



## Research Article

© 2021 Z. Kock and Krishna K. Govender.  
This is an open access article licensed under the Creative Commons  
Attribution-NonCommercial 4.0 International License  
(<https://creativecommons.org/licenses/by-nc/4.0/>)

Received: 7 September 2021 / Accepted: 7 October 2021 / Published: 5 November 2021

# Load-shedding and the Declining Energy Availability Factor: A Case Study of a South African Power Station

Z. Kock

Regenesys Business School,  
165 West St, Sandown,  
Sandton, 2031, South Africa

Krishna K. Govender

University of KwaZulu-Natal,  
238 Mazisi Kunene Rd,  
Glenwood, Durban, 4041,  
South Africa

DOI: <https://doi.org/10.36941/mjss-2021-0063>

## Abstract

*Through a mixed methods study, which included a survey among a stratified sample of 70 employees and interviews with 11 managers, this paper reports on the factors which led to a decline in power generation by Eskom's Camden Power Station. The impact of the declining energy available factor (EAF) was significant, primarily on economic activities, employment, revenue loss due to load-shedding, and corporate social responsibility. The main causes of the declining EAF included leadership instability, financial constraints, inadequate plant maintenance, process-related challenges, bottle necks in the procurement of replacement parts, poor quality spare parts, high staff turnover, poor employee morale, poor workmanship and poor quality coal. It is recommended that funding for EAF related projects be prioritized, the performance of the acting managers needs to be closely managed, sources of coal be streamlined, the training of quality control personnel and contract supervisors be improved and staff morale be urgently addressed.*

**Keywords:** Eskom; energy, power generation, load-shedding; economic impact

## 1. Introduction

Due to the poor performance of coal-fired power stations, the decline in the energy availability factor (EAF) at the South African state owned electricity generation and supply entity (Eskom) has, severely negatively impacted the South African economy. Given the electricity crisis that South Africa currently faces, the Camden power station which is one of Eskom's power generation divisions, was selected for this study because it experienced a drastic decline in EAF since 2019.

Micali (2012) described the EAF as an inferred indicator, which means that it is derived from the planned capability loss factor (PCLF), which relates to maintenance in percentage, the unplanned capability loss factor (UCLF) and the other capability loss factor (OCLF), which are referred to as

random percentage losses. UCLF is used as a determinant of EAF, based on the fact that PCLF can be adjusted by management, as desired.

Schindler (2014) reported that Nigeria, like many other developing countries, also faced many electricity supply challenges resulting from inter-alia, obsolete technology, aging plant and equipment, gas supply disruptions, increased plant breakdowns and failures, overdue maintenance of some units and instability of the national grid system.

According to de Castro Camioto, et al. (2016), the G7 group of countries had an energy efficiency index of 95 %, whereas in the BRICS's countries, it ranged from as low as 23,5%, with Brazil leading, with an energy efficiency index exceeding 95%. At the Camden power station, the EAF declined on average from 78% in December 2017 to 42% in March 2020, against the EAF target of 80% for the period of January 2018 to March 2020. This contributed negatively to generation performance, which in turn led to prolonged load-shedding in South Africa. The persistent decline in the performance at the Camden power station had pushed the station to the verge of being shut down.

KPMG (2017) reported that Camden power station's contribution towards the GDP in Mpumalanga was R4,4 bn, and R2.4bn towards the GDP of South Africa. The power station also provided 11106 jobs, had a generation capacity of 1561 MW and a potential contribution of 3.4% to the national grid.

Based on the 2018/19 and the 2019/20 technical performance reports, the Camden power station's EAF showed a downward trend, resulting from inter-alia, poor coal quality and coal shortages and insufficient space for ashing. Although a new ash dam project was initiated more than a decade ago, due to project delays, it was not completed on time, thus only 50% of the units were operational at the Camden power plant.

Limited studies have been conducted on the causes of the declining EAF at the Eskom in general and at the Camden power station in particular, as well as the impact thereof on South Africa. Thus, this study was undertaken with the aim of ascertaining the causes of the decline in the EAF, and recommending strategies to mitigate the situation.

## **2. Literature Review**

### *2.1 Energy Availability Factor*

EAF is one of the main indicators of the performance of a power plant since it is a measure of power availability across the generation fleet, which considers any unplanned energy losses outside management's control (Eskom Medium-Term System Adequacy Outlook, 2018). An EAF of 75% or above, is generally regarded as being adequate for all demand forecast scenarios. In the financial year 2017/18, the EAF reported for Eskom was 78% and due to coal shortages, the performance of 10 of Eskom's 15 coal-fired power stations was greatly affected.

