POTENTIAL ASSESSMENT STUDY AT Poona Forge Pvt. Ltd., Pune

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Poona Forge Pvt Ltd. has an average energy bill of Rs. 120 Lac per year. Through this energy audit, ECPL has assessed a potential to reduce this bill by at least 25 Lac per annum. The investment proposed shall have an attractive payback of slightly more than one year. The modular investment plan has minimum investment requirement of upto 15 Lacs for demonstration of results.

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PROJECT INTRODUCTION & PREAMBLE:

The efficient use of energy is one of the most important sustainable solutions that allows for economic growth while mitigating green house gas emissions, a key contributor to climate change. The Bureau of Energy Efficiency (**BEE**), Government of India, has taken a lead role in implementing programs to improve energy efficiency, which is one of the key missions of the **GOI** National Climate Change Action Plan.

Despite overall Indian reductions in aggregate energy intensity, the **SME** sector has fallen behind certain larger Indian industry benchmarks in terms of productivity, technology upgradation and energy efficiency (**EE**). While **EE** projects can offer very attractive returns and banks and institutions in India are increasingly willing to finance such **EE** projects, they have not become the norm in Indian **SME** sector despite the best efforts of numerous institutions and organizations over the years. There are clearly several issues/barriers that still need to be addressed before widespread **EE** adoption by **SMEs** is a reality.

The World Bank (**WB**), in conjunction with implementing partner **BEE**, is preparing a new Initiative on **Financing Energy Efficiency in SME** industrial clusters to help overcome some of these barriers. The main objective of this initiative is to improve energy efficiency and reduce **GHG** emissions from Small and Medium Enterprises utilizing increased commercial financing. The project will systematically support development of a large number of **EE** investment proposals under a programmatic approach to aggregate demand for **EE** investment in selected **SME** industrial clusters and will work to create a sustainable mechanism for identifying, preparing and financing these proposals at the local level. The above initiative envisions supporting certain specific industrial clusters in India through provision of assistance for completion of energy audits, preparation of DPRs and support in mobilization of financing from the Indian local banks to ensure that the identified EE measures are implemented. The ultimate goal of the project is to support development of a

large portfolio of **EE** projects in the selected clusters, and help improve market acceptance (both by SMEs and local banks) for this type of product.

World Bank (**WB**) has decided to retain the services of Energetic consulting Pvt. Limited (**ECPL**), an audit firm of repute (3 year award winner of MEDA for excellence in Energy audit area), for providing **EE** facilitation assistance to 5 **SME** units under the proposed **WB** scheme. **ECPL** is required to carry out 5 Potential assessment studies (**PAS**) and then carry out Detailed Energy Audits and develop Investment Grade Detailed Project reports (**DPR**) in 2 **SME** units out of 5 **PAS**. **ECPL** shall also assist the select units in preparation of application to be submitted to banks, if so desired by the units. **WB**'s ultimate objective is to develop bankable **EE** projects in 2 units (with capital expenditure of Rs. 25 Lacs or more) with simple payback period not more than 2 years for the aggregated **EE** measures and ensure that the projects are implemented and units start saving on their energy cost in most cost effective manner. **ECPL** is committed to provide advisory services to the select units during the entire project development cycle till commissioning. WB then proposes to scale up the entire efforts to @ 150 **PAS** and develop @100 bankable **EE** projects for implementation in Forging units in Pune region.

Under the proposed project **WB** will provide entire facilitation, **at its own cost**, to select **SME** units, to address the current gap between energy auditors and bank loan officers and will demonstrate a viable mechanism of synergic tie up between **SMEs**, energy auditors, financial analysts/chartered accountants, local associations and local bankers. The project will also provide complete information on current **EE** lending schemes of Indian banks, to assist the **SME** units to take well informed decision for financing the **EE** project. The ultimate financing choice for identified investments under this project will be demand driven, and participating **SME** units will be free to obtain financing from any of the sources available to them- including their existing banks, new banks who are participating in the **GEF** Project, or other internal/external sources.

A stakeholder workshop was organized by Association to present this new initiative and to solicit response from key SME Forging units in Pune region to participate actively in this WB initiative and take the advantage of soft costs being supported by WB/GEF project to implement the EE project in the SME unit, subject to off course, it being techno-commercially attractive.

