

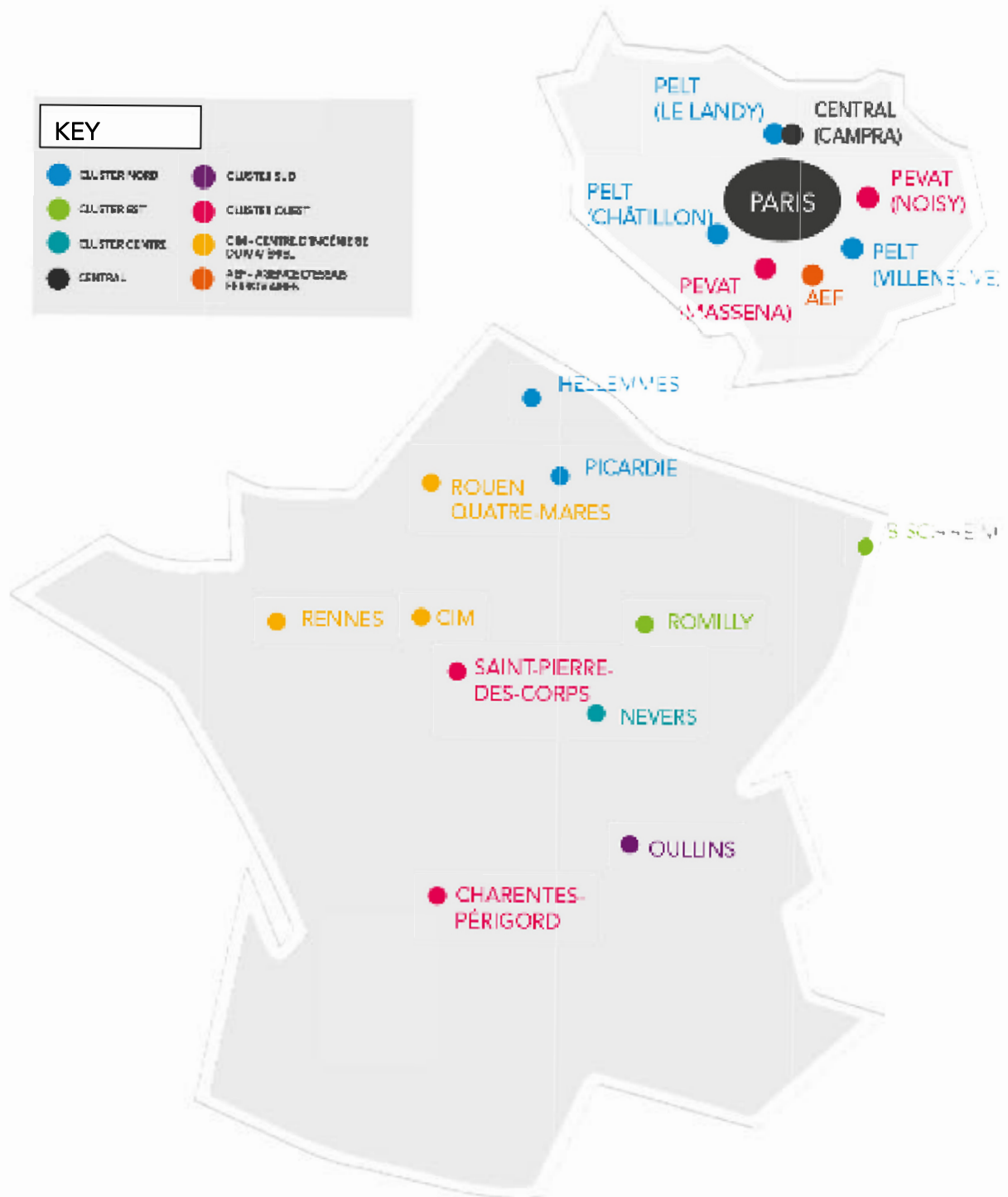
SNCF CATALOGUE OF ENGINEERING SERVICES FOR ROLLING STOCK



Ingénierie du Matériel



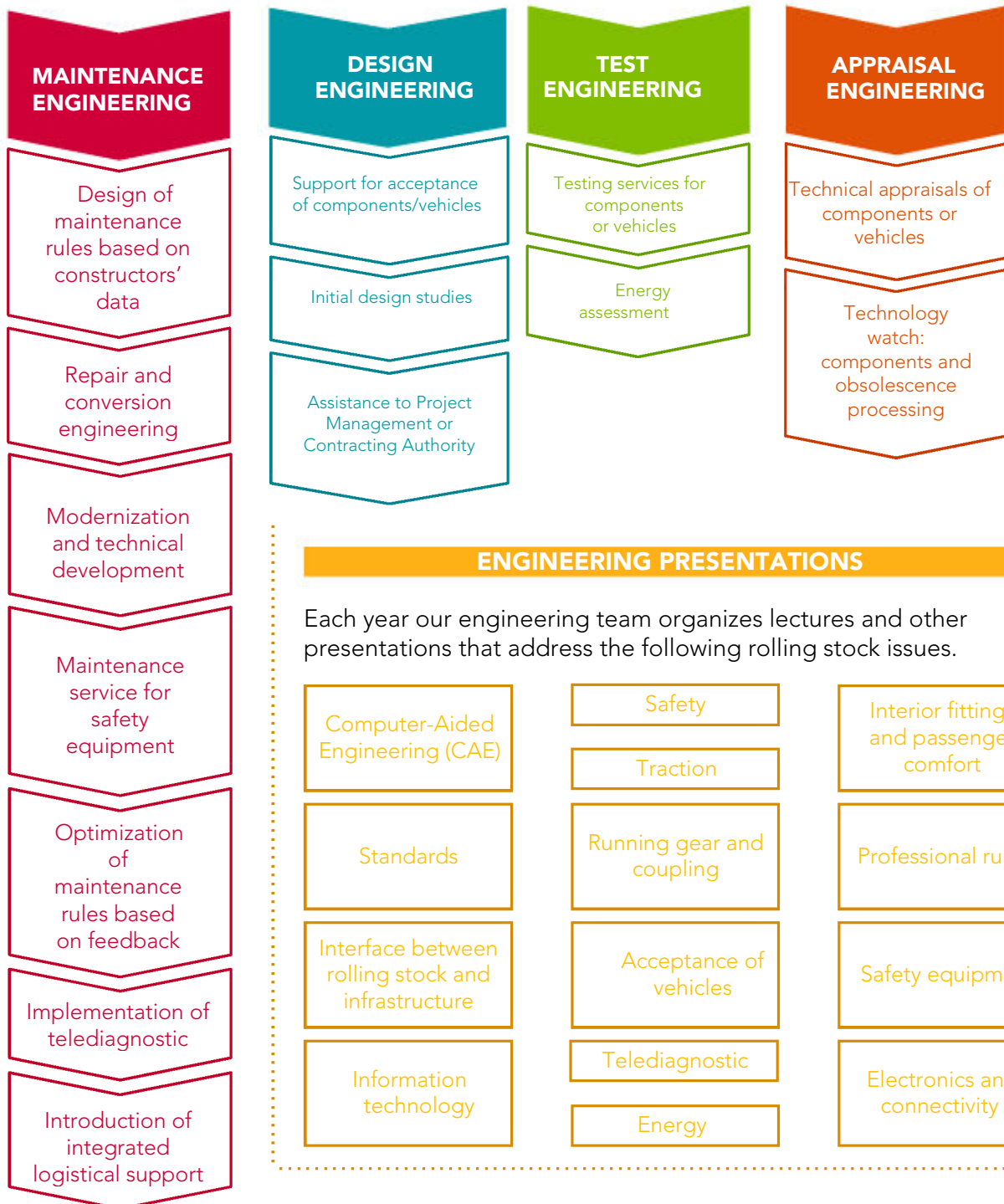
Our sites



Using this catalogue

ENGINEERING SERVICES

We've grouped our engineering services under four main headings, shown below. "Design engineering" is handled by our asset evaluation BU, and "Maintenance engineering/ Operations engineering" are handled by our parts solutions BU. Note that some services may be listed under more than one BU.



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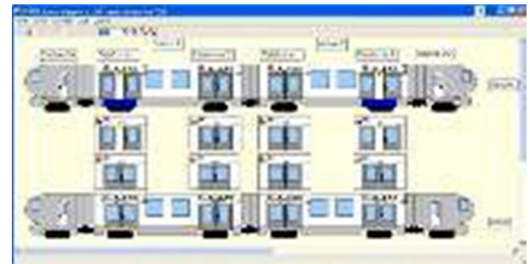
MAINTENANCE ENGINEERING



TECHNICAL ASSISTANCE FOR TRAIN CONTROL MONITORING (ROLLING STOCK)

➤ SERVICE DESCRIPTION

- Technical assistance:
 - help define the design and validation specifications of the train control monitoring system,
 - develop telediagnosics and IOT solutions (Internet of Things/connected objects).
 - assess potential loopholes and protect trains from computer hacking (SSI-Cyber Security),
 - deploy train assistance/transport.
- Simulation of electrical and computer functions: test and validate software modifications and electrical diagrams before train testing.



➤ INPUT DATA

- Type of rolling stock.
- Technical documentation available: plans, electrical diagrams, functional specifications, SDF studies.
- Certified reference configuration and applied configuration.
- Software test and/or train test reports.

➤ TRAINING

- Training in creating a control monitoring architecture (train diagram and onboard computer networks) is available on demand.

➤ WHAT WE DO

- Help clients define their needs.
- Conduct feasibility studies for implementation of new functions.
- Specify technical requirements (performance and constraints) for train control monitoring systems.
- Assess the effects of a modification in control monitoring: impact analysis.
- Audit the engineering process for developing software, networks and train control monitoring systems.
- Check and validate changes to the control monitoring system.
- Diagnose breakdowns using testability data.
- Help integrate the IOT aboard trains (to comply with railway specifications).
- Draft safety procedures for rolling stock

➤ TEST METHODS AND TOOLS USED

- Automation Studio diagram simulator
- ControlBuild Design software
- EBIOS method

➤ APPLICABLE STANDARDS

- RST TSI conventional rail
- EN 13272/15380/50128/50129/50153/50159
- NFF14402
- UIC533/555/612
- SAM E 009 / S002
- OP547 – act of 19/03/2012

➤ REFERENCES

- Alstom
- SNCF's Transilien (Paris region)

DIAGNOSTICS AND ASSISTANCE IN RESOLVING DIESEL POLLUTION ISSUES

➤ SERVICE DESCRIPTION

- Establish cause and effect with respect to fuel pollution, fuel systems, presence (or not) of tank, filling station and storage tank.
- Determine adequate curative measures and support their implementation.



➤ WHAT WE DO

- Offer solutions to reduce pollution.
- Offer preventive measures to fight pollution.
- Provide this service for every traction unit, apparatus or filling station that uses diesel.

➤ INPUT DATA

- Operating conditions (refuelling, use of rolling stock, etc.).
- Technical and/or functional description.
- Fuel system.

➤ TRAINING

- User training available on request.

➤ TEST METHODS AND TOOLS USED

- Sampling kit for fuel analysis
- Licensed biocidal product

➤ APPLICABLE STANDARDS

- NF EN 590
- CSR 4-01-03 (for off-road diesel)

➤ REFERENCES

- French Coordination Group (GFC)
- SNCF Combustible

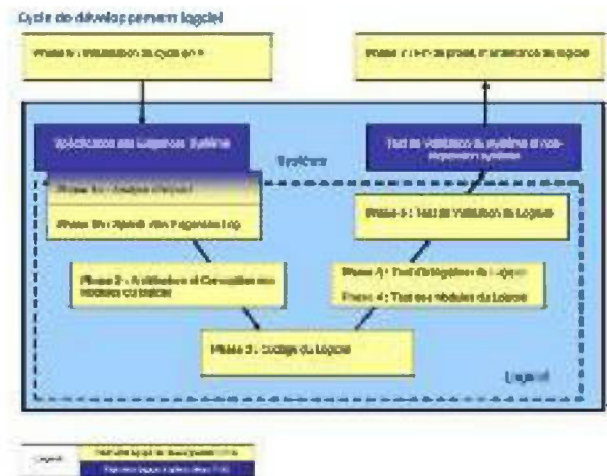
DEVELOPMENT OF MAINTENANCE AND ONBOARD SOFTWARE

➤ SERVICE DESCRIPTION

- Develop and/or appraise maintenance and onboard software:
 - support clients in developing security software
 - specify, design, code and test this software
 - provide client support for needs analysis and definition
 - reverse engineering of software.
- Maintain existing software:
 - improve/correct existing software
 - appraise onboard security software; C & C++ software, Grafcet and assembler,
 - appraise software documentation.

➤ WHAT WE DO

- Reverse engineering of software:
 - analyse software functioning
 - draft a functional or interface specification for software.
- Implementation and maintenance of onboard software:
 - draft software documentation
 - draft, test and validate software
 - ensure after-sales service for software
 - assist clients with preparation of the software evaluation dossier.
- Software appraisal:
 - draft appraisal report.



➤ INPUT DATA

- Software appraisal:
 - elements to be appraised.
- Reverse engineering of software:
 - level of access to the system being analysed (equipment, interfaces, tools),
 - source and documentation of software being analysed.
- Software Implementation and maintenance:
 - specifications
 - technical specification of needs (for onboard software)
 - interface specification
 - source code
 - binary
 - updated software documentation.

➤ TRAINING

- Theoretical and practical training available on request for Onboard Information Systems (PIS and PIDS) and for the tools necessary for their maintenance.

➤ TEST METHODS AND TOOLS USED

- Polarion, SVN, Misra C++ tests, RTRT, Polyspace

➤ APPLICABLE STANDARDS

- EN 50123 - development SIL2; ISO 9001

➤ REFERENCES

- SNCF's Proximités, Freight & passenger services, ONCF

ASSET MAINTENANCE

➤ SERVICE DESCRIPTION

- Study the life cycle of a vehicle at client's request.
- Define benchmarks to be applied when vehicles are overhauled.
- Propose strategic approaches to optimize the asset's life cycle.

➤ INPUT DATA

- Client specifications to define the scope of intervention and type of needs.
- Exchange of views with the client (Assistance to Project Management [MOA], Contracting Authority [MOE]).



➤ WHAT WE DO

- Propose a maintenance plan for the life cycle of the client's rolling stock.
- Optimize the overall ownership cost of rolling stock.
- Conduct specialist studies to define asset maintenance operations.
- Write asset maintenance documents, including benchmarks.
- Propose solutions to specific or particular problems (corrosion, cracking, losses through the line) with a view to implementing repairs.
- Provide solutions to support the end of the vehicle's service life.

➤ TRAINING

- Training available on request for drafting of specialist guides and use of user feedback.

➤ TEST METHODS AND TOOLS USED

- Non-destructive testing tools: dye penetration, magnetoscopy, low frequency.
- Endoscopy.
- Ultrasound equipment.

➤ APPLICABLE STANDARDS

- STI 2014/1302
- LOC and PASS
- ISO9001

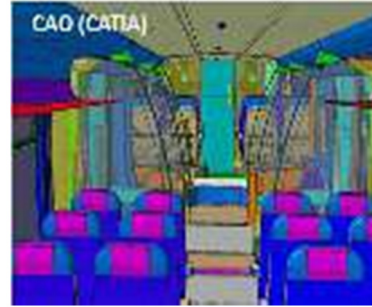
➤ REFERENCES

- Thalys
- SNCB
- Eurostar
- CFL

STUDY OF MODIFICATIONS TO ROLLING STOCK

➤ SERVICE DESCRIPTION

- Carry out modification studies on rolling stock, from (re)design of internal fittings to submission of acceptance dossiers to the national safety authorities.



➤ WHAT WE DO

- Implement reverse engineering for electrical or mechanical equipment.
- Carry out test runs.
- Compensate for obsolescence of materials and components.
- Adapt materials to changes in standards.
- Add functionalities: passenger information system, WIFI, camera, passenger counting.
- Improve comfort and reliability.
- Reinforce structures.
- Modify the following systems: bodies, internal fittings, upholstery, safety equipment, train/ground communications, geo-tracking, general mechanics, onboard computer systems.

➤ INPUT DATA

- Construction documents.
- Client specifications.
- Reliability analysis.
- Reference frameworks (TSI, standards, etc.)
- Usage profile.
- Material, human, environmental and organizational constraints.

➤ TRAINING

- Training courses on different functions and braking subsystem are available for staff.

➤ TEST METHODS AND TOOLS USED

- SI TER simulation benches
- Software: Catia V5, E3S and Keyshot

➤ APPLICABLE STANDARDS

- Decree 2006-1279 of 19 October 2006
- Order of 19 March 2012
- Order of 23 July 2012
- DRN France

➤ REFERENCES

- X72500 ERTMS
- Z21700 bi-standard KVB/TVM
- Video protection on AGC
- Renovation of interior fittings X72500
- SNCF local operations

INTEGRATION STUDY FOR A NEW PIECE OF EQUIPMENT

➤ SERVICE DESCRIPTION

- The service is provided in 2 stages, which can be implemented independently:
- Feasibility study:
 - analyse client's functional needs
 - define possible technical solutions
 - define technical constraints and standards that must be observed
 - quantify possible solutions in terms of costs and timeframes.
- Integration and design study:
 - technical validation and design of the product
 - validate compliance with standards and application of best practice in electronics
 - support the acceptance of the equipment in terms of electromagnetic compatibility.