Some of the causes of the current EAF performance challenges relate to the ageing generation fleet, which has been operating at exceptionally high-energy use levels for a number of years, with minimal maintenance due to financial constraints. Eskom responded to the challenges by embarking on a comprehensive strategic review and implemented four pillars to drive the turnaround plan, namely cost containment, debt relief, tariff increases and separation (Eskom Corporate Plan, 2020).

One of the major issues in the energy sector in South Africa (SA) is political influence, since this affects both energy availability and sustainability (Adedeji et al., 2019). With reference to political influence, the issue of leadership is key, since the SA power utility is state owned and manipulation of appointments is rife, with little regard for the needs of the country. Mc Cafferty (2019) asserts that because of the interim leadership, Eskom had been fraught with problems which negatively impacted employee performance.

Goliada (2018) stated that there were significant inefficiencies in the management of spare parts at power stations in SA, which resulted in periods of high spare parts consumption caused by inadequate maintenance and inappropriate inventory control strategies.

At the Camden power plant, the practice has been to maintain units based on a capacity plan, which resulted in some units being operated with defects, which led to a decline in the reliability of the units. The 2019 Eskom budget review indicates that power stations have been severely impacted due to lack of maintenance and refurbishment over the past years and this had led to a significant compromise in the supply security (South African Government Treasury, 2019).

Mc Nett (2016) argued that the constant pressure to cut costs and the short-term budget constraints have forced asset managers to continue deferring maintenance and investment on aging assets. Furthermore, failure to properly perform a robust risk analysis lead to a lack of understanding of the implications thereof, which resulted in the organisation being exposed to an even higher risk, which offset any cost savings.

Cremer Media's Engineering News (2018) highlighted the risk of coal shortages at power stations due to low coal stockpile levels or suitable quality coal. Coal shortages and sub-standard coal have contributed immensely to load shedding from November to December 2018. Eskom reported that the coal supply challenges in 2018 were mainly due to the Gupta-owned Tegeta Exploration, which lead to the non-supply of coal to the three power stations (Pillay, 2018). According to the National Energy Regulator (NERSA), power stations should maintain a coal stock of at least 21 days at all times, so as to prevent interrupted services. This obviously was not the case at the Camden power station.

Given that 80% of the country's coal comes from the Mpumalanga province and that electricity, manufacturing and mining contribute 41.4% to the province's GDP, coal suppliers benefit hugely from the coal-fired power stations. Undoubtedly, decreased power generation impacts the coal suppliers' revenues drastically. For example, Exxaro's shares fell 8.7%, while Wescoal dropped 6.8%, following a notice issued by Eskom to mines regarding the need to halt fuel purchases, as a result of the nationwide Covid-19 lockdown (Burkhard, 2020). On the 24<sup>th</sup> of April 2020, the Camden power station's management communicated that there is a temporary unit shutdown, due to ash dam constraints and safety risks posed by the existing ash dam (Camden Bulletin, 2020).

According to Allcott et al. (2016), electricity shortages had a negative effect on input choices such as revenue and productivity in the manufacturing sector of India. An article in Fin24 (2019), highlighted the impact of load shedding in South Africa during from December 2019 until January 2020. The country's economic growth for 2019 was down to 1.3%, whereas the National Development Plan states that in order for South Africa to deal with real socio-economic challenges, it will have to have an average economic growth of 5% per year by 2030.

According to the Council for Scientific and Industrial Research (CSIR), load-shedding in 2019 was considered as the worse ever experienced, regardless of reduced power demands induced by COVID-19 (Gernetzky, 2020). Due to the rolling black outs in October 2019, producers such as Implants, Harmony and Sibanye Gold Ltd, ceased operations at their mines The MTN Group's expenditure escalated, due to the added cost of securing batteries, generators and other ordinary site equipment from possible theft. The mobile phone towers of the Vodacom Group Ltd, were also affected during stage four load shedding and to mitigate this risk, Vodacom invested on batteries and generators throughout the country (Nijini et al., 2019).

It is against the above background that this study was conducted to investigate load-shedding and the declining EAF at Eskom's Camden power station, using the research methodology described below.

### 3. Research Methodology

A mixed methods study was undertaken (Saunders et al., 2013), to enable the researcher to clearly describe the causes of declining EAF and the impact thereof, using descriptive research. Table 1 and Table 2 reflect the sample chosen for the quantitative and qualitative studies. The participants had to be at supervisory or managerial level and have been involved in technical operations at the power plant.