FACILITY DESCRIPTION:

Poona Forge Pvt. Ltd., Bhosari, Pune, is one of the leading manufacturing firms having production capacity of average 145 MT per month. The facility mainly has forging furnaces (2 number fuel oil fired and 1 no. induction), heat treatment furnaces (2 numbers) where thermal energy is used. Furnace oil is used for forging applications. LDO is used for box type furnaces and are not used as continuously as other furnaces.

Electrical facility comprises of electrical induction heating furnaces (1 number with 180 kW) capacity, air compressors of total 30 HP motor rating and 300 HP additional hammers and presses. Average power factor is 0.996. Auxiliary system comprises of cooling tower (2 numbers), water pumps, blowers, shot blasting machines and lighting.

The facility has a machine shop where large numbers of small motors are used for individual machines with some of the machines having hydraulic systems.

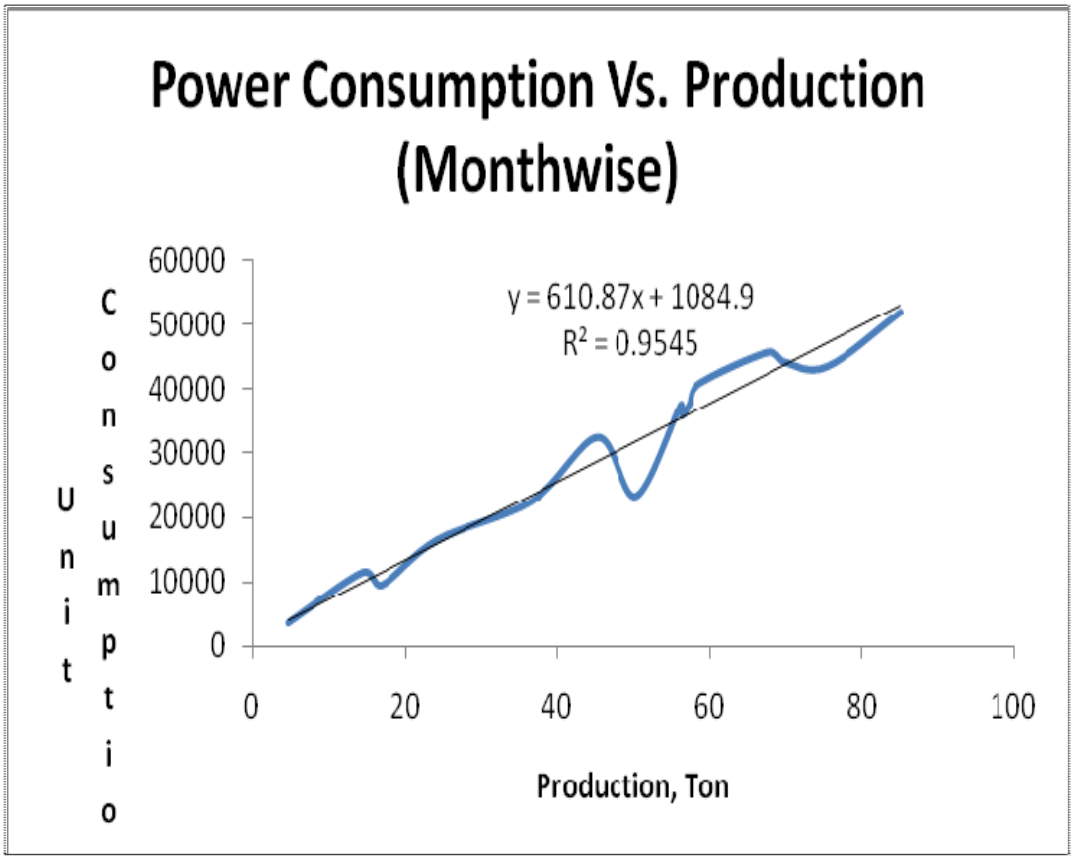
PRESENT ENERGY SCENARIO:

Following table shows energy consumption and production in the plant:

Year	Month	Net Production	Power		Induction heating			Furnace Oil			Light Diesel Oil		
								Plant			Heat treatment		
			Total	per Ton		Total	per Ton	Total	Production	per Ton	Total	Production	per Ton
		Tones	kWh	kWh	Tones	kWh	kWh	liters	Tones	liters	Liters	Tones	liters
2008	January	165.89	52216	315	58.48	40704	696	21478	107.41	200			
	February	118.59	45808	386	57.30	37536	655	13188	61.29	215	6020.25	60.24	100
	March	113.21	61172	540	50.30	23228	462	17796	62.91	283	5505.50	64.68	85
	April	130.37	47940	368	36.67	22484	613	21270	93.7	227	3330.3	39.94	83
	May	152.05	54880	361	56.12	37408	667	22740	95.93	237	6391	65.547	98
	June	185.1	61444	332	67.6	45620	675	22560	117.5	192	6602	86.05	77
	July	200.6	63660	317	75.35	43370	576	24240	125.25	194	6934	94.27	74
	August	205.8	56360	274	85	51848	610	26340	120.8	218	7497	100.568	75
	September	191.58	55790	291	69.73	44110	633	24710	121.85	203	7808	101.598	77
	October	165.18	49120	297	56.31	35712	634	23030	108.87	212	7533	93.973	80
	November	98.25	41112	418	45.31	32368	714	16570	52.94	313	5990	55.477	108
	December	101.98	34028	334	4.67	3504	750	20310	97.31	209	5775	66.256	87
2009	January	107.59	36540	340	24.17	16400	679	18530	83.42	222	4428	60.513	73
	February	113.13	35988	318	14.48	11424	789	21176	98.65	215	6312	68.328	92
	March	119.78	44832	374	16.96	9440	557	26691	102.82	260	7306	94.554	77

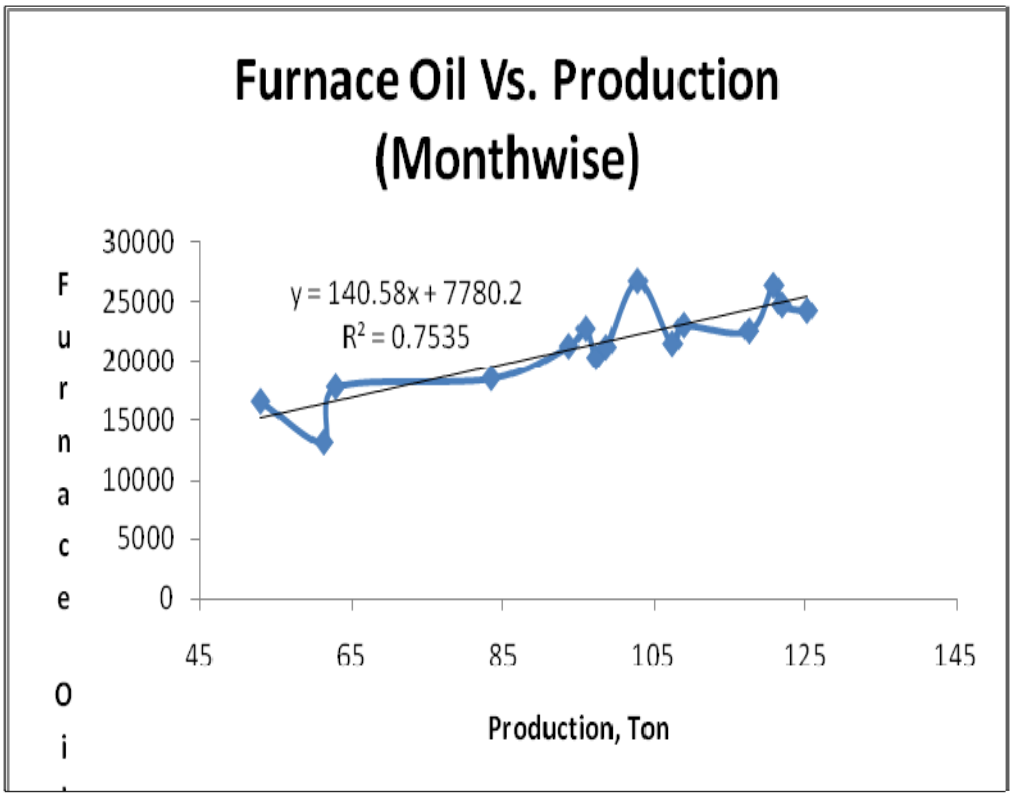
ANALYSIS OF DATA:

The production volumes have changed during the period from a level of 85 MT per month to 5 MT per month for production through induction furnace. Due to these drastic variations, there is no definite trend in the electrical energy consumption. The regression coefficient (R^2) is good (0.95), which means that the data is representative.



