REMOTE SYNCHRONIZED CP OFF-POTENTIAL MEASUREMENTS OF TEST-POSTS

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Background

Cathodic protection is vital for pipeline integrity, but manual monitoring is laborious. Digital solutions enable remote monitoring and analysis, but measuring off potential remains a hurdle due to its unique requirement of having the rectifier to switch off simultaneously with carrying out a measurements at the test post. This article outlines the steps to enable remote off potential measurements.

Introduction

For a Dutch gas grid operators the steel gas pipelines are protected by means of Cathodic Protection. This is done by +/- 200 rectifiers which are inspected every 3 months. In addition, the tests posts are inspected every year. Both activities are carried out by in-house CP specialists.

Figure 1: Geographical overview steel gas Grid

Cathodic protection remote monitoring

By placing remote monitoring devices, it is possible to obtain real-time insight into the performance of cathodic protection. This provides multiple benefits:

- Direct notification of outages
- Fewer manhours required for inspection
- Higher asset integrity
- Longer asset lifetime
- CO2 emissions reduction

For this gas grid operator all 200 rectifiers posts have been outfitted with remote monitoring devices and a subset of test posts.

Figure 2: Cathodic protection remote monitoring

The system comprised of:

- Remote monitoring devices at rectifiers
- Remote monitoring devices at tests posts
- An online cloud application

By having devices at both these locations it is possible to obtain a detailed overview of the CP performance.

Remote monitoring at Rectifiers

With thresholds defined on Voltage DC (see figure below) direct alerts are created in case measurements go outside this boundary.

Figure 3: Rectifier measurements

The rectifier device installed at the site is equipped with a relay that allows for remote deactivation of the rectifier, facilitating maintenance or specialized measurements. Turning off a rectifier before commencing any works can be time-consuming since it is often located far from the worksite. Moreover, occasionally forgetting to reactivate the rectifier after work completion can leave the pipeline unprotected for an extended period. Remote monitoring enables remote deactivation of the rectifier, eliminating the possibility of forgetting to reactivate it.

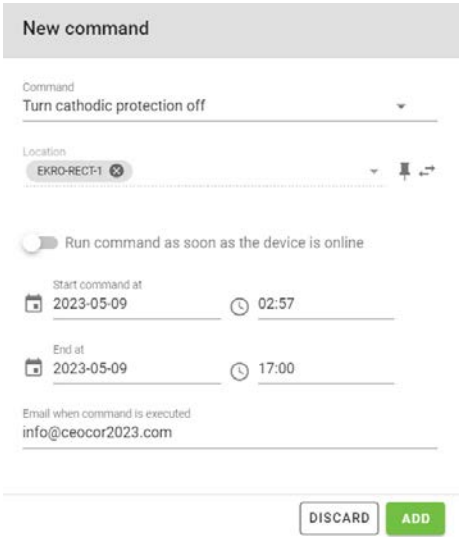

Figure 5: Turning off a rectifier remotely

In addition to turning off the rectifier off for works. The figure below illustrates how to create an "open circuit potential" command to switch off the rectifier and connected test posts simultaneously.

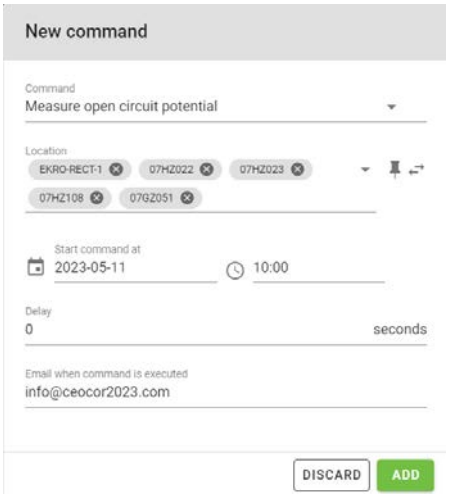

Figure 6: Scheduling a command to switch the rectifier

Remote monitoring at Test posts

By combining the switching possibility at the rectifier site, it is possible to take off-potential measurements at a test post (without a coupon). This function takes 30 consecutive measurements at 100ms intervals simultaneously at the rectifier and the test post. The end result is showing a depolarization curve as shown below. From this graph the off potential can then automatically be selected and analyzed whether this is within the norm or outside. The black line is the rectifier and the pink line is the test post.

