Optimize Inspection Activities for CP Rectifier Devises based on Real-Time GIS System

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Abstract

Oil & GAS companies possess hundreds of remotely installed Cathodic Protection (CP) Rectifier devices that are critical and deemed required to ensure the safety and integrity of their Pipelines Network. This necessitates extensive periodic field inspections trips to check their statuses and operating conditions. Consequently, maintenance trips are planned and executed to fix or calibrate those malfunction units on regular bases. Clearly this process implies many challenges such the lack of knowing the true assets operating conditions and their effects until the next scheduled inspection visits. Also, the difficulties of determining their locations in the field, when and why they stopped functioning, and the potential risk as a result of these failed CP rectifier devices.

Integrating GIS (Geographic Information System) with field data collecting units called Remote Monitoring Units (RMU) provide an innovative solution to address many of these concerns. This application will display real-time statuses of these scattered assets to ensure maintaining the safety and integrity of the companies operations. The system provides visual, SMS, and email alerts to reports immediately any abnormal situations. The GIS provides the user with a presentation layer of how these CP rectifier devices are installed geographically to unify and facilitate locating and navigation tasks based on LBS (location based systems) devices. Also, allow performing "Spatial" analysis to group together maintenance and inspection activities based on priorities and geographical boundaries. As a result, this will lead to resource optimizations, improve efficiency and integrity of assets, and enhance of safety of both field crews and overall operation.

Introduction

Saudi Aramco, the world largest oil producer, has enormous number of assets installed in remote field locations. Its Pipelines' department, which operates/maintains a hydrocarbon pipelines network of a total length of more that 18,000 km, has under its custody a major share of those assets. Those assets are providing and performing various functions ranging from protecting the hydrocarbon major facilities and pipelines network from corrosion or third party damages to remotely control products dispatching. To ensure their reliable and efficient operation, periodic inspection field trips are being performed, nevertheless. For the domain of this paper, the CP (Cathodic Protection) rectifiers will be covered as an example of those assets.

CP rectifiers' devices are providing protection to the pipelines network against external corrosion. These remotely installed devices need to produce the required DC voltage & current needed to protect the outer pipelines walls from external corrosion. To ensure that these devices are functioning as expected, periodic inspection filed trips are perfumed.

However, these periodic site visits don't provide true statuses of the operating conditions of the CP devices. This is because, during these site visits, checking the status and obtaining the voltage and current values will only be reflecting the condition at the time of the scheduled inspection/maintenance trips. However, there is no assurance of the reliability of these devices until the next scheduled trip. As a result, this imposes a concern if these devices are providing the adequate level of protection against pipelines walls external corrosion.

In response to this operation challenge, a system was developed to map these devices on a GIS (Geographic Information System) and continuously remotely monitor the reliability of these devices 24X7.

Methodology

The system consists of several parts. First, RMUs (Remote Monitoring Units) devices were installed in the field inside these CP rectifier devices to transmit the operational data via communication links. These data are the mainly the status of the CP device power (either On or Off) and the produced amount of current and voltage. Then this information from each CP rectifier is written to a field data acquisition system.

The GIS system, maps all these CP rectifier devices as features where their attributes are extracted from the Pipelines attributes database and their real-time statuses are fetched from the field data acquisition system. All CP devices were mapped on the GIS system using their GPS coordinates which were collected using sub-meter accuracy GPS system.

Following this, the system contains these main components:

- Remote Monitoring Units (RMU) that are installed on the CP units to transmit the required data. The data can use any communications links. With this system, data communication exchange medium were used.
- The master Data Control (DC) device to collect and store all unit readings.
- The Geographic Information System (GIS) system that reads and maps the units with their related data captured by the RMUs and stored in the master DC.

