Customer Success Story:
Marathon Oil Company

Markets served
Oil and gas

Marathon Oil Company improves ESP system reliability with high resistance grounding

Location:
Gabon, Africa

Segment:
Petrochemical

Challenge:
To improve the life and reliability of electrical submersible pump systems

Solution:
Apply high resistance grounding units to detect, identify and control hazardous ground fault conditions

Results:
Greater system reliability and increased uptime

"I believe the HRG unit saved the motor on #2. ESP manufacturers are not fond of grounding ESP systems, but, in this case, Marathon may have saved a motor. More important than saving the motor was the rig time and transportation expenses to obtaining a new motor for #3. If both motors had burned, Marathon Oil would have spent another $300–400K."

Marathon Oil Company

Background

Marathon Oil Company wanted to improve the life and reliability of their electrical submersible pump (ESP) systems.

Challenge

The strategy was to apply high resistance grounding (HRG) units to the electrical systems. This technology, proven effective in other industrial environments, reduces the unsafe and damaging over-voltage conditions that may occur under arcing ground fault conditions. The HRG unit can detect, identify and control the ground fault.

What makes this technology so desirable to the application is that it does not necessarily have to take the ground fault system offline. Once the HRG unit has detected and located the ground fault, Marathon would be able to evaluate the situation and determine the best course of corrective action. If the location of the fault is determined to be down-hole and not in a classified wellhead area, then the well could be run with the ground fault indefinitely.

Solution

Marathon applied HRG units to two wells on their Tehatarnha Marin platform located off the coast of Gabon, Africa. Six weeks after the installation of the HRG units, both wells experienced failures. Well #2 failed first, experiencing a phase-to-ground fault followed by a phase-to-phase fault. The well operated for six hours with the phase-to-ground fault because the HRG unit was able to control the overvoltages.

Marathon production engineers pulled well #2 to find that a packer penetrator installation problem had caused the initial ground fault. Further investigation indicated that after the initial ground fault occurred, the HRG unit kept the system online and operating until the phase-to-phase fault occurred. The motor, cable and down-hole sensors were all undamaged and still functional. However, the motor was replaced with a spare as a precautionary measure.

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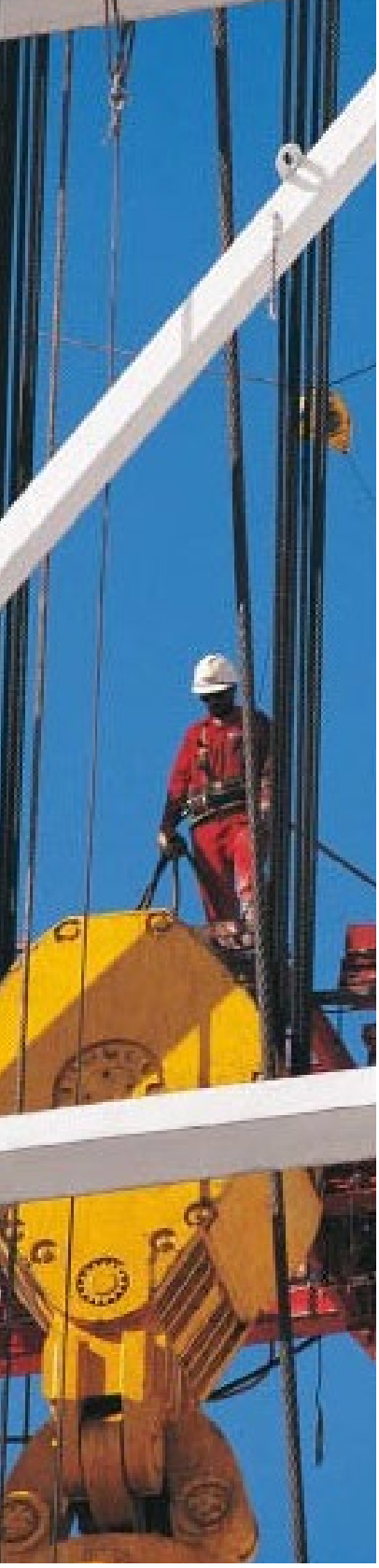

Immediately after finishing well #2, Marathon pulled well #3. The #3 motor was burned at the star point. The Phoenix down-hole sensing system was also destroyed. Marathon did not have a spare motor for well #3, so elected to rerun the motor pulled from the #2 well in #3.

At the time this document was written (six months later), there have been no additional problems with either well. Both ESP systems are running with the HRG units online.

Results

According to Marathon Oil Company, "Both systems were essentially the same except for the operation of high resistance grounding units. I believe the HRG unit saved the motor on #2. ESP manufacturers are not fond of grounding ESP systems, but, in this case, Marathon may have saved a motor. More important than saving the motor was the rig time and transportation expenses to obtaining a new motor for #3. If both motors had burned, Marathon Oil would have spent another $300–400K."

High resistance grounding for electrical submersible pump system

Application

Seventy percent of all faults start out as arcing ground faults. High resistance grounding (HRG) is a long proven technology used to protect electrical systems and equipment from ground faults. When an HRG unit is applied to an electrical system, you have the benefit of a ground protected system without necessarily impairing the continuity of service. When it is determined that there is a ground fault on the system, the HRG unit can alarm or, if desired, trip the system. If the location of the fault is determined to be down-hole and not in a classified wellhead area, then the well can be run with the fault on it indefinitely. HRG technology is as close to an ungrounded system as you can get but without the negatives of an ungrounded system.

Rating and configuration

The Eaton HRG unit is offered up to 5 kV with a nominal voltage of 4.8 kV. It can be applied to delta or wye ungrounded three-wire distribution systems. Standard dimensions are 24"W x 20"D x 97"H.

Protection from overvoltage conditions

The HRG unit protects against transient overvoltages that may occur under arcing ground fault conditions. When a ground fault occurs on a system, high transient voltages can occur, which may cause more frequent equipment failure than if the equipment were grounded.

These transient voltages can escalate over time. When the overvoltage reaches about 700%, the system insulation breaks down.

High transient voltages can result in:

- Motor failure
- Down-hole sensing equipment failure
- Cable insulation failure
- Penetrator failure

Interface with down-hole sensor technology

When down-hole sensing equipment is utilized on a well, the Eaton HRG unit can be equipped with customized signal blocker circuitry. This signal blocker keeps the down-hole sensor signal from erroneously flowing through the HRG unit's ground connection and resulting in an incorrect alarm or trip condition. With the signal blocker circuitry to guard against possible nuisance tripping, the down-hole sensing equipment can use the power conductors as a signal path, thus eliminating the need for an expensive dedicated control cable for a single path. In order to save floor space on a platform, other manufacturer's down-hole sensing equipment can be factory installed in the HRG unit.

Customized for oil fields

The Eaton HRG unit is specially customized for the oil field industry. Each unit is application engineered to apply to specific well requirements. It is designed with a small footprint to accommodate light platform floor space problems. The unit can be a NEMA® 3, 3A or 4A enclosure.

Options

The base HRG unit can be set up for either a wye or delta transformer as well as variable speed drives. It can also be equipped with the following options:

- Signal blocker circuitry
- Space heaters
- Special paint
- SCADA alarms
- Safety door interlocks
- Other options available upon request

Eaton
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Cleveland, OH 44122
United States
Eaton.com

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