Eskom	Technical Instruction	Technology

Title: **STANDBY BATTERY STORAGE IN ESKOM**

Unique Identifier:	**240-87495495**
Alternative Reference Number:	**n/a**
Area of Applicability:	**Engineering**
Documentation Type:	**Technical Instruction**
Revision:	**1**
Total Pages:	**6**
Next Review Date:	**n/a**
Disclosure Classification:	**Controlled Disclosure**

Compiled by	Functional Responsibility	Authorized by
Christo van Zyl	**Thomas Jacobs**	**Amelia Mtshali**
Senior Technologist	**DC & Auxiliary Supplies SC Chairperson**	**Metering, DC & Security Technologies Manager**
Date: 12 May 2015	Date: 12 May 2015	Date:13 May 2015

PCM Reference: **240-45541534**

SCOT Study Committee Number/Name: **Part 16: DC & Auxiliary Supplies SC**

Content

Instruction

This technical instruction has been compiled due to the delays in the timeframes of some projects resulting in the situation where batteries are left in crates (storage) for prolonged periods without being charged during project executions. When a project is delayed, the local DC specialist section (Control Plant Maintenance) shall be informed by Project Management of the battery banks that will be left in storage for an extended period of time until the site is ready for installation. If so, banks are to be rejuvenated as per the Original Equipment Manufacturer instructions before commissioning. Project Management need to take note of cost implications (either by Eskom or the supplier) and the impact on the equipment warrantees.

Different battery technologies can be stored for different time periods.

Nickel Cadmium cells can be stored for up to 24 months without any rejuvenation, however after 2 years the batteries are being damaged due to the internal self-discharge which can result in irreversible capacity loss.

Wet (flooded) charged lead acid batteries can be stored for up to 3 months after which an equalising charge has to been done. Failure to do so may result in sulphation of the plates greatly reducing the capacity and service life of the battery. Dry charged lead acid batteries can basically be stored infinitely if kept in a dry cool place out of direct sunlight, preferably indoors.

The aim of this technical instruction is to raise awareness within Project management departments of the negative impact on battery state-of-health during prolonged storage and to provide detailed instructions on what actions are to be taken if we do need to store batteries for prolonged durations.

Revision history

Date	Rev.	Compiled by	Remarks
May 2015	1	C van Zyl	New document.

1. Storage of new Nickel Cadmium batteries

The nickel cadmium (Nicad) cells are delivered filled with electrolyte and in a charged state. While in storage, the state-of charge of any cell on open circuit slowly decreases with time due to self-discharge. This decrease in state-of-charge is relatively rapid during the first two weeks, but then stabilises to approximately 2% per month at 20 °C. This means that after a year in storage, a Nicad cell would have an estimated 76% of its initial capacity available. The rate of self-discharge (see **Figure 1**) increases with an increase in temperature. At an electrolyte temperature of 40 °C, the Vantex cell will have about 50% of its initial capacity available after a period of 175 days. Due to these factors certain storage and commissioning requirements need to be complied with to prevent damage to the cells.