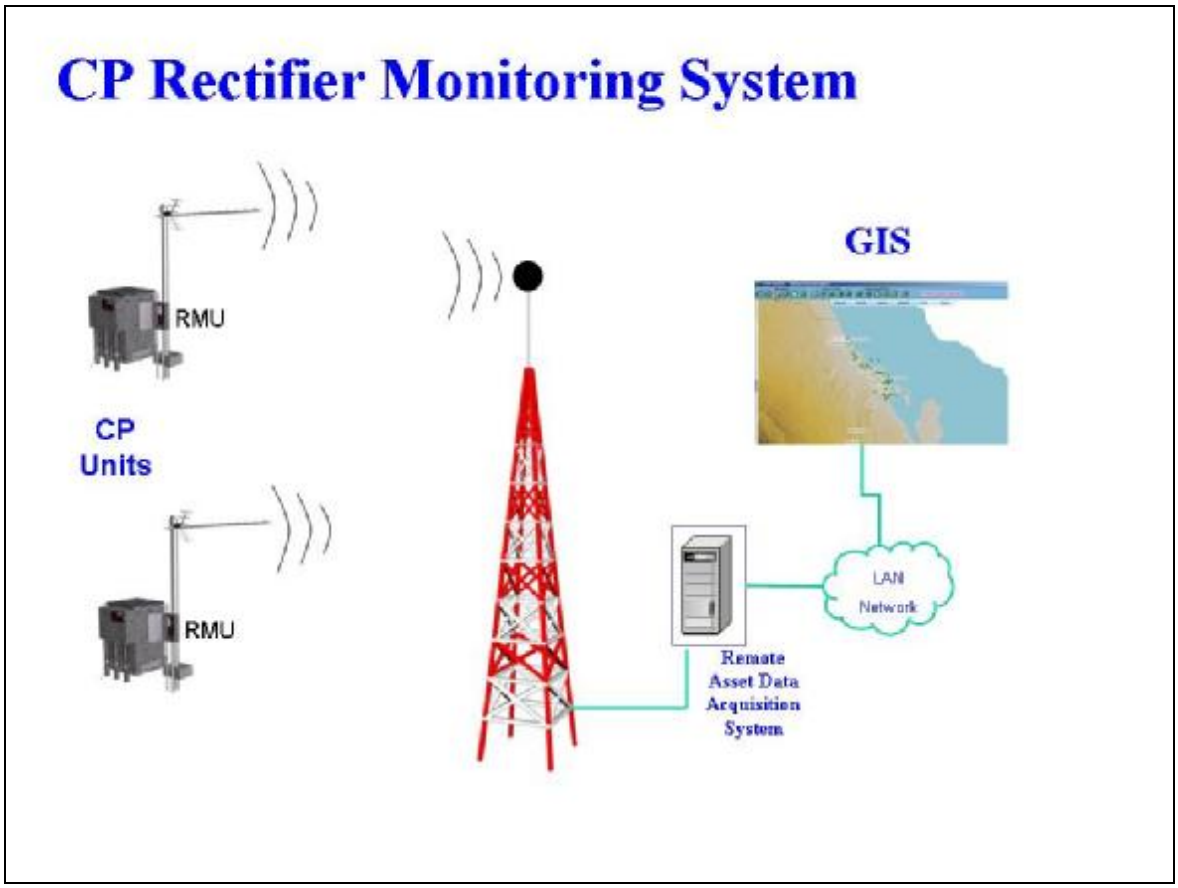

Figure 1: Remote Asset system components

Application Functions

- ## Display

The GIS system will map all CP rectifiers devices based on their geographical locations overlaid over high-resolution satellite images. Devices with normal operating condition are presented in GREEN, while the ones with up-normal operating condition are presented in RED. The system has two eye-catcher lists, the **AAL (Asset Alert List)** which provides a quick summary of failed assets. The second list is the **Failed Asset list** that lists down all failed assets with their status and enable users to navigate to the asset itself by clicking on the asset ID.

The system also provides a wealth of options to search such as searching for a particular asset by ID, or by all assets, or a specific type of asset with a geographical area. The GIS system also allows distance measurements and buffer-zoning to optimize inspection or maintenance site visits to these assets.

As the GIS system will display the GPS coordinates of mapped features (e.g. CP devices), plugging these coordinates into LBS (Location Based Systems) will enable to identify best routing for reaching these remotely installed assets. Also, can generate directional maps to be shared with concerned crews, especially during emergencies.

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Figure 2 : Monitoring CP Rectifiers Using GIS

- ## Reporting

The system is equipped with various types of reports which are ranging from executive summary to details ones suitable for management and inspection/maintenance workforce as well. These reports can be exported as files for easier distributions for further analysis and exchanged electronically.

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Figure 3 : Listing all failed assets

Moreover, the system is capable of generating alert notifications about those failed assets via email messages or SMS and sending them to concerned staff to highlight any failure occur to these assets even during non-working hours. Thus, ensure that maximum reliability and protection are maintained.

Results & Conclusions

Implementing the Asset Remote Monitoring GIS system provides the user with an electronic "AS-Built" geographical reference mapping of all installed CP rectifiers' devices. This will help field crews or other support agencies, especially during emergencies, to instantly reach to any CP device installed remotely while minimizing the hazardous or risks associated with driving to these harsh environment and desert sites. Also, it will expedite and optimize the field trips routes to perform inspection/maintenance activities.

Furthermore, will ensure the 24X7 remote monitoring of these devices and highlight the abnormal statuses by the listing failed units in the alert banner and enabling easy navigation to them by clicking on their IDs. Also, the system will provide various types of reports and alerts for failed CP rectifiers beyond normal working hours through sending eMAIL and SMS messages to designated on-call field teams.

As a navigation guide, the GIS system will also support in how the filed crew plan their routing for attending faulty CP units. Moreover, the system will reflect and easily identify CP units **online** statuses using color coded features, Red for faulty, Green for normal. This would overcome the problem of not having information about their status until next site visits.

As a result, the system will ensure at all times a continuous adequate level of protecting pipelines' external walls against corrosion while resources utilization for inspection/maintenance are optimized.