

1. Grid No.
2. Start destination to end destination
3. Number of household
4. Tagging Location Name/ Land mark
5. Number of Apartments
6. Number of Flats in Apartments
7. Number of Shops
8. Number of malls
9. Number of Hotels/Banquet/Halls/Restaurants
10. Number of religious establishments
11. Number of nursing homes/ hospitals
12. Schools and Banks

Tagging was undertaken for enabling geo-tagging of the landmarks for a robust and diligent monitoring of work during collection and transportation of waste from respective areas.

The survey was carried out by a team of 40 surveyors and 3 supervisors for a period of 15 days in Feb 2017

### **5.1.3. Survey Outcomes**

The survey results were compiled ward wise in a tabulated form for bringing out the number of households and commercial establishments. The numbers of malls and hotels along with banquet halls have been clubbed together as they witness dynamic footfall and occupancy.

As per conducted survey, there are 493194 household spread under Bhopal Municipal Corporation with total comm. establishment of 49154 including institutional and religious places.

## **5.2 Proposed MSW Management Plan**

### **5.2.1 Primary Waste Collection System and operational plan**

**Collection of waste: Door to door collection of waste from all the 85 wards under BMC areas'**

The door to door collection to include all government office complexes, non-government office complex, authorized colonies, unauthorized regularized colonies, all market commercial/ institutional places, slums and even from undesignated points by means of deployment of suitable vehicles. This shall also include by-lanes, lanes and streets. The bidder shall be responsible for collection of waste from road side litterbins, horticulture waste etc.

The wastes generated from household and commercial establishment shall be brought under systematic intervention for high efficiency at ground level. The Solid Waste Management function involves monitoring and management of the

activities of Door-to-Door Collection of Municipal Solid Waste, Dead Animal, Street sweeping, Cleaning of open drains, Transporting of Waste, Scientific Treatment & Disposal of MSW, Maintenance of Waste Collection vehicles and other utilities such as Public toilets/complexes, etc., The process also involves keeping track of the amount of waste treated /disposed at the Processing/Disposal site as the case may be. **However, Street sweeping/cleaning of open drains and maintenance of public toilets/complexes are not a part of scope for this contract.**

The collection shall commence early morning as per the designed plan at street level for different wards. The entire operation shall be monitored at ground level through adequate technological resources.

### **Methodology for Primary Collection**

The collection methodology has been divided into primary and secondary operations. Primary operations shall be covered utilizing vehicles for door to door collection. The methodology for primary operations shall be as under. All the collection and transportation of waste shall be monitored with the help of tracking devices which would have networking with a control room specially built for the purpose. The control room shall be equipped with state of the art IT infrastructure for time and resource management.

Time of primary operations shall be from 6 AM in the morning till 2 PM in the afternoon. Some special and commercial collection shall be completed from 9 PM to 6 AM as and when desired.

Tata Mega/Supro vehicles have been desired to cover 1300 households and Rickshaw has been desired to cover 300 households in Bhopal.

Tata Mega/Supro vehicles have been desired to cover 1200 households and Rickshaw has been desired to cover 300 households in Other ULB's.

Door to Door collection shall be completed using Tata Ace fitted with 2.5 cu.m (1.0 ton) fabricated tipper and Rickshaw fitted with 8 bucket of 40 lt. each (0.3 ton)

Commercial wastes shall be catered by Tata Ace/Supro vehicles. A separated fleet of Tata Ace/supro vehicles shall be procured for covering commercial wastes and for roadside littering.

**90% of Household wastes shall be covered by Tata mega/Supro vehicles and 10% shall be covered by Rickshaw, which shall be deployed in inner lanes and roads in Bhopal. However we shall allocate different % for Rickshaw ward wise based on actual demand.80% of households wastes shall be covered by Tata ace/Supro and 20% of households will be covered by Rickshaw in other ULB's.**

Smaller lanes, by lanes where movement of vehicles are not possible due to insufficient width, shall be served by manual collection through rickshaws.

There will be Time Place Management (TPM) points between 15-20 houses in each route. All the TPM points would be mapped/geo fenced in order to do the real time tracking. Each vehicle would have one driver and one helper and rickshaw have one helper

Vehicles shall be parked at the concerned Mini transfer station (MTS) and fitted with GPS and Hotter on every vehicle. A Time Place Management (TPM) shall be designed and maintained for timely collection. There would be systems in place for ensuring that the vehicles shall adhere to the time factor.

All the vehicles will have a fixed route on which they have to adhere for collection of wastes. Route of each vehicle will be mapped. Any deviation of vehicle would be tracked by control room and alert will be beeped in control room.

The waste so collected by primary vehicles shall dispose the wastes at their respective ward concerned transfer station in Bhopal and Sehore however in other ULB's waste collected through primary vehicle will dispose in refuse compactor. For ensuring that maximum collection efficiency is achieved, each primary vehicle would make 2-3 trips daily.

The waste collected in rickshaw will be transferred to 1.1 steel bin/3.5 cum steel bin or in running tipper.

### **5.2.2. Secondary Waste Storage System (Mini Transfer Station) and operational plan**

#### **Methodology of Secondary Collection**

The collected primary garbage through primary vehicles would be transferred at the concerned Mini Transfer stations. There would be Mini transfer stations with parking station as shown in table no. 10.3.

Average 3 compactors (capacity 16 cu.m) would be placed in each Mini transfer station. Total number of compactors placed in all Mini transfer station would be 69. Hook loader would be mounted on Tata 2516/Ashok Leyland 2518 vehicle.

Approximately 341 unit of 1.1 m<sup>3</sup>, 57 unit of 3.5 m<sup>3</sup> and will be placed at different places and waste collected through these bins will be transported to dumping site with help of 19 units of refused compactor of 14 m<sup>3</sup> capacity and 4 units of tipper and 2 JCB have been taken into provision for road side secondary points.

The Road Side littering bins of capacity of 50 Lt each will be places at road side, commercial places and it will be vacated on daily basis through Tata Ace mega/Supro Mahindra with 2.5 Tipper.

For Dead Animal provision of 13 Animal carcass have been taken for entire project area.

The secondary operation would start from 2 PM to 10 AM. Each Prime mover (Hook Loader) will make 3 trips in a day. The prime movers shall have one driver and one helper. All the Prime movers would be equipped with GPRS machine. Route of all the prime movers would be fixed and they have to adhere the same. In case of any deviation alert will beeped in the control room.

Prime mover will lift the compactors and transfer it to the dumping site after getting it weighed.

The Mini transfer station shall be provided with adequate drainage system. There would be drainage system (if main drainage available) at every Mini transfer station. These shall also have proper lighting facilities as well as water connection for cleaning the area. The Mini transfer stations shall also be provided with round the clock security. The Mini transfer station shall be provided with leachate tanks for collection of leachate. Leachate tank would emptied, as when getting filled, thru tankers. It would go to processing plant for further treatment.

The Mini transfer stations shall be developed and constructed in accordance with the construction requirements at the sites for mini transfer stations and are the points where MSW shall be received by the concessionaire for further transportation to the Processing Facility

*Table No:5.1 List of Transfer Station along with Area required and wards to be served.*

<b>Zone No</b>	<b>Location</b>	<b>Ward No. served</b>	<b>Area Required</b>
1	Sant Hridayasnagar	1 to 5	1 Acre
2	Land has to be identified	6,7,8,10,21	1 Acre
3	Near DIG Bangla	9,11,12,13,14	2 Acre
4		15,16,17,18,20	

Zone No	Location	Ward No. served	Area Required
5	This will be club with Zone 8	19,22,23,24	Nil
6	Near IIFM,Nehrunagar	25,26,27,28	1 Acre
7	In Smart City Area, green belt region in plot no 24	30,31,32,46,51	1 Acre
8	Near Yadgar e Shahjahani Park	33,34,35,42,47	2 Acre
9	Near Danapani	43,45,48,49,50	1 Acre
10	Land has to be identified	36,37,38,71	1 Acre
11	Near Shelter Home in zone no 9	39,40,41,70	1 Acre
12		44,58,59,69	1 Acre
13	Near Laharpur Dam	52,53,54,55	1 Acre
14	Land to be identified, Abadpur site to be checked	56,57,60,61	1 Acre
15	Prakash Nagar(Near Ratnagiri Tiraha)	62,63,64,66,67	1 Acre
16	BhanpurKhanti	65,68,72,73,74	1 Acre
17	Bhanpur khanti	75,76,77,78,79	1 Acre
18	Kolar	29,80,82,83	1 Acre
19	out of three ward 1.5 ward area will be covered by zone no 18 and another 1.5 wards will be covered by zone no 13.	81,84,85	Nil
ULB	Sehore	1 to 35 of Sehore	4 Acre

(Please find some pictures in annexure 14)

Figure No. 5.1 Location of 19 mini Transfer Station

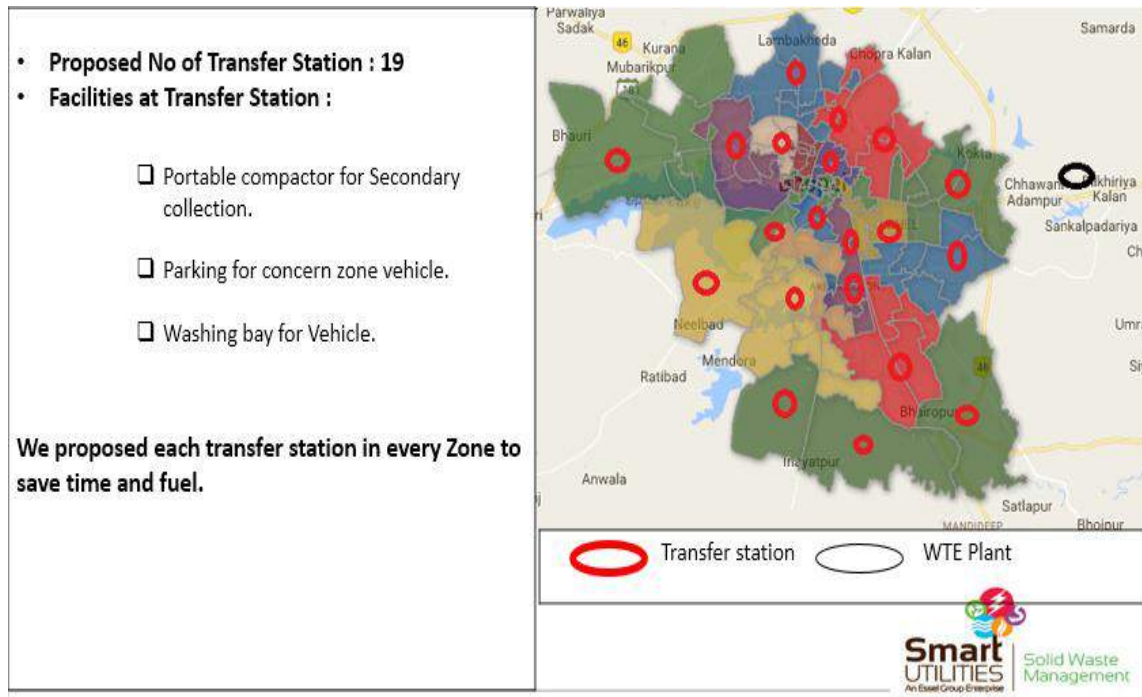


Figure No. 5.2 Photograph of actual site Vs Proposed View



### 5.2.3. Proposed Transportation system from Mini Transfer Station to ISWM Site

The waste so collected shall be transported with the assistance of a dedicated fleet of vehicles which shall be deployed by the company so that maximum efficiency is achieved in the least possible time. This is necessary for a forward linkage to the Dumping site so that the waste collected shall be first transferred to the designated transfer point provided for wards and then for an onward journey to the Dumping site.

Transportation of Waste:

- Collected waste shall be transferred to the closed body stationery compactor at the Mini Transfer stations by tip kart mechanism.
- MSW shall be either managed in existing Bhanpura dumpsite or a piece of land in the proposed Aadampur landfill site can be used to store the waste temporally.
- All the vehicles engaged in this project are provided with OSRT (off site Real Monitoring System) and GPS facilities.

### 5.3. Summary of Collection and Transportation Infrastructure

The collection and transportation infrastructure include all necessary equipment and vehicles for collection of municipal solid waste from respective wards and scientifically processing them at the transfers stations before being transported to the Dumping site.

Table No: 5.2: Infrastructure Details

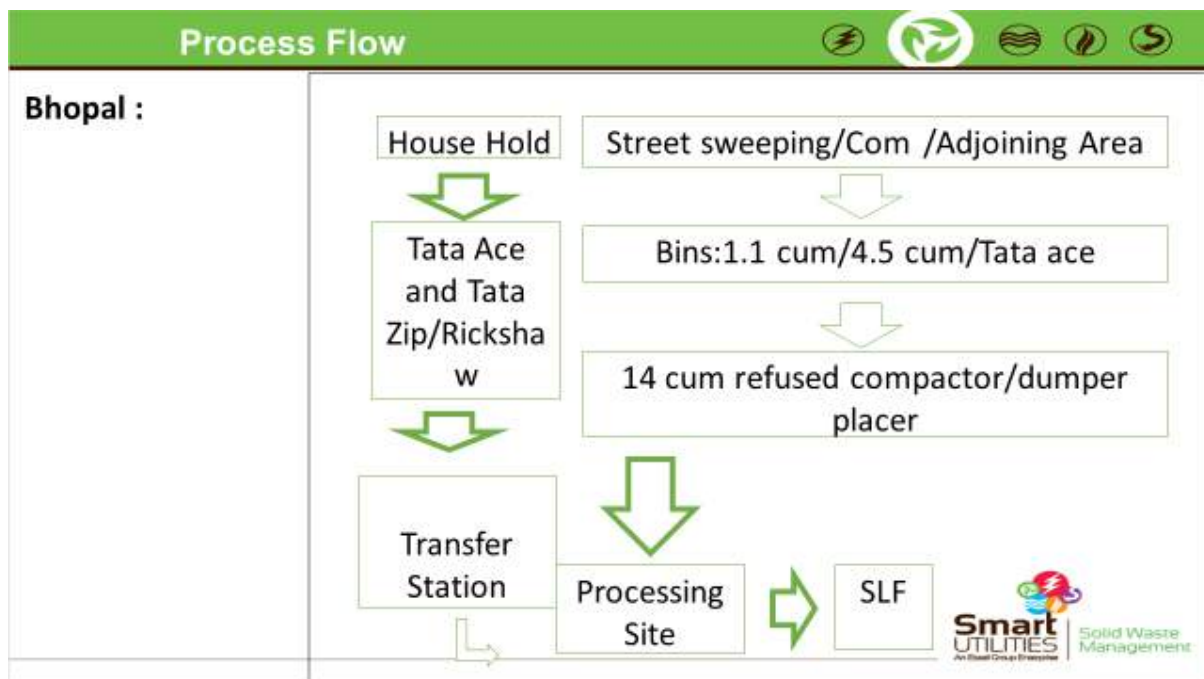
Sr. No	Heads	Qty
1	Tata Ace/Supro (Tipper 2.5 m3)	498

Sr. No	Heads	Qty
3	chassis (2518) for hook loader 16m <sup>3</sup>	24
4	fabrication of hook loader	24
5	Chassis(1616)	19
5	14 cum Refuse Compactor	19
6	Rickshaw	248
7	VTS/GPS	547
8	RFID	42
8	Metal Bins (1.1m <sup>3</sup> ) compactor	341
9	120 Litre Wheeled bins for sweeping and others	7000
10	No. of portable compactors 16m <sup>3</sup>	69
12	generator ( for each parking)	20
13	Tipper 1618	4
14	Bolero	1
15	no. of containers(10ltr.) 2each house	1217668
17	3.5 m <sup>3</sup> DP bin	57
19	Total no. of litter bins required(including 15%yearly replacement)	6000
20	weigh bridge	2
21	workshop establishment	2
22	workshop equipment & tools	2
23	Complaint centre telephones	4
24	CCTV set up for project( cut + dry) for ops location	20
25	Computers	20

Sr. No	Heads	Qty
29	call centre set up	1
30	development of monitoring software	1
31	Control room setup	1
32	Animal Caracas	13
33	Electricity connection for transfer station	20
34	Excavator	2
35	Infrastructure for Billing System(Hand held Devise)	200
36	Uniform and Safety equipment's	1545
37	Digester	1

The C & T Operation Flow Chart is provided below

Figure 5.3: C & T Process Flow Chart



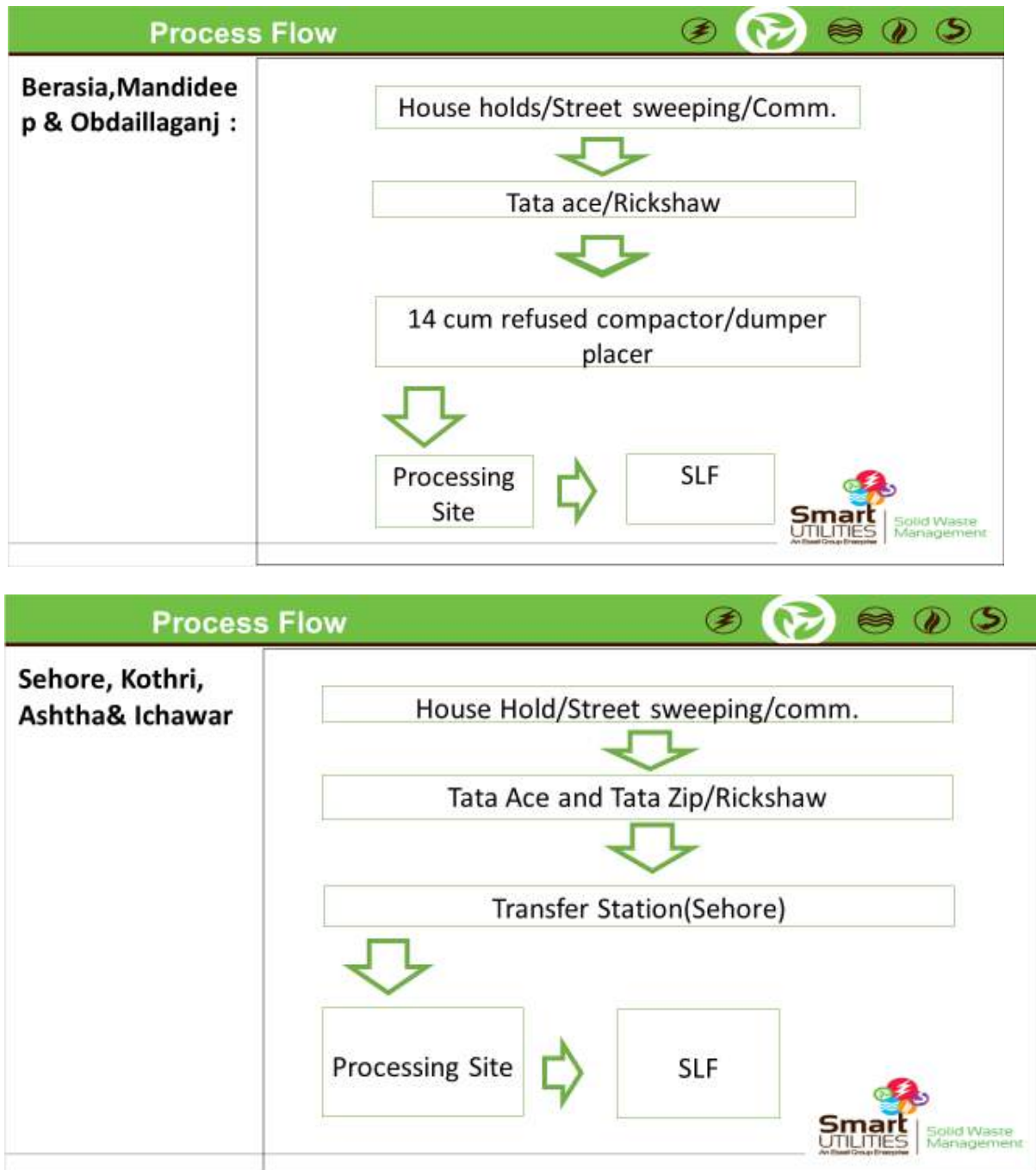
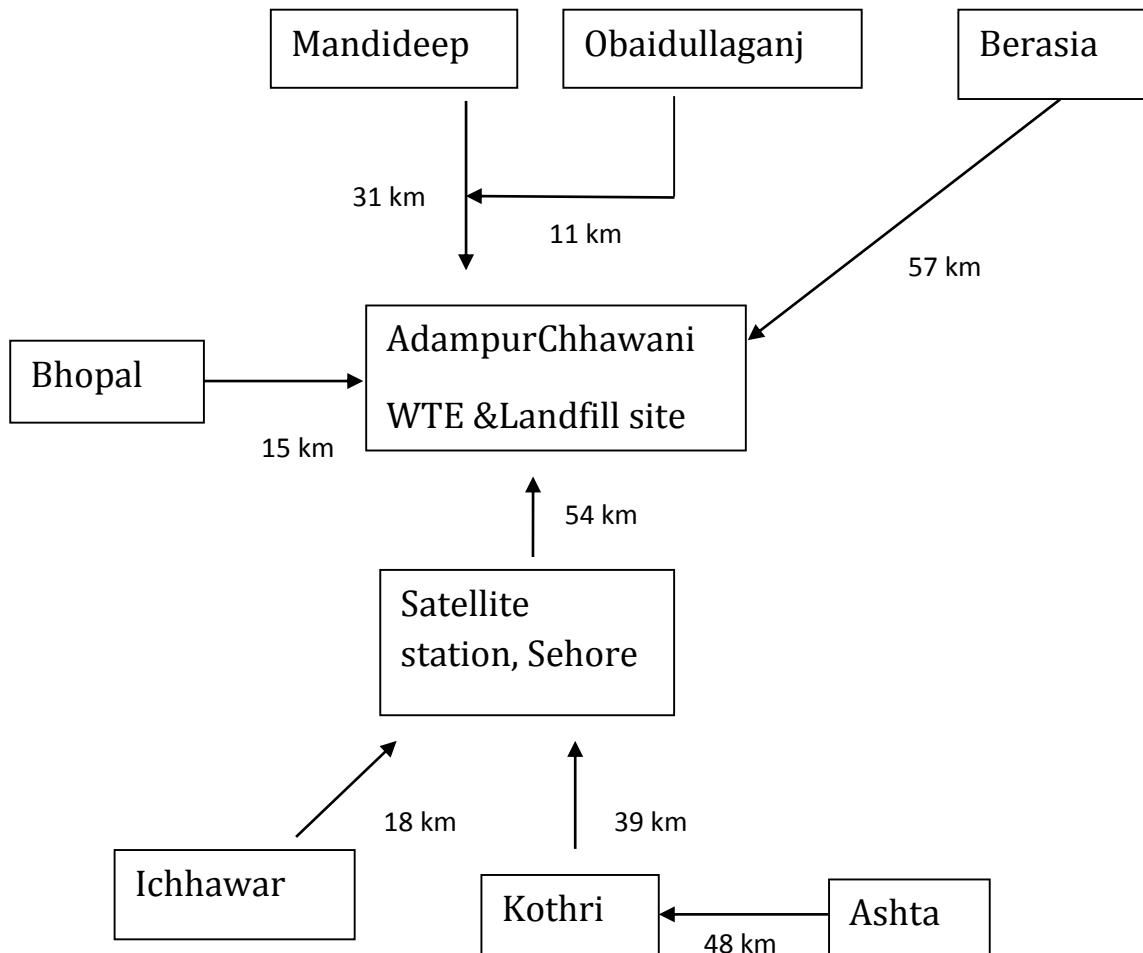


Figure No. 5.4 Distance & route plan of ULBS



### 5.4 Operation & Maintenance (O&M) costs for Collection & Transportation System

The operations and maintenance costs for collection and transportation system shall include but not limited to various costs incurred for upkeep of vehicles and other electronic systems. There shall also be adequate protection against fire for all operational systems including building. The O & M costs also shall include wages and salaries for employees and other contractual staff, if any required for completing the scope of work of the project proponent for carrying out C & T activities. The cost of IEC has also been considered under O & M costs along with utility and sundry costs. The same has been estimated to be 4078.8 Lakhs per annum as provided in table 5.3 below:

Table No: 5.3 O&M Cost for C&T System Annually

<b>Opex</b>		
Designation	Quantity	Annual expenses (lacs)
Driver (Tata ace & Zip)	498	657.36
Driver compactor and tipper	37	71.04
Helper Compactor, tipper, rickshaw	840	957.6
Operator Transfer station	40	52.8
Material and supervisory staff	170	40
workshop staff	30	60
Tax and insurance		60
GPS rent		30
O&M of vehicle		130
Admin expenses		900
Fuel		1000
Misc.		120
<b>Total</b>		<b>4078.8</b>

## 5.5. Scope of Work for Supplies and Services

Scope of Supplies and Services is as per details below:

### 5.5.1 Supply

Table no. 5.4 Scope of supplies

AA: Vehicles & Body:

S. No	Description
1	Manufacture of Vehicles(Incl. Extra Tyre, Tool Kit, Jack and other accessories)
2	Body Design, Specification
3	Body Fabrication
4	Delivery of Vehicles in Bhopal (with fabricated body)
5	After Sales and Service
6	Number of Vehicles- (Quantity may vary plus / minus 10 Nos)

S. No	Description
6.2	Commercial Vehicle: GVW 1500-2500 Kg
6.3	Commercial Vehicle: GVW 25000 Kg
6.3	Commercial Vehicle: GVW 16000 Kg

BB: Price Submission (as per Price Break Up hereunder):

S. No	Description
1	Basic Price
2	Excise Duty
3	Sales Tax against form "C"
4	Ex-Showroom Price
5	Insurance
6	Temporary Registration and Permanent Registration
7	On-Road Price
8	Body design, Fabrication& Specification
9	Excise Duty @ 12.5%(if any)
10	VAT(as applicable) on Body Fabrication
11	Transportation (To & Fro) if any
12	Delivery Terms
13	Delivery Schedule- Vehicle
14	Delivery Schedule- Vehicle with Body Fabricated
15	Payment Terms Confirmation
16	CPBG Confirmation

CC: Warranty

S. No	Description
1	Warranty KM
2	Warranty Period
3	Maintenance Services

## 5.5.2 After Sales Services

Table no. 5.5 Sales services

AA: General

S. No	Description
1	Appointment of Authorized Dealer in Bhopal
2	Ensuring availability of spares for 10 years-Vehicle
3	List of Spares (Including Price)-Vehicle
4	Ensuring availability of spares for 10 years-Body
5	List of Spares (Including Price)-Body
6	Driver's Training ( with repeat periodicity)
7	Daily up keep Check List
8	List of Facilities for Daily Up keep by our contractor
9	Random Check-list and Check by Manufacturer / Dealer
10	Ensuring compliance of all conditions by Dealer

BB: Maintenance

S. No	Description
1	Schedule Maintenance (Including Supplies & Spares)
2	Wear & Tear Maintenance (Including Supplies & Spares)
3	Repair Maintenance (Including Supplies & Spares)
4	Supply of Spares and Services at pre-decided rates

CC: Miscellaneous

Tires and Batteries, except for original supplies as a part of vehicles, are excluded from the scope of work.

DD: Insurance

S. No	Description	Responsibility
1	Loss or Damages to our Vehicles against manmade calamities	BMSWPL
2	Personal accident cover( Vehicle travelling, mounting, or dismounting from Vehicle)	BMSWPL
3	Third Party legal Liability	BMSWPL

S. No	Description	Responsibility
4	Normal Wear & Tear & general ageing of vehicle	BMSWPL
5	Depreciation or any consequential loss	BMSWPL
6	Mechanical / Electrical breakdown	BMSWPL
7	Wear & Tear of consumables like Tyre Tubes	BMSWPL
8	Damage to / by a person driving any vehicle or car w/o any valid license	BMSWPL
9	Damage to / by a person driving any vehicle under the influence of Liquor / drugs	BMSWPL
10	Not having a valid driving license	BMSWPL
11	Loss / damage to mutiny , war, nuclear risk	BMSWPL
12	Accident taking place beyond geographical limits	BMSWPL
13	While vehicle is used for unlawful purposes	BMSWPL
14	Claim settlement in 10 working days of the submission of documents	BMSWPL
15	Spot Survey Waiver	BMSWPL
16	No bills up-to claims of Rs. 50,000/-	BMSWPL
17	Training , Claim Documentation	BMSWPL
18	Claim Realization	BMSWPL

#### EE: Claim Procedure

S. No	Description	Responsibility
1	Immediately intimate to Broker, Police, Insurance Company whenever required.	BMSWPL
2	Vehicle to the nearest garage	BMSWPL
3	Follow up with Surveyor & Garage	BMSWPL
4	Spot Survey – If the vehicle is in immovable conditions	BMSWPL
5	Vehicle unlocked after accident, if there after any theft of parts is not covered in policy	BMSWPL
6	If there is leakage of oil or coolant, please do not drive the vehicle.	BMSWPL
7	Follow up with insured for producing documents.	BMSWPL
8	Completion of repair	BMSWPL

S. No	Description	Responsibility
9	Follow with insurer for settlement where cashless facility not available	BMSWPL
10	Confirmation from insured for receipt of claim	BMSWPL
11	In case there is third party involvement FIR is must	BMSWPL
12	Theft claim, If the vehicle is stolen you must inform to Police & Broker	BMSWPL
13	Maximum Term of Policy for 1 year	BMSWPL
14	At the time of Claim- Policy copy Spot survey Claim form Re-inspection Survey Report( RC copy, Fitness Certificate, DL, Road Permit)	BMSWPL
15	FIR Third Party Injured	BMSWPL
16	Financer NOC	BMSWPL
17	If Vehicle loaded then load challan	BMSWPL
18	Tax Receipt	BMSWPL

## 5.6 Responsibilities

**The responsibility matrix regarding vehicle purchase, fabrication and maintenance are provided below**

Table no. 5.6 Responsibility matrix

### AA: Vehicles & Body:

S. No	Description	Responsibility
1	Manufacture of Vehicles	BMSWPL
2	Body Design	BMSWPL
3	Body Design Approval	BMSWPL
4	Body Fabrication	BMSWPL
5	Inspection and Approval	BMSWPL / BMC

6	Delivery of Vehicles in Bhopal (with fabricated body)	BMSWPL
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**BB: Warranty & Maintenance Services:**

S. No	Description	Responsibility
1	Warranty Execution	BMSWPL
2	Maintenance Services	BMSWPL

**CC: After Sales Services**

S. No	Description	Responsibility
1	Appointing and Authorizing Dealer in Bhopal	BMSWPL
2	List of Spares (Including Price)-Vehicle	BMSWPL
3	List of Spares (Including Price)-Body	BMSWPL
4	Driver's Training ( with repeat periodicity)	BMSWPL
5	Daily up keep Check List	BMSWPL
6	List of Facilities for Daily Up keep	BMSWPL
7	Replacement and maintenance of Tyres	BMSWPL
8	Replacement and maintenance of Batteries	BMSWPL

**DD: Maintenance:**

S. No	Description	Responsibility
1	Daily Upkeep (As prescribed by OEM)	BMSWPL
2	Supervision of Daily Upkeep	BMSWPL
3	Random Check of Daily Upkeep	BMSWPL
2	Schedule Maintenance	BMSWPL
3	Wear & Tear Maintenance	BMSWPL
4	Repair Maintenance	BMSWPL

**EE: After Sales Cost Heads (including Insurance)**

S. No	Description	Responsibility
1	Insurance Cover	BMSWPL
2	Loss or Damages to our Vehicles against manmade calamities	BMSWPL
3	Personal accident cover	BMSWPL

S. No	Description	Responsibility
	( Vehicle travelling, mounting, or dismounting from Vehicle)	
4	Third Party legal Liability	BMSWPL
5	Normal Wear & Tear & general ageing of vehicle	BMSWPL
5	Depreciation or any consequential loss	BMSWPL
6	Mechanical / Electrical breakdown	BMSWPL
7	Wear & Tear of consumables like Tyre Tubes& Batteries	BMSWPL
8	Damage and associated consequential losses due to person driving vehicle w/o valid license	BMSWPL
9	Damage and associated consequential losses due to person driving vehicle under the influence of Liquor / drugs	BMSWPL
11	Loss / damage to mutiny , war, nuclear risk	BMSWPL
12	Accident taking place beyond geographical limits	BMSWPL
13	While vehicle is used for unlawful purposes	BMSWPL
14	Claim settlement in 10 working days of the submission of documents	BMSWPL
15	Spot Survey Waiver	BMSWPL
16	No bills up-to claims of Rs. 50,000/-	BMSWPL
17	Training to Employer's Operational Team on Claim Procedure and Claim Documentation	BMSWPL
18	Claim Realization	BMSWPL

### GG: Claim Responsibilities:

S. No	Description	Responsibility
1	Immediately intimate to Broker, Police, Insurance Company whenever required.	BMSWPL
2	Vehicle to the nearest garage	BMSWPL
3	Follow up with Surveyor & Garage	BMSWPL
4	Spot Survey – If the vehicle is in immovable conditions	BMSWPL

S. No	Description	Responsibility
5	Vehicle unlocked after accident, if there after any theft of parts is not covered in policy	BMSWPL
6	If there is leakage of oil or coolant, please do not drive the vehicle.	BMSWPL
7	Follow up with insured for producing documents.	BMSWPL
8	Completion of repair	BMSWPL
9	Follow with insurer for settlement where cashless facility not available	BMSWPL
10	Confirmation from insured for receipt of claim	BMSWPL
11	In case there is third party involvement FIR is must	BMSWPL
12	Theft claim, If the vehicle is stolen you must inform to Police & Broker	BMSWPL
13	Maximum Term of Policy for 1 year	BMSWPL
14	At the time of Claim- Policy copy Spot survey Claim form Re-inspection Survey Report( RC copy, Fitness Certificate, DL, Road Permit)	BMSWPL
15	FIR Third Party Injured	BMSWPL
16	Financer NOC	BMSWPL
17	If Vehicle loaded then load challan	BMSWPL
18	Tax Receipt	BMSWPL

### 5.7 Conditions for supply and maintenance of vehicles

**These apply for “Supply and Maintenance Service of vehicles up to 1,20,000 Km”**

Table no. 5.7 Conditions for supply & maintenance of vehicles

**AA: Supply of Vehicles-Cost:**

Bidder (supplier and maintenance contractor) shall submit their offer as per heads below:

S. No	Description
1	Basic Price
2	Excise Duty
3	Sales Tax against form "C"
4	Ex-Showroom Price
5	Insurance
6	Temporary Registration and Permanent Registration
7	On-Road Price
8	Body design, Drawing, Fabrication & Specification
9	Excise Duty @ 12.5%(if any)
10	VAT(as applicable) on Body Fabrication
11	Transportation(To & Fro) if any
12	Spare Part Price List-Schedule Maintenance-Vehicle
13	Spare Part Price List-Wear & Tear Maintenance-Vehicle
14	Spare Part Price List-Repair & Breakdown-Vehicle
15	Spare Part Price List-Schedule Maintenance, Wear & Tear and Repair & Breakdown -Body
16	Escalation: @ 5% (on previous year prices), applicable from start of 3 <sup>rd</sup> year onward (i.e. vehicle purchase date 1 <sup>st</sup> April 2016, escalation effective from 1 <sup>st</sup> April 2019) shall be applicable on Supply of Spares.

**BB: Supply of Vehicles-Commercial Terms & Conditions**

Bidder (supplier and maintenance contractor) shall submit their offer as per Commercial Terms hereunder:

S. No	Description	
1	Delivery Terms	FOR Bhopal
2	Delivery Schedule- Readiness of Vehicle (For Body Fabrication)	6 Weeks
3	Delivery Schedule- Vehicle with Body Fabricated	Plus 2 Weeks

S. No	Description	
4	Payment Terms-Vehicles -100% Payment shall be paid upon completion of following;	
4.1	Inspection & acceptance of Vehicles	
4.2	Delivery of Vehicle (at their dealer's Works at Bhopal)	
4.3	Complete set of documents (As per Annexure-V)	
4.4	Submission of CPBG, for 10% of the Ex-Showroom value of order (by OEM / Nominated Dealer) in format provided (Refer Annexure-VI)	
5	Payment Terms-Vehicles with Body Fitted-100% Payment shall be paid upon completion of following;	
5.1	Inspection & acceptance of Vehicles duly with fabricated body	
5.2	Delivery of Vehicle (at companies Parking site at Bhopal)	
6	Payment relating to Services shall be released within 15 days of submission and certification of Bills, subject to other provisions and schedules of Contract.	
7	Liquidity Damages for delay- (applicable separately for vehicle and body).	0.5% per Week Max. 10%
8	Undertaking by Manufacturer (Refer Annexure- IX)	
9	Offer Validity	90 Days
10	Insurance (Vehicle + Body Fabrication)	In Employer's Scope
11	Availability of Spares & Services-Period	10 Years

### CC: Supply of Vehicles-After Sales, Service Terms & Conditions

Bidder (supplier and maintenance contractor) shall consider the following parameters, for submission of their offers

S. No	Description	Remarks
1	Daily Running KM (Basis month average)	35 KM
2	Yearly Running (365X35)	12775 KM
1	Maintenance KM	120000 KM
2	Warranty Period	2 Years
4	Maintenance-Period (Total 2+8) 10 years	8 Years

Repair and Replacement of any part except scheduled maintenance, during warranty period, shall be to Bidder's (supplier and maintenance contractor) account ((i.e. 2 years from date of handing over the vehicles, with duly fabricated body at Bhopal site).

## **DD: Maintenance Services**

BMSWPL shall be responsible for the following:

S. No	Description
1	Schedule Maintenance
2	Wear & Tear Maintenance
3	Repair Maintenance
4	Driver's Training ( with repeat periodicity)
5	Providing Daily up keep Check List
6	Providing List of Facilities for Daily Up keep
7	Random Check by Manufacturer / Dealer

- Services charges shall be claimed by OEM / Dealer as per the prices in there DMS/ CRM Software and discount structure, as per various schedule and provision of the RFP / Contract.
- Bidder shall offer discount applicable all their prevailing prices.

## **EE: Other Terms & Conditions**

### **Contract Performance Bank Guarantee**

1. The successful bidder, irrespective of its registration status etc., will have to furnish Performance Bank Guarantee of 10% of Basic Contract value of supply portion in the form of Bank Guarantee from any scheduled commercial bank duly hypothecated in favor of M/s Essel Infra projects Limited within 20 days of release of LOI. The Performance Bank Guarantee should be valid for 120 months from the date of acceptance of

- the contract. In case bidder is not able to provide Bank Guarantee for 120 months they may provide PBG for a shorter period which shall be extended, before expiry, failing which, it shall be encashed before expiry.
2. Contract Performance Bank Guarantee should remain valid for a period of sixty days beyond the date of completion of all contractual obligations of the supplier or 120 months from the date of acceptance of contract, whichever is earlier.
  3. Contract Performance Bank Guarantee will be refunded without any interest, whatsoever, after the contract is completed in all respects.
  4. Contract Performance Bank Guarantee will be forfeited if the successful bidder fails to perform any of the terms and conditions of the contract, besides it may also be black listed.

### **Additional Conditions**

1. Maintenance work shall be carried out in the service station of the manufacturer / authorized dealer.
2. The workshop should be authorized by the respective manufacturers for repairs and maintenance of its vehicles. Authorized certificate for undertaking repairs/maintenance of a particular make of cars should be furnished with the technical bids. The ordered work shall not be outsourced/assigned to any other parts by the contractor under any circumstance.
3. The workshop should have sufficient parking space/work area within their premises without any infringement of public space so that the Driver of the vehicle is not booked for unauthorized parking when the vehicle is taken to the workshop for repairs etc.
4. Details of trained manpower/automobile engineers/technicians employed by the bidder should accompany the technical bids.

5. In case the vehicle is not repaired within the time frame, as specified as major repairs, a penalty @ Rs 1000/- per day (approximately rental charges for hiring a vehicle for one day) will be imposed and the same will be recovered from the outstanding payment/ Performance Bank Guarantee of the contractor. Bidders shall submit schedule for major repairs, which shall be approved by Employer.
6. The spare parts to be provided should be of original make/genuine quality. The workshop shall stand guarantee for the parts replaced for a minimum period of six months or its effective operational life whichever is later. The Replaced old parts duly tagged as per employer requirement must be returned to the Employer.
7. The Period of contract shall be for 10(ten) year from the date of award of the contract or up to 120000 Km running of individual vehicles.
8. In case of the breakdown of vehicles, the bidder (Supplier and maintenance contractor) will be required to tow the vehicle(s) to workshop free of charge.

## CHAPTER NO.6 MONITORING AND PUBLIC INTERFACE

### 6.1 Establishing GIS-GPS based MIS

Solid Waste Management is one of the complex operation wherein the intervention of information technology until few years ago was minimal and was undertaken a very small part of the total process. GIS could help in dealing with several factors simultaneously which needs to be considered while planning waste management. “GIS is a system of computer hardware and software, designed to allow users to collect, manage, analyze and retrieve large volume of spatially referenced data and associated attribute data collected from a variety of sources.”

As per JNNRUM report, there are several challenges in existing systems without the assistance of GIS and/or GPS based MIS.

- Tracking, monitoring, planning and management of vehicles/ resources are tedious.
- Best Practices in e-Governance Ministry of Urban Development Trip planning can be performed based on the shortest route as visualized routes are not available.
- Difficulty in tracking the non-compliance to the schedules
- Difficulty in locating the bins in a manual process
- Difficulty to monitor actual pick up of the waste from the assigned bins/locality and dumping in the dumping yards
- Difficulty in preparing status reports as it is a manual process and takes a lot of time
- Difficulty in addressing to citizens’ complaints related to SWM within stipulated time

- All the above-mentioned limitations for Solid Waste Management will be taken care with implementing the essentials for e-Governance.

The advent of few technological solutions has changed the scenario as these offer multiple benefits which have a direct impact on the cost of logistics. Some of the major advantages of utilizing a robust information technology system are

- a) Improved monitoring of the logistics
- b) Time Management in an efficient manner
- c) Route management
- d) Tracking as well as in time compliance
- e) Efficient maintenance when demand

There are several other benefits of utilizing a GIS-GPS based monitoring as well as management information systems (MIS). These have also come useful in equipping the system with better management of crucial mandatory functions under the urban domain, as per 12th Schedule of 74th CAA. Better management of SWM includes GPS based vehicle tracking system, tracking clearance of secondary collection points, GIS based shortest route identification to landfill / dumping site etc.

For this project, there shall be a systematic and redundant system designed, developed and implemented for management of municipal solid waste for collection and transportation purpose. The multi-layer GIS system which shall be implemented at ward and further down to street level shall be monitored for efficient management of operations. According to a leading solutions provider “GPS Tracking for commercial vehicles helps businesses save on fuel costs, reduce labor rates and improve fleet productivity”.

The GIS based system shall utilize geo referencing for collection points and geo tagging shall be done for each points at ward level. These geo tagging points shall be monitored and displayed at the central level in a control room. With a

GPS tracking system, managers of a waste management organization can be sure to keep their vehicles and assets safe from theft. In addition, this allows for managers to increase efficiency and productivity, while eliminating unauthorized use, wasted time and the loss of money.

The role of Geographic Information Systems (GIS) in solid waste management is very large as many aspects of its planning and operations are highly dependent on spatial data. GIS is a tool that not only reduces time and cost of the site selection but also provides a digital data bank for future monitoring program of the site

GPS data can be utilized for tracking trucks and personnel on day to day basis. The tracking points shall be recorded, analyzed as well as monitored from the central control room. The GPS is also helpful in measuring the distance and time of a specific route covered and an average time a vehicle requires from the start to finish of the operation. Any deviation from the set route provides a real time indication to the control room

GPS system can also be helpful in tracking route delays from the collection and transfer point to the final destination. GPS system can identify delays such as driver breaks, congestion in traffic, weather delays, and emergencies as well as due to loading and unloading.

*The Mini Transfer stations shall be fitted with "Bio-Metric" devices for all operational and fleet personnel daily attendance. The data shall be linked to the central control room. The fleet attendants (driver and helper) shall commence operation of the respective collection vehicles and follow a fixed route provided to them based on a shortest feasible route possible. Any deviation from the route shall be signaled to the control room. Stoppages and other delays shall also be monitored and communicated to the driver.*

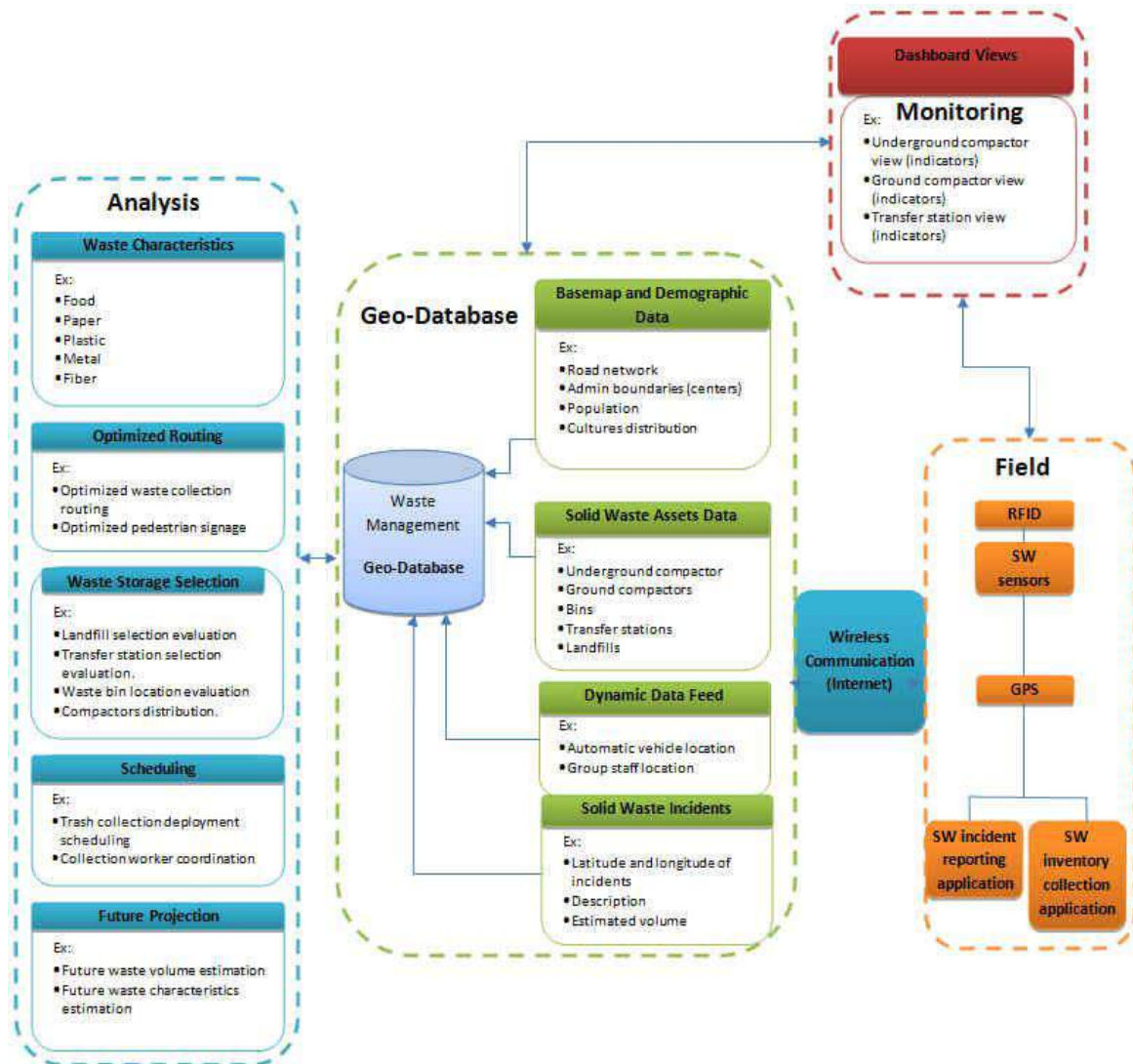


Figure No.6.1: GPS enabled Waste Management System

(Source: Directions Magazine)

## 6.2 Complaint Handling System

There shall be a robust consumer complaint management system consisting of mobile application and online management system

### Complaint management report –

- 1) Report of No. of complaint lodged on daily basis.
- 2) Report of no. of complaints resolved and pending.
- 3) Ward wise/supervisor/contractor wise complaint pending report.
- 4) TAT deviation report and ages report.

5) Feedback report which is to be given to complainant.

### Mobile App reports-

- 1) Customer can lodge the complaint.
- 2) Customer can track their complaint.
- 3) Customer can track their concerned rickshaw/vehicle.
- 4) Customer can pay the user charges thru mobile app.
- 5) Administrator/BMC can see the some part of operational report thru mobile app.
- 6) Photo of the complaint (non-lifted garbage) can be uploaded thru mobile app and after redressing the complaint it can loaded on the web.

### 6.3 Capital Cost of establishing GIS-GPS based MIS System

The capital cost of establishing a GIS-GPS based MIS system has been elaborated below:

Table 6.1: Cost of GIS-GPS based System

Sr. No.	Name and Description	Qty. (Nos)	Total Rs. Lakh
1	GPS tracking system on trucks	547	547
2	Complaint Center Telephones	4	2
3	Computers	20	5
4	CCTV	20	40
5	Monitoring Software	1	170
6	RFID	42	11.80
	<b>Total Cost in Rupees Lakhs</b>		<b>774</b>

### 6.4 Development of software and operational reports

A decision based support system (DBSS) shall be implemented along with a suitable user oriented interface as an output to the various data collected and

analyzed online through GPS. DSS as a computer integrated tools systems is capable to assist the planner or decision makers in various steps of design procedures.

## **RFID TECHNOLOGY**

An RFID system comprises of three elements: (a) one or several RFID tags (also called “transponders” or “RFID labels”); (b) one or several RFID readers (also referred to as “interrogators”); and (c) a computer system (hardware and software).

### **RFID labels or tags**

An RFID tag consists of a microchip (which can be reduced to the size of a point and whose memory stores data) and an antenna (which is printed, etched or stamped onto a substrate). The tag can be stuck on, printed on or incorporated into a product, an animal or a person, providing a unique identifier for each.

Development of Software for on line tracking and generating various on line report –

In this regard scope of IT and various reports to be generated as under-

### **Scope of work-**

- 1) Development of software for tracking day to day operation.
- 2) Installation of GPS and RFID as per the suitability.
- 3) Development of mobile app.
- 4) Mapping of routes, stoppages, bins and mini transfer station.
- 5) Server to be established.
- 6) Installation of Bio metric machine on each transfer station for capturing the attendance of concerned ward.

## **Reports To be Generated-**

### **Operational report-**

- 1) Ward wise manpower status/shortages report. It should be shown on the dash board.
- 2) Ward wise vehicle status/shortage report.
- 3) Trip report of Tata ace, heavy vehicle and E-rickshaw.
- 4) Distance travelling report.
- 5) Tracking report of stoppages covered by Tata Zip and Tata ace.
- 6) Uncovered stoppages should be flashed.
- 7) Compactor lifting report.
- 8) Route deviation report of Tata Zip, Tata ace and HMV. Alert to be sent to administrator.
- 9) Diesel/average report of Tata ace and HMV.
- 10) Bin lifting report. Ward wise pending bins report.
- 11) Online tracking of manpower up to Asst. Manager level, in case anybody cross his ward / Zone alert should be beeped in control room.

### **6.5 Control room**

The control room shall be constructed as per best practices of an electronic equipment control room which shall have fully air conditioned and firefighting provisions along with provisions for adequate data backup for meeting any eventualities. An important condition for the efficient functioning of ICT systems is that ICT rooms are of satisfactory quality. Inadequate quality can lead to reduced productivity on the part of the institution's personnel. In principle, network electronics relating to the backbone network and the horizontal cabling, as well as auxiliary systems such as access control systems, building management systems and so on, should not be installed in server rooms. Server rooms may also be referred to as "computer rooms". Humidity and temperature would be maintained at a level that is compliant with the

equipment installed on the control room center floor. Monitoring would be at a central location such as a Network Operations Center. Monitoring system would support a master reporting console that can also be accessed remotely (including history logs) and must notify support staff of alarms at central and remote sites

**Other features of the control room are:**

- 1) There would be a technologically advanced control room.
- 2) It will function round the clock.
- 3) Control room would do the on line tracking of the vehicle and generate various reports.

## CHAPTER NO.7 IDENTIFICATION OF SOLID WASTE PROCESSING TECHNOLOGIES& ISWM FACILITY, SANITARY LANDFILL

### 7.1 Introduction

The most important objective of municipal waste management is a safe disposal of the waste, generated daily. This would involve the following activities:

- Separation of recyclable fractions and recycling the same
- Beneficial utilization of organic fraction of the waste
- Disposal of inerts into a scientifically designed landfill

The disposal of waste involves processing to separate or utilize the waste fractions organic and inorganic, of which the recyclables are sent for recycling whereas the organics which dominate the proportion go to aerobic composting, vermi-composting or waste to energy conversion.

### 7.2 MSW Processing Techniques:

There are several MSW processing technologies which are being followed in various parts of the world. In India various technologies are used/considered are: 1. Composting 2. Anaerobic digestion to recover biogas and electricity 3. Refused derived fuel 4. Pyrolysis.

Waste to energy (W2E) is a broad term, within which there are multiple techniques such as Mass Burn, Gasification, RDF Incineration, Anaerobic Digestion, etc. Table below compares the advantages and disadvantages of the widely used W2E techniques:

Table no. 7.1 Comparison of common W2E Energy Techniques

Sr No	Parameter	Mass Burn Incineration	Gasification	RDF Incineration	Anaerobic Digestion
1	Process	Controlled combustion	Gasification	Controlled combustion of	Anaerobic digestion

Sr No	Parameter	Mass Burn Incineration	Gasification	RDF Incineration	Anaerobic Digestion
		with Energy recovery		selected high calorie components of the waste with energy recovery	using fermentation - Thermophile / Mesophilic followed by composting
2	Segregation requirement	Not required	Medium	Medium	High
3	Power generation	23	8.4	12	8.4
4	Captive power requirement	12%	13%	15%	17%
5	Land requirement excluding SLF for a 1000 TPD plant	10-12 acres	5 acres	15 acres	8-10 acres
6	Water requirement	Medium	Low	Medium	High 7
7	End process	<ul style="list-style-type: none"> <li>• Steam</li> <li>• Bottom Ash</li> <li>• Fly ash</li> </ul>	<ul style="list-style-type: none"> <li>• Syngas</li> <li>• Blochar</li> <li>• Ash</li> </ul>	<ul style="list-style-type: none"> <li>• RDF fluff</li> <li>• Steam</li> <li>• Bottom ash</li> <li>• Fly ash</li> <li>• Biodegradable &amp; inert rejects</li> </ul>	<ul style="list-style-type: none"> <li>• Biogas</li> <li>• Compost</li> </ul>
8	Useful end products	<ul style="list-style-type: none"> <li>• Electrical power</li> </ul>	<ul style="list-style-type: none"> <li>• Electrical power /fuel</li> </ul>	<ul style="list-style-type: none"> <li>• Electrical power</li> <li>• Organic waste from composting</li> </ul>	<ul style="list-style-type: none"> <li>• Electrical power</li> <li>• Bio fertilizer</li> </ul>

Sr No	Parameter	Mass Burn Incineration	Gasification	RDF Incineration	Anaerobic Digestion
9	Requirement of Auxiliary fuel/ supporting	Yes LSDO during start up	Alumina balls as Heat carrier media	Yes during start up and supporting combustion	No requirement
10	Lead time	24 months	16-18 months	18 months	24 months
11	Process Rejects	15.5	20 %	25 %	25%
12	Plant availability in a year	7000 hours	7000 hours	7000 hours	6500 hours
13	Environment impact	Medium	Low	Medium	Low
14	Flexibility for accommodating the change in waste stream	High	Medium	Medium	Low
15	Demonstration of technology in India- Location	Yes-Okhla, new Delhi	No	Yes- Kanpur, UP (RDF Fluff)	Yes – Solapur, Maharashtra
16	Capital cost (INR-Crores) for a 1200 TPD plant	273	244	385	291
17	O&M cost (INR-Crores) for a 1200 TPD plant	16.4	15	27.1	23.6

Sr No	Parameter	Mass Burn Incineration	Gasification	RDF Incineration	Anaerobic Digestion
18	Expected tripping fee for the project (Rs/Ton)	832	929	1890	1062

Mass Burn with energy recovery results in the least tripping fee for the project considering the capital cost, capacity of the plant, PLF and operation cost, over the project period. Hence after considering pros and cons of various W2E technologies, mass burn with energy recovery has been selected as the MSW treatment technology for the current project.

For the Waste processing the Adampur Chhawani site has been selected which is located at a distance of 16 km from Bhopal's center towards east direction on 23.2552892°N 77.5400876°E. Waste generation through entire city will be processed centrally located at Adampur Chhawani site.

Proposed site is owned by State Government and leased to BMC for 99 years. It is a barren rocky land, about 350 m north of agricultural farms.

### 7.3 Wastes to Energy Technology:

#### **Introduction: Incineration (Thermal power Plant)**

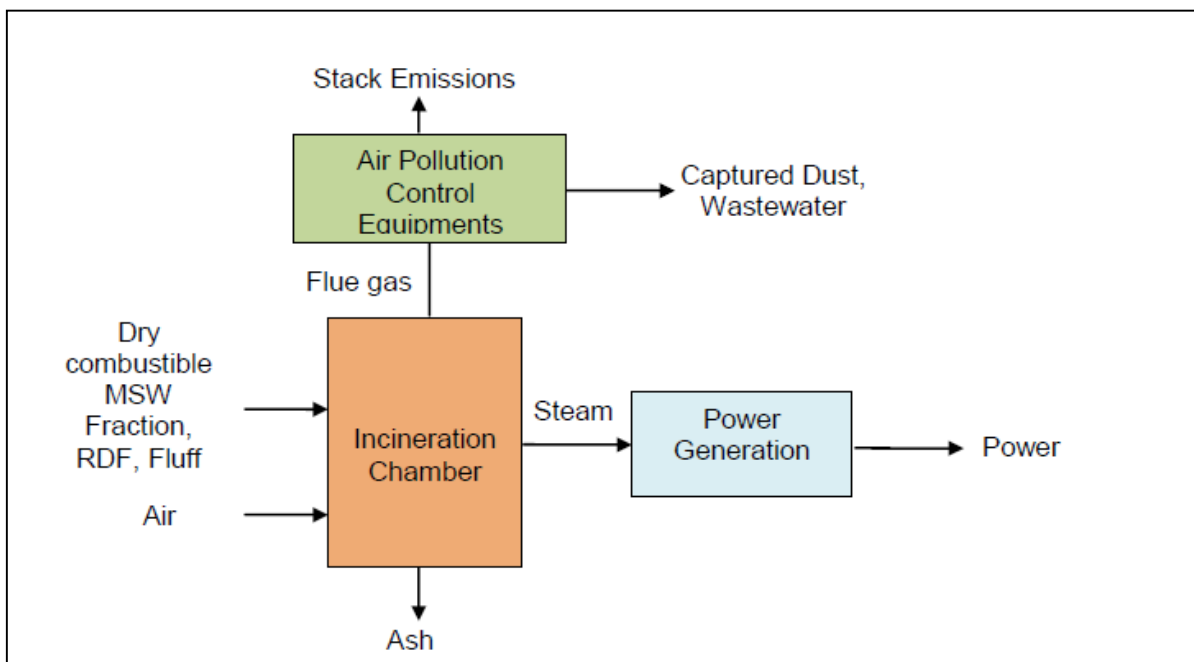
It is the process of direct burning of wastes in the presence of excess air (oxygen) at temperatures of about 800° C and above, liberating heat energy, inert gases and ash. Net waste to energy yield depends upon the following factors

- ✓ Density and composition of the waste (Calorific value)
- ✓ Relative percentage of moisture content and inert material
- ✓ Ignition temperature

- ✓ Size and shape of constituent
- ✓ Design of combustion system

In practice, near about 65 to 80 % of the energy content of the organic matter can be recovered as heat energy, which can be utilized either for direct thermal applications, or for producing power via steam turbine generators (with typical conversion efficiency of about 30%).