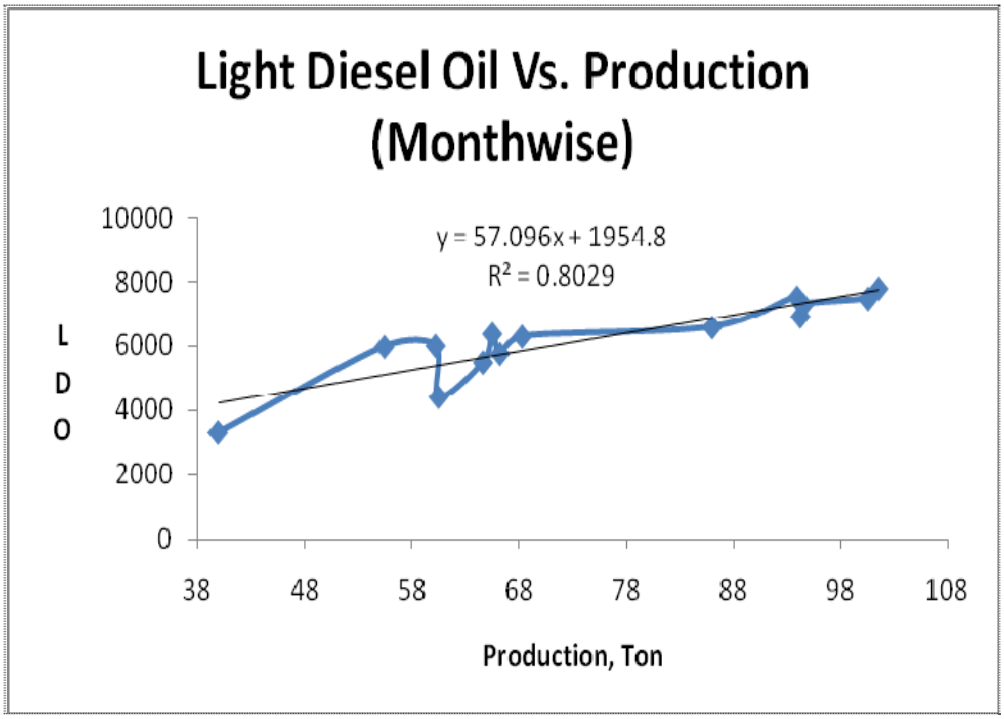
It is evident from the graph that the fixed electrical energy consumption is to the extent of 1085 kWh which is high for lower production volumes. It is necessary to minimize fixed consumptions in electrical energy.

The fixed oil consumption of the plant is 7780 liters per month and variable consumption is 141 liters per ton. Looking at overall oil consumption, 21375 liters per month is very reasonable at higher throughputs but at lower levels, it amounts to 60% of the total oil consumption. The regression coefficient (R^2) is 0.75, which means that the data is not representative.



Average overall specific energy consumption is 227 liters/Ton out of which 141 liters per ton is variable. Considering that the theoretical requirement of heat for metal heating is not more than 20 Liters per ton, 85% of the heat from variable energy is wasted in stack losses which are propotional to the fuel firing(and finally production volume).

The fixed oil consumption of the plant is 1955 liters per month and variable consumption is 57 liters per ton. Looking at overall oil consumption, 1955 liters per month of fixed oil is very reasonable. The regression coefficient (R^2) is 0.80, which means that the data is not representative.



The plant mainly would use LDO for heat treatment and the overall average oil consumption is 85 liters per ton, out of which 57 liters per ton is variable.

RECOMMENDATIONS:

Energy conservation opportunities in forging industry are centered on basic concepts of improving energy efficiency by recouping waste heat from hot gases. There is another way to reduce energy cost by substituting fuel oil or LDO by cheaper fuel like coal or briquettes.

Alternatively, overall system efficiency can be improved by shifting to electrical forging and captive generation of electricity by using Fuel Oil fired generator sets. Though highly capital intensive this option has substantial energy conservation potential. Following chapter provides energy saving potential of each of the ideas and also their budgetary cost benefit analysis:

1. **Waste Heat Recovery though recuperator:**

   Flue gases coming out of the furnace are at 1000 deg C and are vented to the atmosphere. There is a common chimney through which all the furnace exhausts are connected.