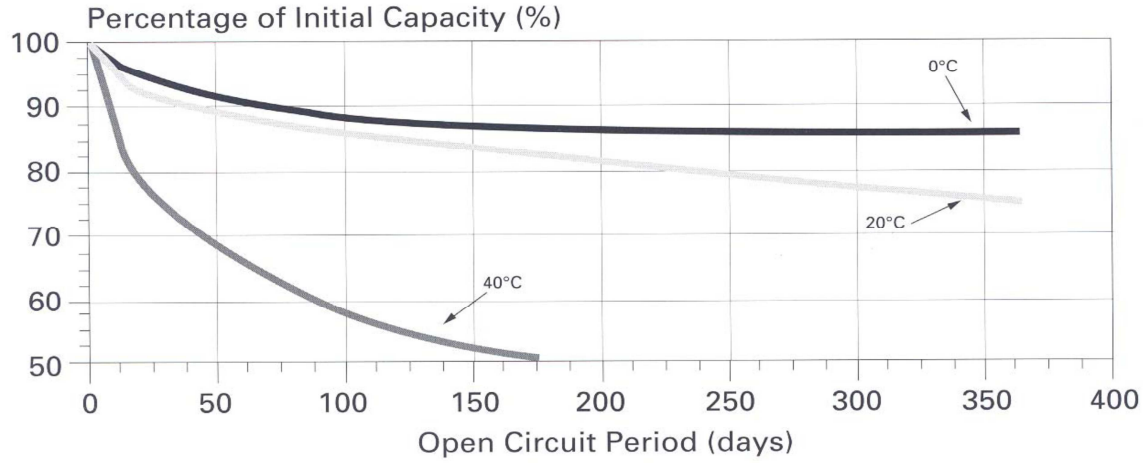

Figure 1: Typical open circuit capacity loss with time

1.1 Prolonged storage requirements for Nickel Cadmium cells

The prolonged storage of nickel cadmium cells is not recommended, however if prolonged storage is inevitable, then the following recommendations shall be adhered to:

- Cells can be stored in original packing crates until required for installation or recharging, however the lid and the packing material on top of the cells must be removed.
- Store the cells indoors in a dry, clean, preferred cool (0 °C to +30 °C) environment.
- Do not store the cells in direct sunlight or expose it to excessive heat.
- Never drain the electrolyte from the cells.
- This means that crates that were normally stacked (up to the maximum recommended limit) shall now be packed next to each other with their lids and packing material removed – this will require more space in terms of floor area.

The prolonged storage of nickel cadmium cells is not recommended. Therefore it is critical that project planning is optimised in order to ensure that the period of storage is kept to an absolute minimum.

Table 1: Nicad storage requirements Storage Period [Months]	**Instructions**
6 or less	• The Nicad cells are delivered fully charged and ready for immediate use. • The cells may be put directly into service on float charge. Therefore, under these conditions, a commissioning charge before putting the cells into service is not necessary.
More than 6, but less than 24	Commissioning charge on installation will be required as per 1.2
24 and more	• Freshening Charge as per 1.3 • Repack and return the cells to storage • Repeat this cycle every 24 months

1.2 Commissioning charge cycle of Nickel Cadmium cells

Nicad cells are to be given a commissioning charge to prepare the cells for installation after prolonged storage of more than 6 months The Nicad cells shall be given the following discharge/charge cycle:

- Discharge the cells at $0.2C_5$ A to an average end-of-discharge voltage of 1.00 V/cell.
- Recharge the cells at $0.1C_5$ A (maximum) for 16 hours until the cells have accepted a capacity of $1.6C_5$ Ah. Voltage control must not be applied as this is a current controlled charge and therefore cell voltages may reach up to 1.85V per cell.
- Top up the electrolyte levels to the MAX mark with de-ionised water if necessary.
- The cells will then be ready for installation.

1.3 Freshening charge cycle of Nickel Cadmium cells

The Nicad cells are normally given a freshening charge to rejuvenate the cells and prepare it for further storing after 24 months storage. This is basically the same as the commissioning charge.

- Discharge the cells at $0.2C_5$ A to an average end-of-discharge voltage of 1.00 V/cell.
- Recharge the cells at $0.1C_5$ A (maximum) for 16 hours until the cells have accepted a capacity of $1.6C_5$ Ah. Voltage control must not be applied as this is a current controlled charge and therefore cell voltages may reach up to 1.85V per cell.
- Top up the electrolyte levels to the MAX mark with de-ionised water if necessary.

- Repack and return the cells to storage

2. Storage of new flooded Lead Acid batteries

Flooded Lead Acid batteries can be ordered as “wet” or “dry” cells. Dry cells are cells without sulphuric acid electrolyte added to the cell. The electrolyte is delivered separate from the cells in containers. The cells can then basically be stored infinitely until required for initial charge and commissioning. This method is recommended when project execution time frames are uncertain.