➤ WHAT WE DO

- Provide technical solutions, a timeframe and figures to satisfy a functional need.
- Implement the solution selected by the client, while complying with applicable standards and best practice.

➤ INPUT DATA

- technical documentation for the product being appraised:
 - functional expression of needs
 - technical solution selected following the feasibility study already carried out
 - descriptive notes and operating manuals.

➤ REFERENCES

- Ensuring secure access to TGV drivers' cabs
- Integration of TBL1+ racks on R-TRI (EMF impact)
- Redesign of the onboard computer system (PIS) of the High Capacity (regional) Train (AGC)
- Demonstrators: communicating train and digital train

➤ APPLICABLE STANDARDS

- NF EN 50155
- NF EN 50121-3-2
- NF EN 61000-4-x
- STM E 001
- IPC 610
- UTE C 80810

DEFINITION(S) AND OPERATING STUDIES FOR MAINTENANCE OF TRAIN INTERIORS

➤ SERVICE DESCRIPTION

- Define benchmarks to be applied when rolling stock is overhauled.
- Define "comfort" upgrades for extending the service life of vehicles.
- Study level 5 conversions to apply when rolling stock is overhauled.
- Define work needed to extend the service life of a vehicle.

➤ INPUT DATA

- Client specifications to define the scope of the study and type of need.
- Meeting to exchange views with the client.

➤ WHAT WE DO

- Carry out specialist studies to identify and define level 4 maintenance operations for interior fittings.
- Draw up level 4 maintenance documents with benchmarks for interior fittings.
- Define conversions to implement in level 5 maintenance at client's request.
- Draw up the modification orders to apply when the vehicles are refurbished or converted.
- Optimize passenger comfort as per client's request.



➤ TEST METHODS AND TOOLS USED

- Non-destructive testing tools: dye penetration, magnetoscopy, low frequency, etc.
- Endoscopy
- Ultrasound equipment
- Test rig

➤ APPLICABLE STANDARDS

- STI 2014/1302
- LOC and PASS
- ISO 9001

➤ REFERENCES

- Thalys
- SNCB
- Eurostar

DEFINITION OF MAINTENANCE OPERATIONS FOR FRAME STRUCTURES

➤ SERVICE DESCRIPTION

- Using specialist studies carried out by our teams or others, define targeted maintenance operations to renovate damaged rolling stock:
 - carry out specialist studies
 - draft a summary of the state of the fleet
 - define benchmarks for repairs and protective measures
 - draft operational methods for repair.
- Operations will be prepared, defined and calibrated to be carried out within short time frames.

➤ INPUT DATA

- Training to diagnose and repair steel/aluminium structures is available on request.
- Client meeting.

➤ INPUT DATA

- Technical data for rolling stock.
- Specialist studies of rolling stock.

➤ WHAT WE DO

- Mirroring “comfort upgrades”, propose targeted “structure upgrades” to get rolling stock back into service, in compliance with regulations set by rail safety authorities.



➤ TEST METHODS AND TOOLS USED

- Endoscopy (3m scope)
- NDT: ultrasound, dye penetration, magnetoscopy, ACFM, eddy current.
- Measurement of thickness
- using ultrasound
- Statistical analysis, SNCF software (MOZART)

➤ APPLICABLE STANDARDS

- NF EN 15085
- NF EN ISO 9712 – COFREND 2

➤ REFERENCES

- Definition of TGV trainsets' residual service life
- Definition of end-of-life stage for Eurostar trainsets
- Intervention at railway incident/accident blackspots

PRELIMINARY STUDIES ON INTERIOR FITTINGS

➤ SERVICE DESCRIPTION

- Use a functional analysis to help the client define needs, while keeping within target budget.
- Reproduce a 3D environment from 2D or from the item and physical material.
- Adjust the 3D environment to represent reality (digital model).

➤ WHAT WE DO

- Transform the physical model into a 3D digital model.
- Provide 3D views of proposed designs.
- Make 2D plans.
- Carry out a risk analysis.



➤ INPUT DATA

- Functional expression of client's needs.
- Target cost.
- Target time frame.

➤ TEST METHODS AND TOOLS USED

- Catia software V5
- Autocad Raster
- 3D Scanner

➤ APPLICABLE STANDARDS

- French and European railway standards

➤ REFERENCES

- Renovation of TGV Duplex trainsets
- Renovation of PBA and PBKA trainsets for Thalys
- Conversion of the TGV Duplex into OUIGO
- Integration of a power socket on TGV Duplex trainsets

PRODUCING EXTERNAL AND INTERNAL LIVERY FOR ROLLING STOCK

↗ SERVICE DESCRIPTION

- Study and implement signage, lamination and/or painting of rolling stock. After receipt of client's visuals, the process is as follows:
 - formatting, recording and preparation for printing
 - printing on PVC film
 - production of complex protective film resistant to UV rays, graffiti, scratches and cleaning
 - cutting to the desired form
 - packing and dispatch.



↗ WHAT WE DO

Create designs and prepare "source" files in a format that can be used by printers:

- measure the supporting 3D envelope
- adapt designer's drawings to surface material
- produce guide to positioning graphics
- guarantee compliance with guidelines from railway regulations
- simulate positioning to facilitate decision-making
- provide technical assistance for the selection of materials and processes
- create templates and stencils
- coordinate works during the prototype phase
- provide technical support for production proper
- monitor provider's input at each stage: preparation, installation, compliance with specifications.

↗ INPUT DATA

- Design, vehicle type, operational constraints.

↗ TEST METHODS AND TOOLS USED

- Illustrator software
- Printer
- Laminator

↗ APPLICABLE STANDARDS ↗ REFERENCES

- STM, TSI and standards in relevant fields: fire, smoke, glass products, travellers with reduced mobility

- SNCF Voyages, Proximité and Transilien services
- Thalys
- Eurostar

INSTALLATION OF ONBOARD WIFI

➤ SERVICE DESCRIPTION

- Conduct an initial audit.
- Propose a comprehensive solution (vehicle and software).
- Assist in development of the WIFI solution.



➤ WHAT WE DO

- Prepare and deliver a report following initial audit/inventory.
- Provide a preliminary analysis.
- Assist the client in drafting benchmarks for modifications to rolling stock.
- Assist the client with certification.
- Develop the wifi access portal.

➤ INPUT DATA

- Level of access to the system being analysed.
- Definition of operational needs.
- Mechanical and electrical diagram of the target (trainset).

➤ TEST METHODS AND TOOLS USED

- Testing/measurement on trainset using Test in Commercial Service
- "Internet of things" bench (hardware test)

➤ APPLICABLE STANDARDS

- EN 50155
- EN 45545

➤ REFERENCES

- Thalys
- Alstom (Citadis)
- SNCF Voyages activities (TGV)
- Demonstrator "DIGITAL train"

ASSISTANCE WITH MAINTENANCE OPERATIONS ON SAFETY EQUIPMENT

➤ SERVICE DESCRIPTION

- Support and advise trained staff in maintenance operations for safety equipment and high/low voltage electrical equipment.
- Specify interfaces between ground and onboard equipment to justify maintenance tests.
- Give examples of latent outages and simulate outages or failures hidden across the maintenance framework.
- Combine support for the maintenance framework with a real-life situation.



➤ WHAT WE DO

- Assist and guide trained and skilled staff in maintenance operations related to safety equipment and electrical equipment.
- Advise client to ensure full control of the product used as part of SNCF's onboard equipment or a foreign network, using a maintenance manual.
- Propose an optimized sequence for maintenance operations using the maintenance framework.

➤ INPUT DATA

- Current audit/review of maintenance carried out on the trainset.
- Maintenance cycles scheduled by the workshop in charge of maintenance.
- List of tools/monitoring equipment/measures available to carry out maintenance.

➤ TEST METHODS AND TOOLS USED

- Fixed equipment in the maintenance centre
- TVM test set
- COAX analyser cable
- Absence of voltage checker (VAT)
- Capacity discharger

➤ APPLICABLE STANDARDS

- ISO 9001
- ISO 14001
- OHSAS 18001

➤ REFERENCES

- Balfour Beathy
- Framofer
- Sifel
- Akiem

FORMULATION OF PREVENTIVE MAINTENANCE RULES

➤ SERVICE DESCRIPTION

- Study constructor's documentation.
- Verify that maintenance body has understood the construction documents.
- Draft a preventive maintenance guide based on the maintenance body's stipulations.



➤ WHAT WE DO

- Appraise a maintenance framework.
- Apply user feedback from the rolling stock fleet maintained by SNCF.
- Provide advice to the maintenance body.

➤ INPUT DATA

- List of constraints that impact maintenance.
- Specifications of safety equipment and high/low voltage electrical components.
- Maintenance cycles scheduled by the workshop in charge of maintenance.
- List of tools available to carry out the maintenance.

➤ TEST METHODS AND TOOLS USED

SNCF inhouse software for developing maintenance guidelines

➤ APPLICABLE STANDARDS

- ISO 9001
- ISO 14001
- OHSAS 18001

➤ REFERENCES

- DB / DB Cargo
- Eurostar
- Siemens
- Network Rail
- Thalys

EXPERTISE IN EQS SYSTEMS ON TRAINSETS

➤ SERVICE DESCRIPTION

- Provide expert analysis of repairs following breakdowns, both complex and minor.
- Provide remote assistance and input to maintenance personnel, train contractors and mechanics in complex breakdowns.
- Conduct expert analysis of integration of safety equipment on board trains to ensure compliance with specifications.
- Appraise basic components, such as parts and electronic cards.
- Draft repair reports and expert opinions, including recommendations.

➤ WHAT WE DO

- Conduct an inventory of relevant safety equipment.
- Identify the cause/source of a malfunction.
- Issue recommendations.



➤ INPUT DATA

- Maintenance documents.
- User manuals.
- Summary documents for components.
- Electrical diagrams for components and trains.
- Notes summarizing settings and tests.
- Incidents, alerts and REX for function or component.
- Integration specifications.
- Other information as requested.

➤ TEST METHODS AND TOOLS USED

- Rack test bay
- Training bay
- Test methods for coaxial and twin axial cables
- Profibus network analyser
- Test case
- Simulation tools
- Maintenance software used: VT32, PROG MID, PC- SAM, Visu-ODO and Bi-standard KVB/ERTMS

➤ APPLICABLE STANDARDS

- Defined on request.

➤ REFERENCES

- SNCF's Transilien, Freight, Voyages and Proximité operations
- Thalys

ACCEPTANCE OF BRAKING GEAR OR FRICTION MATERIAL

➤ SERVICE DESCRIPTION

- Examine and validate the technical file of control/power equipment or of friction material.
- Organize monitoring in commercial service.



➤ WHAT WE DO

- Establish a test programme, conduct test monitoring and draft a technical opinion.
- Set up a test programme in commercial service, using standardization/regulatory documents or a specification as references.
- Give a technical opinion.

➤ INPUT DATA

- Technical data on the vehicle concerned.
- Technical data on the component concerned.

➤ TEST METHODS AND TOOLS USED

- Tools for measuring discs and friction materials (CALIPRI)

➤ APPLICABLE STANDARDS

- STI – Locomotives
- PAS – Rolling Stock
- DRN - France

➤ REFERENCES

- High-speed brake linings
- Brake discs
- Compact brake unit
- Driver's brake valve qualification

SUPERVISION OF TECHNICAL STATE OF ROLLING STOCK BASED ON FAULT CODES

➤ SERVICE DESCRIPTION

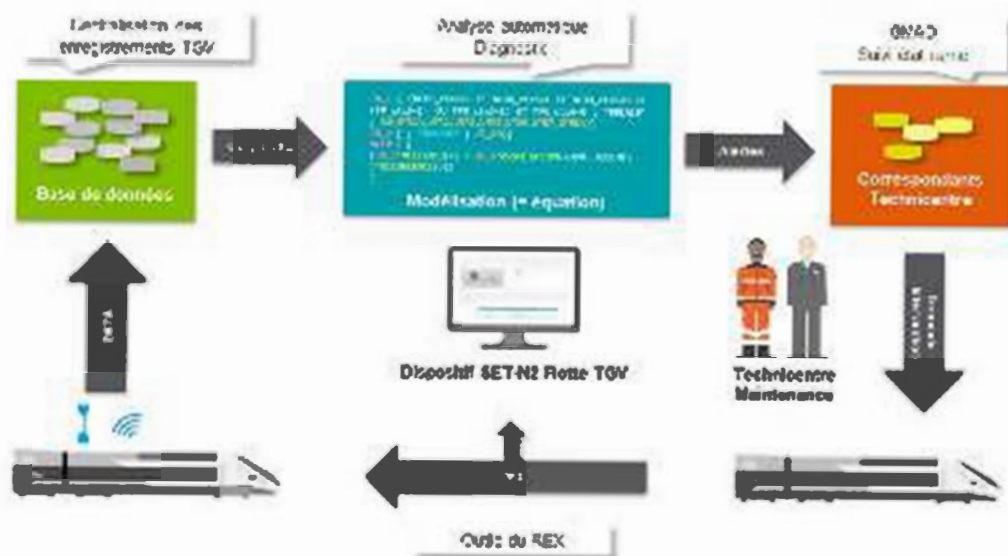
- Retrieve trainset faults from a database.
- Model functional drifts.
- Translate models into equations.
- Define the repair recommendations of the equations.
- Communicate alerts to the client.
- Host the alert processing system/device.
- Adjust equations according to feedback (experience).

➤ WHAT WE DO

- Issue daily alerts enabling:
 - improvements to vehicle reliability, since repair teams step in at the first warning signs
 - a preventive approach to repairs
 - reduced intervention time
 - definition of performance indicators.

➤ INPUT DATA

- Retrieval of faults on the SNCF server.
- Sharing feedback from experience of vehicles.
- Technical support from the client to formulate equations.
- Recommendations for repairs.



➤ TEST METHODS AND TOOLS USED

- MyTrainData digital platform (database that formulates equations and transmits alerts)
- KIBANA (performance dashboards)

➤ REFERENCES

- Activité Voyages de SNCF
- Thalys

EXPANSION STUDY OF THE MAINTENANCE PLAN AND FEEDBACK FROM HANDS-ON EXPERIENCE

➤ SERVICE DESCRIPTION

- Study the equipment maintenance plan.
- In-Depth Analysis of Feedback (AAREX method).
- Propose a solution for achieving economic benefits (in material costs, manpower time, availability of trainset, regularity).

➤ INPUT DATA

- Specifications for planned expansion.
- List of constraints exported in connection with the component.
- Specifications for safety devices and high/low voltage electrical apparatus (technical document, AMDEC).
- Maintenance cycles scheduled by depot in charge of maintenance and/or the constructor’s maintenance manual.
- List of tools available to carry out the maintenance.

➤ WHAT WE DO

- Optimize maintenance of the provider as per maintenance body’s specifications for:
 - greater efficiency
 - reduced maintenance costs
 - reliability judged “acceptable” in terms of required reliability.
- Advise the maintenance body:
 - propose development themes to prepare input data for service
 - assist with drafting of expansion specifications
 - establish traceability to obtain feedback that justifies development.



➤ TEST METHODS AND TOOLS USED

- Feedback (experience)
- “Mozart” package
- Calculation of the economic gain using Net Present Value method

➤ APPLICABLE STANDARDS

- ISO 9001
- ISO 14001
- OHSAS 18001

➤ REFERENCES

- Thalys
- Eurostar

OPTIMIZATION STUDY TO COMBINE TWO SEPARATE MAINTENANCE OPERATIONS

➤ SERVICE DESCRIPTION

- Study the equipment maintenance plan.
- Analyse feedback (experience).
- Propose an optimized package of maintenance operations.

➤ INPUT DATA

- Specifications for planned optimization study.
- List of constraints exported.
- Maintenance cycles scheduled by depot in charge of maintenance.
- List of tools available for maintenance.

➤ WHAT WE DO

- Optimize provider maintenance as per specification.
- Advise the maintenance body.
- Propose an optimized sequence for maintenance operations using a framework model.
- Optimize maintenance costs to reflect all of these factors:
 - machine availability
 - installation availability
 - reliability
 - workforce.



➤ APPLICABLE STANDARDS

- ISO 9001
- ISO 14001
- OHSAS 18001

➤ REFERENCES

- Thalys

OPTIMIZATION OF MECHANICAL MAINTENANCE OF CABLES

➤ SERVICE DESCRIPTION

- Analyse, appraise and test the system and its component parts.
- Technically and statistically analyse the experience feedback or measurements on the system.
- Define a benchmark for each cycle and level of maintenance.
- Draft maintenance documents.
- Define the optimum capacity of spare parts inventory.
- Define a replacement strategy based on technical/business factors (repair or replace).
- Draft functional specifications.
- Define a component development.

➤ INPUT DATA

- Constructors' documents.
- All internal maintenance documentation.
- Traceability, databases, experience feedback.
- Usage profile.
- Material, human and organizational constraints.