**Table 1:** The target population for the quantitative approach

Job Title	Population	Sample Size
General Manager	1	0
Senior Managers	18	15
Line Managers	30	20
Supervisors	40	20
Contract Site Managers	44	15
Employees	278	0
<b>TOTAL</b>	<b>411</b>	<b>70</b>

**Table 2:** The target population for the qualitative approach

Job Title	Population	Sample Size
Outage Managers	2	2
Production Managers	3	2
Engineering Manager	1	1
Operations Manager	1	1
Unit Controllers	12	2
Turbine Engineering Manager	1	1
Boiler Engineering Manager	1	1
Senior Advisor OM	1	1
<b>TOTAL</b>	<b>22</b>	<b>11</b>

This case study used a combination of data gathering tools, namely, a questionnaire and an interview schedule. The survey questionnaire was sent to the sample via e-mail.

### 3.1 Data Collection

Before e-mailing the questionnaires, the researcher held pre-survey phone calls and one-on-one conversations with the sample to discuss the survey. Regular follow ups were also made for the surveys to be completed timeously (Saunders et al., 2013).

The questionnaire was initially piloted among a sample of three managers from different departments at the Camden power station, which included Risk and Assurance, Engineering and Production. The pilot study eliminated misleading questions, since necessary amendments were effected as per the respondents' inputs on the questions. Care was taken to ensure that the questions were clearly phrased and free from jargon and unnecessary abbreviations (Adams, et al., 2014).

The emailed questionnaire comprised two sections, with Part A covering questions pertaining to demographic information, where the participants were required to select the appropriate box with an 'X'. In Part B, close-ended questions were presented to the participants and they needed to indicate whether they strongly disagreed, disagreed, remained neutral, agreed or strongly agreed to various questions relevant to energy generation by the Camden power plant. There were 19 close-ended questions related to the research objectives, with some being clustered into five components, namely, (1) governance compliance, (2) people, (3) procurement process, (4) plant and (5) finance.

With respect to the qualitative data, interviews were conducted via MS Teams, as this approach established credibility so as to gain the interviewee's confidence. Furthermore, the Covid-19 pandemic necessitated on-line conversations. The researcher remained neutral during the interviews and observed a voice tone that projected interest and enthusiasm (Saunders et al., 2013). The data was recorded through the use of MS Teams, after permission for audio-recording was granted by the interviewees, and where this was not possible, only notes were recorded.

### 3.2 Data analysis

The researcher used the Microsoft Excel statistics features for the quantitative data analysis. With respect to qualitative data analysis, thematic analysis was performed, since only 10 participants were involved (Adams et al., 2014).

### 3.3 Reliability and Validity

With respect to the content validity of the questionnaire, all questions were related to possible causes of the decline in the EAF as identified in the energy industry literature, more specifically those which covered the entire domain applicable to the EAF performance of coal-fired power stations. The use of the questionnaire and the interview guide allowed for the demonstration of convergent validity.

According to Heale and Twycross (2015), the Cronbach's alpha coefficient is the most popular way of determining the instrument's internal consistency. Thus, it was also used in this study and the value was 0.79, which Cronbach alpha value is deemed acceptable.

## 4. Research Findings

Camden Power Station is a highly technical organisation in terms of core processes, and thus, the sample consisted of more (70%) males. The majority (585) of respondents were aged between 35 and 44 years, followed by 20% who were between 45 and 54 years. The majority (26%) of participants had between six to 10 years' work experience, 16% had between zero to five year experience, and 12% between 6-10 years.

Figure 1 depicts the distribution of respondents across the various departments at the power station. The high rate of participation from the Engineering department is obvious, since engineers are actively involved in EAF performance by virtue of their positions.

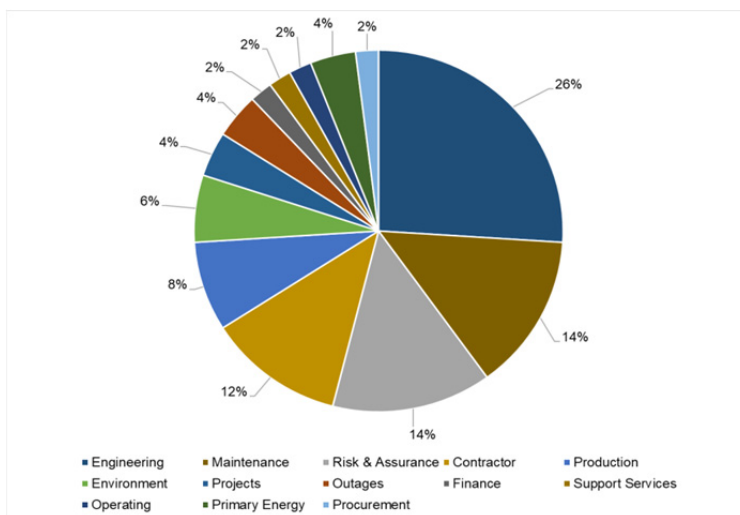


Figure 1: Representation of Sample

The response to the questions related to the participant's perception of the impact of the declining EAF which were developed on a Likert scale where 1: Strongly Disagree and 5 = Strongly Agree, are reflected in Table 3. The mean response (above 3), to the majority of questions indicate a leaning

towards “agreement” with the research statements. The highest mean score (4.72) was in response to the statement about “the negative economic impact of shutting down the power plant”.

