

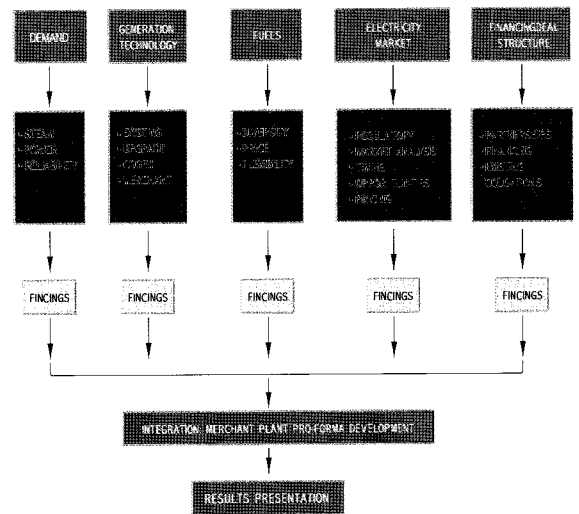
Cogeneration in a Pulp and Paper Mill

이 자료는 지난해 11월 15일부터 18일까지 서울 이마빌딩에서 개최되었던 한·미 에너지 효율향상을 위한 워크숍에서 발표된 내용중 하나이다. 에너지관리공단과 US-AEP가 공동주관한 이 행사에서는 에너지 관리 진단 및 이익, 폐열회수기술 및 방법, 사례 등에 관한 내용들이 주로 소개되었다. 그중 펄프 및 제지공장에서 열병합발전 적용에 대한 부분을 소개한다.

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- I. Introduction
- II. Base Case Definition
- III. Energy Market Assessments
- IV. Project Options Comparison
- V. Conclusions

Approach: Component Review



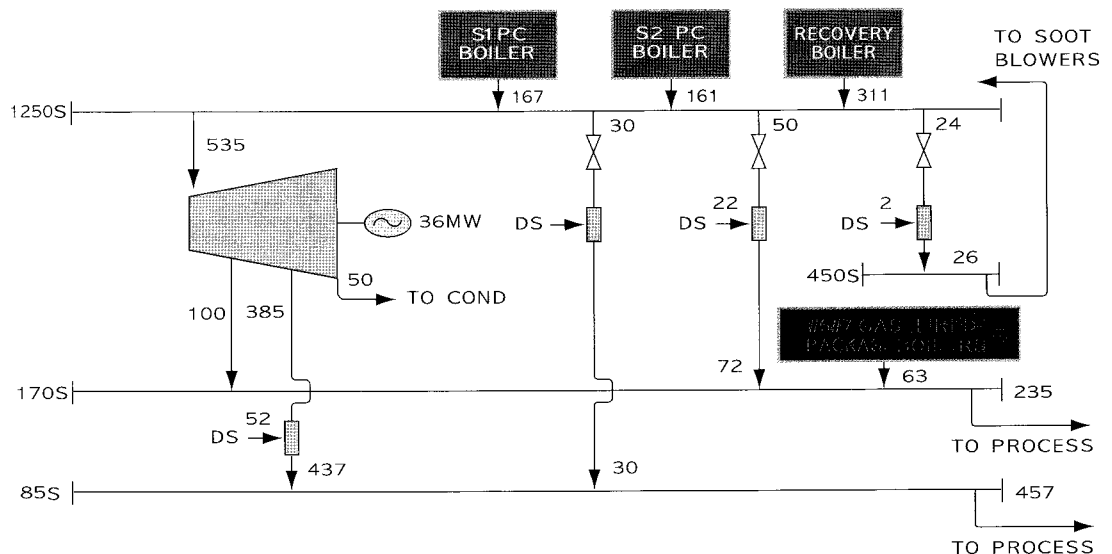
I. Introduction

OBJECTIVES

- Determine the value of a pulp and paper mill site for merchant cogeneration plant development.
- Identify the benefits that the pulp and paper mill might realize from the development of a merchant cogeneration plant.

