PT. KRAKATAU STEEL

Generate Power from Excess High Pressure Natural Gas through Turbine Expansion and Electrical Generator

SUMMARY OF THE OPTION

PT. Krakatau Steel is a large government-owned integrated steel plant in Indonesia and produces hot rolled coils, plates and sheets; cold rolled coils and sheets and wire rods with capacity 2 million, 650.000, dan 20.000 ton per year.

The DR-Plant consumes about 80% of the plant's natural gas. Natural gas is used at high pressure (13-14 bars) for the reduction of iron seed to make sponge iron, called direct reduction iron (DRI), which is used as raw materials for steel making. Natural gas is also used at low pressure (2 bars) as fuel in boiler reformer, gas heater and reactor. It is obvious that there is very large pressure drop from high-pressure header (13-14 bars) to lower pressure header (2 bars).

The proposed option was to expand the gas through a gas expansion turbine and to recover the released energy through an electrical generator. A huge potential therefore exist from the differential pressure to expand the gas through a gas expansion turbine and recover energy through electrical generator.

The purchase and installation of the turbine and electricity generator cost US$ 2.5 million. Savings are up to US$ 774,144 per year, with a payback period of about 3 years. Each year 17,418 MW electricity is generated and therefore an equal amount of electricity is saved because the plant does not need to buy this anymore from the electricity company. GHG emissions are reduced by up to 12,541 ton CO_2 per year.

KEYWORDS

Indonesia, Iron & Steel, Electricity, Turbine, Natural Gas

OBSERVATIONS

Natural gas is one of the main energy sources that is used for production process in an integrated steel plant such as PT. Krakatau Steel. Table 1 show that the DR-Plan consumes more than 80% of natural gas at Krakatau Steel.

Table 1 - Natural Gas Distribution in each plant

Plant	Natural Gas Consumption [NCMH]	
	As material	As fuel
DR-Plant	61800	59400
SSP I & II	-	1200
BSP	-	500
HSM	-	1800
WRM	-	1600
CRM	-	300
T O T A L	61800	64800