**Table 3:** The impact of declining EAF

o	1	2	3	4	5	Mean	SD	Skew	Kurtosis
Possible loss of core and critical skills to other attractive industries.	6%	2%	4%	46%	38%	4,14	1,03	-1,81	3,50
Possible deployment of Camden employees to other power stations outside Mpumalanga.	6%	2%	14%	34%	40%	4,06	1,10	-1,38	1,71
Increased loss of revenue leading to Eskom’s decreased market share.	4%	8%	6%	48%	30%	3,98	1,04	-1,32	1,53
Declined transformation and social sustainability due to discontinued Camden involvement in social responsibility programmes around Ermelo community.	4%	0%	20%	46%	26%	3,94	0,91	-1,22	2,58
Possible reduction of Camden contractors through retrenchments.	6%	6%	14%	40%	30%	3,90	1,13	-1,12	0,79

Causes of the declining EAF

Table 4 - Table 6 reflects the participants perception of the causes of the declining EAF.

**Table 4:** Governance compliance

Likert Scale	1	2	3	4	5	Mean	SD	Skew	Kurtosis
Governance is one of the critical factors resulting to decline in EAF at Camden.	6%	18%	22%	32%	12%	3,43	1,12	-0,34	-0,70
Camden management adheres to Eskom’s ethics policies and programmes, which are monitored consistently.	6%	16%	28%	24%	18%	3,29	1,21	-0,21	-0,81
There are no known acts of sabotage happening in the plant, leading to loss of production at Camden.	4%	16%	48%	20%	6%	3,08	0,91	0,01	0,20
There are no political influences in the implementation of internal governance at Camden.	14%	16%	46%	12%	6%	2,69	1,06	-0,10	-0,38
There are no known cases of acts of corruption, including state capture on site.	20%	18%	46%	6%	4%	2,55	1,10	0,21	-0,19

**Table 5:** The people component

	1	2	3	4	5	Mean	SD	Skew	Kurtosis
In my department, no staff members will retire in the next three years.	8%	4%	16%	40%	26%	3,78	1,14	-1,12	0,83
Low staff morale has contributed to poor performance, leading to declined EAF.	6%	8%	14%	50%	18%	3,68	1,06	-1,03	0,78
Insufficient human resources at Camden has resulted in non-execution of some critical activities in the plant, leading to declined EAF.	8%	14%	22%	34%	16%	3,36	1,21	-0,38	-0,78
The recruitment process still supports sourcing of critical skills to execute the maintenance, engineering and operation of projects related activities.	12%	26%	16%	28%	14%	3,08	1,28	-0,09	-1,14
Camden has sufficient technical skills and experts to timeously address plant and technical challenges.	10%	42%	8%	20%	16%	2,90	1,31	0,36	-1,24
The running of the power station with some managers in acting positions does not contribute to decline in EAF in any way.	14%	26%	24%	24%	6%	2,78	1,16	0,13	-0,91

The questions related to the procurement process related were divided into two sections as tabulated in Table 6.

**Table 6:** The procurement process

	1	2	3	4	5	Mean	SD	Skew	Kurtosis
The procurement process supports plant availability and reliability.	28%	20%	18%	26%	20%	3,67	1,09	-0,72	-0,07
The procurement process turnaround time for sourcing of spares supports timeous response in resolving plant defects.	30%	34%	16%	12%	6%	2,94	1,10	-0,07	-0,75
No reworks are incurred as a result of using sub-standard spares.	36%	34%	18%	8%	6%	2,70	1,13	0,19	-0,64
End-users are pro-active in placing purchased requests (PR's).	8%	26%	28%	28%	4%	2,58	1,28	0,12	-1,35
The turnaround time in creating purchased orders (PO's) is fairly quick.	20%	28%	30%	16%	2%	2,48	1,05	0,22	-0,71
Compliance to SD&L requirements supports plant reliability and availability.	14%	28%	32%	16%	4%	2,18	1,16	0,79	-0,23
Procedure for contract evaluation and award is long.	4%	10%	18%	42%	0%	2,04	0,99	0,58	-0,70

The questions related to plant component were divided into two sections, as tabulated in Table 7.