II. Base Case Definition

Base Case Steam Balance



KEY BASES & ASSUMPTIONS

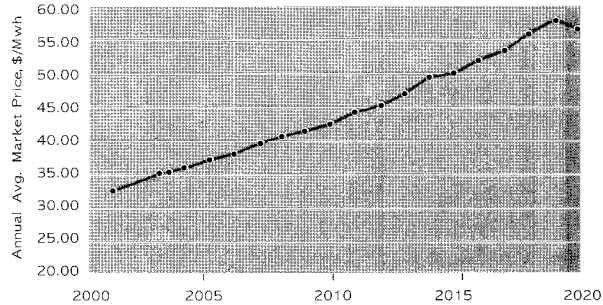
- 40MW Total Site Demand
- 9.6MW Power Island Demand
- 30.4MW Mill Demand
- 36MW Gross Power Generation
- 4MW Supplemental Power Purchases
- \$1.31/MMBtu Del' d Coal(1998) 1% escalation
- 1998 Op Cost \$13.17MM (not including depreciation)
- Required Capital Cost(2000)
 - Flue Gas Desulfurization(FGD) for SO_xControl :\$10.2MM
 - Selective Catalytic Reduction(SCR) for NO₂ Control :\$6.5MM
- Emission Control Equipment O&M Cost
 - FGD Average Annual Cost : \$540k (2000)3% escalation
 - SCR Average Annual Cost : \$1.3MM (2000)3% escalation

IV. Project Options Comparison COGEN OPPORTUNITY

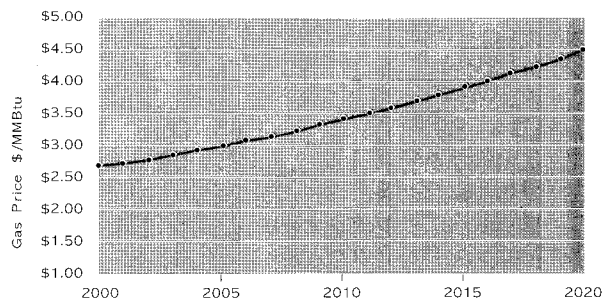
- Mill is currently steam constrained limiting the use of existing steam turbine condensing capacity.
- Low pressure gas-fired package boilers are unreliable and unable to meet steam swing load.
- Environmental issues require near-term capital expenditure.
- Market opportunity and timing.

III. Energy Market Assessment

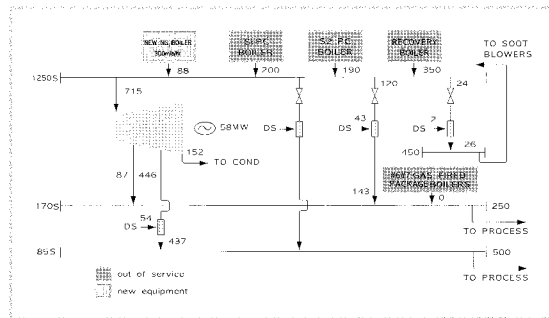
Power Market Assessment
POWER MARKET PRICE FORECAST