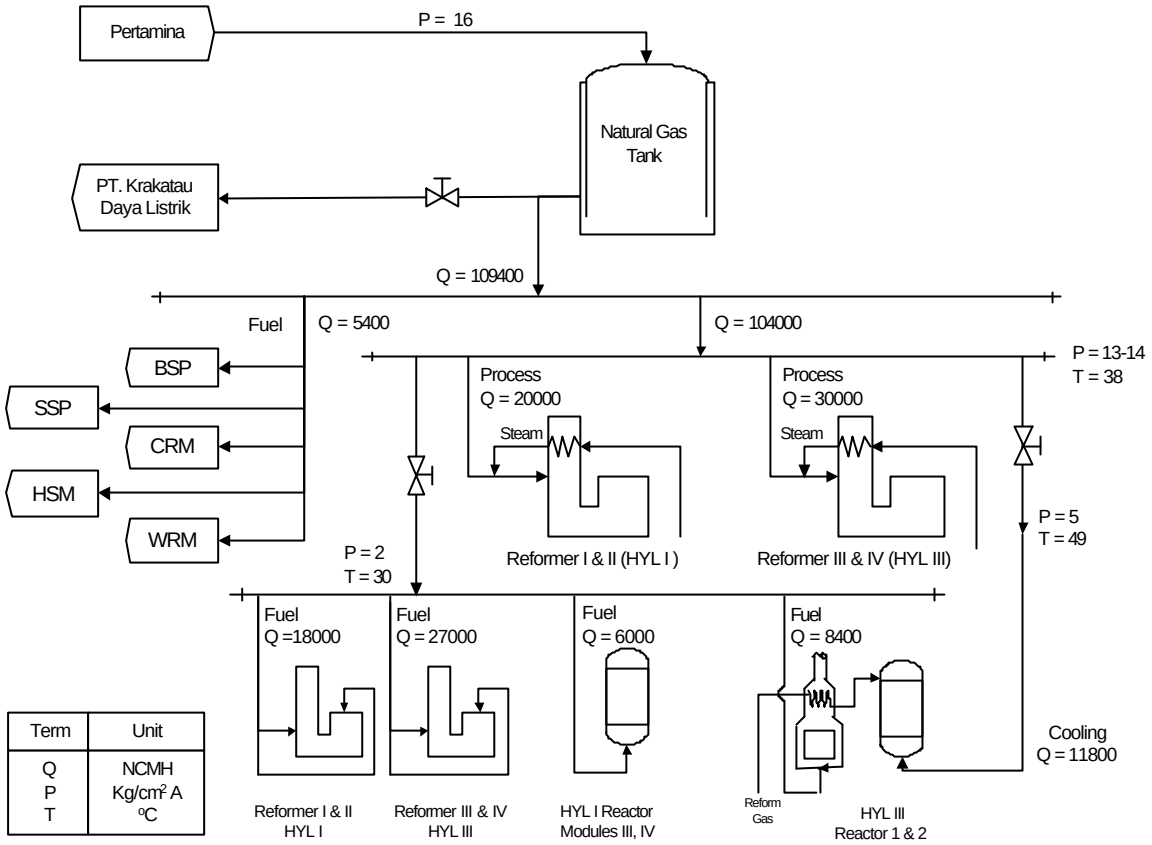

Figure 1 - Distribution of natural gas in PT Krakatau Steel

Figure 1 shows the natural gas distribution at the DR-Plant to two headers:

- H.P Header at 13-14 kg/cm^2, supplying natural gas for the reduction process of iron seed to make sponge iron, called direct reduction iron (DRI), which is used as raw material for steel making
- L.P Header at about 2 kg/cm^2, supplying natural gas for fuel in heating equipment, boiler reformer, reactor and gas heater.

A high pressure drop was observed during the distribution of natural gas, from a high pressure (13-14 bars) after the natural gas leaves the tank to low pressure (2 bars) when it arrives at the LP Header. The high differential pressure means that energy is released in the form of heat when the natural gas expands. This energy could potentially be recovered and reused.

OPTIONS

The proposed option was to recover energy from the differential pressure in a turbine to generate electricity and is shown in figure 2. By producing electricity from energy released during natural gas expansion, the electricity purchased by PT. Krakatau Steel from the National Electric Company (PLN) will be reduced by the same amount.

This option requires:

- A turbine expander with a capacity of 3 MW through which the natural gas can pass and expand and thus reduce the pressure from 13-14 bar to around 2 bar. The expander should allow sufficient variation in the natural gas inlet flow (a turn down ratio of about 1:2) because of different calculated gas flow rates.

- An electricity generator that can be couple to the expander and used to generate electricity from the heat released by expanding natural gas.

