

# **TRI-GENERATION (CCHP) FOR A PHARMACEUTICAL COMPANY WHY IT DID NOT MATERIALIZE?**

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## **1.0 Background:**

A Pharmaceutical company based in Karnataka is engaged in production of Capsules. The company has a connected load of about 3600 kW and contract demand of 2500kVA with Karnataka Power Transmission Corporation Limited (KPTCL). The maximum demand recorded was 1960 kVA. The unit has installed a D.G. set of 1500 kW as standby unit during power cuts. Since the DG set was of smaller size than the max demand one of the production unit is not run during that time.

Electricity is the only form of energy used in production equipment, Air-conditioning, Heating and Lighting purposes. The average cost of purchased electricity works out to Rs.5.74 per unit consumed. The company wanted to find out the techno-economic feasibility of having captive generation combining with cooling and heating requirements. The requirement of air-conditioning is 240 TR. The existing air-conditioning system has 3 nos. 120 TR, (2 W+1S) reciprocating chillers. The chillers are more than 10 years old. The heating demand was for hot water for process and electric heating to maintain low RH ( by sub-cooling and re-heating) in the production areas. This paper explores the Techno-economic feasibility of having tri-generation i.e. Combined Cooling, Heating and Power (CCHP) for the said pharmaceutical company.

## **2.0 Estimation of Cooling, Heating and Power requirements**

In order to decide the capacity of Heat recovery unit to meet the heating and cooling requirements detailed energy audit of the unit was carried out. It revealed the following:

- 1 The power requirement could be drastically brought down by replacing the vapour compression type of chilling unit to vapour absorption type of chilling unit.
2. Instead of using electric heater if hot water was used to control relative humidity, further reduction in electricity demand was possible.
3. By adopting energy efficient lighting fixtures, still more reduction in power consumption was possible.
4. Use of hot water for process was another area where electricity could be saved since the present arrangement involved use of electric heaters.
5. With reduced lighting loads, process heating (some of which were adding heat inside the premises) other measures like insulation etc it was further possible to reduce the refrigeration capacity required.

Based on the above the final requirement of power was estimated to be 1200 kW only with maximum demand below 1500 kVA. The requirement of Air-conditioning was also projected to reduce to only 180 TR against present capacity of 240 TR (working). The hot water circulation requirement was estimated to be about 40 kL/Hr at 80 dg.C.

## **3.0 Selection of CCHH System**

An enquiry was sent to M/s Thermax for finding out the feasibility of having trigeneration in the unit. M/s Thermax sent a questionnaire to be filled in .The desired data were sent to them (Pl. see Excel Sheet-Tri generation questionnaire) .M/s Thermax suggested a Heat Recovery Unit with Vapour absorption type of chiller. The waste heat recovery system was proposed to be installed in the flue gas exhaust path for the generation of hot water, which in turn is used for generation of chilled water in the vapour absorption machines (VAM). The energy from the jacket water used for cooling the DG set engines was proposed to be used for meeting the hot water requirement. The TR that could be generated from the DG set for different engine loading conditions was worked out as given in the table – 2 (Excel sheet – 2).

The complete cost of installing a HRU,VAM and other associated equipment was worked out which showed that with soft loan availability from IREDA it was feasible to install a CCHP System. However, due to certain reasons the company could not get sanction for the soft loan. The project was finally not taken up further.

#### 4.0 Conclusion:

With continuing economic growth, the Indian electricity system is in need of urgent investment and development of CCHP systems. However some barriers exist, such as lack of adequate policy framework, lack of technical knowledge and support services, lack of financing expertise to evaluate such projects.

Generally, CCHP indicates large-scale technologies and applications that appear complicated to some government officials, investors and end users. Thus, the definition, benefits and classification of CCHP systems should be made known universally, since the lack of education and awareness about CCHP remains the foremost barrier to progress. Lack of understanding about CCHP concepts, benefits and technologies have halted its further popularization; “wait and see” is the attitude of both investors and users.

Existing and potential technologies of CCHP are available. These technologies contain both improved conventional approaches, like steam turbines, reciprocating engines, combustion turbines and electric chillers, as well as relatively new technologies such as fuel cells, micro turbines, Stirling engines, absorption chillers and dehumidifiers. Most prime mover technologies are still based on fossil fuel combustion, since renewable energy technologies cannot totally and economically replace traditional technologies in the near future. Therefore, CCHP technologies provide the world with a transitional system of reliable and stable energy supply. There may be grounds for the argument that there are too many alternative technologies and modes of configurations existing, confusing potential users about a particular CCHP unit. However, it is believed that the more choices available, the more possibilities—exist for CCHP utilization in diverse circumstances. Better understanding of user demands, careful selection of technologies and full consideration of revenue are the keystones to a successful CCHP application.