➤ TEST METHODS AND TOOLS USED

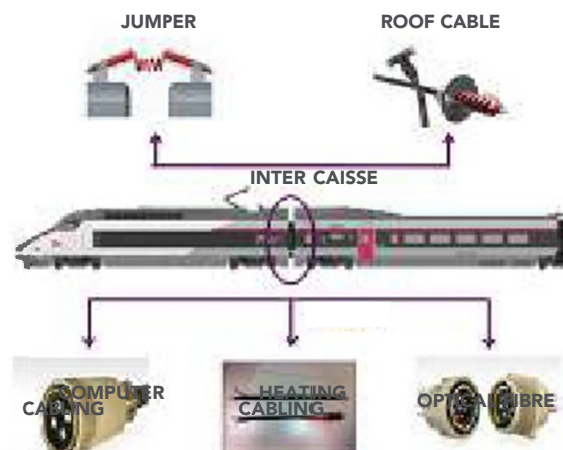
- Internal SNCF test rigs
- Electrical tests (insulation resistance, etc.)
- Software: Catia V5 and AUTOCAD

➤ WHAT WE DO

- Define how maintenance is organized and set benchmark(s).
- Optimize maintenance cycles.
- Analyse feedback to identify areas offering scope for savings.
- Provide training in cable maintenance.
- Adapt parts to changing standards and obsolescence of components.
- Optimize maintenance of: cables, wiring, connections, roof cable, shunt/break/junction box, bundle, cable/connection interface.

➤ TRAINING

- Theoretical and practical training to optimize mechanical maintenance of cabling is available on request.



➤ REFERENCES

- SNCF's Proximité, Transilien and Voyages operations
- Lille's light rail system (Transpole, Keolis)

OPTIMIZATION OF MAINTENANCE FOR RUNNING GEARS AND AXLES

➤ SERVICE DESCRIPTION

- Analyse, appraise and test components and the system as a whole.
- Analyse (technically and statistically) the system's experience feedback or measurements.
- Define the benchmark of each cycle and level of maintenance.
- Draft maintenance documents.
- Estimate component potential.
- Define optimum capacity of spare parts inventory.
- Define a replacement strategy based on technical/business factors (repair or replace).
- Design tools for maintenance and monitoring.

➤ INPUT DATA

- Constructors' documents.
- All internal maintenance documentation.
- Traceability, databases, experience feedback.
- Usage profile.
- Material, human and organizational constraints.



➤ WHAT WE DO

- Optimize the maintenance of axles, axle shafts, wheels, running gears, axle boxes, bearings, return current.
- Define maintenance organization.
- Optimize maintenance cycles.
- Define maintenance benchmarks.
- Identify potential savings by analysing experience feedback.

➤ TRAINING

- Theoretical and practical training in optimizing mechanical maintenance of axles is available on request.

➤ TEST METHODS AND TOOLS USED

- Internal SNCF test rigs

➤ REFERENCES

- Transpole (Keolis)
- SNCF's Proximité, Voyages, Fret, Réseau and Transilien activities

OPTIMIZATION OF MAINTENANCE FOR AIR PRODUCTION EQUIPMENT

➤ SERVICE DESCRIPTION

- Analyse, appraise and test the components and the system as a whole.
- Analyse (technically and statistically) the system's experience feedback or measurements.
- Define a benchmark for each cycle and level of maintenance.
- Draft maintenance documents.
- Estimate the potential of the equipment.
- Define the optimum capacity of spare parts inventory.
- Define a replacement strategy based on technical/business analysis (repair or replace).
- Computerize maintenance test sequences.
- Design tools for maintenance.
- Define a new development/change affecting equipment.

➤ INPUT DATA

- Constructors' documents.
- All internal maintenance documentation.
- Traceability, databases, experience feedback.
- Usage profile.
- Material, human, organizational and environmental constraints.



➤ WHAT WE DO

- Define maintenance organization.
- Optimize maintenance cycles.
- Define a maintenance benchmark.
- Identify potential savings by analysing the feedback.
- Computerize checks.
- Optimize the maintenance of air production, compressors, windscreen wiping systems, electrovalves, audible warnings, air driers, sand ejectors, pneumatic brake tests.
- Propose and design measuring and checking systems for predictive maintenance of assorted air production equipment.

➤ TRAINING

- Theoretical and practical training in optimizing air production equipment maintenance is available on request.

➤ TEST METHODS AND TOOLS

- Internal SNCT test rigs

➤ REFERENCES

- SNCF's FRET, Voyages, Transilien and Voyages activities

OPTIMIZATION OF MAINTENANCE FOR TRACTION POWER TRANSMISSION EQUIPMENT

➤ SERVICE DESCRIPTION

- Analyse, appraise and test how the system operates.
- Analyse (technically and statistically) feedback or system measurements.
- Define a benchmark for each cycle and level of maintenance.
- Draft maintenance documents.
- Estimate equipment's potential.
- Define optimum capacity for the spare parts inventory.
- Define a replacement strategy based on technical/business analysis (repair or replace).
- Design tools for maintenance.



➤ WHAT WE DO

- Define maintenance organization and benchmarks.
- Optimize maintenance cycles.
- Identify potential savings by analysing experience feedback.
- Advise on bolted assemblies and welding.
- Advise on storage conditions.

➤ INPUT DATA

- Constructors' documents.
- All internal maintenance documentation.
- Traceability, databases, experience feedback.
- Usage profile.
- Material, human, organizational and environmental constraints.

➤ TRAINING

- Theoretical and practical training in system maintenance and operation is available on request.

➤ TEST METHODS AND TOOLS USED

- Internal SNCF test rigs

➤ APPLICABLE STANDARDS

- NF EN 15085
- NF EN 25030-1

➤ REFERENCES

- SNCF Proximité, Voyages, FRET and Transilien

OPTIMIZATION OF BOGIE MAINTENANCE

➤ SERVICE DESCRIPTION

- Analyse, appraise and test the functioning of the system as a whole.
- Analyse (technically and statistically) feedback or system measurements.
- Define a benchmark for each cycle and level of maintenance.
- Draft maintenance documents.
- Estimate components' potential.
- Define the optimum capacity of spare parts inventory.
- Define a replacement strategy based on technical/business analysis (repair or replace).
- Design tools for maintenance, jacking, lifting and disassembly.



➤ WHAT WE DO

- Calculate the rates of conformity and failure rates.
- Determine a predictive model.
- Determine the optimal maintenance cycle to meet one or several requirements.
- Develop an interface for visualization of data.

➤ INPUT DATA

- Constructors' documents.
- All internal maintenance documentation.
- Traceability, databases, experience feedback.
- Usage profile.
- Material, human and organizational constraints.

➤ TRAINING

- Theoretical and practical training in optimizing bogie maintenance is available on request.

➤ TEST METHODS AND TOOLS USED

- Internal SNCF test rigs

➤ REFERENCES

- Optimizing maintenance of a complete bogie for SNCF's Proximité, FRET and Voyages operations
- KEOLIS

OPTIMIZATION OF OVERALL MAINTENANCE OF A SERIES

➤ SERVICE DESCRIPTION

- Analyse, appraise and test the functioning of the system.
- Analyse (technically and statistically) all feedback.
- Carry out a risk analysis of the train system.
- Draft maintenance documents.
- Estimate components' potential.
- Define the optimum capacity of spare parts inventory.
- Define a replacement strategy based on technical/business analysis (repair or replace).
- Design tools for maintenance.

➤ WHAT WE DO

- Define maintenance organization with regard to vehicles.
- Optimize maintenance cycles.
- Group maintenance operations optimally.
- Define the benchmark for minor maintenance.
- Identify potential savings by analysing the experience feedback.

➤ INPUT DATA

- Constructors' documents.
- All internal maintenance documentation.
- Traceability, databases, experience feedback.
- Usage profile.
- Material, human, organizational and environmental constraints.

➤ TRAINING

- Theoretical and practical training in optimizing overall maintenance of a series is available on request.



➤ TEST METHODS AND TOOLS USED

- Internal SNCF test rigs

➤ REFERENCES

- SNCF's Proximité and Transilien operations
- Tram-train: Nantes, Lyon, Transilien and Mulhouse

OPTIMIZATION OF TRAIN BODY MAINTENANCE

➤ SERVICE DESCRIPTION

- Analyse, appraise and test the functioning of the system.
- Technically and statistically analyse the experience feedback.
- Define the benchmark for each cycle and level of maintenance.
- Draft maintenance documents.
- Estimate components' potential.
- Define a replacement strategy based on technical/business analysis (repair or replace).
- Design tools for maintenance.

➤ WHAT WE DO

- Define maintenance organization and its benchmark.
- Optimize maintenance cycles.
- Identify potential savings by analysing experience feedback.

➤ INPUT DATA

- Constructors' documents.
- All internal maintenance documentation.
- Traceability, databases, experience feedback.
- Usage profile.
- Material, human and organizational constraints.



➤ TRAINING

- Theoretical and practical training in optimizing body maintenance is available on request.

➤ TEST METHODS AND TOOLS USED

- Subcontracting of possible measurements to AEF

➤ REFERENCES

- SNCF Proximité and Transilien

OPTIMIZATION OF MAINTENANCE OF DRIVER AND PASSENGER SEATS

➤ SERVICE DESCRIPTION

- Analyse, appraise and test the functioning of the system.
- Analyse (technically and statistically) the experience feedback.
- Define a benchmark for each cycle and level of maintenance.
- Draft maintenance documents.
- Estimate the potential of the components.
- Define a replacement strategy based on technical/business analysis (repair or replace).
- Design tools for maintenance.

➤ WHAT WE DO

- Define the organization of maintenance and its benchmark.
- Optimize maintenance cycles.
- Identify potential savings by analysing experience feedback.



➤ INPUT DATA

- Constructors' documents.
- All internal maintenance documentation.
- Traceability, databases, experience feedback.
- Usage profile.
- Material, human and organizational constraints.

➤ TRAINING

- Theoretical and practical training in optimizing maintenance of driver and passenger seats is available on request.

➤ REFERENCES

- Driver and passenger seat of SNCF rolling stock

OPTIMIZATION OF DOOR AND PLATFORM-GAP DEVICE MAINTENANCE

➤ SERVICE DESCRIPTION

- Analyse, appraise and test the functioning of the door system (external, internal and cab) and of platform-gap equipment.
- Analyse (technically and statistically) all feedback.
- Define a benchmark for each cycle and level of maintenance.
- Draft maintenance documents.
- Estimate the potential of the components.
- Define a replacement strategy based on technical/business analysis (repair or replace).
- Design tools for maintenance.



➤ WHAT WE DO

- Define organization of maintenance and benchmarks.
- Optimize maintenance cycles.
- Identify potential savings by analysing feedback.
- Provide training in system functioning and maintenance.
- Define maintenance organization.

➤ INPUT DATA

- Constructors' documents.
- All internal maintenance documentation.
- Traceability, databases, experience feedback.
- Usage profile.
- Material, human and organizational constraints.

➤ TRAINING

- Theoretical and practical training in optimizing maintenance of doors and platform-gap equipment is available on request.

➤ REFERENCES

- All door types used on SNCF TER rolling stock: Autorail Grande Capacité, Régiolis, X73500, X72500
- TRAM light rail and Transilien coaches

OPTIMIZATION OF TONNAGE LIMITS AND LENGTH OF FREIGHT TRAINS

➤ SERVICE DESCRIPTION

- Give technical advice and recommendations concerning the longitudinal dynamics of long, heavy freight trains.
- Analyse the causes of freight train derailments.
- Use Game analysis of derailment risk to optimize length and tonnage limits per regulations:
 - optimize coupling resistance limits
 - analyse the risk of the coupling breaking

➤ WHAT WE DO

- Prepare a review for the French national safety authorities and certifying bodies.



➤ TEST METHODS AND TOOLS USED

- UIC's TrainDy software (recognized internationally)

➤ REFERENCES

- Long, heavy combined transport trains with passenger braking system
- Long work trains on HSR

BIG DATA USED IN MAINTENANCE

➤ SERVICE DESCRIPTION

- Maintenance issues, based on data usage:
 - Couple physical models and statistical tools to predict the behaviour of mechanical components.
 - View results in summarized form to help with operational decision-making.
 - Apply conventional statistical tools: definitions of confidence intervals, development of classifications, identification of correlations.
 - Build physical models to confirm knowhow.



➤ WHAT WE DO

- Depending on available data (existing databases, traceability collections, targeted studies, etc.), achieve the following objectives:
 - Calculate rates of conformity or rates of failure.
 - Establish a predictive model.
 - Establish the optimum maintenance cycle, taking into account one or several constraints.
 - Develop an interface for data visualization.

➤ INPUT DATA

- Maintenance data:
 - Number of maintenance operations to be analysed.
 - Number of maintenance cycles.
 - Volume of data, type of data collected (numerical, Boolean, etc.).
- Technical data:
 - Technical information to understand the context of the study.

➤ TEST METHODS AND TOOLS USED

- "R" open-source software and associated packages.

➤ REFERENCES

- TER, FRET and TGV
- KEOLIS

IMPROVING THE PERFORMANCE OF A ROLLING STOCK SERIES

➤ SERVICE DESCRIPTION

- Based on three identified client needs—Reliability, Availability and Cost—this service focuses on creating a clear trajectory to achieve the customer's objectives over time:
 - Definition and/or installation of necessary indicators in each section
 - An initial round of diagnostics to identify all levers needed to achieve aims
 - Proposal of a roadmap and roll-out of corresponding guidance
 - Definition of an action plan to create this trajectory.



➤ WHAT WE DO

- Aim to reduce the number of rolling stock incidents in service over 3 years.
- Increase the fleet's operational availability.
- Adapt the existing maintenance framework.
- Reduce maintenance costs by 20%.

➤ INPUT DATA

- Information on operating context
- Rolling stock movements
- Technical documentation for rolling stock
- Organization of maintenance (depots, fleet supervision)
- Maintenance plan and associated technical documentation
- Skills mapping
- Detailed figures from 3 previous years for Reliability, Availability, Maintenance costs
- List of client issues and objectives to be achieved.

➤ TEST METHODS AND TOOLS USED

- Methods and tools used in general maintenance (e.g., Fracas: *Failure Report Analysis Corrective Action System*)
- Implementation of Conditional Based Maintenance if the design of the train allows or using IoT

➤ REFERENCES

- New Transilien electric power car in use in the Paris Region (350 train sets in mass transport)
- Regio2N electric power cars in use in the TER areas in France and also in the Ile de France

GUIDANCE ON MAINTENANCE REQUIREMENTS FOR THERMAL ENGINES

➤ SERVICE DESCRIPTION

- Examine a maintenance framework designed for monitoring, validation or optimization:
 - Visit cycles
 - Review cycles
 - Component repair ranges
- Contribute to validation of maintenance and review ranges
- Define solutions for optimizing maintenance ranges
 - expand maintenance cycle
 - expand component potential
 - simplify repair ranges
- Research maintenance solutions that enable optimal use of components



➤ WHAT WE DO

- Assist/advise the maintainer in validating maintenance ranges
- Propose the most economical maintenance ranges. These:
 - Expand maintenance cycle
 - Expand component potential
 - Simplify repair ranges
- Advise and educate users as needed

➤ INPUT DATA

- Technical document w/detailed description of maintenance framework and review of the engine and its components
- Engine's technical features (type, cylinders, maximum power, maximum rating, etc.)
- Conditions of use and of the thermal engine (loading gauge)
- Usage profile (duration of daily, weekly or monthly operation)

➤ REFERENCES

- EDF – Validation of review ranges of backup power generators for 900 MW sections of nuclear power plants
- SNCF – Activité FRET
- SNCF – Activité TER

OPTIMIZATION OF MAINTENANCE FOR TRACTION CHAIN COMPONENTS

➤ SERVICE DESCRIPTION

- Analyse, appraise and test the system and the component parts
- Analyse experience feedback and produce a safety/quality/cost/availability matrix
- Conduct Make or Buy studies, and research into flywheel dimensioning, tools
- Define a benchmark for each cycle and level of maintenance, and draft maintenance documents
- Functional training
- Specify and validate developments
- AMOA definition of Half-Life type benchmark

➤ INPUT DATA

- Constructors' documents
- Traceability, databases and experience feedback
- Usage profile

➤ WHAT WE DO

- Define the strategy of component maintenance
- Optimize maintenance cycles
- Provide training in component maintenance
- Adapt the component to development (jump in performance, obsolescence, development in the context of standards)



➤ TEST METHODS AND TOOLS USED

- CVSLAB: Specialist laboratory
- SIMHIL: Real-time Simulator for traction chain
- Engine test platform
- Internal SNCF test rigs
- Problem analysis and resolution methods: Hishikawa, QQQCCP, 8D.

➤ REFERENCES

- SNCF activities (Fret, Infra, Intercités, TER, Transilien, Voyages)
- SMMRGV
- T2C
- Akiem
- Thalys

VIRTUAL REALITY

➤ SERVICE DESCRIPTION

- Validate the design and the internal and external fittings of rolling stock.

➤ INPUT DATA

- Digital models concerning the format.