**Table 7:** The plant component

	1	2	3	4	5	Mean	SD	Skew	Kurtosis
Though ash dam capacity constraints poses a short term risk, its impact contribution for the period under review has been huge for overall Camden EAF.	2%	6%	26%	24%	38%	3,94	1,05	-0,66	-0,25
Deferred maintenance (philosophy outages) has led to compromised plant integrity in the plant leading to declined EAF.	8%	10%	12%	44%	22%	3,62	1,21	-0,80	-0,24
In the period of January 2018 to December 2019, the ash dam constraints were the main cause for declined EAF.	4%	14%	24%	34%	20%	3,56	1,15	-0,41	-0,69
Engineering change management process supports plant availability and reliability.	2%	18%	22%	48%	6%	3,36	0,98	-0,66	-0,28
The implemented actions from trip investigations prevent recurrence of unit trips.	2%	14%	34%	44%	2%	3,30	0,84	-0,63	-0,18
Utilisation of QCP process during maintenance and outages activities is on standard.	6%	22%	24%	38%	2%	3,08	1,01	-0,84	-0,43
The culture of innovation is embedded to Camden processes and it is effectively improve plant integrity.	2%	26%	34%	32%	2%	3,00	0,93	-0,16	-0,74
Supervision of the plant activities is up to standard.	0%	34%	22%	32%	0%	2,98	0,92	0,23	-1,39
Plant inspections are performed frequently and effectively leading to timeous reporting of the plant defects.	10%	30%	18%	30%	6%	2,80	1,19	-0,05	-1,20
SAP Defect notifications are executed and closed off timeously on the system.	8%	46%	22%	20%	0%	2,58	0,93	0,32	-0,93

The finance component results are tabulated in Table 8.

**Table 8:** The finance component

	1	2	3	4	5	Mean	SD	Skew	Kurtosis
My department's budget supports my department's objectives.	4%	16%	26%	34%	14%	3,41	1,10	-0,30	-0,65
All technical projects applicable in my section and system were executed without financial constraints or delays.	8%	36%	32%	14%	4%	2,67	0,97	0,42	-0,06
Financial constraints has not contributed to declined EAF at Camden.	18%	44%	20%	8%	4%	2,35	1,03	0,79	0,31
My department's budget supports staff retention strategy (if an employee leaves for better offers outside Camden, there will be a way of retaining that employee through offering competitive offers in line with pre-determined market pay rates).	32%	28%	28%	4%	2%	2,14	1,02	0,56	-0,21

The last component was management behaviour results, as tabulated in Table 9 below.

**Table 9:** Management behaviour

	1	2	3	4	5	Mean	SD	Skew	Kurtosis
Management behaviour is contributing positively towards EAF performance.	2%	18%	18%	46%	12%	3,52	1,01	-0,48	-0,50
Senior management ensures that EAF related actions are implemented effectively.	4%	16%	16%	52%	8%	3,40	1,03	-0,65	-0,44
Senior management is supporting line management effectively to achieve EAF targets through effective departmental working team sessions (WTS) or other departmental monitoring meetings in place.	0%	22%	18%	48%	8%	3,38	0,99	-0,45	-0,69
Site managers (contractors) are supporting EAF turnaround through service delivery as per contractual agreements.	10%	18%	22%	30%	16%	3,22	1,23	-0,23	-0,91

#### 4.1 Qualitative Data

Below is a discussion of the seven themes that emerged through analysis of the qualitative data.

##### 4.1.1 Staff morale

It became apparent that the employee morale had been negatively affected because of the poor performance of the power plant. This was confirmed by the statements below:

*P01 said that, "Trust has been broken in that employees do not believe management anymore that in that performance can be turned around. In some toolbox talk meetings, employees' negativity is eminent. Some of the contributing factors include the fact that they feel that sometimes they are not listened when they raise potential risks for action to be taken in advance until the risks manifest."*

*P05 said that, "Staff morale affected by the fact that they do not see any change - no plant improvement and this discourages them from continuing".*

The majority of respondents said that the declining EAF had a significant impact on employees' commitment, such that they no longer trusted that performance would be improved, that the Camden power station would be shut down in the near future and that this would compel them to seek employment elsewhere.



#### 4.1.2 Increased maintenance cost

Increased cost of maintenance has been highlighted as one of the factors that affect the performance of the plant. This was confirmed by some of the statements below.

*Po8 indicated that, "Eskom is losing trust to Camden due to high expenditure on increased maintenance as the station is paying contractors yet there is no improvement and this has a very high financial impact".*

*Po5 said that, "Financial performance has been impacted as the maintenance cost has increased, especially in 2018 where the station experienced high emissions in the plant resulting in increased maintenance activities".*

Given Eskom's financial status, there was need to cut costs in all areas of the business. However, in an attempt to save costs, the station ends up paying more due to increased plant maintenance brought about through increased demand.

