Standard

EPM and Vapormatic LRS's Maintenance Manual

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Johan vd Schyff
(Engineer: SDG Technologies)

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Title

EPM and Vapormatic LRS's Maintenance Manual

Author(s)	
 ..... J van der Schyff Engineer	.....

Approval	-
 ..... P van Zyl Senior Electrical Engineer	

Executive Summary

In this document schedules with different services are being laid out for maintaining EPM and Vapormatic Liquid Resistance Starters such as:

- Major Service, once in every three years
- Minor Service, once a year

In the document information is provided on what the correct quality of water is that should be used and when to replace the electrolyte.

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Amendment History

Rev	Date	Details	Distribution
1.0	2019/09/18	EPM and Vapormatic LRS's Maintenance Manual	
2.0	2021/10/22	Revision	

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1. INTRODUCTION

This document aims to provide clear guidelines for properly taking care of the Liquid Resister Starters in service to ultimately achieve the best reliable service from the equipment as well as the relating equipment.

The aim is to ensure the starter performs as designed and intended to over a continued period of time without introducing damaging torque spikes that easily occur during start-up when the performance of the starter has deteriorated

The information provided is based on collaboration with OEM of liquid starters and own experience. References are being made to the relevant documents and focus is drawn to the case studies done by SDG technologies, (ref 6).

2. SERVICE SCHEDULES FOR EPM LIQUID RESISTANCE STARTERS

The frequency of service is a recommendation based on general and normal plant conditions thus the frequencies might need to be adjusted based on the specific circumstance. For example, if there are on average more than 3 starts per week combined with high dust concentrations leading to more dust accumulation in the electrolyte the Major service frequency will have to be increased to every two years and in worst cases even more frequent.

2.1 Major Service (Once every 3 years)

- Drain electrolyte from LRS and clean the tank.
- Check medium voltage and low voltage connections within the LRS panel.
- Replace fixed and moving electrodes and check alignment. It is not necessary to replace the electrodes when the Turn-down ratio is still high, >70% of the original value.
- Fill up the LRS with new electrolyte using water as recommended under section 5: Quality of water to be used for electrolyte.
- Service the shorting contactors within the LRS.
- Where applicable, service the bypass contactor on the limiting resistor (note: Enhanced LRS only)
- Inspect the components and steelwork of the LRS and tanks for leakage and excessive rust.
- Check if all control and bus bar connections are tight.
- Grease the drive shaft (worm gear)
- Review the overload protection settings for the electrode drive motor and the stirrer motor.
- Check the setting of the thermostat: 40°C for starting the stirrer motor and 60°C for maximum allowable temperature.
- Conduct a functional test on the mechanical and electrical components.
- Simulate interlocking and tripping functionality.
- Conduct a Mill Starting Evaluation test which includes the following. (SDG provide this service)
    - Measuring conductivity and temperature.
    - Torque measurements validate the electrolyte concentration and assessing the magnitude of torque spikes.
    - Determining the TDR (turn down ratio) of the LRS which is the performance criteria of the LRS and the electrodes.
    - Recommendations on how to improve the LRS for optimal working conditions.

2.2 Minor Service (Once every year)

- Conduct inspection of the contamination of the electrolyte.
- Conduct a visual inspection of the components and steelwork.
- Check if all control and busbars' connection are tight.
- Grease the drive shaft (worm gear)
- Inspect the medium voltage and low voltage connections within LRS panels.
- Conduct a functional test on the mechanical and electrical components.
- Simulate interlocking and tripping functionality.
- Conduct a Mill Starting Evaluation test which includes the following. (SDG provides this service)
    - Measuring conductivity and temperature.
    - Torque measurements to validate the electrolyte concentration and assessing the magnitude of torque spikes.
    - Determining the TDR (turn down ratio) of the LRS which is the performance criteria of the LRS and the electrodes, an important function to project the period for the next major service.
    - Recommendations on how to improve the LRS for optimal working conditions.

3. SERVICE SCHEDULE FOR VAPORMATIC LIQUID STARTERS

3.1 Major Service (Once every 3 years)

- Drain electrolyte from Vapormatic and clean the tank.
- Check medium voltage and low voltage connections within the LRS panel.
- Replace electrodes when showing too much degradation.
- Fill up the tanks with new electrolytes using water as recommended under section 5: Quality of water to be used for electrolyte and take samples of each tank for conductivity testing.
- Service the shorting contactors within the Vapormatic.
- Where applicable, service the stage 2/parallel switching contactor
- Inspect the components and steelwork of the Vapormatic and tanks for leakage and excessive rust.
- Check if all control and bus bar connections are tight.
- Simulate interlocking and tripping functionality.
- Conduct a Starting Evaluation test which includes the following. (SDG provides this service)
    - Measuring conductivity and temperature with tanks being opened or by measuring the samples.
    - Torque measurements validate the electrolyte concentration and assessing the magnitude of torque spikes.