Figure 7.1: General Incineration process



In the thermal power plant, solid wastes burned solely. It may not need any auxiliary fuel except for start-up. When the objective is steam production, supplementary fuel may have to be used with the pulverized refuse, because of the variable energy content (or low calorific value) of the waste or in the event that the quantity of waste available is insufficient.

While Incineration based thermal power plant is extensively used as an important method of MSW processing as disposal, it is associated with some polluting discharges which are responsible for of environmental pollution especially air pollution. So that it can be effectively controlled by installing

suitable pollution control devices and by suitable furnace construction and control of the combustion process.

**WtE suppliers and Contractor Selection:**

The following table showing various major technology suppliers and reference plant

Table 7.2: Various major technology suppliers

Technology Supplier	Grate Combustion System for MSW?	Number of reference Plants
Hitachi Zosen	Forward acting reciprocating (formerly Von Roll Inova, HZ was Japanese licensee)	Approx. 833
Martin	Reverse reciprocating grate	389
Keppel Seghers	Multi-acting reciprocating grate (Dynagrate) and forward acting grate	Around 35
Fisia Babcock	Forward acting reciprocating (Steinmuller) and roller	59
Babcock & Wilcox Vølund	DynaGrate, Vølund grate	50
Kawasaki Heavy Industries	Horizontal water cooled grate ('advanced stoker system')	200 – 300 small plants in Japan
Mitsubishi Heavy Industries	Reverse acting reciprocating (Martin grate licensee)	Around 250
JFE	Horizontal stoker grate ('Hyper Grate Stoker')	120

By considering all above, EIL has selected M/s Hitachi Zosen Indai Ltd.as technology provider for Bhopal MSW Cluster (LoCal Plus, Thermal Treatment). As per tender condition EIL has floated an SPV to execute Bhopal MSW Project.

“WTE plant designed to intake waste up to 600 x 2 TPD having a calorific value range from 1100 to 2200 kcal/kg. 1000 TPD of waste is the agreed quantity by municipality for Bhopal city as per concession agreement. If required legacy

waste can be used after presorting for power generation. Along with legacy waste biomass can also be used as and when required. The electrical power output is up to 11.5 x 2 MW per line operating within the Load Range Diagram, with less than 25% process remnants (Ash)”.

Figure 7.2: Proposed 3D WtE Model

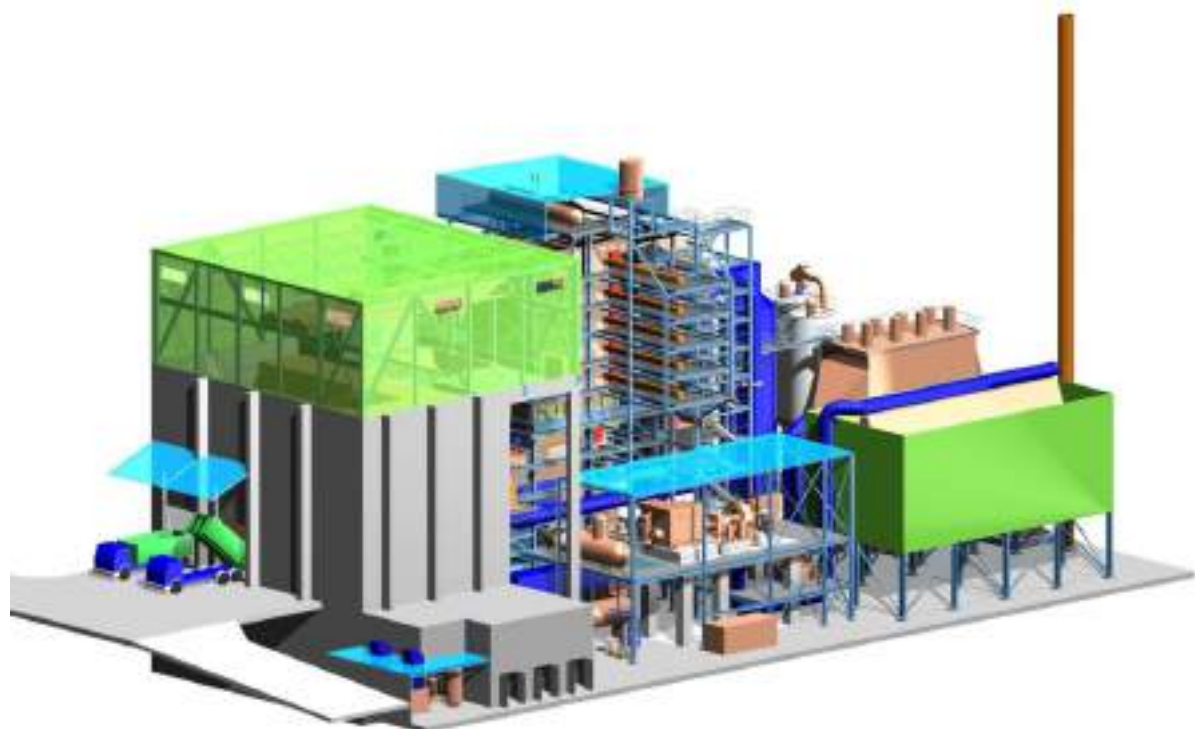
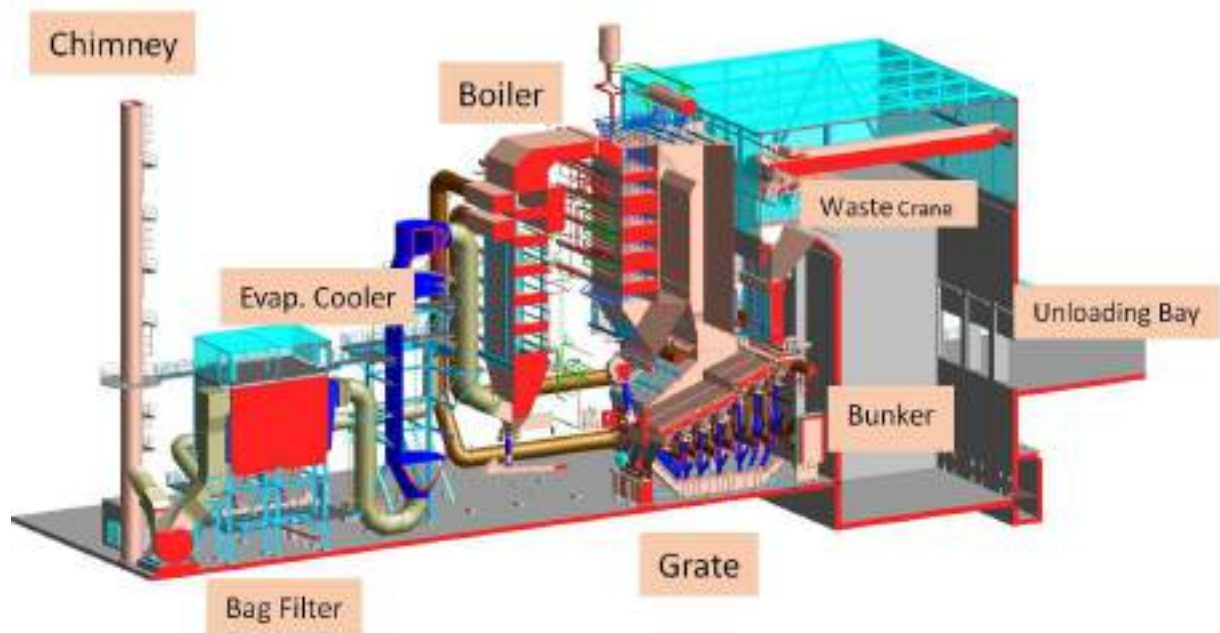
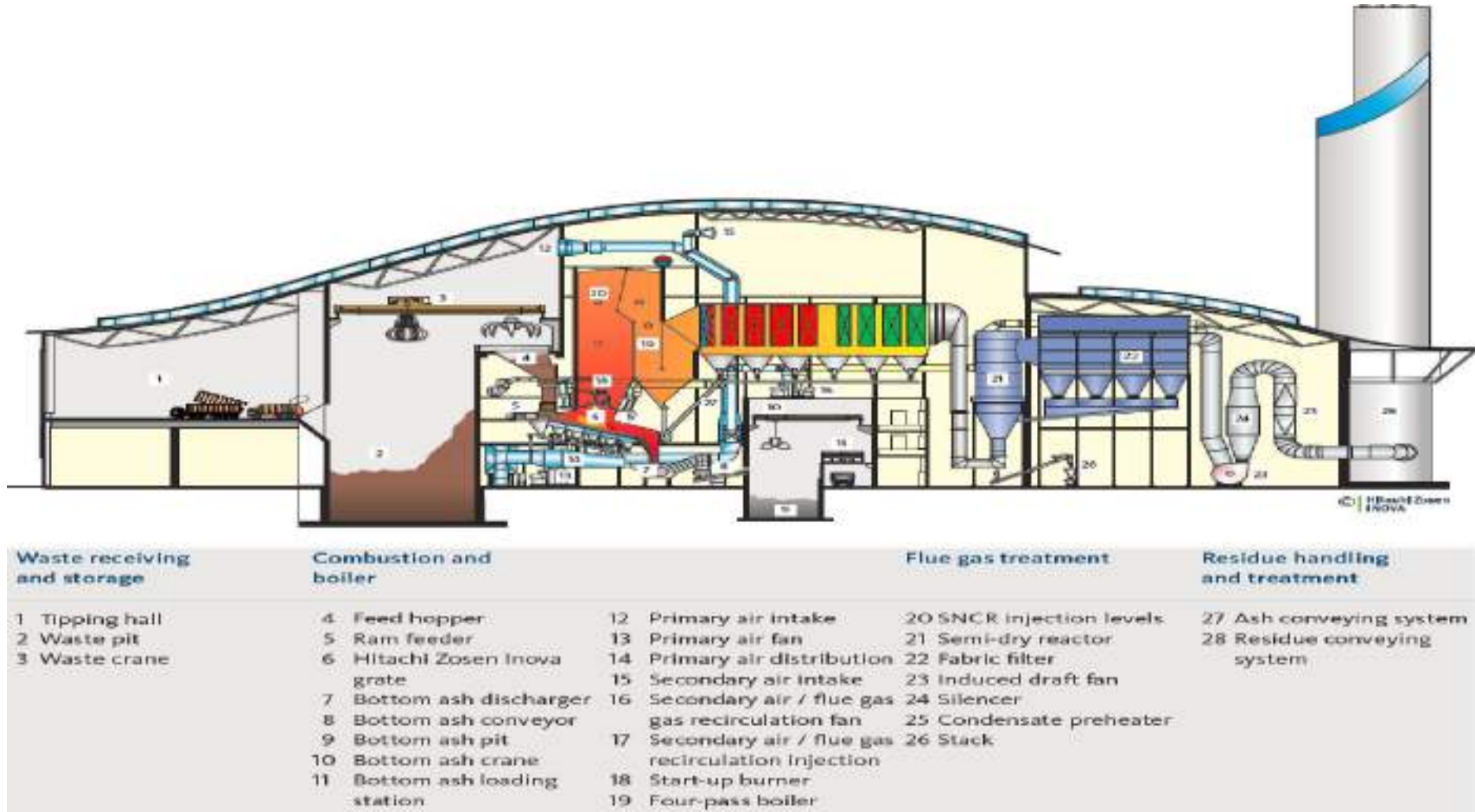


Figure 7.3: Typical Section of Processing Plant Layout



## **Process Description**

The working of thermal power plant is broadly divided into following parts

- A. Waste receiving and storage Section
- B. Combustion and boiler (Heat Utilization and Power Generation)
- C. Flue gas treatment and
- D. Residue handling and treatment

### **Ballistic Separator**

We will dump waste collected via door to door during plant construction period at the Bhanpur khanti. The waste will be presorted by the Ballistic Separator before going for incineration to grate.

The Ballistic Separator is an equipment designed to separate solid waste at the inlet, depending on characteristics of size, density and shape. The ballistic separator performs an effective separation of waste according to different physical characteristics. The ballistic separator classifies the flow of material into three fractions. The types of waste that can be screened with the ballistic separator are numerous: light weight packaging, paper/cardboard, foil and plastic containers, commercial and industrial waste (C&I), municipal solid waste (MSW), waste from construction and demolition (C&D).

### **1) Waste Receiving and Storage Section**

This is the initial section of the thermal power plant. It contains following main components.

#### **1. Tipping Hall**

It work as waste receiving area, vehicle gathered here to unload the waste into waste pit (bunkers) through unloading bays. The tipping bays will be designed according to the waste transport system (e.g. size of trucks & time period of delivery of waste into the pit).

## 2. Waste Pit

It is designed to handle MSW in close controlled area to minimize pollution. Here waste is homogenized with the help of waste loader. If waste contains higher moisture content, a drain system is provided with a pump to extract the water from the waste pit and passed to further treatment. Negative pressure in waste pit is handled through aspirated air. Waste pit will have storage for 6-7 days of waste.

## 3. Waste Crane

The purpose of waste crane is clearing the waste from the tipping bays, mixing and transferring it to the feed hopper and stocking of waste. The waste crane is designed as a bridge crane with a grab trolley, hoisting gear and electro-hydraulic motor grab. It includes the motor control cubical (MCC), switchgear and control consoles required for smooth & safe operation.

The crane is designed for clearing the unloading area, mixing, stocking and continuous feed of waste (24h/day, 7 days/week).

## 4. Combustion and Boiler (Heat Utilization and Power Generation)

This is core part of the thermal power plant. In this section various types of equipment are designed as per characteristics of raw material supplied and expected output from plant.

### 1. **Feed hopper**

The purpose of the feed hopper is to feed the waste into furnace and sealing of furnace from open environment. The feed hopper is designed to have a waste column in the waste chute which allows a



Figure No. 7.4 Feed Hopper with feed Chute

continuous feed to the grate in the combustion chamber.

The feed hopper system (hopper and feed chute) is made of steel. The slope of the hopper walls is designed to prevent arch build-up and to ensure continuous feed to the grate. The height of the feed chute allows a sufficiently high waste column that seals the combustion chamber from the waste pit. The feed chute is designed to resist thermal stress that may occur during operation.

## 2. Ram feeder

The purpose of Ram feeder to feed the waste into the incineration grate. The lower part of the waste column in the feed chute is pushed to the grate by hydraulically operated ram feeders. The speed of the forward movement of the ram feeders defines the waste flow to the grate. The speed is regulated by the Combustion Control System (CCS). To ensure a near continuous waste flow the return movement is at

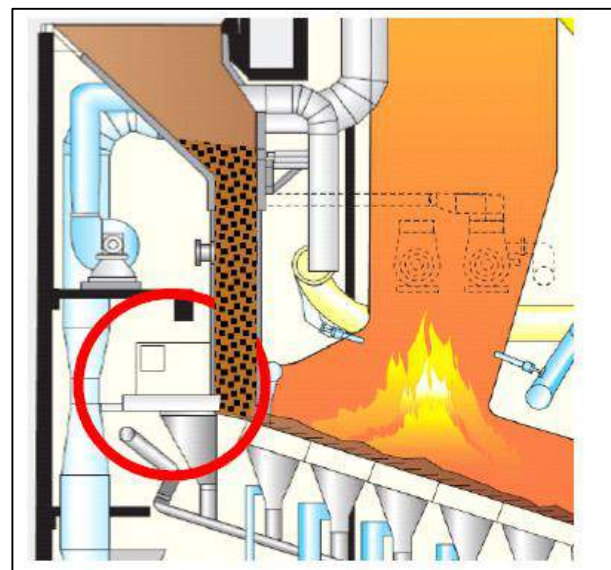


Figure No. 7.5 Ramp Feeder

maximum speed. The ram feeders are hydraulically operated from a local control cabinet. The ram feeder can also be operated manually. This System contains total 3 no. of hydraulic driven ramp feeder.

## 3. Hitachi Zosan Innova Grate (Air Cooled Grate R Type)

The ram feeder uniformly distribute the solid waste across the three lanes of grate. Each lane consists of six elements with a chute after two elements. The process steps in the grate are drying, ignition, combustion and burnout. Swift adjustment of airflows and grate motion in every zone at all times responds to process fluctuations. Two hydraulic cylinders per element move the grate

forwards and backwards for transport and riddling of waste and transport of bottom ash to the extractor. The inclination of the grate, the drop-off after the main combustion zone, and the horizontal burnout zone ensure excellent burnout of all waste fractions. To generate desired power output waste should burn at a minimum 850°C.

The air cooled grate is designed for transport and continuous combustion of waste, good burnout and transport of the bottom ash to the bottom ash extractor.

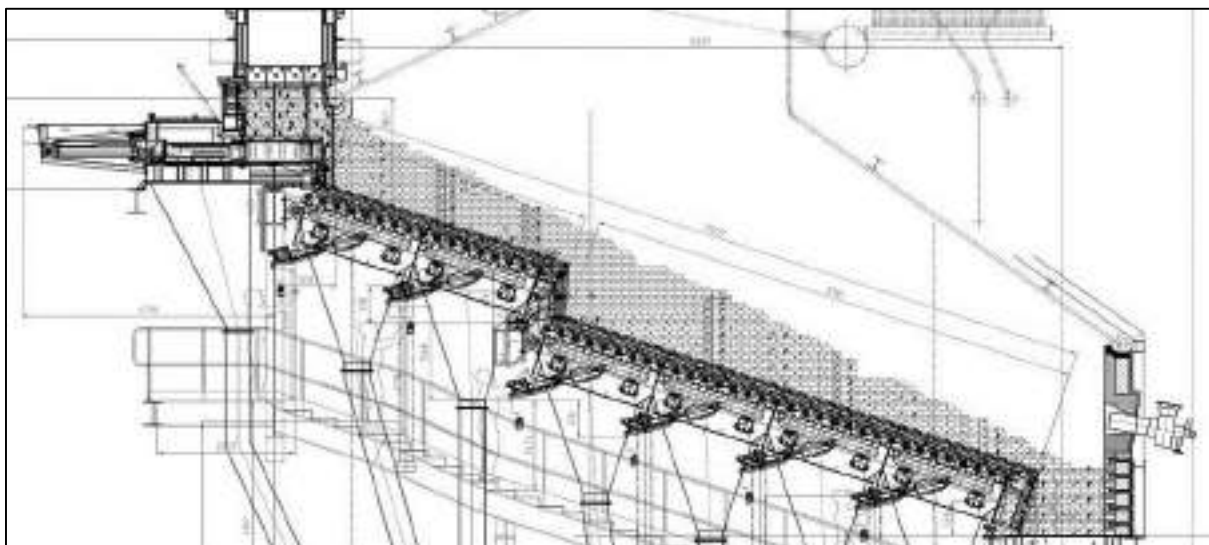


Figure No. 7.6 Overview of the Grate

#### 4. Combustion Air system

It feeds and regulate the air for combustion of grate. Combustion air is aspirated from the waste pit, measured and distributed to the different consumers (Primary Air, Secondary Air & Wall Air).

**Primary Air** is preheated using steam and a flue gas/air heat exchanger. A flue gas/air heat exchanger is necessary to reach sufficiently high primary air temperatures for burning low calorific waste with high water content.

**Primary Air Fan** - The fan and its drive are mounted on a common steel frame structure (base plate). The fan has a radial single-inlet and a statically and

dynamically balanced impeller. It is equipped with openings for inspection and cleaning purposes. Refer point no. 13 in typical section of processing plant layout.

**Combustion Air Preheater** - A five-stage air preheater is installed on the pressure side of the combustion fan. This is used to improve waste combustion.

### **Secondary Air Intake**

It feeds and regulate secondary combustion air to burn out and mix the flue gases.

As waste received is not a homogeneous fuel, flue gases of the first combustion stage above the grate are not completely burnt. The second combustion stage uses tangentially injected secondary air for good gas mixing and adds oxygen for complete gas burnout. Secondary air is extracted from the primary air system at the exit of the high pressure steam preheater. Flow is measured using a venturi tube system and regulated by an automatically operated flap.

The geometry of the combustion chamber and the arrangement of secondary air nozzles (to create swirl flow) are optimized for:

- ❖ Mixing of combustion gases
- ❖ Flow pattern of flue gas

The results of optimized mixing and flow pattern are:

- ❖ Complete burn-out of flue gas
- ❖ Uniform temperature profile across the post combustion chamber
- ❖ Minimize CO-concentrations
- ❖ Minimize risk of corrosion of unprotected heating surfaces
- ❖ Improved burn-out of fly ash

### **Wall air system**

It cools of the combustion chamber side walls. Side walls of the combustion chamber above the grate are made of refractory. The installation of boiler walls is not advisable in this area because of heat loss. The refractory walls have to be cooled to prevent caking of fly ash. The side wall cooling air is extracted from the combustion air system after the fan. It is used as grate drop cooling air before distributed to both sides of the furnace into the wall air system.

### 5. Burner (Strut-up)

During start-up, a burner is needed to heat up the furnace walls and to inflame the waste for combustion. During operation the burner is not in action. Only in case of low temperatures in the combustion chamber the burner will be activated.



Figure No. 7.7 Startup Burner

The Start-up burner which is specially designed for waste incinerators is located above the bottom ash chute. A local control cabinet for the burner regulates the combustion air fan and the fuel flow and ensures the correct stoichiometric ratio. The burner can also be operated locally. A cooling air fan is necessary to prevent damage caused from heat, corrosion and caking of fly ash. Refer point no. 18 in typical section of processing plant layout.

### 6. Pusher type bottom ash/slag extractor

7. The burnt-out waste slag falls through the slag chute into the slag extractor. There the slag plunges into a water bath, is quenched and then discharged hydraulically by means of a pushing shield.

The slag extractor essentially consists of the following components:

- A trough construction and discharging hood (lined with wearing plates),
- A hydraulic drive (cylinder, shaft and lever),
- A pushing shield
- Maintenance openings

The drive cylinder is placed in the middle of the extractor. By using of shaft and lever, the force of the cylinder will transmit to the pushing shield.

In order to empty the slag extractor rapidly during a standstill of the operation, a side door can be opened in the discharge chute area.

The belonging water cabinet (with integrate level measurement) is placed on the side of the extractor. This cabinet is separated, so that no slag gets in this area.

All bearing zones / lubricating points will be lubricated by an automatic lubricating unit.

The construction of the slag extractor including the inlet and exhaust areas is designed to secure the discharge of coarse bottom ash and metal parts free from any disturbance.



Figure No. 7.8 Pusher type bottom ash/slag extractor

## 8. Combustion Control System (CCS)

The Combustion Control System (CCS) ensures operation at a requested load by controlling the combustion process of the fluctuating waste quality. The CCS allows plant operation in compliance with legal conditions (e.g. minimal oxygen content in the flue gas) and guaranteed values.

### Control Goals

Constant steam production: steam flow according to the set point value

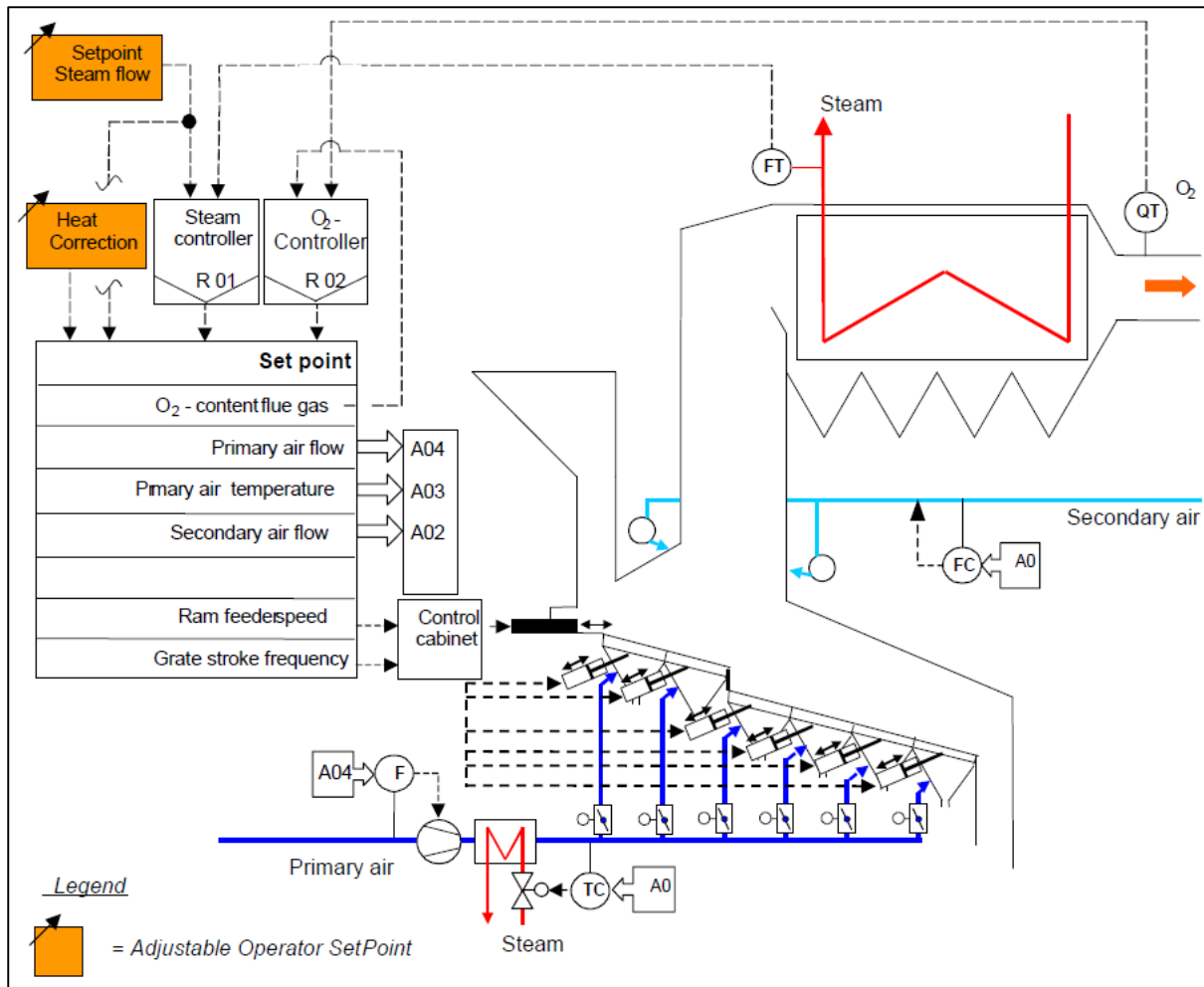
Constant flue gas flow at constant steam set point. This keeps the combustion temperature within permissible limits.

Oxygen concentration in the flue gas within permissible limits.

### Control System Structure

The multivariable controller structure consists of both parallel and serial connections of different controllers. It is realized in the Distributed Control System (DCS). The actuation for the ram feeder and the single grate elements is processed by the grate & ram feeder control system. The set points for the speed are given by the CCS.

Figure no. 7.9 Control system structure



## 9. Heat Recovery Steam boiler

It recovers heat from flue gas and production of superheated steam.

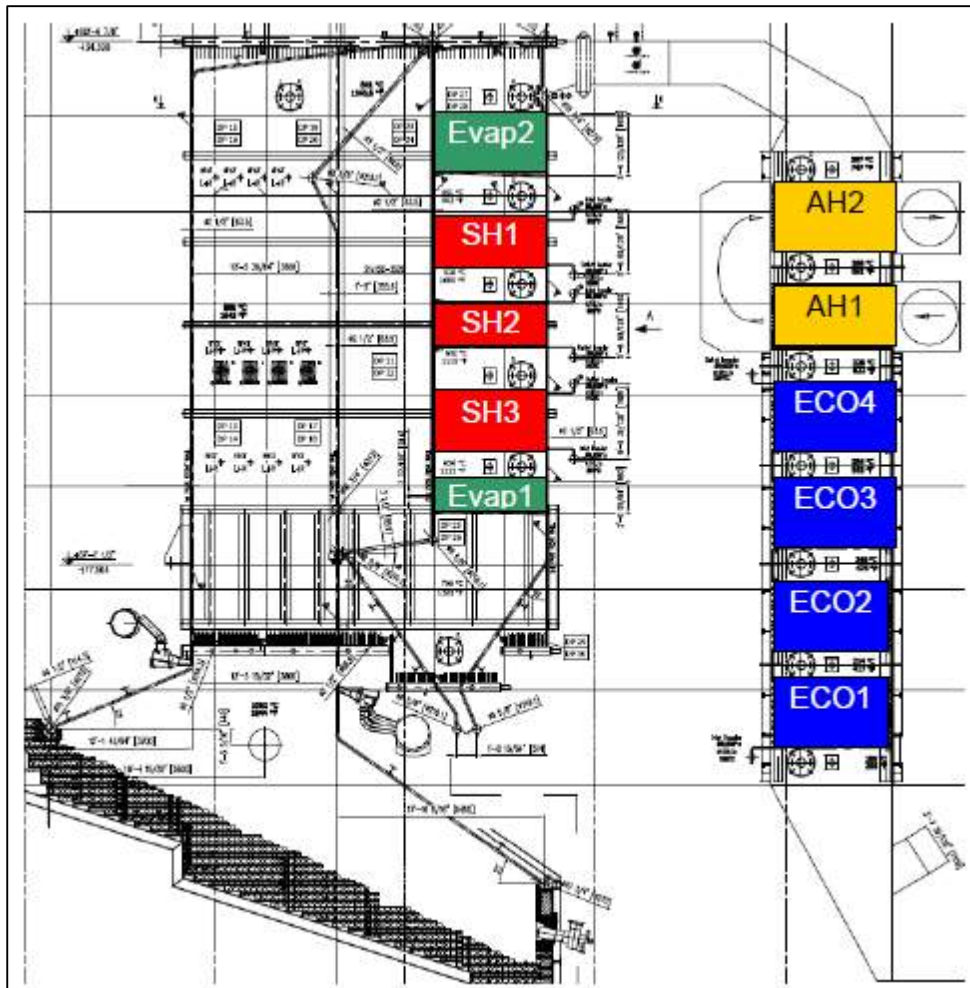
The steam boiler consists of the following sections:

- ❖ 1<sup>st</sup> pass                      Vertical radiation pass made of membrane Evaporator walls with refractory lining.
- ❖ 2<sup>nd</sup> pass                      Vertical radiation pass made of membrane evaporator walls.
- ❖ 3<sup>rd</sup> pass                      Vertical convection pass: 1<sup>st</sup> evaporator bundle (EVAP1),  
 Three super heater bundles (SH) and 2<sup>nd</sup> evaporator bundle (EVAP2); membrane evaporator walls.

- ❖ 4<sup>th</sup> pass Vertical convection pass: two flue gas/air preheater Bundle's (AH) and four economizer bundles (ECO)

Spring-loaded safety valves are provided to protect the heating surfaces from excessive pressure.

Figure no. 7.10 Boiler structure



## Boiler Maintenance and Repair

For maintenance and further repair AMLe space is provided between each tube bundle for adequate inspection and cleaning activities.

## 10. Heat utilization and Power generation

### Heat Utilization

The steam generated in the boiler is supplied to a steam driven turbo-generator set. The turbo-generator set is to generate electrical energy to supply to external electrical grid and also to meet the energy requirement of complete plant auxiliaries. Following equipment's are containing in the heat utilization process for power generation.

**Turbine-** Steam turbine is the main part of power plant, it is the device which transform thermal energy into mechanical energy.

Figure No. 7.11 Turbine



The **control and lubrication oil system** supplies the necessary oil for the bearings and the control oil for control system of the turbine.

**Generator** is provided for transform mechanical energy into electrical energy. For this energy conversion various equipment's are used as their purposes such as Stator, Rotor, shaft, space heaters and RTDs. **Exciters** provides for the purpose to excite and build-up the voltage generators. The cooling of hot generator by adopting generator **cooling system**.

**Air cooled condenser** are provided for to condensate the exhaust steam of the turbine and generators. It is common for two line.

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Apart from this various kind of arrangements of equipment's provided for generation of electrical energy to supply power grid.

The details of the all the components used in the heat utilization process are given in following table with their purpose and description as:

Figure No. 7.12 Schematic process WtE plant with Heat utilization

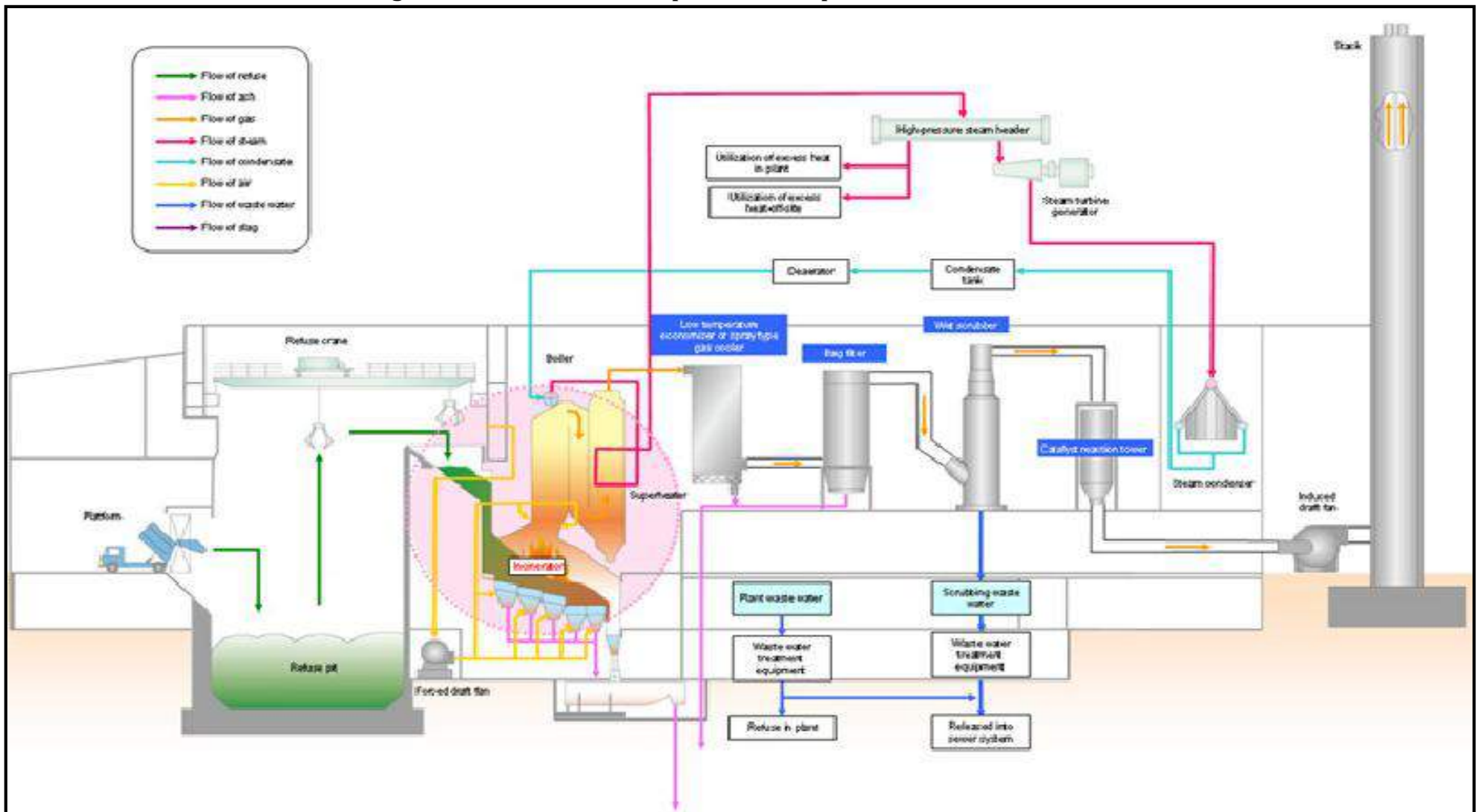


Table No. 7.3 Technical description of components in Heat utilization

Sr. No.	Components	Purpose/Description
1	<b>Turbo generator</b>	The turbo generator set is to generate electrical energy to supply to external electrical grid and also to meet the energy requirement of complete plant auxiliaries.
1.1	Turbine	Steam turbines are main part of power plant, they are the devices which transform thermal energy into mechanical energy.
1.2	Control and Lubrication Oil Supply	To supply the necessary oil for the bearings and the control oil for control system of the turbine.
1.3	<b>Generator System</b>	
1.3.1	Generator	Transformation of the mechanical energy into electrical energy. It consist of components with design according to their purposes such as Stator, Rotor, Shaft, Space heaters and RTDs
1.3.2	Excitation	For excite and build-up of voltage of generator
1.3.3	Generator Cooling	To cooling of hot air of generator
1.3.4	Control cabinet of Generator & system wiring of control cabinet	To control, monitor, measure and protection of generator. The control cubicle consists of control, monitor, measuring and protection equipment of generator. It consist of construction features are system wiring, painting, Cubicle Illumination, earthing, Space heaters, Mimic, NGR & LAVT cubicles(Resistors, Enclosure, terminals, space heaters, cooling, painting etc.
1.4	Cooling System	Cooling of turbine and generator bearing oil. The auxiliary cooling-water system has been designed as an Open cooling-water loop with Auxiliary Cooling tower. Connected to the

Sr. No.	Components	Purpose/Description
		auxiliary cooling-water system are the steam turbine oil cooler and the generator air cooler.
<b>2</b>	<b>Condenser</b>	
2.1	Air-cooled condenser	<p>To condensate the exhaust steam coming from the turbine. For regular plant operation, the exhaust steam from the turbine will condense in the air cooled condenser, which is situated beside the turbine's house.</p> <p>Air and incondensable gases entering the steam turbine and the circuit are extracted from the steam space of the condenser by a steam ejector.</p> <p>It consist of following components: Data Bundles, structural steel, Ducting, Expansion bellows, Piping, Condensate tank, mechanical equipment, Air removal equipment, safety relief equipment, condensate extraction, pump, Drain boot pump, Semi-automatic cleaning system</p>
<b>3</b>	<b>Water-steam-cycle</b>	
3.1	Feed Water System	<p>The feed water system consists of the deaerator/feed water storage tank, the two feed water pumps, the associated pipes and valves. Its purpose is to feed the boiler with deaerated water and to provide spray water as cooling water for the desuper heaters of the boiler, the steam pressure reduction station of the turbine bypass and the High Pressure (HP) – Mid Pressure (MP) steam pressure reduction station.</p>
3.1.1	Feed Water Tank	The horizontal cylindrical tank is supplied with a vertical de-aerator on top. In the deaerator the

Sr. No.	Components	Purpose/Description
		returned condensate is heated using 5 bar steam and deaerated. The waste steam of the deaerator is discharged on top of the building.
3.1.2	Feed Water Pump System	The feed water pump system consists of two electrical feed water pumps (2 x 100%), the associated pipes and valves. Its purpose is to feed the boiler with deaerated water, to provide spray water as cooling water for the desuperheaters of the boiler, the steam pressure reduction station of the turbine bypass and the High Pressure (HP) – medium Pressure (MP) steam pressure reduction station.
3.2	HP Steam System	The boiler produces high pressure steam, which is during the normal operation taken over for utilization by others at the battery limit e.g. steam turbine etc.
3.3	MP Steam System	The 5 bar a steam system supplies steam to the deaerator/feed water tank, air preheater and sealing air heater.
3.4	Condensate System	The condensate system consists of a main condensate tank, the two condensate transfer pumps (2x100%), the steam jet air ejectors including the inter condenser and after condensers of the ejector system, the piping for condensate coming from the air cooled condenser via the two condensate pumps, the ejector condenser to the de-aerator
<b>4</b>	<b>Water Treatment system</b>	
4.1	Water Preparation system	The demineralization plant is designed for a supply of demineralized water continuously at a

Sr. No.	Components	Purpose/Description
		net min capacity of 5 % of the nominal live steam flow.
4.2	Chemical metering system	The water/steam circuit chemistry is controlled in accordance with the requirements in the inquiry by chemical injection, usually Ammonia and Tri-sodium Phosphate, into the feed water.

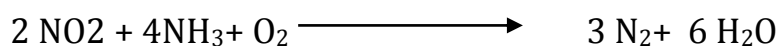
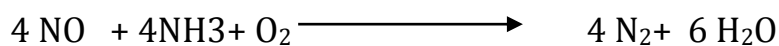
## Flue gas Treatment

This is the middle section of section of the thermal power plant, after incineration of solid particles, it contains following main components

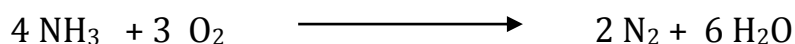
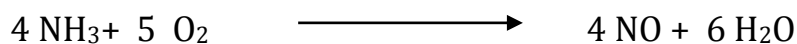
### 1. SNCR Process

In the SNCR process (Selective Non-Catalytic Reduction), NO<sub>x</sub> reacts with ammonia (NH<sub>3</sub>) and is chemically converted into nitrogen (a natural constituent of air) and water vapour. Ammonia is injected directly into the combustion chamber along with steam at a temperature between 850<sup>o</sup>C to 950<sup>o</sup>C.

Main reaction (NO<sub>x</sub> – reduction at > 850<sup>o</sup>C)



Main reaction (NO<sub>x</sub> – reduction at > 950<sup>o</sup>C)



The purpose of SNCR process to achieve high removal efficiency of NO<sub>x</sub> near about 90%. Another advantages of this process is dioxin formation in the flue gas reduced significantly.

This process contain the equipment (ammonia water tank, pump rack, ammonia water and steam distribution pipes) takes very little space and can be added very easily to existing plants. Refer point no. 20 in typical section of processing plant layout.

## 2. Semi-Dry Reactor

The purpose of the semiconductor is the purification of flue gases. Downstream of the combustion section and steam generator, flue gases are channeled directly into the turboadsorber without pretreatment. Reagents for separation (hydrated lime or calcined lime and activated carbon) are metered into the



Figure No. 7.13 Semi - Dry Reactor

stream here, and water is injected at the same time. The temperature drops below 160°C as a result, improving separation while activating the lime. Pollutants react with the additives in the turbo adsorber, forming products that can be trapped by the downstream fabric filter. Refer point no. 21 in typical section of processing plant layout.

## 3. Fabric Filter

The purpose of fabric filter is separation of solids from the flue gas and formation of an adsorbent layer on the filter surface for further reaction of pollutants.

The separation is a physical process where the solids are filtrated on the surface of a gas-permeable fabric.

A fabric filter consists of a large number of filter bags which capture particulate matter. Flue gas enters the base of the filter and flows through the individual bags. Particles are deposited on the outside of the bag and the cleaned gas flows through and exits the top of the unit.

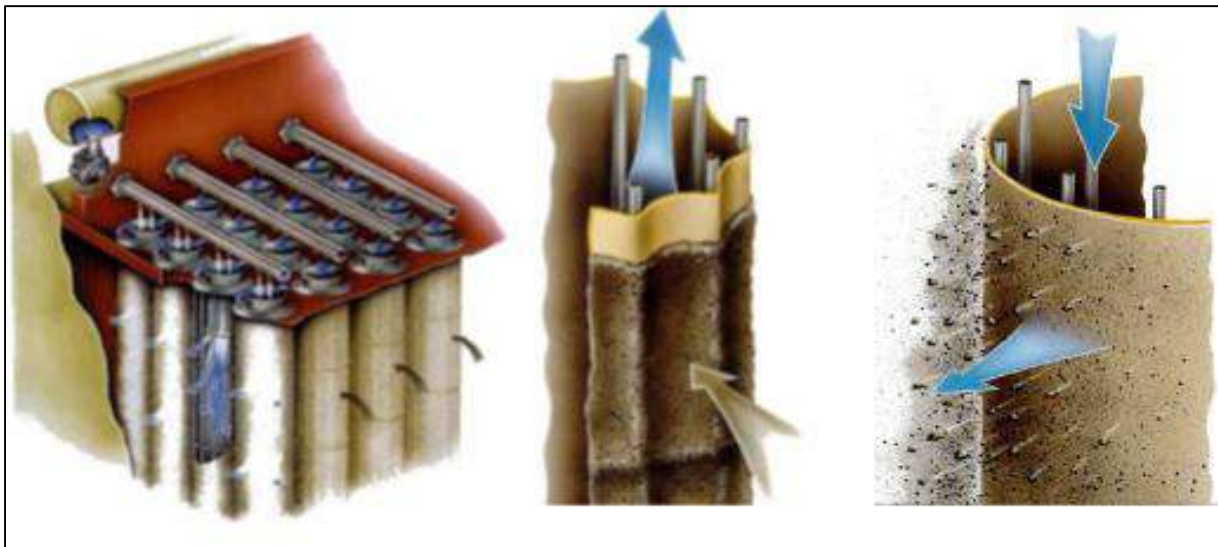


Figure No. 7.14 Fabric Filter

As compare to other Air Pollution Control (APC) equipment, the removal efficiency of fabric filter is high. The filter bags are automatically cleaned. The cleaning of the filter bags is controlled in relation to the pressure drop. For more details refer point no. 21 in typical section of processing plant layout.

#### **4. Induced draft fan, Silencer and condensate preheater**

The Purpose induced draft fan is to move the flue gases from the combustion through the flue gas cleaning system to the stack. The speed of the ID fan is regulated using a frequency converter (Variable Frequency Drive) to maintain a slight negative pressure in the combustion chamber. The negative pressure in

the system prevents any leakage of combustion gases into the surrounding area.

Silencer is fitted to reduce noise generated due to speed of flue gas. Then condensate preheater. For more details refer point no. 23, 24 & 25 in typical section of processing plant layout.

## 5. Stack

The purpose of stack is to expel the cleaned gases from the flue gas treatment system to the atmosphere. The height of is 45 m. For more details refer point no. 26 in typical section of processing plant layout.

The summary of flue gas treatment is given in following

Table No. 7.4 Provision of flue gas treatment by Hitachi

Sr. No.	Components	Purpose/Description
1	SNCR System	Reduction of NO <sub>x</sub> using selective non-catalytic reactions. Ammonic solution is injected into the combustion chamber where the flue gas temperature is between 850 to 950°C.
1.1	NaOH Injection (optional)	Injection of ammonia solution into the combustion chamber at several levels. The 25% aqueous ammonia solution is injected into the flue gas in the radiation zone of the boiler. Steam is used as a carrier medium.
<b>2</b>	<b>Flue gas handling</b>	
2.1	Flue gas ducts, dry	Connection ductwork for flue gas routing between the individual process steps at temperatures above dew point.  The individual flue gas cleaning components are connected to each other by means of ductwork. These ducts provide a

Sr. No.	Components	Purpose/Description
		<p>path for the flue gas to travel between components (e.g. from the boiler to the evaporation cooler and from the bag filter to the ID fan). Dry flue gas ducts are made of sheet steel with reinforcements, supports, holders, suspension devices (hangers), flanges, gaskets and expansion joints, etc. All instrument ports needed for flue gas measurements in the entire flue gas duct system are included.</p>
2.2	Emission measurement	<p>Detection and monitoring of flue gas contaminants in the stack</p> <p>The emission measurement system monitors the flue gas properties and composition in the stack.</p> <p>The main system components include:</p> <p>Instruments for temperature, pressure and flow rate measurement</p> <p>Measurement instrument for particulate matter (dust)</p> <p>Gas concentration measurement system for determination of gaseous flue gas components</p> <p>(H<sub>2</sub>O, O<sub>2</sub>, CO<sub>2</sub>, CO, HCl, SO<sub>2</sub>, NO<sub>x</sub> (option))</p> <p>The instruments are installed directly on the flue gas duct. The emission measurement system is designed to meet the particular requirements of the Operating permit for the plant.</p>
3	Evaporation Cooler	<p>In the evaporation cooler (and following Fabric Filter), chemical reactions with the</p>

Sr. No.	Components	Purpose/Description
		<p>injected hydrated lime and adsorption on the activated carbon assure the separation of pollutants from the flue gas. Activated carbon is used as adsorbent for VOC, mercury and dioxins. Other heavy metals are condensed and separated as well as the entrained fly ash by gas/solids separation.</p>
<b>4</b>	<b>Particle Separation</b>	
4.1	Fabric filter	<p>Purpose - Separation of solids from the flue gas and formation of an adsorbent layer on the filter surface for further reaction of pollutants.</p> <p>General - The fabric filter is used for separation of solids from the flue gas. The separation is a physical process where the solids are filtrated on the surface of a gas-permeable fabric.</p>
4.2	Induced draught fan with frequency converter	<p>To move the flue gases from the combustion through the flue gas cleaning system to the stack.</p> <p>The speed of the ID fan is regulated using a frequency converter (Variable Frequency Drive) to maintain a slight negative pressure in the combustion chamber.</p>
4.3	Stack	<p>The purpose of the stack is to expel the cleaned gases from the flue gas treatment system to the atmosphere. Technical specification will be provided to Owner during detail engineering stage to confirm to meet the statutory requirements.</p>
5	Additives handling	Hydrated lime and activated carbon dosing.

Sr. No.	Components	Purpose/Description
		Dosing of hydrated lime and activated carbon into the evaporation cooler

## Residue Handling and Treatment

In this section discharge and conveying boiler ash to the bottom ash extractor and residues from flue gas treatment to the residue silo under following systems

### 1. Ash conveying system

The ash conveying system is provided along the bottom of semi dry reactor. For the scientific disposal of residue (or ash) conveying system provided. It bring the ash outside the power plant for further treatment. For more details refer point no. 27 in typical section of processing plant layout.

### 2. Residue conveying system- Common for two line

Discharge and conveying boiler ash to the bottom ash expeller and residues from flue gas treatment to the residue silo. For more details refer point no. 28 in typical section of processing plant layout.

Table No.7.5 Provision of residue handling and treatment by Hitachi

Sr. No.	Components	Purpose
1	Residue handling System	Discharge and conveying boiler ash to the bottom ash expeller and residues from flue gas treatment to the residue silo.  The ash from the 2nd / 3rd (super-heater area) and from the 4th boiler pass (economiser) will transport through mechanical / pneumatic conveying system.
1.1	Residues Silo	Storage of the residues. The residues are stored in a welded carbon steel silo. The

		silo cone is equipped with a mechanical system for easy discharge.
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### Auxiliary requirement

Table No. 7.6 Auxiliary requirement

Sr. No.	Components	Purpose/Description
1	Water Supply	
1.1	Raw Water Supply	<p>Raw cum fire water storage tank to store the raw water within the plant premises for plant purpose.</p> <p>The raw water for the plant operation requirement will be stored in a storage tank. The raw water storage tank shall be earthen-bund type. To run 600 TPD Hitachi Power plant nearly 750 M<sup>3</sup>/day water is required. For safe side two days requirement of whole plant i.e. 1500 M<sup>3</sup> provision shall make firefighting system . The raw water will be filtered in the multi grade filter for further use of plant.</p>
1.2	Service water and potable water system	<p>Service water required for plant purpose and drinking water for plant personnel</p> <p>The service water requirements of the entire plant will be met from a HDPE tank of capacity 2 m<sup>3</sup> placed at one corner of the control room slab to meet the demand of service water to the general toilets and toilets of STG building which also includes the potable water demand for working staff at plant side.</p>
2	Compressed Air system for Process and Instrument air	To supply air to operate the control valves, dampers and supply to process requirement.

Sr. No.	Components	Purpose/Description
		<p>The compressed air system for instrument air is designed at 7 Kg/cm<sup>2</sup> for pneumatic operated dampers and process instrumentation. Based on the instrumentation for the plant, the compressed air requirement for process instruments is envisaged as 250 CFM of dry air without any traces of oil.</p>
2.1	Fire Fighting, smoke detection and alarm system	<p>For fighting fire of plant equipment</p> <p>A comprehensive firefighting system, including the fire water sump of suitable capacity by client, is designed for the complete plant. It includes firefighting, smoke detection and alarming facilities in the MCC rooms and control rooms of the power plant which covers all the following potential hazard areas.</p>
3	Fuel Oil supply	
3.1	Fuel oil supply	<p>For unloading fuel oil from the tanks and to directly fill the storage tanks and also to pump the fuel oil to the day storage tanks at the furnace end.</p> <p>The system consists of two pumps (2 nos. of 100%, 1W+1S) with all the necessary accessories, supports etc.</p>
3.2	Fuel oil Pumps	<p>For unloading fuel oil from the tanks and to directly fill the storage tanks and also to pump the fuel oil to the day storage tanks at the furnace end.</p> <p>The system consists of two pumps (2 nos. of 100%, 1W+1S) with all the necessary accessories, supports etc.</p>

Sr. No.	Components	Purpose/Description
4	Electrically operated overhead travelling crane	For maintenance of Turbine generator set EOT Crane and its components will be of heavy duty construction suitable for operation on continuous basis during maintenance of Turbine generator set. The crane will be of Class-2 classification. The design, manufacture, erection and testing of crane and hoists will be carried out as per the latest IS Standards and Indian statutory requirements.
5	Steel structures for Process Equipment	LoCal plus consist of combustion and flue gas treatment including with steel structure. Steel structural roof is covered at the top of boiler drum. Structural system provided for boiler, economizer and flue gas treatment supporting and suitable platforms are provided for the easy access.

### Theoretical Power Generation Potential

Quantity of MSW : 1200 TPD

Assumed Net Calorific Value : 1662.31 Kcal/kg

Assumed Conversion Efficiency : 24%

Energy Recovery Potential from 1200 TPD is estimated as per the following universally accepted general formula.

Total MSW quantity : W tones = 1200 TPD

Net Calorific Value: NCV Kcal/kg. = 1662.51 Kcal/kg

Energy recovery potential (kWh) =  $NCV \times W \times 1200/860$   
 =  $1.163 \times NCV \times W$   
 =  $1.163 \times 1662.31 \times 1200$

	=	2319919.8 Kwh
Power generation potential (kW)	=	1.163 x NCV x W/ 24
	=	1.163 x 1662.31 x 1200/24
	=	96663.3 kW
Conversion Efficiency	=	24%
Gross Generation potential (Minimum)	=	23199.19 kW
	=	<b>23.20 MW</b>
Auxiliary Consumption (16%)	=	3.71 MW
Net Sellable Power	=	19.49 MW

For theoretical power calculation, Assuming MSW net calorific value for power calculation is 1662.51 Kcal/kg. Calorific value will be adjusted by auxiliary fuel like LDF and MSW RDF which are easily available in local market.

