

## RAIL TO EARTH VOLTAGE ON 50HZ AC ELECTRIFIED RAILWAYS

The load and fault currents which flow in an AC railway return to the feeder station neutral via various paths including the earth. The rails at the point where the currents enter will be at a voltage above remote earth; similar they will be below remote earth at a feeder station. Since both rail and remote earth can be in physical proximity (rail and water pipe for example), a safety hazard can exist if this voltage difference exceeds a safe value.

For normal service conditions, a limit value of 60 volts has been set; this might be felt but presents no risk to life. The body can withstand higher voltages for short times, and a value of 430 volts is allowed under fault conditions since the fault will be rapidly cleared by the electrical protection system. This voltage would be felt as a definite electric shock but there is little risk to life unless the individual is unusually vulnerable.

The railway return current system should be designed to ensure that these voltage limits are not exceeded. This report gives general methods of calculation which can be used for AC systems. It is usually found that a system which meets the fault condition limit will be acceptable under service conditions, and hence only the fault condition will be considered. The basic electrical equations and numerical examples are given for typical cases.

The method covers most of the usual track and feeder station configurations. Some of the predicted voltages are in excess of the 430 volt limit, notably on short branch lines near feeder stations. It may therefore be considered worthwhile to carry out practical measurements of voltage, including measurements of mast/earth resistance.