➤ WHAT WE DO

- Accelerate the design validation process.
- Verify and optimize the accessibility of equipment for maintenance operations.



➤ APPLICABLE STANDARDS

- TSI travellers with reduced

➤ REFERENCES

- Ouigo
- Regiolis
- Teoz
- Corail
- TGV Sud-Est
- TGV Lacroix

IMPLEMENTATION OF PREDICTIVE MAINTENANCE USING TELEDIAGNOSTICS

➤ SERVICE DESCRIPTION

- Implement telediagnosics to optimize maintenance on a connected train in three areas:
 - preventive maintenance, based on continuous monitoring of train during commercial service
 - enhanced corrective maintenance, anticipating failures using precursors and data stored in databases (Big Data)
 - maintenance of operational conditions by visualizing the health status of trains.



➤ INPUT DATA

- Data analysis enables creation of dynamic instrument panels for main train functions. This means the state of the train can be known at any moment to anticipate a failure or cancel systematic preventive maintenance. Anticipated results are:
 - reduced maintenance costs
 - improved availability of the rolling stock fleet
 - improved regularity in operation.

➤ WHAT WE DO

- Produce Maintenance Plan for the series.
- Technical experience feedback for the series.
- Software for Computer-Aided Maintenance Management.
- Nature of information available on the train sent to the ground and consumed by maintenance teams.

➤ TRAINING

- Training on telediagnosics is available on request

➤ TEST METHODS AND TOOLS USED

Dispatch and acquisition station
Connected objects
Ground server

➤ APPLICABLE STANDARDS

- EN 50155
- UIC 559

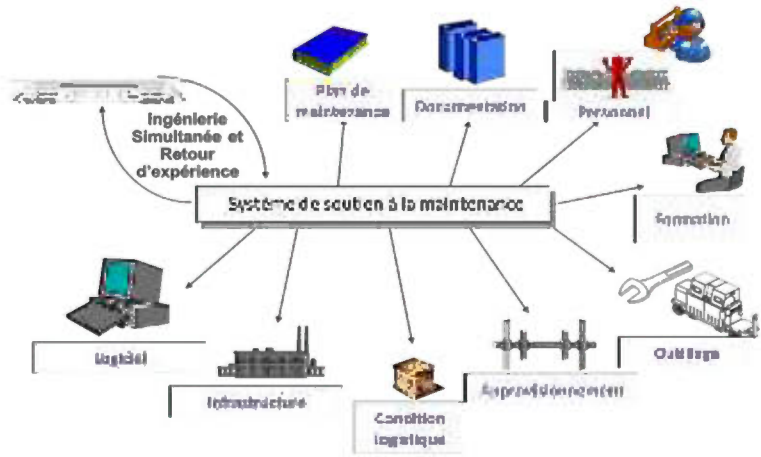
➤ REFERENCES

- NAT
- SNCF's Transilien operations

MATURITY DIAGNOSTICS OF MAINTENANCE SUPPORT PROCESSES

➤ SERVICE DESCRIPTION

- Analyse resources and processes in place to ensure maintenance of rolling stock and spare parts.
- Identify maintenance issues, aims and constraints in terms of safety, cost and availability.



➤ WHAT WE DO

- Supply an audit report comprising:
 - evaluation of the maturity of the processes
 - an action plan to optimize cost of maintenance /availability
 - an estimate of potential gains per action

➤ INPUT DATA

- Access to maintenance methods and processes.
- Maintenance aims (expected performance in reliability, availability and maintainability).
- Specific features of maintenance contract.

➤ TEST METHODS AND TOOLS USED

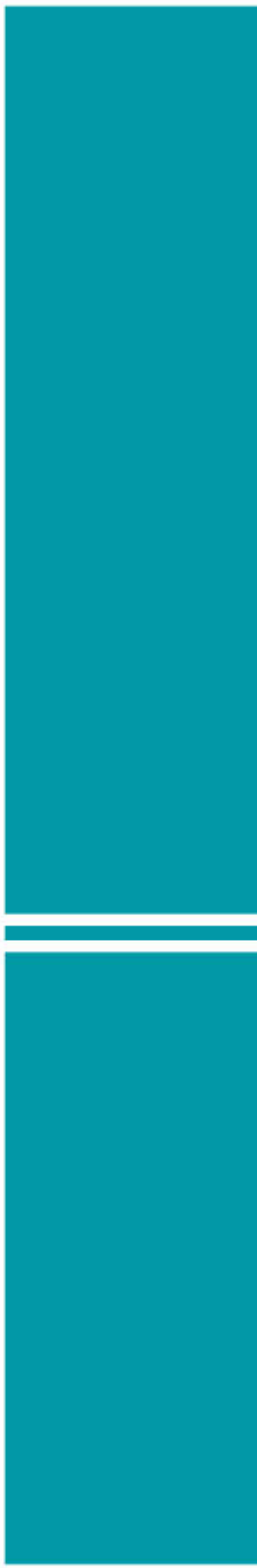
- Maturity grid
- List of maintenance optimization tools

➤ APPLICABLE STANDARDS

- S 3000L, S1000D
- MIL STD 1388 1A / 2B

➤ REFERENCES

- Cuban Railway Union
- Keolis Lyon
- SNCF's Fret, Infra, Intercity and Proximités operations



DESIGN ENGINEERING



ASSISTANCE TO PROJECT MANAGEMENT FOR ACCEPTANCE OF ROLLING STOCK AFTER CONVERSION

➤ SERVICE DESCRIPTION

- Define an acceptance strategy for converted rolling stock.
- Allow modified or converted stock to run on the French national rail network—in compliance with the rail safety framework.

➤ WHAT WE DO

- Analyse impacts for the safety framework (national directives, TSI, European directives).
- Identify deliverables needed to validate acceptance (i.e., components of acceptance file) of modified rolling stock.
- Guide Design Offices in producing these deliverables.
- Validate acceptance applications supplied by Design Offices.



➤ INPUT DATA

- Functional expression of needs.
- Application form for modification.

➤ APPLICABLE STANDARDS

- French National Directive (DRN France)
- European National Directive (Belgium, Netherlands, Luxembourg, Spain, Switzerland, Germany, Italy)
- TSI (TSI MR, TSI Tunnel, TSI PMR, TSI CCS, TSI Noise)
- All applicable standards

➤ REFERENCES

- SNCF Voyages operations
- Thalys
- Eurostar

ASSISTANCE TO PROJECT MANAGEMENT FOR ACCEPTANCE OF NEW ROLLING STOCK

➤ SERVICE DESCRIPTION

- Help define acceptance strategies for converted rolling stock, including all train subsystems and other subsystems
- Assist a third party (sponsor) to compile the documents needed for the safety application/acceptance of rolling stock it has converted. We prepare this application on behalf of the third party as part of the process of authorizing converted stock to run on the national rail network.

➤ INPUT DATA

- Proof of compliance
- Framework to be applied

➤ WHAT WE DO

- Analyse impacts under the safety framework (national directives, TSI, European directives);
- Identify deliverables required as proof for technical and CSM (common safety method) notices; these must be included in the acceptance dossier for modified stock.



➤ APPLICABLE STANDARDS

- French National Directive (DRN France)
- European National Directive (Belgium, Netherlands, Luxembourg, Spain, Switzerland, Germany, Italy)
- TSI (TSI MR, TSI Tunnel, TSI PMR, TSI CCS, TSI Noise)
- All applicable standards

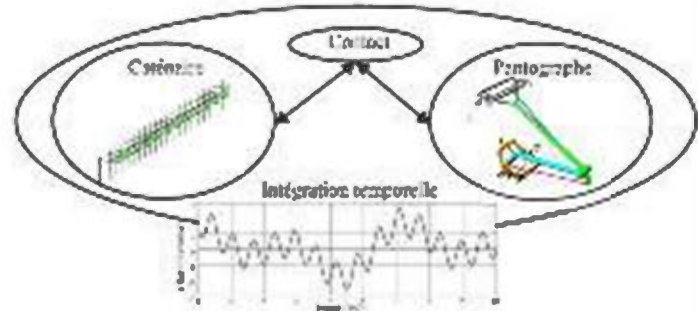
➤ REFERENCES

- Thalys
- Eurostar
- DB
- TP Ferroviaire

SIMULATION OF A PANTO-CATENARY COUPLE

➤ SERVICE DESCRIPTION

- Estimate contact wire rise, pantograph clearances, contact forces and risks of detachment.



➤ WHAT WE DO

- Simulate operating configurations for as many as 6 pantographs under catenary 1.5kV or 25kV, reflecting variations in temperature (summer/winter), particularly for the 1.5 kV.
- Research and diagnose critical combinations of distances between pantographs prior to tests.

➤ INPUT DATA

- The catenary model, supplied by I&P-TE (department of Engineering & Project for Electric Traction), for "conventional" catenaries used on the National Railway Network (if not present in Oscar software).
- The pantograph model, supplied by the pantograph manufacturer (if not present in Oscar).

➤ TEST METHODS AND TOOLS USED

- OSCAR software
EN 50318 certified

➤ APPLICABLE STANDARDS

- EN 50318 standard

➤ REFERENCES

- Alstom
- Bombardier
- Faiveley

SIMULATION OF BRAKING SYSTEM OPERATING UNDER ERTMS

➤ SERVICE DESCRIPTION

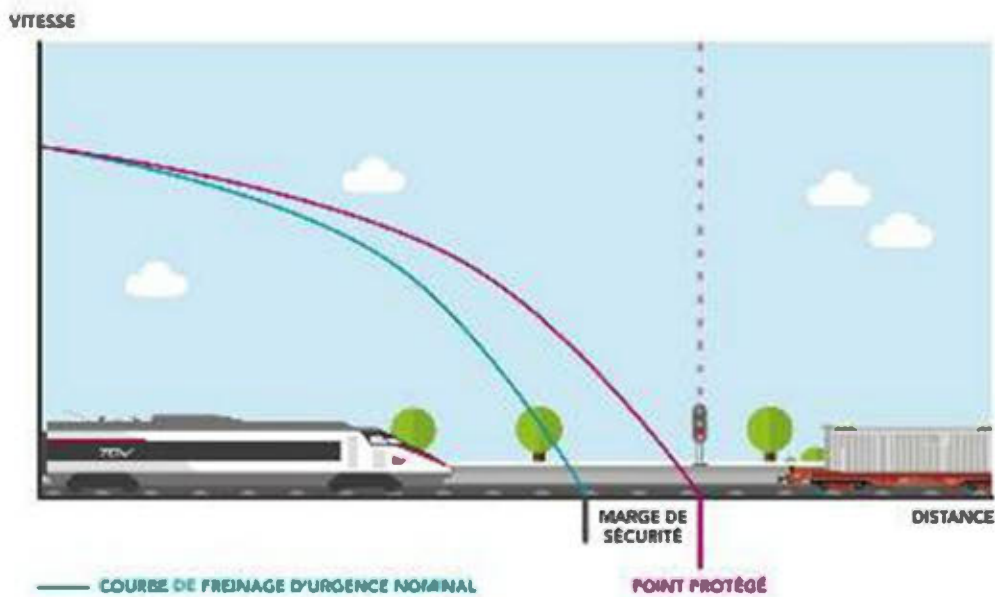
- Determine precisely and for all levels of the ERTMS system, the braking parameters that are necessary for rolling stock operating under ERTMS speed monitoring. This service is geared towards "gamma" trains (fixed trainset composition, including both very high-speed trains and motor coaches).

➤ WHAT WE DO

- Statistical distribution of braking system parameters.
- Data relative to maintenance tolerance.

➤ INPUT DATA

- Determine the guaranteed deceleration of trains occurring in ETCS braking curves with UIC type brakes (International Union of Railways).



➤ TEST METHODS AND TOOLS USED

- ELOÏSE software
- Unique modelling tool recognized by the European Railway Agency (ERA)

➤ APPLICABLE STANDARDS

- European framework ERTMS SRS Baseline 3
- UIC Working Groups B 126 / DT 414

➤ REFERENCES

- Alstom
- CAF
- ERA

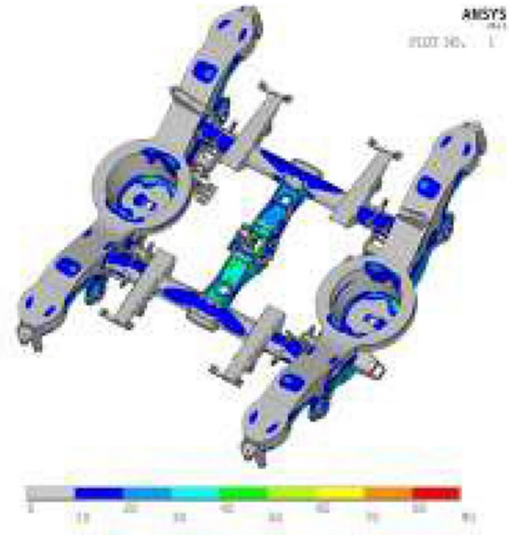
TEST AND FATIGUE DIMENSIONING OF BOGIE FRAMES

➤ SERVICE DESCRIPTION

- Optimize the dimensioning of bogie frames and other mechanical structures such as the body.

➤ WHAT WE DO

- Implement, analyse and validate mechanical dimensioning.
- Provide evidence of authorization for the commissioning of rolling stock.
- Identify the origin of component failures.



➤ INPUT DATA

- Digital model of the bogie frame in .step or plan 2D format
- Construction of the finite element model
- Calculation notes

➤ TEST METHODS AND TOOLS USED

- CAO Catia V5 software
- HYPERMESH or ANSYS for meshing of the model and the stress calculations
- nCode for post treatment of fatigue stresses (static and dynamic)

➤ APPLICABLE STANDARDS

- EN 12663-1 (locomotive/passenger)
- EN 12663-2 (wagons)
- EN 13749
- EN 15827
- ERRI B12 RP60 (UIC)

➤ REFERENCES

- NS Technik
- Matisa
- Framofer
- Alstom
- Eurostar

GAUGE STUDY

➤ SERVICE DESCRIPTION

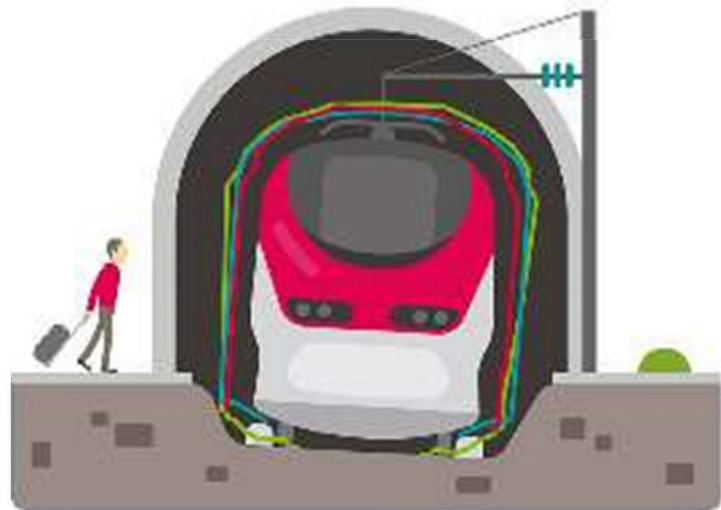
- Verify compatibility of rolling stock gauge with the infrastructure of the national rail network.

➤ WHAT WE DO

- Draw up a summary of risks for platforms studied.
- Draw up a summary of interference zones, identifying critical sections for platforms at risk.

➤ INPUT DATA

- Critical sections of rolling stock.
- Trains' technical and geometric features.
- Laws governing behaviour of frame/bogie interaction as a function of the radius of the curve.



➤ TEST METHODS AND TOOLS USED

- VESPA software

➤ APPLICABLE STANDARDS

- EN 12663-1 (locomotives/passengers)
- EN 12663-2 (wagons)
- EN 13749
- EN 15827 ERRI B12
- RP60 (UIC)

➤ REFERENCES

- Siemens
- SNCF Réseau

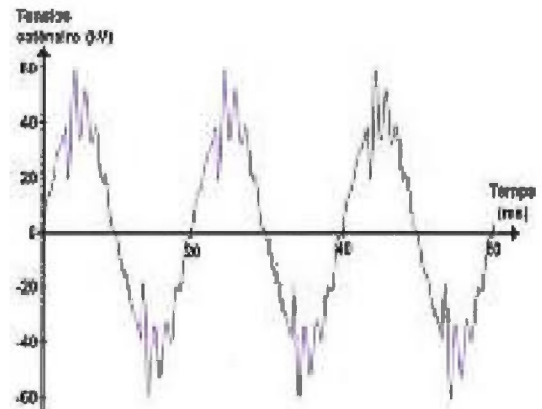
ELECTRICAL COMPATIBILITY BETWEEN ROLLING STOCK AND INFRASTRUCTURE

➤ SERVICE DESCRIPTION

- Analyse electrical interaction between rolling stock and infrastructure with the fixed installations of electrical traction.

➤ WHAT WE DO

- Simulate catenary tension anomalies caused by electrical interactions between rolling stock and fixed installations.
- Propose protective measures to limit risks of disrupting operation and/or damage to components.