#### 4.1.3 Lack of coordination

The respondents are of the view that lack of coordination of efforts results in a delayed response to plant defects. In this regard,

*Po2 said that, "Some things that were in management's power were not addressed timeously addressed such as filling up critical skills when the stations were given the opportunity to so. There is an element of lack of accountability in leadership. The defensive approach at times leads to necessary actions not being taken swiftly to bring about the change that is required".*

*P11 observed that, "There is evidence of shifted focus and "fire-fighting" mode for management at the station. It seems difficult for management to tackle problems according to hierarchy of importance".*

The findings indicated that senior management has been ineffective in getting all employees to be committed and driving EAF. This is partly due to the fact that management did not agree with the power station's contract targets, as they did not factor in the context in terms of the status of the power plant. Senior management did not consistently walk the talk; hence employees resorted to functional duties (silo mentality), instead of cross functional responsibilities. This has led departments to work in a "fire-fighting" mode, meaning the station is more reactive than proactive.

#### 4.2 Uncertainty about the future of the power station

There is currently no finality on the request to extend the power station's life beyond 2023. For this reason, management cannot make sustainable long-term decisions about the plant. Management's inability to commit to long-term decisions that will turn around performance leads to despondent employees on the shop floor. Some specific responses are reflected below:

*P10 said that, "Not knowing the future of the station has precipitated fears that Camden might close down and this has been evident based on their outputs".*

*Po8 said, "Camden must still consider technology for possibilities of extending plant life span. The cost benefit analysis can assist in determining the potential value that can be achieved through technology. South Africa still needs more electricity and Camden can target those areas where the station is losing too much money on to turn around the status quo. There is a need to embrace the change".*

#### 4.2.1 Short-term approach

Some of the activities are not being carried out, either due to inadequate human resources or

financial contracts and management works hard to stretch the available resources. This situation leads to management challenges, since management is compelled to think short-term rather than long-term. The following examples of responses indicate that due to the short term view of the business, short term solutions are being implemented, which eventually impact performance.

*Po6 observed that, "Management is expected to make things happen regardless of the conditions. During the time when there was no milling plant contract in place for 3 months, there were many defects in the plant to be attended to with inadequate resources. This affects the commitment since management expected to do more with less which sometimes such as instances where there is cost cutting leading to some work not being done at all".*

*Po8 said that, "Management is unable to meet their targets and station is experiencing uncontrollable load losses and this has affected commitment. Though it is known which defects are causing EAF decline but to due financial constraints the station ends up implementing short term solutions".*

#### 4.2.2 Increased workload

The continuous decline in performance has resulted in management being despondent due to inter-alia, lack of support in filling critical vacant positions. Most candidates are aware that the power station may close in the near future, which is not an attractive prospect for them. The lack of appropriate reward systems or mechanisms contributes to a loss of critical skills and an inability to attract candidates to fill critical positions. Some of the remarks to confirm the aforementioned views include the following:

*Po6 observed that, "The low staff morale due to high work load due to staff shortages. This leads to short term decisions being taken and encourages staff to seek for other greener pastures".*

*Po9 said that, "Management keeps pushing employees and telling them they are not achieving the targets, results leading to exhaustion and increased sick leave due to hard working. This has led to other team members pulling more whilst others are pulling less".*

*P11 observed that, "Most workers' job description has expanded in order to fulfil the capacity of a complete workforce and this has created lot of frustrations".*

#### 4.3 Overall Performance

The unanimous view of the participants was that a decline in the EAF will definitely impact the power station's overall performance. Some key statements which confirm the above include the following:

*Po9 observed that, "EAF is a key driver of station performance and therefore if EAF is affected, the other KPI's will suffer also, i.e. Trips, UCLF, PLL, OCLF, and Engineering Composite Index. The impact is on both technical and non-technical KPI's, for instance safety performance gets affected if employees are working harder than usual, similarly with HR KPI's - increased sick leaves booked. Whilst trying to meet EAF target, Environmental KPI's get compromised. For an example in 2018, FFP bags incident, where there was the ash dam failure and the station was not able dust this led to high stack emissions".*

*P10 also stated that, "Yes, the EAF has affected many station KPI's including, PCLF, water consumption including loss of revenue". Finally, P11 said, "the performance of Camden is EAF. If the availability of units is compromised, it means there will be a decline in performance. The issue of bonuses being cut off for workers also has had a negative impact on the morale of workers".*

#### 4.4 Socio-economic impact

The majority of respondents viewed the socio-economic impact of the decline in the performance of the power station as being huge on the town (Ermelo) and its surrounding communities. For example,

