CHAPTER III

DESCRIPTION OF THE PROJECT CASE STUDY

3.1 Introduction

This Chapter has an intention to clarify the detail of the case study being incineration power plant. Inside the episode, the description of the project case study, all fundamental information directly dealing with the project including some results getting from those data will be shown in this chapter.

3.2 Description of Project case study

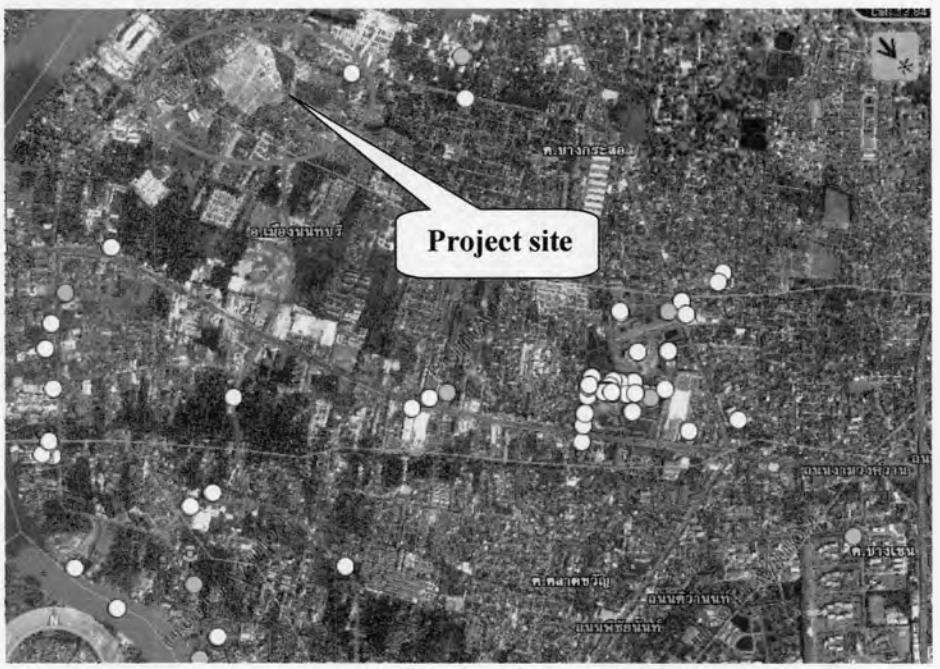
The project case study is an incineration power plant using municipal solid wastes (MSW) generated from Nontaburi province, Thailand to supply as a fuel in the plant by purpose of producing electricity.

The MSW is currently open-dumped, causing various environmental and social problems. The Project is to construct a new waste incineration plant that treats those MSW (target amount is 1,000 tons/ day; otherwise, they will be landfilled) and the plant also generates electricity (rated net capacity is 11.46 MW @19% of net plant efficiency- from EGAT calculation method and from collecting data) by heat steam. It is expected that the power plant will generate about 90.35 GWh of electricity every year, which is to be connected to the national grid.

The waste-to-energy system for the Project incinerates the shredded flammable MSW and uses the heat energy contained in hot steam to generate electricity. Generated electricity is supplied to the national grid outside of waste-to-energy system. About 12% (data from EGAT) of the generated power, or 1.375 MW, is used for internal uses (auxiliary power) such as pumps, shredders and conveyors.

3.3 Detail of physical location

In the physical matters, Nontaburi incineration plant site is expected to be constructed at the Solid Waste Disposal Center in Nontaburi Province, in the northwest suburb of Bangkok. It covers an area of approximately 198 rais (297,600 sq.m).



It owned and operated by Provincial Administration Organization of Nontaburi: PAON (source: feasibility study report in 2005 furnished by EGAT and Nontaburi committee). The center is a waste disposal site so as to accept wastes generated in Nontaburi province being around 1,000 tons per day (forecasted number in year 2007).