➤ INPUT DATA

- Type, parameters and electrical diagram of vehicle's traction chain
- Diagram and description of fixed installation components

➤ TEST METHODS AND TOOLS USED

- SIGHAR simulation tool consisting of configurable nomenclatures of rolling stock and constituent elements of fixed installations, also configurable.
- Digital electrical simulator

➤ APPLICABLE STANDARDS

- EN 50388
- EN 50163
- Specific national frameworks for network studied

➤ REFERENCES

- Eurotunnel
- Lyria
- SBB CFF FFS
- SNCB
- SNCF Réseau

AERODYNAMIC SIMULATION OF TRAIN

➤ SERVICE DESCRIPTION

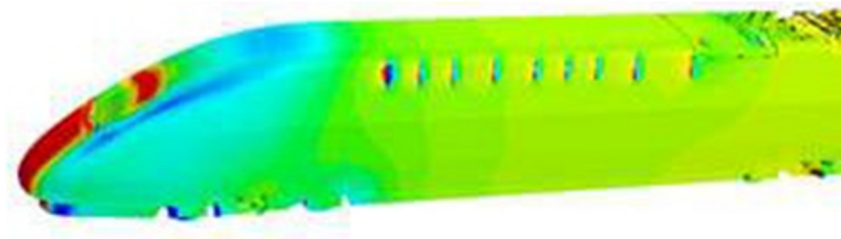
- Determine the aerodynamic part of train resistance [RAV] and evaluate impact of rolling stock modifications on this.

➤ INPUT DATA

- Rolling stock features and plans.
- Digital model of rolling stock (3D).
- If a 3D model does not exist, factor in time to prepare this in addition to the service proper.
- Projected operating speed.

➤ WHAT WE DO

- Estimate and optimize the aerodynamic trail of a train (TGV, TER, goods trains, etc.) to reduce energy consumption and aerodynamic noise.
- Evaluate the impact of modifications on the aerodynamic trail (addition of deflectors, modification of design at front, etc.).
- Optimize and reduce line tests (while identifying the most relevant configuration).



➤ TEST METHODS AND TOOLS USED

- Star CCM+ software

➤ APPLICABLE STANDARDS

- EN 14067-4: 2013

➤ REFERENCES

- SNCF

SIMULATION OF TRACKSIDE VARIATION IN PRESSURE

➤ SERVICE DESCRIPTION

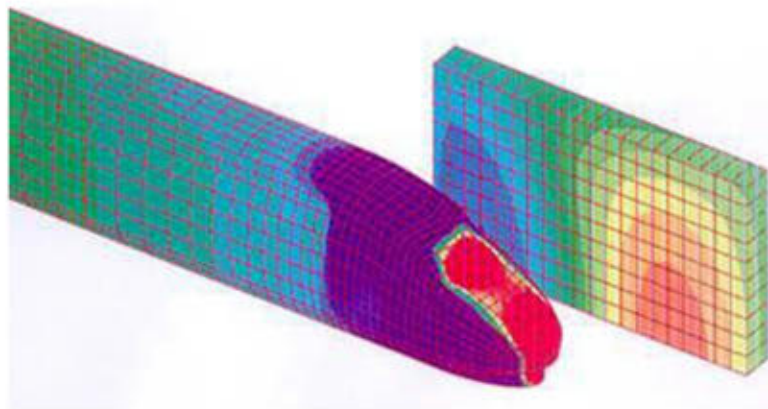
- Estimate variations in pressure generated trackside when a train passes.

➤ INPUT DATA

- Rolling stock features and plans.
- Digital model of rolling stock (3D).
- If the 3D model does not exist, factor in time to prepare this (in addition to the service proper).
- Projected operating speed.

➤ WHAT WE DO

- Evaluate trackside variations in pressure when a train passes to verify compliance with regulatory requirements (TSI).
- Study the aerodynamic load exerted on trackside structures when a train passes.
- Substitute or limit implementation of line tests.



➤ TEST METHODS AND TOOLS USED

- Star CCM+ software
- START software

➤ APPLICABLE STANDARDS

- EN 14067-4: 2013
- STI

➤ REFERENCES

- RATP

SIMULATION OF PRESSURE CHANGE BETWEEN PASSING TRAINS

➤ SERVICE DESCRIPTION

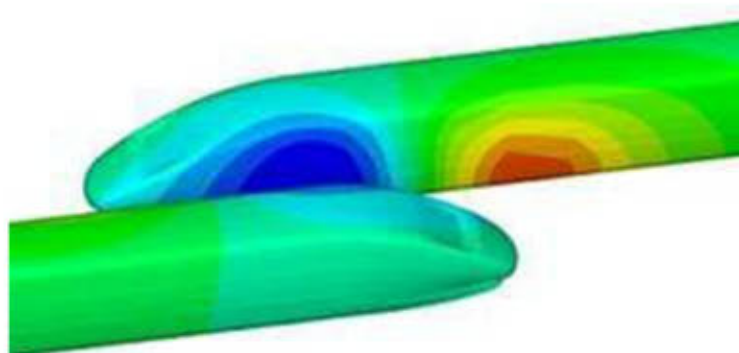
- Estimate changes in pressure generated when trains pass each other.

➤ INPUT DATA

- Rolling stock features and plans.
- Digital model of rolling stock (3D).
- If the 3D model does not exist, factor in time to prepare this in addition to the service proper.
- Projected operating speed.
- Distance between track centres.

➤ WHAT WE DO

- Study the aerodynamic load exerted on a train when it passes another train.
- Evaluate the impact of changes in operating parameters (width between track centres, train operating speed) on the aerodynamic load generated when trains pass each other.
- Avoid or limit line tests.



➤ TEST METHODS AND TOOLS USED

- Star CCM+ software
- START software

➤ APPLICABLE STANDARDS

- EN 14067-4:2013
- STI

➤ REFERENCES

- Oc'via
- SNCF Réseau

SIMULATION OF PRESSURE WAVES IN TUNNELS

➤ SERVICE DESCRIPTION

- Characterize the aerodynamic phenomena generated when a train passes through a tunnel.

➤ INPUT DATA

- Rolling stock: description/features and plan.
- Tunnel: description and plan.
- Projected operating speed.
- Level of sealing against train pressure waves, to study passengers' tympanic comfort.

➤ WHAT WE DO

- Study changes in pressure generated when a train passes through a tunnel.
- Verify compliance with safety criteria and tympanic comfort for passengers.
- Estimate the aerodynamic load exerted on the train or on the trackside components when a train runs through a tunnel.



➤ TEST METHODS AND TOOLS USED

- Transtun software

➤ APPLICABLE STANDARDS

- EN 14067-5: 2006
- STI

➤ REFERENCES

- Systra
- Alstom

SIMULATION OF CROSSWINDS

➤ SERVICE DESCRIPTION

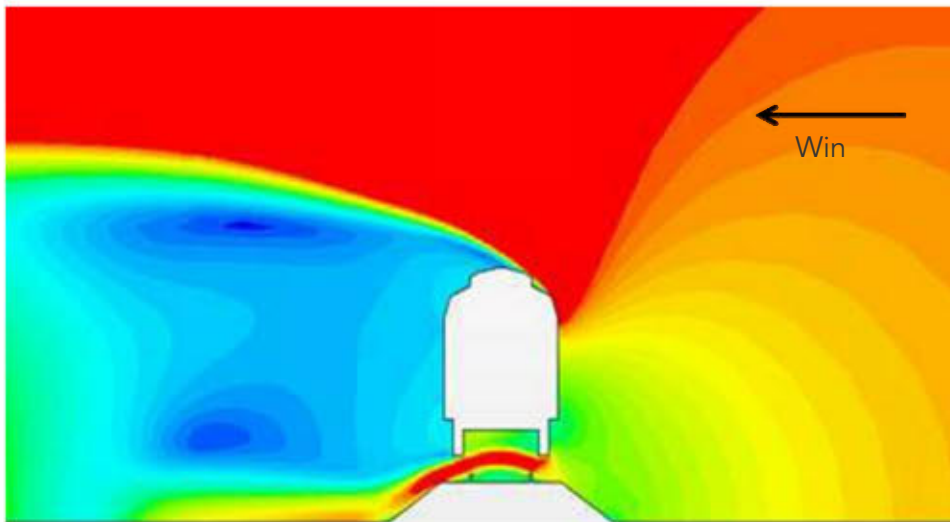
- Study the sensitivity of a vehicle to crosswinds.

➤ WHAT WE DO

- Determine the aerodynamic coefficients of a vehicle subjected to a crosswind.
- Identify beforehand the configurations to be tested in the wind tunnel so as to limit test costs.

➤ INPUT DATA

- Rolling stock: description/features and plans.
- Digital model of rolling stock (3D).
If a 3D model does not exist, factor in time needed to prepare this, in addition to the service proper.
- Projected operating speed.



➤ TEST METHODS AND TOOLS USED

- Star software CCM+

➤ APPLICABLE STANDARDS

- EN 14067-6:2010
- STI

➤ REFERENCES

- Systra
- Oc'via

SIMULATION OF FIRE SAFETY

➤ SERVICE DESCRIPTION

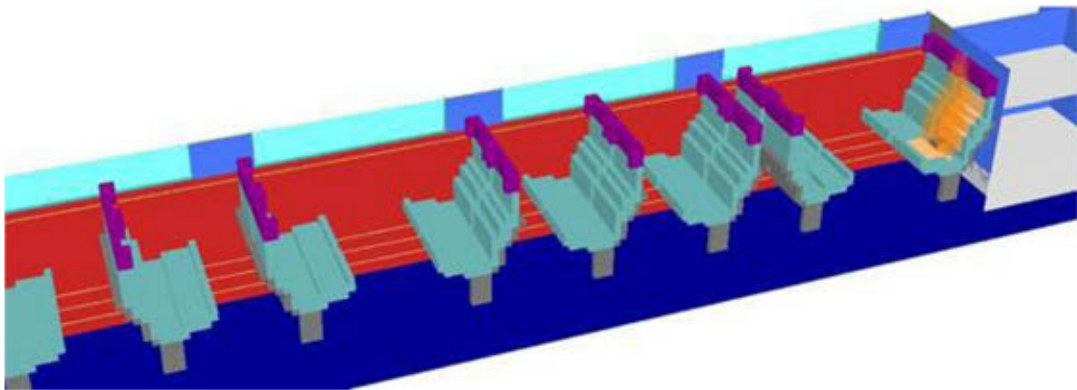
- Simulate the behaviour of materials in fire, and study fire protection measures on all types of rolling stock.

➤ INPUT DATA

- Properties of materials
- Fire model to be used (3 types of model available).

➤ WHAT WE DO

- Determine the place and cause of ignition.
- Analyse factors contributing to propagation.
- Propose technical solutions.



➤ TEST METHODS AND TOOLS USED

- Modelling implemented on Fire Dynamics Simulator (FDS)

➤ APPLICABLE STANDARDS

- EN 45545
- EN 50553
- TSI Loc & Pass
- TSI MR GV
- TSI MR RC

➤ REFERENCES

- Eurostar
- Iris 320
- Locomotive Class 92

SIMULATION OF PASSENGER EVACUATION

➤ SERVICE DESCRIPTION

- Simulate the evacuation of passengers from a vehicle.

➤ WHAT WE DO

- Demonstrate vehicle compliance with evacuation time.
- Study flows between a vehicle and the platform.
- Test multiple examples of evacuation by simulation.



➤ INPUT DATA

- Diagram of the trainset in dxf. format.
- Definition of the population participating in tests.

➤ TEST METHODS AND TOOLS USED

- “Building Exodus” software

➤ APPLICABLE STANDARDS

- TSI Loc & Pass 2014

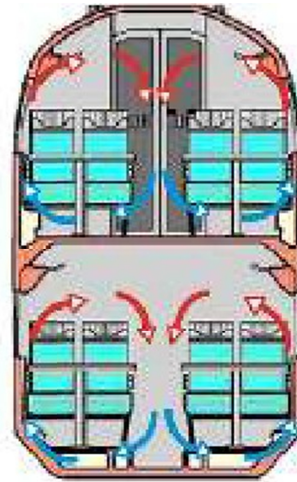
➤ REFERENCES

- Ouigo
- NAT
- TGV 2N2

STUDY OF HVAC SYSTEM

➤ SERVICE DESCRIPTION

- Determine the power necessary to heat and cool a vehicle via HVAC.



➤ WHAT WE DO

- Conduct feasibility studies for the integration or modification of an air conditioning/heating system.
- Appraise the climate control performance of a train set.
- Guarantee a level of thermal comfort.

➤ INPUT DATA

- Geometric data for the vehicle.
- Thermal data (vehicle's thermal exchange coefficient).
- Comfort objectives (heating and cooling performance).

➤ TEST METHODS AND TOOLS USED

- 3CT software (thermal balance)

➤ APPLICABLE STANDARDS

- ISO 7730
- EN 13129
- EN 14750-1/2
- EN 14813-1/2

➤ REFERENCES

- Regional authority in Corsica
- Thalys

QUANTIFYING ROLLING STOCK PERFORMANCE

➤ SERVICE DESCRIPTION

- Carry out calculations to quantify performance, taking into account infrastructure and vehicle constraints.

➤ INPUT DATA

- Rolling stock: SAM X006 / IN 2778 / OP 9929.
- Infrastructure characteristics.

➤ WHAT WE DO

- Calculate journey time.
- Calculate energy consumption.
- Calculate ramp aptitude.
- Calculate heating of the traction chain.
- Reproduce configurations in degraded mode.



➤ TEST METHODS AND TOOLS USED

- THOR (software used on the national rail network)
- PERF (software used on national networks, both French and foreign)

➤ APPLICABLE STANDARDS

- STI

➤ REFERENCES

- Eiffage Rail Express
- Europorte
- LGV Sea
- Siemens
- Vossloh

SIMULATION OF A VEHICLE CRASH TEST

➤ SERVICE DESCRIPTION

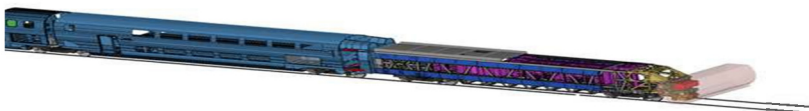
- Analyse the behaviour of a vehicle in case of collision.
- Validate (or optimize) the mechanical performance of a component sensitive to impacts.

➤ INPUT DATA

- Structural data: plans, CAO, finite element files, materials with different loads.
- Test results.

➤ WHAT WE DO

- Examine body structure dimensioning for compliance with current standards at design level, or during an expert analysis following an accident.
- Take into account the protection of sensitive equipment.
- Draw up recommendations for interior fittings that take into account passenger safety.



➤ TEST METHODS AND TOOLS USED

- Hyperworks suite (hypermesh, hypercrash, radioss, hyperview and hypergraph)
- CAO Catia V5 software

➤ APPLICABLE STANDARDS

- EN 15227-7
- EN 12663-1/2
- TSI Pass & Loc
- STRMTG

➤ REFERENCES

- Complete dossiers for Passive Safety on TGV, Tram-Trains, MI84
- SNCF Réseau reconnaissance trains

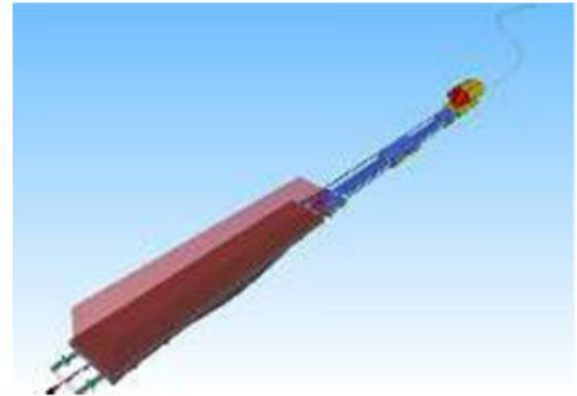
SIMULATION OF LONGITUDINAL FORCES (LF) IN FREIGHT TRAINS

➤ SERVICE DESCRIPTION

- Analyse the longitudinal compression and traction forces developed by braking equipment in freight trains.

➤ WHAT WE DO

- Optimize tonnage and length of freight trains for given operating conditions.
- Prepare the acceptance application for national safety authorities.
- Simulate different running configurations.



➤ INPUT DATA

- 2D plan of the vehicle (wheel-base, bogie, mass layout, centre of gravity).
- Weight.
- Test reports in the area in question.

➤ TEST METHODS AND TOOLS USED

- TRAINDY Tool

➤ APPLICABLE STANDARDS

- EN 15839 (UIC 530-2)
- EN 15839
- EN 14363

➤ REFERENCES

- Fret
- Lorry Rail
- Modalohr
- SNCF Réseau

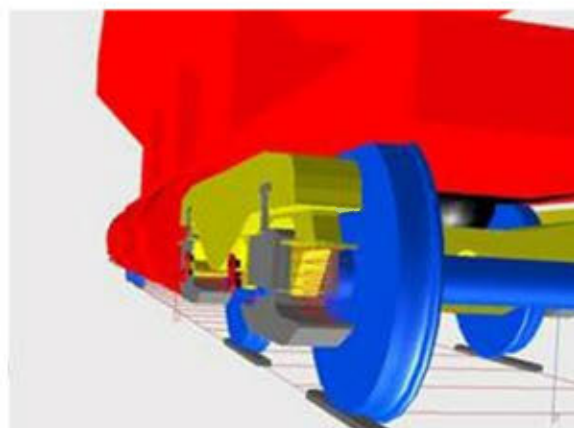
STUDY OF DERAILMENT RISKS

➤ SERVICE DESCRIPTION

- Analyse risks of derailment for all types of rolling stock.