- Determining the TDR (turn down ratio) of the starter which is the performance criteria of the starter and the electrodes.
- Recommendations on how to improve the starter for optimal working conditions.

3.2 Minor Service (Once every year)

- Inspect the contamination of the electrolyte.
- Conduct a visual inspection of the components and the steelwork.
- Check if all control and busbars connection is tight.
- Inspect the medium voltage and low voltage connections within the panels.
- Simulate interlocking and tripping functionality.
- Conduct a Starting Evaluation test which includes the following. (SDG provides this service)
  - Measuring conductivity and temperature, only if samples can be taken.
  - Torque measurements to validate the electrolyte concentration and assessing the magnitude of torque spikes.
  - Determining the TDR (turn down ratio) of the starter which is the performance criteria of the starter and the electrodes.
  - Recommendations on how to improve the starter for optimal working conditions.

4. ELECTROLYTE CONCENTRATION

The required electrode concentration is dependent upon several factors.

The motor rotor current is considered, including the maximum and minimum torque required during start-up.

If the concentration of soda ash is too high, it will increase the starting torque which will reduce the service life of the mill's gearbox and shafts.

If the concentration of soda ash is too low, it will decrease the starting torque but the mill will struggle to pull away and increase the shorting spike, which will reduce the service life of the gearbox and shaft of the mill.

In both cases, if the concentration is too high or too low an arc flash may occur.

The starting torque should be between 110% and 140% of rated torque.

The concentration of soda ash in the electrolyte also depends on the temperature range in which the mill can start to stay within the safe start-up torque range. It is therefore important to establish the electrolyte concentration in combination with setting the temperature range for each application. This can be done with a start-up torque test done by SDG Technologies.

5. QUALITY OF WATER TO BE USED FOR ELECTROLYTE

It is recommended to use demineralized water for making up the electrolyte as any minerals that are present will react to the electrode surfaces during current transfer. The result is that a layer with lower conductivity forms on the surface of the electrodes, which cause the final resistance not to be as low as with new/clean electrodes.

The recommend water quality is as follows:

- Total Hardness (mg/l as CaCO3) – to be less than 20
- Conductivity in µS/cm – to be less than 50
- TDS at 105°C mg/l – to be less than 50

6. INSPECTING AND REPLACING THE ELECTROLYTE SOLUTION

Before replacing the electrolyte solution, first inspect the electrolyte for contamination.

The service life of the electrodes and the electrolyte, depend on the quality of water used for the electrolyte solution and the contamination of the electrolyte.

Low-quality water and high contamination can reduce the service life of the electrode to as little as 6-months and low contamination of the electrolyte can help to achieve a service life of the electrodes of more than 3 years.

Oli should be added to the electrolyte solution to reduce vaporization and contamination. Filters can be added to the LRS panel louvers to reduce the contamination.

7. REPLACING ELECTRODES

Replacing electrodes should be done when the TDR is too low and or when the shorting spike is dangerously high.

Electrodes should never be older than 10 years. (Helmke Liquid Resistance Starter) (ref 3)

The electrodes must not be kept dry for more than one day, otherwise, the brown surface layer would lose its property of conductance and become isolating. (Helmke Liquid Resistance Starter) (ref 3)

8. MILL STARTING EVALUATION TEST

SDG Technologies provides a service which is called the Mill Start-up Evaluation test, which measures the current and voltages on the rotor circuit of the motor during the start-up cycle. From the measurements, the following information is being determined.

- The torque trace of a start-up showing all the torque spikes generated during the start-up.
- The Speed of the mill during the start-up cycle.
- The resistance trace of the LRS during the start-up cycle.
- The TDR (turn down ratio, maximum vs minimum resistance) of the LRS and when it is recommended to replace electrodes.
- The temperature range in which the mill can be started which will result in a safe start.
- The recommending concentration for the electrolyte with the preferred temperature range.
- Recommendations to improve the LRS performance.

SDG Technologies also provides a product called the MillSafeStart. More on the MillSafeStart in LRS evaluation reference document (ref 5)

9. DEFINITIONS AND ABBREVIATIONS

LRS Liquid Resistance Starter. A variable resistor inserted in series with a wound-rotor motor during starting. The resistance is obtained by passing the current through an electrolyte solution.

Tag Air-gap Torque. The torque exerted on the motor rotor by the magnetic field in the stator.

ESLT Equivalent Shock Load Torque. The allowance must be added to the Tag (air-gap torque) to allow for mechanical system response and still be within safety margins.

TDR It is the ratio of the maximum resistance measured to the minimum resistance measured

S.C. Sodium Carbonate also called Soda Ash

10. REFERENCES

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SDG Technologies
14 Partridge Avenue
Kempton Park
Republic of South Africa

P O Box 166
Van Riebeeckpark
1629
Republic of South Africa

Telephone:	**+27 (0)10 003 1015**
Telefax:	**+27 (0)86 606 5312**
Cell:	**+27 (0)82 600 2786**
Email:	**info@sdgtech.co.za**
Web:	**www.sdgtech.co.za**