**Technical specification: Waste to Energy (WtE) power plant consisting of two numbers of 600TPD boilers is designed to intake waste up to 1200 tons per day having a calorific value range from 1100 to 2200 kcal/kg. The Gross electrical power output is up to 23 MW for two lines operating within the Load Range Diagram.**

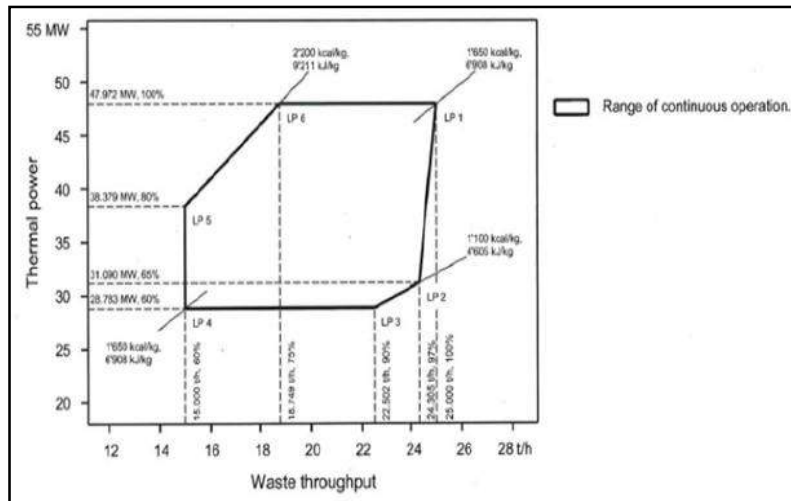


Figure No. 7.15 Load Range Diagram

### Detail Specification of Process Components

Technical specification / details of waste crane, incinerator, Boiler, corrosion diagram and flue gas treatment are as bellow

### Technical Data Sheet of Waste Crane

**Table no. 7.7 Technical Data Sheet of Waste Crane**

1	Number of Cranes	(2 No's) – One in Operation & One in Stand-by
2	Type	Semi-automatic overhead bridge crane with lotus grab
<b>3.0</b>	<b>Basic Data (each)</b>	
3.1	Lifting capacity	10 tons include dead weight of the grab
3.2	Grab dead weight	4.4 tons
3.3	Bridge Crane Span:	25.107
3.4	Crane run way length	25 m
3.5	Maximum Lift of Height:	29.0 m

3.6	Grab Capacity:	6.3 m <sup>3</sup>
<b>4.0</b>	<b>Maximum Speed</b>	
4.1	Hoist (Vertical) Travel	0-50 m/min
4.2	Trolley (Cross) Travel	0-70m/min
4.3	Crane (Long) Travel	0-60 m/min
<b>5.0</b>	<b>Power requirements (per crane)</b>	
5.1	Hoist (Vertical) Travel	90 KW
5.2	Crane (Long) Travel	18.5 x 2 KW
5.3	Trolley (Cross) Travel	7.5 KW
5.4	Grab Motor (KW)	25.5 KW
6	Control method	Remote control from crane control room
7	Operation method	Console and control panel

**Table no. 7.8 Technical Data - Incinerator**

Operation time boiler and grate 7500 h/year

Nominal waste throughput	LP1	25.000	t/h
	LP1	600	t/d
Nominal calorific value	LP1	6908	kJ/kg
	LP1	1650	kcal/kg
Thermal capacity at nominal load	LP1	47.97	MW
Minimum heating value	LP2	4605	kJ/kg
	LP2	1100	kcal/kg
Minimum waste input	LP2	24.305	t/h
<b>12 AA A1 Feed hopper with feed chute</b>			
Feed hopper			
- feed hopper capacity		55	m <sup>3</sup>

- dimensions of feed hopper opening (length x width)		10.1 x 5.6	M
- material thickness		12	Mm
- material		IS2062/SA 516 Gr 70	
Feed chute			
- cross section at top (length x width)		7.2 x 1.159	m
- cross section at bottom (length x width)		7.8 x 1.25	m
- material thickness		12	mm
- material		IS2062/SA 516 Gr 70	
<b>12 AA B1 Feed hopper cooling</b>			
Coolant		Water	
Method of cooling		Natural circulation	
<b>12 AA C1 Ram feeder</b>			
Number of ram feeders (linked up by control system)		3	
Type of drive		Hydraulic	
Stroke length		900 mm	
Material of ram feeder		heat resistant steel	
<b>12 AA D1 Grate</b>			
Type of grate		R-12578	
Grate data			
- grate inclination		18	°
- grate length		12	m
- number of parallel grate tracks		3	
- number of grate rows		6	
- drop in grate after row no.		2	
- total number of grate elements		18	
- grate track width		2.6	M
- total width		7.8	M
- usable grate area (including grate drop)		97.5	M <sup>2</sup>
- static grate surface load at nominal load	LP1	256	kg/(h*m <sup>2</sup> )

- thermal grate surface load at nominal load	LP1	492	kW/m <sup>2</sup>
Type of drive for grate elements		Hydraulic	
Number of hydraulic cylinders per grate element		2	
Stroke length of moving grate block row		150	Mm
Material of grate blocks		Cr-steel	
<b>12 AA F2 Primary air system</b>			
Combustion air fan (for primary, secondary and wall air)			
- number of fans		1	
- nominal air flow	LP1	91100	m <sup>3</sup> /h STP
- design air flow		105000	m <sup>3</sup> /h STP
- design air flow (of nominal air flow)		115%	
- pressure increase at design air flow		71.6	Mbar
- speed		1500	1/min
- type of air flow control		Variable frequency drive	
- electric motor rating		315	kW
- power consumption at nominal air flow	LP1	226	kW
- type of fan		Radial/Axial	
- mounting		single sided	
Combustion air preheater			
- 1st stage		Condensate sub cooler	
- 2nd stage		Condensate sub cooler (HP- 1)	
- 3rd stage		mid pressure steam (5 bara)	
- 4th stage		Condensate sub cooler (HP- 2)	

- 5th stage		high pr. Steam (sat. steam from boiler drum)	
- 6th stage		flue gas/air heat exchanger in 4th boiler pass	
- air flow at inlet (after extraction of wall air)		86100	m <sup>3</sup> /h STP
- design air temperature at inlet		30	°C
- design air temperature at outlet of flue gas/air heat exchanger		app. 290	°C
- temperature control method		steam pressure control / bypass flaps	
- type of heat exchangers		plain tubes	
- arrangement		Aligned	
- material of heat exchanger		St 35.8 / Equivalent IS material	
<b>Air ducts</b>			
- air velocity at nominal air flow	LP1	15	m/s
- number of control flaps (1 per grate zone)		6	
- material thickness of ducts		4	Mm
- material of ducts		St 37-2 / IS 2062 Gr B material	
<b>12 AA G2 Secondary air system</b>			
Secondary air fan		no fan	
- extraction from combustion air preheater		after MP stage	
- nominal air flow	LP1	25319	m <sup>3</sup> /h STP
- nominal air temperature		app. 125	°C
- type of regulation		Flap	
<b>12 AA H1 Wall air system</b>			
Side wall air fan		no fan	
- extraction from combustion		Before air preheater	
- nominal air flow	LP1	5000	m <sup>3</sup> /h STP

<b>12 AA L1 Oil-fired auxiliary burner</b>			
Number of burners		1	
Fuel		Light Fuel Oil	
Thermal power of burner		10.0	MW
Control range		1:5 continuous	
<b>12 AA P1 Hydraulic station</b>			
Supplied systems		Grate, Ram Feeder	
Hydraulic station			
- number of stations		1	
Hydraulic pump			
- number of pumps		2	
- constant operation pressure		140	bar
- electric motor rating		36.64	kW
Hydraulic oil cooler		ambient air	
- system		air cooled	
<b>12 AA Q1 Bottom ash extractor</b>			
Bottom ash extractor system		Plate Conveyor	
Number of extractors		1	
Design capacity of bottom ash extractor		9100	kg/h
Type of drive		E-motor	
Wear plate material		Steel	
Separate waste water collection			
- type		Basin	
- supply pump		1	
<b>12 AA R1 Grate riddling removal</b>			
Number of conveyors		1	
System		Submerged Drag Chain Conveyor	
<b>12 BA A1 Steam boiler</b>			
Operating period between two stops for boiler cleaning		4000	H
<b>Furnace dimensions</b>			
Furnace length (measured horizontally)		12.8	M

Furnace width		7.94	M
<b>Boiler design</b>			
Height 1st pass over feeder table		20.3	M
Depth of 1st pass (center of membrane wall tubes)		4.0	M
Width convection passes (center of membrane wall tubes)		8.1	M
<b>Flue gas at boiler exit</b>			
Nominal flue gas flow	LP1	111268	m <sup>3</sup> /h STP
Nominal flue gas temperature (slightly fouled ) boiler after 800 h	LP1	175	°C
Nominal flue gas composition:	LP1		
- CO <sub>2</sub>	LP1	7.8	Vol.-%
- H <sub>2</sub> O	LP1	19.9	Vol.-%
- O <sub>2</sub>	LP1	7.9	Vol.-%
- N <sub>2</sub>	LP1	64.3	Vol.-%
<b>Boiler cleaning</b>			
System		soot blowers	
Cleaning medium		Superheated steam	
Number of soot blowers		13	

**Table no. 7.9 Technical Data: Boiler Specification**
**1. Boiler Passes:**

		Heating Surfaces (summary of following pages)		
		Membrane wall	Convective surfaces	Total
		m <sup>2</sup> projected (ca.)	m <sup>2</sup> circumferential	m <sup>2</sup>
pass 1	furnace roof, pass 1	556	0	556
pass 2	vertical radiation pass	399	0	399
pass 3	vertical convective pass	435	1,780	2,215

pass 4	economizer and air heater	0	4,071	4,071
<b>Total</b>		<b>1,390</b>	<b>5,851</b>	<b>7,241</b>

## 2. Boiler Operation Data:

Nominal steam temperature at super heater outlet:	410	°C
Nominal steam pressure at boiler outlet:	46	Bara
Superheated steam generation at LP 1 (800 h/4000 h):	57.1 / 56.4	t/h
Steam extraction from boiler drum at LP 1:	0	t/h
Max. allowed continuous superheated steam generation:	60	t/h
Max. allowed continuous total steam generation *):	60	t/h
Max. allowed superheated steam temperature TS:	415	°C
Max. allowed pressure in boiler drum PS:	58	bara

(\*): superheated steam at outlet super heater + saturated steam extraction from drum

## 3. Desuperheaters:

Location downstream	number of desuper heaters	flow range water injection		
		Minimum per desuperh. t/h	Maximum per desuperh. t/h	Maximum total t/h
superheater1	1	0	4.0	4.0
super heater 2	1	0	4.0	4.0
Total	2	-	-	8.0

## 4. Boiler Drum:

cylindrical section		
Length	diameter outside	volume empty
9'960	1700 mm	19.5 m <sup>3</sup>

Remark: normal water level 50 mm above axis of drum

### 5. Start-up valve:

Max. capacity	10	t/h
at	360	°C
	40	Bara

### 6. Boiler cleaning devices:

pass 1	No cleaning device
pass 2	No cleaning device, 2 openings for later installation of shower cleaning system.
pass 3	6 soot blowers, fully retractable
pass 4	7 soot blowers, partly retractable (up- and downstream of each bundle)

### 7. Operating data 1:

<b>load point</b>				
waste	throughput	kg/h	25,000	
	LHV	kJ/kg	6,908	
		kcal/kg	1,650	
	thermal input	MW	47.97	
		%	100	
<b>Operating time after manual boiler cleaning</b>		H	<b>800</b>	<b>4000</b>
<b>Flue gas</b>				
throughput:		Nm <sup>3</sup> /h	110,850	
temperature:	adiabatic upstream SNCR	°C	1100	1100
	at limit refractory	°C	853	896
	inlet pass 2 (in vertical plane above collector)	°C	788.7	844.2
	inlet evaporator 1	°C	633.6	710.4
	inlet SH 3	°C	573.7	650.2
	inlet SH 2	°C	525.5	593.4
	inlet SH 1	°C	457.2	510.9
	inlet evaporator 2	°C	388.1	432
	inlet air heater pass 2	°C	360	399.2

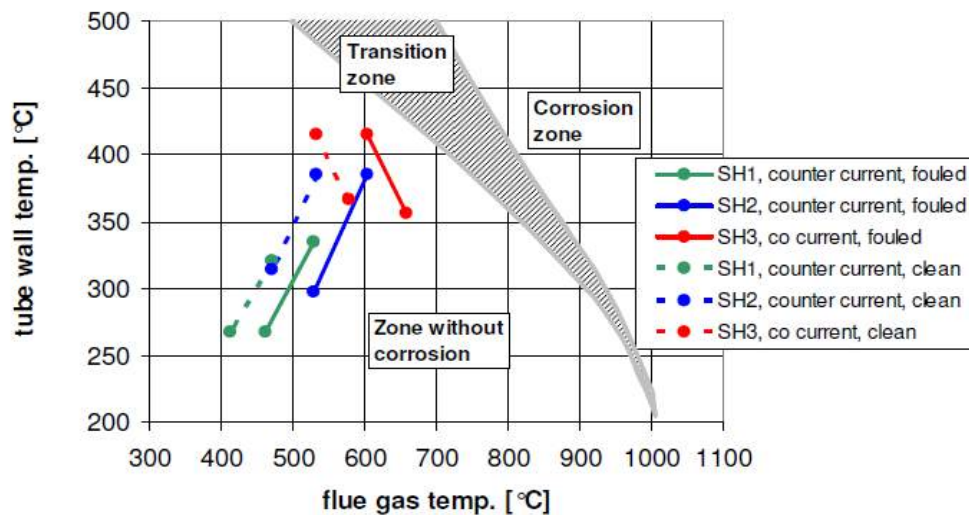
	inlet air heater pass 1	°C	343.9	383.5
	inlet eco 4	°C	316.7	356
	inlet eco 3	°C	262.2	301.9
	inlet eco 2	°C	231.5	256.8
	inlet eco 1	°C	202.4	219
	outlet eco 1	°C	175	187.3
velocity <sup>1)</sup> :				
	pass 1, at 1000 °C	m/s	3.9	3.9
	pass 2	m/s	4.4	4.6
	evaporator 1	m/s	4.2	4.5
	SH 3	m/s	3.8	4.1
	SH 2	m/s	4.1	4.4
	SH 1	m/s	3.7	4.0
	evaporator 2	m/s	3.6	3.8
	air heater pass 2	m/s	4.2	4.5
	air heater pass 1	m/s	4.1	4.4
	eco 4	m/s	4.3	4.6
	eco 3	m/s	3.9	4.2
	eco 2	m/s	3.7	3.9
	eco 1	m/s	3.5	3.6
<b>Water/steam</b>				
temperature:	inlet eco 1	°C	130	130
	outlet eco 1	°C	157	153
	outlet eco 2	°C	185	180
	outlet eco 3	°C	214	211
	inlet eco 4 (after mixing with bypass)	°C	187	211
	outlet eco 4	°C	223	248
	boiler drum / evaporators / inlet SH 1	°C	263	263
	outlet SH 1	°C	322	338
	inlet SH 2 (after injection 1)	°C	309	292
	outlet SH 2	°C	380	380

	inlet SH 3 (after injection 2)	°C	359	347
	outlet SH 3 (outlet boiler)	°C	410	410
velocity <sup>2)</sup> :	eco 1 – 3	m/s	0.18	0.24
	eco 4	m/s	0.28	0.27
	SH 1	m/s	12.8	12.3
	SH 2	m/s	15.4	14.7
	SH 3	m/s	21.7	21.2
throughput:	feedwater total	t/h	57.4	56.7
	Extraction for desuperheating	t/h	2.0	4.8
	Feedwater to eco	t/h	55.4	51.9
	eco 1 – 3	t/h	37.6	51.9
	bypass eco 1 – 3	t/h	17.7	0.0
	eco 4	t/h	55.4	51.9
	superheated steam	t/h	57.1	56.4
	continuous blow down	t/h	0.3	0.3
	injection for desuperheating	t/h	2.0	4.8
	extraction saturated steam from drum	t/h	0.0	0.0
pressure:	boiler drum	Bara	51	51
	outlet superheater 4	Bara	46	46
<b>Air heater</b>				
throughput air:		Nm <sup>3</sup> /h	31,100	26,300
	inlet air heater pass 1	°C	122	122
temperature:	outlet air heater pass 2	°C	294	325

velocity:	air heater pass 1	m/s	10	8
	air heater pass 2	m/s	12	10

Remark: blow down closed, soot blowers not in operation

**Figure No. 7.16 Corrosion Diagram**



**Table no. 7.10 Technical Specification: Flue Gas Treatment**

<b>14 LA SNCR system(options)</b>		
<b>14 LA A1 NH<sub>4</sub>OH injection (option)</b>		
Nominal ammonia consumption (25%)	LP 1	54 kg/h
MP steam (blowing and cooling): flow	LP 1	282 kg/h
MP steam (blowing and cooling): pressure	LP 1	5 bar
MP steam (blowing and cooling): temperature	LP 1	160°C
<b>14 AA Flue gas handling</b>		
<b>14 AA A1 Flue gas ducts, dry</b>		
Nominal flue gas flow (boiler exit to evaporation cooler)	LP 1	112178 m <sup>3</sup> /h STP
Nominal flue gas flow (fabric filter to stack)	LP 1	118244 m <sup>3</sup> /h STP
Flow velocity	LP 1	m/s
Material of flue gas ducts, dry		1.0037 ( IS 2062 Gr B)

<b><u>14 CA A1 Evaporation cooler</u></b>		
Nominal flue gas flow at entry	LP 1	112178 m <sup>3</sup> /h STP
Nominal entry temperature of flue gas		175 <sup>o</sup> C
Maximal entry temperature of flue gas		200 <sup>o</sup> C
<b>Dimensions:</b>		
Diameter		Approx. 5 m
Active Height (water injection to end of cylindrical section )		Approx. 16 m
<b>Water injection</b>		
Nominal water flow	LP 1	Kg/h
Maximal water flow		Kg/h
Nominal compressed air supply	LP 1	497 m <sup>3</sup> /h STP
Water content of flue gas at outlet	LP 1	21 Vol- %
Number of nozzles		6
<b><u>14 BA B1 Fabric filter</u></b>		
Maximal flue gas flow range at 100% load (continuous load)	LP 1	116035 m <sup>3</sup> /h STP
Maximal flue flow range at 110% load (peak load)	LP 1	128000 m <sup>3</sup> /h STP
Maximal flue gas flow range at 60 % load	LP 4	76523 m <sup>3</sup> /h STP
Entry temperature of flue gas at 100 % load		148 <sup>o</sup> C
Flue gas pressure at inlet		-7.9...-21.4 mbar
Gas side pressure loss at 100 % load between inlet and outlet		<20 mbar
Number of filter chambers		4
Number of filter bags in total		1280
Total filter area		3619 m <sup>2</sup>
Filter unit load at 100 % load		0.835 m <sup>3</sup> (min*m <sup>2</sup> )
Online cleaning method		Low pressure direct impact
Number of hoppers per fabric filter chamber		1
Number of hopper heaters per fabric filter		2

Electric power at 100% load per hopper heater		Approx. 11 KW
<b><u>14 AA C1 Induced draft fan wit variable frequency drive</u></b>		
Nominal flue gas flow at 100 % load (continuous load)	LP 1	118244 m <sup>3</sup> /h STP
Maximal flue gas flow at 115 % load (peak load)	LP 1	135981 m <sup>3</sup> /h STP
Minimal flue gas flow at 60% load	LP 4	79078 m <sup>3</sup> /h STP
Head total (continuous and peak load)		54/63 mbar
Entry temperature of flue gas		148°C
Electric rating main motor		500 KW
Sound pressure level at 1 m distance (ISO 3746)		85 dB(A)
<b><u>14 AA H1 Stack</u></b>		
Height		45 m
<b><u>14 JA A1 Hydrated lime supply</u></b>		
Discharge from the hydrated lime silo		
- Discharge method		Mechanical
- Quantity of silo discharge method		1
Supply system to process		
- Method of transport		Pneumatic
- Number of fans installed		1
<b><u>14 JA A1 Activated Carbon supply</u></b>		
Discharge from the hydrated lime silo		
- Discharge method		Mechanical
- Quantity of silo discharge method		1
Supply system to process		
- Method of transport		Pneumatic
- Number of fans installed		1

<b><u>15 CA Residue handling</u></b>		
<b><u>15 CA A1 Discharge of boiler fly ash and residues</u></b>		
2 <sup>nd</sup> / 3 <sup>rd</sup> boiler pass (super heater area)		
- Transport system to bottom ash expeller		Drag Chain Conveyor
- Number of conveyors		1
- Sealing to the environment		Double Flap valve
- Number of double flap valves		1
4 <sup>th</sup> boiler pass (Economiser)		
- Transport system to bottom ash expeller		Drag Chain Conveyor
- Number of conveyors		1
- Sealing to the environment		Double Flap valve (RAL)
- Number of double flap valves		1
Un burnt in boiler ash (measure as TOC)		1.5
Residue from flue gas treatment		
- Transport system to bottom ash expeller		Drag chain conveyor
- Number of conveyors		4
- Sealing to the environment		Rotary Valve
- Number of rotary valves		2
<b><u>15 CA G1 Residue Silo</u></b>		
Capacity		100 m <sup>3</sup>
- Exhaust filter		1
Discharge from the residue silo		
- Residue discharge method		Volumetric
- Quantity of mixing and moistening screw conveyors		1
- Screw conveyor, electric motor rating		Approx. 11 KW

<b>16 EA E1 Storage of solid additives(hydrated lime)</b>		
Quantity of filling stations		1
- Filling method		Conveying system
Silo for hydrated lime		
- Gross capacity		100 m <sup>3</sup>
- Exhaust filter		1
<b>16 EA E1 Storage of solid waste additives(activated carbon)</b>		
Quantity of filling stations		1
- Filling method silo		Small bags
- Gross capacity		1 m <sup>3</sup>

## Power Evacuation and Electric System

### 1. Power Evacuation

The system is designed for 132KV evacuation. The power generated at the generator terminals is at voltage level of 11 KV and will be stepped up to 132 KV, the voltage at which the plant evacuates power to the national grid. Hence, a 132 KV switch yard is proposed at the plant side and to evacuate power.

The plant will be provided with black start cum emergency source supply at 1200 KVA, 415V, 50 Hz, 3 Ph from Diesel Generator. We will consider an Emergency Board with Incomers & outgoing feeders for catering to AC Emergency drives & emergency lighting requirement.

Power evacuation point is nearly 6 km from point of power generation.

### 2. Electric System

Electric system is one of the major component of WTE power plant. The system is designed for 132 KV evacuation. 11 KV power is generated at power generator terminals and will be stepped up to 132 KV as national grid voltage. The brief description of electric components in power evacuation is as follow;

Table No. 7.11 Descriptions of components of Electric system

Sr. No.	Components	Purpose	Description
1	<b>132kV Switchyard</b>	To evacuate power to the grid	The 132kV switchyard is a single bay of outdoor type air insulated. The switchyard consists of SF6 circuit breaker of outdoor type, isolators, LA's, CT's, PT's, control and relay panel.
2	<b>Generator and Auxiliary transformers</b>	To supply power to plant auxiliary loads and To supply power to plant auxiliary loads	The Generator and Auxiliary transformers are located outside the turbine hall in individual compounds designed to minimize the risk of fire spreading from one to another.
3	<b>HT Switch Gear</b>	To facilitate synchronization with grid	Designed the HT switchgear with min. two no. of 11 KV breakers in 11 KV switch board to facilitate synchronization of the turbo-alternator & evacuate power by stepping up the generation voltage at 11KV to 132 KV along with the switch gear & protections as per Electricity Board regulations.
4	<b>LT Switch Gear</b>	To distribute, control and supply of power to plant auxiliary loads	Designed the main LT Power control center with required no. of outgoing feeders to supply auxiliary power requirement to power plant auxiliaries.

Sr. No.	Components	Purpose	Description
5	<b>Power and Control Cables</b>	To supply and control of power to plant loads	<p>The power/control cables are of Aluminum/copper conductor, of XPLE /PVC insulated armoured/un armoured type.</p> <p>Power Cables up to 4 sq.mm shall be of copper conductor and aluminum for above with cable derating factor of 0.7</p>
6	<b>Cable Trays</b>	For instrumentation cables perforated cable trays will be used.	<p>Cable trays will be ladder/perforated type construction. There will be a maximum spacing of 2500 mm between cable tray supports, except fittings (elbows, tees, etc.) which will be supported at each splice.</p> <p>Cable tray fittings will have a radius equal to and greater than the minimum bending radius of the largest cables they contain.</p>
7	<b>Grounding</b>	To protection of the equipment and plant personnel from electrical fault.	<p>The station grounding system will be an interconnected network of GI flat and GI Earth electrode. The system will be provided to protect plant personnel and equipment from the hazards, which may occur during power system faults and lightning strikes.</p>
8	<b>Lighting</b>	To provide general and emergency	Suitable illumination necessary to facilitate normal operation

Sr. No.	Components	Purpose	Description
		lighting for complete plant excluding compound wall lighting.	and maintenance activities and to ensure safety of working personnel will be provided. This would be achieved by artificial lighting.
9	<b>Diesel Generator</b>	To supply black start cum emergency supply to auxiliaries of Turbo-generator and emergency lighting for start-up and safe shutdown purposes	The plant will be provided with Black start cum emergency DG set source supply at 800 KVA, 415V, 50 Hz, 3 Ph from Diesel Generator. We will consider an Emergency Board with Incomers & outgoing feeders for catering to AC Emergency drives & emergency lighting requirement.

### Water Requirement

To run 1000 TPD Hitachi Power plant nearly 1500 M<sup>3</sup>/ day water is required. For safer side two days requirement of whole plant i.e. 3000 m<sup>3</sup>. The raw water will be filtered in the multi grade filter for further use of plant.

### Expected Data used for balance Calculation

Table No. 7.12 Expected Data used for balance calculation

Boiler blow down of live steam	0.5 %
W/S cycle losses @ LP 1 (4000 h)	1.0 %
Steam soot blowers @ LP 1 (4000 h)	2.5 %
Water treatment blow down of make up	30.0 %
Water in bottom drain (% water in waste)	0.0 %
Partly cleaned waste pit drain to process	100.0 %

Humidification of residues (% of residues)	10.0 %
Cooling ( generator/turbine tube oil); % of generator power	6.0 %
Blow down of generator/turbine cooling	30.0 %

### Man Power Requirement

For execution of 1000 TPD capacity Hitachi Zosen power plant nearly 103 man power required including management, engineering, account and work force as follow;

Table No. 7.13 Details of man power requirement

Sr. No.	Details	No.'s
1	Plant Head	1
2	Civil Engineer	1
3	Civil Supervisor	1
4	Mechanical Engineer	1
5	Mechanical Shift Engineer	4
6	Electrical Engineer	1
7	Electrical Shift Engineer	4
8	Instrumentation Engineer	1
9	Instrumentation Shift Engineer	4
10	Admin Officer	1
11	Account Officer	1
12	Store + Material Coordinator	2
13	Health and Safety Engineer Officer	1
14	Work Man	70

Sr. No.	Details	No.'s
	<b>Total</b>	<b>103</b>

## Time frame

Table No. 7.14 Proposed Time frame

Project Key Dates - 24 Month Schedule	
Milestones	Month from NTP
NTP/ Date of Financial Closure	0
Start of Civil Works	1.7
Start of Heavy Erection	8.5
End of Heavy Erection	13.1
Boiler Pressure Test	14.9
Cold Commissioning	16.8
Hot Commissioning	18.6
First Fire	19.7
First Synchronization	20.8
Start of Trial Run	22
End of Trial Run	24

### Note:

1. Zero date will be considered from the date of NTP for Statutory applications, its approvals, designs and drawing for project activities.
2. Zero date will be considered from the date of financial closure for Physical construction of plant activities, ordering and procurement.

### 7.4 ISWM facility & Sanitary landfill:

ISWM means Integrated Solid Waste Management Facility is a Centralized Facility or a Decentralized Facility servicing other ULBs nearby which are

planned in the cluster, as a cluster approach. It consists of processing plant and plant for disposal i.e. engineered secured landfill. Some of the major features of Integrated Solid Waste Management can be listed as follows:

- Holistic approach to the waste streams thus maximizing synergetic benefits in collection, recycling, treatment & disposal.
- Maximize the opportunities for resource recovery at all stages from generation to final disposal
- Accommodate aspirations of all stakeholders from waste generators to waste management and service providers
- Facilitate life cycle view of products and materials; thus, promoting greater resource use efficiency
- Integrate different response functions such as technical, managerial, financial, policy etc.
- Greater local ownership & responsibilities/participation through a consultative approach.

Following is the criteria for setting ISWM & disposal facilities:

- A detailed survey of State / UT with positioning of city / town / village and distance between them.
- Based on local condition, fixing of criteria by the local body to transport the waste for common disposal point without causing public nuisance and traffic hurdles.
- An adequate size of land will have to be acquired which should be free from public objection. Common facility should not have settlement at least 3-5 km from its periphery.
- Common facility should be 'integrated' with facilities for sorting, compost, RDF and energy plant and followed by inert recycling / reuse. Only a fraction of inert waste should go for land filling. FLY ash generated from Plant will be used as brick manufacturing.

## About Adampur Chhawani

For the ISWM & sanitary land filling of solid waste from Bhopal & other ULBs, Adampur Chhawani site has been selected. This site has area of 63 acres and it is located 16 km from Bhopal. The proposed site has little or no vegetation with a small number medium sized tree sparsely located. Thus the site does not involve removal of vegetation or tree cover. A few human settlements (about 10-15 kuchha houses) have encroached over the site over the last few years and these would need to be suitable. A suitable buffer distance should be maintained between the proposed site and the farmlands to ensure minimal adverse impacts.

A leachate treatment facility will have to be provided for the landfill section of the site where residual waste will be scientifically land filled. The operation of the ISWM site functions will require consumption. Technology selection, operation should consider energy efficiency as one of the primary performance area to reduce the footprint of the facility.

Sanitary Landfill (SLF) is the ultimate destination of rejects after processing. An Integrated Solid waste management facility consists of MSW Processing facility, SLF, Leachate Treatment facility, weighbridges, workshop, green belt and other ancillary infrastructure

The table below presents salient features of the site with respect to its suitability for development of an ISWM facility as per the recommendations of CPHEEO guidelines:

Figure No. 7.17 Site photographs of Adampur Chhawani



Table no. 7.15 Silent features of ISWM site

Location Criteria			
	Aspects	Exclusion limit/Desired criteria	Proposed site
A	Proximity to residential, recreational, agricultural, natural protected areas or wildlife habitat & areas prone to scavenging wild life as well as other potentially incompatible land use.		
1	Residential Development	250 m from the proposed landfill cell development	Yes. Induced due to Brick kiln adjacent to the project site
2	Airport	20 km from the proposed landfill site	Raja Bhoj International Airport is located almost 20 km aerial distance from the landfill site.
	Private /public drinking, irrigation or livestock water supply wells located down gradient of landfill	500 m from site parameter	No water bodies utilized for Private /public drinking, irrigation or livestock water supply are located within 500 m from site.

<b>Location Criteria</b>			
	<b>Aspects</b>	<b>Exclusion limit/Desired criteria</b>	<b>Proposed site</b>
1	10 year ground water recharge area for existing or pending water supply development	Outside the landfill site	No ground water recharge area for any water supply development (existing/proposed) is located within the site.
2	Perennial stream	300 m down gradient of the proposed landfill cell.	No perennial stream is located within 300 m (down gradient) of the site.
1	Topography	Located in gently sloped topography, amenable to development using the cell(bund) method, with slopes which minimize need for earthmoving to obtain correct leachate drainage slope of about 2 %	The site is a flat land has a small gradient slope towards south
2	Groundwater's seasonally high table level(i.e. 10 year high)	At least 2.0 m below the proposed base of any excavation or site preparation.	Not detected up to 10 m depth from the surface.
3	Suitable soil cover material	Available in-site to meet the needs for intermediate and final cover, as well as bund construction	Cover material will be available at site resulting from cut-fill operations for developing the facility or C& D waste can also be utilized after crushing.
1	Flood plain	Outside of floodplains subject to 10 yr. floods	Site is not located in flood plain

<b>Location Criteria</b>			
	<b>Aspects</b>	<b>Exclusion limit/Desired criteria</b>	<b>Proposed site</b>
		and if within areas subject to a 100 yr. flood, amenable to economic design to eliminate potential for washout	
2	Seismic risk	No significant seismic risk within the region of the landfill which could cause destruction of berms, drains or other civil works	The region falls in the seismic zone II and is under least active category.
3	Fissured or other porous rock formations	No underlying limestone, carbonate, fissured or other porous rock formations which would be incompetent as barriers to leachate and gas migration	The presence of sandstone beneath the top soil but no limestone, carbonate were detected.
<b>MSW Rules,2000 - 2016</b>			
1	The landfill site shall be away from habitation clusters, forest areas, water bodies monuments, national parks, wetlands and places of important cultural, historical or	Not specified	No such features were observed within 500 m of landfill site.( except for temporary habitation i.e. brick kiln workers)

Location Criteria			
	Aspects	Exclusion limit/Desired criteria	Proposed site
	religious interest		
2	A buffer zone of no-development shall be maintained around landfill site and shall be incorporated in the Town Planning Departments land-use plans	Not specified	Will be complied

### **Design of SLF Landfill:**

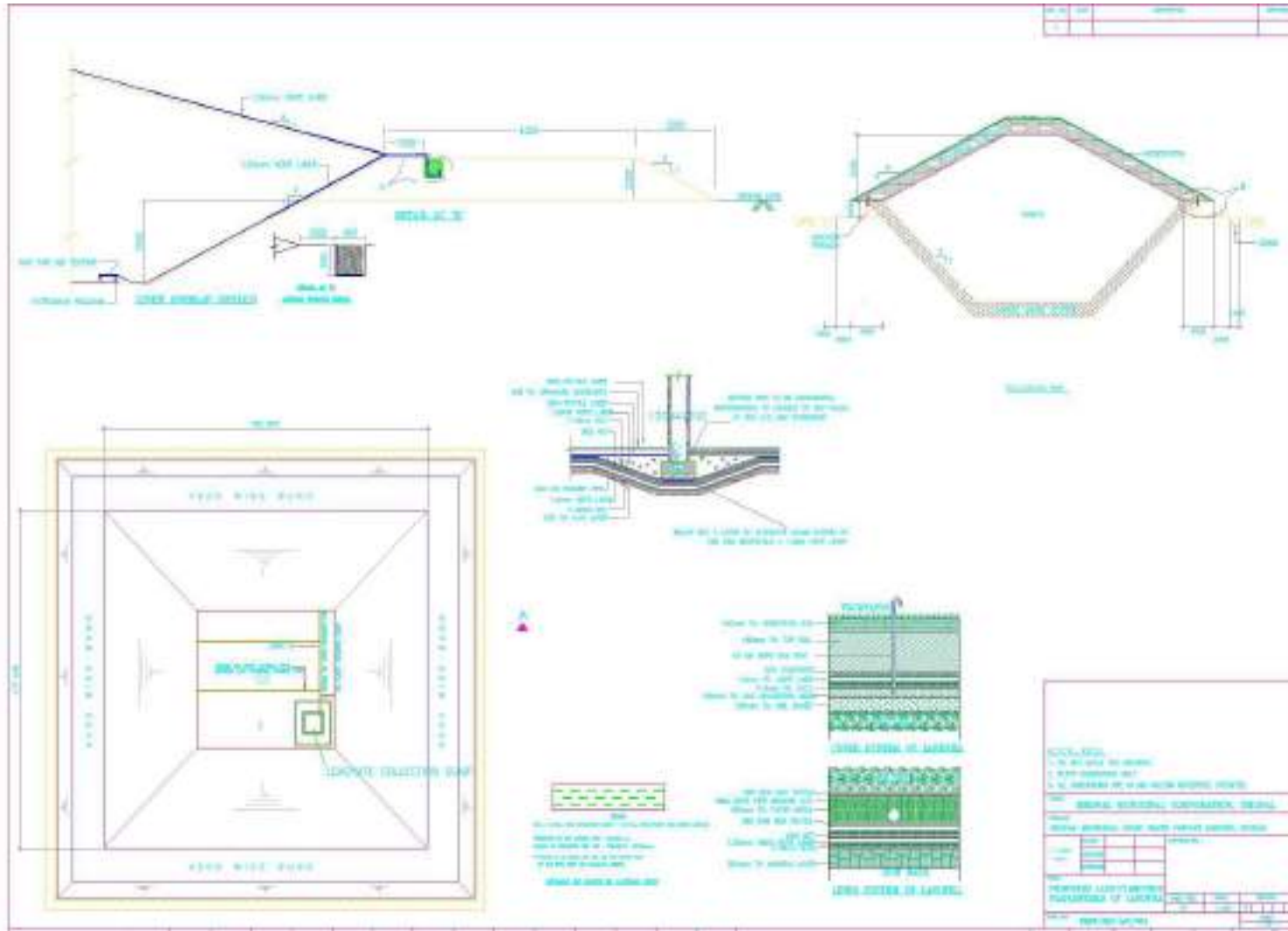
For the design of Sanitary Landfill following assumptions have been made:

- The landfill shall be constructed and ready to accept waste by 2 years from the date of contract award i.e. 2018. Till that period, MSW shall be either managed in existing Bhanpura dumpsite or a piece of land in the proposed Aadampur landfill site can be used to store the waste temporally.
- MSW collection efficiency or the amount of MSW actually reaching the ISWM facility shall be 80 % till year 2021 i.e. first 5 years from the project start date, the 85 % for the next 2 years i.e. 2022 & 2023 and 90 % from year 2024 onwards;

- Life of the landfill shall be 20 years, i.e. from 2018 to 2027 and 2028 to 2037.
- W2E plant shall generate 25 % dry Ash rejects(wrt input raw waste by weight)which shall be land filled completely although it is desirable to use the ash full/partly to produce pavement blocks/other useful material to minimize the quantity of rejects ultimately going to the landfill.

:

Figure showing how SLF design will be like



## **Design of Bottom liner, Top cover & related Infrastructure:**

Base liner and top cover system has been designed based on CPHEEO manual for designing top cover system with active LFG collection system. The proposed top cover system consists of:

1. Base Liner: A typical single liner system has been proposed for the SLF. Each layer of the proposed bottom liner(from bottom to top) has been discussed below-
  - a. A 900 mm and 450 mm thick compacted clay or amended soil of permeability not greater than  $1 \times 10^{-7}$  cm/sec on the bottom and side slope respectively.
  - b. A HDPE geo-membrane liner of thickness 1.5 mm on the bottom and sides.
  - c. Protection layer of geo-textile at least 500 mm or 200 mm thick gravel free soil layer.
  - d. A drainage layer of 300 mm thick granular material of permeability not greater than  $10^{-2}$  cm/sec on the bottom.
  
2. Top cover: The proposed liner consists of 3 layers, where each layer has different function. The bottom most layer is 45 cm thick granular soil, which will act as porous media to retain landfill gas to facilitate further transfer to gas collection pipes for venting. The intermediate layer is 60 cm compacted clay or amended soil with coefficient of permeability less than  $10^{-7}$  cm/sec and a 1.5 mm HDPE liner. Purpose of intermediate liner is to act as impervious barrier to confine the underlying waste. The barrier layer prevents rain water from entering into the waste thus preventing leachate formation. The HDPE line is further protected by 20 cm protection layer, followed by drainage layer of 30 cm thickness. The rainwater from top and slopes is drained through proposed storm water

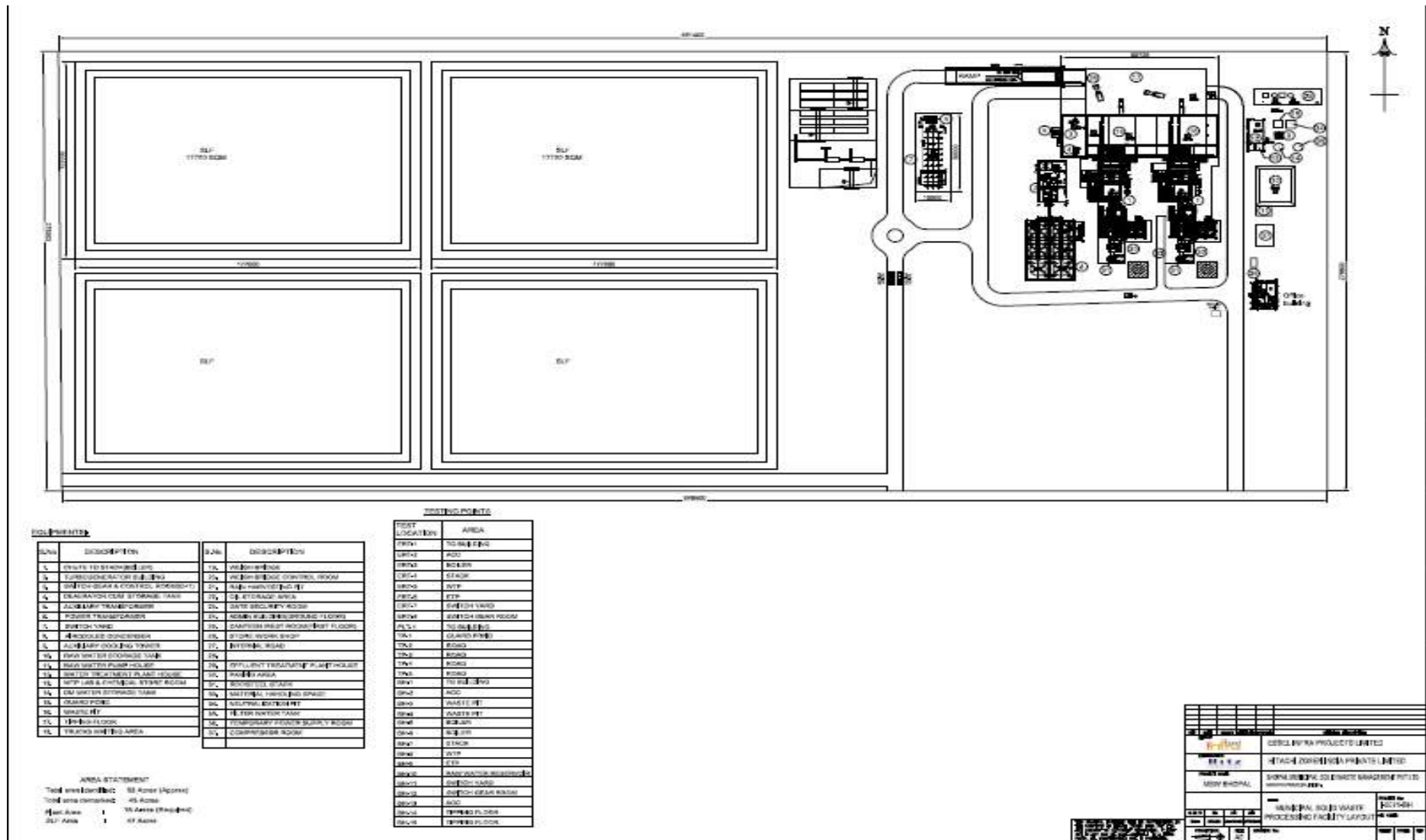
drains. The top most layer is 30-45 cm thick vegetation layer consisting of fertile soil for greenery.

3. The proposed SLF shall consist of 2 cells of capacity 41.36 % and 58.64 % and life 2018-27 & 2028-2037 respectively.

Table no. 7.16 Area Statement of Adampur Chhawani

Total area	63 acres
Plant area	16 acres
SLF area for 20 years + green belt	47 acres

Figure No. 7.18 The detailed layout of site



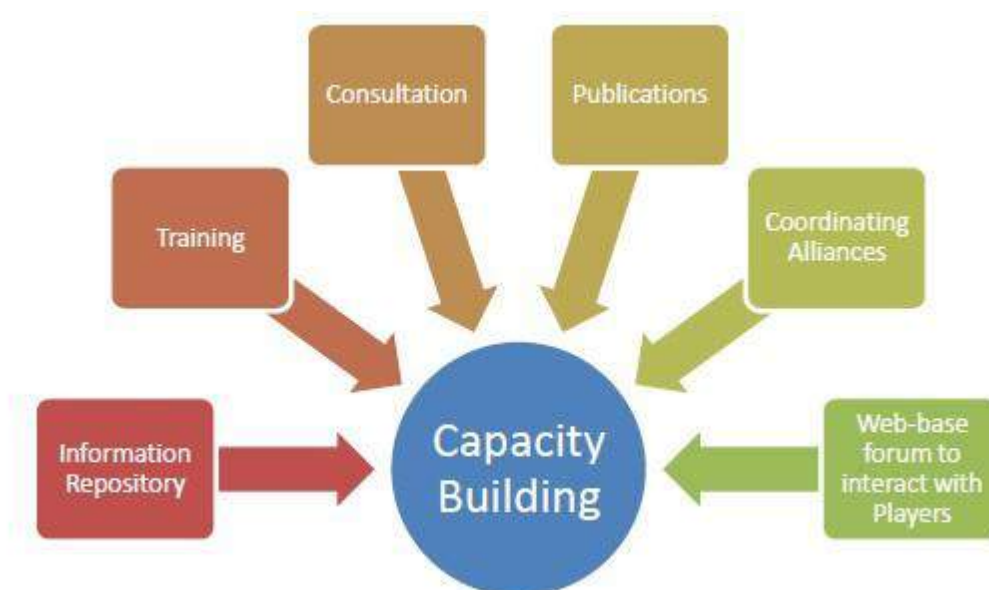
## CHAPTER NO.8 INFORMATION, EDUCATION & COMMUNICATION (IEC)

### 8.1 Introduction

In the process of waste management handling and processing, it is important that all relevant stakeholders are well informed so that the end to end management is well planned. The introduction of information, education and communication (IEC) and capacity building greatly assist in creating windows for knowledge dissemination as well as create a human resource who are apt in sustainable waste management. IEC is not a one-time activity. IEC strategy and plan have to be implemented. The improved standards of living and the extent of commercialization in the cities have significantly changed the consumption patterns and thereby the waste composition. The inability to fully grasp the problems of waste generation and characterization have resulted in transforming Solid Waste Management as one of the most compelling problem of urban environmental degradation.

The IEC process creates systems which are beneficial for the entire supply chain. Each stakeholder has a specific role to play for which IEC is imparted in a phased manner.

Figure No 8.1 capacity building in MSW



The IEC process enable conducive environment for the company who has been entrusted for C & T as well as P & D of the wastes.

Information, Education and Communication (IEC) has to inform, educate and persuade people to realize their roles and responsibilities, and benefits accruing from investing in right practices The focus of any communication activity should be on awareness, sensitization and motivation of people to follow right waste management practices.

In terms of the waste segregation at source, IEC can play a very important role. Proper sensitization of the community and Resident Welfare Associations (RWAs) can greatly enhance the efficiency of waste processing even for waste to energy wastes and improve the productivity of the ground workforce.

IEC can also provide necessary platform for ensuring safety as well as well-being of the workers and management involved in day to day operations as well as plant operations.

The IEC (Information, Education and Communication) is an important element to improve city Solid Waste Management. Popular methods of IEC are:

- Door to Door Awareness campaigns (handouts/ paper bags with messages/ stationary with messages);
- Public events (Environment day, Health day, Clean-up drives, Ward Sabhas etc.);
- Competitions, awards for localities, public places, malls, innovative initiatives;
- Capacity building of staff and other informal stakeholders through onsite and offsite training and visit to best practices, and
- Mass Communication tools like Rallies, Street Plays, Skits, Hoardings, Banners, Theatres, Radio Jingles, Local Cable Network, Telephone

Ringtones/Jingles tie-up with Telecom Companies, Lectures at schools and colleges.

## 8.2 Objectives of IEC

The strategy addresses all sections of rural population to bring about the relevant behavioral changes for improved waste management practices and meet the collection and transportation requirements in an affordable and accessible manner by offering a wide range of technological choices.

Figure No 8.2 Essential Steps for Public Participation, Source: JNURM Toolkit



## 8.3 Delivery of IEC

IEC is generally delivered through various innovative solutions. These are often supported by audio visual aids as well as expert interventions. IEC delivery can be done in several ways such as

- a) Public announcements
- b) Print (Newspaper) coverage
- c) Visual Media coverage
- d) Social Media engagement
- e) Awareness and Sensitization Workshops
- f) Seminars
- g) Informal group discussions
- h) Meetings with stakeholders

- i) Creative contents such as street plays, small documentaries, posters j.  
Star attraction

These are described below:

### **8.3.1 Public announcement**

These are carried out in a small vehicle fitted with necessary equipments for lane to lane delivery of relevant content to the public including households and commercial establishments. These generally carry the message for systematic collection of wastes, general information about waste management. However, these have to short about 2 minutes.

### **8.3.2 Print (Newspaper) coverage**

This is an effective medium for dissemination information about the project, features it offers to the public, and links for obtaining more information and key contacts

### **8.3.3 Visual Media coverage**

This can be one of the platforms for airing relevant content such as documentaries, commentaries as well as interviews of key personnel who would communicate technical contents in a simplified manner to the public and other stakeholders. Visual media can also help in spreading communication among the public about the entire process of C & T.

### **8.3.4 Social Media coverage**

This is very emerging field for obtaining feedback from public as well as connects with younger generations who could assist in improving the effectiveness of the waste management system. Any new feature of any technology can be shared in short time. Any changes in any aspect of the collection and transportation can be easily communicated to the public.

### **8.3.5 Awareness and Sensitization workshops**

These can be of great assistance especially for apartments and RWAs for connecting with the C & T agency and ensuring greater transparency in operations and financial collections. These also help in creating awareness among the public regarding the cycle of waste management, laws and regulations associated with municipal solid wastes. Sensitization workshops with the operational workforce can be done for several issues such as health and safety, environmental conservation, productivity, optimum collection procedures, etc. There is also a dire necessity to integrate the informal sector (comprising of rag pickers, illegal or unauthorized recyclers) into the mainstream waste management process as they handle a substantial amount of waste generated, without the requisite environmental safeguards (UNEP).

### **8.3.6 Seminars**

These can be organized with a larger group involving Government agencies, Semi-Government agencies, NGOs, Workers Unions, etc. for getting them on the same page. These can also be organized for school children and college goers for getting them understanding the macro as well as micro aspects of the waste management collection and transportation as well as providing them with key features so that the message is carried to their respective households. Seminars can also be organised for showcasing the challenges as well as success stories from wards.

### **8.3.7 Informal Group Discussions**

These can be carried out by supervisory staff with the residents, market shop owners, associations and statutory authorities for general feedback and mindsets prevailing at a fixed point of time on the collection and transportation operations among the stakeholders. These can act as inputs for improving finer

aspects of the operations and ensure that there is adherence to the techno-commercial targets as practically as possible.

### **8.3.8 Meetings with stakeholders**

These are formal organized meetings with stakeholders for informing about plans and programs as well as obtain necessary feedback and suggestions on any aspect of the collection and transportation.

### **8.3.9 Creative contents such as street plays, small documentaries, posters**

These are powerful medium for reaching to public who are at a lower level of education but play an important role in the waste management process. These also help public in understanding the importance of a proper waste management process in cities such as Ranchi.

### **8.3.10 Star Attraction**

Stars such as well-known public figures & celebrities can be utilized for spreading the message of an effective waste management in the city and keep it sustainable. It can connect with larger mass about the role it has to be play so that the MSW C & T is highly effective and efficient.

## **8.4 Similar initiatives**

There are very good examples of IEC guidelines. One such is published by the Urban Development Department, Directorate of Urban Development, Shimla of the Government of Himachal Pradesh

Excerpts are provided below:

Solid Waste Management is an activity in which volunteerism and public participation are the keys to success. It is not only the technology but public attitude and behavior that are going to make the difference. An IEC Plan focusing on solid waste management will therefore basically aim at the

following: Creating behavioral change (BCC) for scientific waste disposal. This will include

- 1) adoption of the 4R concept-reduce, reuse, recycle and recover the waste
- 2) storage and segregation at source
- 3) imbibing the civic responsibility of keeping the premises clean
- 4) willingness to accept the civic responsibilities of citizens, and
- 5) Willingness to part with the ad hoc approach of unscientific solid waste disposal.
- 6) Awareness creation on the ill effects of unscientific SWM. E.g., (i) health hazards (ii) aesthetic damage (iii) environmental issues etc.
- 7) Awareness creation on the various technical options of solid waste management and exploring the possibility of converting wastes as a resources.

Figure No 8.3 IEC methods, Source: JNURM Toolkit



## 8.5 Example of IEC material

Figure No 8.4 IEC material for Segregation of Solid Waste

PROPER SEGREGATION OF SOLID WASTE		
Type of Wastes	Recyclables	What You Should Do
<p><b>PAPER</b>            Clean and dry paper such as folders, bond paper, newspaper, magazines, etc.            Corrugated boards, carton boxes of pizza, soap, toothpaste, shoes, etc.</p>		<ul style="list-style-type: none"> <li>* Separate white paper from colored paper</li> <li>* Fold carton boxes to save space</li> <li>* Do not let garbage collectors gather paper wastes when it rains. Paper, once wet, becomes compostable.</li> </ul>
<p><b>PLASTIC</b>            Softdrink PET bottles, bottles of mineral water, ketchup, soy sauce, cooking oil, noodles, shampoo, alcohol, etc.            Broken manoblock tables and chairs, basin, PVC pipes, and other hard plastic</p>		<ul style="list-style-type: none"> <li>* Wash or soak your plastics, cans, bottles and broken glasses in water recycled from washings to clean and prevent insect infestation.</li> <li>* Let the plastics dry before placing them in a recyclable container</li> </ul>
<p><b>STEEL</b>            Aluminum containers like softdrinks-in cans, ice cream and biscuit cans, etc.            G.I. Sheet (Fera), aluminum gutter, brass, copper, washer, stainless steel, scrap metal, etc.</p>		<ul style="list-style-type: none"> <li>* Fold or cut the steel to save space.</li> </ul>
<p><b>BOTTLES OR GLASSES</b>            Bottles of beer, gin, softdrinks, juice, vinegar, soy sauce, catsup, peanut butter, coffee, etc.            Broken glasses and bottles</p>		<ul style="list-style-type: none"> <li>* Place bottles/broken glasses in a sturdy container</li> <li>* One glass color per container</li> </ul>

## 8.6 Guidelines for Swachh Bharat Mission (SBM)

SBM guidelines are covered in section 7, SBM (Urban) Component IV: Solid Waste Management

Municipal Solid Waste Management (MSWM) refers to a systematic process that comprises of waste segregation and storage at source, primary collection, secondary storage, transportation, secondary segregation, resource recovery, processing, treatment, and final disposal of solid waste. The Manual on Municipal Solid Waste Management, 2000-2016 published by M/o UD and revised from time-to-time, may be referenced for DPR formulation and implementation.

ULB's are to prepare DPR for Solid waste management of their city in consultation with state governments. Smaller cities can form clusters to become viable entities to attract private investment. 100% Cost reimbursement for preparing the DPR shall be done by GoI as per unit cost and norms set up by NARC.

State governments may handhold ULB's in quickly preparing DPR's for SWM by empaneling /shortlisting /identifying private or government agencies for the same.

The DPR's should be bankable, having a viable financial model. These will be prepared emanating from the needs identified in the City Sanitation Plan. DPRs should be aligned with Govt. of India's goals outlined in the NUSP 2008, SWM rules, advisories, CPHEEO manuals (including cost-recovery mechanisms), O&M practices and Service-level Benchmark advisories released by M/o UD from time to time.

Street Sweeping and litter control interventions will be part of DPR which is essential for a clean city.

In order to promote projects of waste to energy, it is clarified that the central government Grant / VGF may also be used for such projects, either upfront or as generation based incentive for power generated for a given period of time.

The State High Powered Committee (HPC) will authorize institutes of national repute for appraisal of DPRs for the technical and economic appraisal of DPRs for projects recommended by ULBs. No appraisal will be done by MoUD. The cost of DPR appraisal by these institutes shall be an admissible component under administrative costs, subject to norms as approved by MoUD.

The performance and quality of appraisal by these identified and authorized institutes will be evaluated and monitored by HPEC as well as NARC and corrective actions taken wherever necessary.

The State Level high power committee will approve the DPR as well as the financial model of solid waste management.

The implementation of SWM projects will be as per directions of State Level High Power Committee.

Central government incentive for the SWM projects will be in the form of a maximum of 20% Grant / VGF for each project. The remaining funds have to be generated as indicated in para 2.6 above.

While considering projects under MSWM it will be ensured that there is no duplication in terms of funding under any other scheme or programme.

Detailed technical and financial appraisal of the DPRs will be carried out in the manner prescribed in paragraph 10.5.4. O&M arrangements for the project shall necessarily be an integral part of the project in the DPR.

SWM projects will be sanctioned by the State level HPC which shall include a representative of the MoUD. In the entire project approval and procurement process, all provisions and procedures as prescribed by respective State Governments must be followed in their entirety. The entire approval procedure for MSW projects except for release of Central funds will end at the State Level.

The States shall be free to choose the technology for SWM projects, toilets and street sweeping. The Ministry of Urban Development shall, from time to time, bring to the notice of the States, through advisories and manuals, and other consultative mechanisms, various options available in these fields.

States will contribute a minimum of 25% funds for SWM projects to match 75% Central Share. (10% in the case of North East States and special category states)

## CHAPTER NO.9 ENVIRONMENT MANAGEMENT PLAN

### 9.1 Construction Phase:

Construction Environmental Management Plan (CEMP) is aimed at mitigating the possible adverse impact of a project during construction Phase and for ensuring to maintain the existing environmental quality. The CEMP converses all aspects of planning and construction of the project, which are relevant to environment. It is essential to implement the CEMP right from the planning stage and then continuing it throughout the construction stage.

Therefore the main objective of the CEMP is to identify the project specific activities that would have to be considered for investigation of the significant adverse impacts and the mitigation measures required.

The specific measures that shall be put to practice to minimize the impact on the environment are discussed below:

#### 9.1.1 Air Environment

- Provision shall be made for sprinkling of water on loose soil to avoid dust generation.
- The debris and unutilized construction material and earth from the construction site shall be removed immediately to recycle within the project so that no nuisance dust is generated due to wind.
- The vehicles shall be checked for vehicular emissions.
- The mitigation measures shall include regular maintenance of machinery and provision of personnel protective equipments to workers where needed.
- A Leachate Treatment Plant with tertiary level of treatment shall be provided to avoid any odor pollution from the Leachate generated from the Plant.
- Extensive plantation to mitigate the impact of noise and to improve the ambient air quality shall be provided.

### **9.1.2 Water Environment**

- Construction work requires large quantities of water to be used in various processing plants for material preparation; curing purposes, cooling water in equipments, domestic usages in colonies, etc. wastewater will be generated in various forms in the processing plants and workshops. Additionally, during the construction work, muck transportation and transportation of materials.
- The run-off during development shall be controlled by removing construction related solid waste as construction debris, loose soil, etc.
- A septic tank shall be provided with toilet facilities to meet the daily needs of labor during working hours. Workers shall be discouraged from toilet in open.
- Both roof top rainwater harvesting and storm water run-off shall be tapped for recharging the aquifers and storage.

### **9.1.3 Land Environment**

- To avoid erosion of the top soil the development shall be planned to be done in the shortest possible time and land clearing activity shall be kept to the absolute minimum by working at the specific sites one by one to take place so as to increase detention and infiltration.
- The activities that result in soil being laid bare shall be scheduled in such a way that some type of vegetative cover appropriate to the site shall be established prior to onset of monsoons. Natural waterways/drainage pattern shall be maintained by providing culverts where needed. The solid waste generated from the construction activities shall be effectively recycled within the project.

### 9.1.4 Mitigation

The best way of impact mitigation is to prevent the event occurring. All efforts should be made to locate the developmental activities in an area free of agricultural lands, ecologically sensitive, erosion, forests, flooding, human settlements, landslides, natural scenic beauty, water logging. However, practically, this is not possible as project design criteria govern the location of various activities. Therefore mitigation measures need to be developed.

Following are some mitigation measures:

#### **Air Pollution mitigation:**

- Locate stockpiles of sand in sheltered locations or provide wind breaks.
- Keep the stockpiles to the minimum practicable heights and use gentle slopes.
- Keep site vehicles and plant well maintained and regularly serviced. All vehicles must comply with the traffic Licensing Directorate emission standards at all time.
- Do not burn waste materials on site.
- Use covered containers for organic waste and empty frequently before decomposition.

#### **Water Pollution mitigation:**

- Segregation of different types of wastes at source and avoid their mixing up in the river Surface runoff from oil handling areas/devices (workshops and DG operation areas) should be treated for oil separation before discharge into the environment.
- The growth of aquatic weeds is to be monitored in the reservoir and excess weeds shall be removed.

#### **Land Pollution Mitigation:**

- Proper and secure bunding.

- Minimize the amount of land disturbance, develop and implement stringent erosion and dust control practices.

#### **Noise Pollution Mitigation:**

- Location of the construction equipment to be decided keeping in view the safe distance from habitation.
- Contractors will be required to maintain properly functioning equipment and comply with occupational safety and health standards.
- All the construction equipment will be required to use available noise suppression devices and properly maintained mufflers.
- Staging of construction equipment and unnecessary idling of equipment within noise sensitive areas to be avoided, whenever possible.
- Minimize the use of noise producing equipment during night hours to avoid the disturbance to locals and wild animals of surrounding area.
- Monitoring of noise levels will be conducted during construction phase.
- Educate the personnel at site on the above issues through tool box meetings.

#### **9.1.5. Awareness:**

To lay down the procedure for identification of training needs and providing appropriate training to all Employees and contract employees to ensure effective implementation of EHS & Social management systems at all levels and functions. The organization shall do the necessary training need identification at level and functions.

- General awareness and employees roles and responsibilities in achieving conformance with policy, objective and targets.
- Relevant EHS & Labour laws rules and regulations.
- EHS & Social induction training o Policy goals and objectives.
- Applicable legislative requirements.

- Requirements that are conditions of employment. Benefits of improved personal performance.
- The potential consequence of deviation from specified operating procedures.
- Emergency Preparedness and Response.
- Job Specific Training
- Communication and consultation, both internal & external.
- Awareness regarding Corrective & preventive actions of any accidents happen on site.
- Heavy Goods Vehicles holding areas to be provided for vehicles waiting to deliver loads at work sites so as to avoid queuing on other connecting roads.
- Installations of fire safety equipment's.

### 9.2. Operation Phase:

The Bhopal city & other ULBs witnessed a rapid growth in the population. With rapid urbanization and growth of industry & business has led to increased waste generation but the infrastructure development for MSW management has never kept pace. Alternatives like Land Filling for waste disposal in open space leads to the paucity of urban land. Poor MSW management is associated with increased health problems in all sections of population. General environmental impacts are loss of vegetation due to site clearance, odor nuisance, stray animals and rodent problems, etc. So burning wastes to reduce their volume and weight makes sense. Combustion reduces the volume of material by about 90 % and its weight by 75 %. The heat generated by burning of wastes has other uses as well, as it can be used directly for heating, to produce steam or to generate electricity. The Project proponent wants to set up plant to convert Waste to Energy.

Therefore for the Bhopal city & ULBs has proposed 23 MW of waste to energy plant for the solid waste processing and sanitary landfill at site Adampur Chhawani. Odor management and monitoring will be done as per the CPCB “Odor Management & Monitoring Guidelines 2017”.

In the MSW Landfill, appropriate arrangement may be made for spraying inhibitory agents or masking agent or neutralizers in scenario of intermittent odorous emissions.

## CHAPTER NO.10 FINANCIAL ASPECTS

### 10.1 Introduction

The financial aspects for estimation of project cost and other relevant financial parameters were arrived on the basis of

- A. Plant and Machinery
- B. Construction of Transfer Station
- C. Civil cost ISWM Facility, Site Development and SLF
- D. Engineering expenses
- E. Preliminary and Preoperative expenses
- F. Financing cost
- G. Estimates of contingency.
- H. IDC(interest during construction)
- I. Margin Money for working capital

In addition to the above detailed estimates of all vehicles, equipment such as GPS tracking devices, CCTVs, DGs, computers, utilities and ancillaries along with software design, development and implementation were worked out before arriving at the estimates.