FIGURE 3-1: The Solid Waste Disposal Center in Nontaburi Province

The amount of MSW will be collected by sweepers in order to collect refuses from streets and public places, then there are 164 refuse trucks collect solid waste from households, waste transfer to landfilled directly where located 38 km. far from Nontaburi Municipality as shown below. m^3

Organization	**The amount of vehicles**	**Times of transportation**	**The amount of MSW (m^3/month)**	**Total MSW (Tons/day)**
PAON	8	189	3,208.25	54.66
Thesaban nakhon Nontaburi	38	1,731	28,036.09	382.18
Thesaban Mueang Bang Bua Thong	10	219	3,325.08	57.64
Thesaban Mueang Pak Kret	44	1,138	15,103.88	221.29
Thesaban Bang Kruai District	18	371	5,408.46	72.39
Thesaban Bang Sri Mueang District	10	163	2,392.90	34.40
Thesaban Bang Yai District	3	61	851.16	7.49
Thesaban Bang Muang District	3	40	669.20	8.13
Thesaban Plai Bang District	5	104	1,620.64	19.52
Thesaban Sai Noi District	1	26	433.01	7.15
Thesaban Sai Ma District	4	84	1,088.55	18.16
District Administration Organization of Bang Lane	2	49	826.67	13.70
District Administration Organization of Bang Muang	3	55	587.60	8.33

District Administration Organization of Sao Thong Hin	4	145	2,366.97	27.08
District Administration Organization of Bang Ka-nun	1	10	157.46	4.48
District Administration Organization of Bang Kun Khong	1	22	237.54	3.59
District Administration Organization of Sai Noi	1	22	373.97	9.53
District Administration Organization of Khun Sri	1	24	119.83	2.30
District Administration Organization of Bang Bua Thong	3	74	1,259.68	24.63
District Administration Organization of Bang Rak Noi	2	56	944.76	18.34
District Administration Organization of Tar Ait	2	52	885.71	10.19
TOTAL	**164**	**4,635**	**69,897.41**	**1,005.18**

TABLE 3-1: the amount of waste disposed in Provincial Administration Organization of Nontaburi in 2007 (take portion from year 2005)

From survey, MSW is being generated in an increasing tempo and is becoming more and more difficult to dispose regularly. The capacity of landfilled are almost exhausted and new dump sites are difficult to establish because of comprehensive legislation is agreed over time for the sake of a sustainable environment and because of growing public resistance as a consequence of awareness about related health treats chemical pollution of groundwater and the unwise and wasteful of irrecoverable resource. All of these support the idea that the incineration technology is appropriate one for this situation.

3.4 Waste Composition Analysis

The total amount of wastes generated at Nontaburi province, sampling and composition analyses are conducted for the actual wastes brought into the proposed project site. Based on the results of the analyses and data obtained from Kasetsart University, the waste composition study is classified into two characteristics being 1) Physical Characteristics and 2) Chemical Characteristics as shown in Table 3-2 and Table 3-3, respectively.

Waste Compositions	Wet weight %
- Organic Wastes	63.55
- Papers	4.86
- Plastics	14.44
- Rubbers	0.32
- Leathers	-
- Textiles	2.07
- Woods	0.84
- Glass	10.21
- Metals	1.60
- Batteries (Alkaline, TV)	-
- Hazardous material (Sprey)	0.04
- Tiles & Stones	-
- Other (Sanitary Papers)	2.07
Total	100.0
Density (kg/ m3)	194.96

TABLE 3-2: Waste Composition- Physical Characteristics

In table 3-2, it can be seen that more than half of the total solid wastes generated in Nontaburi is composed of flammable MSW, being organic wastes in very high portion (63.55%), and followed by plastics (14.44%), papers (4.86%), textiles (2.07%), woods (0.84%) and rubbers (0.32%). The remaining fractions including metal and other types of waste are counted into hazardous materials and inflammable materials. Surprisingly no batteries are found in Nontaburi MSW.

