

COGENERATION PLANT DESIGN

OPTIMIZATION STUDY

ECONOMICS-BASED SELECTION OF FUELS AND EQUIPMENT

REPRESENTATIVE RESULTS

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EXECUTIVE SUMMARY

The xxx xxxxxxxxxxxxxxxx Refinery has asked for an assessment of the appropriate technology, fuels and economics of a cogeneration plant for its facility. This study relies on anticipated demands and utility costs that the Refinery provided for this study. *Sensitivity to Process Constraints* is presented for each case studied.

Based on preliminary unit steam, chilled water and electric sales prices and fuel costs (provided by the Refinery), we conclude that:

a cogeneration plant may be designed, constructed and operated whether or not the local Utility Company can and will provide electric power. It, however, is unlikely to be financially attractive to an Independent Power Producer; it will have to be financed by the Refinery, with a combination of equity and debt.

Financibility will undoubtedly depend strongly on the creditworthiness of the Refinery, and the nature of any sovereign guarantees that may be provided by the xxxxxxxxx national government.

Two cases was investigated.

Case 1 assumes that the local utility company can provide electric power to the Refinery, and will purchase excess electric power. Even though vulnerable to loss of production during both scheduled and forced outages, redundancy of drive/generator equipment is not absolutely critical.

Case 2 assumes that the local utility company will provide only backup electric power to the Refinery (at a 50 percent cost premium,), and will not purchase excess electric power. Redundancy of drive/generator equipment is still not absolutely critical, but can be justified by the cost structure and penalties for both scheduled and unscheduled outages.

This study developed the *financially optimum* course of action for each case. Process Requirements and the Economic Basis are presented in Section V.

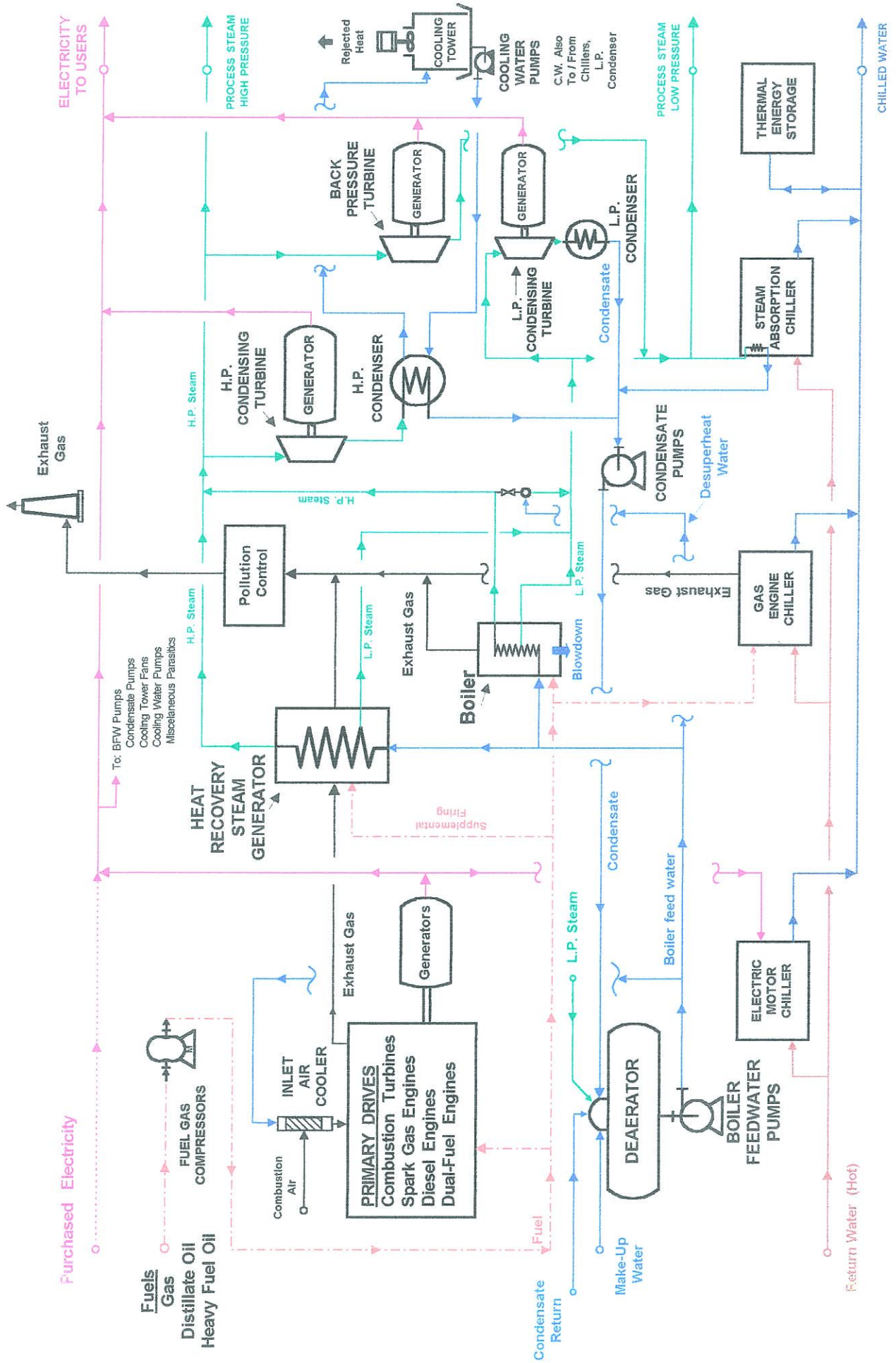
Financially optimum is defined herein as the course of action that leads to the maximum Net Present Value of after-tax cash flow.