The project cost has been estimated as 52561.3 Lakhs, with break up as follows:

Table 10.1: Cost of Project (Capex) for C & T

Description	Annx Nos.	To be Incurred (Rs. Lakh)	Total (Rs. Lakh)
1. Plant and Machinery	1	9816	9816
2. Construction of Transfer station	2	2655	2655
3. Civil Cost ISWM Facility, Site Development and SLF	3	4700	4700
4. Engineering Expenses	4	25	25

Description	Annx Nos.	To be Incurred (Rs. Lakh)	Total (Rs. Lakh)
5. Preliminary and pre-operative expenses	5	2354.3	2354.3
6. Contingencies	6	343.4	343.4
7. Financing cost	7	257.6	257.6
8. IDC(interest during construction)		2857.2	2857.2
9. Margin Money for working Capital		248	248
<b>TOTAL COST OF THE PROJECT</b>		23256.5	23256.5

### **10.1.1 PLANT AND MACHINERY**

This head consist of cost related to the primary and secondary vehicle, equipment for Transfer station excluding civil. Plant and Machinery cost have been estimated at 9816 lacs.

### **10.1.2. Construction of Transfer station**

This head consist of costs related to building construction of relevant design as per transfer station requirements with ventilation and adequate lighting and other arrangements. The cost of workshop is also included under this head. Civil work costs have been estimated at 2655 Lakhs.

### **10.1.3 Civil work of ISWM Facility, site development and Sanitary Land fill**

This head consist of costs related to site development at Adampur Chawani which includes construction of access road (external and internal), boundary wall, sanitary landfill, development of green belt. The costs for same have been estimated at 4700 Lakhs

#### **10.1.4 Engineering Expenses**

This section consists of costs of technical consultant. Costs for collection and transportation has been estimated at 25 lakhs

#### **10.1.5 Preliminary and Pre-operative expenses**

Preliminary expenses are expenses incurred before the incorporation of business, but preoperative expenses are those expenses incurred after the incorporation of the business but before the start of business operations or production. It has been estimated that a sum of 2354.3 Lakhs be kept for preliminary and pre-operative expenses

#### **10.1.6 Estimation of contingency and escalation provisions**

This section contains costs for contingencies and provision for any emergencies. This head has been estimated to be 343.4lakhs

#### **10.1.7 Financing Cost**

This section consists the expense of financing firm. The estimated financing cost is 257.6 Lakhs.

#### **10.1.8 Interest during Construction**

The estimated cost of Interest during Construction would be around 2857.2 lakhs

#### **10.1.9 Margin Money for working capital**

The estimated cost of Margin Money would be around 248 lakhs

**ANNEXURE-1**

Table No. 10.2 Plant Machinery cost

Plant & Machinery (A)			
Sr. No	Heads	Qty.	Amount
1	Tata Ace/Supro(Tipper 2.5 m3)	498	3,234.58
3	chassis (2518) for hook loader 16m3	24	471.63
4	fabrication of hook loader	24	424.46
5	Refuse Compactor (14 cum mounted on Chassis of 1616)	19	742.76
6	Rickshaw	248	86.67
7	VTS/GPS	547	54.68
8	RFID	42	11.80
8	Metal Bins (1.1m3) compactor	341	102.43
9	120 ltr Wheeled bins for sweeping and others	7000	196.00
10	No.of portable compactors 16m3	69	1,397.77
12	generator ( for each parking)	20	70.00
13	Tipper 1618	4	72.00
14	Bolero	1	9.00
15	no. of containers(10ltr.) 2each house	1217668	1,400.32
17	3.5 m3 DP bin	57	34.20
19	Total no. of litter bins required(including 15%yearly replacement)	6000	381.00
20	weigh bridge	2	20.00
21	workshop establishment	2	30.00
22	workshop equipment & tools	2	16.00
23	Complaint center telephones	4	0.16
24	CCTV set up for project( cctv+dvr) for ops location	20	40.00
25	computers	20	5.00
29	call center set up	1	0.50
30	development of monitoring software	1	170.00
31	Control room setup	1	10.00
32	Animal Caracas	13	195.00
32	Digester	1	100

Plant & Machinery (A)			
Sr. No	Heads	Qty.	Amount
33	Electricity connection for transfer station	20	60.00
34	Excavator	2	50.00
35	Infrastructure for Billing System	200	30.00
36	Uniform and Safety equipment's		150
37	Misc.		250
<b>Total</b>			<b>9816.00</b>

## ANNEXURE 2

Table no. 10.3 Construction of Transfer Station

Particulars	Number	Unit Cost	Total (in Lakhs)
No of Transfer station(for single zone)	14	150	2100
No of Transfer Station(For two zone)	2	175.5	351
Construction of satellite facility at Sehore	1	204	204
<b>Total</b>			<b>2655</b>

### ANNEXURE 3

Table No. 10.4 Civil works

Description	Number	Rate	To be	Total(In Lakhs)
			Incurring	
<b>A. Site Development &amp; SLF</b>				
Construction of access roads, internal roads, boundary wall, development of green belt	1	1400	1400	1400
Sub-Total (A)				
Construction of Sanitary land fill	1	3300	3300	3300
Sub-Total (C)			3300	3300
<b>TOTAL</b>			<b>4700</b>	<b>4700</b>

## ANNEXURE 4

Table no. 10.5 Engineering expenses

Description	Number	Rate	To be	Total(Rs In Lakhs)
			Incurred	
Engineering expenses			25	25
<b>TOTAL</b>			<b>25</b>	<b>25</b>

## ANNEXURE - 5

Table no. 10.6 Preliminary and Preoperative Expenses

Description	To be	Total
	Incurred	Rs. In Lakh
Preliminary and pre-operative expenses		
<b>Total</b>	<b>2354.3</b>	<b>2354.3</b>

## ANNEXURE - 6

Table No. 10.7 Estimate of Contingency/Escalation Provision

Item of Cost	Contingency	To be incurred	Total (Rs in Lakhs)
Contingency	2% of hard cost	343.4	343.4

## ANNEXURE 7

Table no. 10.8 Financing Cost

Item of Cost	Contingency	To be incurred	Total (Rs. In Lakh)
Financing cost	1.5% of the hard Cost	257.6	257.6

## ANNEXURE-8

Table no. 10.9 Opex

Opex		
Designation	Quantity (in numbers)	Annual expenses(lac)
Driver (Tata ace & Zip)	498	657.36
Driver compactor and tipper	37	71.04
Helper Compactor, tipper, rickshaw	840	957.6
Operator Transfer station	40	52.8
Managerial and supervisory staff	170	40
workshop staff	30	60
Tax and insurance		60
GPS rent		30
O&M of vehicle		130
Admin expenses		900
Fuel		1000
Misc		120
<b>Total</b>		<b>4078.8</b>

Table 10.10: Cost of Project (Capex) for WTE Plant Facility

Description	To be Incurred (Rs. Lakh)	Total (Rs. Lakh)
1. Plant & Machinery & Services	19084	19084
2. Building & Civil Cost & Collection & Transportation, Ash Disposal	3350	3350
3. Transmission Cost	1200	1200
4. Contingencies	1182.5	1182.5
5. Engineering & Consultancy Charges	1193.8	1193.8
6. Preliminary & Pre-operative expenses	1182.5	1182.5
7. Financing Cost	354.8	354.8
8. Interest During Construction	1368.6	1368.6
9. Margin Money for Working Capital	388.7	388.7
<b>TOTAL COST OF THE PROJECT</b>	<b>29304.8</b>	<b>29304.8</b>

## O &amp; M Cost for WtE Plant Facility

Description	To be Incurred (Rs. Lakh)
SLF O&M expenses (1st year)	Rs. 43.4 lakh
Plant & Machinery O&M expenses (1st year)	Rs. 1260.8 lakh

Table 10.11 : Cost of Project (Capex) for ISWM Facility

Project Cost Break-up	C&T Facility (Rs. Lakh)	WTE Plant Facility (Rs. Lakh)	To be Incurred (Rs. Lakh)	TOTAL (Rs. Lakh)
Plant & Machinery	9,816.0	19,084.0	28,900.0	28,900.0
Building & Civil	-	3,350.0	8,050.0	8,050.0
Sanitary Land Fill & site development	4700.0	-	-	-
Transfer Station	2,655.0	-	2,655.0	2,655.0
Transmission Cost	-	1,200.0	1,200.0	1,200.0
<b>Total Hard Costs</b>	<b>17,171.0</b>	<b>23,634</b>	<b>40,805.0</b>	<b>40,821.0</b>
Contingency	343.4	1,182.5	1,525.9	1,525.9
Engineering & Consultancy Charges	25.0	1,193.8	1,218.8	1,218.8
Preliminary & Pre-operative expenses	2,354.3	1,182.5	3536.8	3,536.8
Financing Cost	257.6	354.8	612.3	612.3
Interest During Construction	2,858.3	1,367.6	4,225.8	4,226.0
Margin Money for Working Capital	248.0	388.7	636.7	636.7
<b>Total Soft Costs</b>	<b>6,085.5</b>	<b>5669.9</b>	<b>11,756.3</b>	<b>11,756.3</b>
<b>Total Project Cost</b>	<b>Rs. 23,256.5</b>	<b>Rs. 29303.9</b>	<b>Rs. 52,561.3</b>	<b>Rs. 52,561.3</b>

**ANNEXURE-9**
**GLOBAL TECH ENVIRO EXPERTS PVT. LTD.**  
 (FORMERLY GLOBAL EXPERTS)  
 An ISO-9001:2008 Certified Company

 C-23, 10/9 Nagar,  
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 Ph : 0674-2436853  
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 visit us [www.globalexperts.in](http://www.globalexperts.in)

No. GTEEPL/F-17-13/77/2016-17

Dt.04.01.2017

 To  
 Essel Infra Projects Pvt. Ltd.  
 Bhopal

Kind attn.: Mr. Brijesh Kumar/ Mr. Vikas Jha

**Sub.: MSW Characterisation Study of Bhopal City and other ULBs.**

Dear Sir,


GTEEPL team had conducted sampling and characterisation of Municipal Solid Waste in Bhopal City and 7 other ULBs based on approved procedures as per ASTM D 5231 and ASTM D240. The location of the samples and findings are given below.

SL NO	Sample Code	Gross Calorific Value (K Cal/Kg.)	Moisture %	Net Calorific Value (K Cal/Kg.)
1	BH - 1	2466	44.52	2379.42
2	BH - 2	1624	62.86	1555.76
3	BH - 3	1732	56.72	1657.62
4	BH - 4	1287	58.48	1214.38
5	BH - 5	1056	61.43	986.33
6	BH - 6	1923	62.58	1854.48
7	BH - 7	2056	51.25	1976.15
8	BH - 8	1392	49.52	1310.42
9	BH - 9	1337	51.35	1257.25
10	BH - 10	2872	33.27	2774.17
11	AS - 1	2346	43.28	2258.18
12	AS - 2	1876	63.42	1808.32
13	KO - 1	2058	42.56	1969.46
14	KO - 2	1872	48.37	1789.27
15	SE - 1	1983	37.91	1889.81
16	SE - 2	1628	43.85	1540.75
17	ICH - 1	1456	58.76	1383.66
18	ICH - 2	2014	48.63	1931.53
19	OBA - 1	1387	56.78	1312.68
20	OBA - 2	1348	57.43	1274.33
21	MAN - 1	1678	49.51	1596.41
22	MAN - 2	1907	52.67	1828.57
23	BER - 1	2492	42.86	2403.76
24	BER - 2	1786	48.26	1703.16
AVERAGE		1744.00	50.01	1662.91

$$NCV = GCV - (52.21 \times H_2) - (5.8 \times \text{Moisture}), \text{Hydrogen Percentage}(H_2) = 2.4 \text{ by wt.}$$

In case of any clarification don't hesitate to contact us.

 Thanking you,  
 Yours faithfully,  
 For Global Tech Enviro Experts Pvt. Ltd.

  
 Bhabani Prasad Nanda  
 Director (Operations)

## ANNEXURE-10

Emission Standards comparison of Hitachi WTE Plant with MSW Rules 2016 .

<b>Guaranteed Emission Values for BMPL Project</b>				
<b>Description</b>	<b>Units</b>	<b>Indian Waste Rules MSW 2016</b>	<b>Local Emission (HITZ)</b>	<b>European Directive 2000/76/EC</b>
Dust	mg/m <sup>3</sup> STP	50	10	10
HCL	mg/m <sup>3</sup> STP	50	10	10
SO <sub>2</sub>	mg/m <sup>3</sup> STP	200	80	50
NO <sub>x</sub> – with SNCR	mg/m <sup>3</sup> STP	400	200	200
Hg	mg/m <sup>3</sup> STP	0.05	0.05	0.05
Cd + TI	mg/m <sup>3</sup> STP	0.05	0.05	0.05
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V	mg/m <sup>3</sup> STP	0.5	0.5	0.5
Dioxins and furans (TEQ)	mg/m <sup>3</sup> STP	0.1	0.1	0.1

**ANNEXURE-11****QA QC PLAN**

EQUIPMENT DESCRIPTION	TESTS
<b>TURBINE</b>	
Complete assembled turbine	1. Visual & dimensional checks 2. No-load run test & functional check on safety devices 3. Vibration check 4. Noise level check 5. Open inspection & dynamic rotor balancing (after no-load run test)
Complete assembled generator	1. Visual & dimensional checks 2. OCC & SCC test 3. Over speed test 4. Vibration check 5. Noise level check 6. HV test 7. Measurement of winding resistance and insulation resistance 8. Measurement of shaft voltage
LAPT panel / NGR panel /AVR panel / Relay panel / Met. Cum synch. panel / TCP / Battery charger panel / Aux. MCC	1. Visual & dimensional checks 2. Operational & functional tests 3. HV test 4. Measurement of insulation resistances
Turbine Gauge Panel	1. Visual & dimensional checks 2. Range calibration
Instruments	1. Visual & dimensional checks 2. Operational & functional tests 3. Range calibration
<b>HYDRAULIC POWER PACK</b>	

Plates for oil Tank, Seam less Tubes & Seam less pipes	1.Chemical & Mechanical Properties 2. Visual & Dimensions
Cylinder Tubes & Piston Rod	1. Dimensions 2. Chemical & Mechanical Properties 3. Internal defects
Final inspection of Cylinders	1. Dimensions
Functional Testing of cylinders	1. Internal Leakage 2. Proof Pressure test 3. Static Friction test 4. Smooth operation
Painting	Shade & DFT
Accumulator(As applicable)	Visual & Dimensions
Filter	Visual & Dimensions
Cooler	Visual & Measurement
Electric Motor	Verification
Pump	Verification
Pressure Switches & Gauges	Verification
Relief Valves & Control Valves	Verification
Oil storage Tank	Visual Dimensional Leakage Test
Completeness Verification	Visual & Dimensions
Functional test	1) Flow, Pressure, etc. & Full Range of Operation 2) Leakage 3) Pressure test 1.25 times working pressure 4) Functioning of all control valve 5) no load/load test for duration of 1 Hr.
Identification	Marking & Stamping
Painting	Final Finish & Paint DFT
Packing	Soundness of packing, Loading, etc.
<b>GRATE RIDDILING CONVEYOR</b>	
Plates, castings, & Forgings	1. Chemical & Mechanical Properties 2. Visual & Dimensions
Bought outs	Chemical & Mechanical Properties, Visual & Dimensions

Welding Documents & Welding Consumables	WPS / PQR / WPQ
Verification of certificates of personal for NDT Testing	NDE
Fit up Inspection	Edge form, match of edges, Root Gap, Clineess of edges
Welding Inspection	1. All Welds 2. Surface Defects on other Welds
Leak Test of slag Extractor	All welds
Final Inspection In the Work Shop	1. Dimensional inspection main dimensions, 2. Visual inspection of fabricated parts 3. Completeness of scope of supply
Functional Test/No Load Mechanical Run Test (At Shop)	Chain movement, smooth operation, etc.
Identification	Marking & Stamping
Surface preparation	Grit Blasting/shot Blasting
Painting	Final Finish & Paint DFT
Packing	Soundness of packing, Loading, etc.
QA Documentation	Document
<b>BOILER PRESSURE PARTS (STEAM DRUM)</b>	
Design & Drawings	Verification of design; drawings and calculations
Inspection & Test Plan (ITP) including NDE plan	Salient features, inspection stages, job specific requirements and NDE Plan
Weld Plan	Joint no./description along with applicable WPS and special instructions, if any
Welding Procedure Specifications (WPS), Procedure Qualification Record (PQR)	Welding parameters, Chemical analysis, Mechanical properties, NDE results

Welder & NDE Operators Qualifications	Skill of the welder / NDE operator, Qualification requirements
Procedures; NDE, Heat treatment, Hydrostatic, Surface preparation & painting	Documented procedures
Material Inspection at Mill/Manufacturer/Supplier	Mandatory requirements of material specification + MPO's supplementary requirements
Material Inspection after receipt	<ol style="list-style-type: none"> <li>1. Review of MTC/Test Report</li> <li>2. Thickness and other dimensions</li> <li>3. Visual; Pitting, laminations and any transit damages</li> <li>4. Co-relation of marking/stamping with MTC</li> </ol>
Final stamping/clearance for fabrication: Pressure parts and directly welded attachments	Identification correlation & transfer of markings, Dimensional & visual, Compliance to ITP-page 3
For Non pressure parts	Identification correlation & transfer of markings, Dimensional & visual
Check testing, if required any, of - Pressure containing parts.	Mechanical / Chemical properties
Fetch up and rolling of shell belts, reinforced pads Forming of heads	<ol style="list-style-type: none"> <li>1. Dimensional (Min thick after removal of scale, diameter, profile, roundness etc.)</li> <li>2. Visual &amp; NDE (Refer NDE Plan)</li> <li>3. Simulation/Mechanical testing</li> <li>4. Heat treatment for/after forming</li> </ol>
Long and circ seams of shell/head	1. Dimension, orientation, straightness,

Nozzle/stub to shell / head joints.	and profile. 2. Weld edge; root gap, angle, offset, cleanliness etc. 3. Visual of weld edges 4. PTC as applicable
Other attachments.	
PMI of pressure parts alloy steel & SS material.	Verification of correct use of material
Welding control	1. Use of correct consumables, monitor parameters; preheat, Interpass, post heat etc. 2. Visual Inspection & NDE after root run / requirements. chip back 3. Welding record of each seam
Weld repair procedure of parent metal, if required any	Prior approval of TPI/Client for weld repairs to parent metal shall be taken
<b>FINAL INSPECTION INSPECTION BEFORE PWHT</b>	
Dimension checks	Elevation/orientation of nozzles, internal & external attachments
Visual checks of surfaces and welds	Reinforcement, undercuts, surface defects etc.
Document Review	Completeness of all previous stages including PTC, Resolution of Non-conformity, if any
NDE Clearance	PT/MT RT-Film
<b>POST WELD HEAT TREATMENT (PWHT)</b>	1. Location of thermocouples 2. Heat treatment parameters; Loading & unloading temperature, soaking temperature & time, rate of heating & cooling.

	3. Main dimensions after PWHT and machining, if any.
<b>TESTING BEFORE HYDROSTATIC TEST</b>	
Non-Destructive Testing	NDE after PWHT
Leak testing of reinforced pads, if applicable	Leak Check
<b>HYDROSTATIC TEST</b>	1. Visual checks of surfaces & welds, Pressure Drop & Permanent distortion 2. NDE after pressure testing, if any
<b>DRILLING AND GROOVING OF TUBE HOLES-if applicable</b>	1. Marking of Tube holes on drum 2. Drilling and Grooving: a. Size, Location, number and surface finish of holes b. Size of groove etc
<b>DIMENSIONAL INSPECTION</b>	Complete Drum - Dimensional check of nozzles/stubs height and weld edge preparation - Visual check of surfaces
<b>DRUM INTERNAL INSPECTION</b>	Assembly of internal. - Visual & Dimensional Check
<b>SURFACE CLEANING &amp; PROTECTION</b>	
Internal surfaces	Draining and drying
External surfaces; Surface Preparation Painting	Surface cleanliness, roughness and contamination Visual and DFT
<b>NAME PLATE STAMPING /FIXING</b>	Verifying stamping details
<b>PACKING AND DESPATCH</b>	Verification of packing and marking
<b>FINAL DOSSIER</b>	Endorsement of final documents
<b>PROCESS STEEL STRUCTURE</b>	

Foundation Bolts & Nuts`	<ol style="list-style-type: none"> <li>1. Mechanical Properties</li> <li>2. Chemical Composition</li> <li>3. Soundness of Bolts</li> <li>4. Final Inspection</li> </ol>
Plates & Sections	<ol style="list-style-type: none"> <li>1. Chemical &amp; Mechanical Properties</li> <li>2. Soundness</li> <li>3. Visual &amp; Dimensions,</li> </ol>
Welding Documents & Welding Consumables	WPS / PQR / WPQ
Edge Preparations	Surface Defects of Weld Edges for thk >25 mm
Weld Setups	Weld Set-up Parameters
Butt & Fillet Welds	Visual Inspection
Butt & Fillet Welds for Main columns, Beams & Girders etc	<ol style="list-style-type: none"> <li>1. Soundness of Butt Welds &gt; 32 mm</li> <li>2. Surface Defects of Butt Welds &gt; 25 mm &amp; ≤ 32 mm</li> <li>3. Surface Defects of Butt Welds &lt; 25 mm</li> <li>4. T-Joints / Web-to- Flange Joints</li> <li>5. Back Gouged Welds</li> </ol>
Welds in Tension Flanges for Main columns ,Beams & Girders etc	<ol style="list-style-type: none"> <li>1. Soundness of Butt Welds</li> <li>2. Surface Defects of Fillet Welds</li> </ol>
PWHT (as applicable )	Temperature & Time Control
Hand Rails	Surface Defects of Fillet Welds
Final Inspection	Visual & Dimensions (Trial assembly, alignment, etc. as applicable)
Identification	Marking & Stamping
Painting	Final Finish & Paint DFT
Packing	Soundness of packing, Loading
Inspection of quality assurance documentation	Documentation
<b>FANS</b>	
Plates, Blades,Shaft, Casing,Bearing housing, etc.	<ol style="list-style-type: none"> <li>1. Chemical &amp; Mechanical Properties</li> <li>2. Visual &amp; Dimensions</li> <li>3. Hardness (Rotor plates/ blades)</li> </ol>

	4. Soundness of Shaft Forgings (for dia > 40 mm)
Accessories like Bearings, Lubricating Unit, Damper, Silencer, Couplings, etc	1. Visual & Dimensions 2. Chem. /Mechanical & Performance & Coupling balancing Parameters
Electric Motor	Performance test
Welding Documents	WPS / PQR / WPQ
Machining of Shaft, Rotor, etc.	1. Visual & Dimensions 2. Surface Defects
Casing & Impeller Welds	Surface Defects
Blades & Impellers	Visual, Profile & Dimensions
Rotor Assembly	Residual Unbalance, Clearance check, Free Rotation of rotor
Completeness Verification	Visual & Over all Dimensions Fans Accessories
Mechanical Run Test	Noise, Vibrations, Bearing temperature, etc.
Performance test	Flow, Pressure, Power etc.
Identification	Marking & Stamping
Painting	Final Finish & Paint DFT
Packing	Soundness of packing, Loading, etc.
QA Documentation	Document
<b>FEED HOPPER</b>	
Plates, Sections, Pipes, Liners, Gasket, Expansion Bellow etc.	1. Chemical & Mechanical Properties 2. Hardness of liners 3. Visual & Dimensions
Welding Documents & Welding Consumables	WPS / PQR / WPQ
Verification of Certificates of personnel for nondestructive testing	NDE-II
Fit up Inspection	Fit up
Weld Inspection	1. Weld Surface Defects 2. Butt Joints
Completeness Verification	Visual & Dimensions

Leak Test	Chute & Fame Jacket -Hydro test
<b>FABRIC FILTER</b>	
Plates & Sections	Chemical & Mechanical Properties
Welding Documents & Welding Consumables	WPS / PQR / WPQ
Verification of Certificates of personnel for nondestructive testing	NDE-II
Fit up Inspection	Fit up
Weld Inspection for casing	Weld Surface Defects
Pent house structure	Weld Surface Defects
Completeness Verification	Visual & Dimensions
Leak Test	Kerosene test or equivalent, etc.
Identification	Marking & Stamping
Painting	Final Finish & Paint DFT
Packing	Soundness of packing, Loading, etc.
Inspection of quality assurance Documentation	Documentation
<b>SLAG EXTRACTOR/BELT CONVEYOR</b>	
Plates, castings, & Forgings	1. Chemical & Mechanical Properties 2. Visual & Dimensions
Bought outs	Chemical & Mechanical Properties, Visual & Dimensions
Welding Documents & Welding Consumables	WPS / PQR / WPQ
Verification of certificates of personal for NDT Testing	NDE
Fit up Inspection	Edge form, match of edges, Root Gap, Clineess of edges
Welding Inspection	1. All Welds 2. Surface Defects on other Welds
Leak Test of slag Extractor	All welds

Completeness verification	<ol style="list-style-type: none"> <li>1. according to list of drawings / list of pieces.</li> <li>2. parts to be delivered loosely: complete and sorted</li> <li>3. all parts labelled or marked / numbered</li> </ol>
Final Inspection In the Work Shop	<ol style="list-style-type: none"> <li>1. Dimensional inspection main dimensions,</li> <li>2. Visual inspection of fabricated parts</li> <li>3. Completeness of scope of supply</li> </ol>
Functional Test/No Load Mechanical Run Test	Extractor movement smooth operation, Stroke etc.
Identification	Marking & Stamping
Surface preparation	Grit Blasting/shot Blasting
Painting	Final Finish & Paint DFT
Packing	Soundness of packing, Loading, etc.
QA Documentation	Document
<b>GRATE ELEMENT</b>	
Castings (For Grate bars )	<ol style="list-style-type: none"> <li>1. Chemical &amp; Mechanical Properties</li> <li>2. Visual &amp; Dimensions</li> </ol>
Plates & Rounds (For grate structure etc.)	<ol style="list-style-type: none"> <li>1. Chemical &amp; Mechanical Properties</li> <li>2. Visual &amp; Dimensions</li> </ol>
Hydraulic cylinders	visual
Welding Documents & Welding Consumables	WPS / PQR / WPQ
Verification of certificates of personal for NDT Testing	NDT
Fit up Inspection	Fit up
Weld Inspection	<ol style="list-style-type: none"> <li>1. All Welds</li> <li>2. Surface Defects on Welds</li> </ol>
Machining	Visual & Dimensions
Final Inspection	<ol style="list-style-type: none"> <li>1. Dimensional inspection</li> <li>2. Visual inspection</li> </ol>
Functional Test	Carriage movement, casting movement, stroke length, smooth operation,

Completeness verification	according to list of drawings / list of pieces, parts to be delivered loosely: complete and sorted, all parts labelled or marked / numbered
Identification	Marking & Stamping
Surface preparation	Grit Blasting
Painting	Final Finish & Paint DFT
Packing	Soundness of packing, Loading.
QA Documentation	Document
<b>RAM FEEDER</b>	
Plates , Structural members, bars, castings etc.	1. Chemical & Mechanical Properties 2. Visual & Dimensions
Hydraulic cylinders	visual
Welding Documents & Welding Consumables	WPS / PQR / WPQ
Verification of certificates of personal for NDT	NDT
Fit up Inspection	Fit up
Weld Inspection	1. All Welds 2. Surface Defects on other Welds
Machining	Visual & Dimensions
Final Inspection In the Work Shop	1. Dimensional inspection 2. Visual inspection
Functional Test (At Shop)	Ram movement, stroke length, smooth operation
Completeness verification	1. according to list of drawings / list of pieces 2. parts to be delivered loosely: complete and sorted
Identification	Marking & Stamping
Surface preparation	Grit/Shot Blasting
Painting	Painting Final Finish & Paint DFT
Packing	Soundness of packing, Loading, etc
QA Documentation	Document
<b>CIVIL</b>	

EXCAVATION AND FILLING IN FOUNDATION WORKS	
Fill/ Backfill -	
Standard proctor Test	Optimum moisture content and max. dry density before fill
Moisture content	Moisture content of fill before compaction
Degree Of Compaction Of Fill / Backfill	Dry density by core cutter method
	----- OR-----
	Dry density in place by sand displacement method
	Relative density (Density Index)
	Dry Density by proctor needle penetration
CAST-IN-SITU CONCRETE	
MATERIALS	
CEMENT	Testing of cement for setting time and strength
Coarse Aggregate	Moisture content
	Specific gravity, water absorption, Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)
	Soundness, Crushing value abrasion value and impact value
	Sieve analysis, flakiness index, elongation index,
Fine Aggregate	Moisture content, water absorption, Sieve analysis
	Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)

	Specific gravity, water absorption, Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)
CONCRETE	Trial mix to ascertain the workability and cube strength
	Crushing strength (works Tests cubes)
	Workability - slump test
	Water content
Admixtures for Concrete	Suitability and review of MTC
Concrete conveying, placing & compaction	
Mixing of concrete	Mixing of concrete shall be done in a approved mixer such as to produce a homogenous mix
	Calibration of Batching Plant
	Temperature Control of Concrete for top deck of TGs Foundations.
	Placement
	Compacting
	Curing
TEST/CHECK ON RCC STRUCTURE IN HARDENED CONDITIONS	
	Dimensional check on finished structures & Dimensional tolerances
	Water Tightness Test of liquid retaining structure/ tanks
	Ultrasonic test on top deck of TG foundation
	Core Test
	Rebound Hammer test
REINFORCEMENT STEEL	Physical and Chemical Properties for each lot as per relevant IS codes
PLACEMENT OF REINFORCEMENT STEEL	Bar bending schedule with necessary lap, Spacers & Chairs

	Bending of bars, cutting tolerance
	Acceptance - Cover, spacing of bars, spacers and chairs after the reinforcement cage is put inside the
STAGING AND FORMS	Materials and accessories
	Soundness of staging, shuttering and scaffolding including application of mould oil / release agent
	Acceptance of formwork before start of concreting
EMBEDDED PART(INCLUDING LAYING OF RAILS & ANCHOR FASTENERS)	Position / alignment / levels of embedded parts / bolt hole / pipe sleeves / rails / PVC pipes / etc
	Welding / tying of embedment to reinforcement
BRICK MASONARY	
Test on Bricks	Dimensions, shape, compressive strength, water absorption, warpage, efflorescence.
Test on Mortar	Compressive strength, consistency
Sand	Grading
Masonry construction	Workmanship, verticality and alignment
PAINTING SYSTEM - CONCRETE WORKS AND PLASTERED MASONARY SURFACES	
Materials and accessories- Oil Bound, Acrylic Emulsion, Chemical Resistant, Oil Resistant Paint etc.	Shade, type from brand and manufacturer as approved by owner
Surface preparation	As required
DOORS , WINDOWS VENTILATORS & GRILL	
Fire proof doors	Source of supply
	Receipt inspection
	Finishing and acceptance
SPECIAL ITEMS	
Earthing Mat (Grounding System)	
Material	Earthing mat

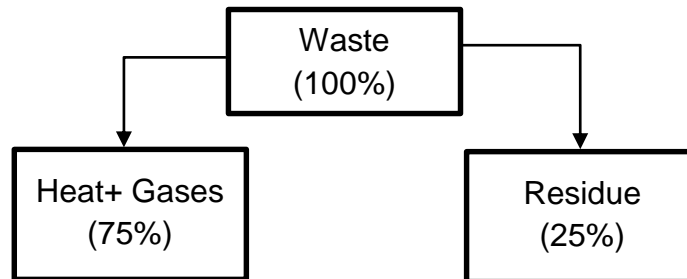
	Weld sizes & length
	D P test
	Earth test
ANTI WEED TREATMENT	Anti-weed treatment materials
	Execution of treatment
PILING WORK	
Execution	100 mm Dia Borehole
	Pile layout
	Recording ground level
	Cleaning/Flushing of pile bore
	Size of bore and During boring of pile record commencement of SPT/ core recovery to ensure socketing length equivalent in terms of the Diameter of the pile below the socketing horizon.
	Pouring of concrete to project above cutoff level.
	Pile termination level
Testing	Bentonite
	Density check on sample of mud collected from pile bore bottom
	Slump test of concrete
	Cube sampling for works cube test
	Initial pile load test, Vertical (Compression), Lateral (horizontal) and pullout (tension).
	Routine pile tests, compression and horizontal Integrity Tests
GEOTECHNICAL INVESTIGATION WORK	Deployment of approved Geotechnical Investigation Agency - Equipments, Manpower etc.
	Execution of Geotechnical Investigation - locations, type etc. as per scheme

	Collection of disturbed and undisturbed samples , their packing and storage
	Conducting filed tests as per investigation scheme- such as, SPT/ERT/SCPT/PLT/PMT etc.
	Submission of Field Bore logs in approved format
	submission of laboratory test schedule and selection of samples for laboratory testing
	Submission of Final Geotechnical investigation report along with recommendations

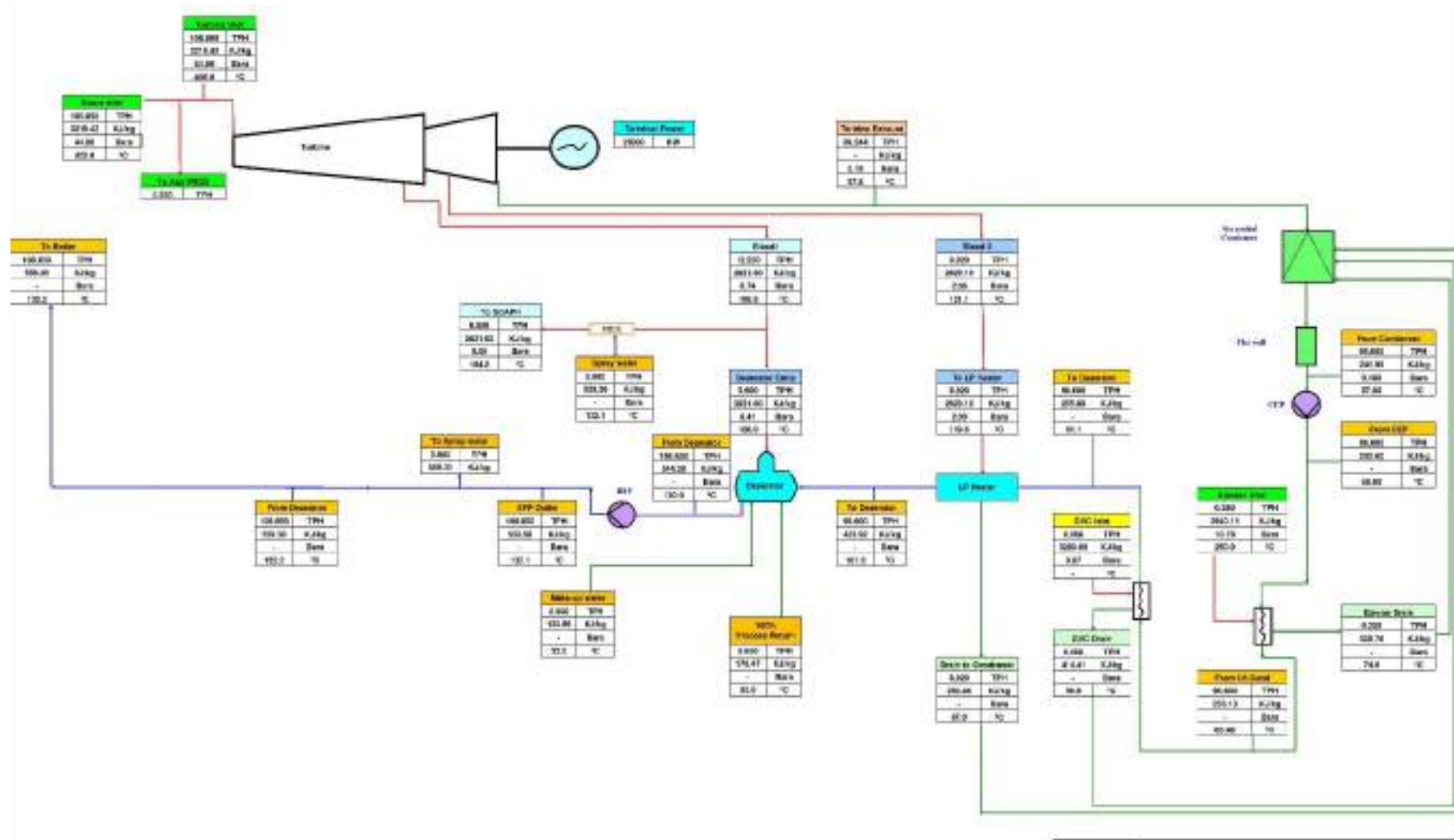
## ANNEXURE-12

### Mass balance of thermal power plant

INPUT				OUTPUT			
<b>: WASTE HANDLING</b>							
	Waste(6959 kJ/kg)	50000			Waste(6959 kJ/Kg)	50000	Kg/h
<b>: RESIDUE TREATMENT</b>							
	Bottom ash wet	15000	Kg/h		Bottom ash Dry (20%)	10000	Kg/h
	Fly ash boiler (5%)	2500	Kg/h				

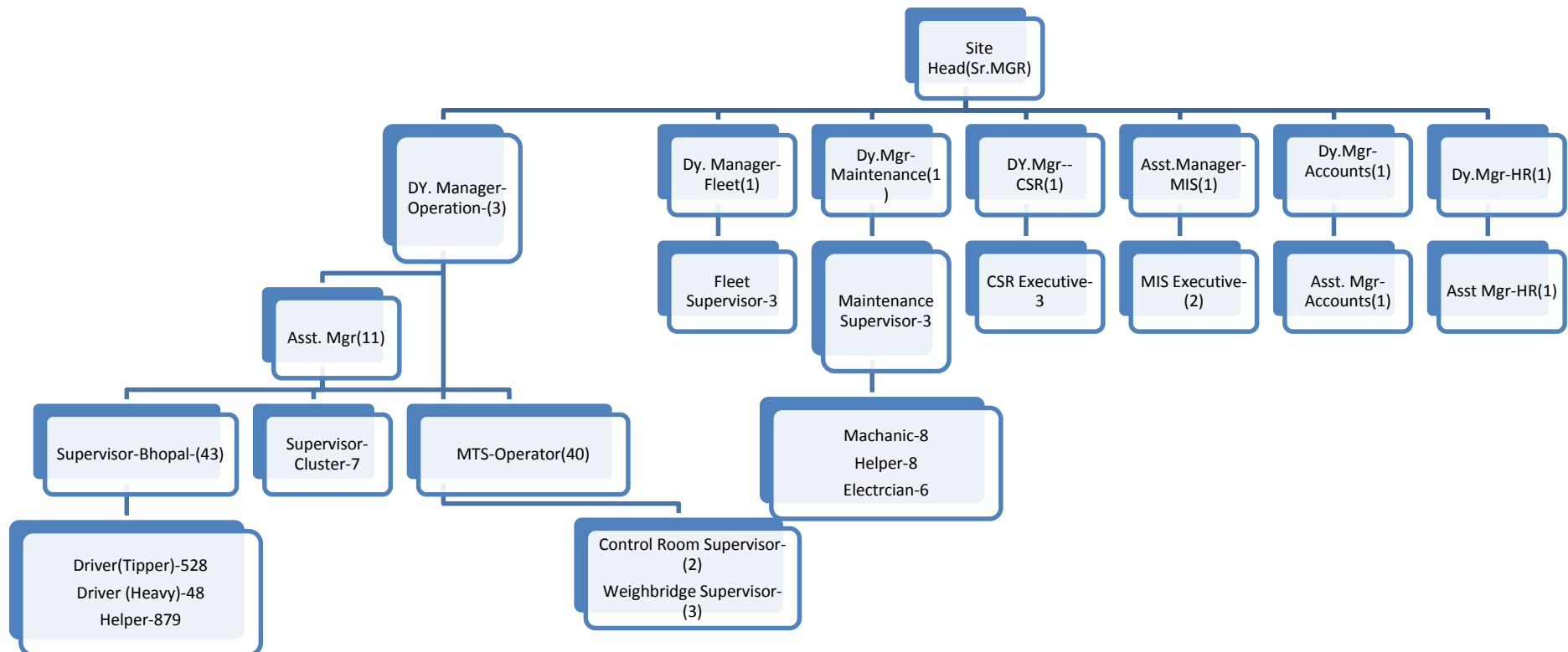


# Tentative Heat Mass Balance of Thermal Power Plant



## ANNEXURE-13

### Organization Chart



## ANNEXURE-14

### Pictures of land for transfer stations



Zone no-4 H.O mob. No.- 9424499804



ZONE-8 H.O Mob. No-9424499808

M/s Bhopal Municipal Solid Waste Pvt. Ltd



Zone-12 ward no- 58,59,69,44 H.o mob.no.-9424499812

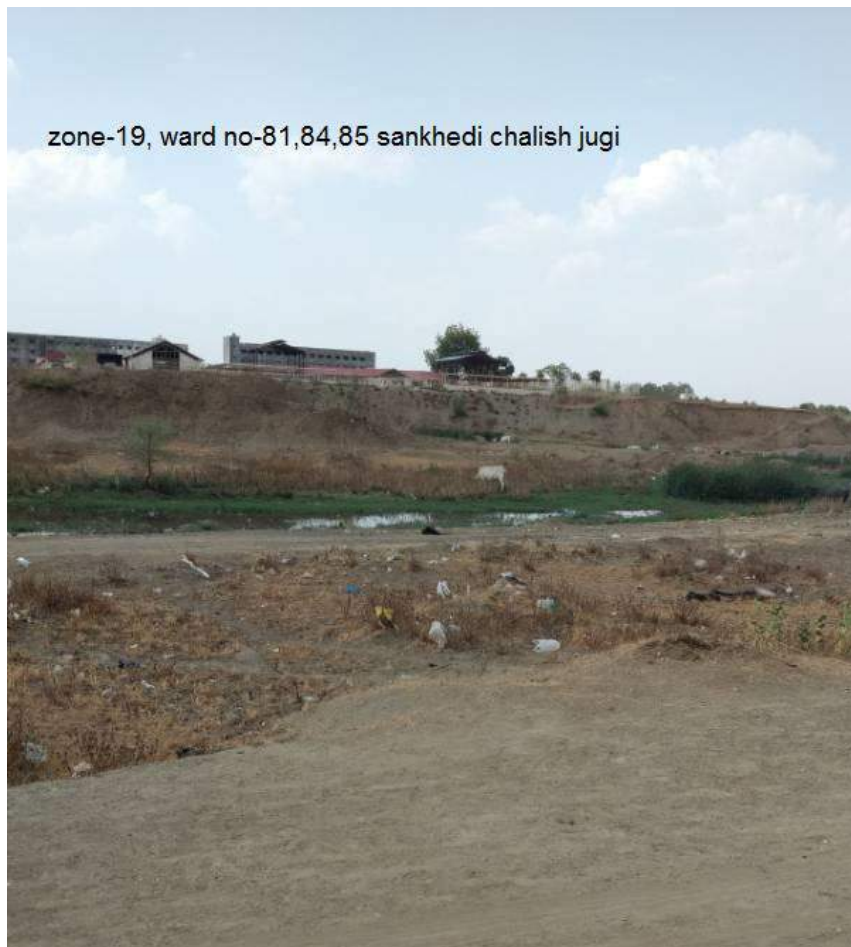


Zone no-11 ward no-39,40,41,70 H.o no-9424499811



Zone-18 ward no-29,80,82,83 H.o Mob.no.- 9424499818

Zone-19 Ward no- 81,84,85 H.O no.- 81,84,85



## **ANNEXURE-15**

### **Quotations Enclosed**



# HYDROTECH INTERNATIONAL

Manufacturer of : Municipal & Hydraulic and Special Application Vehicle  
An ISO : 9001 : 2008 Certified Company  
Registered In : NSIC and DGS&D

Cell: +91 8171112570  
+91 8006000750  
+91 8171112562

34. Chajjura Industrial Area, Behind Mragh Naini Resturent, Opp-Village Kumarhara, Dehradun Road, Saharanpur -247001 (U.P) INDIA

To,  
M/s Bhopal Municipal Solid Waste Pvt limited.

Dated 16.03.2017

Subject: - Supply of Animal Cather mounted on Tata 407.

Dear Sir,

We are enclosing herewith our offer for Supply of Animal Cather along with the terms & conditions.

We would also like to inform you that we are the manufacturer and supplier of these machines and have supplied these machines to various government organizations as well as private parties in India and abroad. We have full fledged factory for manufacturing of *Dumper Placer, Twin Dumper Placer, Sewer Jetting cum Suction Machine, suction machine/ Gulypit emptier, Refuse Compactor/ Collector, Animal Catcher, Hydraulic platform/ Sky lift, Hydraulic Close Top Tipper, Hopper* and all type of refuse bins and after sale support at Saharanpur. The factory have number of qualified engineers and other technical professionals for support of our product. Hope that the above is in line of your requirement, however, if you are require any further information / clarification please contact :-

Cell No. 8171112570 / 8006000750

Email: [hydrotech43@gmail.com](mailto:hydrotech43@gmail.com) / [hydrotech43466@rediffmail.com](mailto:hydrotech43466@rediffmail.com)

Website: [hydrotechinternational.co.in](http://hydrotechinternational.co.in)

Thanking you and assuring you our best co-operation during all the time we remain.

Yours truly,

For Hydrotech International



(Mohit Kumar)  
Manager (Comm.)



# HYDROTECH INTERNATIONAL

Manufacturer of : Municipal & Hydraulic and Special Application Vehicle  
An ISO : 9001 : 2008 Certified Company  
Registered In : NSIC and DGS&D

Cell: +91 8171112570  
+91 8006000750  
+91 8171112562

34, Chajpura Industrial Area, Behind Mragh Nani Resturent, Opp-Village Kuntariem, Dehradun Road, Saharanpur -247001 (U.P) NDIA

## QUOTATION

S. No.	Description of the Item	Price Each Unit (Rs.)	Qty.	Total Amount in (Rs.) F.O.R Bhopal
01.	Animal Cather Mounted on Tata 407.	15,50,000-00	01 Nos.	15,50,000=00
<b>Total Amount</b>				<b>15,50,000=00</b>

### NOTE:

1. Required Road Permit for the transportation shall be account of customer.
2. If the Govt. shall change any percentage of Taxes that shall be account of customer and the Taxes shall be apply at the time of dispatch of material.
3. Central or Entry Tax if applicable shall be account of customer.

### PAYMENT:

50% payment of with the Purchase order and balance 50% payment including taxes and duties shall be demanded at our works at Saharanpur before dispatch after your inspection.

### CANCELTATION:

No Cancellation of order is acceptable, once the order is placed.

### VALIDITY:

Our offer is valid upto 31 March 2017.

### DISPATCH:

The Items shall be dispatch within 30 days from the date of receiving of Purchase Order & advance payment.



## HYDROTECH INTERNATIONAL

Manufacturer of : Municipal & Hydraulic and Special Application Vehicle  
An ISO : 9001 : 2008 Certified Company  
Registered In : NSIC and DGS&D

Cell: +91 8171112570  
+91 8006000750  
+91 8171112562

34, Chajjura Industrial Area, Behind Miragh Naini Resturent, Opp-Village Kumarhera, Dohradun Road, Saharanpur -247001 (U.P) INDIA

### **WARRANTY:**

The Animal Cather (Only Hydraulic System) shall be warranted against all manufacturing defects for a period of **ONE YEAR**. The following warranty is applicable:

"We undertake to rectify any defect resulting from faulty design, material of workmanship appearing during a period of **ONE YEAR** after the date of delivery of machine. Our liability shall only apply to defects that appear under normal condition and do not cover defects arising from faulty maintenance, alteration carried out by third party or from normal deterioration, rubber parts, seal, Suction Hose, mishandling or accidental case etc...etc.. are not covered under warranty. We shall be in no event liable for damage other than in respect of norm fulfillment of above warranty. Obligation: any claim in respect of operation losses or other indirect losses shall be excluded.

For Hydrotech International



(Mohit Kumar)  
Manager (Comm.)



# HYDROTECH INTERNATIONAL

Manufacturer of : Municipal & Hydraulic and Special Application Vehicle  
An ISO : 9001 : 2008 Certified Company  
Registered In : NSIC and DGIS&D

Cell: +91 8171112570  
+91 8006000750  
+91 8171112562

64, Chhapra Industrial Area, Behind Mragh Naim Restaurant, Opp-Village Kumarhera, Dehradun Road, Saharanpur-247001 (U.P) INDIA

## TECHNICAL SPECIFICATION OF ANIMAL CATCHER

- Lifting Platform** : Side 2 mm  
Floor 2 mm  
The body shall be supported with square pipes and floor will be 100X50X5 Channels.
- Hyd. System** : Hyd. Pump shall be of 3.5GPM Capacity and Hyd. Valve will be reputed make with single Spool double acting & two no. cylinder for operating of animal lifting Platform.
- Hyd. Tank** : Hyd. Tank shall be 40 Ltrs. Capacity with Return line filter & Suction Filter, Air breather.



60, Tripuri Chowk, Garha, N.H. 7, Jabalpur (M.P.), Ph. No. : (0761) 2673202, Fax No. : 2673203

1714

Email - starautomobilesjbp@yahoo.co.in, salespersonalstamp@gmail.com

Branches at :  
 Jabalpur : 9009775211, 9009775239 Umariya : 9009775212, 9009775214  
 Damoh : 9009775207, 900977206 Katni : 9009775216, 9009775242  
 Gadarwara : 9009775244, 8966903418 Narsinghpur : 9009775240  
 Shahpura : 9009775248 Sihora : 9009775218

REF NO. / SAS / SCO / BOL / XYLO / XUV.....

QUOTATION

Date: 16/03/17

To: M/s. BHOPAL MUNICIPAL SOLID WASTE Pvt. Ltd.

Ph. 9717148111

Ref. No. .... Place of Delivery JBP ..... Financed by .....

Dear Sir,

While thanking you for your enquiry, we are pleased to quote our lowest rates as under :-

Mahindra Vehicle Model	:	B76 - BOLERO - P/L - UP	
Ex-showroom Price	:		6,65,476/-
Accessories Kit	:	DISCOUNT: -	9907/-
Net Ex Showroom	:		6,55,569/-
Handling Charge	:		6,000/-
Insurance / Pvt. / Taxi	:		85,830/-
Extended Warranty Shield- 2nd / 3rd / 4th years	:		
R.T.O. - Pvt. / Taxi	:		62,738/-
<b>Scheme</b> : (1) Cash	:		
(2) Insurance	:		
(3) Accessories	:	FEBRICATION	2,40,000/-
(4) Other	:		

GRAND TOTAL

ON ROAD ⇒ 10,00,137/-

Note : Payment by Bank Draft will be accepted only in favour of STAR AUTOMOBILES (M.P.) LTD. payable at Jabalpur only.

**Terms & Condition of Sale :**

1. Equipments, Specification and Price quoted above are subject to change without notice.
2. No receipts are valid unless obtained on our official receipt form. 3. Any dispute subject to SATNA COURT only.
4. No Interest shall be payable for any delay in supplies. 5. Delivery shall be made within 15 days, against booking, subject to availability of stock from our principals. 6. Booking cancellation charge is applicable if booking is cancelled.
7. WARRANTY : As per manufactures term and conditions only
7. PRICE PREVAILING AT THE TIME OF DELIVERY SHALL BE APPLICABLE

"I hereby confirm the acceptance of all conditions referred above"

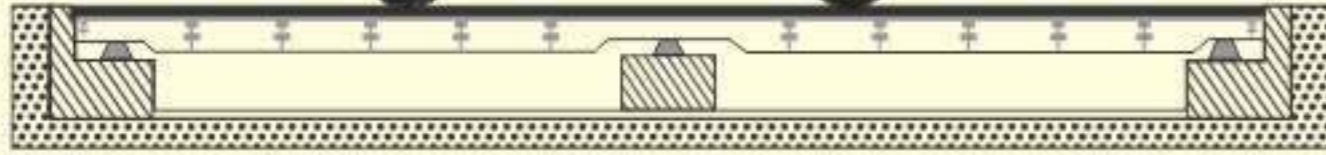
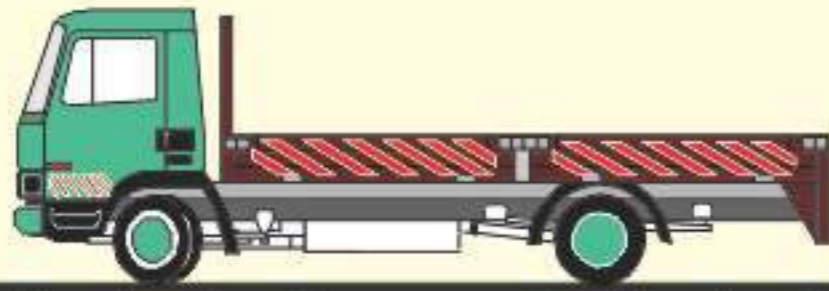
\* BOOKING CANCELLATION CHARGES IS APPLICABLE, IF BOOKING IS CANCELLED

For :- Star Automobiles (M.P.) Ltd.

Customer

Name of Sales Consultant, Mob. No.

  
 Authorised Signatory



PIT TYPE STEEL STRUCTURE WEIGHBRIDGE



MOBILE STEEL STRUCTURE WEIGHBRIDGE

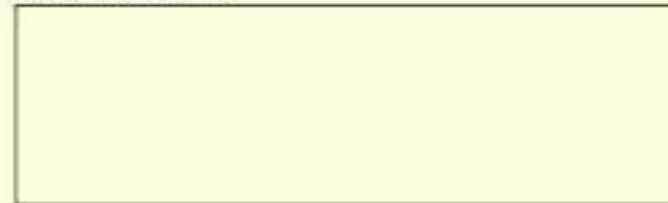
**FEATURES OF RCC WEIGHBRIDGE :**

1. Prices most economical
2. Maintenance free weighbridge
3. Life of the RCC structure is approx 50 years
4. More accuracy, because of less vibrations
5. Annual painting, Oiling not required
6. Options for PIT type / PIT less weighbridge
7. Options for steel or concrete Joists.
8. No mechanical components therefore no wear and tear.
9. Tyre of truck can not be removed from platform, hence no manipulation by driver.
10. Effect of Lightning on load cells is minimum as Concrete is a Bad Conductor of electricity.

**FEATURES OF DIGITAL LOAD CELLS :**

1. Accuracy is enhanced by multiple folds.
2. Each load cell is pre-calibrated therefore no Corner Error.
3. No weight disturbance due to change in temperature.
4. No need for callibration.
5. Self identifying and convenient for malfunctional diagnosis.
6. Easy installation and interchanging.

Authorised Dealer :



Manufactured & Marketed by :



**MULTI-WEIGH (India) Pvt. Ltd.**

Office : 182/72, Industrial Area, Phase-1, Chandigarh-160 002  
 Phone : 0172-3299270, 5024750, 5024753, 5024755, 092165-61284  
 E-mail : multiweigh1@gmail.com Website : www.multi-weigh.com  
 Works : Ropar Road, Near Petrol Pump, NALAGARH (H.P.)

Printed at: Ashi Graphics, 144, Phase 1, Sector 14, Chandigarh-160 002  
 0172-4417481, 333255, 332154 www.multiweigh.com

# MULTI-WEIGH



**No. 1 IN CONCRETE  
 WEIGHBRIDGE TECHNOLOGY  
 NOW WITH DIGITAL LOAD CELLS**



INTELLIGENT TERMINAL (I.T.)  
 SUITABLE FOR DUSTY ENVIRONMENT



DOUBLE ENDED DIGITAL LOAD CELL

**MAINTENANCE FREE CONCRETE TRUCK/TRAILER SCALES  
 SOLID AS ROCK**

Model Approved by Govt. of India

## TECHNICAL SPECIFICATION OF HOOK LOADER

<b>Model</b>	<b>Palfinger T-15</b>
Tank	100 L
Pump	63 L
Control	Pneumatic Control
Valve Elements	4
Locking	External Hydraulic locking
Hook Safety	Mechanical
Control	Cab Control – Through Double acting Valve element
Color	Primer Coated
Standard features	Loading & Tipping function Load holding valves for all movements Automatic tipping frame – hinge locking Long life bushes Spare Parts Catalogue Roller Stabilizers
Suitable Truck	25T Customer Scope
Bin & Fabrication	As required @ Customer Scope



## महिंद्रा सुप्रो मैक्सि ट्रक विवरण चार्ट

विवरण	T2	T4	T6
इंजन	इन्फेक्ट इंजिन चयन डीजल इंजन		
प्रकार	909 cc		
डिस्ट्रीब्यूट क्षमता	34 kW @ 3750 rpm (45 HP)		
अधिकतम टॉर्क	98 Nm / 9.99 kgm @ 1600 - 3000 rpm		
प्रकार	5 स्पीड गियर बॉक्स		
प्रकार	मैन्युअल	पावर	पावर
प्रकार	कॉयल स्प्रिंग के साथ मैक्सिम स्ट्रट		
प्रकार	तीफ़ स्प्रिंग		
प्रकार	ऑटो एडजस्टर के साथ वैक्यूम एसिस्टेड हाइड्रॉलिक		
प्रकार	डिस्क		
प्रकार	ड्रम		
कार्गो बॉक्स का आयाम L X W X H (mm)	2500 X 1540 X 330		
व्हील बेस (mm)	2050		
GVW (kg)	2070		
पेलोड (kg)	1000		
व्हील रिम साइज	4.5J x 13 (33.02 cm)		
टायर साइज	155/80 R13 (33.02 cm)		
प्रकार	D + 1	नहीं	हां



मेटालिक रंग

डीज चार्ज ब्यू

डायमंड क्लाइड

सुप्रो मैक्सि ट्रक  
अपलॉय कलर

एक बड़े नाम, रिजर्वेड नई एनवीसीएच स्टेजड उच्चतम का रिकॉर्ड नहीं है. \*VMOU इंडिपेंडेंस के अनुसार, स्टेजड इंडिपेंडेंस एकाजी पर शिफ्ट.  
1 - 2 साल या 60,000 km, जो भी पहले हो.



महिंद्रा एंड महिंद्रा लिमिटेड, ऑटोमोबिल सेक्टर, महिंद्रा टॉवर्स, तीसरी मंजिल, अणुदुर्गा रोड, कांदिवाडी (पु), मुंबई 400 101.  
उत्पाद की नई नयी डिजाइनर लची संरचना पर उपलब्ध नहीं है. • डिजल एवं एनवीसीएच स्टेजड उच्चतम का रिकॉर्ड नहीं है. • टैटल चरमों से निम्न चरमों से  
कार्यक्षमता के आंकड़े निम्न ही प्रदर्शित हैं. • वाहन की वही का जो इसे टूट गिर के निम्न ही संख्या है. • अपने टैटल चरम से निम्न गुण की एनवीसीएच  
के अंतर्गत किंग ऑफ सुपर गैर नाम निम्न किंग ऑफ डिस्टिन्शन एवं विश्वास को बताने का अर्थवाचक एवं गुरुरि है. • गुणवत्ता एवं गुरुरि है. • गुणवत्ता एवं गुरुरि है.

