



Modernisation of the railway signaling systems in India

Railway network in India is the 2nd largest network in Asian subcontinent just behind China and 4th largest network in the world. Daily about 3423 trains runs through Indian Railway network. Indian Railways has more than 64,015 km (39,777 miles) railway network with about 6,909 stations, carrying 6.2 Billion passengers per year, highest in the world.

A giant on its way towards the future



“Railway signaling” is a control and monitoring system used to control railway traffic safely, essentially to prevent trains from colliding. Furthermore, trains cannot stop quickly, and frequently operate at speeds that do not enable them to stop within sighting distance of the driver. A minor malfunction in signaling system due to earth leakage/fault will cause a catastrophe which is unimaginable, leading to loss of life of thousands.

Apart from meeting the basic requirement of necessary safety in train operation, modern railway signaling plays an important role in determining the capacity of track section. The capacity decides the number of trains that can run on a single day in a section. By proper and efficient signaling the capacity can be increased to a considerable extent without resorting to costlier alternatives.



From oil candle to relay

The first train was installed in India in Mumbai in 1853 by British engineers. The railway network and signaling system in India further evolved in similar lines of railway system in Britain, which is still followed in India. However the developments in USA and Europe are now incorporated in the railway system in India. The railway signaling system evolved from the manual system using oil candles with coloured glass filters, further induction of electric lights and contacts and currently computer based programmable complex and efficient signaling and interlocking systems keeping in line with latest development in science and technology. Similar to British Railways, various types of ungrounded (IT system) low voltage power supplies viz. 110 V AC/DC, 60 V AC/DC, 24 V AC/DC and 6V AC/DC with maximum operating current of 150 mA to 200 mA per circuit is currently used.

The advantages of IT system are to increase the availability and reliability of signaling circuits. First earth fault does not affect the required functions of the system. The various signal and switching circuits include Track Point Switches, Track Motors, Signal Control Relays and Signaling Lamps. The design now generally conforms to national and international standards. The railway signaling system in India have now ranging from 4-5 relay racks in a small signaling station to tens of relay racks in a large station. Majority of the cables associated with the above mentioned circuits are outdoor and run along railway tracks to a distance of 2 to 3 km either buried or over ground. They are exposed to the harsh weather and unfavorable environment and human induced damage and theft. These affect their insulation resistance and are subject to deterioration in the harsh environment over a period of time. This leads to mal-operation and unreliable operation of signal systems.

India being a labour intensive country and Indian Railways a completely government controlled company having the philosophy to support employment has a large pool of human labour. Most of the maintenance jobs are manual with prescribed preventive maintenance schedule. This leads to high failure rates with corrective maintenance as a standard method of maintenance procedure. With growing economy at fast pace and a need for reliable, safe and efficient infrastructure like railways, malfunctions and failure in signaling system will jeopardize the essence of safety, reliability and efficiency of railway system and may cause horrible railway accidents. A need for continuous monitoring of the health of signaling system to aid in predictive and preventive maintenance without shutdown is the need of the day.

Real-time monitoring

US, British and European in-house railway standards recommend continuous monitoring of the insulation resistance of the signaling circuits to ensure reliable, efficient and safe movement of trains. Currently railway signaling system uses electronic relays, electronic power supplies, programmable computer systems and communication circuits which are inherent source of EMI. The monitoring system should work in presence of such electrical noises without spurious operation and indications (EMI/EMC qualified). Further they should conform to the latest standard IEC 61557-8 for insulation monitoring system and IEC 61557-9 for fault location system and shall be EMC qualified as per IEC 61326 or equivalent.

Railway signaling system in India till date did not have any international standard qualified continuously monitoring facility for monitoring of insulation level





of the circuits online. Only indigenously developed basic insulation monitoring system not conforming to any international standards was used and still in use. It totally depends upon periodic manual checking of insulation level in stipulated time interval. This led to many malfunctions and failures in signaling circuits causing appreciable down time and affecting smooth running of trains and jeopardizing safety. Therefore an international standard qualified on-line insulation monitoring and fault location system is the need for railway signaling system in India.

Complex demands ...

