Emergency ventilation for rolling stock applications

Railway carriages are air-conditioned and windows cannot be opened.

This requires regulated incoming and outgoing air ventilation. What we are able to breathe free of charge in nature is a considerable cost factor for railway applications because air must be processed for air conditioning and passenger's comfort. Air volume is regulated by fans with inverters and frequency / voltage conversion. If now the three phase on-board network fails, all fans must carry on with reduced power/speed/voltage. There for SYKO modified an emergency inverter, which is build up with three components:

A) *passive or active feed-in module either from three-phase voltage or from power factor treated single phase with 16,7Hz or from 600/750 V DC traction line to an intermediate level output of 560-700 V DC*

B) *Frontend DC/DC-converter from battery network 24/36/72 or 110 V generates an intermediate level, which equates the three-phase voltage for emergency operation mode*

C) *Three phase inverter with f/U-Control and sinus choke, whereat the control unit, functionality and communication runs through an isolated CAN-Bus interface*

Emergency inverter Series NLD

Theoretically an identical peak level output voltage can be generated from 400/460 V three phase. Components such as input filters, rectification, three phase bridge and especially the sinus choke lead to voltage drops. Functional a passive input module will work to the same output level as input level but for the synthetic sinus output the output will be lower about 30V AC. An active module works with an intermediate sided boost topology to generate the intermediate level of approx. 700 V DC to achieve that the AC-output voltage (up to 460 V AC) can be higher than the input amplitude. This lowers the efficiency about 2% approximately. Additional options are single phase power factor stage or traction line supply.

Compliant to the standards the DC/DC-frontend unit processes the according on-board input battery voltage and generates an intermediate level of approximately 350-400 V DC (e.g.), which is quasi regulated with ±3 % and short circuit proof. With the use of very fast switching semiconductors (three phase bridge) and processor controlling the three phase output voltage is build-up. Three single phase chokes or one three phase choke re-generate PWM power as synthetic sine wave with limited dU/dt-rising.

SYKO offers standard sinus-frontend units from 400/500 W up to 2500/3000 W to supply fans in normal operation on AC-input voltages with 1 kW up to 6 kW 460 V/60 Hz and with 400 up to 2500 W in emergency operation. In general the three phase bridge can be controlled in voltage and frequency through R or U-adaptation or via isolated CAN interface. All auxiliary levels are generated b an internal house keeper power supply. Air and creepage distances are compliant to the regulations. With this topology no change-over contactors are needed and the overall efficiency is at 91 up to 96 %.For an input sided single phase 16,7 Hz-supply we currently bring our cascadable power factor stage with n x 1 kW to series status, which will reach an extremely good efficiency. Mechanically these three functional items fit into our standard housings of our DRR.H2 up to DRR.H6 solutions.

In the case of an input sided AC-voltage failure the intermediate level shuts down and the sinus output voltage and frequency follows this value accordingly. At the same time the front-end unit, which is connected to the battery with low stand-by current consumption (1 mA), runs up the output intermediate level with the result that the fan continues the operation without interruption. The unit's interfaces are complying with railway standards, shock/vibration and temperature.

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