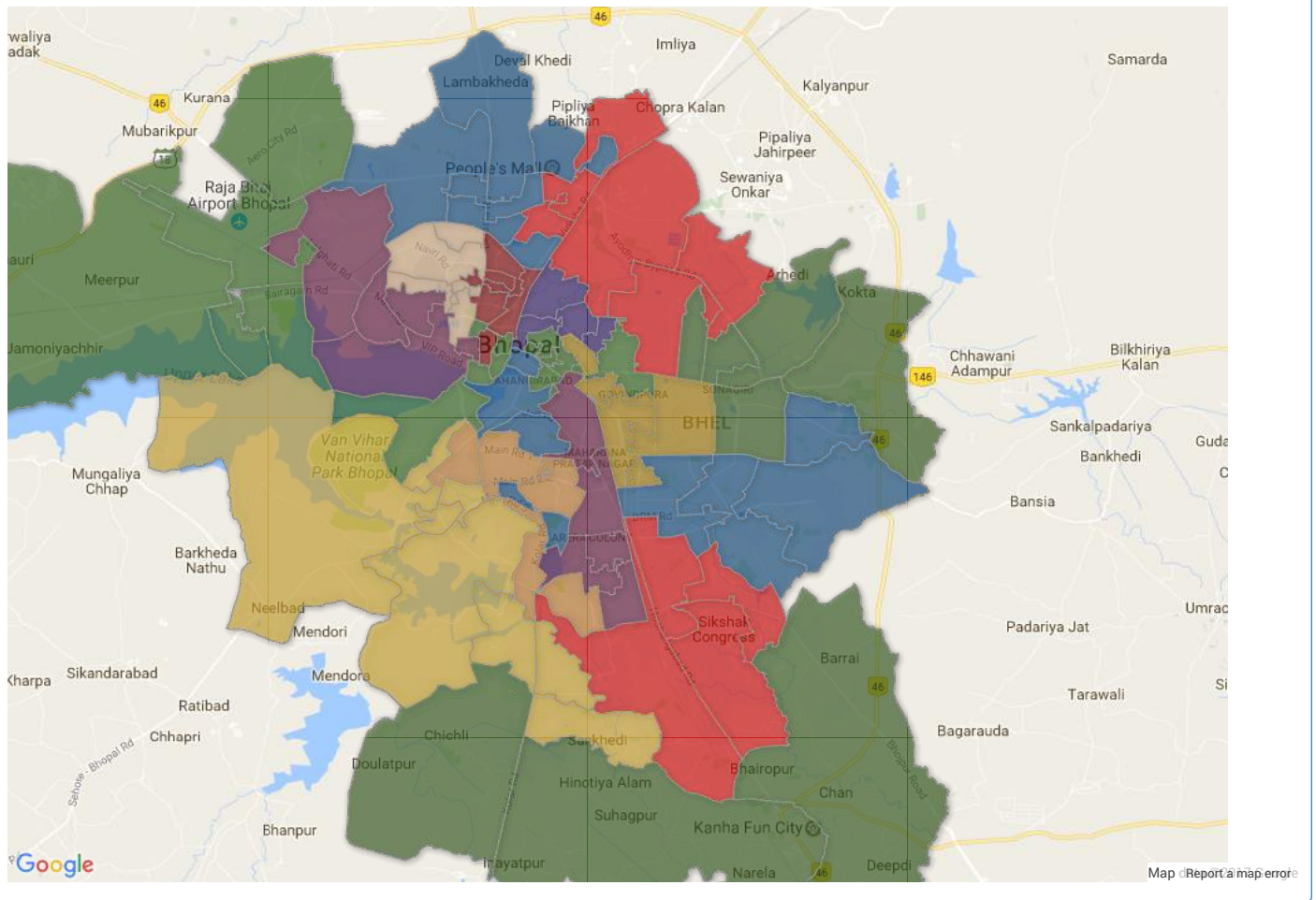
फीचर्स	T2	T4	T6
पुनरी संभाल, बॉलर डीलर के साथ	×	×	✓
डीजल	×	×	✓
नई स्टाइल का इन्फेक्ट फेसल	✓	✓	✓
मैक्सिम डीलर	×	×	✓
एनवीसीएच	✓	✓	✓
विश्व क्वालिटी का डीलर	✓	✓	✓
मैक्सिम चार्जिंग सुविधा	✓	✓	✓
डायर डेस्टेड	✓	✓	✓
बॉडी कलर ऑप्शन और डोर कलर	×	×	✓
मेटालिक कलर	×	×	✓
उच्चतम टोन इंडिपेंडेंस	×	✓	✓



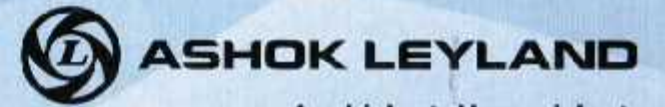
**SUPRO**  
MAXITRUCK

तरसुकी की पहचान

# Informative Map



1618



Aapki Jeet. Hamari Jeet.



HIGHER FUEL EFFICIENCY ■ IMPROVED DRIVABILITY ■ LOWEST OPERATING COST

## THE 1618 BSIV VEHICLE, POWERED BY THE FUEL EFFICIENT 'H' SERIES ENGINE

### ENGINE



- Turbocharged intercooled, 5.7 litre six cylinder, 'H' series BSIV engine, delivering 180 PS @ 2400 rpm
- Optimised torque of 660 Nm in a wider rpm band of 1200 - 1900 rpm, enables lesser number of gear changes, and offers better driveability
- Optimized engine power for better fuel mileage and higher kmpl

### EGR SYSTEM



- Exhaust Gas Recirculation system
  - A portion of the exhaust gases, after cooling, is re-circulated back to the cylinders for re-combustion, thus reducing NOx. **No need to recharge with urea**
  - Based on inputs from ECU, an electrically actuated EGR valve regulates gas flow from the exhaust

### GEAR BOX



- ZF S636-6 speed gear box for higher durability
- First gear ratio of 8.97:1 for higher gradeability

### DRIVE HEAD



- Heavy duty rear axle with drive head ratio of 4.88:1 for better fuel economy and speed

### 300 LTS. POLYMER DIESEL TANK



- Rugged polymer diesel tank ensures purity of diesel. No contamination due to rusting or paint flakes

### OPTIMISED DRIVE TRAIN



- Peak torque in a wide engine rpm range (1200 ~ 1900) for easy driveability, and lower number of gear shifts that do not vary significantly with driving habits
- Proven ZF S636 gearbox with 8.97:1 FGR, for high initial pick-up – at any load, on any terrain
- 4.88:1 RAH for reaching higher speeds, coupled with 180 HP max power, for TAT sensitive applications such as express cargo and agri perishables

## DIMENSIONS, WEIGHTS AND TECHNICAL SPECIFICATIONS:

### Leading dimensions in mm

Wheelbase	4330
Front overhang (With Bumper)	1468 (1218 over frame)
Rear overhang	1980
Overall length (with bumper & RUPD)	7788
Overall width	2432
Track – Front	1978
Track – Rear	1816
Minimum ground clearance	253
Min turning circle diameter (kerb to kerb)	16600
Grade ability	31.4%

### Weight distribution (Kgs)

	Front	Rear	Total
Laden	6000	10200	16200

### Chassis

Suspension	Semi-elliptic multi leaf at front and at rear
Frame	Dimension : 228.2 X 75 X 6 mm - 6 cross members
Steering	Power assisted
Brakes	Full air dual line; Spring actuated parking brakes at rear wheels only
Fuel Tank capacity	300 ltrs polymer tank with Fuel filter cum water separator and pre filter in fuel line
Electrical	24V (2 X 12V) single pole wiring Battery - 110AH x 2; Alternator – 55 Amps capacity
Tyre	10.00 X 20 - 16PR Cross ply / Radial

### Cabin

Cowl	G45 day cowl
------	--------------

### 1618 Maintenance intervals in kms

	1618 Maintenance intervals in kms	Recommend lubricants
Engine Oil change interval	80000	Gulf Superfleet LE Dura Max 15W40 / Indian Oil Servo Pride-ALT Plus 15W40
Engine Coolant Change interval	200000	Gulf Eurocool LL Max50 / Indian Oil Servo Kool ALT 50
Gear Box Oil change interval	120000	Gulf Gear XP Dura Max 80W90 / Indian Oil Servo Gear ALT 80W90(LL)
Rear Axle Oil change interval	80000	Gulf Gear DB Dura Max 85W140 / Indian Oil Servo Gear Axle ALT 85W140
Power Steering Oil change interval	160000	Gulf Power Steering Dura Max / Indian Oil Servo Transdex II
Wheel Bearing Grease interval	80000	Gulf Crown Dura Max NLGI3 / Indian Oil Servo Grease Super 3

### Coach builder drawing



04/20/2021



Total Maintenance Solution



Basic Free Maintenance For 2 years / 2,00,000 kms



Covers Vehicle Agreements For 3 years / 3,00,000 kms



Covers Vehicle Agreements For 4 years / 4,00,000 kms



Covers Vehicle Agreements For 5 years / 5,00,000 kms



Insurance Schemes with options of Add-on covers



Assured Emergency Response



Original Quality Parts



24 x 7 National Helpline

Registered Address: Ashok Leyland Ltd. No.1, Sardar Patel Road, Guindy Chennai- 600032 | Ph no: 044-2220 6000 | Website: www.ashokleyland.com  
Email: reachus@ashokleyland.com | CIN: L34101TN1948PLC000105

**2518**

**6x2 MAV**



**ASHOK LEYLAND**

Aapki Jeet. Hamari Jeet.



FUEL EFFICIENT | IMPROVED DRIVABILITY | LOWEST OPERATING COST

# THE 2518 POWERED BY THE FUEL EFFICIENT 'H' SERIES BSIV ENGINE

## ENGINE



- Turbocharged intercooled, 5.7 litre six cylinder, 'H' series BSIV engine, delivering 180 PS @ 2400 rpm
- Optimised torque of 660 Nm in a wider rpm band of 1200 - 1900 rpm, enables lesser number of gear changes, and offers better driveability
- Optimized engine power for better fuel mileage and higher kmpl

## EGR SYSTEM



- Exhaust Gas Recirculation system
- A portion of the exhaust gases, after cooling, is re-circulated back to the cylinders for re-combustion, thus reducing NOx. **No need to recharge with urea**
- Based on inputs from ECU, an electrically actuated EGR valve regulates gas flow from the exhaust



### GEAR BOX



- Proven ALB940 gearbox with 9.01:1 FGR, for high initial pick-up – at any load, on any terrain

### DRIVE HEAD



- Heavy duty rear axle with drive head ratio of 5.57:1 for better fuel economy and speed

### 400 LTS. POLYMER DIESEL TANK



- Rugged polymer diesel tank ensures purity of diesel. No contamination due to rusting or paint flakes

## TECHNICAL SPECIFICATIONS

Engine	H - series BSIV with EGR
Maximum power	180 HP @ 2400 rpm
Maximum torque	660 Nm @ 1200 – 1900 rpm
Clutch	380 mm dia, axial spring with ceramic lining and clutch booster
Transmission	ALGB940 6 speed synchromesh - FGR 5.01:1
Front axle	Forged-section Reverse Elliot
Rear axle	R-149.7 with RAR 5.57:1
Frame	Ladder-type with heavy-duty frame
Suspension	Front: Semi-elliptic multi-leaf Rear: Semi-elliptic multi-leaf with equaliser link
Brakes	Full-air dual-line with ABS
Parking brakes	Flick-valve operated pneumatic hand brake on rear wheels only
Fuel tank capacity	400 L Plastic - rectangular
Battery	24 V 110 AH
Tyres	10x20 - 16 PR - Radial

## WEIGHTS (KGS)

	Laden
Front axle	6000
Rear axle	19000
Total	25000

## MAJOR DIMENSIONS (IN MM)

Wheelbase	A	4902
Overall length	B	9444
Overall width	C	2432
Front overhang	D	1468
Rear overhang	E	2372
Front track	F	1978
Rear track	G	1816
Min. ground clearance		260
Min. turning circle dia.		17500

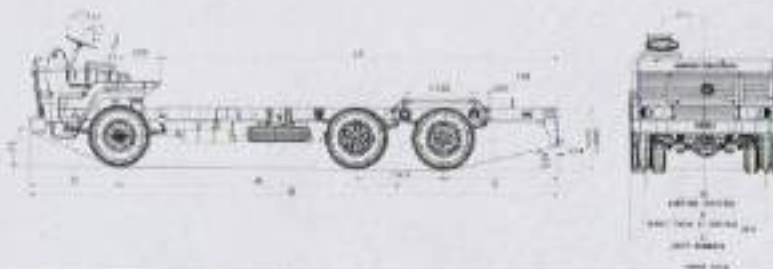
## PERFORMANCE

Maximum speed in top gear*	80 kmph
Maximum gradeability	22.8%

\* As per CMVR

Specifications are subject to change due to continuous improvements and are for reference only. Do no drill or weld on the frame.

## COACH BUILDER DRAWING



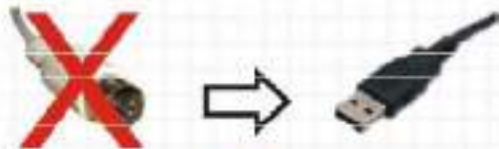
## ALPHA NUMERIC WEIGHT INDICATOR



**AND-7300A** is Multi weigh latest weight indicator cum intelligent terminal for weigh bridge application. It has many user friendly & sophisticated features, that makes it much more advance than the regular indicators. Multi weigh

## USB Port for Keyboard

Eliminates the use of outdated PS-2 keyboard, whose availability will be a problem in future.



## USB Port for Pen Drive

Insert Pen-drive in the USB port & transfer data into pen-drive. Details in the Pen-Drive will be stored in Excel format.



View Report in Excel format										
Sl No	VEHICLE NO.	CUSTOMER	COMMODITY	WEIGHT 1	DATE1	TIME 1	WEIGHT 2	DATE 2	TIME 2	NET
1	MP05AB090	RONI	IRON	9450 kg	02-03-11	10:35	17000 kg	02-03-11	11:30	7750 kg
2	MP05AB194	RAJA	IRON	8700 kg	10-03-11	09:30	14000 kg	10-03-11	10:30	7300 kg
3	MP05AB1234	RONI	IRON	9990 kg	01-03-11	11:30	20000 kg	01-03-11	12:30	7100 kg

## Built-in SMS feature

User can switch to SMS option any time, just need to attach Modem with the indicator.

### SMS to Additional Mobile Phone

SMS can be sent to any Mobile no. entered during data entry (Customer or Driver).  
Mobile no. entry with party code.



## 2 Lac Weightment Records

Higher memory eliminates the need of data erasing to accommodate new weightment records.



## 20 step calibration with random load sequence

Higher weight accuracy can be achieved, and all defects in load cell & structure can be rectified to a great extent.

20 steps smart calibration



## Field programmable Pre-printed tickets

Customized tickets can be programmed in the field. No need for factory programme in EPROM. It saves time & hassles of inventory management for field support.



## Time Report

Details of Time & Date of both the weighments in the report helps in better analysis of weightment data.



## 10 Ticket entry

More information can be entered with each weightment for data processing.



## 100 codes for 4 entries

More codes can be created to speed up weighment.



## LCD with backlight control & LED brightness control

Helps in saving electricity, especially when Indicator is running on Battery back-up.



## Agriculture produce Application

In-built agriculture produce application for rate amount karda. Useful application for Cotton ginning industries, Grain industries, Sugar industries.



## Vehicle-wise Working

Second weight of vehicle will be done by his vehicle no. instead of RST no.



## Multiple Passwords for operation

Different password are required to enable/disable any feature. This eliminates unauthorized access of indicator.



Note :- Option of customized housing is also available.

## Technical Specification

- ▶ Processor: 32bit Processor
- ▶ Processor clock frequency: 50 Mhz
- ▶ Real time clock: On board battery backed RTC.
- ▶ Power supply: SMPS power supply
- ▶ Input Voltage: 90V to 270V AC @ 50Hz.
- ▶ A/D converter: 24 Bit Sigma Delta type
- ▶ Load cell excitation: 8V DC,  
Can drive up-to 12 load Cells of 350 ohms each.
- ▶ Serial port: RS-232 serial

### PROTECTION:-

- (A) 2.5A fuse for input AC mains.
- (B) Input line filter for EMI and RFI suppression.
- (C) Spike suppressor for input transients.
- (D) Opto-isolation of signals and I/Os for high immunity from electrical noise.



# HYDROTECH INTERNATIONAL

Manufacturer of : Municipal & Hydraulic and Special Application Vehicle  
An ISO : 9001 : 2008 Certified Company  
Registered In : NSIC and DGS&D

Cell: +91 8171112570  
+91 8006000750  
+91 8171112562

14, Coojipura Industrial Area, Behind Mugh Nansi Resturent, Opp-Village Kumarhera, Dehradun Road, Saharanpur -247001 (U.P) INDIA

To,  
M/s Bhopal Municipal Solid Waste Pvt limited.

Dated 16.03.2017

**Subject: - Supply of Cycle Rickshaw with 8 Bins, 3.5 Cum bins & 1.1 Cum Steel Bin with Steel Wheel.**

Dear Sir,

We are enclosing herewith our offer for Supply of Cycle Rickshaw with 8 Bins, 3.5 Cum bins & 1.1 Cum Steel Bin with Steel Wheel along with the terms & conditions.

We would also like to inform you that we are the manufacturer and supplier of these machines and have supplied these machines to various government organizations as well as private parties in India and abroad.

We have full fledged factory for manufacturing of *Dumper Placer, Twin Dumper Placer, Sewer Jetting cum Suction Machine, suction machine/ Gulypit emptier, Refuse Compactor/ Collector, Animal Catcher, Hydraulic platform/ Sky lift, Hydraulic Close Top Tipper, Hopper* and all type of refuse bins and after sale support at Saharanpur. The factory have number of qualified engineers and other technical professionals for support of our product. Hope that the above is in line of your requirement, however, if you are require any further information / clarification please contact :-

Cell No. 8171112570 / 8006000750

Email: [hydrotech43@gmail.com](mailto:hydrotech43@gmail.com) / [hydrotech43466@rediffmail.com](mailto:hydrotech43466@rediffmail.com)

Website: [hydrotechinternational.co.in](http://hydrotechinternational.co.in)

Thanking you and assuring you our best co-operation during all the time we remain.

Yours truly,

For Hydrotech International



(Mohit Kumar)  
Manager (Comm.)



# HYDROTECH INTERNATIONAL

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An ISO : 9001 : 2008 Certified Company  
Registered In : NSIC and DGS&D

Cell. +91 8171112570  
+91 8006000750  
+91 8171112562

34, Cusjpara Industrial Area, Behind Mriagh Nami Resturent Opp-Village Kumarhera, Dohradun Road, Saharanpur -247001 (U.P) NDIA

## QUOTATION

S. No.	Description of the Item	Price Each Unit (Rs.)	Qty.	Total Amount in F.O.R Bhopal(Rs.)
01.	3.5 Cum Bins	60,000=00	01 Nos.	60,000=00
<b>Total Amount</b>				<b>60,000=00</b>
02	1.1 Cum Steel Bin with Steel Wheel.	30,000=00	01 Nos.	30,000=00
<b>Total Amount</b>				<b>30,000=00</b>
03.	Cycle-Rickshaw with 8 bins	35,000=00	01 Nos.	35,000=00
<b>Total Amount</b>				<b>35,000=00</b>

### NOTE:

1. Required Road Permit for the transportation shall be account of customer.
2. If the Govt. shall change any percentage of Taxes that shall be account of customer and the Taxes shall be apply at the time of dispatch of material.
3. Octroi or Entry Tax if applicable shall be account of customer.

### PAYMENT:

50% payment of with the Purchase order and balance 50% payment including taxes and duties shall be demanded at our works at Saharanpur before dispatch after your inspection.

### CANCELATION:

No Cancellation of order is acceptable, once the order is placed.

### VALIDITY:

Our offer is valid for a period of 30 days.



## HYDROTECH INTERNATIONAL

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An ISO : 9001 : 2008 Certified Company  
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Cell: +91 8171112570  
+91 8006000750  
+91 8171112562

34, Chajpura Industrial Area, Behind Mragh Naini Resturent. Opp-Village Kumarhera, Dehradun Road, Saharanpur -247001 (U.P) INDIA

### DISPATCH:

The Items shall be dispatch within 30 days from the date of receiving of Purchase Order & advance payment.

For Hydrotech International



(Mohit Kumar)  
Manager (Comm.)



# HYDROTECH INTERNATIONAL

Manufacturer of : Municipal & Hydraulic and Special Application Vehicle

An ISO : 9001 : 2008 Certified Company

Registered In : NSIC and DGS&D

Cell: +91 8171112570

+91 8006000750

+91 8171112562

34, Chajoura Industrial Area, Behind Mugh Naini Restaurant Opp. Village Kumarhara, Dehradun Road, Saharanpur -247001 (U.P.) INDIA

## TECHNICAL SPECIFICATION OF GARBAGE BIN OF 3.5 CUM CAPACITY

Capacity	:	3.5cum
Side Sheet	:	3 mm M.S. Sheet
Bottom Sheet	:	4 mm M.S. Sheet
Lifting Hooks	:	38 mm M.S. Rod
Angle	:	40X40X5 mm
Channel	:	75x35 mm





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An ISO : 9001 : 2008 Certified Company  
Registered In : NSIC and DGS&D

Cell: +91 8171112570  
+91 8006000750  
+91 8171112562

34 Chappara Industrial Area, Behind Mugh Naini Restaurant, Opp-Village Kumarhara, Dehradun Road, Saharanpur -247001 (U.P) INDIA

## TECHNICAL SPECIFICATIONS OF HYDROTECH M.S STEEL BIN OF 1.1 Cum (1100 Ltrs.)CAPACITY.

The Closed Bin for waste collection shall be provided with 4 Castor Wheels. The Garbage Collection Bins shall be of 1100 Ltrs. Capacity. These shall be closed type hygienic bins with the Lid which shall open freely while unloading the garbage into the compactor hopper. The Bin construction shall be of Steel Sections for ensuring adequate structural strength required for handling with the Compactor Bin Lifter. Also, Bin shall be designed to be lightweight and with facility to be easily handled by two Bin Handlers.

The Bins shall be designed to be lifted by compactors having universal bin lifters.

- |   |   |
|---|---|
| 1. CAPACITY                                     | : 1.1 Cum (1100 Ltrs.)  |
| 2. BASE MATERIAL                                | : M S Steel Sheet   |
| - Lid   | : The Lid of the Bin shall be of Minimum 1.5mm M.S Sheet                                      |
| - Sheet Thickness                               | : The M.S Steel Sheet Thickness shall be of 3 mm  |
| - Dimensions                                    | : Height - 1280 mm Approx.<br>: Overall Length - 1200 mm Approx.<br>: Width - 1050 mm Approx. |
| 3. STANDARD CONTAINER SHALL HAVE :              |   |
| - Four heavy duty swivel castors (360° turning) |   |
| - Handles on body                               |   |





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Manufacturer of : Municipal & Hydraulic and Special Application Vehicle

An ISO : 9001 : 2008 Certified Company

Registered In : NSIC and DGS&D

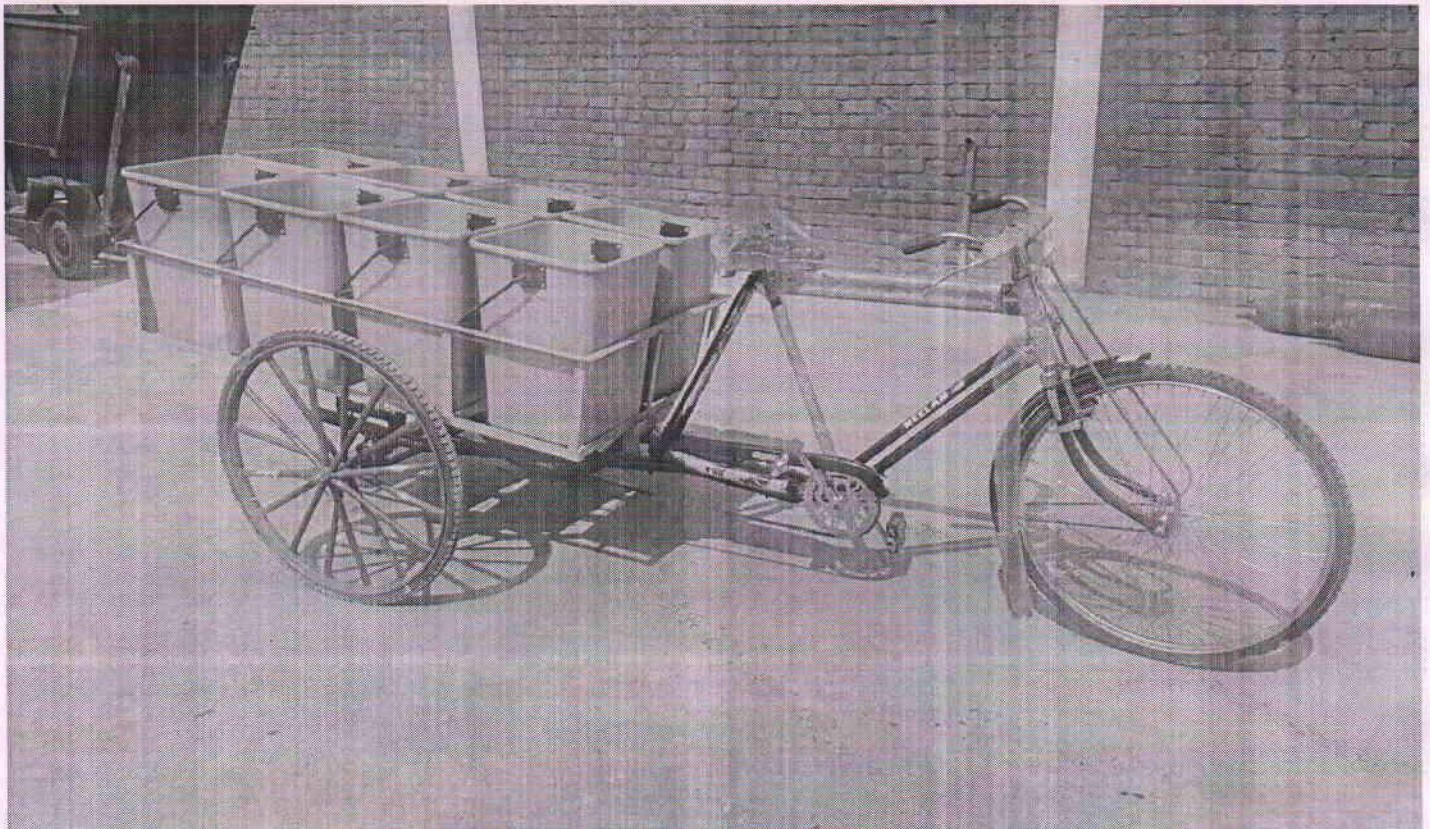
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14, Chajpura Industrial Area, Behind Mraigh Nani Resturent, Opp-Village Kumarhara, Dehradun Road, Saharanpur -247601 (U.P) INDIA

## Cycle Rickshaw with 8 Bins:



Email: [hydrotech43@gmail.com](mailto:hydrotech43@gmail.com) / [hydrotech70@gmail.com](mailto:hydrotech70@gmail.com) / [hydrotech43466@gmail.com](mailto:hydrotech43466@gmail.com)  
Website: [www.hydrotechinternational.com](http://www.hydrotechinternational.com)



**ASHOK LEYLAND**

PI: AL/AD/ESS/15  
Date 12/12/2016

Hosur-2 Factory : ASHOK LEYLAND LIMITED  
: 77, SIPCOT Electronic Complex,  
: Perandapalli  
: Hosur 635 109, T.N

**PROFORMA INVOICE**

M/s Essel Infraprojects Limited  
18, Ramnath House  
5<sup>th</sup> Floor, Yusuf Sarai,  
New Delhi – 49

KA : Mr. Deepshikhar Aggarwal

TIN No. : 3351108003 dt.01.01.2007  
CST No. : 049930 dt.26.06.57  
PAN No. : AAACA4651L  
ECC No. : AAACA4651LXM003  
Excise Range : A(L20101) LTU Chennai  
Excise Division. : LTG1(L201) LTU Chennai  
Excise Commissic : : LTU, Chennai (L2)

Address : LTU CHENNAI, 1775 Jawaharalal  
Nehru Inner Ring Road, : Anna Nagar West Extn., : Chennai  
– 600 101

TERMS : 100% Advance Against  
Proforma Invoice  
Delivery at : Amritsar

**PARTICULARS**

1618 BS4 HAULAGE /4330 mm WB / 180HP BSIV EGR ENGINE / 15IN RDC CERAMIC DISC / ZF S6-36 GB 8.97FGR /  
MERITOR MR148 4.88RAR AXLE / FA91 FRONT AXLE / 10R20 TYRES / All Steel Day Cabin

TYRES : 3 nos. 10.00 x 20- 16 PR nylon + 4 nos. 10.00 x 20 - 16 PR PD nylon

PRICE : Basic without ED	1393277
Special Discount	230120
PRICE: Basic after Discount	1163157
ED @ 13%	151210
Auto Cess @ 0.125%	189
Final Cum Duty Price Ex RSO Indore	1314556
VAT @ 15%	197183
Delivery extra upto Bhopal	15000
PTO	25000
Insurance (Comprehensive)	51000
Total Inclusive of Delivery Charges	1602740
TCS @ 1% on Invoicing Amount	16027
Total Inclusive of TCS	1618767
Quantity	1
Grand Total for 1 nos.	1618767

**Rupees Sixteen Lacs Eighteen Thousand Seven Hundred and Sixty Seven Only**

NOTE : Prices, Taxes, Duties and Other Statutory levies are subject to revision and those ruling on the date of Invoice shall only be applicable.

Price Validity: The special price offer up to 31st Dec 2016

Delivery : Vehicle readiness - 30 days after receipt of Confirm PO with advance, post which Physical delivery only on receipt of full payment

Payment Terms : 100% advance before delivery.

Entry Tax: Entry Tax if applicable shall be in the scope of consignee only

Form 'C' if applicable & any other applicable entry form in favour of Ashok Leyland Ltd. shall be furnished along with Payment/delivery order

E & O E  
For ASHOK LEYLAND LTD.



**ASHOK LEYLAND**

PI: AL/AD/ESS/78  
Date 12/12/2016

Hosur-2 Factory : ASHOK LEYLAND LIMITED  
: 77, SIPCOT Electronic Complex,  
: Perandapalli  
: Hosur 635 109, T.N

**PROFORMA INVOICE**

M/s Essel Infraprojects Limited  
18, Ramnath House  
5<sup>th</sup> Floor, Yusuf Sarai,  
New Delhi – 49

KA : Mr. Deepshikhar Aggarwal

TIN No. : 3351108003 dt.01.01.2007  
CST No. : 049930 dt.26.06.57  
PAN No. : AAACA4651L  
ECC No. : AAACA4651LXM003  
Excise Range : A(L20101) LTU Chennai  
Excise Division. : LTG1(L201) LTU Chennai  
Excise Commissio: : LTU, Chennai (L2)

Address : LTU CHENNAI, 1775 Jawaharalal  
Nehru Inner Ring Road, : Anna Nagar West Extn., : Chennai  
– 600 101

TERMS : 100% Advance Against  
Proforma Invoice  
Delivery at : Amritsar

**PARTICULARS**

2518/ H6 180HP BS-IV EGR WITH CB18 / 6X2 / 193 INCH WB / G45 MKIII SL FES / 15 INCH RDC WITH ORGANIC  
F510MCC FACING MATERIAL/ EATON ES9306A - 9.01 FGR / 5.57 RAR / RANE P.STG / ALL STEEL SL. CABIN

TYRES : 3 nos. 10.00 x 20- 16 PR nylon + 8 nos. 10.00 x 20 - 16 PR PD nylon

PRICE : Basic without ED	1848398
Special Discount	385815
PRICE: Basic after Discount	1462583
ED @ 13%	190136
Auto Cess @ 0.125%	238
Final Cum Duty Price Ex RSO Indore	1652956
VAT @ 15%	247943
Delivery extra upto Bhopal	15000
PTO charges	25000
Insurance	61000
Total Inclusive of Delivery Charges	2001900
TCS @ 1% on Invoice Amount	20019
Total Inclusive of TCS	2021919
Quantity	1
Grand Total for 1 nos.	2021919

**Rupees Twenty Lacs Twenty One Thousand Nine Hundred and Nineteen Only**

**NOTE :** Prices, Taxes, Duties and Other Statutory levies are subject to revision and those ruling on the date of Invoice shall only be applicable.

**Price Validity:** The special price offer up to 31st Dec 2016

**Delivery :** Vehicle readiness - 40 days after receipt of Confirm PO with advance, post which Physical delivery only on receipt of full payment

**Payment Terms :** 100% advance before delivery.

**Entry Tax:** Entry Tax if applicable shall be in the scope of consignee only

Form 'C' if applicable & any other applicable entry form in favour of Ashok Leyland Ltd. shall be furnished along with Payment/delivery order

E & O E  
For ASHOK LEYLAND LTD.

**Proposal for**  
**Vehicle Tracking System**

**Submitted To**

**Bhopal Municipal Solid Waste Private Limited**

**Submitted By**



**AEON SOFTWARE PRIVATE LIMITED**

A-103, Everest Grand, MIDC, Mahakali Caves Rd, Shanti Nagar, Andheri East, Mumbai, Maharashtra  
400093

## Overview

This is a proposal created for Implementation of GPS Tracking Devices in Waste Collection Vehicle.

## About Us

**AEON Software Private Limited**, is a Mumbai based software company with 15 Years of business experience in Various domains with a niche in Travel and Transport Domain. We are serving around 8 big STU across India.

Please visit our website for more details:

<http://www.aeonsoftware.net/>

## What is AEON Vehicles Tracking System (Location Tracker)

We would like to take this opportunity to introduce our self, we are a full IT service provider, that has been helping businesses, organizations and individuals to achieve their potential. We provide GPS based vehicle tracking solutions with a combined platform of high-performance fleet management system and robust GPS devices. We are dedicated to meet your objectives in critical vehicle tracking solutions. We offer powerful solution to satisfy your industrial needs. Our flagship web tracking systems have been developed to help you manage your vehicles, Whether you run a Courier service or a trucking company. We at AEON provide you with: Economic Benefits o Increasing revenue through optimal productivity.

### Economic Benefits

- o Increasing revenue through optimal productivity.
- o Reducing cost.
- o Improve driver safety.
- o Increase fuel economy.
- o Increasing security.

### Real time tracking with

Live Tracking your vehicles location and movement Updating within a time interval of every 10 Sec x Supporting various alarms including SOS alarm, Speed alarm, low power alarm, Geo-fence alarm etc. x Historical data storage (minimum 6 months) x Multiple browser compatibility and smart phones/ iPad etc.

If you own or manage any of the following types of businesses or any business that requires a fleet of vehicles then AEON can help you save time and expense with a low maintenance and hassle free solution:

- Transportation Services
- Taxi Services

### **AEON SOFTWARE PRIVATE LIMITED**


A-103, Everest Grand, MIDC, Mahakali Caves Rd, Shanti Nagar, Andheri East, Mumbai, Maharashtra  
400093

- Vehicle/Equipment Rentals
- Delivery/Courier Services
- Utilities
- Maintenance and Repair Services
- Sales
- Security Services

<b>Our Client Base</b>
<p style="text-align: center;"><b>Premium Client</b></p> <div style="text-align: center;"> <b>GSRTC</b> 8000 Devices UP and Running.</div> <div style="display: flex; justify-content: space-around; align-items: center;"><div style="text-align: center;"> <b>adani</b></div><div style="text-align: center;"> <b>dishman</b></div><div style="text-align: center;"> AIA Engineering Ltd.</div><div style="text-align: center;"></div></div> <div style="text-align: center; margin-top: 20px;"> <b>RELIANCE</b></div> <div style="text-align: center;"></div>

**Solution Proposal**

**Option 1**

Product / Service details	Price in Rupees (per-unit)
Manufacturer/European  IP65 Standards Product Name: <b>Ganesha</b>	
Vehicle Tracking Unit (VTU) Model:- TP-1 (per-vehicle/per-unit)	<b>Rs. 10000/- *</b>
<b>Software Subscription Charges (per-vehicle/per-unit)</b>  <b>1. Annual (Payable in Advance)</b> (Including Activated SIM, GPRS, Reports, Web Hosting, Data Backup & Storage, Google Maps, Fixed Alerts )  Application Feature Set:- <ul style="list-style-type: none"> <li>• Live Tracking on Map</li> <li>• Geo Fence</li> <li>• User Management</li> <li>• Trip Management</li> <li>• Personalized Landmarks</li> <li>• Reports</li> <li>• Vehicle Maintenance</li> <li>• SMS / Email Alerts</li> </ul> <b>2. Installation (Per Vehicle / One Time)</b>  <b>Out Station Installation:</b> Wiring, outstation travel, accommodation & food charges included Local Bhopal Installation: Wiring, local Bhopal travel charges included	<p style="text-align: center;"><b>Rs. 500/- *</b></p> <p style="text-align: center;"><b>Rs. 500/- *</b></p>

**AMC after 1 Year**

Description	Amount per unit per year
AMC Charges after 1 Year	Rs. 500.00 **

\* ---- Value Added Tax (CST/VAT) 5% is extra as applicable on the price quoted.

\*\* ---- Service Tax 15% is extra as applicable on the price quoted. Octroi Extra if applicable



# NILKAMAL LIMITED

Head Office: Nilkamal House, Street No. 14, M.I.D.C., Andheri (East), Mumbai – 400 093. Tel: 022-26818888/28361366  
Regional Office: “Asarpota Chamber” 2<sup>nd</sup> Floor, N/r. Swastik Char Rasta, C.G. Raod, Navrangpura, Ahmedabad – 380 009.  
Telefax: 079 – 26448324 / 26402663 Fax : 079- 26402602 .E-mail : [ahmedabad.ro@nilkamal.com](mailto:ahmedabad.ro@nilkamal.com) [swm.ahmedabad@nilkamal.com](mailto:swm.ahmedabad@nilkamal.com)

NL/QUOT/SWM/083/2016-17/R0

DATE: 16<sup>th</sup> March 2017

TO,


**Bhopal Municipal Solid Waste Pvt. Limited,  
Madhya Pradesh.**

**KIND ATTENTION: Mr. Deep Shikar Agarwal**

**SUBJECT: Budgetary Quotation for Waste Bin**

Dear Sir,

This is with respect to your enquiry received for the requirement of Waste Bin. We are glad to inform you that we have been awarded “ISO 9001 CERTIFICATE” by “TUV SUDDEUTSCHLAND - GERMANY” as a mark of our very high Quality Management System for manufacturing of plastic crates. As per your requirement for various type of waste Bins we are hereby providing you with our best rates:-

Sr. No.	Product	Rate @ per pcs	Image for reference
1	<b>MODEL : RC10L1</b> <b>Manufacturing Process :INJECTION MOLD</b> <b>Dimension</b> Top O.D.: Dia 270 mm Top I.D.: Dia 240 mm Bottom O.D.: Dia 200 mm Height: 270 mm Capacity: 10 Ltrs. Material : HDPE Colour : Red / Green	<b>Rs. 115/-</b>	

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Telefax: 079 – 26448324 / 26402663 Fax : 079- 26402602 .E-mail : [ahmedabad.ro@nilkamal.com](mailto:ahmedabad.ro@nilkamal.com) [swm.ahmedabad@nilkamal.com](mailto:swm.ahmedabad@nilkamal.com)

2	<p><b>Model: RFLB60L1</b> <b>Manufacturing Process :ROTO MOLD</b> <b>Dimension:</b> Top O.D : 400 (L) x 400 (B) mm approx Bottom O.D:332(L)x332(B) mm approx Height (without lid) : 563mm approx. Height (With Lid) :711 mm approx. LID : 415 (L) x 415 (B) x 180 (H) mm Capacity: 60 Ltrs. Material: LLDPE Colour: Red/ Blue / Olive Green / Green Usage : With &amp; without single / dual mounting pole</p>	Rs. 6,350/-	
3	<p><b>Model : Nilkamal WB 120L</b> <b>Manufacturing Process :</b> <b>INJECTION MOLDED</b> <b>Dimension:</b> Top O.D. : 560(L) x 477(B) mm approx. Bottom O.D. :495(L) x 490(B) mm approx. Height (Without Lid): 882 mm approx. Height (With Lid): 955 mm approx. Capacity: 120 Ltrs. Material : HDPE EN Standard Colour : Green Usage: Wheel Bin</p>	Rs. 2,800/-	

## OTHER TERMS & CONDITIONS:

**TAXES** : Inclusive

**DELIVERY** : Will be started within 15 day on receipt of your purchase order.

**F.O.R** : Destination

**PAYMENT** : 100% advance along with the Purchase Order

# NILKAMAL LIMITED

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Head Office: Nilkamal House, Street No. 14, M.I.D.C., Andheri (East), Mumbai – 400 093. Tel: 022-26818888/28361366  
Regional Office: “Asarpota Chamber” 2<sup>nd</sup> Floor, N/r. Swastik Char Rasta, C.G. Raod, Navrangpura, Ahmedabad – 380 009.  
Telefax: 079 – 26448324 / 26402663 Fax : 079- 26402602 .E-mail : [ahmedabad.ro@nilkamal.com](mailto:ahmedabad.ro@nilkamal.com) [swm.ahmedabad@nilkamal.com](mailto:swm.ahmedabad@nilkamal.com)

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**VALIDITY** : Offer valid for 15 Days

**OCTORI** : If applicable will be borne by the customer

**ROAD PERMIT** : If required has to be provided by the customer

It would give us a great pleasure to be associated with you for the keep the surrounding & environment green & clean by using of Solid Waste bin.

**Thanking you and assuring you our best of services for all times.**

**For, Nilkamal Limited**

**Jignay H Dave**  
General Manager  
Mob. 9727716997  
Email- [jignay.dave@nilkamal.com](mailto:jignay.dave@nilkamal.com)

## Quotation

AMPL/QUO/321/16-17

16.03.2017

To,  
ESSEL INFRA PROJECT PVT. LTD.

Sub: Price offer for Fabrication, mounting and supply of 14 cum Refuse Compactor on suitable chassis with PTO PUMP supplied by you.

Dear Sir,

With reference to the subject matter and referred your enquiry wherein we hereby pleased to submit our best and lowest offer for Fabrication, mounting and supply of 14 cum Refuse Compactor on suitable chassis with PTO PUMP supplied by you in the following format.

Part-I Commercial Terms and Conditions.



Part-II Priced Offer.

We hope you shall find our offer in line with your requirement. In case of any further clarifications/ confirmations required from us please feel free to contact us.

Thanking you,

Yours faithfully

**For Antony Motors Private Limited**



**Authorized Signatory**

**PART-I**  
**COMMERCIAL TERMS AND CONDITIONS**

- 1. Validity** : This price offer is valid for 30 days from the date hereof.
- 2. Delivery** : Ex-Works Mahape, Navi Mumbai.
- 3. Payment** : 50% advance with PO and balance before delivery
- 4. Taxes** : VAT @ 13.5% extra on below offered price
- 5. Note** : Any price revision due to change in the government levies will be charged extra at the time of dispatch.

**PART - II**  
**PRICE OFFER**

Sl. No.	Description	Quantity (Nos.)	Unit Price (Rs.)	Total Price (Rs.)
1	Fabrication, mounting and supply of 14 cum Refuse Compactor on suitable chassis with PTO PUMP supplied by you	1.00	2,000,000.00	2,000,000.00

Thanking you and assuring you of our best attention and services at all times, meanwhile looking forward to receive your order very soon.

Thanks & Regards

For **Antony Motors Pvt. Ltd**



Authorized Signatory

# **Client List of Construction Companies:**

**1. M/s Gouri Construction Company,**  
Takoli, Dist. Mandi (H.P)  
Mr. Kamal (Site Person) 094594-00127  
Mr. Rakesh (098160-18025)

**2. M/s Ahuja Builders,**  
Noida  
Mr. Gaur (098686-13536)

**3. M/s Garg & Garg Construction Co.**  
Near Ambuja Cement Factory  
Bharatgarh Distt. Ropar  
Punjab  
Mr. Bajinder Singh (094180-94106)

**4. M/s ART Infra Structure,**  
Jhansi  
Mr. Sourav Gupta (099350-41405)

**5. M/s Cosmic structures Ltd**  
Tech Zone Yamuna Express Gr.Noida  
Mr.Vijay Choudhary (098103-04697)

**6. M/s Assotech**  
Gurgaon  
Mr. Mishra (088262-97766)

**7. M/s ART Construction,**  
Kotputli.  
Mr. Banwarilal (097725-59922)

**8. M/s Thousand Trees,**

Gurgaon.

Mr. Darminder (085279-40055)

Mr. Arun (085273-90033)

**9. M/s Deepak Builders,**

Mohali

Mr. Upesh (098762-66011)

**10. M/s M.G Contractor,**

Agra, Patna

Mr. Ganesh (099346-63071)

**11. M/s C & C Construction Company**

Una, H.P.

Mr. H.C.Rana (098160-03998)

**12. M/s Atlanta Limited**

101, Shree Amba Shanti Chambers,  
Opp. Hotel Leela, Andheri - Kurla Road,  
Andheri (East), Mumbai - 400 059.

Mr. A.K. Jha (081466-12275)

**13. M/s Progressive construction Ltd**

Gorakhpur

Mr. R Koteswara Rao (99590-22002)

**14. M/s R.S Infrastructure Pvt Ltd**

UPSIDC Indl. Area Sikandarabad Bulandshahr (U.P.)

**15. 3 C Infra Pvt Ltd**

Mr. Devender Mishra 9910230419

Sector-168, Expressway Noida

- 16. Three C Universal Developers Pvt Ltd**  
Mr.Dinesh Singhal 9910500361  
Sector-107, Noida
- 17. Earth Infrastructures Ltd**  
Earth Towne Sector-1 Greater Noida west.  
Mr.Tarun Maheshwari 9266637076
- 18. Sadbhav Engineering Ltd (DMRC Site)**  
Bahadurgarh Haryana  
Mr. Bipin Kr.Karn 7834804619
- 19. Assotech Ltd,**  
Mr. Mishra (96431-00324)  
Gurgaon
- 20. M/s Mohammad Stone Crusher**  
Mr. Ash Mohammad (98125-45786)  
NAgeena
- 21. M/s Ramjan Stone Crusher,**  
Mr. Tamil Khan (98122-28786)  
Mewat
- 22. M/s Shivalik Stone Crushing Company**  
Mr. Vijay Arora (94161-61190)  
Mewat
- 23. M/s K.C Stone Crushing**  
Mr. Ashok (94160-67277)  
Soahana

# MULTI WEIGH (INDIA) PVT. LTD.

(AN ISO 9001:2008 Certified Co.)

MANUFACTURER OF ELECTRONIC & MECHANICAL WEIGHING SCALES & WEIGHBRIDGES

NCR Delhi Office: C-145, S.F, Sector-10, Noida (UP). +91 999999236, 9810041236,0120-4324983

Head Office: 182/72, Industrial Area Phase-I CHANDIGARH-160002 Ph. 0172-4009035, 4009043.

Works: Vill- Bhagwanpur, Barwala Road, (Near Ind- Swift Lab.) Derabassi, Distt- Mohali (PB) 140507

(Most Experienced Team of Technocrats in India)

To,  
**Bhopal Municipal Solid Waste Pvt Ltd**  
**Bhopal (M.P)**

Dated: 16.03.2017

**Kind Attn: Mr Deep Shikhar Agarwal (Manager)**

Multi Weigh (India) Pvt. Ltd. is one of the leading Weigh Bridge/Weighing Machine manufacturing company having installed over **One thousand five hundred Weighbridges** across India & abroad and its manufacturing unit in Nalagarh (Near Baddi) in Himachal Pradesh, its corporate office at Chandigarh. Mr. R.K. Dixit, Managing Director of the company has a vast experience of 42 years in the weighing industry. Our core management team is as follows:-

	<b>Name</b>	<b>Designation</b>	<b>Experience</b>
1.	R.K. Dixit	M.D	42 years
2.	P.Raghu Ram	Executive Director	35 years
3	B. N. Roy	Director (Projects)	43years
4.	Alok Madan	G.M (Designs)	40 years
5.	A.K. Sharma	G.M. (Technical)	38 years

Multi-Weigh is one of the very few companies which has incorporated **DIGITAL LOAD CELL** Technology and because of this technology accuracy of the Weighbridge increases multifold and it also makes our product completely maintenance free.

Multi-Weigh (India) Pvt. Ltd. has a diversified domain comprising of all kinds of weighing systems and our major achievement has been the introduction of a **Concrete Platform Weighbridge** in the Indian market log on to our site [www.multi-weigh.com](http://www.multi-weigh.com) for more information.

## OUR STRENGTHS:-

- ❖ Longest Experience in the weighing Industry.
- ❖ Focused only on manufacturing, sales, & maintenance of weigh Bridge.
- ❖ Strong network of sales & services team pan India.
- ❖ Dedicated & trained team of 42 Engineers employed across India.
- ❖ Dedicated experience team of civil, mechanical, electronics & IT engineers for handling various technical aspect of weighbridge.
- ❖ Experience of installation from Kashmir to Kanyakumari across all weather.
- ❖ Well versed with the compliances of legal laws of weights & measurement. Dedicated staff for assistance to customer for W & M Certification.

Yours truly,

For Multi Weigh (India) Pvt. Ltd.

Vinod Sharma (Mgr Sales Weighbridge)  
+91 9999999 236

**At Multiweigh, We Neither Compromise On Quality nor On Price**

# **MULTI -WEIGH**

**(Most Experienced Team of Technocrats in India)**

## **QUOTATION & SPECIFICATION**

### **Steel Weigh Bridge**

<b>MODEL NO</b>	<b>MWC – STL</b>
<b>CAPACITY</b>	<b>50 Ton</b>
<b>PLATFORM SIZE</b>	<b>9000mm x 3000mm (30' x 10')</b>
<b>DIVISION/ACCURACY</b>	<b>5kg</b>
<b>STEEL STRUCTURE</b>	<b>6 No. Digital Load Cells of 30 Ton Capacity each with suitable I-Beams supported by 12 mm thick MS Plates with Anti Skid Ribs over it with suitable no. of transoms. (Back to back welded with mig welding with stiffeners to be placed under I-beams).</b>
<b>TYPE OF LOAD CELL</b>	<b>Double Ended Shear Beam (Digital Load Cell)</b>

### **MAJOR ADVANTAGES OF DIGITAL LOAD CELLS:**

- **Accuracy is enhanced in multiple folds.**
- **Each load cell is pre calibrated therefore no corner error and no need of frequent calibration.**
- **There is no difference in weight when there is change in temperature; calibration remains the same in summer, Winter & Rainy.**
- **Display can be put as far as up to 1 Km from the installed weighbridge.**
- **Built in diagnosis can help speed up faultfinding.**
- **Easy installation and interchanging.**

# **Multi-Weigh**

## **(Most Experienced Team of Technocrats in India)**

<b>Digital Indicator</b>	Our highly precise microprocessor based Digitizer, displays the output from the load cells via a terminal box.
<b>Price &amp; Taxes</b>	<u>Rs. 9, 32,000/- (Rupees Nine Lac Thirty Two Thousand Only)</u> F.O.R Bhopal ,Excise duty is 12.5% inclusive , CST@ 14.3% inclusive
<b>Payment Terms</b>	50% Advance & 50% prior to dispatch at our works.
<b>Delivery Period</b>	Approx. Three to Four weeks.
<b>Civil Foundation &amp; Erection</b>	Civil foundation including ramp to be laid down by customer as per drawings provided by us. Labour / Crane to be provided at the time of Unloading/Installation by the customer. Earthing and Electrification would be done by customer at their own cost. Erection will be carried out under the supervision of our service Engineer.
<b>Legal Metrology Compliance</b>	Verification & Stamping Charges Inclusive.
<b>Refund of Advance</b>	Advance against the order is non-refundable
<b>Warranty</b>	All other equipment is warranted against any manufacturing defect for a period of one year from the date of installation.
<b>Regular Maintenance/ (AMC)</b>	We are fully equipped to provide after sale services after the expiry of the warranty period also, subject to a nominal service charge.
<b>Validity</b>	Offer is valid for 60 days from the date of quotation.

**Yours Truly.**

**For**  
**Multi Weigh (India) Pvt. Ltd.**

**Vinod Sharma**  
**(Mgr Sales Weighbridge)**  
**+91 9999999 236**

**ANNEXURE-16**  
**Water Test Report**



# Creative Enviro Services

Accredited Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL), National Accreditation Board for training And Education (NABET) and ISO 9001:2008



Cert No.: T-2565

## TEST REPORT

Name & Address of the Customer To, <b>M/S Bhopal Municipal Solids, Waste Pvt. Ltd. (Bhopal)</b>	Test Report No.: 1181/CES/Lab/16-17/BMS/ 1255 Issue Date : 31.05.2017 Client Ref: Date:
Qty : 1 No. x 10 litre	Date of Collection : 20.05.2017
Method of test : APHA 22 <sup>nd</sup> edition	Date of Receipt : 20.05.2017
Packing :- Plastic bottle	Period of testing : 20.05.2017 TO 30.05.2017
Sample Condition at receipt: Ok	Method of sampling : By Client
Sample Particulars: Ground Water	Sample tested as received : Ok
Sample collected by: By Client	Page no. 1 of 2

S. No.	Visual Observation	Unit	Requirement as per IS-10500-2012		Results
			Desirable Limit	Permissible limit	
1	Appearance	-			Clear
2	Odour	-	Unobjectionable	Unobjectionable	Unobjectionable
3	Colour	Hazen	5	25	Yellow
4	Taste	-	Unobjectionable	Unobjectionable	Unobjectionable

Sr. No	Test Parameters	Unit	Requirement as per IS-10500-2012		Hand Pump
			Desirable Limit	Permissible limit	
1	pH	-	6.5-8.5	No relaxation	5.71
2	Conductivity	µmhos/cm	-	-	186.10
3	Turbidity	NTU	1	10	42.10
4	Total Solid	mg/lit	-	-	164.00
5	Total Dissolved Solid	mg/lit	500	2000	117.00
6	Total suspended solid	mg/lit	100	-	47.00
7	Total Alkalinity	mg/lit	200	600	62.00
8	Total Hardness as CaCO <sub>3</sub>	mg/lit	200	600	38.00
9	Ca Hardness as CaCO <sub>3</sub>	mg/lit	-	-	22.00
10	Mg Hardness as CaCO <sub>3</sub>	mg/lit	-	-	16.00
11	*Calcium as Ca	mg/lit	75	200	08.82
12	*Magnesium as Mg	mg/lit	30	100	03.89
13	Sulphates as SO <sub>4</sub>	mg/lit	200	400	04.52
14	Chlorides as Cl	mg/lit	250	1000	22.83
15	Iron as Fe	mg/lit	0.30	1	0.06
16	Nitrate as NO <sub>3</sub>	mg/lit	45	No relaxation	0.98
17	Nitrite as NO <sub>2</sub> -N	mg/lit	-	-	<0.10
18	Phosphate as P	mg/lit	-	-	<0.10
19	* #Phosphate as H <sub>2</sub> PO <sub>4</sub>	mg/lit	-	-	0.16
20	Fluoride as F	mg/lit	1.0	1.5	<0.10
21	Copper as Cu	mg/lit	0.05	1.5	<0.10
22	Chromium as Cr <sup>6+</sup>	mg/lit	0.05	No relaxation	<0.10

For Creative Enviro Service

Authorised Signatory



4, Shri Ramkunj, E-8, Bharat Nagar, Shahpura, Bhopal-462 039, Phone : 0755-4299319, Telefax : 0755-243510, Mobile : 9425009319

Email: creativelab.bpl@gmail.com, creative.bpl@gmail.com, Websearch : www.creativeenviroservices.com

### Note:

- No statutory liability will be accepted for samples not collected by Creative Enviro Services.
- The report shall not be reproduced except in full without permission of Laboratory, Creative Enviro Services, Bhopal
- The tests and/or calibration marked with an\* are not accredited by NABL.



# Creative Enviro Services



Cert No.: T-2565

Accredited Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL), National Accreditation Board for training And Education (NABET) and ISO 9001:2008

## TEST REPORT

Name & Address of the Customer To, M/S Bhopal Municipal Solids, Waste Pvt. Ltd. (Bhopal)		Test Report No.: 1181/CES/Lab/16-17/BMS/ 1285 Issue Date : 01.06.2017 Client Ref: Date:	
Qty : 1 No. x 10 litre	Date of Collection	: 20.05.2017	
Method of test : APHA 22 <sup>nd</sup> edition	Date of Receipt	: 20.05.2017	
Packing :- Plastic bottle	Period of testing	: 20.05.2017 TO 30.05.2017	
Sample Condition at receipt: Ok	Method of sampling	: By Client	
Sample Particulars: Ground Water	Sample tested as received	: Ok	
Sample collected by: By Client	Page no.	2 of 2	

Sr. No	Test Parameters	Unit	Requirement as per IS-10500-2012		Hand Pump
			Desirable Limit	Permissible limit	
23	* #Phosphate as $\text{HPO}_4$	mg/lit	-	-	0.15
24	* #Phosphate as $\text{PO}_4$	mg/lit	-	-	0.15
25	* #Sulphide as $\text{S}^-$	mg/lit	-	-	1.49
26	* #Sulphite as $\text{SO}_3$	mg/lit	-	-	3.77
27	* #Lime as CaO	mg/lit	-	-	12.34
28	* Total Volatile solids	mg/lit	-	-	44.00
29	* Total Fixed solids	mg/lit	-	-	120.00
30	* Methyl orange alkalinity as $\text{CaCO}_3$	mg/lit	-	-	62.00
31	* Phenolphthalein alkalinity as $\text{CaCO}_3$	mg/lit	-	-	Nil
32	* Zinc as Zn	mg/lit	5	15	<0.05
33	* Total Chromium	mg/lit	0.05	No relaxation	<0.05
34	* Cadmium as Cd	mg/lit	0.003	No relaxation	<0.05
35	* Lead as Pb	mg/lit	0.01	No relaxation	<0.05
36	* Mercury as Hg	mg/lit	0.001	No relaxation	<0.05
37	* Nickel as Ni	mg/lit	0.02	No relaxation	<0.05
38	* Arsenic as As	mg/lit	0.01	0.05	<0.05
39	Sodium Na	mg/lit	-	-	27.19
40	Potassium K	mg/lit	-	-	2.93
41	* Boron as B	mg/lit	0.5	1.0	<0.10
42	* Selenium as Se	mg/lit	0.01	No relaxation	<0.05
43	Bio-Chemical Oxygen Demand (BOD)	mg/lit	-	-	4.00
44	Dissolved Oxygen	mg/lit	-	-	06.1
45	Chemical Oxygen Demand (COD)	mg/lit	-	-	8.00

# By calculation method

For Creative Enviro Service

Authorised Signatory



4, Shri Hamkunj, E-8, Bharat Nagar, Shahpura, Bhopal-462 039, Phone : 0755-4299319, Telefax : 0755-4243518, Mobile : 9425009319

Email: creativelab.bpl@gmail.com, creative.bpl@gmail.com, Websearch : www.creativeenviroservices.com

Note:

1. No statutory liability will be accepted for samples not collected by Creative Enviro Services.
2. The report shall not be reproduced except in full without permission of Laboratory, Creative Enviro Services, Bhopal
3. The tests and/or calibration marked with an\* are not accredited by NABL.



