Engineering Compliance

STANDARD OPERATING PROCEDURE FOR EMERGENCY POWER

Approved by Emergency Power Response Team on: 19 March 2024.

1 Objectives

The objective of this Standard Operating Procedure (SOP) is to put the emergency power generators' capacity, usage, availability and distribution priorities in perspective.

2 Current emergency power generating capacity

It must be emphasised that the emergency power generating plants (also referred to as the emergency generators) cannot replace Eskom or municipal supply. The systems are defined in such a way to keep the core business of the NWU operational during power outages or during loadshedding events.

The three campuses have central emergency power generating plants, and there are also numerous dedicated generators placed at critical installations such as data centres and research facilities on all three campuses. However, during normal business hours the central emergency power generating plants cannot supply the total demand for the respective campuses, and therefore emergency power is supplied as per the distribution priority list.

This means that when the capacity is not sufficient or when there is a failure of emergency power generating plants and supporting infrastructure some buildings will be without emergency power during normal operating hours.

Installation of solar plants and expansion of the emergency power generating capacity are in process via various projects. The aim is to install solar plants to supply the base load of each campus. This means that the emergency power generating plants will be able to supply the added demand as solar and emergency power can co-generate during office hours. This will lead to a reduction in the use of emergency power generated through the emergency power generating plants and a reduction in utility consumption when there is normal utility supply power.

3 Priorities for distribution of emergency power

The emergency power generating plants were installed between 2008 to 2012, and at that stage the electricity generation capacity was sufficient seen in context with the on-campus activities and demand. This however is not the case anymore.

To protect the emergency generators and supporting infrastructure, we cannot allow the equipment to generate more than 90% of the electricity generation capacity, which recently frequently required, especially on the Potchefstroom and Mahikeng campuses.

Medium voltage load control at the 11 000V substations is part of the systems design. This means the system can automatically switch off some sections off the campuses to try and supply emergency power to those areas where core business operations are conducted during the power outage.

The main distribution substations consist of medium voltage breakers which are remotely controlled via the load control systems and priority setpoints. Lecture and exam facilities, research areas and dining halls are the buildings defined as core business and will be supplied with emergency power at all times as far as possible.

4 Emergency power systems

The distribution network is managed per campus as described below:

4.1 Potchefstroom Campus: Usage 8,5 MVA, generation capacity 6,5 MVA, reduction of 2 MVA

The main substation consists of 22 panels that distribute power to the campus. These panels are used to control the generator capacity.

The current control methodology informs the supply of emergency power whereby the following areas are switched off:

i. West Campus housing and residences;
ii. University residences on campus;
iii. Dennepark facilities, Sports Village, North West Cricket and the RAG Farm grounds (unless there are televised events);
iv. Sport facilities on Fanie du Toit (unless there are televised events);
v. Astro Villa and Astro hockey fields (unless televised events); and
vi. Buildings that are not essential to the core business.

4.2 Mahikeng Campus

4.2.1 Mahikeng Campus: Usage 4,9 MVA, generation capacity 4 MVA

The main substation consists of 13 panels that distribute power to the campus. These panels are used to control the generator capacity.

The current control methodology informs the supply of emergency power whereby the following areas are switched off:

i. University residences situated on East Campus;
ii. University residences situated on West Campus;
iii. Sport facilities (unless there are televised events); and
iv. Buildings that are not essential to the core business.

4.2.2 Mahikeng residences: Usage 1,2 MVA (current will increase), generation capacity 3 MVA

The main substation consists of five panels that distribute power to the residences. These panels are used to control the generator capacity.

The current control methodology informs the supply of emergency power whereby the following areas are switched off:

1. University residences operating on *Ring A*;
2. University residences operating on *Ring B*; and
3. Buildings that are not essential to the core business.

4.3 Vanderbijlpark Campus: Usage 1,2 MVA, generation capacity 1,7 MVA

The main substation consists of six panels that distribute power to the campus. Currently the generators can still supply the whole campus, but since the campus is expanding rapidly, loadshedding during normal operating hours is a reality.

The current control methodology informs the supply of emergency power whereby the following areas are switched off:

1. University residences separated via the 11 000V *Rings*;
2. Sport facilities (unless there are televised events); and
3. Buildings that are not essential to the core business.

4.4 Emergency control protocols

Emergency control protocols are managed via the central load control systems, where radio signals, Global System for Mobile Communications and other load switches are used to switch off among others, non-essential loads such as heaters, split unit air conditioners, hot water systems, etc. This is linked to the available emergency power capacity as measured in real time for real-time control.

5 Water reservoirs and emergency water systems

5.1 Background

The strategy is to install water reservoirs on all campuses to have spare water capacity in the event of a water outage.