List	% Wet Weight
- Moisture Content	59.54
- Total Solids	40.46
- Combustible Solids	97.56
- Ash Content	9.45
- Volatile Solids	29.55
- Calorific Value of Waste (HHV, High Heating Value- kcal/ kg)*	4,917
- Calorific Value of Waste (LHV, Low Heating Value- kcal/ kg)*	1,446
- Carbon Content	16.42
- Nitrogen Content	1.66
- Phosphorus Content	0.42
- Potassium Content	0.57

* The functional relation between HHV and LHV is LHV=HHV-mH_2O*2.4425 where mH_2O is the mass of water (in kg) generated by one kg of fuel during the combustion process, and mH2O = (9H+xH_2O)/100

TABLE 3-3: Waste Composition- Chemical Characteristics

3.5 Conceptual Design for Incineration Power Plant

As mentioned in Chapter 1, incinerator is a combustion technology chosen to be a main topic in the research by having the concept is worldwide experience indicates that biomass fuels, such organic wastes, can be successfully burned by all of the major combustion technologies currently used in steam generation. However, in selecting any combustion technology, it depends on characteristics of biomass which have to be properly evaluated. For the research, the combustion technology which selected for the project will follow up with technology applied in Phuket Plant because, from survey, the heating value getting from the sample wastes in two areas has not quite different being around 1,400- 1,500 kcal/ kg (from: www.senate.go.th/web-senate/research49/pdf/b001.pdf), and the portion of combustible matters in waste compositions is not also different (around 80% of total solid wastes). Judging from these facts, it can be concluded that the combustion technology, employed in Phuket, can probably be applied into Nontaburi plant also.

3.5.1 Technology to be employed by the project activity

The Project will employ the technology being the same with Phuket power plant use that is the incinerator with moving grate (shown in the Figure 3-2). The burning process keeps on working all time. The temperature in burning room is about 800-900°C. The movement of grate enables to have the complete burning. Computer controls all processes.

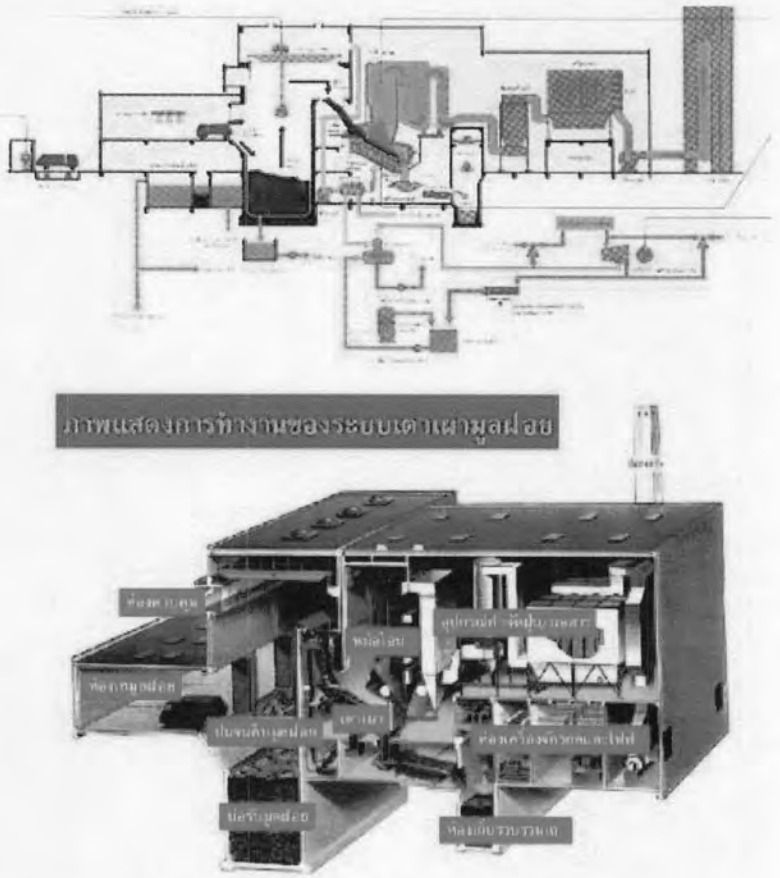
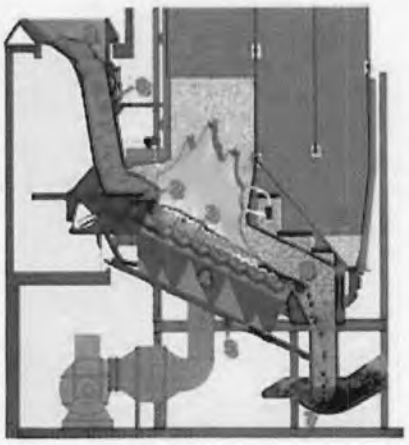