**ANNEXURE-17**  
**Ward Level Survey**

Name of Transfer Station	Zone list	Distance from Dumping site	Ward No	Ward Name	Population @ 2011	No of HH	No of HH	No of Commercial	Total no. of Properties	No. of Tata Ace HH @1300 HH (Covering 90%)	No. of rickshaw @300 HH	No. of Tata Ace for Comm @ 1300 Properties (Covering 90% of the total properties)	No. of Rickshaw for Com. @300HH (Covering 10%)	No of Tata Ace for waste form street sweeping	Total Domestic Tonnage (in MT)	Total Comm. Tonnage in MT	Waste from Street sweeping, Mandis, Markets & other sources	Total Tonnage	Total TATA ace	Total Rickshaw	Tonnage from Tata Ace	Tonnage from Rickshaw	No of Pritable compactor	No of hook loader	No of 1.1 steel bin	No of 3.5 Steel bin	No of Refuse compactor	No of Domestic bin	No of Road side littering Bin
Sant Haridasnagar	1	32	1	Mahatma Gandhi	25889	2877	3309	258	3567	2	1	0	0	0	5	0.5	0.5	6	3	1	5	0	2	1	3	3			7133
			2	Airport	23173	3306	3802	346	4148	3	1	0	0	0	6	0.7	0.5	7	3	1	6	0							8296
			3	Bhauri	21182	1912	2199	555	2754	2	1	0	0	0	3	1.1	0.4	5	2	1	4	0							5508
			4	Hemu Colony	24527	4526	5205	984	6189	4	2	1	0	0	8	2.0	0.8	11	5	2	8	1							12378
			5	Sadhu Vasvani	21500	4572	5258	834	6092	4	2	1	0	0	8	1.7	0.8	10	5	2	8	1							12184
Land Has to be Identified	2	30	6	Mahaveer Giri	21267	6255	7193	415	7608	5	2	0	0	0	11	0.8	1.0	13	6	3	10	1	3	1	3	3			15217
			7	Koh-e-Fiza	23744	5825	6699	185	6884	5	2	0	0	0	10	0.4	0.9	11	5	2	9	1							13768
			8	Royal Market	25975	2773	3189	334	3523	2	1	0	0	0	5	0.7	0.5	6	3	1	5	0							7046
			10	Edgah Hills	25194	4170	4796	1236	6032	3	2	1	0	0	7	2.5	0.8	10	5	2	8	1							12063
Near DIG Bangla	3	24	21	Jain Mandir	19288	4587	5275	1204	6479	4	2	1	0	0	8	2.4	0.9	11	5	2	9	1	3	1	3	3			12958
			9	Bagh Munsif Husan	26000	2166	2491	320	2811	2	1	0	0	0	4	0.6	0.4	5	2	1	4	0							5622
			11	Babu Jagjivan Ram	25852	2427	2791	319	3110	2	1	0	0	0	4	0.6	0.4	5	2	1	4	0							6220
			12	Narial Kheda	22511	3179	3656	243	3899	3	1	0	0	0	5	0.5	0.5	6	3	1	5	0							7798
Land Has to be Identified	4	23	13	Gitanjali	25322	3009	3460	222	3682	2	1	0	0	0	5	0.4	0.5	6	3	1	5	0	2	1	3	3			7365
			14	Sahjahanabad	25884	1416	1628	157	1785	1	1	0	0	0	2	0.3	0.2	3	1	1	2	0							3571
			15	J.P. Nagar	19438	2786	3204	157	3361	2	1	0	0	0	5	0.3	0.4	6	3	1	5	0							6722
			16	MotilalNehru	21167	3661	4210	142	4352	3	1	0	0	0	6	0.3	0.6	7	3	1	6	0							8704
Land Has to be Identified	5	25	17	Ibrahim Ganj	24291	3675	4226	1226	5452	3	1	1	0	0	6	2.5	0.7	10	4	2	7	1	3	1	3	3			10905
			18	Ram Mandir	25109	5623	6466	939	7405	4	2	1	0	0	10	1.9	1.0	13	6	2	10	1							14811
			19	Mahaveer Swami	19269	5828	6702	2210	8912	5	2	2	1	1	10	4.4	1.2	16	7	3	12	1							17824
			20	Lal Bahabur Shastri	19733	5623	6466	2210	8676	4	2	2	1	1	10	4.4	1.2	15	7	3	12	1							17353
Land Has to be Identified	6	24	22	Moti Masjid	23646	2498	2873	211	3084	2	1	0	0	0	4	0.4	0.4	5	2	1	4	0	3	1	3	3			6167
			23	Islampura	21005	2035	2340	201	2541	2	1	0	0	0	4	0.4	0.3	4	2	1	3	0							5083
			24	Rani Kamalapati	25001	3297	3792	1217	5009	3	1	1	0	0	6	2.4	0.7	9	4	2	7	1							10017
			25	Swami Vivekanand	21361	4416	5078	201	5279	4	2	0	0	0	8	0.4	0.7	9	4	2	7	1							10559
Near IIFM,Nehr unagar	7	16	26	Dr. Ambedkar	20121	3513	4040	372	4412	3	1	0	0	0	6	0.7	0.6	7	3	1	6	0	2	1	3	3			8824
			27	Goswami Tulsidas	24989	6374	7330	538	7868	5	2	0	0	0	11	1.1	1.0	13	6	3	11	1							15736
			28	Rani Awanti Bai	24155	5201	5981	85	6066	4	2	0	0	0	9	0.2	0.8	10	5	2	8	1							12132
			30	Kushabhai Takre	23007	6239	7175	1105	8280	5	2	1	0	1	11	2.2	1.1	14	6	3	11	1							16560
Land Has to be Identified	8	20	31	Chatrapati Sivaji	21171	5781	6648	405	7053	5	2	0	0	0	10	0.8	0.9	12	5	2	10	1	5	2	3	3			14106
			32	Jawaharlal Nehru	19830	6802	7822	804	8626	5	3	1	0	1	12	1.6	1.1	14	6	3	12	1							17253
			46	Pandit Ravi Sankar	20605	4357	5011	191	5202	3	2	0	0	0	8	0.4	0.7	9	4	2	7	1							10403
			51	Sahpura	20880	12306	14152	667	14819	10	5	0	0	1	21	1.3	1.9	24	11	5	20	1							29638
Near Shadgare Shahjahan i Park	9	22	33	Jit Madan Mohan Ma	24819	4443	5109	1084	6193	4	2	1	0	0	8	2.2	0.8	11	5	2	8	1	3	1	3	3			12387
			34	avindra Nath Chauha	22798	3511	4038	466	4504	3	1	0	0	0	6	0.9	0.6	8	3	2	6	0							9007
			35	Jahagirabad	25485	2197	2527	544	3071	2	1	0	0	0	4	1.1	0.4	5	2	1	4	0							6141
			42	Maharani Laxmi Bai	23677	2803	3223	385	3608	2	1	0	0	0	5	0.8	0.5	6	3	1	5	0							7217
Near Danapani	10	20	47	Dr Rajendra Prasad	24018	3253	3741	435	4176	3	1	0	0	0	6	0.9	0.6	7	3	1	6	0	3	1	3	3			8352
			43	Maha Rana Pratap	22288	6484	7457	1898	9355	5	2	1	1	1	11	3.8	1.3	16	7	3	13	1							18709
			45	Indira Gandhi	19282	3089	3552	3122	6674	2	1	2	1	0	5	6.2	1.0	13	5	2	9	1							13349
			48	Arera Coloney	20926	3626	4170	218	4388	3	1	0	0	0	6	0.4	0.6	7	3	1	6	0							8776
Near Dwarakana gar Nala	11	16	49	Ashaniketan	19623	4526	5205	235	5440	4	2	0	0	0	8	0.5	0.7	9	4	2	7	1	3	1	3	3			10880
			50	Gulmohar	19719	3638	4184	226	4410	3	1	0	0	0	6	0.5	0.6	7	3	1	6	0							8819
			36	Chandbad	22512	2613	3005	293	3298	2	1	0	0	0	5	0.6	0.4	6	2	1	4	0							6596
			37	Kapramill	23324	3627	4171	118	4289	3	1	0	0	0	6	0.2	0.6	7	3	1	6	0							8578
Land Has to be Identified	12	18	38	Semra	21249	3360	3864	216	4080	3	1	0	0	0	6	0.4	0.5	7	3	1	6	0	2	1	3	3			8160
			71	Ashoka Garden	20706	3118	3586	908	4494	2	1	1	0	0	5	1.8	0.6	8	3	1	6	0							8987
			39	Naveen Nagar	22521	2799	3219	544	3763	2	1	0	0	0	5	1.1	0.5	6	3	1	5	0							7526
			40	Eshbagh	23230	2283	2625	664	3289	2	1	0	0	0	4	1.3	0.4	6	2	1	4	0							6579
Land Has to be Identified	13	17	41	Bagh Pharat Aaphija	25430	2368	2723	908	3631	2	1	1	0	0	4	1.8	0.5	6	3	1	5	0	2	1	3	3			7262
			70	Panjabibagh	19809	3276	3767	305	4072	3	1	0	0	0	6	0.6	0.5	7	3	1	6	0							8145
			44	Subhaschandra Bos	19506	3089	3552	281	3833	2	1	0	0	0	5	0.6	0.5	6	3	1	5	0							7667
			58	Kasturba	20690	4623	5316	965	6281	4	2	1	0	0	8	1.9	0.8	11	5	2	9	1							12563
Near Laharpur Dam	14	20	59	Barkhera BHEL	20402	6154	6435	281	6435	4	2	0	0	0	9	0.6	0.8	11	5	2	9	1	4	1	3	3			12869
			69	Gurunanak Dev	19363	5805	6676	1228	7904	5	2	1	0	0	10	2.5	1.1	14	6	3	11	1							15808
			52	Misrod	23781	11647	13394	2019	15413	9	4	1	1	1	20	4.0	2.1	26	12	5	21	2							30826
			53	Jatkheri	21924	9528	10957	482	11439	8	4	0	0	1	16	1.0	1.5	19	9	4	15	1							22878
Near Aims Prakash Nagar(Near Ratnagiri Tiraha)	15	10	54	Barkatullah	25940	4931	5671	236	5907	4	2	0	0	0	9	0.5	0.8	10	4	2	8	1	4	1	3	3			11813
			55	Baghmugaliya	25213																								

S.No.	ULB Name	No. of Wards	<a href="#">Population @ 2016</a>	No. of HH	80% covered by Tata Ace	20% covered by Rikshaw	Tonnage from Tata Ace	Tonnage from Rikshaw	tonnage from litering ( 30 kg/km)	total Tonnage	No. of Tata Ace reqd. for HH	No. of Tata Zip reqd. for HH	Tata Ace reqd. for Comm. Est.	No. of Rikshaw	No. of TS	No. of Portable compacto	No. of Hook Loader	No. of metallic bin of 1.1	No. of RC compacto r rqd.	No of Domestic biin
2	Berasia	18	33686	6737	5390	1347	7	2	1	10	4			4				6	1	13474.4
3	Mandideep	26	87676	17535	10822	2706	14	3	1	17	9			9				11	2	27056
4	Obedullaganj	15	24798	4960	3968	992	5	1	2	8	3			3				4	1	9919.2
5	Sehore	35	118944	23789	19031	4758	24	6	2	32	16			16	1	4	2	20	2	47577.6
6	Ichhawar	15	16275	3255	2604	651	3	1	0	4	2			2				3	1	6510
7	Kothri	15	11695	2339	1871	468	2	1	0	3	2			2				2	0	4678
8	Ashta	18	59394	11879	9503	2376	12	3	1	16	8			8				10	2	23757.6
	<b>Total</b>	<b>142</b>	<b>352468</b>	<b>70494</b>	<b>53189</b>	<b>13297</b>	<b>66</b>	<b>17</b>	<b>7</b>	<b>91</b>	<b>44</b>	<b>0</b>	<b>0</b>	<b>44</b>	<b>1</b>	<b>4</b>	<b>2</b>	<b>55</b>	<b>9</b>	<b>132972.8</b>

Note : We have considered No of Vehicle based on common assumptions and taken 10% extra of planned requirement.However Actula allocation will be differ as per area wise demographical conditions and same will be considered while procurement of vehicle.

Zone No-1									
Ward No	Households	Restaurant	Hotel	Shop	offices	Religious Places	Schools	Hospital	Banquet Hall
1	3,309	2	18	178	10	20	29	0	1
2	3,802	6	20	263	15	24	13	5	0
3	2,199	3	46	405	22	38	28	9	4
4	5,205	1	200	714	30	10	13	16	0
5	5,258	2	120	642	60	5	1	4	0
<b>Total</b>	<b>14514.2</b>	<b>12</b>	<b>284</b>	<b>1560</b>	<b>77</b>	<b>92</b>	<b>83</b>	<b>30</b>	<b>5</b>

Zone No-2									
Ward No	No. of Individual House	Restaurant	Hotel	Shop	offices	Religious Places	Schools	Hospital	Banquet Hall
6	7193	0	65	278	21	29	18	4	0
7	6699	0	10	160	2	0	1	12	0
8	3189	5	36	254	4	13	22	0	0
10	4796	5	233	930	4	13	10	39	2
21	5275	2	303	877	3	10	3	6	0
<b>Total</b>	<b>17081</b>	<b>12</b>	<b>647</b>	<b>2499</b>	<b>34</b>	<b>65</b>	<b>54</b>	<b>61</b>	<b>2</b>

Zone No-3									
ward no	No. of Individual House	Restaurant	Hotel	Shop	offices	Religious Place	Schools	Hospital	Banquet Hall
9	2491	5	21	224	0	10	18	42	0
11	2791	2	55	247	7	4	1	1	2
12	3656	0	15	195	4	11	12	6	0
13	3460	5	2	200	2	5	5	3	0
14	1628	1	1	133	6	9	5	2	0
<b>Total</b>	<b>12398.2</b>	<b>12</b>	<b>93</b>	<b>866</b>	<b>13</b>	<b>30</b>	<b>36</b>	<b>52</b>	<b>2</b>

Zone No-4									
Ward No	No. of Individual House	Restaurant	Hotel	Shop	offices	Religious Places	Schools	Hospital	Banquet Hall
15	3204	1	1	133	6	9	5	2	0
16	4210	0	43	90	2	2	4	1	0
17	4226	7	364	835	14	4	0	2	0
18	6466	0	80	798	13	27	16	4	1
20	6702	2	216	1957	3	26	2	3	1
<b>Total</b>	<b>18106.8</b>	<b>10</b>	<b>704</b>	<b>3813</b>	<b>38</b>	<b>68</b>	<b>27</b>	<b>12</b>	<b>2</b>

Zone no-5									
Ward No	No. of Individual House	Restaurant	Hotel	Shop	offices	Religious Places	Schools	Hospital	Banquet Hall
19	6466	0	526	1645	28	5	4	2	0
22	2873	2	72	102	3	23	5	3	1
23	2340	0	24	156	10	2	7	2	0
24	3792	1	63	1038	73	11	18	11	2
<b>Total</b>	<b>15471</b>	<b>3</b>	<b>685</b>	<b>2941</b>	<b>114</b>	<b>41</b>	<b>34</b>	<b>18</b>	<b>3</b>

Zone No/Ward No-6									
Ward No	No. of Individual House	Restaurant	Hotel	Shop	offices	Religious	Schools	Hospital	Banquet Hall
25	5078	0	24	156	10	2	7	2	0
26	4040	0	38	263	13	15	35	4	4
27	7330	0	45	480	8	5	0	0	0
28	5981	0	26	42	4	9	3	1	0
<b>Total</b>		<b>0</b>	<b>133</b>	<b>941</b>	<b>35</b>	<b>31</b>	<b>45</b>	<b>7</b>	<b>4</b>

Zone No-7									
ward No	No. of Individual House	Restaurant	Hotel	Shop	offices	Religious Places	Schools	Hospital	Banquet Hall
30	7175	0	64	841	162	26	5	7	0
31	6648	0	28	334	9	20	10	1	3
32	7822	0	13	770	11	4	4	2	0
46	5011	0	42	135	5	6	3	0	0
51	14152	0	159	503	0	3	1	1	0
<b>Total</b>	<b>40808</b>	<b>0</b>	<b>306</b>	<b>2583</b>	<b>187</b>	<b>59</b>	<b>23</b>	<b>11</b>	<b>3</b>

Zone No-8									
Ward No	No. of Individual	Restaurant	Hotel	Shop	offices	Religious Places	Schools	Hospital	Banquet Hall
33	5109	0	69	681	316	4	12	2	0
34	4038	0	10	438	13	1	3	1	0
35	2527	9	5	459	12	30	24	3	2
42	3223	0	1	374	7	1	1	1	0
47	3741	1	31	354	23	13	9	4	0
<b>Total</b>	<b>18638.05</b>	<b>10</b>	<b>116</b>	<b>2306</b>	<b>371</b>	<b>49</b>	<b>49</b>	<b>11</b>	<b>2</b>

Zone No-9									
Ward No	No. of Individual	Restaurant	Hotel	Shop	offices	Religious Places	Schools	Hospital	Banquet Hall
43	7457	34	259	1265	304	11	18	6	1
45	3552	1	574	2275	234	16	5	10	7
48	4170	0	25	160	10	10	9	4	0
49	5205	0	101	120	0	9	0	5	0
50	4184	0	8	176	31	5	0	5	1
<b>Total</b>	<b>24567.45</b>	<b>35</b>	<b>967</b>	<b>3996</b>	<b>579</b>	<b>51</b>	<b>32</b>	<b>30</b>	<b>9</b>

Zone No-10									
Ward No	No. of Individual	Restaurant	Hotel	Shop	offices	Religious Places	Schools	Hospital	Banquet Hall
36	3005	2	17	251	2	8	9	2	2
37	4171	0	2	105	4	2	3	2	0
38	3864	0	2	168	24	13	7	2	0
71	3586	12	51	798	13	12	20	2	0
<b>Total</b>	<b>14625.7</b>	<b>14</b>	<b>72</b>	<b>1322</b>	<b>43</b>	<b>35</b>	<b>39</b>	<b>8</b>	<b>2</b>

Zone No-11									
Ward No	No. of Individual House	Restaurant	Hotel	Shop	offices	Religious Places	Schools	Hospital	Banquet Hall
39	3219	9	5	459	12	30	24	3	2
40	2625	6	19	565	35	14	9	10	6
41	2723	12	51	798	13	12	20	2	0
70	3767	0	5	230	48	11	7	4	0
<b>Total</b>	<b>12335</b>	<b>27</b>	<b>80</b>	<b>2052</b>	<b>108</b>	<b>67</b>	<b>60</b>	<b>19</b>	<b>8</b>

Zone No-12									
Ward No	No. of Individual	Restaurant	Hotel	Shop	offices	Religious Places	Schools	Hospital	Banquet Hall
44	3552	0	1	262	5	4	5	4	0
58	5316	0	62	900	0	0	3	0	0
59	6154	5	26	200	20	15	6	7	2
69	6676	0	209	1006	6	4	2	0	1
<b>Total</b>	<b>21698.2</b>	<b>5</b>	<b>298</b>	<b>2368</b>	<b>31</b>	<b>23</b>	<b>16</b>	<b>11</b>	<b>3</b>

Zone No-13									
Ward No	No. of Individual House	Restaurant	Hotel	Shop	offices	Religiou	Schools	Hospital	Banquet Hall
						s Places			
52	13394	5	215	1646	89	37	21	5	1
53	10957	0	65	323	13	29	49	2	1
54	5671	0	9	200	10	12	4	1	0
55	7453	1	73	340	0	4	4	1	0
<b>Total</b>		<b>6</b>	<b>362</b>	<b>2509</b>	<b>112</b>	<b>82</b>	<b>78</b>	<b>9</b>	<b>2</b>

Zone No/Ward No-14									
Ward No	No. of Individual House	Restaurant	Hotel	Shop	offices	Religiou	Schools	Hospital	Banquet Hall
						s Places			
56	3467	1	55	477	0	27	9	5	0
57	4253	0	28	135	0	7	8	1	0
60	9254	4	7	385	1	7	20	1	0
61	7943	7	18	238	7	8	15	1	2
<b>Total</b>	<b>24917.05</b>	<b>12</b>	<b>108</b>	<b>1235</b>	<b>8</b>	<b>10</b>	<b>52</b>	<b>8</b>	<b>2</b>

Zone No/Ward No-15									
Ward No	No. of Individual House	Restaurant	Hotel	Shop	offices	Religiou	Schools	Hospital	Banquet Hall
						s Places			
62	4593	4	53	574	4	21	21	1	2
63	4837	0	10	85	22	9	5	2	0
64	7679	0	69	321	12	11	10	0	0
66	8044	0	29	250	0	6	4	0	0
67	9216	2	39	666	2	3	2	0	0
<b>Total</b>		<b>6</b>	<b>200</b>	<b>1896</b>	<b>40</b>	<b>50</b>	<b>42</b>	<b>3</b>	<b>2</b>

Zone No/Ward No-16									
Ward No	No. of Individual House	Restaurant	Hotel	Shop	offices	Religiou	Schools	Hospital	Banquet Hall
						s Places			
65	8193	0	222	817	102	27	26	18	0
68	9216	0	7	307	5	2	3	0	0
72	3901	1	23	508	10	29	18	4	2
73	5247	3	15	159	5	10	8	4	2
74	6691	0	15	298	3	2	1	0	0
<b>Total</b>	<b>33248</b>	<b>4</b>	<b>282</b>	<b>2089</b>	<b>125</b>	<b>70</b>	<b>56</b>	<b>26</b>	<b>4</b>

Zone No/Ward No-17									
Ward No	No. of Individual House	Restaurant	Hotel	Shop	offices	Religiou	Schools	Hospital	Banquet Hall
						s Places			
75	7498	10	14	220	10	22	16	8	0
76	4668	1	20	163	9	13	0	0	2
77	5563	10	25	173	6	7	5	3	0
78	6984	0	91	200	2	0	2	1	0
79	6019	0	52	243	1	7	11	0	0
<b>Total</b>	<b>30731</b>	<b>21</b>	<b>202</b>	<b>999</b>	<b>28</b>	<b>49</b>	<b>34</b>	<b>12</b>	<b>2</b>

<b>Zone No-18</b>									
<b>Ward No</b>	<b>No. of Individual</b>	<b>Restaurant</b>	<b>Hotel</b>	<b>Shop</b>	<b>offices</b>	<b>Religious</b>	<b>Schools</b>	<b>Hospital</b>	<b>Banquet Hall</b>
29	7229	1	45	168	9	9	21	3	0
80	9460	0	66	345	175	15	4	2	5
82	11682	0	39	580	0	7	4	2	5
83	12804	0	80	912	0	6	3	0	0
Total	28371	1	150	1093	184	31	29	7	10

<b>Zone No-19</b>									
<b>Ward No</b>	<b>No. of Individual</b>	<b>Restaurant</b>	<b>Hotel</b>	<b>Shop</b>	<b>offices</b>	<b>Religious</b>	<b>Schools</b>	<b>Hospital</b>	<b>Banquet Hall</b>
81	11512	1	22	197	10	13	8	3	8
84	11512	1	51	150	3	31	14	0	0
85	11512	0	20	106	1	17	7	3	1
Total	28371	2	93	453	14	61	29	6	9

**ANNEXURE-18**  
**Time Line of Bhopal**

Timeline(From the date of NTP after DPR Approval)																																
(A) Procurement of Vehicle and Equipment			Week																													
S.No	Activities	Duration	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
<b>Note to Proceed/Date of Financial Closure</b>			0+																													
<b>Procurement of Vehicle/Contractor and other equipment</b>																																
1	Submission of Technical and commercial Proposal	2 Week	■																													
2	Approval form I/B/MC on Technical and commercial Proposal(Three quotation along with Technical specification)	1 Week		■																												
3	Releasing the order to vendor(From Date of Approval of DPR)	1 week			■																											
4	Delivery of vehicle as per schedule(will be shared letter stage)	12 week				■																										
5	Registration and insurance work of vehicle to be finished	2 week					■																									
<b>Development of Software and mobile App</b>																																
6	Submission of Commercial and Technical Proposal	2 week	■																													
7	Approval from I/B/MC on Commercial and Technical Proposal	1 week		■																												
8	Placing work order to software vendor(after DPR Approval)	1 week			■																											
9	Delivery of Software and mobile App	12 week				■																										
10	Testing to be done(after Starting of Operation)						■																									
11	Mapping to be done(after Starting of Operation)							■																								
<b>Development of Vehicle Tracking System/Control Room/Call centre</b>																																
12	Time line would have been finalise after starting of operation																															
<b>Weighbridge Installation</b>																																
13	Submission of Commercial and Technical Proposal(after Finalisation on Vite&SLF layout)	4 week	■																													
14	Approval form I/B/MC on Technical and commercial Proposal	2 Week		■																												
15	Placing workorder for the same(after DPR Approval)	1 Week			■																											
16	Completion of weigh bridge/Calibration	7 Week				■																										
<b>(B) Construction of Transfer Station-Phase 1(Transfer station 1-5)</b>																																
<b>Construction of Transfer station ,workshop and parking station</b>																																
17	Submission of Drawing/BOQ(Phasewise)	3 week	■																													
18	Approval from I/B/MC on Drawing and BOQ	1 week		■																												
19	Receipt of commercial offer	2 Week			■																											
20	Finalization of contractor	1 Week				■																										
21	Release of commercial order to contractor	1 Week					■																									
22	Completion of 1st phase Transfer Station	7 Week					■																									
23	Electrification of TS	7 Week						■																								
24	Construction of Civil work for workshop	7 Week							■																							
25	Mechanical work to be completed for workshop	7 Week								■																						
26	Purchasing of workshop tools	7 Week									■																					
<b>(B) Construction of Transfer Station-Phase 2(Transfer station 6-10)</b>																																
<b>Construction of Transfer station ,workshop and parking station</b>																																
17	Submission of Drawing/BOQ(Phasewise)	7 week	■																													
18	Approval from I/B/MC on Drawing and BOQ	1 week		■																												
19	Receipt of commercial offer	1 Week			■																											
20	Finalization of contractor	2 Week				■																										
21	Release of commercial order to contractor	1 Week					■																									
22	Completion of 1st phase Transfer Station	7 Week					■																									
23	Electrification of TS	7 Week						■																								
24	Construction of Civil work for workshop	7 Week							■																							
25	Mechanical work to be completed for workshop	7 Week								■																						
26	Purchasing of workshop tools	7 Week									■																					
<b>(B) Construction of Transfer Station-Phase 3(Transfer Station-11-15)</b>																																
<b>Construction of Transfer station ,workshop and parking station</b>																																
17	Submission of Drawing/BOQ(Phasewise)	11 week	■																													
18	Approval from I/B/MC on Drawing and BOQ	1 week		■																												
19	Receipt of commercial offer	2 Week			■																											
20	Finalization of contractor	1 Week				■																										
21	Release of commercial order to contractor	1 Week					■																									
22	Completion of 1st phase Transfer Station	7 Week					■																									
23	Electrification of TS	7 Week						■																								
24	Construction of Civil work for workshop	7 Week							■																							
25	Mechanical work to be completed for workshop	7 Week								■																						
26	Purchasing of workshop tools	7 Week									■																					
<b>(B) Construction of Transfer Station-Phase 4(Transfer Station-16-18)</b>																																
<b>Construction of Transfer station ,workshop and parking station</b>																																
17	Submission of Drawing/BOQ(Phasewise)	15 week	■																													
18	Approval from I/B/MC on Drawing and BOQ	1 week		■																												
19	Receipt of commercial offer	2 Week			■																											
20	Finalization of contractor	1 Week				■																										
21	Release of commercial order to contractor	1 Week					■																									
22	Completion of 1st phase Transfer Station	7 Week					■																									
23	Electrification of TS	7 Week						■																								
24	Construction of Civil work for workshop	7 Week							■																							
25	Mechanical work to be completed for workshop	7 Week								■																						
26	Purchasing of workshop tools	7 Week									■																					
<b>(C) IEC Activity</b>																																
<b>IEC Activity at SLF Location</b>																																
27	Branding and signage at SLF Location after transfer of land					■																										
28	Meeting/Presentation with Adjoining Gram Panchayat with coordination with BMC & Local statutory Bodies						■																									
<b>IEC Activity in wards (Phase wise)-Ongoing activity</b>																																
29	Personal interaction with Public including Rwa's/Vayapar Mandal of concern wards/Zone																															
32	Public announcement in concern ward through Announcement/Media																															
<b>(D)CONSTRUCTION OF SLF-SCHEDULE</b>																																
S.No	Activities	Duration																														
1	ENGINEERING & DESIGN OF SLF SITE SURVEY LAYOUT FINALIZATION	7 Week	■																													
2	ENGINEERING & DESIGN & BOQ APPROVAL OF DRAWING DESIGN & BOQ	1 Week		■																												
3	VENDOR FINALIZATION FOR CIVIL WORK				■																											
4	VENDOR FINALIZATION FOR LINER WORK	1 Week				■																										
5	CONSTRUCTION OF CIVIL WORK OF SLF EXCAVATION/ EARTH WORK DRESSING & LEVELLING COMPACTION OF EXCAVATED AREA FORMATION OF EMBANKMENT	13 Week					■																									
6	LINER WORK INSTALLATION LINING OF GCL LINING OF 1.5MM TH HDPE LINING OF GEOTEXTILE SPREADING & LAYING OF 20 MM AGGREGATE SPREADING & LAYING OF SAND	4 Week						■																								
7	CONSTRUCTION OF LEACH TANK EXCAVATION/ EARTH WORK PCC/RCC STEEL REINFORCEMENT CENTERING & SHUTTERING								■																							
<b>(E)CONSTRUCTION OF APPROACH ROAD-SCHEDULE-APPROX. 1.5KM</b>																																
S.No	Activities	Duration																														
1	ENGINEERING & DESIGN OF APPROACH ROAD SITE SURVEY LAYOUT FINALIZATION	3 Week	■																													
2	ENGINEERING & DESIGN & BOQ APPROVAL OF DRAWING DESIGN & BOQ	1 Week		■																												
3	VENDOR FINALIZATION FOR CIVIL WORK				■																											
4	CONSTRUCTION OF CIVIL WORK OF APPROACH ROAD UPTO WBM EXCAVATION/ EARTH WORK@ 4 days DRESSING & LEVELLING@ 5 days COMPACTION OF EXCAVATED AREA@ 2																															

<b>CONSTRUCTION OF SLF-SCHEDULE</b>		
<b>S.No</b>	<b>Activities</b>	<b>Duration</b>
	Date of NTP/Date of Financial Closure	
<b>1</b>	ENGINEERING & DESIGN OF SLF/TEMPORARY FACILITY FOR INTERIM FACE	<b>7th Week</b>
	SITE SURVEY	
	LAYOUT FINALIZATION	
	ENGINEERING & DESIGN & BOQ	
<b>2</b>	APPROVAL OF DRAWING DESIGN & BOQ	<b>8th Week</b>
<b>3</b>	VENDOR FINALIZATION FOR CIVIL WORK	<b>9th Week</b>
<b>4</b>	VENDOR FINALIZATION FOR LINER WORK	
<b>5</b>	CONSTRUCTION OF CIVIL WORK OF SLF	<b>22th Week</b>
	EXCAVATION/ EARTH WORK	
	DRESSING & LEVELLING	
	COMPACTION OF EXCAVATED AREA	
	FORMATION OF EMBANKMENT	
<b>6</b>	LINER WORK INSTALLATION	<b>26th Week</b>
	LINING OF GCL	
	LINING OF 1.5MM TH. HDPE	
	LINING OF GEOTEXTILE	
	SPREADING & LAYING OF 20 MM AGREEGATE	
	SPREADING & LAYING OF SAND	
<b>7</b>	CONSTRUCTION OF LEATCHE TANK	<b>26th Week</b>
	EXCAVATION/ EARTH WORK	
	PCC/RCC	
	STEEL REINFORCEMENT	
	CENTERING & SHUTTERING	

<b>CONSTRUCTION OF BOUNDARY WALL-SCHEDULE-APPROX. 1.5KM</b>		
<b>S.No</b>	<b>Activities</b>	<b>Duration</b>
<b>1</b>	ENGINEERING & DESIGN OF BOUNDARY WALL	<b>2nd Week</b>
	SITE SURVEY	
	LAYOUT FINALIZATION	
	ENGINEERING & DESIGN & BOQ	
<b>2</b>	APPROVAL OF DRAWING DESIGN & BOQ	<b>3rd week</b>
<b>3</b>	VENDOR FINALIZATION FOR CIVIL WORK	
<b>4</b>	CONSTRUCTION OF CIVIL WORK OF BOUNDARY WALL	<b>16th Week</b>
	EXCAVATION/ EARTH WORK@ 10 days	
	DRESSING & LEVELLING@ 3 days	
	PCC BELOW FOUNDATION@ 5 days	
	RCC COLUMNS WITH FIXING OF SHUTTRERING@ 20 Days	
	BRICK WORK @ 20 Days	
	<a href="#">PLASTERING@ 20 Days</a>	
	<a href="#">PAINTING@ 10 Day</a>	

<b>CONSTRUCTION OF APPROACH ROAD-SCHEDULE-APPROX. 1.5KM</b>		
<b>S.No</b>	<b>Activities</b>	<b>Duration</b>
<b>1</b>	ENGINEERING & DESIGN OF APPROACH ROAD	<b>3rd Week</b>
	SITE SURVEY	
	LAYOUT FINALIZATION	
	ENGINEERING & DESIGN & BOQ	
<b>2</b>	APPROVAL OF DRAWING DESIGN & BOQ	<b>4th Week</b>
<b>3</b>	VENDOR FINALIZATION FOR CIVIL WORK	
<b>4</b>	CONSTRUCTION OF CIVIL WORK OF APPROACH ROAD UPTO WBM	<b>9th Week</b>
	EXCAVATION/ EARTH WORK@ 4 days	
	DRESSING & LEVELLING@ 5 days	
	COMPACTION OF EXCAVATED AREA@ 2 days	
	SUPPLY & LAYING OF WATER BOUNDED MACADAM (WBM), MORRUM@ 15 days	
	COMPACTION AFTER WBM LAYING, MORRUM FILLING, WITH WATERING@ 5 days	



**ANNEXURE-19**  
**Project Schedule**

## Project schedule for 2x600 TPD MSW Based Waste to Energy Power Plant-Bhopal

Sno	Activity	Duration ( in months )			Activity Bar Chart ( in months )																								
		in Months	Start	End	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	M-11	M-12	M-13	M-14	M-15	M-16	M-17	M-18	M-19	M-20	M21	M22	M23	M24	
1	NTP/ Date of Financial Closure	0	0	0																									
2	Civil Works	13	2	14																									
3	Enquiry & Procurement	12	1	12																									
4	Erection of Heavy Equipment	12	6	17																									
5	Boiler Pressure test	1	17	17																									
6	Refractory & Insulation work	2	17	18																									
7	Cold Commissioning	2	18	19																									
8	Hot Commissioning	2	19	20																									
9	First Fire	1	20	20																									
10	First Synchronisation	1	18	18																									
11	Trial Run	3	22	24																									

Note: The project start date shall be the date of receipt the following:

1. NTP
2. Land lease agreement
3. Complete access to Site
4. Zero date will be considered from the date of NTP for Statutory applications, its approvals, designs and drawing for project activities.
5. Zero date will be considered from the date of financial closure for Physical construction of plant activities, ordering and procurement.



**ANNEXURE-20**  
**Soil Investigation Report**



**VISHWA BHUMI TECHNOLOGIES**

**PROJECT NO. 98**

**REPORT ON**  
**GEOTECHNICAL INVESTIGATION FOR 1000 TPD WASTE TO**  
**ENERGY PLANT AT BHOPAL, MADHYA PRADESH**

**SUBMITTED TO**  
**M/s ESSEL INFRAPROJECTS LIMITED**  
**1<sup>ST</sup> FLOOR A26/3, MOHAN COOPERATIVE INDUSTRIAL ESTATE**  
**MATHURA ROAD, DELHI**



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# VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 98

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## **1.0 INTRODUCTION**

### **1.1 Project Description**

M/s ESSEL INFRAPROJECTS LIMITED has planned for **GEOTECHNICAL INVESTIGATION FOR 1000 TPD WASTE TO ENERGY PLANT AT BHOPAL , MADHYA PRADESH.**

M/s Vishwa Bhumi Technologies 305, Vardhman Master Plaza, L.S.C. IP Enclave , Gazipur Chowk, Delhi – 110096 has carried out the geotechnical investigation.

### **1.2 Purpose of Study**

The overall purpose of this study is to conduct a geotechnical investigation to assess the stratigraphy and to develop geotechnical recommendations for foundation design. To accomplish these purposes the study was conducted in the following phases:

- i) Drilling boreholes at proposed locations.
- ii) Testing samples in laboratory to determine the engineering properties of the strata.
- iii) Analyzing all field and laboratory data to develop preliminary geotechnical recommendations for foundations.



Details of the proposed structure investigated is tabulated below.

<b>S.no.</b>	<b>Test Designation</b>	<b>Ground Level of Boreholes</b>	<b>Ground water level ( m )</b>
1	BH – 12	100.00	Nil

1.3 Report Format

This report is based on field and laboratory results of boreholes drilled at structure location.

The initial sections of this report presents brief descriptions of the field work methodology together with list of various laboratory tests conducted. This is followed by site stratigraphy and engineering recommendations.

This is followed by the foundation construction considerations. The report closes with conclusions and recommendations.

**2.0 FIELD INVESTIGATION**

2.1 Soil Boring

The borings were progressed using a shell and auger to the specified depth or refusal whichever occurs earlier. Casing were used



for advanced borings. The casing with a diamond shoe bit was used to assist the casings to advance. The work was in general accordance with IS 1892 – 1979.

Standard Penetration Test (SPT) was conducted in the boreholes at 1.5 m depth intervals by connecting the split spoon sampler to SPT rod and driving it by 45 cm using a 63.5 kg hammer falling freely from a height of 75 cm.

The test was conducted in accordance with IS 2131 – 1981. The number of blows for each 15 cm of penetration of the split spoon sampler was recorded. The number of blows required to penetrate the initial 15 cm of the split spoon is ignored for seating the sampler due to possible presence of loose materials or cutting from the drilling operation. The cumulative number of blows required to penetrate the balance 30cm out of 45cm is termed as the SPT or N values.

Refusal to further boring penetration was considered when the N value exceeds 75 blows for 30 cm penetration or when practical refusal to further penetration by shell and auger was encountered.



Disturbed samples were collected from split spoon after conducting the SPT. The samples were preserved in transparent polythene bags. Undisturbed samples were collected by attaching 75 mm diameter thin walled 'Shelby' tubes and driving the sampler using the 63.5 kg hammer in accordance with IS 2132 – 1986. The tubes were sealed with wax at both ends. All samples were transported to our laboratory at Gazipur for further examination and testing.

## 2.2 Rock Drilling

Rotary drilling through the rock was performed using heavy-duty skid mounted Joy V oltas 12 B diamond coring rotary drill machine. The drill machine has a hydraulic feed and is driven by a bevel gear system run by a 28 HP Perkin engine. The drill chuck has four jaws to accommodate NW size drill rod.

Drilling and sampling of the rock was performed using a NX size double tube core barrel. A tungsten carbide bit was used to drill through rock. It was attached to the end of a core barrel, which is connected to the machine by a string of NW drill rods and rotated by the drilling machine.



Water was circulated through the drill rods to the bottom of the hole. The water serves the purpose of lubrication, cooling and protection of the drill bit in addition to flush the cuttings out of the hole. A reciprocating pump was used to circulate the water. While drilling through soft rock that is likely to collapse, casing was installed.

The percent recovery and Rock Quality Designation (RQD) was measured for each core run. The Rock Mass Rating (RMR), an engineering parameter assists in assessing the rock quality and behavior.

This may be used for an assessment of the nature of rock, water-tightness of joints and possible presence of interconnected channels / cavities.

### 2.3 Drilling in Gravel & Boulder Deposits

IS 10042: 1981 was taken into consideration when gravel & boulder deposits are encountered.



#### 2.4 Groundwater

Groundwater level was measured in the boreholes in 24 hours after drilling and sampling was completed. The measured water levels are recorded on the individual soil profiles.

### **3. LABORATORY TESTS**

The laboratory testing has been carried out in our laboratory. The testing programme was aimed at verifying the field classifications and developing parameters for engineering analysis. All testing was performed in accordance with the current applicable IS specifications. The following tests were conducted on selected rock samples and groundwater samples recovered from the boreholes.

#### **On Boulder & Gravel Deposit**

All laboratory tests are performed as per IS 10042 ( 1981 )

**On Soil**

<b>Laboratory Test</b>		<b>IS code referred</b>
Grain Size Analysis		IS 2720 ( Part 4 )
Liquid Limit & Plastic Limit		IS 2720 ( Part 5 )
Chemical	Ph Value	IS 2720 ( Part 26 )
Analysis of soil	Total Soluble Sulphates	IS 2720 ( Part 27 )
	Total Soluble Chlorides	IS 3025 ( Part 32 )
Classification of soil		IS 1498
Specific gravity of soil		IS 2720 ( Part 3 )
Direct shear test on cohesion less		IS 2720 ( Part 13 )
Moisture content		IS 2720 ( Part 2 )
Dry Density / Bulk Density		IS 2720 ( Part 29 )
Free Swell Index		IS 2720 ( Part 40 )
Consolidation Test		IS 2720 ( Part 15 )
Shrinkage Limit		IS 2720 ( Part 6 )
Swell Pressure Test		IS 2720 ( Part 41 )
Compaction Test		IS ( Part 7 and 8 )
Lab California Bearing Ratio Test		IS ( Part 16 )

**On Rock**

<b>Laboratory Test</b>	<b>IS code referred</b>
Water Absorption	IS 13030
Point Load Strength Test	IS 8764
Unconfined Compression Test	IS 9143
Type of Rock ( Rock Classification)	IS 13365 ( Part 1 )
RQD	IS 11315 ( Part 11 )
Porosity	IS 13030

Engineering terms used to describe the soils are explained in Table 1.



#### **4. REGIONAL GEOLOGY**

Bhopal is the capital of the Indian state of Madhya Pradesh and the administrative headquarters of Bhopal district and Bhopal division. Bhopal is known as the City of Lakes for its various natural as well as artificial lakes and is also one of the greenest cities in India.

The city attracted international attention in December 1984 after the Bhopal disaster, when a Union Carbide India Limited (UCIL) pesticide manufacturing plant (now owned by Dow Chemical Company) leaked a mixture of deadly gases composed mainly of methyl isocyanate, leading to one of the worst industrial disasters in the world's history.

Bhopal has been selected as one of the first twenty Indian cities to be developed as a smart city under PM Narendra Modi's flagship Smart Cities Mission and will be the first smart city of India in coming years. The city has been adjudged as the 2<sup>nd</sup> cleanest city in India.

Bhopal has an average elevation of 500 metres (1401 ft).

Bhopal is located in the central part of India, and is just north of the



upper limit of the Vindhya mountain ranges. Located on the Malwa plateau, it is higher than the north Indian plains and the land rises towards the Vindhya Range to the south. The city has an even elevation and has small hills within its boundaries. The prominent hills in Bhopal are Idgah hills and Shyamala hills in the northern region, Katara hills in southern region. City's geography has in it two lakes namely upper lake and lower lake.

Bhopal city nestles in a hilly terrain which slopes towards north and south – east. The general ground level is nearly 460m along the south – eastern and north – eastern portion of the city.

Bhopal district forms the part of Malwa Plateau with generally an undulating topography.

The district covers part of two river sub – basins. Betwa river sub – basin covers 82 % of the area and lower Chambal basin covers 18 % area of district. The district is drained by river Betwa with its main tributaries.

Almost three fourth area of the district is covered with black cotton soils formed by the weathering of basaltic rocks. The rest part



of the district area is covered with yellowish red, mixed soils derived from sandstones and shale. The alluvial soils are found along the river courses. The higher elevations i.e. the hilly regions have a cover of murum which is made up of small rounded pieces of weathered basalts.

Bhopal has a humid subtropical climate, with cool, dry winters, a hot summer and a humid monsoon season. Summers start in late March and go on till mid-June, the average temperature being around 30°C (86 °F), with the peak of summer in May, when the highs regularly exceed 40°C (104 °F). The monsoon starts in late June and ends in late September. These months see about 40 inches (1020 mm) of precipitation, frequent thunderstorms and flooding. The average temperature is around 25 °C (77 °F) and the humidity is quite high. Temperatures rise again up to late October when winter starts, which lasts up to early March. Winters in Bhopal are cool, and not very much comfortable like summers, with average daily temperatures around 16 °C (61 °F) and little or no rain. The winter peaks in January when temperatures may drop close to freezing on some nights. Lowest



temperature ever recorded was 0.3<sup>0</sup>C. Total annual rainfall is about 1146 mm (46 inches).

**5. PROPOSED FOUNDATIONS & THEIR DEPTHS**

Open Foundation /Raft footing may be provided depending upon load coming on the foundation.

The settlement of sandy layers below the foundation level and up to the zone of influence are computed by using the chart of settlement v/s SPT 'N' given on page 17 of IS 8009.

For Raft footings the zone of influence below the foundation depth is considered as 2.0B, where B is the width of foundation.

The total permissible settlement for raft footing = 75mm

**6. SITE DETAILS**

One borehole was planned at Switch Gear Room location. The borehole was drilled upto 5.0m depth. The site conditions were reviewed by our geologist for generalized assessment of the strata conditions.

The details of the borehole is as follows:

<b>Test Designation</b>	<b>Ground Water Level ( m )</b>
BH – 12	Nil



All test results are presented in Appendix of this report.

### 6.1 Site Stratigraphy

Detailed description of the strata encountered at the borehole is presented in Appendix on the soil profile on Table 2 & Table 3. The summary of the borehole is presented on Fig. 1. SPT Graph is presented in Fig 2.

### 6.2 Groundwater

Based on our measurements in the completed borehole, groundwater was not encountered in BH – 12 during the period of our field investigation.

Fluctuations may occur in the measured water level due to seasonal variation in the rainfall and surface evaporation rates, in addition to flow of water in the water body.

### 6.3 Foundations

#### 6.3.1 Suggested Net Allowable Bearing Pressures

Reviewing the available borehole data, we suggest the following values for open foundation.



BH-12

<b>Foundation Depth Below EGL(M)</b>	<b>Foundation Width (M)</b>	<b>Suggested Net Allowable Bearing Pressure (T/m<sup>2</sup>)</b>	<b>Likely Foundation Bearing Material</b>
2.5	11x12	103.13	Sandstone
3.0	11x12	112.50	Sandstone

6.4 Chemical Attack

We recommend the following measures as a good practice to limit the potential for chemical attack:

- 1.) Foundation concrete should contain minimum cement content of 330 kg / m<sup>3</sup> of cement.
- 2.) Water cement ratio in foundation concrete should not exceed 0.50
- 3.) A clear concrete cover over the reinforcement steel of at least 40 mm should be provided for foundations.
- 4.) Foundation concrete should be densified adequately using a vibrator so as to form a dense impervious mass.



7. FOUNDATION CONSTRUCTION CONSIDERATIONS

7.1 Variability in Sub – Surface Conditions

Subsurface conditions encountered during construction may vary somewhat from the conditions encountered during the site investigation. In case significant variations are encountered during construction we request to be notified so that our engineers may review the recommendations in this report in light of these variations.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

- The strata encountered is dense.

8.2 Recommendations

BH-12

Foundation Depth Below EGL(M)	Foundation Width (M)	Net Allowable Bearing Pressure (T/m <sup>2</sup> )	Likely Foundation Bearing Material
2.5	11x12	103.13	Sandstone
3.0	11x12	112.50	Sandstone



*Note :*

- *The depth and type of foundation is to be decided by the structure engineer depending upon the SBC values provided in the above tables and type of loading / structure and site conditions.*
- *Upon Completion of filling & Grading, care must be taken to maintain the sub grade moisture content prior to construction of pavements.*
- *If the sub grade become frozen, desiccated, saturated or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned and re-compacted prior to pavement construction.*



**9. CLOSURE**

We appreciate the opportunity to perform this investigation for you and have pleasure in submitting this report. Please contact us when we can be of further service to you.

for VISHWA BHUMI TECHNOLOGIES

A handwritten signature in black ink, appearing to read 'Dinesh Bhardwaj', is written over a light blue horizontal line.

**DINESH BHARDWAJ**



**DENSITY CLASSIFICATION BASED ON N VALUES**

<b>Density Descriptor</b>	<b>SPT ( N ) Value</b>
Very Loose	0 – 4
Loose	4 – 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	>50

**TABLE 1 : ENGINEERING DESCRIPTION OF SOILS**



VISHWA BHUMI TECHNOLOGIES

TABLE NO - 2  
BORE HOLE NO - 12

RL OF GROUND BORE ( M )		100.000	BORING DATE 08/06/2017				WATER TABLE ( M ) NIL		FIELD TEST RESULTS						DATE COMPLETED 08/06/2017		TERMINAL DEPTH ( M ) 5																	
ELEVATION IN METRES	DEPTH IN METRES BELOW REFERENCE	DATE OF SAMPLING	NATURE OF SAMPLING	DEPTH OF SAMPLE BELOW REFERENCE LEVEL	LEVEL OF WATER TABLE / L.W.L	LEVEL AT WHICH ARTESIAN CONDITION EXPERIENCED IF ANY	ARTESIAN PRESSURE	DEPTH IN METRES	SPT BLOWS PER 30 CM VALUE	CORRECTED N VALUES	POINT RESISTANCE	STATIC PENETRATIO N	SKIN RESISTANCE	RESISTANCE KG/CM <sup>2</sup>	DIA OF CASING USED (MM)	TIME TAKEN FOR BORING FOR EACH 30 CM IN MINUTES	PERCENT CORE RECOVERY	RQD ( % )	DESCRIPTION OF CORE ROCK TYPE COLOUR GRAIN SIZE TEXTURE MINERAL COMPOSITION DEGREE OF WEATHERING	STRUCTURE DETAIL OF JOINTS BEDDING FAULTS FOLIATION VIEW SEEN CRUSHED ZONE	DETAILS OF WATER COLOUR ETC.	SIZE OF CORE PIECES	SIZE OF HOLE	WATER LOSS ( % )	IN SITU ROCK TESTS	SYMBOLIC REPRESENTATION	VISUAL DESCRIPTION OF SOIL	IS CLASSIFICATION						
99.500	0.50	8/6/2017	DS - 1	0.50																										Filled Up				
98.500	1.50	8/6/2017	SPT - 1	1.50				1.50	> 100	> 100							42.67	42.67						50							Sandstone			
97.500				2.50																														
97.000	3.00	8/6/2017	SPT - 2	3.00				3.00	> 100	> 100							45.33	35.33					50											
95.500	4.50	8/6/2017	SPT - 3	4.50				4.50	> 100	> 100							41.33	41.33					25											
95.000				5.00																														

NOTES:- 1 Classification of shall be as per IS 1498 : 1970 REAFFIRMED 2007  
2 Abbreviation used  
SPT = Standard penetration test  
DS = Disturbed Sample  
3 Type of Machine used in Boring

Hydraulic

4 Size of Samples

5 Position of Ground water table

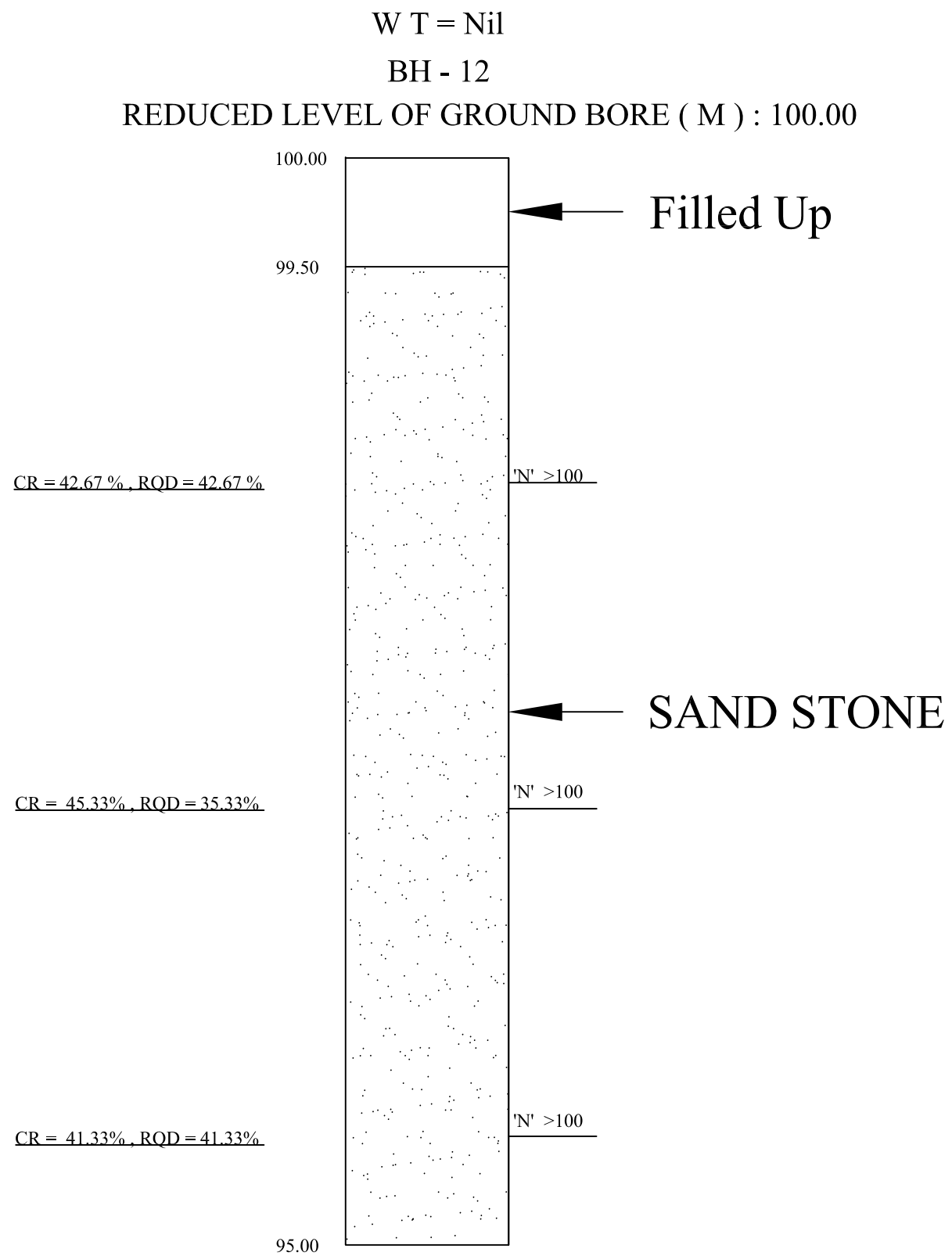
NIL

POSITION OF BORE HOLE WITH REFERENCE TO REFERENCE POINT

PROJECT : - GEOTECHNICAL INVESTIGATION FOR 1000 TPD WASTE TO ENERGY PLANT AT BHOPAL, MADHYA PRADESH

BORE HOLE NO. 12

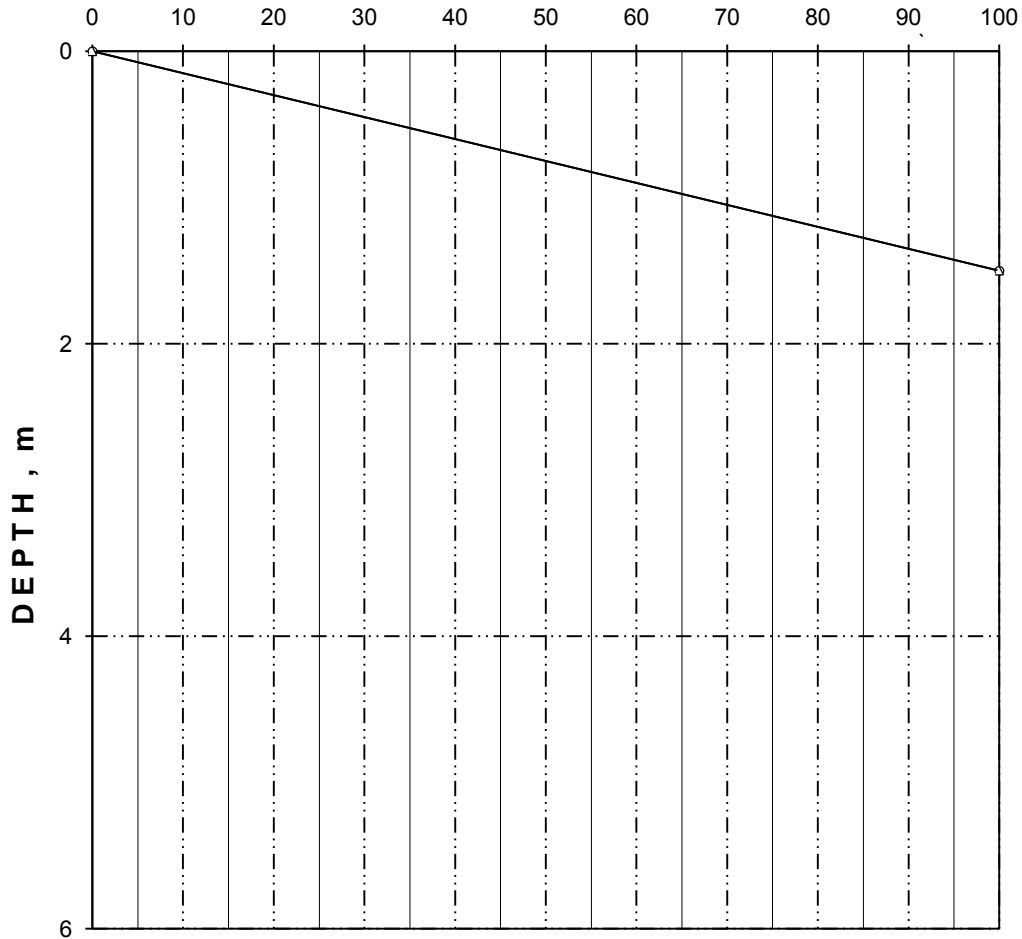




SUB SOIL PROFILE

# VISHWA BHUMI TECHNOLOGIES

## STANDARD PENETRATION TEST OBSERVED / CORRECTED 'N' VALUE



LEGEND	
Symbol	BH.No.
○	N <sub>o</sub>
△	N <sub>c</sub>

BH - 12

PROJECT NAME:- GEOTECHNICAL INVESTIGATION FOR 1000 TPD WASTE TO ENERGY PLANT AT BHOPAL, MADHYA PRADESH

Fig No. 2



# VISHWA BHUMI TECHNOLOGIES

## BEARING CAPACITY ANALYSIS FOR FOUNDATIONS ON ROCK

ANALYSIS AS PER IS 12070-1987 REAFFIRMED 2010

**PROJECT :- GEOTECHNICAL INVESTIGATION FOR 1000 TPD WASTE TO ENERGY PLANT AT BHOPAL, MADHYA PRADESH**

**BH - 12**

BEARING CAPACITY ANALYSIS FOR OPEN FOUNDATIONS BEARING ON ROCK HAS BEEN DONE BY THREE DIFFERENT METHODS AS GIVEN BELOW:

- 1) Presumptive Values of safe bearing capacity as per Clause 5.2 of IS 12070-1987
- 2) Based on RMR value as per Clause 5.3 of IS 12070-1987
- 3) Based on Core Strength as per Clause 6.2 of IS 12070-1987

Rock Type: Sandstone

Foundation Depth: 3 m

Rock Core Recovery: 45.33 % (at 3.00 m Depth) RQD Average value 41.33% (Below foundation Level)

### 1) Presumptive Values: Clause 5.2 of IS 12070-1987

$$q_{net\ safe} = q_s * c_{sub} * c_c * c_s$$

where:

$q_{net\ safe}$  = safe net bearing capacity  
 $q_s$  = safe bearing capacity  
 $c_{sub}$  = correction for saturation / submerged condition  
 $c_s$  = correction for orientation of joints  
 $c_c$  = correction for solution cavities (in limestone)

#### Net safe Bearing Pressure based on rock classification:

Material	$q_{net\ safe}$ , T/m <sup>2</sup>
Massive crystalline bed rock including granite, diorite, gneiss, trap rock	1000
Foliated rocks such as schists or slate in sound condition	400
Bedded limestone in sound condition	400
Sedimentary rock, including hard shales and sandstones	250
Soft or broken bed rock (excluding shale) and soft limestone	100
Soft shale	30

#### Presumptive Value of safe bearing capacity for design:

$q_s = 250$  T/m<sup>2</sup>

Correction for saturation/submergence:

$c_{sub} = 0.75$

Correction for orientation of joints

$c_c = 0.60$

Correction for solution cavities (in limestone)

$c_s = 1.00$

$$q_{net\ safe} = 112.50 \text{ T/m}^2$$

### 2) Based on RMR value: Clause 5.3 of IS 12070-1987

Class of rock	I	II	III	IV	V
Description of rock	Very Good	Good	Fair	Poor	Very Poor
RMR	100-81	80-61	60-41	40-21	20-0
$q_{net\ safe}$ (T/m <sup>2</sup> )	640 - 448	440-288	280 - 141	135 - 48	45 - 30

RMR value for design = 45 Class of Rock: III Rock Description: Fair

$$q_{net\ safe} = 178.16 \text{ T/m}^2$$

1	Rating of Strength of Rock ( Uniaxial Compressive Strength )	4
2	Rating of RQD	8
3	Rating of Spacing of Discontinuities	5
4	Rating of Condition of Discontinuities	20
5	Rating of Ground Water	15
6	Rating of Strike and Dip Orientations for foundation	-7
Total RMR Value		45



# VISHWA BHUMI TECHNOLOGIES

PROJECT : - GEOTECHNICAL INVESTIGATION FOR 1000 TPD WASTE TO ENERGY PLANT AT BHOPAL, MADHYA PRADESH

BH - 12

Depth of Foundation = 3.00 m

## Bearing Capacity Calculation For Foundations on rock as per IS:12070-1987

### 3) Based on Core Strength as per Clause 6.2 of IS 12070-1987

The safe bearing pressure should be estimated from the equation(  $q_s$  ) =  $q_c N_f$  (  $t/m^2$  )

$$( q_s ) = 2857.02 * 0.25 * 0.75 * 1$$

$$Q_{net} \text{ safe based on Core Strength} = \mathbf{535.69 \text{ T/m}^2}$$

Where:

- $q_s$  = Safe Bearing Pressure
- $q_c$  = Average Uniaxial Compressive Strength of Rock
- $N_f$  = Empirical Coefficient depending on the spacing of discontinuities

### SUMMARY OF ANALYSIS

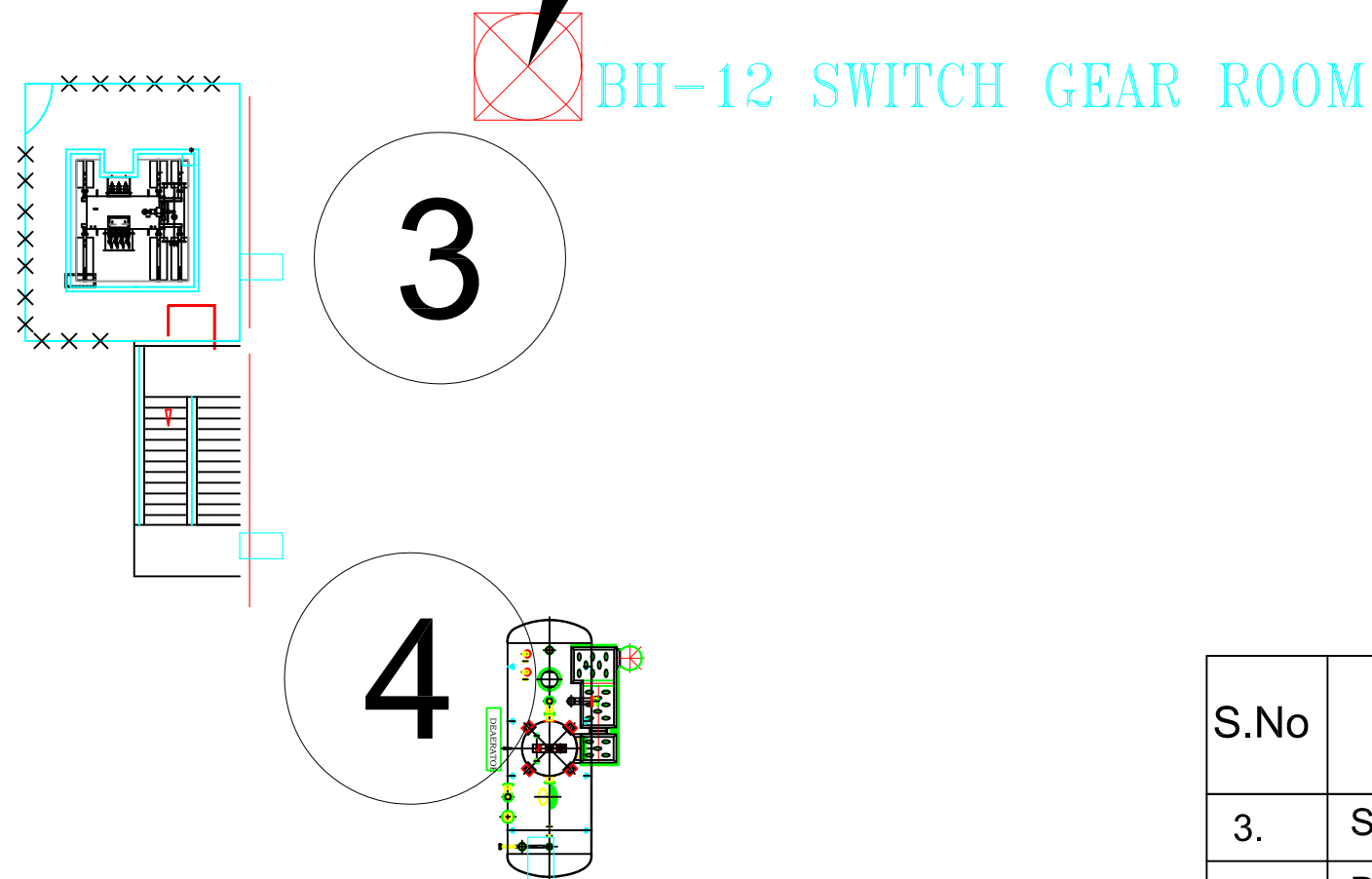
Method of Analysis	Computed Safe Net Bearing Pressure, $T/m^2$
Presumptive method	112.50
RMR value	178.16
Based on Core Strength	535.69

Recommended value of Net Safe Bearing Pressure for Design = **112.50  $T/m^2$**

# VISHWA BHUMI TECHNOLOGIES



E=632423.2815  
N=2527202.5685



S.No	DESCRIPTION
3.	SWITCH GEAR & CONTROL ROOM(G+1)
4.	DEAERATOR CUM STORAGE TANK

PROJECT NAME : -

**GEOTECHNICAL INVESTIGATION FOR 1000 TPD WASTE TO ENERGY PLANT AT BHOPAL, MADHYA PRADESH**





**VISHWA BHUMI TECHNOLOGIES**

**PROJECT NO. 98**

APPENDIX  
**APPENDIX**

**GEOTECHNICAL INVESTIGATION FOR 1000 TPD WASTE TO ENERGY PLANT AT BHOPAL,  
MADHYA PRADESH**



## VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 98

### CONCEPTS FOR FOUNDATION ANALYSIS

#### General

A suitable foundation for any structure should have an adequate factor of safety against exceeding the bearing capacity of the supporting soils. Also the vertical movements due to compression of the soils should be within tolerable limits for the structure. We consider that foundation designed in accordance with the recommendations given herein will satisfy these criteria.