   It is recommended to install a recuperator to recoup waste heat and utilize it in the furnace through combustion air preheating. It is possible to increase temperature of the combustion air from ambient upto 500 deg C. This combustion air shall then require lesser fuel to achieve desired temperatures, thus resulting in energy conservation.

   Design basis of 15 liters of oil per hour is considered for computation of energy conservation potential and investment analysis. Typical production output from the furnace shall be 0.5 MT/shift or 1.5 MT per day. The recuperator installation is expected to reduce the oil consumption to 11.5 liters per hour expected to result in 3.5 liters of FO saving per hour. Specific fuel consumption per ton shall thus reduce from 226 liters/ton to 170 liters per ton. For average production volume of 1.5 MT per day the savings amount to 84 liters per day. Considering 250 working days per year of the furnace and Rs. 18 per liter of FO, the annual energy savings go upto Rs. 3.78 Lacs per annum **or Rs. 1008 per MT**.

   Capital investment proposed shall be in the range of 7.5 Lacs and the simple payback period is expected to be 24 months.

Energy saving potential estimation in forging furnaces based on past 12 months

Year	Month	Furnace Oil					
		Present Consumption	Present Production	Present specific energy consumption, liters per Ton	Propose specific energy consumption, liters per Ton	Saving Potential, liters/month	Saving Potential, Rs./month
2008	January	21478	107.41	200	170	3218	57929
	February	13188	61.29	215	170	2769	49837
	March	17796	62.91	283	170	7101	127823
	April	21270	93.7	227	170	5341	96138
	May	22740	95.93	237	170	6432	115774
	June	22560	117.5	192	170	2585	46530
	July	24240	125.25	194	170	2948	53055
	August	26340	120.8	218	170	5804	104472
	September	24710	121.85	203	170	3996	71919
	October	23030	108.87	212	170	4522	81398
	November	16570	52.94	313	170	7570	136264
	December	20310	97.31	209	170	3767	67811
2009	January	18530	83.42	222	170	4349	78275
	February	21176	98.65	215	170	4406	79299
	March	26691	102.82	260	170	9212	165809

From the above table it is seen that the overall potential to save is in the range of Rs. 13.32 lacs per annum. Considering the new furnaces having potential to forge 1.5 MT per day, two such furnaces can deliver the desired output. Capital investment for the two furnaces shall be Rs. 15 Lacs and simple payback period shall be 14 months.

2. Energy cost reduction through Producer Gas:

Furnace oil, as a fuel can be replaced by coal fired Producer Gas. This gas, which is mixture of carbon Monoxide and Hydrogen, is generated at site by incomplete combustion of coal. There are several advantages of PG over furnace oil viz;

1. Reduction in fuel cost
2. Downsizing of furnace and making it compact thereby reducing radiation losses and improving furnace efficiency
3. Reduction in scaling losses of metal due to clean combustion with less excess air

Once again, design basis of 15 liters of oil per hour is considered for computation of energy conservation potential and investment analysis. Typical production output from the furnace shall be 0.5 MT/shift or 1.5 MT per day. Imported coal is considered as replacement fuel and the PG plant capacity after recuperator installation is expected to be equivalent to 1.0 MT of coal per day. Cost of imported coal shall be Rs. 4500/- per day (@Rs. 4.5 per kg) as against equivalent Furnace oil cost of Rs. 6,480/- per day (@Rs. 18 per liter). The average production volume considered is 1.5 MT per day, and the savings amounts to Rs. 1980/- per day or equivalent to **Rs. 1320 per MT**. Considering 250 working days per year of the furnace the annual energy savings go upto Rs. 5.00 Lacs per annum. ***Please note that this saving is over and above the Rs. 13.32 Lacs saving expected out of recuperator.***

Capital investment proposed shall be in the range of 7 Lacs and the simple payback period is expected to be 17 months.