FIGURE 3-2: The incineration system

The burning processes of the incineration system

1. All Solid Waste will be gathered, weighted and then temporarily stored. After that it will be out into the slot of the stove.
2. The Solid Waste will flow into the slot to the stoker.
3. The new Solid Waste will be mixed with the burning Solid Waste.
4. The Solid Waste burning process will be continuous. Then some of the burned Solid Waste will be sent back to mix with the new Solid Waste which is just put in the stove.

5. When the last burning step comes, all Solid Waste will be completely burned. Then the rolling machine part at the end of stoker will push the burned ash to the flowing slot.



(1). Solid Waste coming slot
(2). Solid Waste feeding machine
(3). Stoker
(4). Air opening slot under grate
(5). the shifting funnel
(6). Hard-stone rolling machine
(7). Ash-flowing machine
(8). Solid Waste feeding funnel

Solid Waste stoker

The auto reversing solid waste stoker system consists of grates indifferent layers. The lowest layer grate is motionless but others are alternately movable. These movable layers make all substances, such as, lead, aluminum, plastic to be completely and thoroughly burned or melted. The heat from burning procedures will flow through grates. It erases the substance which will be clung the funnel.

For the construction period, it is assumed that the power plant and other facilities will be approximately used in 2 years (2008-2009) by having 20 years of project lifespan, and will be able to generate electricity to transmit to the national grid in 1 January 2010.

3.6 Technical Result

By following with EGAT calculating method, available data shown in this chapter are used to calculate and to find the technical result of the project that is:

As the complete project, the gross power output of the Incineration Power Plant is expected to be 12.84 MW. This study assumes that the auxiliary power

consumption is 12% of gross plant output. Thus, the net power output send to the PEA's grid is approximately 11.46 MW.

The Table 3-4 shows the summary of the Incineration Power Plant. The followings are the basic parameters:

Gross plant output	12.48	MW
Net plant heat rate (LHV)	18,947	kJ/kWh
Net plant efficiency (LHV)	19.0	%
Estimated aux. power consumption	12	%
Net plant output	11.46	MW

TABLE 3-4: illustrates Simplified Diagram for Municipal Solid Wastes Power Plant Project.

Furthermore, the totally electricity generated by the Project will be transmitted through the PEA's 22 kV transmission line. Based on the Small Power Producer (SPP) contract, the power plant will generate electricity at 100% of contract capacity during peak and off-peak period. To optimize the electricity generation, the power plant will be operated as criteria described as follows:

Description	Unit	Hours
Operating period		
Peak Period (8:00-24:00, Mon-Fri.)	hr/day	16
	day/yr	293
Off-Peak Period (24:00-8:00, Mon-Fri)	hr/day	8
	day/yr	293
Off-Peak Period (Sat.-Sun. and Holiday)	hr/day	24
	day/yr	72
Plant Factor	%	90
Total Operating Hour	hr/ yr	7,884

(**Source**: EGAT regulations for the purchase of power from Small Power Producers)

For the entire operating hours, the plant factor will be taken into account due to, in actual plant operation; maintenance period (either minor or major overhaul) is inevitable thing for power plant in each year, so this factor is brought to use in calculation to make the result getting more accuracy.

3.7 Conclusion

The incineration technology with moving grate is a chosen combustion technology that will be applied for this case study by having Nontaburi province is an expected area for making a research. The 11.46 MW power plant will transmit through the PEA's 22 kV transmission line by based on SPP contract. In Figure 3-3, it shows the expected area which the power plant will be constructed.

