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Implementation of Energy Management System in Power Generation from Gas Processing Field of Pakistan Oil and Gas Sector

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***Abstract*—**World energy demand is increasing day by day due to increase in population and economic growth. This increase in demand expands range of energy sources to renewable energy production, however, world still depends mostly on fossils fuels for its energy need. Reservoir of fossil fuels are being depleted and these energy sources needs to be utilized efficiently. To extract fossil fuels from reservoirs and convert them into useful form of energy for end users, oil & gas industry is working across the world. In this article, Pakistan oil and gas processing field was considered for implementation of energy management system. It was found that two gas gensets are in continuous operation to keep running its process, but the energy demand of the field can be achieved by operating single genset. This can significantly reduce the operations and maintenance expenditure on site. It was observed that by implementing energy management system in the field, organization can save 80M PKR cost per year and reduce carbon emission to environment. Saving energy will achieve the goal of economic development, energy security and environmental protection.Furthermore, this study provides information about energy audit procedures and basic framework for Oil and Gas sector industries to look into cost saving and energy management practices. It is also recommended that organization shall develop strategies for implementation of energy management in all areas, energy benchmarks shall be developed, energy conservation awareness shall be created among the staff.

***Keywords*—**Energy Management System, Cost Savin, Oil and Gas Sector.

I. Introduction

Global economic growth and success dependent on Oil and gas and it will remain crucial to worldwide for decades to come. Global warnings of climate change, however, result in a focus on the amount of energy needed to produce these hydrocarbon-based fuels, and more unconventional sources and methods continue to increase output energy intensity. Due to these challenges the oil & gas sector recognizes that use of fossil fuels causes atmospheric green house gas (GHG) concentrations, and the emission shall be minimized. [1] Both environmental protection and energy security can be achieved through Energy efficiency and conservation. End users may have most of the possibilities for saving energy. Moreover, producing oil and gas industry also utilized oil and gas in its own operations, therefore energy management implantation is necessary to save energy wastage [1] Depletion of traditional hydrocarbon energy resources makes the production of energy from difficult environments is becoming increasingly complex. In order to ensure that Oil & gas will continue to available, industry is focusing efforts on energy efficiency, while addressing energy security and environmental concerns in the best, most cost-effective way. [2]

Energy efficiency and energy conservation are two different things; however, in reducing the amount of energy used both can play a role. Energy efficiency is about the energy strength of a job in order to allow less energy to produce the same product or service. Awareness to new more efficient technologies can achieve this. On the other hand, conservation of energy is different, it is generally related to culture, human behavior and operational procedures. This means using less energy by reducing usage (e.g. shutting off equipment when not needed) or removing unnecessary tasks and loss of energy, rather than using less energy to do the same. Improving energy efficiency is an important issue for oil & gas companies which can contribute by implementing changes in their processes, planning and investments. [3,4] Improve productivity, lower operating costs and reduce environmental impacts can be achieved through Energy efficiency and proper energy management techniques. Through energy efficiency and conservation, finite natural resource life can also be extended and help to keep energy affordable to consumers by reducing investment and operating costs to connect new energy resources to meet increased demand. Oil and gas companies need to raise awareness of the benefits of energy efficiency & management and encourage the sharing of best practices. [4]

Saving energy will help us in financial and environmental benefits. Energy management may help to reduce energy consumption of a company by implementing energy management policies.

In Pakistan we need to be focused on energy management as most of the time we either intentionally or un-intentionally wasting the energy, although energy production is also very important, but the same importance shall be given to energy management as well. This research will help us to identify area where energy management techniques can be applied.

This research is based on Pakistan Gas processing field where Currently, two gas gensets are operating parallelly, although the available load can be fulfilled by only one gas genset having capacity of 3100 KW, that result in energy wastage, fuel wastage and higher maintenance cost. This research will help us in identifying true load available and requirement of genset to be in operation, either one or two based on the requirement.

In oil and gas industry in Pakistan, no importance is being given to energy management. As most of the time fuel is available free of cost as Oil or gas well is being drilled and same gas is utilized as a fuel so there is no cost of fuel, however cost incurred on maintenance of gensets. If one gas genset is in operation at a time this will save fuel cost as well maintenance cost because maintenance is dependent on running hours and the most important is that there will be no energy wastage.

II. METHODOLOGY

This is purely field based study in which all the data has been gather for energy optimization. 03 Gas Engine are installed at the field to fulfill the energy demand of the plant. As per normal operation 02 gas gensets are in operation and 01 genet are standby. This research has been conducted to verify that plant energy demand could be fulfilled by operating single genset.

To evaluate the requirement of the genset operation, following strategy has been adopted.