Typical costs of equipment, construction and project development have been used, and a very simple financial plan has been assumed (a single loan with constant repayment of principal, no tax consideration beyond the Cogeneration Project, straight-line depreciation of the Total Project Cost over the life of the project, etc.)

Every fuel type and every equipment type (and capacity) shown on the general process flow diagram (Figure 1) and listed in the *MAJOR EQUIPMENT - DESIGN CAPACITIES & COSTS* tabulations were evaluated for each case. The particular combinations of equipment and fuels selected as *financially optimum* are presented for each case.

It is specifically noted that with the high discount from the published electric tariff, sales of electric power to the Utility Company are not economically justifiable at any time. A major advantage of connecting to the Utility Company is being able to purchase power when appropriate during scheduled or forced electrical outages.

Figure 1
Cogeneration Plant
Process Flow Diagram



Importantly, although there may be alternate plant configurations and operating scenarios that are equally good with respect to economics, there will be none that are better within the assumed cost and financial framework.

Additionally, it is noted that the economically optimum design presented herein will undoubtedly need to be altered to meet space constraints as well as operators' experiences and preferences. These practical aspects have not been addressed.

Dynalitics' experience is that a study with considerably more detail will:

- *change the absolute level of the financial measures somewhat, but*
- *not substantially change the optimum mix of equipment and fuels indicated for each case*

Information related to "Carbon Footprint" and a possible "CO2 Tax" is included for information on Tables VI-9 and II-1 respectively. Since there are no carbon regulations at this time, the potential carbon tax, although quite significant, has not been included in the optimization.

OPTIMIZATION SUMMARY

	CASE 1	CASE 2
ELECTRIC POWER AVAILABLE FROM UTILITY CO.	Yes	Backup Only (at 50 % cost premium)
NET ELECTRIC CAPACITY (MW) FROM COGENERATION PLANT <i>(not including any purchased power)</i>	8.737	10.109
STEAM EXPORT CAPACITY ('000 Lb/Hr) FROM COGENERATION PLANT	19	19
CHILLED WATER CAPACITY (Tons) FROM COGENERATION PLANT	11,000	11,000
TOTAL PLANT COST (U.S. \$)	\$61,032,000	\$70,971,000
INTERNAL RATE OF RETURN ON EQUITY (Percent)	3.1	-3.80