Fuel Market Assessment
DELIVERED NATURAL GAS PRICE FORECAST



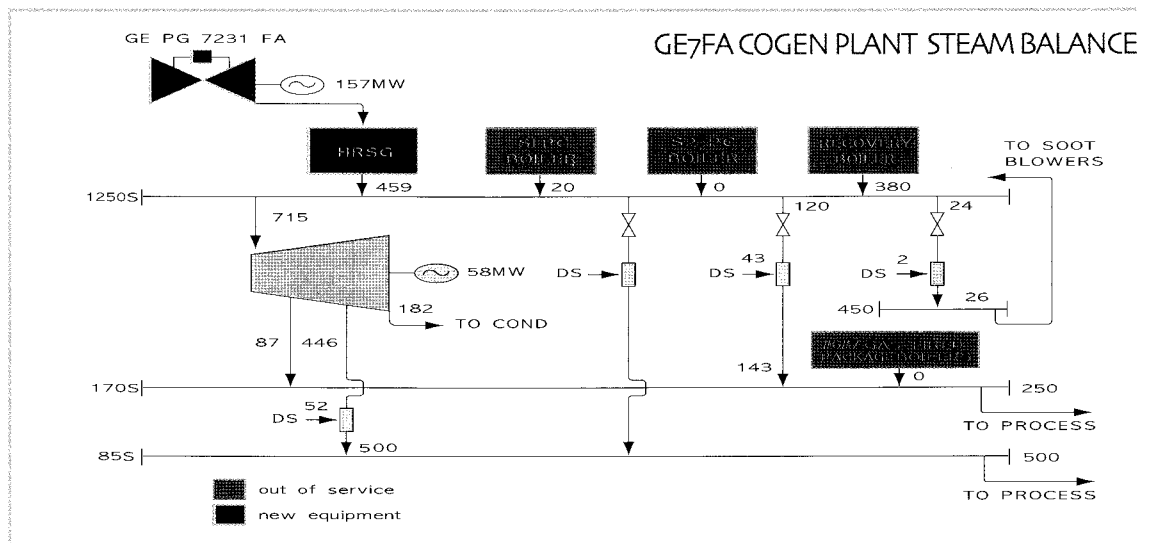
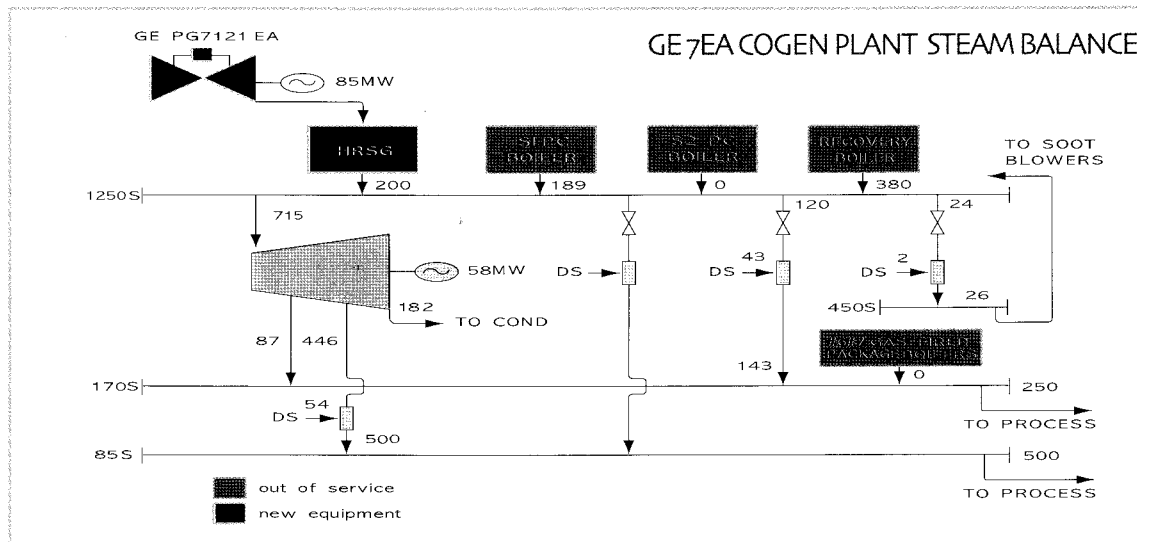
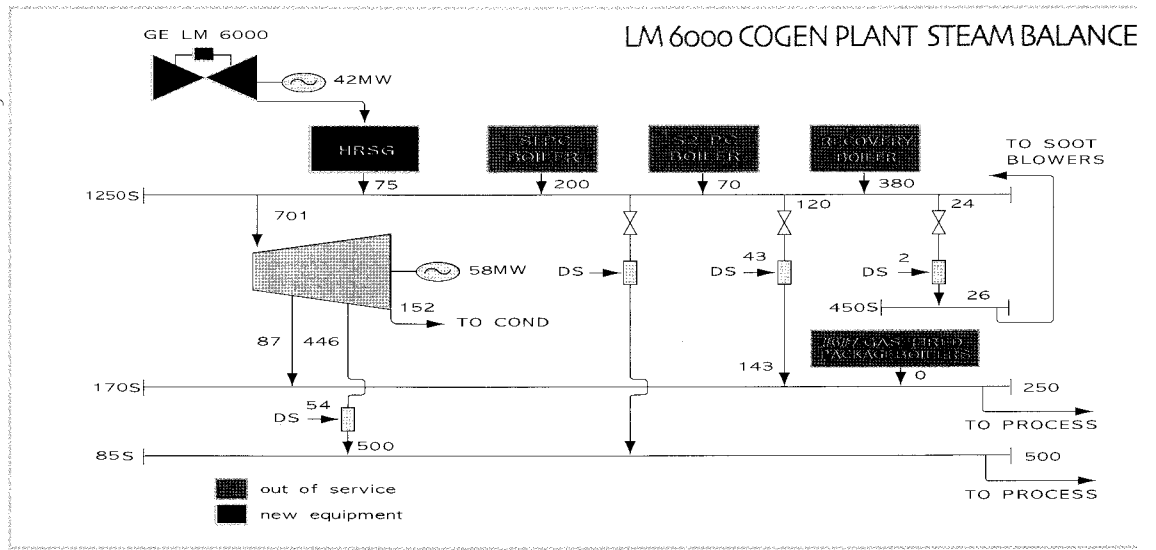
HIGH PRESSURE NG BOILER STEAM BALANCE