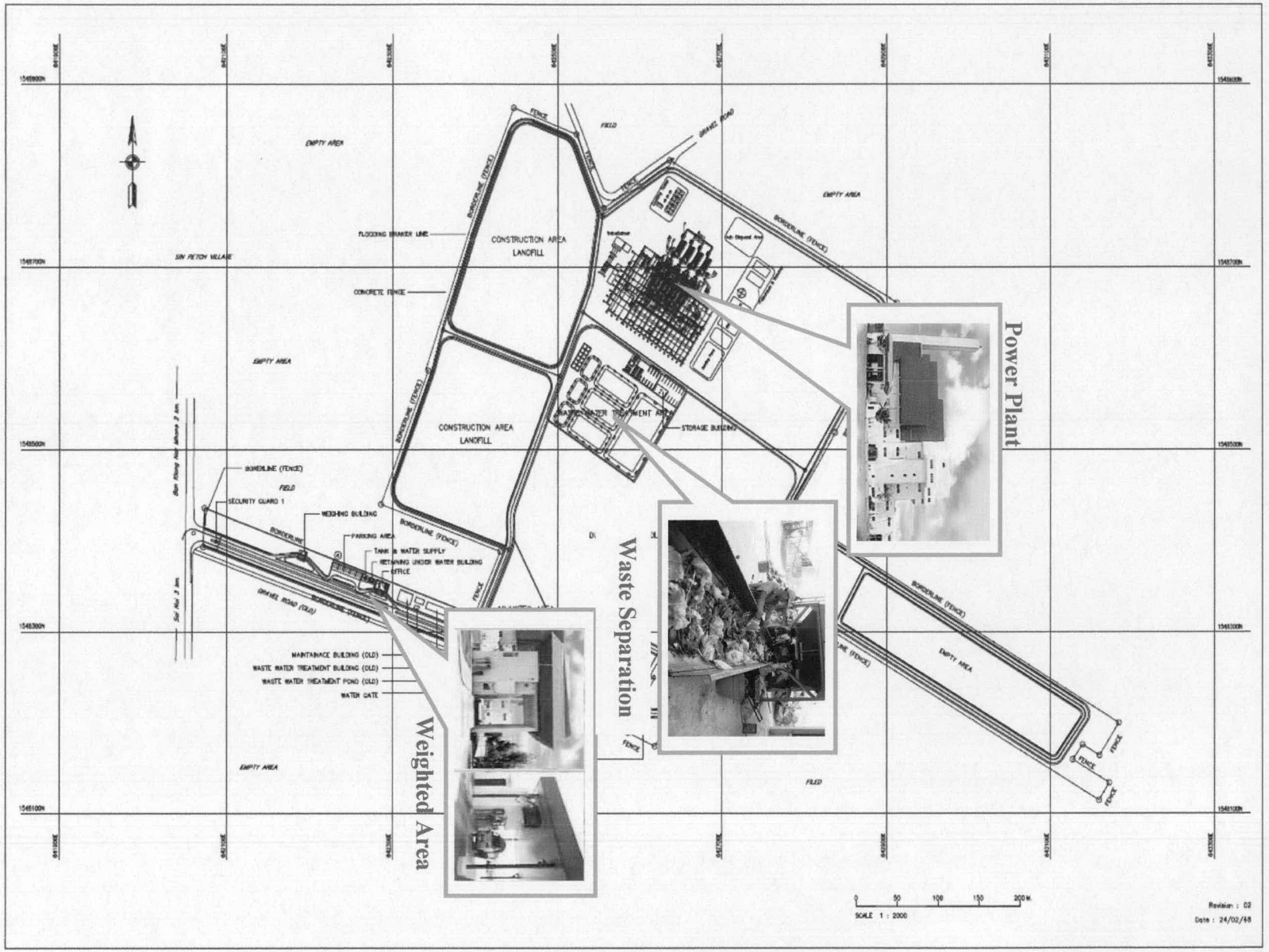


FIGURE 3-3: Provincial Administration Organization Layout of Nontaburi