GEC ALSTHOM TRACTION

When a major railway operator required GEC Alsthom to demonstrate the safety of their new electric traction design, GEC Alsthom turned to SaberDesigner.™ Real world testing was not an option, so GEC Alsthom used Saber® to successfully model the complex interactions of their mixed-technology equipment.

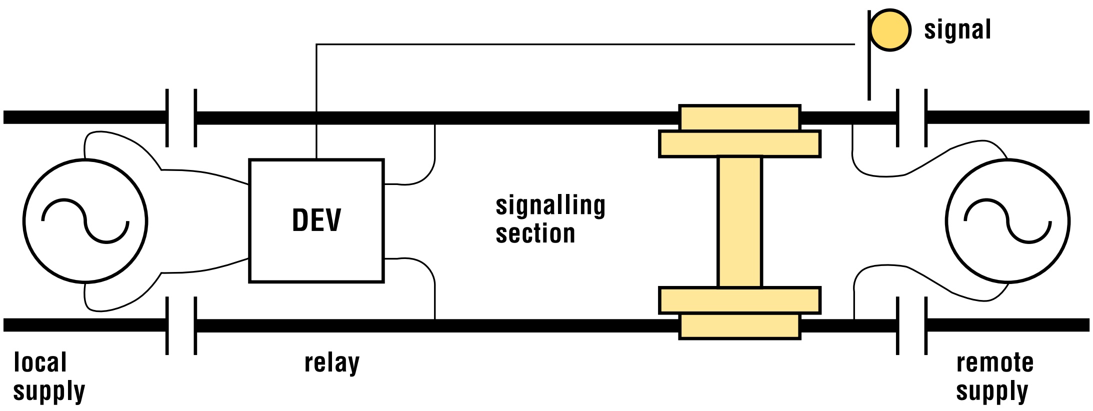
> **"Saber is the only tool we've found with a comprehensive library of device models and the ability to handle the interactions of our analog, digital, mechanical and hydraulic subsystems."**
>
> **Jim Moreland, Senior Systems Engineer**

Railroads are the workhorses of transportation throughout the world, hauling everything from coal and cabbage to pipes and passengers. Safety is always a top priority for the railroad industry — quite understandably, when you consider the disaster potential of thousands of tons of metal traveling at speeds sometimes exceeding 100 m.p.h.! To avoid problems, it's critical that trains stay on schedule and on the assigned tracks. Signalling is especially critical — switches must be 100% reliable in routing trains down the correct tracks.

GEC Alsthom is a major player in international rail transport systems, including the manufacture of freight and rolling stock, propulsion systems, and electric traction assemblies. Most modern trains use electric motors for propulsion, but the source of the electrical power varies. Diesel engines can be used to drive onboard electrical generators, but in many parts of the world, electrical traction is the preferred method — the transmission of electricity to the train via an overhead grid or a third rail. Naturally, the voltages required are high, ranging up to 50,000 volts in some countries. These propulsion voltages have the potential to interfere with the lower voltage signals used to control track switches, warning lights, and other critical safety equipment — especially in systems where the metal rails are used to transmit both types of signals.

When GEC Alsthom contracted to supply electric traction assemblies for new metro trains in Europe, they faced a challenge: The GEC Alsthom project team had to provide design documentation to show that the equipment would not interfere with the railway signalling system. Real-world testing was not well suited to this task; it's nearly impossible to stage the full range of real-world conditions necessary for a rigorous study of the interactions between railroad equipment and signalling devices. The only option was to conduct comprehensive mixed-signal, mixed-technology simulations.

Jim Moreland was the GEC Alsthom systems engineer heading this project.



Saber was used to simulate the worst case scenarios that these double-element vane (DEV) relays would encounter in controlling railway signal lights.

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“Without Saber, it would have been extremely difficult to prove the safety of the system. Our Saber simulations definitely helped the customer meet their in-service deadlines for these new trains.”

He chose Analogy’s SaberDesigner because previous experience had shown him the value of Saber’s mixed-technology simulations: “SaberDesigner is the only tool we’ve found with a comprehensive library of device models and the ability to handle the interactions of our analog, digital, mechanical and hydraulic subsystems,” he said. “The customer would not have accepted anything less than a full-system simulation, complete with worst-case transient scenarios.”

The customer’s signalling system used double-element vane relays (DEVs). One pole of the relay is supplied from a local AC supply at the signalling frequency (S.F.) and the other pole from a remote supply via the rails. If the remote supply is at the correct frequency and at 90° phase shift to the local supply, the relay is energized, causing the signal light for that section of track to be green. When a train enters that track section, it short circuits the remote supply, causing the relay to drop out and turns the signal red when the train passes. However, if the train generates an off-frequency current, it will cause the relay to pick up a wrong-side failure, thus producing the wrong signal light color.

GEC Alsthom developed a MAST® model of the traction equipment, rails, and high-voltage supply to investigate the behavior during transient conditions such as voltage interruptions or surges. “The hierarchical structure of Analogy’s MAST models made it easy to modify the model for different scenarios, just by changing parameters.”

Unfortunately, these simulations showed that certain transient conditions could produce out-of-spec levels of S.F. current. So, GEC Alsthom tested the customer’s DEV relays in the lab, to characterize current levels versus the time required to switch the device. Because the traction equipment produced currents that were not uniform sine waves, GEC Alsthom developed a MAST model of the DEV relay itself. This was incorporated into the train/rail/supply model to evaluate performance under worst-case conditions.

Because of the relay’s highly non-linear response, GEC Alsthom developed a Saber MAST model to derive torque from flux and current. They used a Saber sensitivity analysis to identify the critical parameters, and this produced a model that matched the customer’s ‘real world’ relay measurements.

The customer accepted the new model, so the relay model was added to the simulation and the final tests run. The results? Even under worst-case conditions, the traction equipment could not cause the kind of wrong-side failure that would generate the wrong color of signal light on the track.

GEC Alsthom then used SaberScope™ to customize the test graphs and transfer them electronically into the customer’s documentation package. After a careful review, the customer approved the product and the new trains were cleared for operation.

Jim Moreland has been in the railway industry for 20 years and has used Saber for 5 years. He recently took a position with ENOTRAC after serving as a Senior Systems Engineer with GEC Alsthom Traction, in Preston, England. At GEC Alsthom, he provided expert technical assistance to the company’s project teams, including simulation and RAMS work. Jim has a BSc in Electrical Engineering from the University of Manchester Institute of Science and Technology (UMIST).

GEC Alsthom’s success story was chosen by Analogy’s review board as the winner of the 1997 Saber Success Award.

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9205 S.W. Gemini Drive • Beaverton, OR 97008 • E-mail: info@analogy.com • Website: www.analogy.com

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