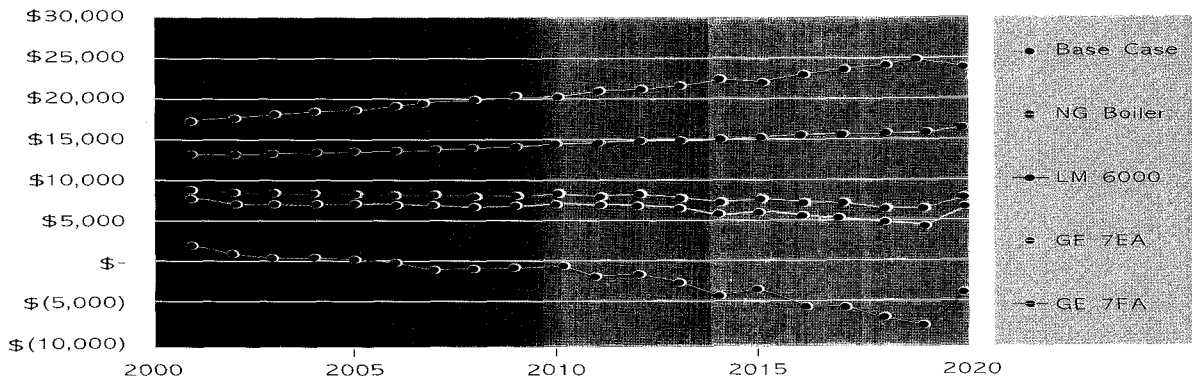
COGEN PROJECT OPTIONS EVALUATED

	Power Generation Capacity	Steam Generation Capacity	Capital Cost
New NG Boiler	0MW	300mlb/hr	\$21.1MM
GE LM 6000	42MW	275mlb/hr	\$38.0MM
GE 7EA	85MW	690mlb/hr	\$47.9MM
GE 7FA	157MW	1060mlb/hr	\$74.2MM

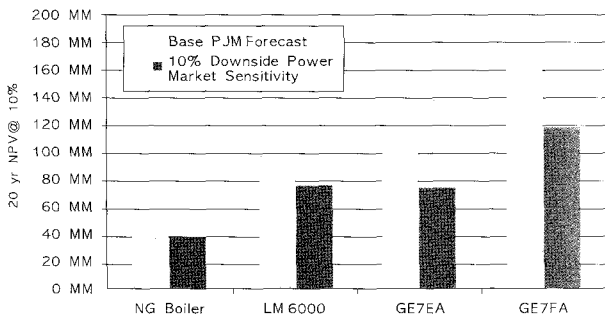
New Technology



COGEN PROJECT OPERATING COSTS



COGEN PROJECT SAVINGS NPV



COGEN PROJECT IRR COMPARISON

15-year Internal Rate of Return on a 100% Equity Investment

	Without Residual Plant Value	25% Residual Plant Value
NG Boiler	13.3%	14.0%
LM 6000	17.0%	17.5%
GE 7EA	18.1%	18.5%
GE 7FA	21.0%	21.3%

20-year Internal Rate of Return on a 30% Equity Investment

	Without Residual Plant Value
NG Boiler	26.1%
LM 6000	45.3%
GE 7EA	49.2%
GE 7FA	58.2%

Note: debt financed at 8.15%

V. Conclusions

- ▶ The pulp and paper mill site appears to offer an excellent opportunity for development of a merchant Cogen plant.
- ▶ Cogen Plant Offers the following potential benefits:
 - Fully satisfy existing mill demands and proposed near-term expansion loads.
 - Fully utilize condensing capacity of existing steam turbine generator.
 - Retire unreliable #6 & #7 natural gas-fired package boilers.
 - Improves energy supply reliability.
 - Avoid \$16.7MM capital cost of emissions control equipment for Pulverized Coal Boilers.
 - Avoid capital expenditures on new package boilers (excluded from analysis).
 - Eliminates supplemental power and reduces back-up power purchases.
 - Generate up to 180MW of low-cost excess power available for sale.
 - Provide up to \$160MM(20yr NPV, 10%) of savings over current operations.