*Po2 indicated that, "Businesses and local people around Ermelo are impacted due to job losses leading to economic impact because Camden is the biggest employer of permanent and non-permanent employees".*

*Po7 said that, "There is a lot of contractors that employ people from surrounding communities. When they see Camden not performing, job opportunities are affected. To some degree, some members of the communities may cause unrest when they are not being employed as it has happened in the past. Camden is a National Key Point and so controls to such events could be improved so that EAF improvement could be prioritized rather than allowing some members of the community to dictate when it comes to employment of contractors".*

### 5. Conclusion and Recommendations

The study revealed that the majority of respondents concurred that the declining EAF had a significant negative impact on economic activities, the unemployment rate, revenue and CSR. The declining EAF therefore has a significant negative impact on the power station's macro-environment, especially on the provincial and national GDP. It was ascertained that the five main causes of the decline on the EAF at the Camden power station were leadership, finance, plant, process and people. Since Contract managers (CMs) manage the relationship between Eskom and the service provider once the supply chain (procurement) department has concluded the contracting process, the CMs should ensure that the supervisors have the requisite contract management skills, so that they can be effective in managing their contracts.

The Procurement department could investigate causes of delays in the turnaround time for creating purchase orders (POs). This department should also determine if the power station leverages the value existing in eProcurement software.

The Maintenance department should assess the skills gap in quality control and benchmark against the best and/or better performing power stations. This will improve the quality of inspections conducted during outages, maintenance and projects related activities. The Human Resources department should consider assessing the level of employee morale at the station and address gaps which are identified.

In summary, it is recommended that the power plant management:

- strategically channel required funds to projects aimed at improving the EAF at the power station.
- aim to be consistent when applying procedures and focus more on strategic planning. Furthermore, where managers take control for extended periods, they should not only inspect what they expect, but also take accountability for the performance of delegated managers.
- should drive reliability maintenance recovery (RMR), which is an Eskom Generation initiative, to restore service prior to, during and post the outages. Implementation of RMR will address poor technical performance related to outage deferrals.
- should consider the feasibility of streamlining the sourcing of coal and reduce dependence on a single source, so as to influence conditions related to coal contracts. This could also assist in addressing issues associated with poor coal quality.