#### Open Foundation on Soil

Bearing capacity analysis was carried out based on the shear parameters ( $c - \phi$ ) as interpreted from field and laboratory tests to determine the safe net bearing capacity. The bearing capacity equation used is as follows:

#### For General Shear

$$Q_{ns} = [cN_c \cdot S_c \cdot d_c \cdot i_c + q(N_q - 1) \cdot s_q \cdot d_q \cdot i_q + 0.5 \gamma_{eff} \cdot B \cdot N_\gamma \cdot S_\gamma \cdot d_\gamma \cdot i_\gamma \cdot w'] / FOS$$

#### For Local Shear

$$Q_{ns} = [2/3 cN_c \cdot S_c \cdot d_c \cdot i_c + q(N_q - 1) \cdot s_q \cdot d_q \cdot i_q + 0.5 \gamma_{eff} \cdot B \cdot N_\gamma \cdot S_\gamma \cdot d_\gamma \cdot i_\gamma \cdot w'] / FOS$$

$$\phi = \tan^{-1} [ 2 / 3 (\tan \phi) ]$$



## VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 98

### For Interpolate

$$Q_{ns} = \text{Local SBC} + \frac{(\text{General SBC} - \text{Local SBC})}{0.75 - 0.55} \times (0.75 - e_0)$$

Where,

$e_0$  = Void Ratio

$Q_{ns}$  = Safe net bearing capacity of soil based on the shear failure criterion

$c$  = Cohesion Intercept

$q$  = Overburden Pressure

$B$  = Width of foundation

$w'$  = Water table correction factor

FOS = Factor of safety

$N_c, N_q, N_\gamma$  = Bearing Capacity Factors which are a functions of  $\phi$ .

$\phi$  = Angle of internal friction

$S_c, S_q, S_\gamma$  = Shape Factors

$D_c, D_q, D_\gamma$  = Depth Factors

For Rectangular footing  $S_c = S_q = 1 + 0.2B/L, S_\gamma = 1 - 0.4 B/L$

For Square Footing  $S_c = 1.3, S_q = 1.2, S_\gamma = 0.8$

For  $\phi \leq 10$

$$D_c = 1 + 0.2 [\tan (45 + \phi / 2)] D / B$$

$$D_q, D_\gamma = 1$$



## VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 98

For  $\phi > 10$

$$D_c = 1 + 0.2 [\tan ( 45 + \phi / 2 ) ] D / B$$

$$D_q, D_v = 1 + 0.1 [\tan ( 45 + \phi / 2 ) ] D / B$$

Inclination factors:

$$i_c = i_q = i_v = 1$$

Appropriate values have been substituted into the bearing capacity equation given above to compute the safe net bearing capacity. The lower of the two values computed from the bearing capacity shear failure criterion as well as that computed from the tolerable settlement criterion has been taken.

### Foundations on Rock - Analysis Methodology

Analysis for allowable bearing capacity on rock has been done by the following methods.

- a) Based on Pre assumptive values as per Clause 5.2 of IS 12070
- b) Based on rock mass rating (RMR value) as per Clause 5.3 of IS 12070
- c) Based on core strength of intact rock specimen using the procedure given in IS: 12070

**Rock quality designation (RQD)** - This classification is based on a modified core recovery procedure, which in turn, is based indirectly on the number of fractures and the amount of softening or alteration in the rock



## VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 98

mass as observed in the rock cores from a drill hole. RQD shall be based on IS: 11315 (Part 11) - 1985. Expressing the RQD as a percentage, the rock quality is described as follow:

RQD%	Description of Rock Quality
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

### Safe Bearing Pressure from the RMR System

Analysis has been carried out using the RMR also known as Geo-mechanics classification by considering various parameters such as uniaxial compressive strength, RQD, spacing and condition of discontinuities and ground water condition. The correlation between the RMR value and allowable pressure has been given in Table –3 of IS: 12070. This will ensure settlement of raft foundation to be less than 12 mm.



## VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 98

### Net Safe Bearing Pressures Based on RMR

Classification No	I	II	III	IV	V
Description of Rock	Very Good	Good	Fair	Poor	Very Poor
R M R	100-81	80-61	60-41	40-21	20-0
$Q_{ns}$ (T/m <sup>2</sup> )	600-448	440-288	280-141	135 - 48	45 - 30

#### Estimated RMR values

Rock Mass Rating (RMR) of jointed rock masses, may be worked out based on IS 13365 (Part I). Rock Mass Rating parameters are reproduced from Annexure B of IS 13365 (Part I) below for ready reference



## VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 98

### Strength of Intact Rock Material (MPa)

	<b>Compressive Strength (MPa)</b>	<b>Point Load Strength</b>	<b>Rating</b>
Exceptionally Strong	>250	>8	15
Very Strong	100-250	4 – 8	12
Strong	50-100	2 – 4	7
Average	25-50	1 – 2	4
Weak	10-25	Use of Uniaxial Compressive Strength is preferred	2
Very Weak	2-10		1
Extremely Weak	<2		0



## VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 98

### Rock Quality Designation (RQD)

	RQD (%)	Rating
Excellent	90-100	20
Good	75-90	17
Fair	50-75	13
Poor	25-50	8
Very Poor	<25	3

### Spacing of Discontinuities

	Spacing (m)	Rating
Very Wide	>2	20
Wide	0.6-2	15
Moderate	0.2-0.6	10
Close	0.06-0.2	8
Very Close	<0.06	5

*NOTE – If more than one set of discontinuity is present and the spacing of discontinuities of each set varies, consider the set with lowest rating.*



## VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 98

### Condition of Discontinuities

Very rough and unweathered wall rock surface ,tight and discontinuous, no separation	Rough and slightly weathered wall rock surface, separation < 1 mm	Slightly rough and moderately to highly weathered wall rock surface, separation < 1 mm	Slicken sided wall rock surface or 1-5 mm thick gauge or 1-5 mm wide opening, continuous discontinuity	5 mm thick soft gauge 5 mm wide continuous discontinuity
30	25	20	10	0

### Ground Water Condition

General Description	Completely Dry	Damp	Wet	Dripping	Flowing
Rating	15	10	7	4	0



## VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 98

### Adjustment for Joint Orientation

Strike and Dip Orientations of Joints for		Very Favorable	Favorable	Fair	Unfavorable	Very Unfavorable
Ratings	Tunnels	0	-2	-5	-10	-12
	Raft	0	-2	-7	-15	-35
	Foundation					
	Slopes	0	-6	-25	-50	-60

### Safe Bearing Capacity from the Core Strength

The safe bearing capacity has been estimated from the following equation given in IS: 12070.

$$q_s = q_c N_j$$

$q_s$  = gross safe bearing pressure (includes safety factor of 3)

$q_c$  = average uniaxial compressive strength of rock cores

$N_j$  = empirical coefficient depending on the spacing of discontinuities

$$= (3 + S / B_f) / 10 \sqrt{(1 + 300 \delta) / S}$$

$$= \mathbf{0.10 \text{ for spacing of discontinuities 300 mm to 1000 mm}}$$

Where

$\delta$  = thickness of discontinuities (cm)

$S$  = spacing of discontinuities (cm)

$B_f$  = width of footing (cm)



## VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 98

This relationship is valid for a rock mass with spacing of discontinuities greater than 0.30m, aperture of discontinuities less than 10 mm ( 15 mm if filled with soil or rock debris ) and foundation width more than 0.30 m.

### Correction to be applied

For getting the allowable bearing pressure the safe bearing pressure obtained from core strength shall be multiplied with the correction factors according to the geological conditions as per IS: 12070 Clause 9.2

- |  |   |  |
|--|---|--|
| For submerged conditions                                   | - | correction factor of 0.50 to 0.75 depending upon the aperture of joints    |
| For major Cavies inside Limestone ( Core Recovery < 70 % ) | - | correction factor of 0.50  |
| For orientation of joints                                  | - | correction factor of 0.50 to 1.00 depending upon the orientation of joints |

These correction factors are not applicable for bearing pressure from RMR system.

# **Annexure-II**



# Office of the Municipal Corporation, Bhopal

"B" wing, 11<sup>th</sup> Floor, Above Passport office, Kushabhau Thakre Inter-State Bus Terminal  
(ISBT) Campus, Ambedkar Marg, Near Chetak Bridge, Bhopal (M.P.)

No.: BMC/SWM/SBM/BPL/2018/ 665

Bhopal, Date:- 03/11/18

To,

Bhopal MSW Private Limited,  
54, Shyamla Hills, Near Bharat Bhavan,  
Bhopal (MP).

Ref: 1) Your Letter, dated 02/11/2018, regarding water requirement of the plant.  
2) MoEF letter dated 23.10.2018

Sub: Water Requirement for your upcoming 23 MW MSW Plant at Adampur Chawni area.

This is in reference to your letter regarding water requirement for your upcoming 23 MW MSW plant at Adampur Chawni, Bhopal MP. It is to intimate you that the project will be provided water of 500 KLD from Ghoda Pachh ad Dam, located near to project site for operation of the plant.

Ramanjay Singh

  
City Engineer (SBM-Project & Health)  
Municipal Corporation Bhopal

# **Annexure-III**



- iv. Ensure that the building plans for the Project Facilities at Site and each the Sites for Satellite Facility are duly and expeditiously approved by the concerned authorities under the relevant Acts/ building by-laws / other relevant by-laws or regulations.
  - v. Co-ordinate signing of Land Agreement and grant of the Applicable Approval from Participating ULBs for the land required for creation of Satellite facilities.
- d. The Authority agrees, for the purposes of the Financing Documents, to intimate to the Lenders by such notice as required under the Financing Documents:
- i. Of the happening or likely happening of an Event of Default on the part of Concessionaire;
  - ii. Of the Termination of this Agreement by the Authority;
  - iii. Of the occurrence, continuance and cessation of any Force Majeure cause; Or
  - iv. Other breach or default on the part of Concessionaire under this Agreement.
- e. The Authority shall reimburse the Financing Support to the Concessionaire within 15 (fifteen) days of accordance with the Schedule 16: Disbursement Schedule
- f. The Authority shall enter into an Escrow Agreement in accordance with Clause 7.3(a) and Schedule 15: Escrow Agreement within 180 (One Hundred Eighty) days of signing date.
- g. The Authority shall deposit the initial amount in the Escrow Account as per the Clause 7.3(b) and shall replenish the Escrow Account B as per Clause 7.3(e), failing which shall revoke the Clause 7.3(f).
- h. The Authority shall recommend the Escrow Agent to pay Tipping Fees on a monthly basis to Concessionaire for collection, transportation, segregation and disposal at ISWM Facility as per provisions of Clause 7.2 and Escrow Account: Schedule 15.
- i. The Authority shall arrange with the State Government of Madhya Pradesh to demarcate and designate, in line with the provisions of the Madhya Pradesh Gram Tatha Nagar Nivesh Adhiniyam, 1973, a regulated zone around the ISWM Facility where only certain designated uses of land shall be permitted.
- j. Water and power supply to the outer limits of the Sites for ISWM Facility shall be provided by the Authority at applicable charges payable by the Concessionaire.

For Bhopal Municipal Solid Waste Private Limited

Nagar Palik Nigam Bhopal  
आयुक्त  
नगर निगम

  
Authorized Director Signatory

# **ANNEXURE-IV**



# कार्यालय नगर पालिक निगम, भोपाल

बी-बिंग, द्वितीय तल, पासपोर्ट कार्यालय के ऊपर, कुशामाऊ ठाकरे इन्टरस्टेट बस टर्मिनल  
(आईएसबीटी) परिसर, अम्बेडकर मार्ग, चेतक ब्रिज के पास, भोपाल (म.प्र.)-462011

क्रमांक/BMC/2018 / 6581-6582

भोपाल, दिनांक. 18/10/18

प्रति,

विशेष कर्तव्यस्थ अधिकारी,  
वृहद परियोजना नियंत्रण मंडल,  
जल संसाधन विभाग,  
कक्ष क्रमांक 409, चौथी मंजिल,  
तुलसी नगर भोपाल-462003  
टेलीफोन: 0755-2557255

विषय: नगर पालिक निगम, भोपाल को भोपाल शहर की इटीग्रेटेड सालिड वेस्ट मैनेजमेंट परियोजना  
(ISWM) एवं स्लाटर हाउस परियोजना हेतु घोड़ापछाड़ बांध से जल आवंटन के संबंध में।

संदर्भ: आपका पत्र क्रमांक वृ.प.नि.म./31/तक/रा.स्त-861/2018/820 भोपाल दिनांक  
26.09.2018

उपरोक्त विषयान्तर्गत लेख है कि पत्र के साथ जल आवंटन हेतु विभाग के निर्धारित  
प्रपत्र-199 संलग्न कर आपकी ओर अग्रिम कार्यवाही हेतु प्रेषित है।

संलग्न: प्रपत्र-199

पृ. क्रमांक/BMC/2018 / 6581-6582  
प्रतिलिपि:

1. आयुक्त, नगर निगम भोपाल की ओर निज सचिव के माध्यम से सूचनार्थ प्रेषित।
2. अपर आयुक्त, नगर निगम भोपाल की ओर निज सचिव के माध्यम से सूचनार्थ प्रेषित।

Ranajay Singh

25/10/18

0/1  
नगर यंत्री (स्वच्छ भारत मिशन)  
नगर पालिक निगम, भोपाल  
भोपाल, दिनांक. 18/10/18

0/1  
नगर यंत्री (स्वच्छ भारत मिशन)  
नगर पालिक निगम, भोपाल



**(APPLICATION FOR WATER ALLOCATION FROM NATURAL  
RESOURCES/RIVER/STREAM/GOVT.WATER SOURCE)**

1.	Name of application/firm	Bhopal Municipal Corporation
2.	Name of the project	1. Development and O & M of Regional Integrated Solid Waste Management (ISWM) Project, Door to Door Collection (DTDC), Transportation (Primary and Secondary), Processing and Regional Landfill Facility for Bhopal (Lead ULB) Cluster of Eight cities (M.P.) 2. Establishment of Modern Abattoir On Design, Build, Finance, Operate & Transfer (DBFOT) Basis Under Public Private Partnership
3.	Proposed location	Adampur Chawani
4.	Details of the project	A. Development of Regional Integrated Solid Waste Management (ISWM) Project at adampur chawani on 44.9 acres of land consist of 23MW waste to energy plant and door to door collection of 1000 TPD municipal waste from bhopal & 7 ULBs for processing and Scientific Landfill. B. Construction of modern Abattoir at Adampur chawani on 10 acres(approx) of land Consist of minimum capacity of slaughtering approx. 800 buffaloes and approx 400 goat / sheep per day. And construction of Effluent treatment plant.
5.	Full address/Telephone no./Fax/E-mail of applicant	
	• Registered office	Harshwardhan Complex, Near Awanti Bai Chauraha, T.T. Nagar, Bhopal 462 003 commbhopal@mpurban.gov.in
	• Corporate office	"B" wing, IInd Floor, Above Passport office, Kushabhau Thakre Inter State Bus Terminal (ISBT) Campus, Ambedkar Marg, Near Chetak Bridge, Bhopal- 462011 Mob: 9424499930 Email: op.bhardwaj.opb@gmail.com
	• Local office	"B" wing, IInd Floor, Above Passport office, Kushabhau Thakre Inter State Bus Terminal (ISBT) Campus, Ambedkar Marg, Near Chetak Bridge, Bhopal- 462011 Mob: 9424499930 Email: op.bhardwaj.opb@gmail.com
6.	Name and address of the Project Head/CEO/Telephone No./Fax/E-mail	Commissioner, Bhopal Municipal Corporation Harshwardhan Complex, Near Awanti Bai Chauraha, T.T. Nagar, Bhopal 462 003 commbhopal@mpurban.gov.in
7.	Particular of the contact person	O.P.Bhardwaj City Engineer (SBM) Mob: 9424499930

*Ranajay Singh*

8.	Constitution of the firm (please Tick)		
	Proprietorship	Partnership	Public Limited
			Other (please specify) Constituted under Municipal Act 1956
9.	Required water allocation (M.cum or Cum/ year)	5,50,000 Cum/year	
10.	Name of proposed source/place:	Ghoda Pachad Dam	
	a) Name of District.	Bhopal	
	b) Tehsil	HUZUR	
	c) Name of nearest village	Near Adampur Chawani	
	d) Name of River/Nalla/Stream/Resource(Enclose index map showing location of source from where withdrawal is proposed)	Ghoda Pachad Dam	
11.	How the water is planned to be drawn from the source		
	a) Direct from source by pump	With laying of Pipeline & Storage tank	
	b) By construction stop dam /weir at own cost		
	c) From Govt.Dam/Canal/Stop Dam/Weir		
12.	Schedule date of commissioning of Industries/Plant/Power House(if units please mention date of commencement of each unit)	June, 2020	
13.	Particulars of Mou/Eoi signed with Govt.Deptt./Agency	Enclosed copy of Agreement	
		Signature of Applicant	
		Name	O.P.Bhardwaj
		Post	City Engineer (SBM)
		Telephone No.	Mob: 9424499930
		e-mail	op.bhardwaj.opb@gmail.com
		Fax	

*Rameshwar Jitoh*

*O.P. Bhardwaj*

City Engineer(Project)  
Bhopal Municipal Corporation

जल संसाधन विभाग  
वृहद परियोजना नियंत्रण मंडल

पत्र क्रमांक 409, बीबी रोड, जल संसाधन विभाग  
दुर्गा नगर, भोपाल - 462002  
Tel. 0755-2557256  
Email - chmupbl@gmail.com

पत्र क्रमांक वृ.प.नि.म./31/तक/रा.स्त.-861/2018/820 भोपाल, दिनांक 26/9/2018

145  
28/9

प्रति,

मुख्य अभियंता,  
वंदल बेतवा कछार,  
जल संसाधन विभाग,  
भोपाल, (म.प्र.)

3906  
27-09-18

विषय-

नगर पालिक निगम, भोपाल को भोपाल शहर की इंटीग्रेटेड सालिड वेस्ट मैनेजमेंट परियोजना (ISWM) अंतर्गत घोड़ापछाड़ बांध से 0.475 मि.घ.मी. वार्षिक जल आवंटन के संबंध में।  
आयुक्त, नगर पालिक निगम, भोपाल का पत्र क्रमांक बी.एम.सी./6418 भोपाल दिनांक 29.08.2018।

आयुक्त

नगर पालिक नि.म., भोपाल

विषयान्तर्गत संदर्भित पत्र (छायाप्रति संलग्न) द्वारा आयुक्त, नगर पालिक निगम, भोपाल ने भोपाल शहर की इंटीग्रेटेड सालिड वेस्ट मैनेजमेंट परियोजना (ISWM) अंतर्गत घोड़ापछाड़ बांध से 0.475 मि.घ.मी. वार्षिक (1.30 एम.एल.डी) जल आवंटन जल आवंटन की मांग की गई है।

कृपया आयुक्त, नगर पालिक निगम, भोपाल की मांग के परिपेक्ष्य में प्रस्तावित घोड़ापछाड़ बांध में जल की उपलब्धता के परीक्षणोपरान्त इण्डेक्स मैप सहित विस्तृत विवरण, संलग्न प्रपत्र 203 (ए) में जानकारी के साथ आपकी स्पष्ट अनुशंसा/अभिमत सहित प्रस्ताव इस कार्यालय को उपलब्ध कराने का कष्ट करें, जिससे नगर पालिक निगम, भोपाल को जल आवंटन किये जाने की कार्यवाही नियत समय सीमा में प्रमुख अभियंता कार्यालय स्तर से की जा सकें।

संलग्न- उपरोक्तानुसार  
एव प्रपत्र 203 (ए)

Sanjay Gupta  
(संजीव गुप्ता) 25/9/18

विशेष कर्तव्यस्थ अधिकारी  
वृहद परियोजना नियंत्रण मंडल  
जल संसाधन विभाग

पृष्ठां. क्रमांक वृ.प.नि.म./31/तक/रा.स्त.-861/2018/821 भोपाल, दिनांक 26/9/2018  
प्रतिलिपि:-

1. आयुक्त, नगर पालिक निगम, भोपाल की ओर कृपया जल आवंटन हेतु विभाग के निर्धारित प्रपत्र-199 (संलग्न) में आवेदन पत्र यथाशीघ्र इस कार्यालय को उपलब्ध कराने का कष्ट करें।
2. अधीक्षण यंत्री, जल संसाधन मण्डल, भोपाल,
3. कार्यपालन यंत्री, जल संसाधन विभाग, भोपाल,  
की ओर संदर्भित पत्र के परिपेक्ष्य में कृपया सूचनार्थ एवं आवश्यक कार्यवाही हेतु।

संलग्न- उपरोक्तानुसार, संक. 1 के लिये प्रपत्र-199  
एवं 2,3 के लिये प्रपत्र 203 (ए)

Sanjay Gupta  
(संजीव गुप्ता) 25/9/18

विशेष कर्तव्यस्थ अधिकारी  
वृहद परियोजना नियंत्रण मंडल  
जल संसाधन विभाग

Sanjay Gupta  
Keep in File

2/17  
17/10/18

Ramesh Singh  
Gupta

Ref.: BPL MSW/CGWA/231018

Date: 23/10/2018

To,  
The Regional Director  
Central Ground Water Board (NCR)  
Block -1, 4<sup>th</sup> Floor, Paryavas Bhawan  
Arera Hills, Jail Road,  
Bhopal - 462011 (MP)



**Sub: Submission of reply of queries raised for application for Permission/NOC to withdrawal of ground water by M/s Municipal Solid Waste Processing at their MSW based power plant- Koluva Khurd, block Phanda, Tehsil Huzur, district Bhopal (M. P.).**

**Reference : Your quarry, issued to us.**

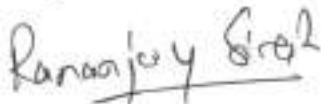
Dear Sir,

This is the reference for your above letter. We are submitting herewith our reply of query raised by you for Permission/NOC to withdraw ground water by M/s Municipal Solid Waste Processing at their MSW based power plant- Koluwa Khurd, block Phanda, Tehsil Huzur, district Bhopal (M. P.). The point wise reply is enclosed as Annexure 'A'. Ground water requirement has been reassessed and revised typed application is submitting herewith for consideration.

Hope the reply in line with your requirement and we are requesting you to consider our case and recommend to CGWA to grant us NOC for withdrawal of ground water.

Thanking You,

Yours Faithfully  
For Municipal Solid Waste Processing,



Authorized Signatory

Director / Authorised Signatory



**Bhopal Municipal Solid Waste Private Limited**

Corp. off: 6th Floor, Plot No 19 & 20, Sector 16 A, Film City, Noida, Uttar Pradesh - 201 301, T: 0120-4849500  
Mumbai off: 18th Floor, A Wing, Marathon Futurex, Lower Parel, Mumbai - 400 013, T: 022 - 7108 - 4400

# **Annexure-V**



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Project Name: KADAPA 330 TPD, KADAPA MSW PVT. LTD.

Cust. Doc. ID:

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# **SPECIFICATION FOR STEAM TURBINE AND ITS AUXILIARIES**

## **FOR**

### **330 TPD WASTE TO ENERGY PLANT, KADAPA**

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## 1. INTRODUCTION

This document is intended to describe the specification for steam turbine and its auxiliaries for 330 TPD Waste to energy Plant located in Kadapa, Andhra Pradesh, India.

CITEC Engineering India Private Limited, New Mumbai (Consultant) have been retained by the Owner / Purchaser for carrying out detailed engineering services for the installation of above mentioned steam turbine and its auxiliaries.

This specification covers the minimum requirements and guide lines to be considered by the Vendor for design, manufacture, shop inspection and testing, transportation, erection, site testing, trial runs, carrying out performance guarantee tests, and commissioning of steam turbine and its auxiliaries for the waste to energy plant.

## 2. REFERENCE STANDARDS / DESIGN CODE

- IEC 60045-1 - Steam turbines - Part 1: Specifications
- IEC 60034 - Rotating Machines
- AGMA (American Gear Manufacturers Association)
- ISO 1680-1 and 2 - Acoustics - Test code for Measurement of Airborne noise.
- ASME B31.1 - Power Piping.
- ASME IX - Welding and Brazing Qualifications.
- AWS D1.1 - Structural Welding Code.
- IS-1893 - Criteria for design of earthquake resistant structure.
- ASCE - 7 - Minimum Design loads for Building and other structures.
- ASME (ANSI) B16.5, B16.47 - Pipe Flanges and Flange Fitting.
- OSHA (Occupational Safety & Health Administration)
- IS 325 : Three phase Induction Motor.
- IS 4722: Rotating electrical machines Specification.
- IS 4691: Degree of Protection provided by enclosures for rotating electrical machinery.
- IS 2147: Degree of Protection by Enclosures for Switchgear.

All conflict between the requirements of these specifications, standards, data sheets and purchase order shall be referred to the ESSEL / CITEC INDIA for clarification during design stage and or before manufacturing begins.

If there is any conflict between the specifications, codes & standards the most stringent one shall be follower.

### 3. TERMS AND DEFINITIONS

VENDOR : It means the Material & Services vendor  
BUYER : ESSEL

### 4. SCOPE OF SUPPLY & SERVICE

This enquiry document covers the specification for design, engineering, procurement, manufacture, fabrication & assembly, inspection, shop testing, painting at Vendor/Contractor's and/or his sub-vendor /sub-contractor's works, documentation, packing & forwarding, transportation, delivery to site including comprehensive transit insurance, unloading at site, unpacking, inspection & checking, packing, storing at site, transporting from stores to the place of fabrication, erection, testing, commissioning, performance testing, training of owner's personnel and handing over equipment & systems as detailed herein.

The scope of work covered in this enquiry also includes supply of all labour, technical & non-technical personnel, obtaining statutory approval & clearances as required, all materials and equipment required for proper completion of the work.

The estimated Heat and Mass Balance Diagram (HMBD) is enclosed for the reference of the vendor. The diagram depicts the broad configuration of the steam water cycle; however the parameters mentioned are indicating only and the vendor shall optimise the steam turbine cycle especially regenerative heating system based on his judgement and shall submit the heat and mass balance diagram for the review of ESSEL / consultant.

#### 4.1. DETAILED SCOPE OF WORK

Design, manufacture, supply, erection, testing, commissioning, conducting performance testing etc. as per scope indicated in above one no., steam turbine and its auxiliaries unit of capacity as specified in the data sheet, steam piping & condensate piping upto terminal points and comprising of the following.

- One (1) unit of Turbine Generator of 6.0 MW MCR rating and 10 % VWO margin for Steam turbine generator to generate 6.0 MW continuously at VWO condition. The steam

turbine shall be rated for 6.0 MW (MCR) and the generator shall be rated for 6.0 MW (MCR).

- Other auxiliary equipment's and system described in this specification.
- Interconnecting piping within the battery limits. (As shown in agreed P&ID)
- Furnishing all documentation as described in Annex - 1.3 of this section.
- List of mandatory spare parts for Two (2) years of normal trouble free operation of the equipment/system supplied with additional price
- Provide post sales service by remote assistance.
- Supply of special tools and tackles required for operation, maintenance, inspection & repair, removal of generator rotor etc.
- Training of ESSEL's personnel in the operation and maintenance of the equipment/system offered.
- Price breakup for Supervision during erection, trial run and commissioning.
- Separate price for erection and commissioning
- Any required additional equipment to improve the performance of the system has to be provided by the vendor

## 4.2. STEAM TURBINE

One (1) no. sole plate mounted top exhaust steam turbine, single casing, multistage type, uncontrolled extraction condensing type including the following equipment as a minimum for the turbine shall be as follows:

- Inlet stage and exhaust casings.
- One no. emergency stop valve complete with electro-hydraulic actuator including integral strainer & fine mesh start-up strainer with requisite steam blow-out provisions.
- Hydraulically/ pneumatically operated quick closing non return valves in the turbine bleed piping.
- Hydraulically operated control valves for the turbine along with actuator.
- Motorised turning gear complete with automatic engage/disengage facility along with manual turning provision.
- Fully automatic gland sealing steam and leak off system, all necessary control valves and piping and gland steam condenser.
- Flexible couplings shall be provided between turbine and the gear box and rigid coupling shall be provided between the gear box and the generator with necessary coupling guards.
- Exhaust hood spray system.
- Turbine cladding/enclosure.

- Complete inter connecting piping, fittings, safety devices, counter flanges, fasteners etc.
- Thermal insulation
- Over speed trip bolt
- Earthing brush.
- Pneumatic controllers for which spares would not be available indigenously (for overseas vendors).
- Speed reduction gear box with independent common lubrication system

#### 4.3. TURBINE OIL PLANT

- One (1) no. Turbine Oil Plant for the turbine shall contain following as minimum:
- One (1) main oil tank including oil strainers with drains in each compartment, maintenance opening vents with vent connections and connection for oil purification system unit.
- One (1) overhead turbine run down tank of adequate capacity as per manufacturer's standard with requisite integral piping and fittings for operation during turbine coasting down period
- One (1) 100% capacity main oil pump either shaft driven or AC motor driven.
- One (1) 100% capacity auxiliary oil pump with AC motor drive.
- One (1) emergency oil pump with DC motor drive.
- One (1) jacking oil pump with AC motor drive/ any similar device to be confirmed by vendor
- 2 x 100% Oil vapour extraction fan with AC motor drive with oil separator in the piping.
- Vent pipe routed to a safe height outside building.
- Two (2) lubrication oil coolers, (one working, one standby) equipped with flow change over device (allowing continuous operation without interruption of oil flow) along with vents and drains.
- 2x100% Duplex filters for the complete lubrication oil flow along with transflow change over valve.
- 2x100% Duplex filters for the complete control oil flow along with transflow changeover valve.
- Oil Pressure throttle valves near the bearings.
- Oil level indicators and level switches.
- Complete interconnecting piping, fittings, valves, safety devices, fastenings, supports etc for the complete lubricating and control oil systems.
- Sheet metal ducts or cover for oil piping and other equipment against oil spray
- Flow glass indicators in oil return lines from bearings

- Accumulator

#### 4.4. OIL PURIFICATION SYSTEM

- The Oil Purification System for the unit consisting of the following as minimum
- One (1) no. Centrifuge oil separator with drive motor built in feed pump and accessories such as bowl hood, sludge basket, disc stack & gravity disc, distributor etc.
- One (1) no. untreated (dirty) oil feed gear pump with drive motor.
- One (1) no. water bath electric heater for indirect oil heating complete with thermostat temperature switch, and necessary drains & isolation valves.
- One (1) no. anti-flood device with liquid seal breakage alarm device, complete with anti-flood tank and drains.
- One (1) no. clean oil discharge booster pump with drive motor.
- One (1) no. polishing filter (if necessary) with accessories such as built in pressure relief valve, differential pressure gauge/switch etc.
- Necessary instruments & controls for the safe and reliable operation of equipment.
- M.S. fabricated skid for the above, with foundation bolts. Suitable provision for collection of spillage oil shall be provided in skid.
- Local control panel, push buttons for all equipment and necessary annunciators. All alarms and running status of the centrifuge shall be incorporated in the DCS. Potential free contacts to be considered accordingly.
- Centrifuge water sealing to be provided with necessary hose, nipples and valves.
- Any other components required for safe & reliable operation of oil purification unit.

#### 4.5. AC GENERATOR

The AC Generator system for the unit consisting of the following as minimum.

Rated output	:	6000 kW
Rated voltage	:	11 KV +/- 10 %
Rated frequency	:	50 Hz +/- 5%

Combined variation of voltage & frequency	:	+ / - 10 %
Rated p.f.	:	0.8 (lag)
No. of phases	:	3 phase, 3 wire system

No. of terminals	:	3 for phase & 3 for neutral
Connection	:	Star
Rated speed / No. of pole	:	1500 rpm / 4 pole
Short circuit ratio	:	More than 0.5
Ambient temperature	:	38 Deg. C
Excitation	:	Brush less
Rotor	:	Cylindrical
Cooling method	:	CACW
Mounting	:	Horizontal
Insulation	:	Class H (both rotor and stator)
Temperature rise	:	Class H limits (both rotor and stator)
Enclosure	:	IP-54 (Stator) & IP-23 (Exciter)
Duty	:	Continuous and suitable for parallel operation with grid
Rotation	:	To suit driver output
Noise level	:	85 dB (A)
Terminal box	:	To suit HT cable connection
Reference standard	:	IS-4722
Fault Rating	:	Specify

### **Bearings**

Type	:	Sleeve
Accessory	:	Temperature gauge

### **Lube oil system**

Type	:	Forced feed
Source	:	Turbine lube oil system

### **Air coolers**

Cooling method	:	CACW
Capacity	:	2 x 60%
Cooler tube material	:	SS-304 ERW
Mounting	:	TOP

### **Anti-condensation heaters**

Type : Resistance heating  
Power supply : 230 V, Single phase, 50 Hz

#### **Water leakage detector**

Location : Bottom of cooler  
Quantity : 1 No. per cooler

#### **AVR cum excitation panel**

##### ***Design***

Control type : Analog  
Control modes : 2 auto + 1 manual  
Voltage adj. Range : +/- 10%  
Regulation : +/- 0.5%  
Dead time : Less than 30 mS

##### ***Features***

Compounding  
Diode failure detector  
Auto PF controller  
Remote voltage control  
Auto-Manual follow-up  
Under frequency protection  
Field flashing provision

AVR cum excitation panel shall be complete with generator voltmeter, field voltmeter, field ammeter, PF meter, null meter, Auto/Manual selector switch, AC supply & DC supply on /off control switches, indicating lamps and space heater with thermostat.

##### **General**

Type : Simplex, dead front & free standing

#### **Generator relay panel**

MICOM P-343 Numeric relay consisting of:

DESCRIPTION	TAG NO. (Option to choose own tag no.)
Voltage controlled over current protection relay	51 V
Stator earth fault protection relay	51 N
Restricted earth fault protection relay	64
Differential protection relay	87
Over voltage protection relay	59
Timer for over voltage protection relay	2-59
Under voltage protection relay	27
Reverse active power protection relay	32 P
Under frequency protection relay	81 O
Over frequency protection relay	81 U
PT fuse failure sensing relays	60 A 60 B 60 C
Loss of excitation (Field failure) protection relay	40 G
Auxiliary relays & timers for loss of excitation protection relay	40 X 27/40 G T1/40 G T2/40 G
Trip circuit supervision relay	95
Negative phase sequence protection relay	46
DC supply supervision relay	80
Earth fault protection relay	59G

**Electro-Mechanical relays**

DESCRIPTION	TAG NO. (Option to choose own tag no.)
Reverse reactive power protection relay	32 Q
Generator master trip relay	86G
Turbine master trip relay	86T

The panel shall be complete with AC supply & DC supply on /off control switches, indicating lamps and panel space heater with thermostat.

**General**

Type : Simplex, dead front & free standing

**Generator Control (metering cum synchronising) Panel**

Generator control panel shall house the following:

**Meters**

- System : 3 phase, 4 wire, unbalanced load
- Digital Tri-Victor meter : 1 No. (to indicate Current, Voltage, Power Factor, Frequency, kVA, kW, kVAR, kWh & kVAh)
- Synchro scope : 1 No.
- Check synchronizing Relay : 1 No.
- Aux. relays for Synchronising scheme : 1 Set
- Auto Synchroniser : 1 No.

- Temperature scanner for monitoring generator winding and bearing temperature
- Alarm annunciator for generator fault monitoring

The panel shall be complete with synchronising selector switches, breaker control (T/N/C) switches, push buttons, AC supply & DC supply on /off control switches, indicating lamps and panel space heater with thermostat.

**General**

Type : Desk & free standing

**Generator Breaker Panel**

Generator breaker panel in Purchase scope. TG Vendor need to provide interconnection control cable schedule from TG control Panel to MV Switchgear.

**Generator Neutral Box:**

**Current transformers**

<i>For</i>	<i>Quantity</i>	<i>CT's Ratio</i>	<i>Class</i>	<i>Burden</i>
Differential protection CT's 2 Cores	3 Nos.	500 / 1A	PS	N/A

**LA, SC & PT panel**

LA, SC & PT panel shall house the following

**Lightning arrestor**

Discharge current, Voltage : 10 kA, 12 kV  
 Quantity : 3 Nos. (1 per phase)

**Surge capacitor**

Capacitance per phase / Voltage : 0.25  $\mu$ F / 12 kV  
 Quantity : 3 Nos. (1 per phase)

**Current & Potential transformers:**

Vendor to refer attached single line diagram, "CIT-EIPL-KDP80094" for CT's & PT's details.

**Excitation Transformer:**

<b>Rating</b>	<b>Voltage Ratio</b>	<b>Class</b>	<b>Quantity</b>
Vendor to specify	11kV/180V, $\pm$ 10%	5	1 No.

The panel shall be complete with AC supply on /off control switch, illuminating lamp with limit switch for each PT compartment, indicating lamps and space heater with thermostat.

**General**

Type : Simplex, modular & free standing  
 Terminal box : To suit HT cable connection

**Standby Excitation Transformer Unit**

<b>Rating</b>	<b>Voltage Ratio</b>	<b>Class</b>	<b>Quantity</b>
Vendor to specify	415V/180V	5	1 No.

The panel shall be complete with AC supply & DC supply on /off control switch, illuminating lamp with limit switch for each PT compartment, indicating lamps and space heater with thermostat

**Neutral grounding resistor panel**

NGR panel shall house the following

**Resistor**

Type : Naturally air cooled

Rated current : Specify

Duty rating : 10 seconds

Resistor grid type : Punched steel

Temperature rise : 375<sup>0</sup> C over ambient (max.)

Mounting & fixing of Resistor units : Mounted on grid rods; fixed and assembled in tiers separated by porcelain insulators

**Neutral isolator**

Operation : Motorised Isolator

No. of poles : One

Limit switches : 2 Nos. (For on/off positions)

**Earth connection**

Type : Porcelain insulated 12 mm terminal studs

Quantity : Two Nos.

**Current transformers**

<b>For</b>	<b>Quantity</b>	<b>CT's Ratio</b>	<b>Class</b>	<b>Burden</b>
Generator Protection	1 No	100 / 1 A	5 P 20	Vendor to specify
Generator Protection Spare CT	1 No	100 / 1 A	5 P 20	Vendor to specify

The panel shall be complete with AC supply & DC supply on /off control switch, illuminating lamp with limit switch for each PT compartment, indicating lamps and space heater with thermostat.

**General**

Type : Simplex, dead front & free standing

Terminal box : To suit HT cable connection

Material of bus-bars : Copper

**DC Distribution Board:**

Vendor to provide DCDB for dc power distribution within battery limit.

Vendor need to provide DC load details information (Continuous, momentary /starting with starting time, load cycle) within battery limit to size 110V DC battery and charger.

**DC distribution system**

Panel shall be provided with feeders for

DC motor starter panel : 1 No.

Relay panel : 1 No.

Generator control panel : 1 No.

AVR cum excitation panel : 1 No.

Turbine control panel : 1 No.

Spare : 2 Nos.

**General**

Type : Simplex, dead front & free standing

**AC motors**

Type : Induction

Winding connection : Delta

Duty : Continuous

Enclosure : IP-55

Cooling : TEFC

Insulation : Class "F"

Power supply : 400 V, 3 Phase, 50 Hz

Speed / No. of poles : To suit driven equipment

**DC motor**

Type : Shunt field

Duty : Continuous

Enclosure : IP-55

Cooling : TEFC

Insulation	:	Class "F"
Power supply	:	110 V
Speed	:	1440 RPM

## Control & instrumentation

### Turbine Control from DCS

Turbine control panel shall house the following:

- Electronic governor (Make - Woodward, Latest Version)
- Condenser hot well level indicator cum controller
- DCS based turbine safety interlocks and trip logic
- Remote controls comprising of selector switches, ammeters, push buttons & indicating lamps for :
  - AOP motor
  - EOP motor
  - Extraction Actuator motor
  - Barring gear motor
  - Oil vapour extractor motor
  - Air Blower Motor
- Push buttons for turbine speed raise and lower
- Turbine remote trip/reset push buttons
- Temperature indications for Monitoring turbine and gearbox bearing oil temperatures at DCS
- Alarms for Turbine & Generator fault monitoring in DCS
- Vibration monitoring system
  
- The panel shall be dead front free standing panel and complete with AC supply & DC supply on /off control switches, indicating lamps and space heater.

#### **General**

Type : Desk & free standing

### Turbine Auxiliary MCC

1. Turbine MCC incomer shall be provided with 4P, MCCB incomer if rating is less than 630A with Multi-function meter.
2. Motor feeder rated 30kW and more to be provided with CT operated ammeter.

MCC panel shall house the following:

- Incoming feeder complete with switch-fuse unit, voltmeter, CT operated ammeter, indicating lamps & bus bars
- DOL starter complete with switch-fuse unit, contactor, overload relay, CT operated ammeter, indicating lamps & local Emergency Stop & ON pushbuttons for :
  - AOP motor
  - Extraction Actuator motor
  - Barring gear motor
  - Oil vapour extractor motor

- Air Blower motor
- Turbine speed indicator and speed raise / lower push buttons

### General

Type : Simplex, dead front & free standing

### DC MOTOR (EOP) STARTER PANEL

DC motor starter panel shall house the following:

- Incoming feeder complete with switch-fuse unit, voltmeter, ammeter and indicating lamps
- 2 step resistance starter for EOP motor complete with switch-fuse unit, contactor, overload relay, ammeter, indicating lamps & pushbuttons.

### General

Type : Simplex, dead front & wall mounting

### GENERAL SPECIFICATIONS OF INSTRUMENTS

#### Pressure and temperature gauges

Dial : 150 mm circular  
Scale : 270 Deg. arc with black pointer  
Type : Bourdon (pressure gauge)  
Mercury in steel (temperature gauge)  
Accuracy : +/- 1 %  
Over range protection : 125 %  
Accessories : Shatter proof safety glass

#### Pressure transmitter

Type : 2-Wire, capacitance & electronic  
Output : 4-20mA  
MOC : SS-316

#### Pressure switch

Sensor type : Bellows  
Material of case : Die cast aluminium  
Material of bellows : SS-316

#### Resistance temperature detectors:

Element type : PT-100, 3 wire

### **Solenoid valve**

Power supply : 110 V DC

Operation : De-energise to open

Type : 2 way, universal ports

### **Level switch**

Type : Magnetic float

Material of body & float : AISI-304

Material of case : Die cast aluminium

### **Level transmitter**

Type : DP transmitter  
(2 wire, capacitance & electronic)

Input : 0 to 750 mmWC

Output : 4 – 20 mA

Material for process

Connection internals : SS-316

### **Level control valve**

Type : Single seat and globe

End connection : Flanged

Actuator type : Pneumatic diaphragm with spring

Packing material : PTFE

Plug characteristic : Equal percentage

Plug material : SS-316+Stellited

Seat ring material : SS-316+Stellited

Diaphragm material : Neoprene rubber

Stem material : AISI-304

Yoke material : Cast steel

Action : Air to close (Re-circulation line)

Air to open (By-pass line)

Accessory : Positioner

Air lock-up relay

Hand wheel

### **Current to pneumatic converter**

Supply	:	Air at 1.5 Kg/cm <sup>2</sup> .G
Input	:	4 – 20 mA
Output	:	0.2 to 1.0 Kg/cm <sup>2</sup> .G (air)
Enclosure	:	Die-cast aluminium alloy body
Accessory	:	Pressure gauges for supply & output

### **Air filter regulator**

Filter element	:	5 microns
Element material	:	Sintered bronze
Body material	:	Cast aluminium

### **Temperature Scanner**

Power supply	:	230 V, AC, Single phase
Input	:	PT-100, 3 wire RTD
Display	:	Channel No. & bearing / winding temperature
Display mode	:	Auto / Manual
Scan rate	:	Programmable
Accuracy	:	+/- 1 Deg.C

### **Alarm Annunciator**

Type	:	Modular, plug-in cards, interchangeable
Input protection	:	Optical isolation provided through opto couplers
Colour of window	:	Milky white (pre-trip alarm) Red (Trip alarm)
Power supply	:	110 V DC
Fault initiation	:	Make to alarm
Accessories	:	Electronic hooter and Push buttons for Test, Acknowledge & Reset

### **Vibration monitoring system**

Make	:	Bently Nevada / Alan Bradely
Type of detectors	:	Magnetic probes
Type of display	:	Bargraph display (LCD) through panel mounted dual channel monitors
Accessories	:	Power supply module
System Monitor	:	Proximitors and extension cables

### **4.6. PIPING & VALVES**

- Complete piping, supports & valves forming part of turbine system within specified battery limits.
- Integral piping, pipe supports & valves for auxiliary PRDS, auxiliary steam to deaerator.
- Integral piping, pipe supports & valves for turbine to heaters and gland steam condenser to deaerator including heater drains and vents.
- Piping & valves for the turbine drains and vents.
- Other integral piping all types, pipe supports & valves of STG package as specified

### **4.7. MISCELLANEOUS**

- Rust preventive and final site/shop painting of all components.
- Consumables required for startup, commissioning and initial filling is included in the vendor's scope and shall be supplied at appropriate time.
- Mating flanges, jointing materials with bolts, nuts, and gaskets as required at all terminal points.
- All commissioning spares
- Special tools and tackles for maintenance.
- Any other "special equipment and system" not specifically mentioned but essential for the package to be provided by the vendor

### **4.8. ELECTRICAL**

Design, engineering, procurement, supply and installation of steam turbine and auxiliaries within battery limit.

**Generator & Auxiliaries:**

One (1) nos. 6.0 MWe, 11 kV, 50 Hz, 0.8 P.F, 4 Pole generators (having MVA rating to suit the Maximum Continuous Rating ( MCR ) of associated turbine along with its auxiliaries). Generator will be connected to 11 kV switchgear via LA, SC, PT/ CT cubicle by means of 11 kV Cable.

**The generator shall be equipped with following auxiliaries:**

One (1) no. brushless excitation system with automatic voltage regulator, PMG, complete with all accessories, cubicles, including DC field breaker interconnecting cables required for the excitation system.

One (1) no. 12 kV, 100A neutral grounding resistor transformer rated for 30 sec with on load isolator housed in an enclosure.

One set of phase side LA, SC, PT/ CT cubicle & one set of neutral side CT cubicle containing current transformers for metering, protection system and automatic voltage regulator system, one set of surge arrester & surge capacitor as indicated in the typical metering and protection as per drawing no. CIT-EIPL-KDP80094, enclosed.

One (1) set of standby excitation transformer of voltage rated 415V/180V, 1 Phase.

One (1) set of shorting cum isolating links for shorting the three phases at a suitable location to facilitate dry out operation of the generator.

**Generator Relay Panel and Generator Metering, Control and Synchronising Panel**

Generator Relay Panel and Generator Metering, Control and Synchronising Panels for the Generator as specified in the specification.

Design, engineering and fabrication of panels as per specification.

Supply and mounting of all the equipment specified in the specifications.

Base channel, vibration-damping pads, kick plates for all panels complete with holding down bolts and nuts.

Numerical relays (with disturbance recorder) shall be used for all the protection functions.

**D.C drive starter Panel**

Design, manufacturing, assembly, supply, inspection, testing, supply and commissioning

Set of DC drive starter panel as required

The scope shall also include the following, whichever ticked (√) on box:

Supporting structure

:

List of Spare parts required for two (2) years trouble free operation

:

Spare parts for commissioning

:

Sets of special maintenance tools and tackles

:



Relevant drawings, data and O&M instruction manuals shall be furnished, including drawings that are required to be approved by ESSEL / Consultant.

**Other equipment / system**

General scope & exclusion for other electrical equipment / systems shall be as follows:

S. No.	Item Description	Purchaser's Scope	Vendor's Scope
1)	All Motors (AC/DC) and actuators	--	Design, engineering, procurement, supply & installation.
2)	Motor Control Centre (MCC)	--	415V, TG MCC Panel design, supply and installation in vendor scope. Load list for MCC sizing to be furnished by vendor.
3)	Power cabling	Design, supply and laying up to Vendor supplied equipment (TG MCC, DC DB, DC Starter Panel)	<p>a. All power, control cabling from TG MCC to varies field equipment in vendor scope.</p> <p>b. All power and control cables from TG MCC/ACDB/DCDB to field/drives/motor terminals/LPBS including all interconnection accessories/ terminations shall be included in the scope of vendor.</p> <p>c. All power and control cables for vendor supplied panels, interconnection to various areas like exciter, NGR, ACDB etc shall be included in vendor scope.</p> <p>Necessary information such as load list, starter type and location detail of electrical equipment shall be furnished by vendor.</p>
4)	Control cabling	Design, supply and laying of control cables	Control cable schedule for entire package shall be

S. No.	Item Description	Purchaser's Scope	Vendor's Scope
		up to Vendor's panel / equipment	furnished. Interconnecting cables between equipment / panels supplied by the vendor shall be in the scope of the vendor.
5)	Cable trays	Detailed engineering, supply and installation	Vendor to furnish requirement of cable tray on and around TG Deck.
6)	Earthing System	Design, Supply & Installation. Underground Earthing will be done by purchaser and risers will be provided at specific locations.	Vendor to keep necessary provision for all supplied equipment. Also, vendor shall furnish requirement of any special earthing if applicable.
7)	Local Push Button Stations	Design, supply & installation included, based on requirement being furnished by Vendor.	Vendor to give type and quantity requirement for procurement by purchaser.
8	DC drive starter Panel	--	Design, supply & installation by Vendor.

#### 4.9. INSTRUMENTATION & CONTROL SYSTEM

##### Scope

The Instrumentation and Control system for the Turbo Generator shall comprise of the following as a minimum:

- Instruments mounted locally on or near machine/equipment and piping.
- Instruments mounted on local panel adjacent to the machine/equipment on the turbine skid.
- Electro hydraulic turbine governing system.
- Electronic Governer with electro-hydraulic actuator and magnetic speed pickups (Make - Woodward, latest configuration)
- Turbine supervisory instrumentation & digital control system for turbine supervisory, control, protection systems.
- Instrumentation and control for the turbine lube oil, jack oil, control oil system.
- Instrumentation and control for the generator cooling system.
- Necessary no. of additional potential free contacts of 5A rating

- All necessary cabling from field instruments to junction boxes and from junction boxes and turbine control system. (In case any special cabling is envisaged, by the vendor, the same shall be included in his scope).
- All necessary erection hardware shall be in vendor's scope.
- Necessary Turbo generator interlock & protections system.
- Turbine control panel.

#### **Turbine Supervisory Instrumentation**

The turbine-generator unit shall be provided with the following supervisory instrumentation.

- Bearing metal temperature monitors for turbine, generator, exciter and gear box.
- Turbine speed monitor. - 3 nos.
- Shaft vibration monitors. - 4 places X&Y
- Axial shift monitors. - 2 places
- Turbine casing differential expansion monitor
- Turbine casing overall expansion monitor
- The system shall be complete with non-contact type pickups, proximeters, analog monitors (BN3500 or similar) and isolated 4-20 mA output signals for remote indication. The analog monitors shall be complete with high and very high alarm and trip indications and relay outputs for the same.
- Necessary turbine interface, initiating devices etc. as required to ensure proper functioning of the generator protections and interlocking system.
- Turbine local gauge board on skid.

#### **4.10. CIVIL & STRUCTURAL WORKS**

- All anchoring facilities for the turbine, gear box and generator, heaters, turbine sole plate, foundation bolts, jack bolts, levelling screws etc.
- All embedded parts, pipe inserts requiring machining, threading, tapping etc.
- All embedded steel, pipe inserts for STG foundation.
- All structural steel works for main columns, auxiliary columns, platforms, walkways, stairs, handrails, duct supports etc.
- Supply, fabrication and erection of all required support steel columns and steel work for steam turbine and auxiliaries (RCC foundation base pedestal / foundations upto a height of 300mm above grade level will be provided by Purchaser).

