

The search for cost-effective and reliable technology to remotely monitor cathodic protection (CP) installations is essential in today's oil industry. While technology that relies on the hardware of the supervisory control and data acquisition (SCADA) network has proved successful, it requires extensive pre-acquisition, pre-planning and lengthy administration.

Despite the economic setbacks of the world economic situation, new oilfields are being constructed and old wells brought back to life. This has led to the installation of underground structures from pipelines to storage tanks to well casings, which has made remote monitoring a necessity.

The maintenance of a CP system can be extremely demanding under stringent monitoring system procedures. The periodic surveys for vast areas require that CP personnel set priorities on maintenance and remedial actions to maximise the use of their available resources. The decision to install a remote monitoring system (RMS) for a CP system should be based on the following factors: local laws and regulations on monitoring; available resources; geography; the critical nature of the structure that the CP system protects; and economics.

Many CP operators are struggling with scarce resources in manpower and trained

personnel to perform CP monitoring. Local laws and regulations dictate that CP is reported and maintained frequently to ensure its adequate operation, otherwise operators may be subjected to penalties or accountability. The inclusion of an RM unit should be evaluated on a case-by-case basis considering the above factors. CP operators maintaining the system are familiar with the challenges facing them and should be able to make that judgment. The Saudi Aramco organisation policy to install an RMU is mandatory for cross-country pipelines, but for other locations the decision is

driven by economics at the time of the project proposals study.

Monitoring strategy

A comprehensive and stringent procedure for monitoring CP systems has been established (Table 1). Each facility by procedure is requested to conduct the survey and issue an annual report detailing deficiencies and the recommendations to correct them. The standards provide minimum criteria for designing CP systems and set specifications for the RMU.

The procedure governing monitoring gives details for each test and task to be

Table 1. Cathodic protection monitoring procedures at Saudi Aramco

Period	Rectifier	Anode bed	Anode junction box	Annual survey
Monthly	Check if the rectifier is operating.	n/a	n/a	n/a
Quarterly	Record voltage and amp. Calibrate the meter. Record oil and temperature readings.	n/a	n/a	n/a
Annually	General inspection. Replace oil if necessary.	Measure the current output of anode bed.	Inspect and perform general maintenance.	Take potential readings at the surface and every 10m thereafter. Take current reading for each well casing.

Source: Saudi Aramco

The Middle East oil industry has seen tremendous growth in oil producing and handling facilities, matched by an increased number of cathodic protection installations. Monitoring these installations presents challenges to CP operators. However, these can be overcome by using a remote monitoring system, says **Abdulhameed Bukhamsin**, Saudi Aramco.



A close look from afar

performed and gives minimum protection criteria that should be met.

Facility overview

Saudi Aramco's area of responsibility covers onshore and offshore locations in Saudi Arabia's Eastern Province. On these sites, there are 400 rectifiers located in five geographical zones. They protect numerous platforms, hundreds of wells, over 50 tanks and more than 100 pipelines.

The CP crew conducts periodic surveys to these locations on a regular basis to check the rectifiers and perform the close interval survey. All these surveys, whether monthly, quarterly or annually, consume hundreds of hours in travelling time and task performing. Pre-planning and coordination for logistics is a tedious and costly task: it is estimated that one day trip using a boat can cost \$5,000 (Table 2).

RMS technologies

Saudi Aramco uses three systems. The remote monitoring of case one at well sites is based on telephone modems with landlines. The retrieval of data is conducted by dialing telephone lines and downloading the data required. This system's drawbacks include susceptibility to noise, data not given in real time, dialing can be done from anywhere to get the data, and too many components, which make maintenance cumbersome.

Case two is an upgrade of case one. It involves the removal of modems, power supplies and batteries, and adding RS-485/RS-232 converters and reconfiguring the existing servers so that using RS-485 communication requires RS-485 to RS-232 converters; each unit has an internal address; and communication to all RMUs can be used by re-configuring the existing server. The system's advantages include inline real-time data and using fewer electronic components.

Case three is under testing and evaluation. This system is a wireless multipurpose spread spectrum product. Instead of operating at a fixed frequency, it uses frequency hopping radio technology in a fast and well-choreographed manner. Some units were brought for testing at the local vendor sites where Saudi Aramco gave a live demonstration. Frequency allocation for this particular product presented several challenges to the applications. The manufacturer produced the radio frequency units in the 900MHZ and 400MHZ ranges. The

Table 2. Current practice cost estimate

Task	Total per year	Total annual costs (\$)
Total labour hours	192 hours	12,000
Logistics (boat and others)	12 trips per year	60,000
Unforeseen costs (15%)		11,000
Grand total (\$)		83,000

Source: Saudi Aramco

900MHZ is reserved for GSM and therefore could not be used. The 400MHZ range is used by another operator in the area and was ruled out. The debate over the frequency use ended with the local agent requesting the manufacturer to produce units in the 2.4GHZ unlicensed frequency. This system's advantages include unlicensed frequency, quick installation and configuration, long range with repeaters, interface flexibility and security. The 2.4GHZ range was initially believed to be unlicensed free and without restrictions. As it turned out, these devices have some limitations, according to the Communication and Information Technology Commission Authority, for example:

- indoor use: no licence for personnel use and commercial purposes
- outdoor use: only permitted for fixed facility-based providers or data service providers
- the effective isotropic radiated power (the actual power emitted by the antenna) is limited to 100MW.

At the time of writing this article, the agent of the product is evaluating this regulation with the authority to investigate its application in Saudi Arabia. It is claimed that these frequencies are used in North America without restrictions.

Economic evaluation

The primary benefits achieved from CP remote monitoring are: streamlined resources; timely reporting and tracking; cost savings in logistics and transportation; effective monitoring; immediate access to remote areas; and higher life cycle costs for the structure.

CP monitoring is stringent where periodic

frequencies are required to visit the rectifier sites and perform the close interval survey. The periodic survey is done on monthly, quarterly and annual intervals. The nature of the work conducted for each survey varies in work details with the annual survey involving the most thorough checks and includes a close interval survey. The annual cost avoidance with CP monitoring is calculated using the following formula: cost avoidance = 12 x number of hours expended for each rectifier x hourly labour work, plus the costs incurred by logistics and other contingency and unforeseen expenses.

Offshore case study

An existing offshore remote facility without RMS was selected for the evaluation to show the benefits attained from having remote monitoring. The field selected for the evaluation is an offshore field with 42 transformer/rectifiers. The structures monitored are platforms and well casings.

The current practice is to make a field visit each month and record voltage and current readings and take some potential readings. This approach is considered inadequate and falls short of covering all rectifiers in the three periodic surveys over a given time. With the proposed RMS installation, monitoring can be adjusted to include only the annual survey of one visit per year. This adjustment meets company procedures without compromising the reliability of the CP system.

Although the realised cost saving is small and cannot be calculated with confidence, the gains for the company are tremendous. The modified monitoring gives confidence in the monitoring practice and avoids due diligence and audit items. ■

Abdulhameed Bukhamsin

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