## References

- Adams, J., Raeside, R., and Khan, H., 2014, *Research Methods for Business and Social Science Students*, 2<sup>nd</sup> ed., New Delhi: Sage Publications Pvt. Ltd.
- Adedeji, P.A., Akinlabi, S. Madushele, N. & Olatunji, O.O. 2019, *Towards Low-carbon Energy State in South Africa: A survey of Energy Availability and Sustainability*, European Union Digital Library, Research Article, <https://eudl.eu/doi/10.4108/eai.13-7-2018.161751>
- Allcott, Hunt; Collard-Wexler, Allan; O'Connell, Stephen D., 2016, *American Economic Review*, Vol. 106 Issue 3, pp. 587-624.
- Burkhardt, P., 2020, *South Africa Utility Eskom Warns Coal Suppliers*, Bloomberg Green, <https://www.bloomberg.com/news/articles/2020-04-21/eskom-widens-force-majeure-to-coal-miners-as-virus-hobbles-power>.
- Camden Bulletin, 2020, *Temporal Unit Shutdown Update Bulletin*, Camden Communication.
- Creswell, J., 2013, *Research Design: qualitative, quantitative, and mixed methods approaches*, 4<sup>th</sup> ed., Los Angeles: Sage Publications
- Creamer, T., 2020, *As Eskom rolls out boiler fixes to more Medupi units, it confirms FGD talks with World Bank*, Creamer media's Mining Weekly, [https://m.miningweekly.com/article/as-eskom-rolls-out-boiler-fixes-to-other-medupi-units-it-confirms-fgd-talks-with-world-bank-2020-05-21/rep\\_id:3861](https://m.miningweekly.com/article/as-eskom-rolls-out-boiler-fixes-to-other-medupi-units-it-confirms-fgd-talks-with-world-bank-2020-05-21/rep_id:3861).
- De Castro Camioto, F., Morales H., Mariano E. and do Nascimento Rebelatto, D, 2016, *Energy Efficiency Analysis of G7 and BRICS considering total-factor structure. Journal of Cleaner Production*, [https://www.researchgate.net/publication/294103350\\_Energy\\_efficiency\\_analysis\\_of\\_G7\\_and\\_BRICS\\_considering\\_total-factor\\_structure](https://www.researchgate.net/publication/294103350_Energy_efficiency_analysis_of_G7_and_BRICS_considering_total-factor_structure)
- Eskom, 2020, *Eskom Holdings Generation Business Plan, FY 2021-2023, Rev 9, No. 240-56927206* [https://hyperwave.eskom.co.za/Eskom/Generation/Strategy%2C%20Technology%20and%20Assurance/Plan%20Performance/APPROVED\\_GX%20BUSINESS%20PLAN%20FY2021-23%20REV5.pdf](https://hyperwave.eskom.co.za/Eskom/Generation/Strategy%2C%20Technology%20and%20Assurance/Plan%20Performance/APPROVED_GX%20BUSINESS%20PLAN%20FY2021-23%20REV5.pdf)
- Eskom, 2020, *Temporary shutdown of Camden units due year to date progress on temporary shutdown of Camden units*, Camden communication, Issue date: 22.08.2020.
- Gernetzky, K., 2020, *Eskom to start stage 2 load-shedding — may last through weekend*, <https://www.businesslive.co.za/bd/national/eskom-to-start-stage-2-load-shedding-may-last-through-weekend/>
- Goliada, R., 2018, *An Investigation on Inefficiencies in Spare Part Management, Processes in South African Power Plants*, University of Pretoria <https://repository.up.ac.za/handle/2263/6619537>. Creamer Media, 2020, Eskom breakdowns are shrinking slowly, Koeberg unit back online, Polity, News.
- Heale, R., and Twycross, A., 2015, *Validity and Reliability in Quantitative Studies*, School of Nursing, ResearchGate [https://www.researchgate.net/profile/Alison\\_Twycross2/publication/280840011\\_Validity\\_and\\_reliability\\_in\\_quantitative\\_research/links/55c8e88c08ae2d9bdc92052/Validity-and-reliability-in-quantitative-research.pdf?origin=publication\\_detail](https://www.researchgate.net/profile/Alison_Twycross2/publication/280840011_Validity_and_reliability_in_quantitative_research/links/55c8e88c08ae2d9bdc92052/Validity-and-reliability-in-quantitative-research.pdf?origin=publication_detail)
- KPMG, 2017, *Economic Impact Assessment of five of Eskom's Coal Power stations*, KPMG, Report, <https://cer.org.za/wp-content/uploads/2018/02/Economic-impact-assessment-of-5-CFPSs.pdf>.
- McCafferty, R., 2019, *Akron's leadership instability creates 'Interim U'*, Crain's Cleveland Business. 3/25/2019, Vol. 40 Issue 12, p6-6. 1p. ISSN:0197-2375
- Mc Nett, M., 2016, *Deferred maintenance and risk assessment: Technical analysis is critical to the process*, Plant Engineering <https://www.plantengineering.com/articles/deferred-maintenance-and-risk-assessment-technical-analysis-is-critical-to-the-process/>
- Micali, V., 2012, *Prediction of Availability for New Power Plant in the Absence of Data, Proceedings of the 9<sup>th</sup>, Industrial and Commercial Use of Energy Conference*, Stellenbosch, pp. 1-8.
- Njini, F., Naidoo, P., & Prinsloo, L., 2019, *Blackouts Hit Phone Networks, Spur Equipment Theft: Eskom Update*, Bloomberg.com. 12/10/2019, pN.PAG-N.PAG. 1p. <https://news.futunn.com/stock/10230135?src=3>
- Pillay, K., 2018, *Coal Shortages could Spark Power Cuts*, The Mercury, News <https://www.iol.co.za>
- South African Government Treasury, 2019, *Fiscal Support for Electricity Market, 2019 Budget Review*, reform <http://www.treasury.gov.za/documents/National%20Budget/2019/review/Annexure%20W3.pdf>
- Schindler, J., 2014, *The Availability of Fossil Energy Resources*, [https://www.researchgate.net/publication/299672641\\_The\\_Availability\\_of\\_Fossil\\_Energy\\_Resources](https://www.researchgate.net/publication/299672641_The_Availability_of_Fossil_Energy_Resources)
- Saunders, M., Lewis, P. and Thornhill, A. 2013, *Research Methods for Business Students*, 6<sup>th</sup> ed., Cape Town: Pearson Education

Statistics South Africa, 2019, *Statistical release*, P0211, Quarterly Labour Force Survey, Quarter 1: 2019,  
<http://www.statssa.gov.za/publications/P0211/P02111stQuarter2019.pdf>

Statistics South Africa, 2019, *Statistical release*, P0211, Quarterly Labour Force Survey, Quarter 1: 2019,  
<http://www.statssa.gov.za/publications/P0211/P02111stQuarter2019.pdf>.

[www.fin24.com/Economy/eskom-starts-shutting-down-old-coal-power-plants-20190301-2](http://www.fin24.com/Economy/eskom-starts-shutting-down-old-coal-power-plants-20190301-2)