

101, VALLEY FIELD COURT, KOROSHO ROAD, off-Gitanga Road Kobil  
petrol station, NAIROBI – 00604, P.O. BOX: 23365



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**Client – Beta Healthcare Limited**

**Service provider: Blackstone Synergy Consulting Group Limited, Nairobi**

## **THE WHITE PAPER ON THE STATUS OF THE COMPREHENSIVE ENERGY MANAGEMENT PROGRAM**

- **Engagement chronology:**

1. Proposals for comprehensive energy management that included productivity enhancements on a sustainable basis as part of RME (resource management efficiency) component given out on dated 27<sup>th</sup> May, 2015 to Dr. Nelson Odhiambo and reportedly internal assessment was initiated as per the communication received on the email.
2. The proposals included the regulatory ERC energy audit as a component of the overall engagement on clear terms and conditions with no ambiguity whatsoever.
3. The energy audit was conducted in the run-up to the ERC deadline after an introductory meeting with the CEO with Dr. Nelson as the coordinating manager.
4. The current proposals that are active in the engagement were part of the original proposals and no component of the engagement process inclusive of the delivery points has changed except for the quote itself.
5. As per the ERC guidelines, all the findings and recommendations of an energy audit report need to be validated through an actual implementation of at least 50% of the investment outlay in the three years prior to the filing of the report – the ERC clarifies that the onus on proving the savings lies as much with the site team as well as with the audit team; in other words, it is imperative that the audit team retains the onus of proving the savings in the light of their findings at site. There is essentially no conflict of interest whatsoever in the energy audit process and in guiding the investment – savings loop.

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- **Current status and future roadmap:**

1. The current status of the EMP and the roadmap chalked out for the future implementation are discussed hereunder.
2. The final conclusions for the management approval are drawn in at the end of the document with the clarified investment outlay and the commensurate payback timeline with the mapping of the probability of achieving the same targets.

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- Graphical representation of the energy audit findings

ANALYSIS OF FINDINGS - STAGE WISE			
ELEMENT OF INTERVENTION	FINDINGS WITH IMPACT MAPPING		
ENERGY AUDIT	Area	Observations	Root Cause Analysis
	Mains	Voltage drops are high	Contactor settings - CF needs to be $\geq 2.0$ ; lower ratings lead to current leakage around the MCBs and lower induction leading to voltage drops



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		CF is high	Quality deficiency in the cables arising from the copper impurities is the prime Cause for the high CF factors
	Machinery in process lines	Low PF	Motors have developed high impedance factors causing magnetic redundant field
	Machinery in process lines and AHU	High THD%	Non-linear load application
	Boilers	High fuel / steam ratio	Inadequate combustion caused by contaminants in the IDO

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ANALYSIS OF INVESTMENT AND PAYBACK FUNDAMENTALS		
RECOMMENDATIONS	COST ESTIMATES IN IMPLEMENTATION	ACTUAL QUOTES FOR TOTAL INVESTMENT OUTLAY (during current EMP implementation)
Reconfiguring the MCB settings and changing the mains MCCB circuitry	1,500,000	<u>40% OF</u> <u>ESTIMATED</u> <u>PROJECTION</u>

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Changing the cables with 40-50% higher current ratings to accommodate for deficient copper purity and consequent prevalence of higher CF factors	3,500,000	
Rewiring with 40% higher rating wirng as per the slot accommodation	2,000,000	
The PFC bank with harmonic filters that can work as anti-resonants and reduce impedance in the systems	4,000,000	
Introduction of anti-static additives like the car engine oil to eliminate friction through neutralization of static charges	127,500	

SAVINGS DYNAMICS AS PER INVESTMENT PLANS FOR BETA HEALTH CARE (as recommended in the	Total Investment	Total kWH savings	Total savings	Payback period in months (investment weighted)	Overall ROI%
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energy audit report)	11,127,500	231,120	3,690,900	39	33%
	SAVINGS ON CURRENT ENERGY	26%	20%		

- Graphical representation of the proposal component**

ELEMENT OF INTERVENTION	PERFORMANCE VARIABLE	TIMELINE	LIKELIHOOD RATING / PROBABILITY	GAINS-ASSURED
PROPOSAL COMPONENT	Savings on total energy bill	3 MONTHS	0.9	10%
	Productivity Enhancement on critical machinery		0.9	15%
	Maintenance and repair costs		0.95	30%
	Condition based maintenance systems		0.95	Validation in the process



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	Integrating the statistical process control models in the SHE accreditation documents for external audits		0.95	and adaptation in the mainstream activity list
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- **Note on the compression machinery:**

**A. Rotational torque and the impact on the elements:**

- i) The changing torque values on rotary elements bring in major changes in both the magnitudes and the angular displacement of the vector in infinitesimal time frames causing centripetal thrusts on to the bed.
- ii) The resolution of the vector changes can only be done through adequate design features to compensate the thrusts through anti-vibration pads. Damping of vibrations caused by the rotary elements is of paramount importance to improve on the performances during the compression process.
- iii) The current make of the machines have fundamental flaws in design causing perpetual problems of the compression quality.