#### 4.11. SPARE PARTS, SPECIAL TOOLS & TACKLES, LUBRICANTS & CONSUMABLES

- Mandatory O & M Spares sufficient for Two (2) years of normal trouble free operation for the unit
- In addition to the above spares, the Vendor shall also supply spare parts (commissioning spares) along with the main equipment as per his experience, for replacement of damaged or unserviceable ones during the execution of the project at site for start up to avoid delay in the project schedule.
- A set of special tools & tackles required for operation and maintenance shall be supplied by the vendor.
- Required quantity of flushing oil, together with first fill of oil and / grease for all parts of equipment requiring lubrication shall be provided by Vendor.
- Supply of consumables chemicals, oil etc required for commissioning and performance testing shall be included in the scope and the same shall be supplied by the vendor after the award of contract at appropriate time.
- The idea of having required spares along with turbine generator set is to facilitate Pre commissioning and commissioning as well as performance guarantee period to avoid unwanted stoppages. As such a list of such spares is to be provided besides the following mentioned items.
- Commissioning spare list to be provided by turbine vendor.

#### 4.12. MISCELLANEOUS SUPPLIES

Material handling equipment consisting of monorails, trolleys, handling equipment with all ancillaries including supporting structures etc. as required shall be provided for maintenance.

#### 4.13. LIST OF BOUGHT OUT ITEMS MAKES

Item / Equipment Name	Vendor Name
<b>MECHANICAL</b>	
Gear Box	Triveni /Flender
Ejector	Mazda
Lube oil system	Southern Lub./ Enpro
High pressure valves	L & T / KSB

Low pressure valves	BDK / Fluidline / Steelstrong
Control valves	Mazda / MIL / Forbes Marshall
Steam traps	Pennant / Spirax Marshall
Thermal insulation	Lloyds / National Ins. / Baroda Ins.
<b>ELECTRICALS</b>	
Alternator	TDPS/BHEL/Siemens /VA Tech / Leroy Somer
Relay and control panel	E.I.C. / AREN
CTs and PTs	Pragati / Kappa
LAPT	E.I.C. / Power Gear / NES / Ampcontrol Equipment Pvt. Ltd.
NGR	Resitech Electricals/ Vee Vee Controls/ Ampcontrol Equipment Pvt. Ltd.
Relays	Alstom / ABB / Siemens/
Meters	Rishabh / Conzerv/AE/Secure/
<b>INSTRUMENTATION</b>	
Transmitters	ABB / Rosemount / Yokogawa / honeywell / E & H
Pressure and temperature gauges	Wika / GIC / Waree / Forbes Marshall
Pressure switches	Switzer / Indfoss / Vermatrafag / Danfoss / Wika / Ashcroft
Level gauge / switch	V. Automat / Bliss Anand / Emerson / Magnetrol
RTD / Thermocouple	Pyrotech / Waaree / GIC / Emerson / ABB / Tempsens
Annunciators	Proton / Minilec / ICC
Vibration probes	Bently Nevada

Solenoid valves	Rotex / Aquila / Schneider / Parker
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## 5. SCOPE OF SERVICE

- Furnishing of all engineering data / drawings / documents for the review of ESSEL Purchaser / Consultant as well as those required for interface engineering.
- Mechanical Run Test of the Steam Turbine as per API 612
- Supervision of erection, commissioning, trial operation and guarantee performance testing of the complete turbine generator with auxiliaries and accessories as per PTC - 6S.
- Training of the ESSEL's operating personnel, in operation and maintenance of the equipment / systems offered.
- Common equipment services (to be included in the corresponding supply item).
- All necessary noise prevention measures as required.
- Complete painting including corrosive protection and prevention measures.
- Complete detailed labelling of all installations.
- All necessary couplings and coupling guards.
- All necessary venting and draining equipments.
- All necessary piping, fittings, safety devices, fasteners, supports etc. within the Vendor's scope of work.
- All necessary base frames, base plates, anchor bolts, supports, covers etc.
- All necessary equipments to comply with safety requirements.
- All standard equipment and accessories normally included in the STG package scope but not specifically listed herein.
- IBR approval for relevant equipment / piping at manufacturer's works / Site.

## 6. TERMINAL POINTS

### 6.1. MECHANICAL

Live steam - At the inlet flange of turbine.

Cooling water - Inlet and outlet flanges of cooling water connection oil coolers and generator air coolers.

Gland steam - As shown in enclosed P&ID.

(Auxiliary PRDS in vendor's scope)

Instrument Air - At 1 m near the consuming point. Instrument air manifold

shall be in package vendor scope.

Drains - Drain lines after the collection funnel terminated at suitable point within TG hall ground floor (All integral drains as per TDP are included in vendor's scope, to be routed to condenser).

Vents - Vent lines after vent valves above the STG building roof at minimum 3M height.

Exhaust steam - Outlet of turbine counter flange

Aux. steam for air - One point in STG building (As per enclosed PID)

Evacuation

Turbine Extraction Steam

For Deaerator - Turbine outlet flange (bleed) (As per P&ID)

Note: All the counter flanges, fasteners and gaskets for all the terminal flange connections shall be supplied by the vendor.

## 6.2. ELECTRICAL

Refer Clause 4.8 Electrical System.

## 6.3. INSTRUMENTATION & CONTROL

For interfaces to other system not covered in this contract, 4-20 mA isolated signals or potential free contacts as required at Vendor's panel. Turbine supervisory and governing system shall have one no. RS-232 / 485 PORT for communication with DCS. The PROTOCOL shall be MODBUS RTU.

In addition to this, Communication protocol shall match with DCS available communication protocol. Vendor should have suitable provisions; requirement shall be confirmed upon DCS Order finalization.

For areas where instruments covered under this contract and piping by others, STG Vendor's scope shall include root isolation valves.

## 7. SUPPLIES AND SERVICES BY PURCHASER

Cooling water at Inlet and outlet flanges of cooling water connection of oil coolers and generator air coolers.

U.P.S 230 V A.C

110 V DC power supply and DC distribution boards.

415 V, 3 Ø, 50 Hz auxiliary power.

For electrical system refer clause 4.8

## 8. QUALITY ASSURANCE AND TESTING

Steam turbine and generator shall be tested at manufacturer's works for mechanical-full speed no-load run test with job bearings and job governor. In addition, the over speed run test at 120% of rated speed shall also be conducted.

In general, the inspection and testing of the turbine generator and various material tests certificates shall be guided by the Vendor's QA Plan (Shop QA & Field QA separately) to be duly approved by the ESSEL / Consultant.

### Site Performance Tests

Vendor shall conduct the performance guarantee test as per IEC 1953 – Part-II & FQAP mentioned above. All instruments required as per agreed performance test codes for performance testing of various equipment covered in this specification shall be arranged by the STG vendor at no extra cost to ESSEL. The test instruments may be taken back by the STG supplier only after satisfactory completion of tests. Stubs, thermowell, tapplings, etc., required for performance testing of steam turbine generator, instrumentation system, electrical equipment, etc. shall be provided as required. Commissioning spares if any shall be separately mentioned identifying instrument for Performance guarantee test.

Instrument accuracies for performance guarantee testing shall be as follows:

Barometer Pressure	:	± 1%
Pressure Indicator	:	± 0.3%
Pressure Transmitter	:	± 0.2%
Temperature Element	:	± 0.4%
Temperature Indicator	:	± 0.3%
Flow Element	:	± 0.5%
Differential Pressure Transmitter	:	± 0.2%
Flow Totalizer	:	± 0.36%
Flow Indicator	:	± 0.36%
KWH meter	:	± 0.2 S class
Recorder	:	0.5 class
Potential transformer and current transformer	:	0.2 class

All special instruments supplied by Vendor exclusively for PG test shall be calibrated by the vendor before and after the test in a reputed international institute as approved by the

Purchaser. These calibrations shall be performed in the presence of the Owner/ESSEL. All calibration results shall be made available prior to the test.

The instruments required for the performance guarantee testing shall be brought by the vendor and taken back after the testing.

Performance test tapping points for the measurement of pressure, flow and level shall be terminated with suitable reducer and nipple with screwed plug after double root valves on high pressure system or single root valve on low pressure system by Vendor.

**Q A Plan**

EQUIPMENT DESCRIPTION	TESTS
Complete assembled turbine	<ol style="list-style-type: none"> <li>1. Visual &amp; dimensional checks</li> <li>2. No-load run test &amp; functional check on safety devices</li> <li>3. Vibration check</li> <li>4. Noise level check</li> <li>5. Open inspection &amp; dynamic rotor balancing (after no-load run test)</li> </ol>
Ejector	<ol style="list-style-type: none"> <li>1. Visual &amp; dimensional checks</li> <li>2. Operational &amp; functional tests</li> </ol>
GVC with air blower	<ol style="list-style-type: none"> <li>1. Visual &amp; dimensional checks</li> <li>2. Operational &amp; functional tests</li> </ol>
Complete assembled generator	<ol style="list-style-type: none"> <li>1. Visual &amp; dimensional checks</li> <li>2. OCC &amp; SCC test</li> <li>3. Over speed test</li> <li>4. Vibration check</li> <li>5. Noise level check</li> <li>6. HV test</li> <li>7. Measurement of winding resistance and insulation resistance</li> <li>8. Measurement of shaft voltage</li> </ol>
LAPT panel / NGR panel /AVR panel / Relay panel / Met. cum synch. panel / TCP / Aux. MCC	<ol style="list-style-type: none"> <li>1. Visual &amp; dimensional checks</li> <li>2. Operational &amp; functional tests</li> <li>3. HV test</li> <li>4. Measurement of insulation resistances</li> </ol>
Turbine Gauge Panel	<ol style="list-style-type: none"> <li>1. Visual &amp; dimensional checks</li> <li>2. Range calibration</li> </ol>
Instruments	<ol style="list-style-type: none"> <li>1. Visual &amp; dimensional checks</li> <li>2. Operational &amp; functional tests</li> <li>3. Range calibration</li> </ol>

**NOTE:** 1. Material test certificates from manufacturers shall be submitted for major components of turbine and other bought-out items along with supply.

The Steam Turbine offered shall fully comply with the design standards mentioned in the specification and also as per the Attachments mentioned in the above table.

## 9. PERFORMANCE LOADING FOR BID EVALUATION

The following figures shall be considered for determining the net bid price for unit of 6.0 MW owing to variations in the parameters quoted by the vendors.

Sr.No.	Description	Price Loading
1.0	For every One (1) Tonne/Hr increase in steam consumption	To be decided by PIPL
2.0	For every One (1) kW differential <b>auxiliary power consumption</b> (based on the lowest quoted value)	To be decided by PIPL

### PRICE ADJUSTMENT FOR SHORTFALL IN PERFORMANCE

Vendor shall provide guaranteed performance for the entire steam turbine generator package in the format given in this specification and the values provided therein shall be binding on him. The performance guarantee test shall be conducted within a mutually agreed period from the date of completion of trial operation and provisional take over by ESSEL.

Vendor shall ensure that the steam turbine generator units and auxiliaries meet the guaranteed parameters.

Should Vendor not be able to improve the plant performance to meet the above mentioned guaranteed parameters then the total contract price will be adjusted as follows:

Sl.No	Description	Price reduction applicable
1	For every one (1) kW by which the <b>gross power output</b> of the turbine generator falls below the guaranteed value indicated in the Schedule of Guarantees, Schedule 5.0	To be decided by PIPL
2	For every One (1) TPH increase in <b>inlet steam consumption</b> from the guaranteed value indicated in the Schedule of Guarantees, Schedule 5.0	To be decided by PIPL
3	For every one (1) kW by which the <b>auxiliary power consumption</b> is in excess of the guaranteed value indicated in the Schedule of Guarantees, Schedule 5.0	To be decided by PIPL

**Maximum permissible shortfall in guarantee parameters beyond which the equipment is liable for rejection are as follows:**

Shortfall in guaranteed power generation	:	500 kW
Shortfall in guaranteed heat rate at 100% MCR	:	25 kcal/kWhr
Excess auxiliary power consumption	:	10 kW

If the reduction in the total value of Contract Price on account of shortfall in performance exceeds 10% of Total Contract Price then the ESSEL retains the right to reject the entire equipment. Prior to exercising such option, Vendor will be given reasonable opportunity to carryout the necessary repair work or replacement with new equipment at his own expense and risk, (a reasonable time period of 2 months), to prove the guaranteed performance of his supplied equipment to meet this specification requirements.

## 10. TEST / INSPECTION

Vendor to submit the QA / QC plan, inspection & test plan for review and approval of Buyer.  
Vendor shall test Turbine with auxiliaries' performance to meet the performance guarantee figures specified in the enclosed Data Sheet.

## 11. GUARANTEE

Vendor to submit the QA / QC plan, inspection & test plan for review and approval of Buyer.  
Mechanical guarantee shall be for proper design, workmanship and material of construction for all fabricated items, bought out items and the complete package to be supplied by vendor.  
Vendor shall stand guarantee for a period of 12 months from commissioning or 18 months from supply, whichever is earlier.

Life of the turbine shall be 20years based on regular operation and maintenance, the guarantee an availability of at least 8500 working hours per year

Performance Guarantee shall include, but not limited to the following:

Turbine Exhaust	:	Multistage extraction cum condensing, Top
Turbine speed	:	Specified
Gear box output speed	:	1500 RPM

### Performance

Turbine Inlet Steam Pressure	:	44.6 bar (a)
Turbine Inlet Steam Temperature	:	408o C
Turbine Inlet Steam Flow	:	28.1 t/h (as per HMBD)
Turbine bleed Pressure for deaerator	:	2.735 Bar (a) (as per HMBD)
Turbine bleed steam flow for deaerator	:	3.3387 t/h (as per HMBD)
Turbine Exhaust steam Pressure	:	0.135 Bar
Electrical Output at Generator terminals	:	6000 KW

@ 11 KV, 50 Hz

### **Constructional Guarantees**

The Supplier guarantees the quality of design and construction, the quality of materials and components for a two year period starting from the preliminary taking over of the plant.

All defects occurring during the specified guarantee period which are provably attributable either to defective material or to improper design and construction, or to any other faults ascribable to the Vendor, shall be remedied by the Vendor free of charge and within a reasonable period of time.

### **12.NOISE LEVEL**

The sound pressure level inside the STG building shall not exceed 85 dB(A) when all equipment is running at MCR. This level will be measured in one (1) meter distance from any point of the equipment.

### **13.SURFACE PREPARATION & PAINTING**

Vendor to submit the QA / QC plan, inspection & test plan for review and approval of Buyer.

Surfaces to be painted shall be thoroughly cleaned with suitable solvent for oil, grease removal and sand blasted giving a clear dry and rust free surfaces. Two coats of suitable primer of 35 micron DFT each shall be applied prior to applying two coats of final epoxy paint totalling 150 micron DFT on all CS parts. The shade shall be as per Vendor's standard practice. In case of any specific requirement of shade from Client, same will be intimated during the evaluation.

Surface preparation, supply and application of paint to all equipment and accessories, uninsulated piping and structural steel work as per details specified. The colour schemes shall be based on Indian Standard and shall be approved by Purchaser before application of painting.

### **14.WORK SCHEDULE**

The entire scope of work (supply, erection & commissioning) specified shall be completed within a time frame of 8 (eight) months from the date of LOI.

The Performance "Guarantee Testing" shall be conducted, within a reasonable period from **TRIAL OPERATION**, which may be agreed upon mutually.

**SCHEDULE- 1****SCHEDULE OF AUXILIARY POWER & UTILITY CONSUMPTION**

The Vendor shall furnish below the following utility and auxiliary power requirements, for Purchaser's review/Approval along with the bid.

<b>SL. No.</b>	<b>Description</b>	<b>Consumption</b>	<b>Site Condition</b>	<b>Remarks</b>
1.	Auxiliary Power details			
2.	Construction Power Requirement			
3.	Construction water Requirements			
4.	Any other consumables as required			







### SCHEDULE- 5

#### SCHEDULE OF PERFORMANCE GUARANTEE

Vendor shall guarantee the following performance parameters at design condition

Parameter	Units	<b>Base Load operation</b> <b>At Site Reference condition</b> <b>(GUARANTEED)</b>

**SCHEDULE- 6****SCHEDULE OF WEIGHTS & DIMENSIONS FOR SHIPPING**

Vendor to indicate the details of each shipment, no of shipments and the dimensions of each shipment so as plan the transportation vendor by the owner.

<b>SL no</b>	<b>Transporting unit</b>	<b>Dimension in 'mm' (LXBXH)</b>	<b>Weight in 'kg'</b>

**Signature & Seal of the Vendor**

**SCHEDULE- 7****SCHEDULE OF START-UP & COMMISSIONING SPARES**

The Vendor shall indicate the quantum of Start-up & Commissioning spares, as required for the plant included by him in his Scope of supply.

<b>SL. No.</b>	<b>Manufacturer &amp; Part No.</b>	<b>Description</b>	<b>Quantity Included in offer</b>	<b>Remarks</b>

**Signature & Seal of the Vendor**



**SCHEDULE- 9****SCHEDULE OF RECOMMENDED SPARES**

The Vendor shall give a list of spare parts recommended for ten years of trouble-free performance of the equipment offered by him in the format given below.

<b>S L N O</b>	<b>Manufacturer &amp; Part No.</b>	<b>Description</b>	<b>Qty. per Unit/ eqpt.</b>	<b>Qty. Recommended</b>	<b>Remarks</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>9</b>

**Signature & Seal of the Vendor**

**SCHEDULE- 10**

**SCHEDULE OF SPECIAL TOOLS & TACKLES**

The Vendor shall give the list of special tools and tackles offered by him in the format given below.

SL. No.	Particulars including Part No.	Quantity Required

**Signature & Seal of the Vendor**

**SCHEDULE- 11****SCHEDULE OF DEVIATIONS FROM TECHNICAL SPECIFICATIONS**

All deviations from the Technical Specification shall be filled in by the Vendor clause by clause in this schedule

<b>SL. No.</b>	<b>Section &amp; Clause no.</b>	<b>Deviation Taken</b>	<b>Reason for Deviation</b>

The Vendor hereby certifies that the above mentioned are the only deviations from the Specifications of this enquiry.

**Signature & Seal of the Vendor**

**SCHEDULE- 12****SCHEDULE OF DEVIATIONS FROM GENERAL & COMMERCIAL SPECIFICATIONS**

All deviations from the General & Commercial Specification shall be filled in by the Vendor clause by clause in this schedule.

<b>SL. No.</b>	<b>Section &amp; Clause no.</b>	<b>Deviation Taken</b>	<b>Reason for Deviation</b>

The Vendor hereby certifies that the above mentioned are the only deviations from the Specifications of this enquiry.

**Signature & Seal of the Vendor**

**15. TECHNICAL DATA SHEET TO BE FILLED BY VENDOR**

Technical Parameter	Value
Turbine Speed (RPM)	
Gear box output speed (RPM)	
Inlet Steam Pr. ata	
Inlet Steam Temp. (0 C)	
Inlet Steam Flow (TPH)	
Exhaust Pressure (Ata)	
Max Exhaust Flow (TPH)	
Bleed Steam for deaerator (ata)	
Bleed Steam for deaerator (TPH)	
Bleed Steam for HP heater (ata)	
Bleed Steam for HP heater (TPH)	
Rated Power (kW)	
<b>Noise level</b>	
Max. vibration velocity at bearing housing (Vrms) Mm/sec s	
Maxm noise level at 1.0 m (db)	
<b>STEAM TURBINE</b>	
<b>Design Details</b>	
Type	
Rotor type	
Casing	
Shaft seal	
No. of governing valves	
Dimensions in mm.	

<b>Base Plate OR Sole Plate</b>	
Steam Turbine	
Gear Box	
Generator	
HP Heater	
<b>Foundation bolts and Shims</b>	
<b>Extraction arrangement</b>	
Type of NRV	
Safety valve	

Technical Parameter	Value
Desuperheater	
<b>Bleed arrangement</b>	
Type of NRV	
Safety valve	
<b>ESV</b>	
Type	
All matching flanges	
MOC of strainer	
<b>Journal Bearings</b>	
Type	
Material	
Quantity	
<b>Thrust Bearings</b>	
Type	
Material	
Quantity	
<b>Governor:</b>	
Type	
Model	
Inputs (critical)	
Control range	
Control accuracy	
Speed droop	
Power supply	
Accessories	
<b>Hydraulic Accumulator:</b>	

Type	
Working fluid	
Capacity	
<b>Insulation</b>	
<b>PROTECTION FUNCTIONS</b>	
Overspeed Trip	
Low lube oil pressure trip:	
Low control oil pressure trip	
<b>Technical Parameter</b>	<b>Value</b>
High thrust wear trip:	
High exhaust pressure trip	
Hand trip	
Operation	
Solenoid trip:	
Operation	
Electronic Over speed trip	
Mechanical Over speed trip	
Governor Emergency trip	
Axil Shift	
Vibration High	
Lube oil pressure LOW LOW	
Control oil pressure LOW LOW	
Vacuum LOW LOW	
Manual Trip	
Remote Trip	
Bearing Temp. High High	
Main steam Temp LOW LOW	

Main steam Temp High High	
Main steam Pr. LOW LOW	
Main steam Pr. High High	
<b>GEAR BOX</b>	
<b>Design:</b>	
Type	
Input / Output speed (rpm)	
Service Factor	
Accessory	
Ratio	
<b>Barring gear:</b>	
Type	
Driver	
Hand barring arrangement	
<b>COUPLINGS</b>	
High Speed Coupling	
Low Speed Coupling	
<b>Lubrication &amp; Control Oil system:</b>	
Governing oil pressure (kg/cm <sup>2</sup> g)	
Lube oil pressure (kg/cm <sup>2</sup> g)	
Oil type	
<b>Technical Parameter</b>	<b>Value</b>
<b>Oil Reservoir:</b>	
MOC	
Capacity(lt.)	
Retention time (min)	
Oil quantity for initial fill and flushing (lt)	
<b>Overhead Oil Tank- MOC</b>	

Capacity	
Driver	
<b>Main oil pump :</b>	
Type	
Operating speed (rpm)	
Capacity (Lt/min)	
Driver	
Material of drive gear	
Discharge pressure (ata)	
<b>Auxiliary oil pump :</b>	
Type	
Capacity (Lt/min)	
Discharge pr.( V)	
Operating speed (rpm)	
Driver (KW)	
Material of body	
<b>Control oil Pump</b>	
Type	
Operating speed (rpm)	
Capacity (Lt/min)	
Driver	
Material of drive gear	
Material of body	
Discharge pressure (ata)	
<b>Emergency oil pump</b>	
Type	
Capacity (Lt/min)	
Discharge flow (lt/min)	

Operating speed	
Driver (KW)	
Material of body	
Material of rotor	
Material of drive gear	
<b>Technical Parameter</b>	<b>Value</b>
<b>Lube Oil cooler</b>	
Design code	
Oil inlet / Out let temperature (°C)	
Change over arrangement	
Tube material	
Plugging margin	
Oil flow Capacity (Lt/min)	
Mounting	
Inlet temperature gauges & RTD's	
<b>Lube oil filter</b>	
Type	
Element type	
Oil filtration (micron)	
Oil flow Capacity (Lt/min)	
Mounting	
Redundancy	
<b>Oil Vapour Extractor:</b>	
Type	
Element	
Driver	
Oil flow Capacity	
<b>Oil Pr. Adjusting valves</b>	

Qty.	
<b>Oil Filter</b>	
Element Type	
Oil flow Capacity (Lt/min)	
Oil filtration (micron)	
<b>MOC of Oil Piping</b>	
From Pumps to filters	
From Filters to bearings	
From Bearings to reservoir	
<b>Turbine connection will provide</b>	
Inlet Steam	
Extraction steam	
Exhaust steam	
Noise level	
Approx. Dimensions of turbine (including gearbox) in mm	
<b>Weights (Approx.)</b>	
Weight of rotor	
Weight of upper half casing	
Weight of gearbox	
Weight of base plate	
<b>Technical Parameter</b>	<b>Value</b>
Weight of turbine(including Gearbox)	
<b>GLAND SEAL SYSTEM</b>	
Steam pressure	
<b>Gland vent condenser</b>	
Design code	
Type	

Tube material	
Shell & end cover material	
Blower	
Driver for air blower	
<b>AC GENERATOR</b>	
<b>Design:</b>	
Type	
Rated/Active output (kW)	
Apparent Output	
Rated voltage (V)	
Rated current (amp.)	
Rated frequency (Hz)	
RPM	
No. of poles	
Combined variation of voltage and frequency	
Rated p.f.	
No. of phases	
No. of terminals	
Connection	
Short circuit ratio	
Ambient temperature	
Excitation	
Cooling method	
Insulation	
Temperature rise	
Type of protection	

Technical Parameter	Value
Duty	
Noise level (db)	
Reference standard	
Generation voltage	
Harmonic loading	
LT cables	
LPBS and all cables	
Earthing	
Drives operatable from DCS	
KWh meter	
Auto Synchronizer	
Design Ambient temp.	
<b>Air coolers:</b>	
Cooler tube material	
Mounting	
Cooling water inlet / outlet temp (Deg C)	
Cooling method	
Capacity	
<b>AVR CUM EXCITATION PANEL</b>	
<b>Design:</b>	
Control type	
Control modes	
Make	
Voltage adj. Range	
Regulation/Control Accuracy	
Dead time	

Setting range of reactive current droop	
<b>Features:</b>	
Compounding	
Auto PF controller	
Remote voltage control	
Auto-Manual follow-up	
Under frequency protection	

Technical Parameter	Value
Field flashing provision	
Complete with generator voltmeter, field voltmeter, field ammeter, PF meter, null meter, Auto/Manual selector switch, AC supply & DC supply on /off control switches, indicating lamps and space heater with thermostat.	
<b>GENERATOR PROTECTION AND METERING PANEL</b>	
Numeric Relay for generator protection:	
<b>DESCRIPTION</b>	
Under voltage protection relay	
Reverse active power protection relay	
Loss of excitation (Field failure) protection relay	
Auxiliary relays & timers for loss of excitation protection relay	
Negative phase sequence protection relay	
Voltage controlled over current protection relay	
Over voltage protection relay	
Timer for over voltage protection relay	
Over current protection relay	
PT fuse failure sensing relays	

Stator earth fault protection relay	
Rotor earth fault protection relay	
DC supply supervision relay	
Under & over frequency protection relay	
Differential protection relay	
Generator master trip relay	
Turbine master trip relay	
Thermal Relay	
Dead Bus Sensing relays	
Panel Type	
Dimensions in mm	
Weight (kg)	
<b>Meters</b>	
Type	
System	
Reference standard	
Ammeters	
<b>Technical Parameter</b>	<b>Value</b>
Voltmeter	
KW meter-Active Power	
KVA meter	
KVAR / MVA <sub>r</sub> meter	
Kwh (Energy) meter	
PF meter	
Frequency meter	
Trivector meter (tvm)	
Kilowatt Transducer	
<b>GENERATOR CONTROL</b>	

<b>(Synchronising panel)</b>	
<b>Synchronising equipment</b>	
Double voltmeter	
Double frequency meter	
Synchroscope	
Check synchronizing Relay/SKE relays	
Aux. relays for Synchronising scheme	
Synchronizing Auto/manual selector switch	
The panel shall be complete with synchronizing selector switches, breaker control (T/N/C) switches, push buttons, AC supply & DC supply on /off control switches, indicating lamps and panel space heater with thermostat	
Panel Type	
Dimensions in mm	
Weight (kg)	
<b>LA,SC &amp; PT PANEL</b>	
<b>Lightning arrestor</b>	
Discharge current	
Quantity	
<b>Surge capacitor</b>	
Capacitance per phase ( micro farads)	
Quantity	
<b>Protection Transformers</b>	
Protection	
Metering	
Excitation	

Panel Type	
Terminal box	
Material of busbars	
Dimensions in mm	
Weight (kg)	
LAPT	
NGR panel shall house the following:	
<b>Technical Parameter</b>	<b>Value</b>
Relays	
Meters	
Motors	
<b>NEUTRAL GROUNDING RESISTOR PANEL</b>	
NGR panel shall house the following:	
<b>Resistor</b>	
Type	
Rated current (A)	
Duty rating (sec)	
Resistor grid type	
Temperature rise (°C)	
Mounting & fixing of Resistor units	
<b>Neutral isolator</b>	
Operation	
No. of poles	
Limit switches	
<b>Earth connection</b>	
Type	
Quantity	

<b>Current Transformers</b>	
Generator Protection	
Differential Protection	
Earth Fault Protection	
Metering	
Compounding	
Panel Type	
Terminal box	
Material of busbars	
Dimensions in mm	
Weight (kg)	
<b>BATTERY</b>	
Type	
Capacity	
Rating	
Volt per cell	
No. of cells	

Technical Parameter	Value
<b>DC distribution system</b>	
Panel shall be provided with feeders for:	
DC motor starter panel	
Relay panel	
Generator control panel	
AVR cum excitation panel	
Turbine control panel	
PCC	
Spare	
<b>General</b>	
Type	
Dimensions in mm	
Weight (kg)	
<b>AC Motors</b>	
Type	
Winding connection	
Technical Parameter	Value
Duty	
Enclosure	
Cooling	
Insulation	
Power supply	
Speed/no of plates	
<b>DC Motors</b>	
Type	
Duty	

Enclosure	
Cooling	
Insulation	
Power supply	
Speed	
<b>TURBINE CONTROL PANEL(Governor Panel)</b>	
- Electronic governor with keyed-in operating program	
- Condenser hotwell level indicator cum controller	
- Relay based hard wired turbine safety interlocks and trip logic	
- Remote controls comprising of selector switches, ammeters, push buttons & indicating lamps for:	
· AOP motor	
· EOP motor	
· Barring gear motor	
· Air blower motor	
· Vapour extractor motor	
- Push buttons for turbine speed raise and lower	
- Turbine remote trip/reset push buttons	
- Temperature scanner for Monitoring turbine and gearbox bearing temperature	
- Alarm annunciator for Turbine fault monitoring	
<b>TURBINE GAUGE PANEL</b>	
Turbine RPM - Local	
<b>Pressure gauges for:</b>	

Inlet steam before & After ESV	
HP Wheel case	
Bleed Steam	
<b>Technical Parameter</b>	<b>Value</b>
Exhaust steam	
Lube oil	
Control oil	
<b>Temperature gauges for:</b>	
Inlet steam	
Bleed steam	
Exhaust steam	
<b>DC MOTOR (EOP) STARTER PANEL</b>	
DC motor starter panel shall house the following:	
Incoming feeder complete with switch-fuse unit, voltmeter, ammeter and indicating lamps	
2 step resistance starter for EOP motor complete with switch-fuse unit, contactor, overload relay, ammeter, indicating lamps & pushbuttons.	
<b>TURBINE AUXILIARY MCC</b>	
Incoming feeder complete with switch-fuse unit, voltmeter, CT operated ammeter, indicating lamps & bus bars	
DOL starter complete with switch-fuse unit, contactor, overload relay, CT operated ammeter, indicating lamps & pushbuttons for :	
AOP motor	
Barring gear motor	
Vapour extractor motor	

Turbine speed indicator and speed raise / lower push buttons	
<b><u>Local push button station</u></b>	-
· AOP motor	
· EOP motor	
· Barring Gear motor	
· Air blower motor	
Vapour extractor motor	
<b>Instrumentation (Compitable to hook up with DCS)</b>	
<b>Turbine &amp; Steam Piping</b>	
RPM meter	
PT- 01 no at main steam line before ESV	
TE- 01 no at main steam line before ESV	
PT- 01 no at both bleed lines	
<b>Technical Parameter</b>	<b>Value</b>
TE- 01 no at both bleed lines	
PT- 01 no at ist stage wheel pr.	
TE - for casing temp.(Top & Bottom both)	
Flow nozzle at inlet steam line	
Flow nozzle at Extraction steam line	
RTD at Bearings	
Axial Shift measurement	
Vibration probes.	
<b>Gear Box</b>	
RTD at Bearings-04 nos.	
Vibration probe - 8 nos	
<b>Generator</b>	

RTD for winding temps 06 nos	
RTD for bearing temps	
Vibration probes 04 nos	
TE for hot and cold air temp.	
<b>Lube Oil System</b>	
Level switch for Main oil Tank	
DPT for lube oil filters	
PT at discharge header	
TE Before the cooler	
TE after the cooler	
PS for auto start/ stop of AOP	
PS for auto start of EOP	
DPT for Control oil filters	
Pr. switch at Control oil header	
PT at Control oil header	
PT after CPC	
Set of pr. & Temp. Gauges	
<b>Condensate System</b>	
Control Valves - 2 nos.	
PT at turbine exhaust	
Pr. Switch at turbine exhaust	
TE at turbine exhaust	
LT for condenser	
Level switch for condenser	
Flow orifice in condensate line	
TE in gland steam line	
PT in gland steam line after CV	
<b>Technical Parameter</b>	<b>Value</b>
Set of pr. gauge, Temp. Gauge and level gauge for all the systems for local indication.	

<b>Utilities</b>	
Gland sealing steam	
Ejector steam	
Cooling water	
Instrument air	
<b>LIST OF TOOLS AND TACKLES</b>	
All LT cabling	
control and instruments cables	
Complete Earthing and earth pits	
TG MCC	
ACDB	
DCDB	
Oil Centrifuge	
Auto synchroniser	
LPBS	
Vibration monitoring system	
Overhead oil tank	
Steam Flow Meters	
Flushing and first fill of oil	
Erection of equipments	
Unloading and storage	
Statutory Approvals	
<b>GENERAL SPECIFICATIONS OF INSTRUMENTS</b>	
<b>Pressure and Temperature Gauges</b>	
Dial	
Scale	
Type	
Accuracy	

Over range protection	
Accessories	
<b>Pressure Switch</b>	
Sensor type	
Material of case	
<b>Technical Parameter</b>	<b>Value</b>
Material of bellows	
All Transmitters	
Pr. & Temp. Gauges	
Pressure switches	
Level gauge / Switches	
RTD /Thermocouple	
Annunciators	
Vibration Monitoring system	
Over speed module	
<b>Pressure Transmitter</b>	
Type	
Input	
Output	
Material for process connection internals	
<b>Resistance Temperature Detectors:</b>	
Element type	
<b>Solenoid Valve</b>	
Power supply	
Operation	
Vacuum breaking valve	
Type	

<b>Level Switch</b>	
Type	
Material of body & float	
Material of case	
<b>Level Transmitter</b>	
Type	
Input	
Output	
Material for process connection internals	
<b>Level Control Valve</b>	
Type	
End connection	
Actuator type	
Packing material	
Plug characteristic	
Plug material	
Seat ring material	
Diaphragm material	
Stem material	
Yoke material	
Action	
Accessory	
<b>Technical Parameter</b>	<b>Value</b>
<b>Level Indicating Cum Controller</b>	
Type	
Input	
Output	
Input & output display	

Power supply	
<b>Current to Pneumatic Converter</b>	
Supply	
Input	
Output	
Enclosure	
Accessory	
<b>Temperature Scanner</b>	
Power supply	
Input	
Display	
Display mode	
Scan rate	
Accuracy	
<b>Alarm Annunciator</b>	
Type	
Input protection	
Colour of window	
Power supply	
Fault initiation	
Accessories	
<b>Air Filter Regulator</b>	
Filter element	
Element material	
Body material	

## 16. ATTACHMENTS

Vendor shall refer & confirm full compliance to the following project specifications (including additional codes mentioned in respective specifications), datasheets, which form an integral part of this specification.

<b>Sr. No.</b>	<b>Description</b>	<b>Document No.</b>
1	P&ID for Steam system 1(2)	CIT-EIPL-KDP50006
2	P&ID for Steam system 2(2)	CIT-EIPL-KDP50007
3	Water analysis for Kadapa plant	-
4	Motor data sheet	Vendor to provide
5	Vendor Document Requirement & Schedule (VDRS)	-
6	Deviation List format (Vendor to fill-up & return with the offer)	-
7	11kV Generator Single Line Diagram	CIT-EIPL-KDP80094

**ANNEX - 1.1****SITE CONDITIONS**

Refer the below table for the site conditions for 330TPD Waste to energy project.

<b>1</b>	<b>Design Air Temperature</b>	<b>DEG. C</b>
	Anantpur	44
	Kadapa	38
	Thadepalligudem	42
<b>2</b>	<b>Relative Humidity</b>	<b>%</b>
	Anantpur	69
	Kadapa	69
	Thadepalligudem	80
<b>3</b>	<b>Plant Elevation from Mean Sea Level</b>	<b>m</b>
	Anantpur	350.5
	Kadapa	137.2
	Thadepalligudem	12.25

**ANNEX - 1.2****AVAILABLE UTILITIES****Service Air**

		<b>Min</b>	<b>Normal</b>	<b>Max.</b>
1	Pressure Kg/cm <sup>2</sup> (g)	-	6	-
2	Temperature °C	-	45	-
3	Dew Point			
4	Oil content		NIL	

**Instrument Air**

1	Pressure Kg/cm <sup>2</sup> (g)	-	7	-
2	Temperature °C	-	45	-
3	Dew Point (Atm)		(-) 40°C	

## Power

For Instrumentation / UPS 230 V +/- 10%, 1 Phase, 50Hz, AC

For interlocks and annunciation 24V DC +/-10%

### For motors

a) For 200 kW and below 415 V,  $\pm 10\%$  3 ph, 50  $\pm 5\%$  Hz

b) For above 200 kW 11 kV,  $\pm 10\%$  3 ph, 50  $\pm 5\%$  Hz

### ANNEX - 1.3

#### DRAWINGS, DATA / DOCUMENTS TO BE SUBMITTED AT VARIOUS STAGES

Sr. No.	Description	With Bid	During Detail Engg.		
			For Approval	For Info.	As Final
	<b>GENERAL &amp; MECHANICAL</b>				
1.	Heat and mass balance diagrams for all the operating conditions at various loads <b>(Guarantee, Maximum, Minimum and 100 % dumping conditions)</b> .	Yes	Yes		Yes
2.	Process flow diagrams and piping and instrumentation diagrams for the various systems (steam / condensate system, drain system, oil system, oil purification system etc.).	Yes	Yes		Yes
3.	Duly filled-in technical data sheets and guarantee schedules as included under Section 7.0 to 8.0.	Yes	Yes		Yes
4.	General arrangement drawings of steam turbine generators and auxiliaries in the turbine building with overall dimensions TG foundation plan and preliminary loading data.	Yes	Yes		Yes
5.	Correction formulae or curves for guarantees.				
	- live steam pressure and temperature	Yes	Yes		Yes
	- Condenser vacuum	Yes	Yes		Yes

Sr. No.	Description	With Bid	During Detail Engg.		
			For Approval	For Info.	As Final
6.	Detailed description of turbine governing, lube oil, oil purification, turbine protection and control system within the scope.	Yes	Yes		Yes
7.	Performance Guarantee test instruments.	Yes	Yes		Yes
8.	Steam consumption curve with respect to turbine output matching with HMBD.	Yes		Yes	
9.	Regulation diagram along with governor characteristics like sec. oil pressure Vs. Steam flow, valve lift Vs. steam flow.			Yes	
10.	Max. Permissible magnitude of frequency of power and temperature jumps and gradients.	Yes		Yes	
11.	Dimensional drawings and sectional drawings of all equipment alongwith preliminary loading data.	Yes	Yes		Yes
12.	Quality Assurance Programme and detailed quality plan for all shop tests for the main equipment at manufacturer's works.	Yes			
13.	List of mandatory spares	Yes	Yes		Yes
14.	List of spare parts recommended for two (2) years trouble free operation.	Yes	Yes		Yes
15.	List of special tools and tackles for operation, maintenance, inspection and repair.	Yes	Yes		Yes
16.	List of consumables	Yes	Yes		Yes
17.	Detailed Bill of Material (BOM) clearly identifying the scope of supply and services.	Yes	Yes		Yes

Sr. No.	Description	With Bid	During Detail Engg.		
			For Approval	For Info.	As Final
18.	List of Instruments.	Yes	Yes		Yes
19.	Terminal point details.	Yes	Yes		Yes
20.	Piping layouts, isometric drawings, valve schedules etc.		Yes		Yes
21.	Piping and instrument diagrams for all media showing all related equipment	Yes	Yes		Yes
22.	Pipe line reference list (PLRL)		Yes		Yes
23.	Valve schedule		Yes		Yes
24.	Detailed drawings and dimensional drawings for the connection of condenser to the turbine.		Yes		Yes
25.	Detailed nozzle orientation drawings for hotwell		Yes		Yes
26.	Schedule of allowable forces and moments on various equipment battery limits.		Yes		Yes
27.	Thermal movement at turbine flanges		Yes		
28.	Startup and shut down diagrams and description.		Yes		
29.	Detailed testing and commissioning procedures		Yes		Yes
30.	Detailed erection scheme and sequence along with diagrams		Yes		Yes
31.	Detailed checklist for commissioning.		Yes		Yes
32.	Performance test procedures		Yes		Yes
33.	Operation and maintenance programme			Yes	

Sr. No.	Description	With Bid	During Detail Engg.		
			For Approval	For Info.	As Final
34.	Instruction manual for O & M in English along with recommended maintenance schedule.			Yes	
35.	Details of preventive maintenance programme			Yes	
36.	List of consumables.	Yes	Yes		
37.	Correction curves or formula for guarantees.	Yes	Yes		
38.	(a) Performance curves (b) Alternator capability curve	Yes	Yes		
	<b>Startup and shutdown curves for-</b>				
39.	Cold start condition (Greater than 36 Hrs. shutdown)	Yes	Yes		
40.	Warm start condition (Between 10 & 36 Hrs. shutdown)	Yes	Yes		
41.	Hot start condition (Less than 10 hours shutdown)	Yes	Yes		
	Note : These curves shall show starting from warm-up to MCR steam flow, steam pressure and temperature metal temperature of critical turbine parts.				
	Maximum permissible magnitude of frequency of power and temperature bumps and gradients.		Yes		
42.	Details of insulation		Yes		Yes
43.	Auxiliary power consumption break-up	Yes	Yes		Yes
44.	DCS input for TG		Yes		Yes
45.	Design calculations (process & mechanical) for all equipment in vendor's scope of work.		Yes		Yes

Sr. No.	Description	With Bid	During Detail Engg.		
			For Approval	For Info.	As Final
46.	Time schedule for design, manufacture, testing, delivery, erection and commissioning.	Yes	Yes		
47.	Price schedules.	Yes			
48.	Monthly Progress Report.		Yes		
49.	Steam and Water Quality Data	Yes	Yes		Yes
	<b>ELECTRICAL</b>				
1.	Load list of electrical consumers including power demand and voltage etc. including UPS and DC supply.	Yes	Yes		Yes
2.	Detailed description of the generator protection system.	Yes	Yes		Yes
3.	Generator characteristics diagrams, such as power chart, V-curves, no-loads and short circuit curves, efficiency curves, droop characteristics, under-frequency with stand capability.			Yes	Yes
4.	Detailed layout drawings of all equipment including auxiliary equipment, cubicles etc.		Yes		
5.	Terminal connection drawings for Generator & Auxiliaries		Yes		Yes
6.	Logic & control schematic diagrams for generator protection, measurement and interlocking system for all generator auxiliaries	Yes	Yes		Yes
7.	Design calculation for sizing protection CTs, PTs and Auxiliary Equipment.		Yes		
8.	List of manufacturers for bought out items and descriptive write-up.	Yes		Yes	

Sr. No.	Description	With Bid	During Detail Engg.		
			For Approval	For Info.	As Final
9.	Single line diagram of generator.	Yes	Yes		Yes
10.	Scheme of Brushless excitation system			Yes	Yes
11	Cable schedule & interconnection details for the interconnection between equipments under Vendor's scope of supply.			Yes	Yes
12	Cable schedule & interconnection details for interconnection between equipment under Vendor's and Purchaser's scope of supply			Yes	
13.	Input details of DC drive starter panel including sizing calculation		Yes		Yes
14	Cable tray requirement on and around TG deck			Yes	
15.	Details of local push button Station			Yes	
16.	Relay coordination & setting details		Yes		Yes
17	Relay catalogues (technical)			Yes	
	<b>INSTRUMENTATION</b>				
1.	Master Instrument index	Yes	Yes		
2.	Detailed specification for all I & C equipment with list of sub-vendors		Yes		
3.	Logic diagram for TG and auxiliaries interlock & protection			Yes	
4.	Schematic diagram and detailed description of turbine governing system			Yes	
5.	PLC system configuration and cabinet details.		Yes		

Sr. No.	Description	With Bid	During Detail Engg.		
			For Approval	For Info.	As Final
6.	Layout and details of all local and central control panels.			Yes	
7.	Control loop schematics & panel wiring drawings			Yes	
8.	Cable schedule and interconnection schedules for instruments in vendor's scope of supply.		Yes		
9.	Instrument installation drawings		Yes		
10.	Instrument air requirement			Yes	
11.	Instrument power requirement			Yes	

**Notes :-**

- 1) The time schedule for submission of documents during detail engineering shall be finalized during kick off meeting with the successful vendor after finalisation of order.
- 2) Soft copies of all the equipment and piping layout / isometric drawings during detail engineering stage shall be submitted by the vendor.



**ANNEX - 1.4**

Turbine process parameters													
Parameter	Unit	Boiler outlet			Turbine Inlet			Turbine exhaust (Note 1)			Turbine bleed (Note 1)		
		Minimum case	Operating Case	Maximum case	Minimum case	Operating Case	Maximum case	Minimum case	Operating Case	Maximum case	Minimum case	Operating Case	Maximum case
Pressure	Bar (a)	46	46	46	44.6	44.6	44.6	0.135	0.135	0.135	6	6	6
Temperature	° C	410	410	410	408	408	408	51.83	51.83	51.83	160	160	160
Steam flow	TPH	16.75	28.5	31.35	16.35	28.1	30.95	13.02	22.65	24.94	3.331	5.449	6.007
Enthalpy	kJ/kg	3227.9	3227.9	3227.9	3225.5	3225.5	3225.5	2352	2352	2352	2759	2759	2759

	Case	Minimum case	Operating Case	Maximum case
Dearator In from BLEED Pressure	Bar (a)	2.703	2.735	2.76
Dearator In from BLEED Temperature	° C	147.9	148	148.1
Dearator In from BLEED Flow	TPH	1.9383	3.3387	3.6856
Make up water flow	TPH	0.06	0.112	0.113
Make up water Press.	Bar (a)	4	4	4
Make up water Temp.	° C	32	32	32
SCAPH return flow	TPH	1.393	2.11	2.321
SCAPH return Temp	° C	80	80	80
Deaerator temp	° C	130	130	130
Note -1	Vendor to confirm			

Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
TD-1	<b>Steam Turbine</b>				
	Manufacturer	---	.....	.....	.....
	Type	---	Condensing, Indoor Type	Condensing, Indoor Type	Condensing, Indoor Type
	Model number	---	.....	.....	.....
	Weight	kg	.....	.....	.....
	Nominal Turbine speed	rpm	.....	.....	.....
	Turbine over speed trip	rpm	.....	.....	.....
	Turbine rotation direction	---	.....	.....	.....
	Turbine staging	---	.....	.....	.....
	Turbine Nozzle Grouping	---	.....	.....	.....
	Number of Shut off valve(s)	---	.....	.....	.....
	Number of Main control valve(s)	---	.....	.....	.....
	Number of Cross over valve(s)	---	.....	.....	.....
	Turbo Generator Set dimension				
	• Width	mm	.....	.....	.....
	• Length	mm	.....	.....	.....
• Height	mm	.....	.....	.....	
Insulation					

Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
	<ul style="list-style-type: none"> <li>• Material</li> </ul>	---	.....	.....	.....
	<ul style="list-style-type: none"> <li>• Thickness</li> </ul>	mm	.....	.....	.....
	Cladding				
	<ul style="list-style-type: none"> <li>• Material</li> </ul>	---	.....	.....	.....
	<ul style="list-style-type: none"> <li>• Thickness</li> </ul>	mm	.....	.....	.....
	Noise				
	<ul style="list-style-type: none"> <li>• Expected noise level Turbo Generator complete</li> </ul>	dB(A)	.....	.....	.....
	<ul style="list-style-type: none"> <li>• Maxm noise level at 1.0m (db)</li> </ul>	dB(A)	85	85	85
	<b>Lube Oil System</b>				
	Lube oil pressure	bar(g)	.....	.....	.....
	Lube oil temperature after temperature controller	°C	.....	.....	.....
	Lube oil tank quantity	l	.....	.....	.....
	Lube oil tank dimension				
	<ul style="list-style-type: none"> <li>• Width</li> </ul>	mm	.....	.....	.....
	<ul style="list-style-type: none"> <li>• Length</li> </ul>	mm	.....	.....	.....
	<ul style="list-style-type: none"> <li>• Height</li> </ul>	mm	.....	.....	.....
	Main lube oil pump (Shaft driven)				



Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
	• Protection class	IP	IP55	IP55	IP55
	• Supply Voltage	V	415V	415V	415V
	• Starting Current	A	.....	.....	.....
	• Nominal Current	A	.....	.....	.....
	Emergency lube oil pump				
	• Quantity	---	1	1	1
	• Pump Manufacturer	---	.....	.....	.....
	• Type	---	.....	.....	.....
	• Model number	---	.....	.....	.....
	• Speed	rpm	.....	.....	.....
	• Capacity	l/min	.....	.....	.....
	• Power consumption	kW	.....	.....	.....
	• Motor Manufacturer	---	.....	.....	.....
	• Type	---	.....	.....	.....
	• Model number	---	.....	.....	.....
	• Insulation class	---	.....	.....	.....
	• Protection class	IP	IP55	IP55	IP55
	• Supply Voltage	V	415V	415V	415V

Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
	• Starting Current	A	.....	.....	.....
	• Nominal Current	A	.....	.....	.....
	Lube oil coolers				
	• Quantity	---	2	2	2
	• Manufacturer	---	.....	.....	.....
	• Type	---	Tubular / Plate	Tubular / Plate	Tubular / Plate
	• Model number	---	.....	.....	.....
	• Oil capacity (per cooler)	l/min	.....	.....	.....
	• Outlet oil temperature	°C	.....	.....	.....
	• Cooling water quantity	l/min	.....	.....	.....
	• Cooling water inlet temperature	°C	.....	.....	.....
	Thermostatic valve				
	• Quantity	---	1	1	1
	• Manufacturer	---	.....	.....	.....
	• Type	---	.....	.....	.....
	• Model number	---	.....	.....	.....
	• Operating temperature	°C	.....	.....	.....
	Lube oil filters				
	• Quantity	---	2	2	2
	• Manufacturer	---	.....	.....	.....

Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
	<ul style="list-style-type: none"> <li>Type</li> </ul>	---	.....	.....	.....
	<ul style="list-style-type: none"> <li>Model number</li> <li>Oil capacity (per filter)</li> <li>Filter size</li> </ul> Lube oil pressure control valve	--- l/min micron	.....	.....	.....
	<ul style="list-style-type: none"> <li>Quantity</li> <li>Manufacturer</li> <li>Type</li> <li>Model number</li> <li>Size</li> <li>Range</li> </ul>	--- --- --- --- DN bar(g)	1 ..... ..... ..... ..... ..... .....	1 ..... ..... ..... ..... ..... .....	1 ..... ..... ..... ..... ..... .....
	<b>Control Oil System</b> Control oil pressure Control oil pump	bar(g)	.....	.....	.....
	<ul style="list-style-type: none"> <li>Quantity</li> <li>Pump Manufacturer</li> <li>Type</li> <li>Model number</li> <li>Speed</li> </ul>	--- --- --- --- rpm	2 ..... ..... ..... .....	2 ..... ..... ..... .....	2 ..... ..... ..... .....

Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
	• Capacity	l/min	.....	.....	.....
	• Power consumption	kW	.....	.....	.....
	• Motor Manufacturer	---	.....	.....	.....
	• Type	---	.....	.....	.....
	• Model number	---	.....	.....	.....
	• Insulation class	---	Class F	Class F	Class F
	• Protection class	IP	IP55	IP55	IP55
	• Supply Voltage	V	415	415	415
	• Starting Current	A	.....	.....	.....
	• Nominal Current	A	.....	.....	.....
	Control oil filters				
	• Quantity	---	2	2	2
	• Manufacturer	---	.....	.....	.....
	• Type	---	.....	.....	.....
	• Model number	---	.....	.....	.....
	• Oil capacity (per filter)	l/min	.....	.....	.....
	• Filter size	micron	.....	.....	.....
	Control oil pressure control valve				
	• Quantity	---	1	1	1

Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
	<ul style="list-style-type: none"> <li>Manufacturer</li> </ul>	---	.....	.....	.....
	<ul style="list-style-type: none"> <li>Type</li> <li>Model number</li> <li>Size</li> <li>Range</li> </ul> Hydraulic Accumulator	--- --- DN bar(g)	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....
	<ul style="list-style-type: none"> <li>Quantity</li> <li>Manufacturer</li> <li>Type</li> <li>Model number</li> <li>Capacity</li> <li>Nitrogen pre-charge pressure</li> </ul>	--- --- --- --- l bar(g)	..... ..... ..... ..... ..... .....	..... ..... ..... ..... ..... .....	..... ..... ..... ..... ..... .....
	<b>Extraction System</b> Extraction non-return Stop valve				
	<ul style="list-style-type: none"> <li>Quantity</li> <li>Manufacturer</li> <li>Type</li> <li>Model number</li> <li>Design pressure</li> </ul>	--- --- --- --- bar(g)	..... ..... ..... ..... .....	..... ..... ..... ..... .....	..... ..... ..... ..... .....

Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
	<ul style="list-style-type: none"> <li>Design temperature</li> </ul>	°C	.....	.....	.....
	<ul style="list-style-type: none"> <li>Design steam flow</li> <li>Size</li> <li>Required air pressure</li> </ul>	t/h DN bar(g)	..... ..... .....	..... ..... .....	..... ..... .....
	Swing non-return check valve				
	<ul style="list-style-type: none"> <li>Quantity</li> <li>Manufacturer</li> <li>Type</li> <li>Model number</li> </ul>	--- --- --- ---	1 ..... ..... .....	1 ..... ..... .....	1 ..... ..... .....
	<ul style="list-style-type: none"> <li>Design pressure</li> <li>Design temperature</li> <li>Design steam flow</li> <li>Size</li> </ul>	bar(g) °C t/h DN	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....
	<b>Gland Steam System</b>				
	Gland steam supply control valve				
	<ul style="list-style-type: none"> <li>Quantity</li> <li>Manufacturer</li> <li>Type</li> <li>Model number</li> </ul>	--- --- --- ---	1 ..... ..... .....	1 ..... ..... .....	1 ..... ..... .....

Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
	<ul style="list-style-type: none"> <li>Design pressure</li> </ul>	bar(g)	.....	.....	.....
	<ul style="list-style-type: none"> <li>Design temperature</li> <li>Design steam flow</li> <li>Size</li> <li>Required air pressure</li> </ul>	°C t/h DN bar(g)	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....
	<b>Turning gear system</b> Turning gear motor <ul style="list-style-type: none"> <li>Quantity</li> <li>Manufacturer</li> <li>Type</li> <li>Model number</li> <li>Insulation class</li> <li>Protection class</li> <li>Supply Voltage</li> <li>Starting Current</li> <li>Nominal Current</li> <li>Power consumption</li> </ul>	--- --- --- --- --- IP V A A kW	1 ..... ..... ..... Class F IP55 415 ..... ..... .....	1 ..... ..... ..... Class F IP55 415 ..... ..... .....	1 ..... ..... ..... Class F IP55 415 ..... ..... .....
	<b>Gearbox</b>				

Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
	• Quantity	---	1	1	1
	• Manufacturer	---	.....	.....	.....
	• Type	---	.....	.....	.....
	• Model number	---	.....	.....	.....
	• Size	---	.....	.....	.....
	• Ratio	---	.....	.....	.....
	• Gear teeth type and form	---	.....	.....	.....
	<b>Generator</b>				
	• Quantity	---	.....	.....	.....
	• Manufacturer	---	.....	.....	.....
	• Type	---	.....	.....	.....
	• Model number	---	.....	.....	.....
	• Weight	kg	.....	.....	.....
	• Nominal speed(*)	rpm	1500	1500	1500
	• Rated Power(*)	MVA	.....	7.5	.....
	• Power factor (cos φ) (*)	---	0.8	0.8	0.8
	• Nominal Power(*)	MW	.....	6	.....
	• Rated current(*)	A	.....	394	.....
	• Rated frequency (*)	Hz	50	50	50

Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
	<ul style="list-style-type: none"> <li>Stator resistance per phase</li> </ul>	Ω	.....	.....	.....
	<b>Stator</b> <ul style="list-style-type: none"> <li>Weight</li> <li>Insulation class</li> <li>Temperature rise at maximum load</li> </ul> <b>Rotor</b> <ul style="list-style-type: none"> <li>Number of Poles (*)</li> <li>Weight</li> <li>Insulation class</li> <li>Temperature rise at maximum load</li> </ul>	kg --- °K	..... ..... ..... 4 ..... ..... .....	..... ..... ..... 4 ..... ..... .....	..... ..... ..... 4 ..... ..... .....
	<b>Excitation</b> <ul style="list-style-type: none"> <li>Quantity</li> <li>Manufacturer</li> <li>Type</li> <li>Model number</li> </ul>	--- --- --- ---	1 ..... Brushless .....	1 ..... Brushless .....	1 ..... Brushless .....
	<b>Generator coolers</b> <ul style="list-style-type: none"> <li>Quantity</li> </ul>	---	1	1	1

Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
	<ul style="list-style-type: none"> <li>Manufacturer</li> </ul>	---	.....	.....	.....
	<ul style="list-style-type: none"> <li>Type</li> <li>Model number</li> <li>Outlet air temperature</li> <li>Cooling water quantity</li> <li>Cooling water inlet temperature</li> </ul>	--- --- °C l/min °C	..... ..... ..... ..... .....	..... ..... ..... ..... .....	..... ..... ..... ..... .....
	<b>Control cabinets</b> <ul style="list-style-type: none"> <li>Quantity</li> <li>Manufacturer</li> <li>Type</li> <li>Protection class</li> <li>Colour</li> <li>Dimensions               <ul style="list-style-type: none"> <li>Width</li> <li>Length</li> <li>Height</li> </ul> </li> </ul>	--- --- --- IP --- mm mm mm	..... ..... ..... 41 ..... ..... ..... .....	..... ..... ..... 41 ..... ..... ..... .....	..... ..... ..... 41 ..... ..... ..... .....
	<b>PLC</b> <ul style="list-style-type: none"> <li>Quantity</li> </ul>	---	.....	.....	.....

Section	Plant Component/Parameter	Unit	Value / Description / Reference		
			Max. load	Operating load	Min. load
	<ul style="list-style-type: none"> <li>Total installed el. load</li> </ul>	kW	.....	.....	.....
	<ul style="list-style-type: none"> <li>Manufacturer</li> <li>Type</li> <li>Communication Interface</li> </ul>	<p>---</p> <p>---</p> <p>---</p>	<p>.....</p> <p>.....</p> <p>.....</p>	<p>.....</p> <p>.....</p> <p>.....</p>	<p>.....</p> <p>.....</p> <p>.....</p>
	<p><b>Cable Installation</b></p> <p>Specification</p> <ul style="list-style-type: none"> <li>Low voltage cable</li> <li>Instrumentation</li> <li>Communication</li> </ul> <p>Routing material type</p>	<p>---</p> <p>---</p> <p>---</p> <p>---</p>	<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>	<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>	<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>

NOTE :

(\*) - Vendor to provide.