When Lead Acid cells are ordered in the “wet” state, they are delivered filled with electrolyte, initial charged, tested and in a fully charged state. They will however self-discharge over a short time period which can lead to sulphation of the plates and greatly reduced capacity and expected service life.

2.1 Prolonged Storage requirements for flooded Lead Acid cells

The prolonged storage of “wet” flooded lead acid cells is not recommended, however if prolonged storage is inevitable, then the following recommendations shall be adhered to:

- Cells can be stored in original packing crates until required for installation or recharging, however the lid and the packing material on top of the cells must be removed.
- Store the cells indoors in a dry, clean, preferred cool (0 °C to +30 °C) environment.
- Do not store the cells in direct sunlight or expose it to excessive heat.

2.2 Storage period of less than 3 months for flooded Lead Acid cells

The “wet” flooded lead acid cells are delivered fully charged and ready for immediate use and provided that they had not been stored for more than 3 months, they may be put directly into service on float charge. Therefore, under these conditions, an equalizing charge before putting the cells into service is not necessary. A normal Boost charge cycle for 4 hours is recommended.

2.3 Storage period in excess of 3 months for flooded Lead Acid cells

To prevent damage to “wet” flooded lead acid cells an equalizing charge must be performed after a maximum storage period of 3 months. If the storage period extends over several months the equalizing charge has to be repeated every 3 months. It is recommended that the storage time should not exceed 24 months.

2.4 Equalizing charge for flooded Lead Acid cells

- Charge the cells at $0.07C_{10}$ A continuously for up to 72 hours. At his point the cells should be gassing vigorously with voltages in the region of 2.5 to 2.75 volt per cell. Voltage control must not be applied as this is a current controlled charge.
- Continuously monitor the cell electrolyte temperature and if the temperature exceeds 50 °C, interrupt the charging process or continue with a reduced current.
- The end of equalizing charge is reached when the electrolyte densities and cell voltages no longer changes within a 2 hour period.
- Top up the electrolyte levels to the MAX mark with de-ionised water if necessary.

3. Storage of new Valve Regulated Lead Acid (VRLA) Lead Acid batteries

VRLA batteries will self-discharge over a 6 months period at 20 °C which can then lead to sulphation of the plates and greatly reduced capacity and expected service life. The storage temperature for VRLA batteries however is very critical, as an increase of 8 °C will reduce the storage time by 50%.

3.1 Prolonged Storage requirements for VRLA Lead Acid cells

The prolonged storage of VRLA lead acid cells is not recommended, however if prolonged storage is inevitable, then the following recommendations shall be adhered to:

- Cells can be stored in original packing crates until required for installation or recharging.
- Store the cells indoors in a dry, clean, preferred cool (0 °C to +30 °C) environment.
- Do not store the cells in direct sunlight or expose it to excessive heat.

3.2 Storage period of less than 3 months for VRLA Lead Acid cells

The VRLA lead acid cells are delivered fully charged and ready for immediate use and provided they had not been stored for more than 3 months, they may be put directly into service on float charge. Therefore, under these conditions, an equalizing charge before putting the cells into service is not necessary.

3.3 Storage period in excess of 3 months for VRLA Lead Acid cells

To prevent damage to VRLA lead acid cells, an equalizing charge shall be performed after a maximum storage period of 3 months. If the storage period extends over several months, the equalizing charge has to be repeated every 3 months. It is recommended that the storage time should not exceed 24 months.

3.4 Equalizing charge for VRLA Lead Acid cells

The standard equalization charge would be for 24 hours at a constant voltage of 2.35 Volt per cell at 20 ºC or 2.33 Volt per cell at 25 ºC.

4. Implementation by Project Management

Project Management shall be held accountable for the implementation of this Technical Instruction. If not implemented, new batteries can be damaged beyond repair even before commissioned and as such it must become a standard Project Management meeting agenda point at all site project meetings, i.e. *refresh/equalizing charge required yes/no, if yes to be done by the DC specialist section and recorded accordingly*.