➤ WHAT WE DO

- Research and analyse possible causes of derailment.
- Draft an expert analysis to serve as a basis for recommendations issued by BEA-TT, France's national rail and road accident investigation unit.
- Analyse the risk of derailment using the 3 methods detailed in EN14363.



➤ INPUT DATA

- 2D vehicle plan (wheel-base, bogie, mass layout, centre of gravity).
- Description of track (for an investigation into causes of a derailment).
- Weight.
- Test reports or expert reports in the case of accidents.

➤ TEST METHODS AND TOOLS USED

- SIMPACK software

➤ APPLICABLE STANDARDS

- EN 14363
- ORE B55 RP8
- UIC 518

➤ REFERENCES

- Areva
- BEA-TT
- STSI

DETERMINATION OF PERMISSIBLE LONGITUDINAL COMPRESSION FORCES (LCF) ON WAGONS

SERVICE DESCRIPTION

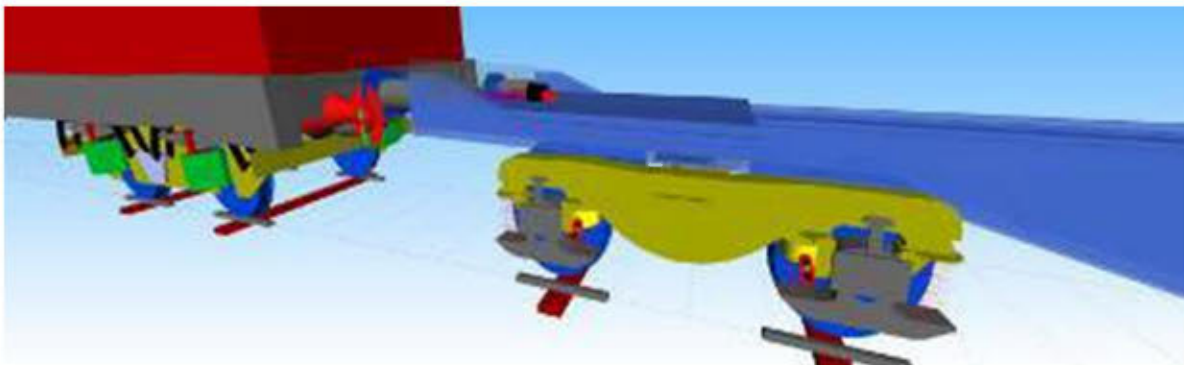
- Determine the permissible longitudinal compression forces on a wagon by simulating its dynamic behaviour in an S curve as per EN 15839 (UIC530-2).

➤ INPUT DATA

- 2D vehicle plan (wheel-base, bogie, mass layout, centre of gravity).
- Weight.
- Test reports for the field in question.

➤ WHAT WE DO

- Evaluate and validate a coupling mechanism.



➤ TEST METHODS AND TOOLS USED

- SIMPACK software

➤ APPLICABLE STANDARDS

- EN 15839 (UIC530-2)
- EN 14363

➤ REFERENCES

- Lorry Rail
- Modalohr
- VTG

SIMULATION OF THE DYNAMIC BEHAVIOUR OF A VEHICLE

➤ SERVICE DESCRIPTION

- Simulate the dynamic behaviour of all types of rolling stock on actual track

WHAT WE DO

- Provide partial virtual approval of the dynamic behaviour of a vehicle.
- Analyse the dynamic behaviour of a vehicle on given infrastructure (coupling, crosswinds).
- Dimension and optimize the mechanical equipment under stress.
- Predict the most relevant configurations for testing, validate the choices between technological solutions, reduce the number of line tests.
- Simulate degraded modes not considered in testing.



INPUT DATA

- 2D vehicle plan (wheel-base, bogie, mass layout, centre of gravity).
- Weight.
- Static test and line test reports for correlation of model.
- For a partial virtual approval: measurement of track defects, recordings of test measurements UIC 518.

➤ TEST METHODS AND TOOLS USED

- SIMPACK software

➤ APPLICABLE STANDARDS

- EN 14363
- EN 12299
- EN 14067-6

➤ REFERENCES

- AGC
- CMI
- MI2N
- Régiolis
- VB2N

DIMENSIONING OF AXLE SHAFTS

➤ SERVICE DESCRIPTION

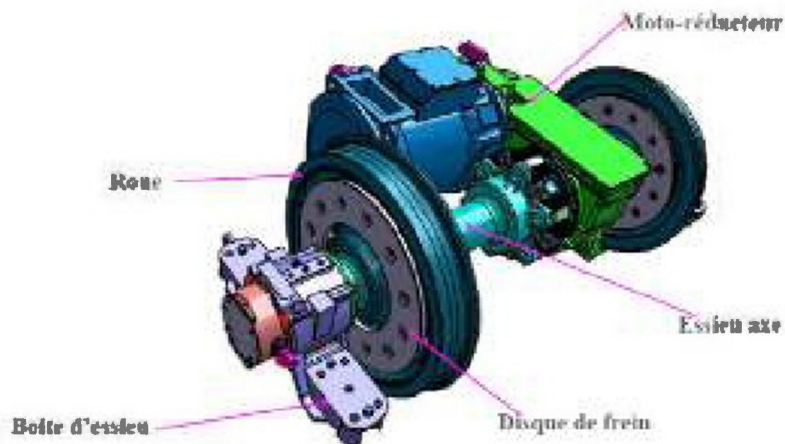
- Dimensioning an axle for fatigue stress.

➤ INPUT DATA

- Drawings of axle-wheel components (CAO 2D or 3D formats).
- Axle/wheel: axle loads, braking forces, position of the vehicle's centre of gravity.

➤ WHAT WE DO

- Dimension axle shafts.
- Investigate defects to identify root causes.
- Determine repair and maintenance options for a damaged or overloaded axle.
- Issue a technical opinion for a certifying body.



➤ TEST METHODS AND TOOLS USED

- Software

➤ APPLICABLE STANDARDS

- EN 13103
- EN 13104

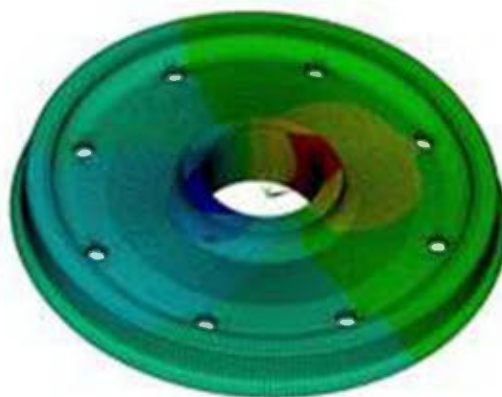
➤ REFERENCES

- DB
- Matisa
- STSI
- UIC
- Voies Navigables de France

FATIGUE BEHAVIOUR OF WHEELS

➤ SERVICE DESCRIPTION

- Study the behaviour of wheel centres for fatigue stress



➤ WHAT WE DO

- Dimension the wheels.
- Appraise the origin of a failure.
- Issue technical opinions for certifying bodies.

➤ INPUT DATA

- Drawings of axle-wheel components in .step format CAO, 2D.

➤ TEST METHODS AND TOOLS USED

- Modeller, CAO Catia V5 software
- Mesher (hypermesh, CAO Catia V5 software)
- Solver (Ansys)
- Fatigue extraction tool developed inhouse by SNCF

➤ APPLICABLE STANDARDS

- EN 13979-1

➤ REFERENCES

- UIC
- DB
- Alstom
- STSI
- Bonatrans

THERMOMECHANICAL PERFORMANCE OF WHEELS

➤ SERVICE DESCRIPTION

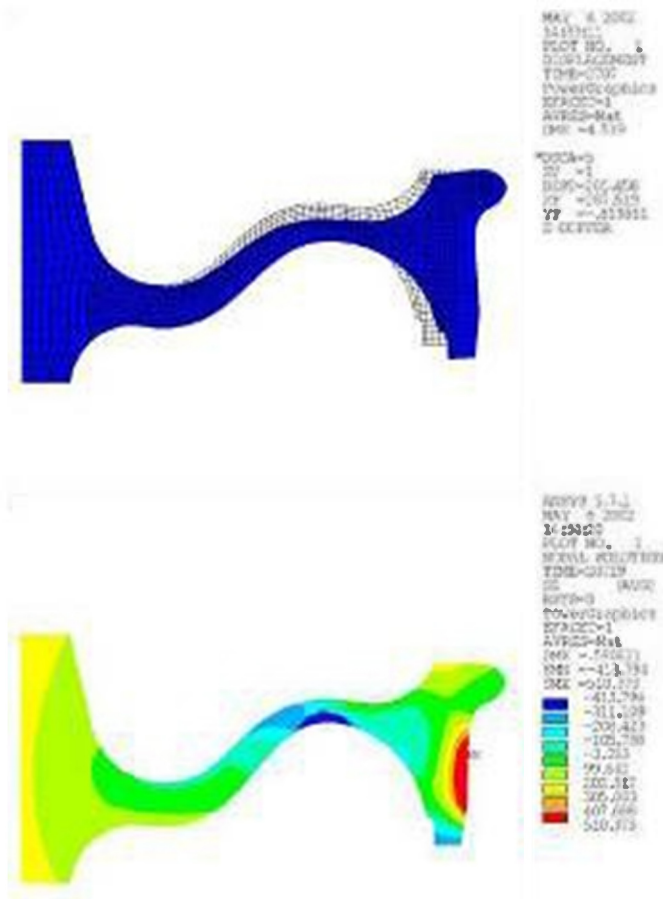
- Determine the residual stresses and deformations of a wheel after heating caused by friction of the brake pads on the running surface.

➤ WHAT WE DO

- Verify the performance of a wheel during a cycle of holding or stop braking, particularly the absence of risk of breakage and excessive deformation.

➤ INPUT DATA

- Thermomechanical: braking cycle (braking power curve, time speed).



➤ TEST METHODS AND TOOLS USED

- Modeller: CAO Catia V5 software
- Mesher: Hypemesh, CAO Catia V5 software
- Solver: Ansys

➤ APPLICABLE STANDARDS

- EN 13979-1 (paragraph 6)

➤ REFERENCES

- Alstom
- Bonatrans
- SNCF Réseau
- UIC
- Valdunes

DESIGN OF AXLES AND THEIR COMPONENTS

➤ SERVICE DESCRIPTION

- Design wheelsets and their components (axle shafts, wheels and axle box bearings) in accordance with the NF EN 13260 standard.
- Validate the design of axles mounted in compliance with the NF EN 13260 standard and their components (axle shafts, wheels and axle box bearings).

➤ WHAT WE DO

- Provide a turnkey solution for wheelsets to be integrated into the original design or upgrade of a train.
- Benefit from SNCF feedback from experience concerning the products it accepts.
- Increase the reliability of the running gear.

➤ INPUT DATA

- Technical specification: constraints due to the environment, load and brake forces.



➤ TEST METHODS AND TOOLS USED

- CAO Catia V5 software
- Finite element calculation code

➤ APPLICABLE STANDARDS

- EN 13260
- TSI LOC & PASS
- TSI WAGON

➤ REFERENCES

- Validation and/or design of all axles registered in France

STUDY AND DESIGN OF A FIXED INSTALLATION FOR BRAKE TESTS OF ROLLING STOCK

➤ SERVICE DESCRIPTION

- Draw up a specification following an analysis of on-site needs, and have the client validate this.
- Conduct a design study of the fixed installation on a given maintenance track, with technical pre-validation of the track.
- Build the fixed installation.
- Design an automatic test programme to test the fixed installation (and its annual maintenance).
- Acceptance and validation of equipment.



➤ INPUT DATA

- Data on rolling stock fleets that will use the future installation.
- Civil engineering plans of equipment powered from the track (and its immediate environment).
- A description of additional equipment on the track and how it is operated (hoods, captor hoods, mobile gantries).

➤ WHAT WE DO

- Install equipment on a depot's maintenance track to run brake tests on several types of rolling stock in optimized mode (i.e., simultaneous tests on several vehicles).

➤ TEST METHODS AND TOOLS USED

- Recent generation brake test station (METEOR or SIMEF)
- Vehicle in actual configuration

➤ APPLICABLE STANDARDS

- NF C 15-100
- NF EN 60-073
- NF EN 61-310-2
- NF EN 61000-6-2
- NF EN 61000-6-4
- NF EN ISO 15537
- NF F 61-030
- NF F 11-013
- NF F 11-017
- NF F 11-018
- NF F 11-070

➤ REFERENCES

- SNCF Transilien activities
- SNCF Proximités activities
- SNCF Voyages activities

APPRAISAL OF BEHAVIOUR IN SERVICE OF DISCS AND BRAKE LININGS OR WHEEL AND BRAKE-PAD COUPLES

➤ SERVICE DESCRIPTION

- Study the technical design of the vehicle and give a technical opinion.
- Establish a rig test programme based on standards, regulatory documents or a technical specification.

➤ WHAT WE DO

- Examine test results.
- Give a technical opinion following test results.

➤ INPUT DATA

- Technical data for the vehicle in question.
- Technical data for the component in question.



➤ TEST METHODS AND TOOLS USED

- Tools for measuring disks and friction materials (CALIPRI)

➤ APPLICABLE STANDARDS

- TSI – Locs
- PAS – Rolling Stock
- DRN - France

➤ REFERENCES

- Development of high-speed brake
- Development of high-speed brake lining

NUMERICAL SIMULATION OF THE TRACTION CHAIN FUNCTION

➤ SERVICE DESCRIPTION

- SIMHIL is a real-time “Hardware In the Loop” simulator of the traction/braking chain. It interfaces Engine Block and Auxiliaries control calculators with models of power electronics and of the kinematic chain.
- Many services are possible:
 - Test and validation services when software and/or material for the Engine Block and Auxiliaries control are developed
 - Simulation of the behaviour of a traction chain as a function of line models.
 - Help with appraisal of complex defects.
 - Tests and validation prior to acceptance of new designs (Virtual Acceptance).



➤ WHAT WE DO

- Reduce the cost and duration of acceptance tests (modification of vehicles or new rolling stock)
- Improve the failure rates of traction/braking electronics
- Validate new designs in draft phases TRL5 to 8

➤ INPUT DATA

- Functional specification of the system
- Validation dossier for the system
- Technical dossier for equipment
- Equipment to be appraised or validated

➤ TEST METHODS AND TOOLS USED

- “Hardware in the Loop” simulator (real-time technology calculator eHS OPAL RT)
- Test and validation environment: Labview, Testand

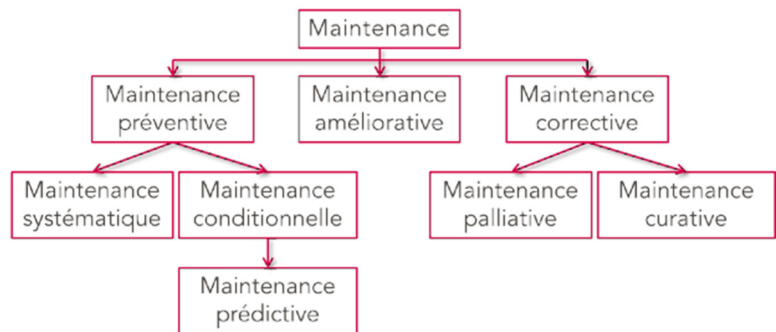
➤ REFERENCES

- New service offered with “Engine block” TGV DUPLEX and TGV POS interfaces. The simulator is universal and can interface with other products as needed.

CREATION AND OPTIMIZATION OF A MAINTENANCE FRAMEWORK

➤ SERVICE DESCRIPTION

- Define maintenance cycles adapted to the manufacturing base that respond to expected performance aims in terms of reliability, availability and maintainability.



➤ WHAT WE DO

- Support clients in defining their technical needs.
- Produce technical specifications and requirements.
- Help the client with guidance in technological choices.
- Lead and monitor the development of all stages of the V-model.
- Define maintenance cycles adapted to the client's manufacturing base.
- Provide effective maintenance tools.

➤ INPUT DATA

- Design and validation specifications of the system studied.
- Technical or operating data enabling:
 - pre-project support,
 - leading and monitoring the development phase,
 - definition of maintenance cycles.
- Maintenance aims (expected performance in reliability, availability, maintainability).
- Description of the manufacturing base.

➤ TEST METHODS AND TOOLS USED

- Investigation order
- Tests/measurements in commercial service

➤ REFERENCES

- SNCF's Fret, Infra, Intercités and Proximité activities

LIFE-CYCLE EXTENSION STUDY

➤ SERVICE DESCRIPTION

- Carry out engineering and industrial studies to enable operators to extend the service life of all types of rolling stock.
- These studies must fulfil the expected performance aims of reliability, availability, maintainability and be adapted to the manufacturing base.



