

# Increased Safety: ARCON Arc Fault Protection System on Ships

Safety as a design criterion for seagoing vessels and shipping systems will be a major factor in determining the requirements of the shipbuilding process in future – from the design phase to approval, production, commissioning, supply and operation, including the logistics aspects up to service and maintenance. International efforts to draw up new shipbuilding regulations with a risk-based approach as well as the European SAFEDOR research project also indicate this trend. The potential hazards resulting from an arc fault in low-voltage power distribution systems on ships are enormous. Moeller's ARCON arc fault protection system offers effective protection against this.



*Arc fault at the front of a low-voltage power distribution system.*

International and national regulations of the IMO with their various conventions, classification societies as well as flag state institutions set the requirements for the design and approval process for ships and shipping systems. It has already been shown in the past that some new solutions for the design of ships and ship systems breach the existing regulations in place. In individual cases, these kinds of solutions have nevertheless been implemented by means of equivalence processes as special approvals. A new regulatory framework for the design and approval process is to be added to existing shipbuilding regulations. As safety is a key

objective, the risk-based approach is a top priority. Ship owners, shipyards, suppliers, classification societies and possibly flag state institutions will in future have to work together at a very early stage.

### Personnel and system protection

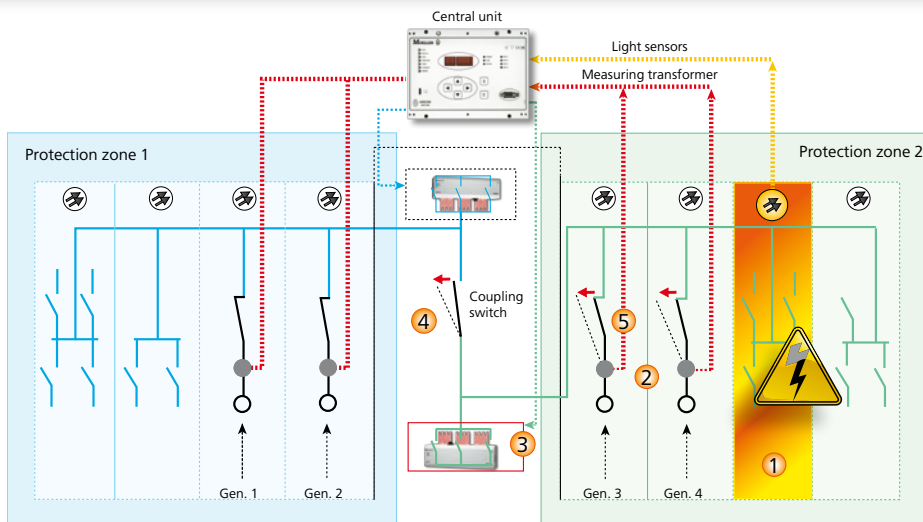
The electrical power supply and distribution systems are ideal solutions for the safety of a ship in its entirety. It must be taken into account here that the energy requirement on seagoing vessels is continuously increasing and that these types of systems are increasingly

operating close to their limits. Short-circuits are one of the events that have the most devastating effects on the power supply of onboard electrical loads.

A bolted short-circuit on a switchboard designed in compliance with the regulations is required not to lead to any restriction in the ship's operation after the leakage current is removed. Without doubt, however, short-circuits that occur together with arcs in switchboards and distribution systems have the most devastating consequences. Arc faults still occur in electrical power distribution systems in spite of all the precautionary

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- Function of ARCON arc fault protection system**  
**Scenario 1:**
1. Arc fault in protection zone II -> Signal of light sensors to central processing unit
  2. Incoming supply current transformers -> Signal to central unit
  3. Quenching device is activated -> Arc fault is quenched after 2ms
  4. Coupling switch opened by the short-circuit current according to selectivity
  5. Incoming supply circuit-breakers in protection zone II open as a result of the short-circuit current Protection zone I stays in operation

measures taken, and are caused by human error when working on the switchboard, contamination or condensation, overvoltages or similar occurrences – with far reaching consequences for humans and systems.

After this kind of damage has occurred in the main switchboard of a ship, at least half of the power supply system is no longer operational. In accordance with the applicable regulations (SOLAS) the ship should at best be suitable for take home operation. Moeller's ARCON arc fault protection system prevents this scenario.

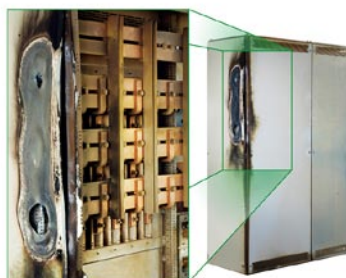
**Function of arc fault protection systems**

In the event of an arc fault, the air pressure and temperature reach their maximum values within 10-15 ms so that the arc fault can very well be compared to an explosion. As the electrical characteristics depend on the conditions at hand, such as generator output or the length of the connection cables, only the duration of the arc fault is a controllable variable. ARCON quenches the arc fault in only two milliseconds – long before any serious damage to persons or to the switchboard can occur. This special capability was recognised by VdS Schadenverhütung (loss prevention) and certified.

The function of ARCON is quickly described: The light emitted from the arc fault, as well as its short-circuit current, can be detected very easily. Special sensors connected to fibre-optic cables are laid along the active switchboard sections for detecting the light. Some of the extremely bright light of the arc fault enters the fibre optic cable radially and is transferred to the evaluation device where this information is processed. ARCON uses the current transformers present in the incomers to detect the second variable. If both detection variables exceed certain specified threshold values at the same time,

the evaluation unit triggers the quenching device. The device produces a three-phase bolted short-circuit as close as possible to the incoming supply and parallel to the fault location. The current takes the path of least resistance and the arc fault is quenched. The entire process - consisting of detection, evaluation and quenching - is completed within two milliseconds. The value of the arc fault current, whether 67 kA, 65 kA or 100 kA is not important. The incoming circuit-breaker also only isolates the section of the system that is affected by the arc fault. All unaffected areas are kept in operation.

As a backup measure and to prevent automatic restarts, ARCON triggers all shunt releases of the circuit-breakers feeding this area. ARCON fully meets here the selectivity requirements in marine power supply systems. Once the causes of the fault have been rectified and the quenching device replaced, the switchboard is ready for service without any restriction.



The modular ARCON arc fault protection system consists of the ARC-AT quenching device, ARC-EM and ARC-EL3 electronic evaluation units and sensors.

Quicklink ID:

**CONCLUSION**

Prof. Dr. Ing. Wilfried Hensel, Maritime Consultant, summarises: "The ARCON arc fault protection system makes a substantial contribution to increased safety for power distribution systems on seagoing vessels. ARCON covers both IMO requirements with regard to the protection of human life and the environment, as well as the financial and logistic risks of the operator. This kind of protection system is not explicitly stipulated in the existing shipbuilding regulations. In order to boost their competitive strength worldwide, shipyards can already considerably increase the safety standards of their products through innovative solutions such as ARCON."

Destroyed conventional low-voltage power distribution systems after an arc fault. Enclosure wall and busbar system melted due to the intense heat.

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