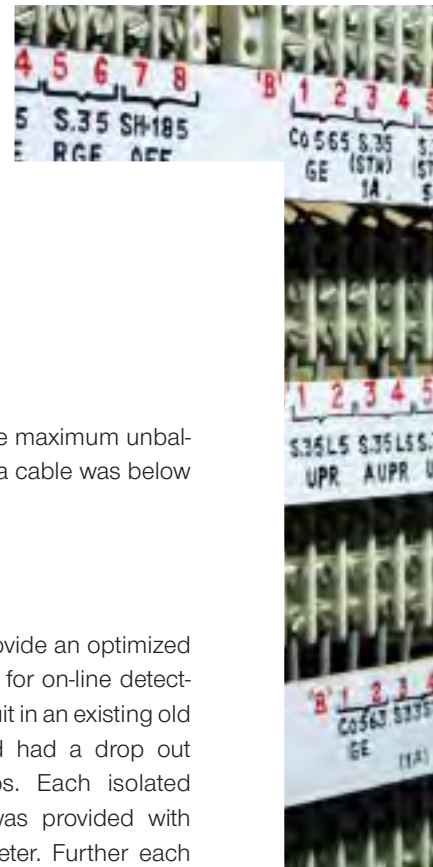
With technical support from Bender India for the first time Bender solution was implemented in some of the existing railway signaling stations in India. Typical railway signaling system in India consists of various ungrounded isolated power supplies viz. 110 VAC 3-phase for Track motors, Main Signaling, Shunt Signaling, 110 VDC for Track Point Control and 60 VDC for Relays, 24 VDC for Flashers and Axle Counters and 12 VDC for Communication. Further the individual circuits are passed through relay and interlocking circuits/racks in the signal room and run to the outside field via a terminal distribution frame located in signal room along the railway tracks through multi-core PVC cables.

A typical signal station may have 50 to 60 cables going out of the signal station. Any single cable may have circuits of different system voltages. Further the circuits in the cable are such that one wire of the circuit may pass through one cable and the return wire in other cable. Therefore the normal operation residual current was not zero in any cable. Signal cir-

cuits being low power the maximum unbalance/residual current in a cable was below 4 to 5 Amps.

... simple solution

The challenge was to provide an optimized solution with lowest cost for on-line detecting fault in individual circuit in an existing old station. The relays used had a drop out current of 40 milliamps. Each isolated power supply system was provided with its own IRDH575 A-Isometer. Further each outgoing cable was installed with appropriate Bender Current Transformer suitable for the cable diameter. For cost considerations closed core Bender CTs were provided but created a lot of installation problems and time consuming due to the requirement of shut down for opening the existing cable connections. In all future old installations we have now finalized to install Bender split core CTs which has made life very easy and less time consuming without reducing any sensitivity and reliability. For newly designed stations closed core CTs will be preferred for cost considerations. Bender CTs being designed to operate even in presence of residual current below 10 Amps, there was no problem in operation of fault location system and the system performed reliably with the required sensitivity even in presence of residual current of about 5 Amps. Based on the number of CTs, the required numbers of EDS460-D Insulation Fault Evaluators were used.





Retrofitting during operation

All the IRDH575 and EDS460-D were interconnected via RS-485 BMS network for control and transfer of information. In this way we could identify which power supply system had a fault and which of the outgoing cable in the field was faulty. Based on the information of the circuits of the faulty power supply passing through the faulty cable, only those limited number of circuits in the cable of the faulty power supply was checked manually with portable EDS3090 to identify the actual faulty circuit. This was done within few minutes of fault alarm on IRDH575 and EDS460-D on-line without the need of shut down. The solution provided the railways state of the art on-line insulation monitoring and fault location system monitoring continuously 24 x 7 without any spurious alarms.

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ROAD AHEAD

With the initial success in implementation in Indian Railways and moved by the excellent Bender technology and performance and its R&D efforts, Research Designs and Standards Organization (RDSO) the main decision making authority on system design and requirements of Indian Railway signaling system is in process of standardizing on Bender insulation monitoring and fault location solution in Indian Railway Signaling System through out the country. Work has already been completed in some stations in Western as well as in Northern Railways. This is just a beginning of Bender solution in Indian Railways. We have a very wide road ahead. ■