CAPITAL PROJECTS - POWERHOUSE

Two capital projects in the powerhouse will have an energy savings impact on the plant operations. They are:

WQC Blast Furnace Gas Cleaning Loop Refit	**Project No. 9**
No. 1 Turbine Generator Refit	**Project No.10**

Details and justifications for both of these projects follow after the description of the Powerhouse.

Description of operation

The “powerhouse” is actually four buildings providing a variety of services/utilities to iron making and general plant operations. They are the new boiler house, steam powerhouse, gas engine house, and old boiler house. Utilities provided are 25 cycle AC electricity, 250 volt DC electricity, 900 & 250 pound steam, blast furnace wind, service and recycle water, and compressed air.

25 cycle electricity is generated by #2 Turbine Generator, driven by 250 psi steam, and having a peak output of 17-17.5 MW. The unit acts as a buffer for the steam system which exists primarily to drive the turbo blowers making blast furnace wind, and secondarily to generate 25 cycle power. If there are any problems in the steam loop, the generator is dropped off line first.

25-cycle electrical generation provides two basic benefits to the plant:

- As an independent power source for river pumps, dc generation, boiler fans, it’s own injector pump, and as back up power to blast furnace pumps.
- It provides a cost avoidance opportunity for electrical service by converting the 25- cycle electricity to 60-cycle electricity in #4 Bloom Mill’s frequency changer. The 60- cycle electricity is distributed through the “Clinton” grid, resulting in a reduction of purchased power from Ohio Edison.

Direct uses for 25-cycle power include:

- Generation of 250-volt DC through either a motor generator set or a single field rotary AC-DC converter, servicing iron making. (Back up DC is provided by House Set #2, a 250-pound steam powered DC generator.)
- #s 3 & 4 Blast Furnace stand-by pumps.
- #5 injector at #2 HPT.
- #1 circuit to Frequency Changer.
- #2 pump house.

A second turbine generator, No.1, also generates 25 cycle power and has a potential capacity of 12 Megawatts. The cost of refitting this equipment is covered in the scope of No.1 Turbine Generator Refit, (Project 10).

The Ladd boilers #7, #8 and #9 in the Old Boiler House produce 250 psi steam which supplies the #5 turbo blower used to create wind for the #3 blast furnace, #2 high-pressure 25 cycle turbo generator, the power plant auxiliaries and the plant steam system. Water for these boilers is provided from the recycle system.

900 psi steam is produced only in the New Boiler house and supplies #6 turbo blower used to generate wind for #4 Blast furnace. Feed water is supplied from powerhouse condensate and iron making. Make up water comes from the treated water system. # 6 Turbo Blower can also use 250-pound steam if required.

In case of a turbo blower failure, #4 Turbo Blower can service either furnace using 250 pound steam.

Service water comes from the Black River into the site through either #2 and #3 pump houses, or the lower tunnel. The pump houses lift the water to the main plant header while the lower tunnel draws water directly from the river to the powerhouse at the $30 Million Hole.
Compressed air is produced at the power house services iron making. It can also supply the plant wide system if needed. Back up for #6 and #7 Ingersoll Rand compressors is provided by the PAP, a steam driven air compressor.

Costs

WQC Blast Furnace Gas Refit	Project No.9	$2,213,000
#1 Turbo Generator Refit	Project No.10	$3,416,000
Total Costs		**$5,629,000**

Benefits

WQC Blast Furnace Gas Refit	Project No.9	$1,325,000
#1 Turbo Generator Refit	Project No.10	$3,100,000
Total Benefits		**$4,425,000**

Revised 3/24/98
Capital project power house

<u>WQC BLAST FURNACE GAS CLEANING LOOP REFIT</u> **Project No. 9**

Description of Project

USS/Kobe unnecessarily purchases about $230,400 of electricity annually because of reduced efficiency of the fuel used in the powerhouse boilers. This loss could be offset by removing water from the blast gas

Blast gas is the primary fuel for the powerhouse boilers. The current avoidable expenditure for make-up electrical power results from the high temperature of the blast gas used to fire the boilers. Since March 1996 the average blast gas temperature has been 120 ° F, which is greater than the average temperature of 96 ° F previous to that date. The elevated temperature results in more saturated water in the blast gas which, in turn, causes combustion inefficiencies for the boilers since the water must be removed by heat before the fuel can burn effectively. A crisis loop results because to evaporate the entrained moisture some of the energy in the fuel must be expended, thereby reducing the combustion efficiency of that same fuel. More of the water saturated and inefficient fuel is then required to make up the loss and ultimately steam output to the turbo-generator is also reduced forcing USS/KOBE to purchase more power from the grid.

