Designing a safe connection

Safe reefer operations require a receptacle system that exceeds minimum standards in electrical codes

Safely connecting and disconnecting reefer containers operating on 3 Phase 440-480v power represents one of the largest safety risks from an electrical hazard at the majority of container terminals.

Reefer receptacles are designed and listed to electrical safety standards of UL and CE self-certification, but these only "certify" that the receptacle can carry the required electrical load. Other standards, such as IEC 60309-1 and 60309-2 (formerly IEC 309-1 and 309-2) cover configurations of the plug and receptacle and ensure compatibility.

According to Michael Hellmers, president of Corona, California-based ESL Power Systems Inc, which specialises in electrical solutions for reefer plugs and receptacles, the industry has virtually standardised on safety interlocked reefer connections. It is widely accepted that dealing with 480v, 32A supply presents a safety (and liability) risk and "the standard is having interlocked connections," he says.

A safety interlock is a mechanical or electrical device that prevents a receptacle from being energised unless the male plug is properly engaged and disconnects the power supply automatically as the plug is removed.

But although the safety interlock design prevents operators from "making" or "breaking" under load, it is not required under electrical codes and in some cases, terminal construction contractors look to install non-interlocked receptacles, which pose a higher safety risk to operators, but offer cost savings.

ESL has dealt with situations where contractors facing cost overruns try to install non-interlocked receptacles. The solution is to make sure interlocked receptacles rather than "complying" receptacles are specified when projects are tendered, Hellmers says.

As far as the design of the interlock is concerned there are several options. ESL's standard system detects the ground pin of the male plug before allowing the unit to be energised, whereas other designs interlock off the key on the side of the plug. Hellmers says ESL believes the ground pin is the safer option.

Furthermore, in some markets plug keys are frequently "shaved off" to allow a 32A plug to mate with a 30A (non-interlocking) receptacle, meaning the 32A male plug must be replaced elsewhere in the supply chain in order to safely connect to a receptacle that interlocks at the key.

Operating efficiently

Another important aspect of reefer power supply is designing the receptacle system so the terminal can perform reefer operations efficiently. In considering the layout of the reefer area(s), terminal management has to weigh the initial costs of installing more reefer outlet assemblies (ROAs) against the labour costs of managing cabling from fewer centralised ROAs.

A reefer rack structure is typically six or seven containers wide and some operators opt for an ROA with six or seven receptacles mounted centrally. This configuration is more prone to tangled reefer cables, which present tripping hazards and the chance of disconnecting the wrong cable. Terminals with wider reefer racks may even require extension cables to reach the outer containers.

According to Hellmers, installing more receptacles per ROA is ultimately a cheaper solution, but ESL is seeing a trend towards two and three-gang ROAs due to operational efficiencies.

More customers are also asking for two LED lights, one to indicate line power is available to the ROA and a second to show that the receptacle is energised and power is flowing. If the first LED is not showing, the operator will know immediately that there is an upstream power supply problem.

A recent development is the incorporation of an equipment ground fault protection (GFP) device on an outlet module to isolate the effect of a phase to ground short. ESL has frequently been asked to incorporate a simple ground fault protection device that can isolate a fault at the receptacle and prevent upstream switch gear from being tripped by a short.

Hellmers advises terminal design engineers to be aware of the fact that reefers generate ground currents during the defrost cycle, so the GFP devices should be selected and set at a value above the defrost cycle ground currents to avoid nuisance tripping.

Increasing safety

While little has changed in the construction of the receptacles themselves over the years, ESL is constantly challenged to find new solutions that meet unique customer safety and operational requirements.

Usually terminal operators have limited or no control over the maintenance and standards associated with male plugs on reefer container cables, the quality of which varies considerably. A male plug with water and salt ingress can "flash" outwards into the operator when the interlock actuator is engaged.

The Centerm Terminal in Vancouver (now operated by DPW Canada) had faced this problem and approached ESL about a receptacle that could be energised from a safe distance. ESL designed a rear-actuated receptacle that removes this safety risk by requiring the operator to engage the actuator rod from behind the assembly enclosure, out of the way in case of a flashover.

Since the Centerm application, ESL has installed rear-actuated systems at terminals in Philadelphia, Nairobi and Vancouver. In Philadelphia, ESL added LED lights on the rear of the enclosures so operators can see they have energised the correct receptacle.

ESL also has designs for bunker and pedestal-mounted rear actuating units, but Hellmers says the industry is still largely unaware of this option and unless they are specified by terminal operators, contractors will not consider installing them because of the extra cost.

Damage control

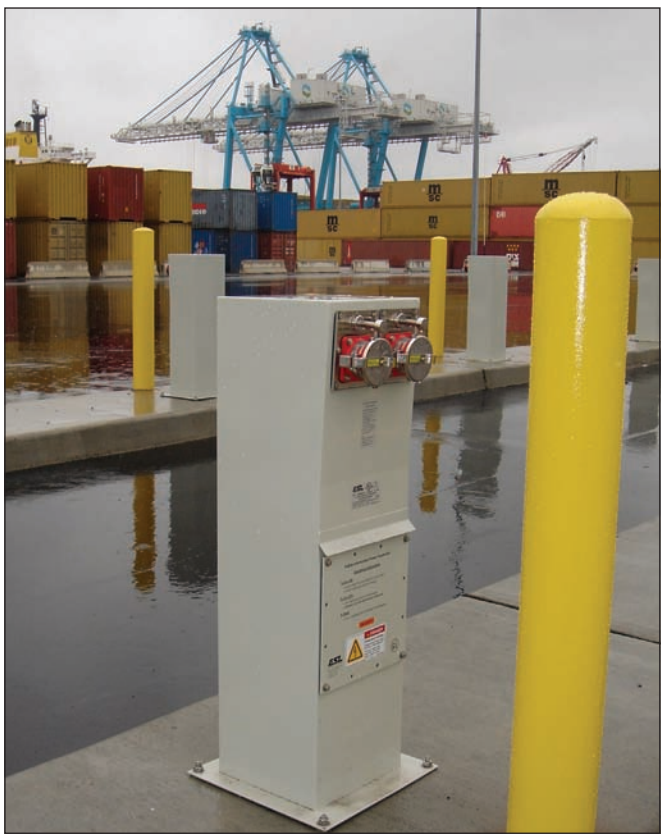
Properly treated and maintained, a safety-interlocked reefer receptacle is designed to last many years. The reality, however, is that equipment is often damaged through misuse.

According to ESL, the number one cause of receptacle damage is "drive-offs", where the reefer is moved without being first disconnected. This will destroy a nylon or plastic ROA, but not a stainless steel one, which can be repaired by just replacing the receptacle or swapping out a safety-interlocked outlet from another ROA.

In North America, the incidence of drive-offs is such that stainless steel ROAs should be considered as an industry standard, ESL says.

ESL is now working on a project with a customer in the Middle East to incorporate a microswitch in the receptacle that signals whether a container is connected, regardless of whether the reefer is energised or not. This information could be sent to the terminal operating system (TOS) and an instruction to move a reefer could be blocked if it is still connected.

There are some issues to resolve, such as how to make sure reefers are connected to the correct plug for the stack slot, but ESL says the system has the potential to save a great deal of equipment damage. ❑



More and more terminal operators are opting for two and three-gang ROAs like this twin outlet assembly in a pedestal design for a straddle carrier terminal

ESL now offers receptacles with an integrated ground fault protection device