


Tested and approved

A Siemens Vectron locomotive is shown in motion, pulling a freight train. The locomotive is white with "Vectron" and "SIEMENS" written on its side. The train is moving on a track, and the background is a blurred landscape. The overall image has a blue and white color scheme.

New rail vehicles for international operation often have to complete a veritable marathon of approval procedures, since a separate operating license is required for each country. The whole process lasts many months – and often takes longer than planned. With the Vectron locomotive family, Siemens applied a new process for the first time, demonstrating that tomorrow's approval procedures can be fast-tracked using the cross-acceptance and delta review processes.



New cars require one, so do new planes – and trains as well, of course. Without a type approval and operating license, locomotives, trains and trainsets are not allowed out onto the track. Yet there is a crucial difference. Air and road vehicles, having been approved for operation, can travel across borders and be flown or driven all over the world without complications. For rail transport it's another story altogether.

Particularly in Europe, national rail systems are in place that have been built up historically. Cross-border rail transport is complicated through diverse technical standards: different track widths, various direct or alternating current systems using distinct voltages, numerous incompatible train-safety systems ... the list goes on. For this reason, just a few years ago it was normal to switch locomotives at border train stations.

By contrast, modern locomotives and multiple unit trains for cross-border connections have multi-system capability, which means they can cross the borders into certain countries and rail systems, depending on how they are equipped technically. Multi-system trains for use in Germany and France, for example, can handle the German rail safety systems PZB for conventional routes and LZB for high-speed routes, plus the two French systems KVB and TVM. These trains are also equipped with the new European Train Control System (ETCS), which is gradually being installed on key international routes and will eventually replace the national rail safety systems as a Europe-wide solution.

EU aims for standardized criteria

The ETCS is not the only standardization project of the European Union. "The definition of technical specifications for interoperability (TSI) in rail transport should also bring about greater clarity in the future," explains Winfried Mahr, Head of Locomotive Approval at Siemens Rail Systems. The TSI functions as technical regulations of a legal nature, determining the criteria for an interoperable rail system – from infrastructure and power supply, vehicle specifications and signaling to maintenance and operation. Mahr: "TSI certification is a kind of basic approval that is automatically valid throughout the EU."

Unfortunately, many technical requirements of rail vehicles are not covered by the TSI. The numerous specific national features still remain – even regulations for braking systems and fire protection, crash safety and air-conditioning systems can vary from country to country. This means that

Track tests are part of the approval procedure.



“The modular approach of the Vectron concept helps optimize the approval procedure.”

there will be no way around national testing and approval procedures for the foreseeable future. "For us as a manufacturer that brings rail vehicles to market internationally, each certification for a different country is another obstacle course to negotiate," says Mahr. "Unfortunately, the approval procedures of the relevant authorities are often extremely complex and take a huge amount of time – it's very difficult to predict how long, actually."

That's why Siemens has joined forces with other manufacturers to campaign for international harmonization of the authorities' requirements. Cross-acceptance is the name of the process in which approval authorities recognize the testing certificates of other countries in cases where the national testing criteria share the same key points. "The goal of cross-acceptance is to simplify future approval procedures and thus ultimately cut delivery times," says Mahr. This principle avoids the unnecessary repetition of tests while maintaining the same level of test reliability.

There are already agreements of this kind in place between several European states: Germany and France accept certain certificates from the other country; there is some cross-acceptance between Germany, Austria, Switzerland, Italy and the Netherlands; and also between Belgium, the Netherlands, France and Luxembourg. "There is further potential for optimization by distributing the approval process between several countries. This involves a prior agreement about which national authority is responsible for which areas of testing. The others commit to recognizing the determined scope of these tests. The ideal result is that approval can be granted in several countries almost at the same time."



Modern locomotives and trainsets can easily cross borders.

Vectron family: modular design, modular approval

The practical benefits of this process are demonstrated by the complex and very diverse Vectron locomotive family. It includes DC versions for direct current traction grids at voltages of 1.5 kV and 3 kV, AC locomotives for alternating current grids at 15 kV and a frequency of 16.7 Hz or 25 kV and 50 Hz, plus multi-system locomotives with several national packages and a diesel-electric version. Additional versions are equipped for the different track widths and various drive powers used in European countries.

Of course, this diversity is only possible because the Vectron family is designed as a modular platform – a kind of locomotive construction kit. “There’s a specific position where every module and every system is installed,” explains Mahr. “If this module is not required, its position is simply left free – for instance a direct current locomotive that has no need for alternating current equipment. Connections and cable harnesses are installed all the same. That means a Vectron locomotive can easily be modified or fitted with additional equipment packages for other countries if its area of operation changes at some point in time.”

The modular approach means the approval procedure can also be optimized. “The usual method involves submitting each locomotive as a whole for approval, then applying for a new certificate for each modified version. But with the Vectron platform we initially submit a fully equipped, multi-system locomotive for approval – that is, a version that already has traction current and train safety modules for most European countries

installed,” explains Mahr. “By leaving out or deactivating certain modules, we can show that this has no repercussions and the remaining systems continue to function flawlessly.”

Perfect distribution of labor: cross-acceptance and delta review

This new, top-down testing procedure offers multiple benefits: once the different module combinations have been proven free of repercussions, the approval for the fully equipped model is also automatically valid for all “slim line” versions with less equipment installed. In turn, any subsequently required equipment modules can be certified more easily at a later date via delta reviews – only the new components have to be assessed. Finally, the international cross-acceptance agreements described above enable certain testing work to be distributed between the relevant national authorities. The certification agencies work in parallel and then accept the certificates issued by the other test institutes for full national approval.

In spite of this, it was around two years in total before the first important national approvals were granted for the Vectron locomotive, which has been newly developed from scratch. By current standards that’s a relatively short period, as Mahr summarizes: “This shows that there is still a lot of work to do in order to get new vehicles out onto the track more quickly and simply in the future. One way of achieving this is to push ahead with the harmonization at the European level. This measure alone offers great potential for improvement.” ■