Clean drinking water is, and will become, the scarcest resource in the world due to water pollution, poor condition of water treatment plants, and waterworks not functioning or being maintained. This means that the university must ensure that we have a reliable supply of clean water to the campuses. Municipalities and water companies cannot commit to the reliable supply of drinking water anymore, and constant interruptions are experienced.

The practice to use boreholes to supply emergency water is one of the only ways to supply the campuses with emergency water, and this approach has already been implemented at the Mahikeng Campus. Water treatment plants on campuses are also being installed to enable the university to use grey water and clean it to be useable for irrigation and possibly human consumption.

Treatment plants for sewerage are also being investigated.

5.2 Current reservoir capacity

Currently, the university has the following reservoirs:

5.2.1 Mahikeng Campus:

i. 1 x Campus reservoir with a capacity of 1,1 million litres.
ii. 1 x University residences reservoir:1,1 million litres.

5.2.2 Potchefstroom Campus:

i. 1 x Reservoir situated at Veritas men's residence with a capacity of 1,1 million litres.
ii. 1 x Reservoir situated at De Wilgers men's residence with a capacity of 1,1 million litres.
iii. 1 x Reservoir situated on West Campus with a capacity of 1,1 million litres.

5.2.3 Vanderbijlpark Campus:

- New installations are currently being procured.

5.3 Additional water systems processes and initiatives

The following also forms part of reservoir installations:

i. Major water reticulation to enable the reduction of municipal connections.
ii. Upgrading infrastructure with ring reticulation to enable supply when there are leaking pipes.

6 Current challenges

6.1 Reliable water and electricity supply

Reliable water and electricity supply are not guaranteed by the utility suppliers, and constant price increases do not justify the financial impact to the university. Sustainable sources are being used and being investigated to ensure reliable supply.

6.2 Emergency power

The current strategy is to switch off non-essential loads to ensure emergency power for classes, exams and other core business functions. During afterhours outages the generator capacity is sufficient, and campuses will be supplied by emergency power if all the emergency generators are operational.

During emergency power usage it's imperative to note that non-essential electrical usage such as, space heating and cooling in offices, and sport field lights (especially at night), **are not allowed**. Non-essential electricity usage creates unnecessary capacity issues and damages the university's reputation by the local community perceiving the NWU as wasting emergency power. The higher the generated capacity, the higher the running expenses the lower the expected lifespan of equipment.

Currently, the emergency power generation equipment is used excessively and beyond the initial design parameters indicate, which leads to unexpected failure of some equipment and supporting infrastructure. Even though maintenance of these units is a high priority, repairs are expensive and difficult to achieve due to a shortage in available parts and resources, both nationally and internationally.

6.3 Behavioural change

Looking at all the possible options for conserving resources and reducing consumption, it is a reality that staff and students do not always limit or reduce their consumption, which is very concerning. It is of utmost importance to ensure that staff and students comply and assist collaboratively with the reduction of energy usage, use water sparingly, minimise waste, and realise that every person plays a critical role in the sustainability of the NWU.

7 Strategic energy projects

The strategic energy projects enable the NWU to start controlling large energy using equipment with a multitude of devices, programs and load controllers. The inclusion of UPSs and small hybrid grid-tie solar systems are in process, and certain critical equipment such as lights and lecture equipment will be moved to sustainable uninterruptable power supply sources to minimise interruptions.

8 Cost impact of emergency generated power

The effective cost of energy supplied by diesel generators in the central generating plants – which includes capital, maintenance, breakdown and running costs – is approximately R12/kWh compared to the normal utility cost of R3,5/kWh (as per the utility account of September 2023 – last of the winter tariffs). Emergency power is almost four times more expensive than normal utility supply. The diesel costs for running the emergency power generation plants are summarised below:

	Campus	**Cost per hour**
1..	Potchefstroom Campus	± R40 000/hour
2.	Mahikeng Campus	± R30 000/hour
3.	Vanderbijlpark Campus	± R15 000/hour
4.	**Institutionally**	**± R85 000/hour**

***Amounts indicated above are approximate calculations based on data available at the time of the development of this SOP.*

9 Summary

With the uncertainty of electrical supply from Eskom, local municipalities and loadshedding, the NWU has to be prepared for the worst. The stark reality is that the NWU's emergency supply is not sufficient to supply all activities on the campuses anymore, and by minimising the emergency power demand by implementing generator load control is an expensive and extensive process.

The *Strategic Energy Projects* will assist with methods, processes, and equipment to reduce the required emergency power. This will enable the generators to add sustainable power to classes, exams and other core business functions during office hours and supply university residences at night.

With the central plants it's less complicated to maintain, fill, test and ensure sustained power delivery compared to decentralised loose standing units. However, the systems are tested weekly and run monthly to ensure optimal operation.

"*Energy conservation has to become a way of life, with every person at the NWU using electricity and water sparingly.*"

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