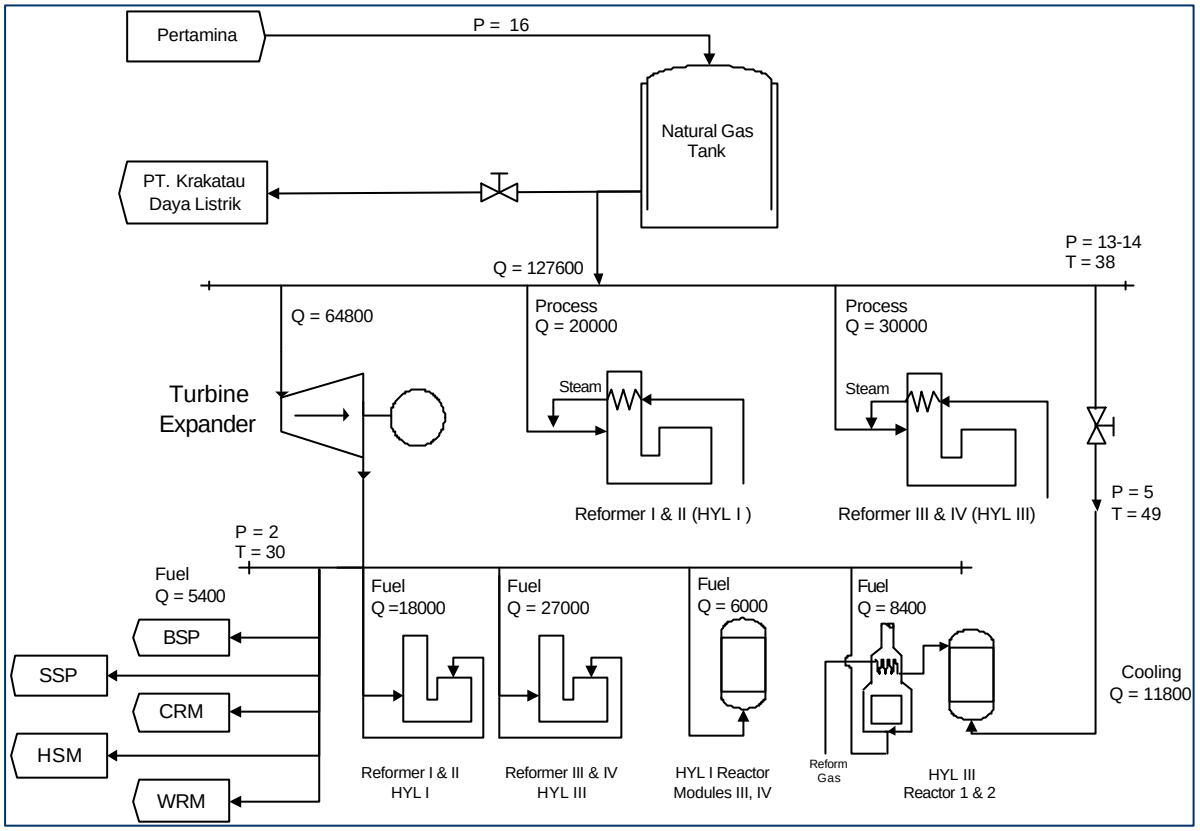

Figure 2 - Proposed modification of natural gas distribution

Table 2 shows the estimated amount of electricity that could be generated by implementing this option at the DR-Plant 1 and DR-Plant 2 (DR 1 + DR 2), at DR 2 only, and at DR 2 but only for 75% of the natural gas flow.

Table 2: Calculation result of estimated electricity produced

ITEM	Unit	Case		
		DR 1 + DR 2	DR 2	75% DR2
Inlet Pressure	kg/cm^2	13.5	13.5	13.5
Inlet Temp	^oC	38	38	38
Outlet Pressure	kg/cm^2	2	2	2
Outlet Temp	^oC	38	38	38
Flow NG	Kg/hr	44,028	27,721	20,791
Pre-heater	KW	3,149	1,982	1,487
Pre-heater Outlet Temp	^oC	149	149	149
Output	KW	2,856	1,719	1,232

This option seems to be feasible, but has not been implemented considering the Company priority on production improvement projects.

RESULTS

Financial benefits

- Investment: US$ 2,500,000
- Annual cost savings: US$ 331,776 to US$ 774,144
- Payback period: 3.10 years

Environmental benefits

- Annual electricity savings: 7,464,960 to 17,418,240
- Annual GHG emission reductions: 5.375 to 12,541 ton CO_2

Item	Unit	Pessimist	Optimist
Electricity production capacity	kW	1,200	2,800
Electricity price	Rp/kWh	400	400
Electricity produced (= electricity consumption reduction)	kWh/year	7,464,960	17,418,240
Electricity cost savings	Rp/year	2,985,984,000	6,967,296,000
	US$/yr	331,776	774,144
GHG reduction (kW X 0.724 t CO_2/1000 kWh*)	Ton CO_2 per year	5,375	12,541

* This is the standard emission factor for electricity generation in Indonesia

FOR MORE INFORMATION

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