CASE STUDY

Littelfuse Relays Drill Home a Safety Solution for Hydraulic Fracturing

SITUATION

Hydraulic fracturing is undergoing a shift toward a more environmentally-friendly way of extracting natural gas and petroleum from the earth by changing its fracturing methods.

Hydraulic fracturing is a technique in which rock is fractured by a pressurized liquid. The process involves the high-pressure injection of fluid into a borehole to create cracks in the deep-rock formations that will allow natural gas and petroleum to flow more freely.

Hydraulic fracturing traditionally relied on fleets that use 20 or more diesel-powered engines. The negative environmental consequences of these diesel engines—such as carbon emissions, noise pollution and silica dust— is driving many companies away from the former method and toward the use of electrical hydraulic fracturing methods, which are significantly better for the environment.

Electrical hydraulic fracturing removes diesel engines from the hydraulic fracturing site and replaces them with electric motors that are powered by turbine generators. This enables the fleet to run completely on electric power. Instead of 20 or more diesel engines, three natural-gas-fueled turbine engine generators at 13,800 volts generate the electric power for the fleet. Using transformers, the power is then decreased to 600 volts.

U.S. Wells Services, Inc. uses electrical hydraulic fracturing in their Clean Fleet* to make the process more seamless, efficient, safe, and environmentally friendly.

Electric well stimulation fleets have proven great advances in environmental responsibility. U.S. Well Services can reduce emissions by up to 99 %, reduce fire risk with some fire hazards being eliminated, and reduce low frequency noise by 95 % at the site [1].

Although electrical hydraulic fracturing eliminates fire hazards and fuel spills (that are associated with refueling diesel-powered equipment), it introduces the hazard of ground faults.

Long power cables connect the natural gas generators to the electric pumps used in the hydraulic fracturing process. These long power cables create a potential hazard in the form of ground faults on the cable. The ground faults might be caused by trucks driving over the cables, cables getting bent during installation or moving equipment, and normal wear and tear of the cable over time. These ground faults can be a potential shock hazard to personnel and can damage equipment such as pump motors and associated electrical controls.

NEC Article 590, Temporary Installations, requires the monitoring of the ground on these long cables, which protects against the hazards of long cables used in these applications. Companies have a choice in how they satisfy the code. They can use an engineering control such as a protection relay or an administrative control such as manual checks as part of the Assured Grounding Program.

The requirements for assured equipment grounding conductor programs are strict:

- a written description of the program, including the specific procedures adopted by the employer;
- the designation of a competent person to implement the procedures;
- a daily visual inspection of each cord set, attachment cap, plug, and receptacle of cord sets, and any equipment connected by cord and plug, except cord sets and receptacles which are fixed and not exposed to damage; and
- electrical tests for continuity and correct attachment of the equipment grounding conductor

These tests must be done before first use, before the equipment is returned to service following any repairs, before the equipment is used after any incident that can be reasonably suspected to have caused damage (for example, when a cord set is run over by a vehicle), and at a minimum increment of every three months (except for cord sets and receptacles that are fixed and not exposed to damage, which must be tested at an interval that does not exceed six months). The results of these tests must be recorded and kept available for inspections. This is a time consuming and manually-intensive process.

Ground-check monitors fall within the hierarchy of control's most protective type of method: engineering controls. Ground-check monitors verify that there is a continuous low-impedance ground path travelling from the equipment frame to the source, which eliminates the possibility of hazardous ground-fault touch potential. They also detect potentially hazardous conditions, such as open cable couplers or receptacles, a shorted ground-check to ground that was caused by cable damage and initiates a trip signal to de-energize the system if a coupler becomes uncoupled under load.

A SAFETY CULTURE

U.S. Wells Services, Inc., which has a culture that strives for zero safety hazards and distractions, implemented engineering controls—the safest method of the hierarchy of controls— by using the Littelfuse SE-134C Ground-Fault Ground-Check Monitor.

The Littelfuse SE-134C Ground-Fault Ground-Check Monitor was chosen because it eliminates potential hazards by continuously monitoring a ground check wire in the power cable, and shutting off power if that ground check wire loses continuity. The SE-134C protects cables up to 25 kV and up to 10 km or 6 miles to ensure portable equipment is grounded. Each truck in the fleet uses 30 SE-134C monitors.

OUTCOME

Littelfuse ground-fault ground-check relays deliver a safer working environment for oilfield personnel, meeting codes that require monitoring the ground without a labor intensive assured grounding program, and continuous protection for expensive pump motors and electrical controls.

For more information on Littelfuse Ground-Fault Protection. visit **Littelfuse.com/GroundFault**

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1 J.M. Oehring, "Environmental Benefits of Electric Powered Hydraulic Fracturing," presented at the SPE Eastern Regional Meeting, Morgantown, WV, USA, Oct. 13–15, 2015, SPE-177308-MS

*Clean Fleet is a trademark of its respective owner.