**B. Hopper feed zone and impact on the powder:**

- i) The hopper feed needs to accommodate larger volumes of powder commensurate with the design speed. Adept and Cadpress have inadequate hopper volumes and the vertical pathways do not ensure smooth flow of the powder causing the possibilities of trapped air and hence a decline in the compressed tablet quality.

**C. Envisaged solutions as part of the EMP:**





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i) Machinery optimization is the key delivery point of the EMP program to ensure improved energy-density and resource utilization.

ii) The major RCA (root cause analysis) of the compression process calls in for improving on the drive quality through a) Motor PF enhancement, b) Eliminating harmonics to strengthen power quality and c) ensuring the mechanical trueness of the drive elements including shafts and minimizing the vibration nodes in the rotary motion of the frame

iii) Finally, capping all the activities through improvements on the flow mechanism

- **ESTIMATED COSTS: A) CADPRESS – KSH 250,000.**

**SUGGESTTION; To go in for the overhaul of the CADPRESS while working on the electrical aspects and observe performances before moving on with the other machinery**

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ELEMENT OF INTERVENTION	PERFORMANCE VARIABLE	TIMELINE	LIKELIHOOD RATING / PROBABILITY	GAINS- ASSURED
SERVICES PROVIDED HITHERTO	Studies to reconfirm and validate the energy audit findings	2 WEEKS	0.9	THE PROJECTIONS SHALL BE FULFILLED WITH 90% PROBABILITY OF LIKELIHOOD
	Clarifying strategies for savings working in energy - with foolproof guarantees			
	Demonstrated potential thermal energy savings of 25% with productivity enhancement possibilities of 20% for granulation and syrup			
PROJECTED TIME TO COMPLETE PROPOSED GAINS	Thermal energy optimization - boiler service mechanism	1 WORKING DAY		
	Thermal energy optimization - condensate recovery mechanism	5 - 8 WORKING DAYS TO COMMISSION AND REALIZE THE SAVINGS		

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	Motor rewinding for compression, stirrer motors and low PF elements	1 MONTH TO COMPLETE THE CRITICAL MACHINES		
	Rectifiers for THD% controls	6 - 7 WEEKS		
	Establishing the statistical models for machinery, electrical and process controls on a multi-domain data	1 MONTH		
	Establishing the condition based maintenance systems for costs reduction and process efficiency improvements			

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ANALYSIS OF PAYBACK FOR THE EMP PROJECT		
Thermal energy optimization - condensate recovery mechanism	KSH 150,000 INCLUSIVE OF FABRICATION, INSTALLATION AND COMMISSIONING	5 WEEKS OWING TO MINIMUM 30% IMPROVEMENTS IN IDO CONSUMPTION
Motor rewinding for compression, stirrer motors and low PF elements	KSH 400,000 FOR THE ENTIRE PLANT	2 MONTHS OWING TO IMPROVED ENERGY BILLS - KPLC
Rectifiers for THD% controls	US \$ 20-22k INCLUSIVE OF AIR FREIGHT FOR THE ENTIRE PLANT	6 MONTHS OWING TO LITERALLY ZERO ELECTRICAL BREAKDOWN AND REDUCED ENERGY BILLS
CADPRESS - MC MECHANICAL OVERHAUL	KSH 250,000	2 WEEKS OWING TO PRODUCTIVITY INCREASE
Establishing the statistical models for machinery, electrical and process controls on a multi-domain data	NA	
Establishing the condition based maintenance systems for costs reduction and process efficiency improvements		



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- **CONCLUSIONS:**

**A. Thermal Energy**

1. The achieved results in the thermal energy aspect are fool proof and proven.
2. The solutions related to thermal energy optimization and the related implementation of the new SOP for productivity enhancements in the FBD and syrup processes are ready for immediate implementation with literally nominal costs.