➤ WHAT WE DO

- Support clients in defining their technical needs.
- Draft technical specifications and requirements.
- Help clients in making technological choices.
- Lead and monitor the development of all stages of the V-model.
- Define actions for extending service life adapted to the client's manufacturing base.
- Provide adapted maintenance tools for extension of service life.

➤ INPUT DATA

- Design and validation specifications of the system studied.
- Technical or operating data enabling:
 - pre-project support
 - leading and monitoring the development phase
 - definition of maintenance cycles.
- Maintenance aims (expected performance in reliability, availability, maintainability).
- Description of the manufacturing base.

➤ REFERENCES

- SNCF's Fret, Infra, Intercités and Proximité activities

ASSISTANCE TO PROJECT MANAGEMENT IN THE ACQUISITION OF ROLLING STOCK

➤ SERVICE DESCRIPTION

- Assist the project manager, from drawing up tender documents to commissioning into commercial service, in the acquisition of rolling stock or spare parts.
- Identify maintenance issues, aims and constraints: safety, costs, availability.



➤ WHAT WE DO

- Support the client in:
 - preparation of tender documents
 - technical analysis of tenders (preparation of provisional clauses)
 - helping to prepare the call
 - monitoring development and production
 - assessment of compliance with requirements
 - helping to prepare the safety file
 - monitoring commissioning and adjustments.

➤ INPUT DATA

- Design and validation specifications of the system studied.
- Technical and operating data for providing assistance to the project manager.
- Maintenance aims: expected performance in reliability, availability, maintainability.
- Description of the manufacturing base.

➤ APPLICABLE STANDARDS

- S 3000L, S1000D
- MIL STD 1388 1A / 2B

➤ REFERENCES

- Deutsche Bahn, Eurostar, Thalys
- SNCF's Fret, Infra, Intercités and Proximité activities



TEST ENGINEERING



MONITORING SERVICE FOR NON-DESTRUCTIVE TESTING (NDT) AND MAINTENANCE

➤ SERVICE DESCRIPTION

- Develop techniques for non-destructive inspection.
- Design processes for non-destructive monitoring.
- Draft maintenance documents and operating modes.
- Assist mechanical engineers with monitoring solutions for manufacture and maintenance.

➤ INPUT DATA

- Plan of the component or part to be monitored.
- Criterion for fault notation.
- One reference part for prototyping.
- Calculation notes.
- Monitoring environment and condition.

➤ WHAT WE DO

- Define Non-Destructive Test techniques to be implemented as needed.
- Implement procedures or operating modes for component/part monitoring.
- Advise clients on Non-Destructive Test techniques to be implemented.
- Arrange laboratory appraisals of parts or components.



- Support the client in analysing standards.

➤ TEST METHODS AND TOOLS USED

- Monitoring apparatus for ultrasound, brands Olympus, GE, EKOSCAN
- Portable electro-magnet or current generator for magnetic crack detection
-

➤ APPLICABLE STANDARDS

- NF EN ISO 9712

➤ REFERENCES

- SEMITAG
- SETRAM
- KEOLIS
- ERION
- SNCF's Voyages, Proximité, FRET and Transilien activities

MAPPING OF A VEHICLE'S ENERGY CONSUMPTION POINTS

➤ SERVICE DESCRIPTION

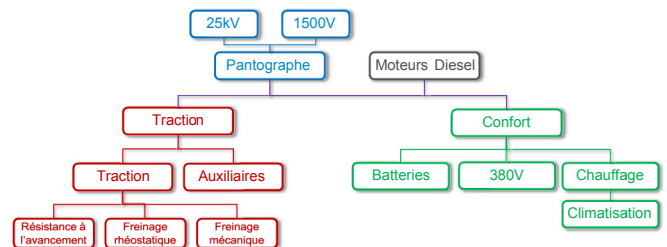
- Conduct detailed mapping of the vehicle's main energy consumption points (traction, traction auxiliaries, comfort accessories) depending on types of operation.
- Quantify the fraction of braking energy which is not recovered because it is lost during rheostatic and mechanical braking.
- Reassess the train's resistance coefficients (RAV) by simulations using measurements made during coasting in commercial service.
- Conduct a data sensitivity analysis and note the dispersal of consumption.
- Produce a "running duration" vs "stationary duration" distribution.

➤ INPUT DATA

- For rolling stock: engine characteristics, traction diagrams.
- For operation: running of trainsets and occupancy (passenger numbers).
- For infrastructure: data on lines travelled and data on electric traction fixed installation.

➤ WHAT WE DO

- Conduct full energy consumption diagnostics by developing a complete overview of rolling stock consumption points in actual operating conditions.
- Extract a summary presentation of data based on millions of base data.
- Establish a model of annual consumption by rolling stock.
- Determine sources of energy savings for a vehicle cycle of use by highlighting "easy wins".
- Simulate consumption over the cycle of use.
- Calculate return on investment of energy-saving solutions.



➤ TEST METHODS AND TOOLS USED

- SPU-Box recording systems
- 72V/220V converters
- Sensors for voltage, current, pressure Galvanic insulation devices
- Hour meters
- DK CO2 recorder
- Temperature/hygrometry

➤ APPLICABLE STANDARDS

- NF EN ISO/CEI 17 025: 2000
- EN 50591

➤ REFERENCES

- Diagnostics TGV 2N2
- Diagnostics REGIOLIS Alsace
- Diagnostics REGIOLIS Midi-Pyrénées
- Diagnostics Z20900
- TGV POS on LGV Est



APPRAISAL ENGINEERING



REVERSE ENGINEERING OF MECHANICAL COMPONENTS: METROLOGY, CAO AND 3D PRINTING

➤ SERVICE DESCRIPTION

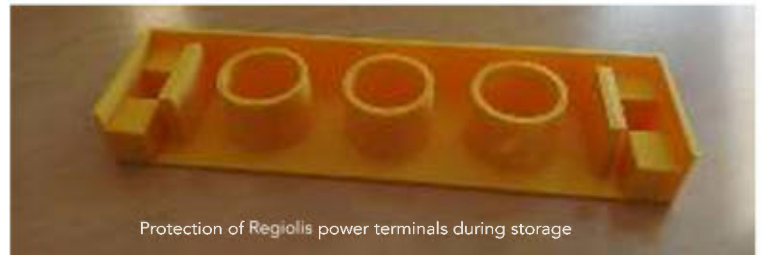
- Make identical or new mechanical components using 3D printing.

➤ WHAT WE DO

- Decentralize mechanical components.
- Use 3D printing to make (filament, L300xD200xH300mm): small series prototypes or components intended for the process: tooling, covers, supports.
- Use CAO for: design, modification, reconstruction, transcription of old paper or computer plans.

➤ INPUT DATA

- Component(s) to be defined.
- Plans.
- Environment.
- Specifications.



➤ TEST METHODS AND TOOLS USED

- 3D printer (filament, L300xD200xH300mm)
- CAO software: Catia V5 and Autocad 2010
- Plain paper plotter and scanner
- Scanner 3D

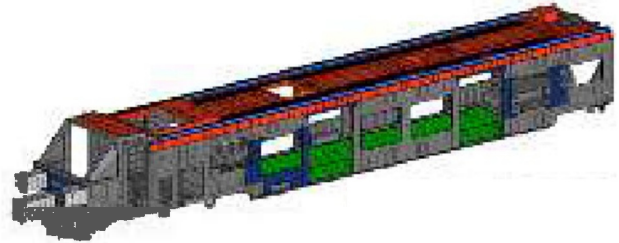
➤ REFERENCES

- Activités Proximité de SNCF

APPRAISAL OF VEHICLE BODY

➤ SERVICE DESCRIPTION

- Appraise and test vehicles to assess the residual service life of a body structure.
- Write appraisal reports, supported by pictures and listing repairs, either essential or recommended, to put the vehicle back into service in an exact timeframe if the routes covered are extended.
- Conduct technical/economic studies to define a replacement strategy (repair or replace).



➤ INPUT DATA

- Use of machines: intended route and type of route.
- Precise definition of need: estimated potential, quantity of machines concerned, extension time (if applicable).
- Vehicle accessibility: locations and number of machines.

➤ WHAT WE DO

- Draft an appraisal guide for the entity performing the works.
- Specify repairs.
- Demonstrate the possibility of extending service life of vehicles that are close to being withdrawn.

➤ TRAINING

- Theoretical and practical training for body appraisal is available on request.

➤ TEST METHODS AND TOOLS USED

- Endoscope to inspect areas which are difficult to access
- Technicentre/maintenance depot installations: bridges and pits
- Non-destructive tests

➤ REFERENCES

- AGC mid-life intervention for SNCF Proximité activity
- Mid-life intervention Tram Train for SNCF Proximité activity
- Journey extension, X1501, X4391 et 4630 for SNCF Proximité activity
- Journey extension of Train jaune Z100 for SNCF Proximité activity

STUDIES CONCERNING VEHICLE LIFTING OPERATIONS

➤ SERVICE DESCRIPTION

- Identify the features/ characteristics of a vehicle that are useful for lifting personnel (weight, lifting points, protection of personnel).
- Draft a technical document listing procedures be applied when a vehicle is lifted.

➤ WHAT WE DO

- Based on vehicle characteristics, we draft a technical document summarizing factors of use to lifting personnel.

➤ INPUT DATA

- Client specification to define the scope of the study and the nature of needs.
- Meeting to exchange views with the client.



➤ TEST METHODS AND TOOLS USED

- Lifting tools specific to the vehicle

➤ APPLICABLE STANDARDS

- STI 2014/1302
- LOC and PASS
- ISO9001

➤ REFERENCES

- Thalys
- SNCF
- Eurostar
- CFL

DIAGNOSTICS AND APPRAISAL OF BATTERIES ON VEHICLES OR ON A REMOVED COMPONENT

➤ SERVICE DESCRIPTION

- Install a sensor on the battery to measure charging and discharging current and its ambient temperature over a significant period.
- Analyse the constituent part of the battery to gather detailed information on its technical state.
- Propose and draft a maintenance document for the type of battery equipping the vehicle.

➤ INPUT DATA

- Complete technical characteristics of the electrical equipment of the machine (actual battery charging system).
- Client specification.
- Precise description of the failure established.
- Technical characteristics of the battery and the machine.
- List of routes covered by the vehicle.

➤ TRAINING

- Training in the maintenance of lead and nickel-cadmium batteries is available on demand.

➤ WHAT WE DO

- Following analysis of the information recorded by the sensor, the following services may be proposed:
 - establish a diagnosis based on the parameters recorded
 - propose solutions to rectify the failure
 - propose a type of replacement battery equivalent in voltage and power (including the maximum possible footprint) in case of obsolescence
 - propose new technology that is better adapted to use and maintenance
 - propose one or several types of tools for maintenance
 - define the preventive maintenance framework.



➤ TEST METHODS AND TOOLS USED

- Battery sensor
- Battery charger / discharger
- Densimeter
- Battery charging point

➤ SCOPE OF STANDARD

- NF EN 45545
- ISO 9001

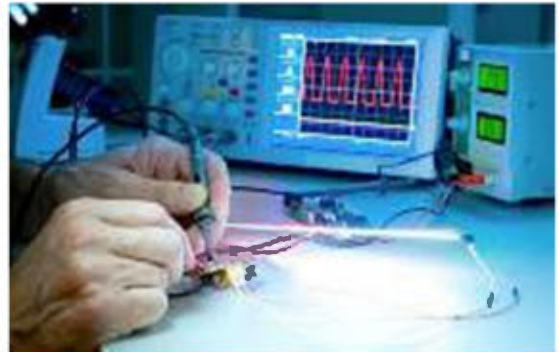
➤ REFERENCES

- SNCF's Transilien, Fret and Infra activities
- Keolis
- Eurostar

APPRAISAL OF ELECTRONIC RACKS AND CARDS

➤ SERVICE DESCRIPTION

- Test an electronic rack or card to establish diagnostics for identifying possible causes of failure.
- Investigate the origins of failures identified.
- An appraisal of an electronic rack or card may be conducted following:
 - a failure, whether or not this has caused an incident or removed a vehicle from service
 - a more serious incident, such as a Feared Safety Event.



➤ WHAT WE DO

- An appraisal will enable the origin of the fault to be understood and solutions to be proposed. The aims of this appraisal are:
 - to determine the precise origin of the fault
 - to propose reliability actions.

INPUT DATA

- Technical documentation regarding the product for appraisal:
 - contextual information regarding the incident
 - descriptive and operating notices
 - adjustment and monitoring notices
 - principle diagram
 - interface specifications.
- The complete list of documents will depend on demand.

➤ TEST METHODS AND TOOLS USED

- Bench measuring devices:
 - oscilloscope,
 - multimeter
- Test bay

➤ APPLICABLE STANDARDS

- Standards are defined as a function of demand

➤ REFERENCES

- PIS TGV, AGC, TMST appraisals of electronic racks / cards
- KVB appraisals of electronic racks / cards
- ATESS appraisals of electronic racks / cards
- Engine Block TGV- RBI appraisals of electronic racks / cards
- TVM430 appraisals of electronic racks / cards

APPRAISAL OF MAIN TRANSFORMER

➤ SERVICE DESCRIPTION

- Carry out electrical measurements and interpret oil analyses.
- Conduct a visual appraisal of the components, the tank, terminals, connections, peripherals, valves and radiators.
- Conduct various measurements: electrical, isolation, winding resistance, conversion ratios, inductance, dielectric.
- Take an oil sample to send to the laboratory to understand rigidity, acidity and dissolved gases.

➤ WHAT WE DO

- Carry out diagnostics of the functional state of a transformer based on electrical measurements, interpretation of oil analyses and visual appraisal of the different components.

➤ INPUT DATA

- Technical characteristics of the transformer series to be appraised.
- Ex factory test reports.
- Type of oil used.



➤ TEST METHODS AND TOOLS USED

- Isolation measurement: Megger
- Measurement of winding resistance, inductance, conversion reports (CPC 100 OMICRON)
- Dielectrical measurement (CPC Sync OMICRON)

➤ APPLICABLE STANDARDS

- NF EN 60310
- NF EN 60296
- NF EN 60599

➤ REFERENCES

- SNCF's Transilien, Fret, Voyages and Proximité activities
- Thalys

EVALUATION OF SOFTWARE UPGRADE AS PER STANDARD EN50128

➤ SERVICE DESCRIPTION

- Implement ISA (Independent Safety Assessor) recommendations: confirm the SIL level of software security (Safety Integrity Level).
- Conduct EN50128 audits.
- Perform independent software evaluations in report form.

➤ INPUT DATA

- For an ISA recommendation: an impact analysis of the software for safety functions, software documentation allowing the impact analysis to be conducted, all other documents drawn up by the applicant enabling the SIL to be confirmed.
- For an evaluation: all documents produced as per EN50128; documents which cannot be distributed must be available for consultation on company premises.

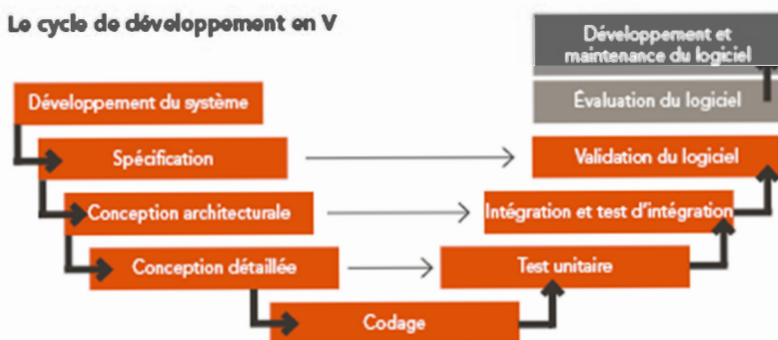
➤ TRAINING

- Training in independent software evaluation is available.

➤ WHAT WE DO

- ISA recommendations: confirm the SIL to be applied to software modifications (mail referenced).
- EN50128 audit: process enabling factual evidence to be obtained and evaluated objectively to determine whether the criteria defined in standard EN 50128 are met (audit report).
- Independent evaluation: analysis to determine whether the product meets specified requirements and to assess whether the product corresponds to the expected aim. Such an evaluation is obligatory if the Safety Integrity Level (SIL) ≥ 2 (evaluation report).

Le cycle de développement en V



➤ REFERENCES

- ALSTOM
- ONCF
- FAIVELEY
- BOMBARDIER
- EUROSTAR

➤ APPLICABLE STANDARDS

- EN 50128: 2011
- EN50657: 2017

ASSISTANCE WITH THERMOGRAPHIC ANALYSIS

➤ SERVICE DESCRIPTION

- Conduct a thermographic analysis to identify visible faults by temperature difference or emissivity.
- Set up an analysis methodology and protocol for specific components of the vehicle to improve reliability.
- Study and draw up a maintenance benchmark based on thermography.
- Share SNCF expertise and investigate new situations for using thermography on a given vehicle.