Overall, the FO consumption is expected to reduce to 200 MT per annum due to recuperator and lower production volumes compared to previous year. Equivalent imported coal consumption is expected to be 540 MT if PG is considered as fuel. Cost reduction potential due to implementation of this suggestion is expected to be Rs. 11.70 Lacs per annum. Though exact investment can be calculated only after knowing number of furnaces (or PG plants), an estimation of 2 furnaces and PGs works out to be Rs. 14 Lacs. The simple payback works out to be 15 months.

3. Furnace oil fired DG set:

Typical fuel consumption of FO fired forging furnace is in the range of 200 liters per MT of production. Several power cuts make it difficult to ensure constant throughput in the production machines. It is possible to reduce these power cut related losses and simultaneously reduce energy cost by shifting to FO fired DG sets.

Once again, design basis of 15 liters of oil per hour is considered for computation of energy conservation potential and investment analysis. Typical production output from the furnace shall be 0.5 MT/shift or 1.5 MT per day. Electrical energy consumption in electrical induction heaters is 650 kW per MT. If same 15 liters of FO is fired in the generator, power output is expected to be 69 kW.

In order to match the production output of 0.5 MT per shift, 53 kW out of 69 kW would be consumed and 16 kW equivalent of surplus energy would be available to operate electrical gadgets and machinery. The savings thus accrued would correspond to Rs. 1536/- per day on account of electrical energy substitution. Therefore, the overall cost reduction potential shall be **Rs. 1000 per MT** of production.

Since the plant already has an induction heater of 180 kW capacity, the production capacity of 150 MT /month could be matched if we provide electricity through furnace oil fired D.G. sets. However, typical configuration of hammers and presses does not allow this furnace to feed hot metal to all. It is possible to consider a generator of 0.3 MW capacity to meet the entire factory demand, including electrical induction heaters and hammers. The capital investment for the generator sets would be in the range of Rs. 75 Lacs. The FO consumption on account of these engines would be 22 kL per month and equivalent production output of 150 MT per month. The energy saving potential equivalent to Rs. 1000 / MT shall work out to Rs. 18 Lac per annum with a simple payback period of 4 years.

It is also possible to replace part of / entire furnace oil with producer gas. This would reduce the cost of power generation by another 40% and payback period of entire project can be brought down to two years.

The project may be viable considering additional benefits like loss due power outages and scaling.

4. Lighting energy controller:

The plant lighting load is around 2.90 kW (based on the data provided by plant personnel) which corresponds to 5 kVA equivalent load. Considering 12 hours per day of light burning hours, the average energy bill of lighting would be Rs. 0.52 Lacs per annum out of which 25% can be reduced by installing lighting controller panel on the lighting feeders. Typical cost of the system would be Rs. 0.5 Lacs depending upon number of panels required. The payback period is expected to be in the range of 45 months. Vendors have been informed to contact facility and provide exact quotation.

5. Oxygen enrichment of air:

This is one of the proven techniques to improve efficiency of furnaces, particularly where the temperature requirements are above 600 deg C. Conceptually, every kg of oxygen required for combustion is associated with 3.27 kg of nitrogen in air. This nitrogen does not contribute to chemical reaction with carbon from fuel but carries heat at very high temperature (around 1000 deg C) amounting to huge heat loss.

It is possible to enrich atmospheric air oxygen content from 23.6% to 35% thereby reducing energy loss by 15%. Cost benefit analysis of this suggestion can be worked out only after detailed study as nitrogen separated from air is available to replace compressed air and composite benefit should be considered.

CONCLUSION

There are several opportunities for the units to reduce their energy cost substantially. Innovation would be the essence of such implementation project. Demonstration projects shall be implemented in this phase of pilot study and the benefits shall be showcased.

Summary of all ideas for energy conservation are as follows:

Particulars Of Proposed Recommendation	Investment, Rs. Lacs	Energy Saving potential, Rs. Lacs	Simple Payback, Months	GHG Reduction Potential, ton of CO_2
Waste Heat Recovery though recuperator	15	13	14	180
Energy cost reduction through Producer Gas	14	11.7	14	NA
Furnace oil fired DG set	75	18	50	250
Lighting energy controller	0.5	0.13	46	NA
Oxygen enrichment of air	NOT QUANTIFIED			

Though the figures indicated in the savings and investment column are fairly indicative, the basis of calculations is data provided by the unit. It is essential to verify the data through detailed measurements by auditors at the DPR stage and design the solutions in consultation with the plant management.