- Calculate total energy demand of the plant.
- Review Total energy production of installed system
- Analysis of the available actual data, log sheets, to verify the energy demand of the plant.
- Cost optimization of the system by operating single genset despite of 02 gensets.

A. Generator Set Sizing and Ratings Methodology:

Generator set is the most expensive and critical part in a plant. Therefore, many factors must be considered when determining the proper size or electrical rating of an electrical power generator set.

Calculating total energy demand of the plant for exact genset sizing, following scenarios are considered.

1) Capacity for Normal and Essential Peak Load Demand

The generator is sized to supply the kVA needed at startup and during normal running operation. It also providesvoltage control through the use of a brushless exciter and voltage regulator. Together the engine and generator provide the energy necessary to supply electrical loads in many different applications encountered in today's plant operation. If generator is not capable to meet required demand of voltage and Frequency, generator will trip, therefore proper sizing of the generator is very important that will provide necessary load during startup and during normal operation.

2) Capacity by Voltage Drop during Motor Starting on VFD & DOL.

The generator set must be able to supply the starting and running electrical load. It must be able to pick up and start all motor loads and low power factor loads and recover without excessive voltage dip or extended recovery time.

Nonlinear loads like variable frequency drives, uninterruptible power supply (UPS) systems and switching power supplies also require attention because the SCR switching causes voltage and current waveform distortion and harmonics. The harmonics generate additional heat in the generator windings, and the generator may need to be upsized to accommodate this.

3) Capacity Considering GENSET Overload Capability

For this calculation, following conditions has been considered.

All electric generators have a maximum capacity based on two things—the capacity to generate electricity, and the engine that drives that generator.

The greater the load, the more work the engine must do.Operating the generator beyond the rated capacity of the generator causes an overload condition because the generator is overloaded by the demand placed upon it. The breaker will trip, so to avoid the unwanted situation, two different conditions are considered.

- All Loads are in operation except one largest motor on VFD (200 kW).
- All Loads are in operation except one largest motor on DOL (75kW).

4) Capacity Considering Essential Load

In this scenario all the essential load is considered to be operative and calculate the demand load of the system. Standby load and other unnecessary loads are not considered in it.

B. Analysis of the Available Actual Data, Log Sheets

Log sheets maintained by operator on daily basis to record the necessary parameters. All the available data will be analyzed and observe the actual energy demand throughout the year. This data will provide the actual energy demand as these records the actual parameters and provide the true picture of energy demand.

C. Cost Optimization of the System

Maintenance is necessary for all equipment for reliable operation of the plant. Different types of maintenance are planned throughout the year to ensure equipment availability at all time. Heavy cost is also linked with maintenance to procure spare parts and outsourcing of services, if required, for performing maintenance. In this research all the related cost of preventive maintenance will be calculated for both spares and services and compare it with the genset operation, that if single genset can fulfil the requirement then how much will be saving.

D. Total Load Overview

Sizing calculation for GAS GENSET is based on the data listed in following table. Total plant is calculated and below table shows the different type of available load in plant.

III. RESULTS

Electrical department daily monitored several parameters of the genset, it also includes real power of the plant. All the data from the log sheets have been compiled in the following tables. Data have been logged04 time daily at different time i.e 0800 hours, 1400 hours, 20000 hours and 0200 hours to monitor any variation in parameters. Single sheet has been considered each month to compile the real power of the plant.

Below graph depicts that maximum load reach only 2,320 KW in the month of June 19 which is only 75% of the single engine capacity and 01 engine can easily handle this load as the capacity of the engine is 3100 KW.