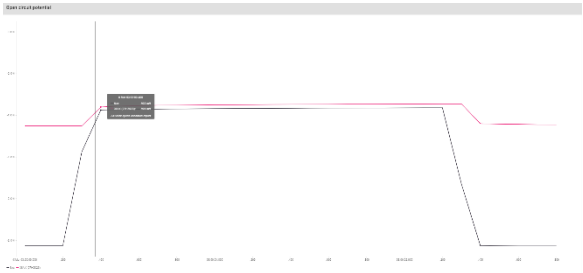

Figure 4: Cathodic protection open circuit potential (see appendix for larger version)

Remote monitoring at Test posts with coupon

For test posts with a coupon the remote monitoring unit can also measure the off potential. In the diagram below the blue line is the on potential of the pipe and the brown line is the off potential of the coupon.

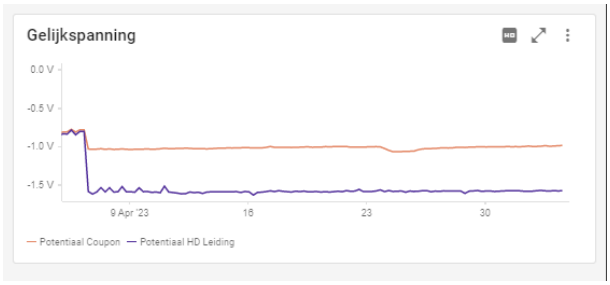

Figure 7: Coupon measurement

To take into account the different soil conditions, and the difference in depolarization speed, it is possible to manually configure the time delay after opening the relay before measuring the off potential. It is also possible to customize the shunt resistance and coupon surface area.

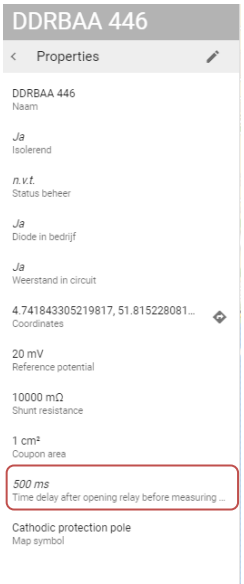

Figure 8: Configurating measurements at a test post with coupon

The remote monitoring device is also able to measure current. As a result, the corrosion risk can automatically be calculated based on the AC/DC current ratio.

Figure 9: AC/DC current ratio at Test post with coupon

Challenges at scale

To implement remote monitoring for cathodic protection at scale (thousands of test posts) a number of challenges needed to be overcome. Installing devices is one thing, but being able to generate high quality data and manage insights in a meaningful manner is another:

- Updating the data model to know which tests posts are connected to which rectifier
- Discard threshold crossings of test post measurements when rectifier is in switching mode (to avoid too many and irrelevant issues being triggered)
- Ability to set off potential commands for multiple rectifiers and tests posts at the same time

Conclusion

This project realized an implementation of CP remote monitoring including off-potential measurements. Customers can realize both on and off potential measurements required according to the norms and digitalize its CP monitoring.

Key success factors

- Having a software solution that is able to deal with CP measurements at scale
- Linking with gas grid operator systems including GIS topology
- Working closely together and thinking through the operational process with all parties involved

Key learnings

Real-time insights into cathodic protection increases asset integrity. Remote monitoring connected with a CP software solution Withthegrid provides many operational benefits both for asset owner and operator.