The CCHP world market has grown rapidly in the last decade, despite the fact that development levels differ from country to country. CCHP development in the US and Europe restarted recently, after a short period of slow growth. Nonetheless, barriers to development still exist in these countries, such as limited liberated electricity market, gas price volatility, high initial cost, etc. Development in Japan seems to be steady; the number of sites and the total capacity are gradually increasing. The two newly emerging markets, China and India still are a long way from a boom in CCHP applications. Other developing countries have begun to encourage development of CCHP in their domestic energy supply market, and the governments of these countries follow various strategies according to the unique characteristics of their countries. From analysis of the world market, section by section, it is apparent that government policies, liberation of the electricity market and price of electricity and fuels are critical in the development of CCHP. Many countries have set a short-term target for CCHP applications, so the capacity share of CCHP is planned to double from 7% currently to 14% in 2012, with the combined efforts of governments, entrepreneurs, energy professionals and end users.

<b>Hot water &amp; VAM TR estimation</b>				
Particulars	Units	<b>DG Set</b>		
Engine capacity	kW	1500	1500	1500
Engine loading	kW	1200	1190	1225
Percentage of engine load	%	0.80	0.79	0.82
Flue gas flow rate	kg / h	7999.3	7730.9	8736.8
Flue gas temperature	oC	422	418	412
Heat available in flue gas	kCal / h	566811	538739	593487
<b>TR generation potential from exhaust gases @ 1.4 COP</b>	TR	<b>320</b>	<b>304</b>	<b>335</b>
HT water flow rate to radiator	m3 / h	53	53	53
HT water diff temp across radiator	oC	5	5	5
Heat recovery from HT water	kCal / h	323300	323300	323300
<b>Hot water generation potential at 85 deg. C</b>	klt/Hr	<b>33.6</b>	<b>33.6</b>	<b>33.6</b>

**QUESTIONNAIRE FOR COMBINED HEATING, COOLING AND POWER REQUIREMENTS****I CUSTOMER DETAILS -**

Customer name:	M/s ABC Ltd.	Dsgn:	1	MD
Address:	Karnataka			
Contact persons:	1		2	Plant Manager
	2			
Contact Numbers		Fax Numbers		
Industry	Pharmaceuticals	email:		
Products manufactured	Capsules	Total power requirement of the plant :		
		Contract with Grid :		
		Grid power tariff : (Rs/unit)		Rs 5.74

**II SPECIFICATIONS -**

<b>A. DG SET DETAILS:</b>				
<b>A1. NEW REQUIREMENT:</b>				
Requirement of power?		1200 KW		
Whether Continuous or Standby?		Continuous (Hr/day):	24 Hrs	Standby (Hr/day):
Nos. of days in a year.				
Normal operating load on DG as % of full load (ie 50%, 60%, 75%) ?				75 %
<b>A2. EXISTING DG's AVAILABLE:</b>				
Make:		Models:		Commissioning date?
Nos. working:		Nos. as standby:		Fuel used: HSD
Nature of operation:		Continuous (Hr/day)	Continuous	Standby (Hr/day)
Nos. of days in a year.				
Normal operating load on DG as % of full load (ie 50%, 60%, 75%) ?			75%	%
SEB power cost in your area:		5.74 Rs./kWh		Existing DG power cost: Rs/KWh.

<b>B. HEATING REQUIREMENT:</b>				
<b>B1. NEW REQUIREMENT:</b>				
Requirement of steam?		Kg/hr.		@ Kg/cm <sup>2</sup>
Nos. of days in a year.				Conti. (Hr/day)
Application:				Batch (Hr/day)
Hot water requirement?		40 Kcal/hr.		85 Temperature regd.
Nos. of days in a year.				24 Conti. (Hr/day)
Application:				Batch (Hr/day)
<b>B2. EXISTING HEATING EQUIPMENT'S AVAILABLE:</b>				
Boiler details.		Kg/hr.		@ Kg/cm <sup>2</sup>
Nos. of days in a year.		Landed cost of fuel used:		Rs/Kg
				Conti. (Hr/day)
				Batch (Hr/day)
Hot water generator details.		Kcal/hr.		
Nos. of days in a year.		Landed cost of fuel used:		Rs/Kg.
				Conti. (Hr/day)
				Batch (Hr/day)

<b>C. CHILLING REQUIREMENT:</b>				
<b>C1. NEW REQUIREMENT:</b>				
Requirement of process chilling.		TR.		Temp. of chilled water reqd. (deg. Cent.) In/Out
Hours of operation		Hrs/day		Nos. of days in a year:
Requirement of air-conditioning.		180 TR.		Temp. of chilled water reqd. (deg. Cent.) In/Out
Hours of operation		Hrs/day		Nos. of days in a year:
<b>C2. EXISTING CHILLERS AVAILABLE:</b>				
Type (Recips/Centris etc.):			Nos. working	Nos. as standby
Capacity:		TR	Hours of operation	hr/day
Power consumption/TR Of conventional chillers:			Kw/TR.	
Year of commissioning:			Nos. of days in a year:	

<b>D. SPACE AVAILABILITY:</b>				
Area available for installing the equipment's: EGB:		LXBXH (in metres)	Heat pump:	LXBXH (in metres)
Approx. distance from DG set to utility area:		25 M		
<i>Please include layout drawings for reference.</i>				

<b>E. ANY OTHER INFORMATION RELATED TO POWER, HEATING &amp; COOLING:</b>				