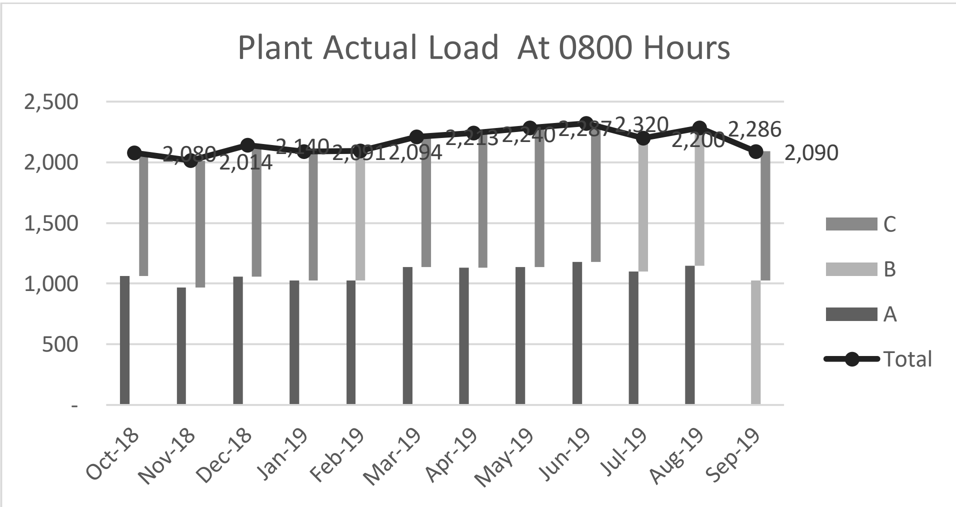

Fig.1 Monthly Actual load at 0800 Hours

Below graph depicts that maximum load reach only 2,685 KW in the month of April 19 which is 87% of the single engine capacity and 01 engine can easily handle this load as the capacity of the engine is 3100 KW.

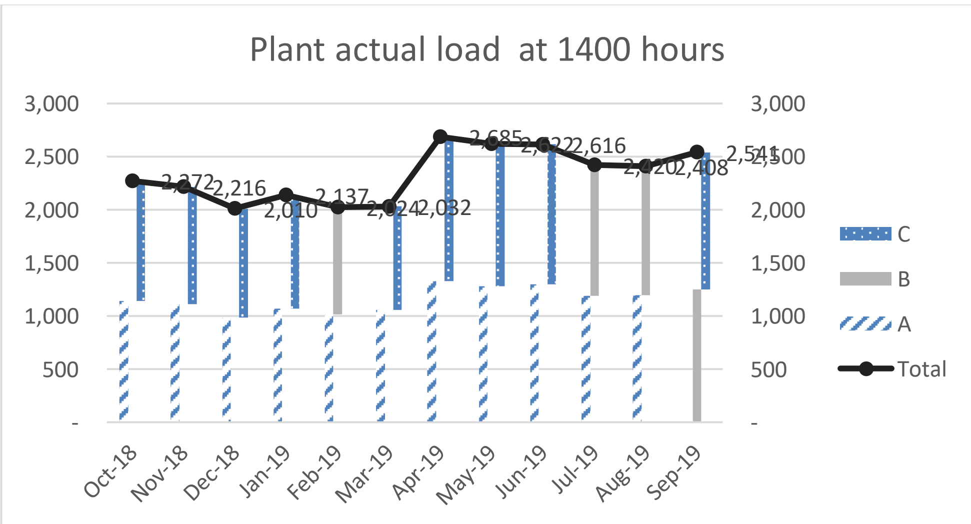

Fig.2. Monthly Actual load at 1400 Hours

Below graph depicts that maximum load reach only 2,586 KW in the month of June 19 which is 83% of the single engine capacity and 01 engine can easily handle this load as the capacity of the engine is 3100 KW.

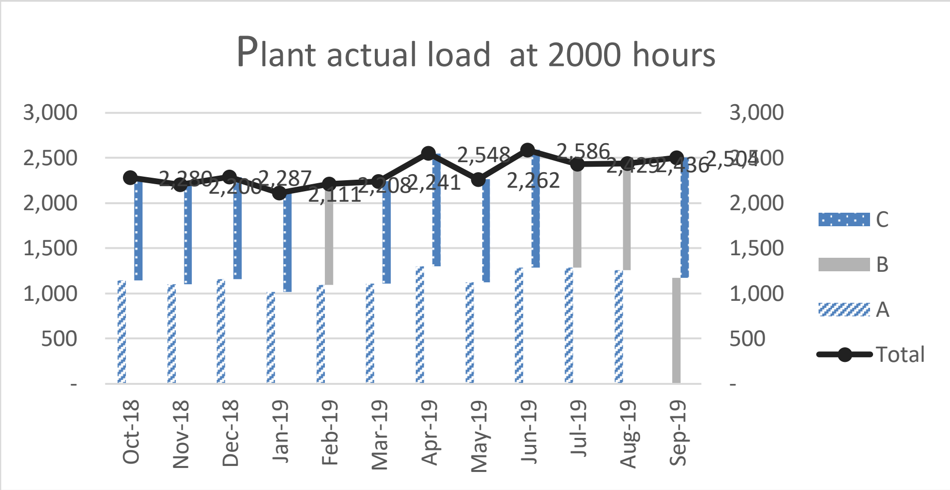

Fig.3. Monthly Actual load at 2000 Hours

Below the graph depicts that maximum load reach only 2,586 KW in the month of June 19 which is 83% of the single engine capacity and 01 engine can easily handle this load as the capacity of the engine is 3100 KW.

