The “Green Train” is a multi-disciplinary research and development program involving several members of the KTH Railway Group. KTH is performing research on selected topics and is also appointed as total programme manager. The programme also involves several other members of the Swedish railway sector, such as Banverket, Bombardier Transportation, Tågoperatörerna (The Association of Swedish Train Operators), Transitio, VTI and CHARMEC, as well as some consultants as Interfleet Technology, Transrail and Ferroplan. The public funded part constitutes some 50 MSEK (5 MEUR) besides still higher contributions from industry (as decided at the end of 2007). The duration is from 2005 to 2011.

The overall aim is to safeguard and further develop knowledge and technologies required for specification and development of a new generation high-speed train for Swedish (Nordic) conditions – fast and attractive, economically viable and still friendlier to the environment. The top speed is aimed for 250-300 km/h, running both on the existing Swedish rail network and on future high-speed lines.

Investigation and specification of appropriate suspension parameters for radial self-steering high-speed bogies. The aim is to contribute to the development of bogies allowing a high degree of passenger comfort, dynamic stability at high speed, moderate track forces and a low wheel-rail wear in curves. This is made by an extensive set of multi-body simulations taking a large number of possible track conditions into account. During summers 2006-08 these developments were successfully tested on various straight and curved tracks in Sweden. A Swedish speed-record of 303 km/h was set in Sep 2008, on a conventional Swedish track for 200 km/h.


RV12. Gröna Tåget: High-speed vehicles with carbody tilt

Project leader
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Sources of funding: Banverket/Trafikverket, Bombardier Transportation, SL AB, Tågoperatöreuna, Interfleet Technology, Vinnova, VTI.

This project aims at investigating possibilities for improved performance of rail vehicles equipped with a carbody tilt system. Firstly a review was made on state-of-the-art in this field, followed by an analysis of suitable cases for tilted rail vehicles. At the second stage a thorough analysis was made on possible causes for motion sickness in tilting trains, presently being a major limitation of tilted vehicles. Suitable improvements in the vehicle technology are now investigated as well as suggestions for suitable track geometry parameters. In particular a more advanced choice of tilting angle will be studied. Field tests, including test subjects, are being planned.

Persson R: Identification of areas where the competitiveness of tilting trains can be further improved, Railway Engineering, London, 2007.
Persson R: Tilting trains - benefits and motion sickness. Accepted for Journal of Rail and Rapid Transit.
In this project a study is made on human annoyance of different characters of railway noise, as radiated to the surrounding environment. This is made by recording sound (noise) from different types of trains and subsequently exposing these noises to human test subjects in a laboratory. The latter noises are normalized with respect to duration and A-weighted sound pressure level. The results so far show that there are significant differences in human annoyance from different characters of railway noise, although all these noises have the same A-weighted sound pressure level.

RV14. Gröna Tåget: Energy consumption

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Sources of funding: Banverket/Trafikverket

Possible levels of energy consumption - per seat-km or per passenger-km - have been estimated for future high-speed trains, in particular for the Green Train concept. The study shows that appropriate train design makes it possible to reduce energy consumption by 25 – 40 % both on the existing railway network and on future high-speed lines - despite shorter travel time and higher speeds.


At increased rail vehicle speed it may be difficult to maintain acceptable passenger ride comfort with conventional passive secondary suspension. Within this project in co-operation with Bombardier Transportation it is investigated whether active technology is able to maintain good passenger comfort although vehicle speed is increased and track conditions are worse. The possibility of reducing travel in the lateral suspension – and thus allowing a wider carbody within the prescribed dynamic envelope – is also investigated. After design studies with help of computer simulation, on-track tests have been performed with an active lateral secondary suspension concept implemented in a two-car Regina train during the summers of 2007 and 2008. The evaluated measurement results are encouraging and the device has been implemented in long-term tests in service operation. A Regina train with active lateral suspension has now been operating since March 2009. In June 2009 Anneli Orvnäs presented her licentiate thesis within the project. Since the summer 2009 work has been concentrating on improvements of the control algorithms, e.g. by testing H-infinity control instead of Sky-Hook control.
RV16. Gröna Tåget: Overhead power systems for operation of high-speed trains in Sweden

Project leader
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Sources of funding: Banverket/Trafikverket

The overhead power system has been identified as one of the critical areas when increasing train speed. Several questions can not be answered today:

- Which performance do pantograph, catenary and traction system need to have - especially in case of multiple units?
- Does the maximum speed need to be limited in case of more than one pantograph with short distance between each other? The issue does not exist in the same way for other European high speed traffic since the trainsets and thus the distance between pantographs are significantly longer e.g. in Germany or France.
- Could active pantographs work at the desired speed without changing the catenary system?

Within the project the dynamic interaction pantograph/catenary will be studied mainly by use of computer simulation. Existing measurement results shall be used as long as possible. During the on track test summer 2008 further measurements were carried out.

The criterion for satisfying interaction is the variation in the contact force. Therefore the contact force will be studied in the first place. A verification of the existing programmes that shall be used in the project will be done and necessary improvements will be implemented. After that parameter studies will be started. Type of catenary resp. pantograph, speed, number of and distance between pantographs are examples of parameters that will be examined. Finally the potential improvement of active pantographs will be evaluated.