Acknowledgements

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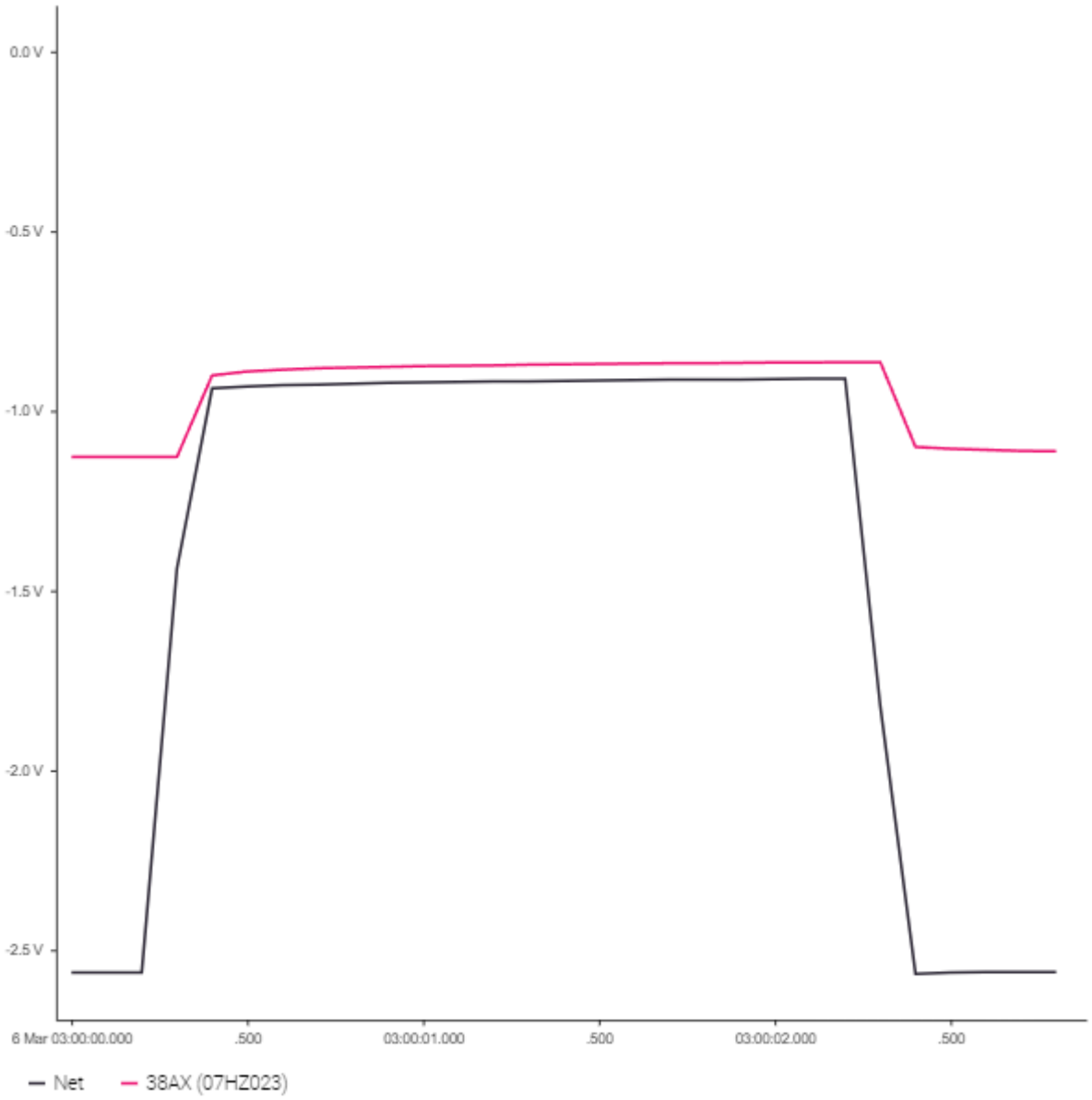
Appendix: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