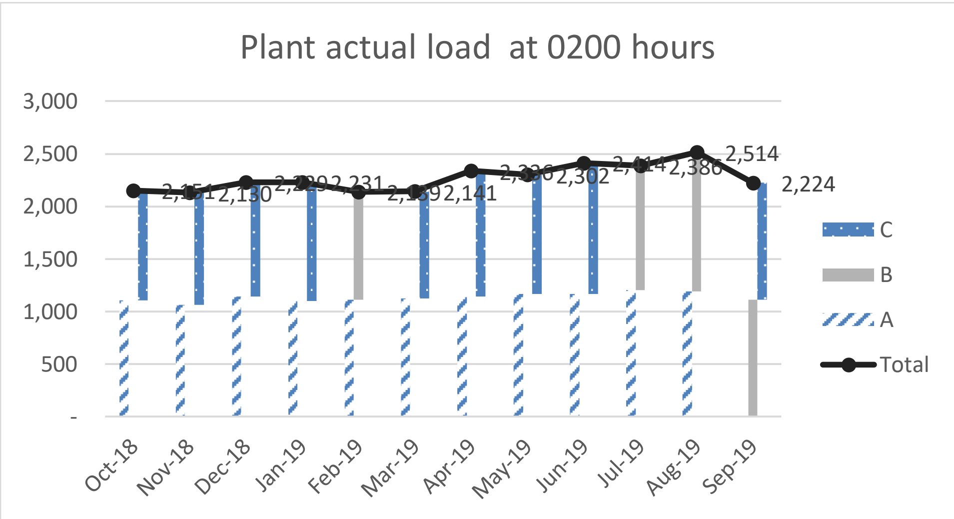

Fig.4 Monthly Actual load at0 200 Hours

IV. Disscussion

As it depicts in the above chapters that power requirement of plant can be fulfilled by operation single generators instead of 02 generators soby implementing energy management system, we can save maintenance cost incurred.

Maintenance work which takes place depending on the number of operating hours is divided into maintenance levels. All the maintenance work listed must be carefully performed according to the maintenance schedule specific to the genset.

Table 1

Maintenance Schedule

OH	E10	E40	E50	E60	E70
300	X				
3,000		X			
6,000		X			
9,000		X			
12,000			X		
12,300	X				
15,000		X			

18,000		X			
21,000		X			
24,000				X	
24,300	X				
27,000		X			
30,000		X			
33,000		X			
36,000			X		
36,300	X				
39,000		X			
42,000		X			
45,000		X			
48,000					X

A Operating Personnel

E10 is type of maintenance that is due once after commissioning and after replacement of the cylinder heads respectively. E20 is daily inspection round to be carried out by maintenance personnel to check parameters.. E30 is periodic maintenance (small scale). E40: It is periodic maintenance (medium scale) that is due after 3000 hours.

B Service personnel

E50 is periodic maintenance (extended scale) that is due after 12000 hours.. E60 is Interim overhaul maintenance that is due after 24000 hours. E70 is Major overhaul of equipment and due after 48000 hours. Maintenance work dependent on operating hours.

C Total Cost Saving

Below table shows maintenance cost incurred on single genset in 5.5 years. If both genset operate in parallel, then double cost i.e 800M will be incurred but as we have seen that plant requirement can be fulfilled with only one genset so 400M cost can be saved by operating single genset.

Table 2

Cost of the project

Maintenance Type	No. of Maintenance	Service Cost	Spares Cost	Single Cost Maintenance	Total Cost
E40 -3000 Hours	12	264,000	4,200,000	4,464,000	53,568,000
E50 - 12000 Hours	1	1,500,000	17,600,000	19,100,000	19,100,000
E60 - 24000 Hours	1	3,000,000	100,000,000	103,000,000	103,000,000
E50 - 36000 Hours	1	1,500,000	17,600,000	19,100,000	19,100,000
E70 - 48000 Hours	1	6,000,000	200,000,000	206,000,000	206,000,000
Total				**351,664,000**	**400,768,000**

CONCLUSIONS

An organization energy wastage not only affect the organization itself but most of other things are related with it, it alsoaffects country economy environment and society. Energy management techniques is the process of making decisionregardingactual energy requirement of the organizations and avoid wasting of energy that benefits not only organization but society as a whole and minimizing its effect on environment. This is achieved by ensuring that energy management techniques have been implemented in the company.

It is evident from the log sheet data that real power of the plant reaches maximum of 87% capacity of 01 genset and that can be handle by operating 01 generators instead of operating two gensets. Also, it is evident from the above data that power requirement increases in summer season that is from April to August and in rest of the season power requirement is under 75%.

By operating single genset, we can save 80M PKR cost per year.Also, reliability of the equipment can be improved as currently genset have not been operating on the capacity for which they are designed and operating under load which may cause wear & tear problems and in long run will affect the overall life of the equipment.

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