**B. Electrical energy**

1. The principles of electrical engineering that have been used to analyze data and arrive at conclusions are universal in nature and supported by the related literature review of both Schneider and ABB products – both being state of the art and world class leaving no room for speculation whatsoever.
2. The PF enhancement in motors is guaranteed with rewinding properties of higher wire cross-section since this initiative factors in the copper impurities and general quality issues of the wiring that cannot absorb the high thermal stresses in the power.
3. Factors of thermal stresses shall get eliminated in the future when harmonics is controlled through the rectifiers since the load factors will drop down significantly resulting in lasting energy savings and minimized breakdowns – of both electrical and mechanical nature.

**C. Compression machinery – mechanical overhaul**

1. CADPRESS overhaul is recommended and shall yield outstanding performance output with assured guarantees.
2. That could then become the foundation for improved performances on the other lines like the Megapress, the Adept and the Cadmac.



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- **Relevant literature review:**

### 3.2 Chemical / Food and Beverage Manufacturing

In this industry there are many motors and variable speed drives controlling pumps, centrifuges & separators as well as packaging lines. Many variable speed drives use 6 pulse rectifiers which draw considerable low frequency harmonics. Direct online motors present poor displacement power factor and cause voltage dips when started due to the inrush current.

Example VSD and direct online pumping plant	Poor power factor that varies due to DOL motor load	Harmonic current draw from 6 pulse rectifiers, predominantly 5 <sup>th</sup> and 7 <sup>th</sup> harmonics	Voltage dips to do direct online motor starts
RPC capabilities	Dynamic correction of the displacement power factor back to a set point	Reduction of the 5 <sup>th</sup> and 7 <sup>th</sup> current harmonics.	Voltage or PF control, whereby reactive current is injected to support the voltage during motor starts.

Note: Harmonic current correction possible for 400Vac and lower voltages.



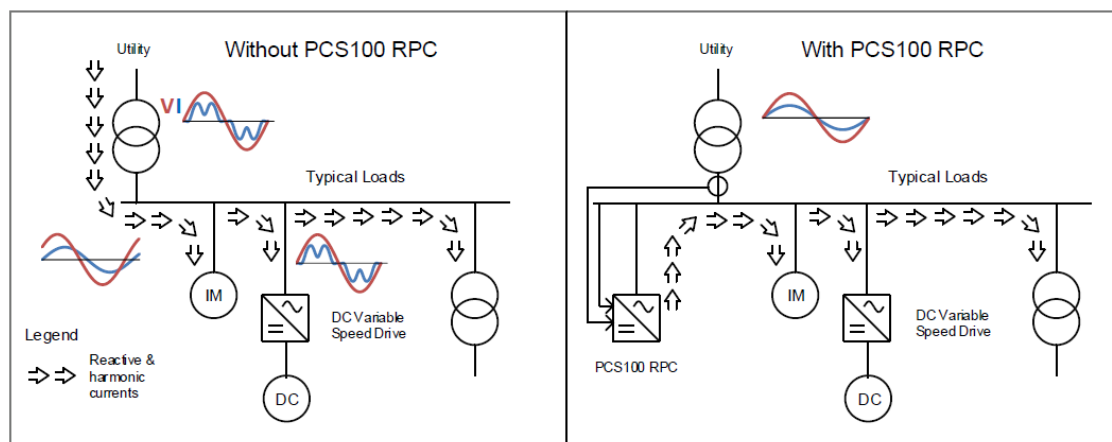
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#### 4.2.1 Displacement Power Factor Correction

This is the typical RPC configuration to correct for the most common power quality problems. Without the RPC reactive and harmonic currents must be sourced from the utility. This leads to additional load on transformers and switchboards, increasing losses and reducing lifetime. In many cases utility penalties will apply for excessive reactive power draw or harmonic pollution.

With the PCS100 RPC installed these currents are supplied via the ultra-fast power electronic inverter. Voltage and current feedback from the point of connection allows the Power Factor to be controlled according to the set-point.





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- **SUSTAINABILITY FACTORS:**

1. The phase imbalances are extremely high right through the factory and pose a potential fire hazard.. The cable change is of primary importance and the estimated costs shall be around Ksh 2M. the exact figures shall come in after the estimation of the length required.
2. The line instruments required include the vibration tester, the laser gun, the ultra-sonic leakage detector and the energy analyzer as also the energy meters for evaluating the machinery performances.

**Finally, the consulting company – Blackstone Synergy and the undersigned CEO has the primary accountability in realizing the gains for the company- Beta Healthcare Limited in no unambiguous terms and conditions.**

Warm regards,

Debashish Banerjee

CEO

Blackstone Synergy Consulting Group Limited

Nairobi – 00604

Dated : 25<sup>th</sup> July, 2016