The reasons for this lie in the inadequate performance of the Water Quality Control (WQC) system because it is unable to cool the gas cleaning water sufficiently to remove the moisture from the gas stream.

There are two main reasons for the inadequacy.

- Within the gas-cleaning loop there is a strainer with an isolation valve on either side. The strainer could normally be isolated and removed for cleaning and repair during blast furnace outages. However it has been noted that the isolation valves cannot now be closed completely preventing the removal of the strainer for overhaul.
- During the last double outage the repair was attempted but a Well valve failed flooding the system and effectively stopping any attempt to re-open the system.

The clarifiers are now bypassed and the heated cooling water is sent directly to the cooling tower.

Recommendations

1. Purchase and install new clarifier screens to stop contaminants entering the WQC system.
2. Clean the cells and spray deflectors of the cooling tower.
3. Increase the capacity of the WQC system. Originally, the WQC pumping was designed to provide 9,000 gallons per minute, but because of increased blast gas production, the current cooling water requirement has bee increased to 12,000 gallons per minute. For every degree that the blast furnace gas temperature is lowered, an estimated savings of $1200 per month can be expected

Cost to Refit

Cleaning and removal	$600,000
Filter Pump	$ 75,000
Pumps	$150,000
Underflow Pumps	$ 75,000
Motor Repair	$ 60,000
Valve Repair	$ 50,000
Pipe Repair	$ 50,000
Instrument Repair	$ 60,000
Clarifiers #1 & 2 Rebuild	$140,000

Electrical & Instrument Contractor	$ 60,000
Vacuum Pump Repair	$ 77,000
Cooling Tower Repair	$ 77,000
Clarifier #1 &2 Screens	$250,000
New Settling Basin	$250,000
Contracted Labor	$125,000
Replace Hot Well Strainer	$ 25,000
Valves (Strainer)	$ 24,000
Piping	$ 50,000
Engineering, Procurement and Finance	$263,760
Total to Refit	**$2,461 ,760**

Benefits	
Annual savings from cooler water = 24°F x $1200 x 12 months	$345,600
Currently budgeted cost for clean out contractor	$250,000
3% Expected increase in stove efficiency	$500,000
Total annual savings	**$1,095,600**

WQC Blast furnace gas
Revised 2/24/98

No. 1 TURBINE GENERATOR REFIT. **Project No. 10**

Description of Project

The #1 Turbine Generator is of the same vintage as the #2 Turbine Generator described in Project No.9. This equipment is in poor repair and needs a major overhaul to be operational. The current contract relations between USS/KOBE and Ohio Edison preclude new electric generating capacity at this site until after the year 2004. This 25 cycle generator can be effectively and economically restored at a lesser cost than the cost would be for new generating capacity. Certain improvements are needed in the auxiliary systems to allow this equipment to reach its 12 MW capacity.

Recommendations

A refit primarily requires a complete overhaul of the turbine side of the unit, an increase of the transformer capacity leading to the frequency changer, and new steam piping supplying the turbine. In addition there will a cost to purchase the necessary parts, and to supply all the labor for the refit.

Justification

When this machine is back in service, its output will supplant about $3 million of Ohio Edison power currently being purchased.

Cost to Refit

Replacement of turbine blades	$ 2,000,000
Replace rotor bearings	$ 350,000
Replace transformer	$ 200,000
Piping	$ 250,000
Labor	$ 250,000
Engineering, procurement and financing	$ 366,000
Total cost of refit	**$3,416,000**
Annual Benefits (Estimated)	**$3,000,000**

#1 TG refit
Revised2/1 9/98