➤ WHAT WE DO

- Extend the analysis of a component beyond what is visible to observe thermal variations which are otherwise imperceptible.
- Set up a quantitative monitoring process which is supervised to assess reliability.
- Carry out systematic thermographic monitoring in order to implement standardized monitoring; this is both more accurate and faster than visual monitoring.
- Investigate new monitoring situations in operationally strategic areas (electrical, hydraulic, climatic and mechanical).

➤ INPUT DATA

- Desired level of expertise.
- Vehicle in question.
- Client location.



➤ TEST METHODS AND TOOLS USED

- Thermographic cameras FLIR E6, E95 and One Pro

➤ REFERENCES

- Integration of thermographic monitoring into the maintenance frameworks of TGV 1 level vehicles
- Implement battery monitoring
- Investigation into imbalance faults in the supply of electrical circuits

TECHNICAL APPRAISAL OF THERMAL ENGINES

➤ SERVICE DESCRIPTION

- Intervene rapidly off-site to conduct a pre-appraisal of the engine
- Appraise the engine:
 - vibration measurements
 - disassembly and inspection of components
- Carry out monitoring and analyses on site:
 - measurements of functional clearances
 - measurements of surface state
 - measurements of component dimensions
- Carry out monitoring and analyses on site:
 - Oil analysis
 - Microscopy
- Determine repair specifications as necessary
- Implement repair measures



➤ WHAT WE DO

- Perform diagnostics of the general wear and tear of the engine and its components
- Perform, if necessary, diagnostics to determine the origin of damage
- Present preventive measures that ensure optimum conditions of use for the engine
- Advise and train users as necessary

➤ INPUT DATA

- Technical characteristics of the engine (type, cylinder capacity, maximum power, maximum rating, etc.)
- Operating conditions for the thermal engine (load profile)
- Profile of use (daily, weekly or monthly/duration)
- Statement of fault codes or damage report, if applicable

➤ TEST METHODS AND TOOLS USED

- Traditional tool kit allowing the engine to be disassembled
- Equipment for measuring vibration + ONEPROD operating software

➤ REFERENCES

- Euro Cargo Rail
- EDF
- National Railway Company of Cuba

DIGITIZE THE IDENTIFICATION AND TRACEABILITY OF COMPONENTS

➤ SERVICE DESCRIPTION

- Provide a service—complete or on demand—based on a diagnosis of a baseline situation:
 - choice of technology adapted to need: RFID/Datamatrix,
 - choice of reading device: tablet, smartphone, RFID reader
 - development of a specific digital application
 - project tracking, guidance on the identification standard (GS1), technical documentation, preparation for full-scale application.

➤ INPUT DATA

- Presentation of issues and the current situation.
- Technical definition of components for identification: detailed drawing, assembly drawing, photo, footprint, integration stresses (temperature, accessibility, environment), compatible fastening methods.
- IT tools—existing and impacted by the target solution.

➤ WHAT WE DO

- Identify and ensure traceability of a component or component assemblies throughout their service life.
- Optimize the organization's supply chain.
- Reduce the risk of product reference inversion and guarantee the uniformity and precision of components selected by the operator.
- Improve configuration management of rolling stock.
- Set up an automated inventory of components.
- Modernise and digitize a process that is time-consuming, labour-intensive and repetitive.
- Provide standardization among the intermediaries involved in a complex logistical circuit.



➤ TEST METHODS AND TOOLS USED

- Development software for digital applications

➤ APPLICABLE STANDARDS

- Global Standard 1
- EPC framework Gen 2

➤ REFERENCES

- MOBICLIM application for air conditioning systems of TGV Duplex
- Integration of NFC tokens on TGV noses
- Integration of TAGS RFID UHF

OBSOLESCENCE MANAGEMENT AND PROCESSING OF ELECTRONIC COMPONENTS

➤ SERVICE DESCRIPTION

- Introduction of a provisional action plan in case of manifest obsolescence without prior management of product continuity.
- Based on SNCF data, integrate electronic equipment, quantities and nomenclatures of what are known as "low-level components".
- Alert users if an obsolete electronic component is detected.
- Propose replacement solutions depending on each system or component:
 - stock low-level components
 - replace with an equivalent and interchangeable component
 - design a chart incorporating the same functions to replace the old one
 - redesign the obsolete function with new equipment.

➤ WHAT WE DO

- Place onboard electronic equipment under surveillance.
- Ensure train functions, and anticipate the risks of obsolescence by identifying action plans for each function.
- Propose solutions for each new obsolescence situation.
- Validate and qualify new products proposed.
- Store electronic components in racks with controlled temperature and humidity.

➤ INPUT DATA

- Technical documentation on the product being appraised:
 - descriptive and function notices
 - adjustment and monitoring notices
 - nomenclature for low-level components
 - logistical hierarchy of vehicle under inspection.



➤ TEST METHODS AND TOOLS USED

- Base IC2E
- Racks with controlled temperature and humidity.

➤ APPLICABLE STANDARDS

- NF EN 50155
- NF EN 50121-3-2
- NF EN 61000-4-x
- STM E 001
- NF EN 62402
- UTE C96-027
December 2011

➤ REFERENCES

- Onboard information systems on AGC and TGV
- RedFox Routers on NAT
- TGV 2N2 Onboard Passenger Information Systems
- MESD racks
- Windriver sensors

FEASIBILITY STUDY: REPAIR OF ELECTRONIC RACKS AND CARDS

➤ SERVICE DESCRIPTION

- List all available documentation.
- Analyse this documentation and determine whether an electronic rack or card can be repaired.
- Quantify the costs and time necessary to repair electronic cards.
- Conduct GO/NOGO testing and repair cards within SNCF or on a sub-contracted basis.



➤ WHAT WE DO

- Propose an alternative solution to complete replacement of electronic racks or cards.
- Reduce the costs of repairing electronic cards.

➤ INPUT DATA

- Technical documentation for product(s) being appraised:
 - function and descriptive notices
 - adjustment and monitoring notices
 - principle diagram
 - nomenclature
 - interface specifications.
- A complete list of documents is defined on request.

➤ TEST METHODS AND TOOLS USED

- Bench measuring devices: oscilloscope, multimeter.
- A card or rack (PRM) forming the subject of the study

➤ APPLICABLE STANDARDS

- IPC 610
- UTE C 80810
- Complete on request.

➤ REFERENCES

- AGC geared motor doors
- GPS antennae and clocks
- EBULA console
- ATESS bare racks
- Régional Onboard Information System (PIS) and PIDS

INTRODUCTION OF A TEST BAY FOR REPAIRING ELECTRONIC CARDS

➤ SERVICE DESCRIPTION

- Design and implement tests to validate the correct functioning of electronic racks and cards.
- Draft documentation for tests as formulated.

➤ WHAT WE DO

- Provide clients with a test bay for functional testing and validation of electronic racks and cards.
- Internalize electronic card maintenance.
- Reduce repair costs of Repairable Vehicle Components [PRM].
- Improve the availability of PRM.

➤ TRAINING

- Training in the use of test bays is available.



➤ INPUT DATA

- Technical documentation regarding the product for appraisal:
 - function and descriptive notices
 - adjustment and monitoring notices
 - principle diagram
 - nomenclature
 - interface specifications.
- A complete list of documents will be defined on request.

➤ TEST METHODS AND TOOLS USED

- Bench measuring devices (oscilloscope, multimeter)
- A rack or card (PRM) for panel validation as part of the internalization study
- National instruments products
- Software LabView, TestStand, VeriStand

➤ APPLICABLE STANDARDS

- IPC 610
- UTE C 80810
- CE marking directive
- Complete on request

➤ REFERENCES

- Bay SBBM Bloc Moteur Bi
- STV bay for an Onboard Information System
- TVM-ODO test case bay
- ATESS bay
- Training bays

IMPLEMENTATION OF A TEST PANEL FOR ELECTRONIC CARDS

➤ SERVICE DESCRIPTION

- Design a panel to test and confirm that electronic racks and cards work properly.
- Draw up documentation for tests formulated.



➤ WHAT WE DO

- Provide clients with a panel for testing electronic racks and cards.
- Reduce the repair costs of Repairable Vehicle Components [PRM].
- Internalize maintenance of new electronic cards [PRM].
- Improve the availability of PRM.

➤ INPUT DATA

- Technical documentation for the product being appraised:
 - function and descriptive notices
 - adjustment and monitoring notices.
- A complete list of documents will be defined on request.

➤ TRAINING

- Training in the use of this test panel is available.

➤ TEST METHODS AND TOOLS USED

- Bench measurement apparatus: oscilloscope, multimeter.
- A card or rack (PRM) to be examined.
- Produits National Instruments.
- Software LabView, TestStand, VeriStand

➤ APPLICABLE STANDARDS

- IPC 610
- UTE C 80810
- CE marking directive
- Complete on request

➤ REFERENCES

- Test panel card INR / INT.
- AGC geared motor doors test panel.
- KRAVAT test panel (ASIG test on ATESS) / ITMV.
- Dielectric test panel for PZB-LZB cable.
- BCONV test panel.



ENGINEERING PRESENTATIONS



Safety	Software safety	Reliability Confidence Quality Techniques – Living with faults Contractual requirements — EN50128 standard EN50128:2001 vs EN50128:2011 Overview: Where are we today? Formal approach	2h
	Feedback from fire ignitions	Fire safety Feedback on ignition European regulation EN 45545 and TSI Simulation tools	2h
	Structures	Introduction to the study of functions: “Bodystructure” Technical development of the function User feedback and perspectives	1h30
	Overview of railway system safety	A brief history: railway accidents and the rail system Risk control: references and procedures Risk control: technical issues Risk control: human factors	2h
	Operational security	An introduction to operational security Validation of needs and determination of functions Risk identification Risk analysis	2h
	Cybersecurity	Introduction to Computer System Security [SSI] Safety and SSI Favourable technology context Agencies & bodies / Legal framework / Standards / Guides to good practice Company reference framework Integration of SSI into projects Project examples	2h
Computer-Aided Engineering (CAE)	3D models	Background 3D models at SNCF: what we know how to do 3D models: risks: how are they made? The virtual numerical world: what could be done?	2h
	ControlBuild: workshop software design and validation of automated control monitoring systems	Benefits of a software platform Using Controlbuild Using Computer-Aided Engineering Other tools Commission for Computer Aided Engineering (CAE)	2h

Interior fittings and passenger comfort

Thermal comfort

Human physiological needs
 Thermal exchanges (body)
 Thermal comfort — Key parameters
 Dimensioning an installation
 Thermal comfort — Standards 2h
 Air diffusion — examples / Provisional calculations
 Climate control tests / Client perceptions

Accessibility for people with reduced mobility (PRM): usage and requirements

Overview: societal developments – aging population / support for PMR
 Accessibility by SNCF: background / situational analysis / organization 2h
 Development of analyses: from technical to usage
 Standard developments
 Accessibility as a source of innovation: example of industrial design

Toilet

Background
 Toilet/lavatory functions
 Various WC solutions 2h
 Technical issues
 Future solutions

Passenger access: doors

Passenger access: issues, background & development, operating issues 2h
 Technical development: passenger access equipment

Passenger access: Operational issues

Introduction
 Technical development: operation of passenger access 3h
 Operational issues: security and reliability of passenger access
 Analysis of an incident

Awareness of design and ergonomics

Background: the purpose of train design
 What is design? 2h
 Rolling stock—design serving brand

Acoustics—the human factor

Physical phenomena
 Regulation and comfort 2h
 Sources of railway noise
 V cycle—Noise control plan

Standards

Forbidden or restricted materials: REACH

Europe’s REACH regulation
 Activities concerned and REACH statutes for rolling stock 2h
 Applying REACH to rolling stock
 Special cases

Traction	Electric traction and performance	Traction programme - F(V) simplified architecture and engines Energy Overview: key features	2h
	Diesel traction and sustainable development	Summaries of traction performance Diesel traction chain Diesel motor circuits Fluid analyses Energy economies	2h
	Permanent Magnet Synchronous Machine (PMSM)	Position of PMSM in the environment of electric traction machines Theoretical review of synchronous machines BLONDEL diagram Calculation of EMC electromagnetic couple Why salience? Effect of salience on the selection of rotor type Selection of number of pairs of p poles	2h
	Formation of an electric traction chain	Definition of traction chain Principle of an electric traction chain Technology: changes in components of an electric traction chain Transformers How static switches work Converters How continuous motors work How synchronous and asynchronous motors work How permanent magnet synchronous motors work Example: traction chains Traction chain and acceptance obligations What lies ahead	2h
	CVS auxiliaries	The conversion of auxiliary energy in trains: overview The design of auxiliary converters—key components Close-up: a selection of specific functions The future of railway energy conversion	2h
Professional rules	Welding requirements for railway components	Who is affected? Issues in our organization Presentation of the NF EN 15085 standard Facilitating change Presentation of the welding commission	2h
	Bolted assemblies	Faults that have made the news Static characteristics of screws Dynamic characteristics of screws Different types of stresses Dynamic behaviour of an assembly Clamping methods Railway cases of non-compliance with professional rules	2h

Interface between rolling stock and infrastructure	Rolling stock gauges	Definition of gauge Consequences of non-compliance with rules Definition of reference profile Composition of related rules Definition of maximum construction profile Operation of maximum construction profile	2h
	Electromagnetic compatibility between rolling stock and infrastructure	Overview/review Electric traction subsystem Railway system: electric compatibility between rolling stock and infrastructure (electric traction fixed installations, signalling and telecoms) Electromagnetic emissions in the rail industry Acceptance procedure and reference framework	2h
	Collection	French national rail system's electrified network How energy collection works Main catenary groups (25 kV, LGV, 1.5kV) System limits and qualification of collection Numerical simulation Pantographs Friction materials Catenary incidents Current research	2h
	Rolling stock/ infrastructure interface	Problems and issues Certification of compatibility Technical interfaces rolling stock / infrastructure The MD / IGT chart Committee of railway operators (COOPERE) Impacts of 4th rail package	2h
	Railway aerodynamics	Introduction to aerodynamics Problems of railway aerodynamics and their issues SNCF players and interfaces Reference framework Railway aerodynamics—background Detailed presentation of issues and aerodynamic studies (train resistance, running in tunnels, crosswinds, aeroacoustics, stresses on train components, etc.)	2h

Running gear and coupling	Railway dynamics	Concept of railway dynamics Regulatory aspect Validations Aspect of numerical simulation	2h
	Bogie	Presentation of running gear Dimensioning and validation of running gear, fault modes	2h
	Transmission	Transmissions: overview Railway traction transmissions Transmission components (reducers, motor axles, couplings, etc.) Mechanical components of transmissions (gears, bearings, casings, etc.) Lubrication / tightness Examples of technical improvement axes (research & development, optimization of vehicle, etc.)	2h
	Axle engineering: design and maintenance	Design of running gear Manufacturing quality Maintenance	2h
	Coupling, impact and traction	General, photo library Conventional couplings / Automatic couplings Coupling bars Emergency coupling - transport Shunting couplings Feedback - maintenance Suppliers	2h
Safety equipment	Principle of speed	Conversion of auxiliary energy in trains: overview Design of auxiliary converters—key components Close-up: selected functions Future of railway energy conversion	2h
	Brakes	Basics Different brake types Braking systems Different technologies Performance / Interfaces	2h
	Presentation of European Railway Traffic Management System (ERTMS) — How the European Train Control System works (ECTS)	Background Basic principles of ERTMS Modes and levels Principle displays Standard Architecture and equipment of bi-standard ERTMS/ Machine Track Transmission Issues and challenges	2h

Information technology	Onboard software and networks	General principles/overview Onboard software Networks on board trains Network examples Standardization Architecture in flux	2h
	SMIT: SIVE, video surveillance, passenger counting, train network architecture, train/track communication	The functional scope of SMIT Onboard computer networks Train/track communication and infrastructure / Onboard Passenger Information System (PIS) Passenger Counting (CAVE) Video protection / Retrocognition PA system, intercom and alarm signal / Telediagnosics	2h
	Electric operating architecture of trains and its development	The functional train (FET) / FET support Constraints (examples) Networks and trains Building a functional architecture	2h
	Onboard communications (trains)	PA system for passengers Intercom (onboard telephone) Sound signals (sound alarms, ARP, etc.) Passenger alarms (SAP, SAI, SAFI, PAS) Wheelchair user calls Current regulations and impact on vehicles	2h
Telediagnosics	Architecture and design of fault codes	Onboard computer architecture (New Generation Vehicles) Testability Creation of fault codes Storage and access to faults Development of fault codes Developments in maintenance	1h30
	Data collection and transmission	Data collection / Data Information Meeting the challenge	1h30
	Data processing – Big Data – CIM – Maintenance	Data Data processing procedures and tools Usage situations Outlook Organization of maintenance using telediagnosics	1h30
	Internet of Things (IOT): scaling up for roll-out	Overview of technologies Connected objects for vehicles/rolling stock MARTI project (Agile Module for Receiving and Transmitting Information) / MELI (Onboard Modem for Information Liaison) Examples: usage	1h30

Energy	Energy metering on vehicles	Introduction to energy meters Standards and regulatory context Deployment of meters Using data	2h
	Emission of pollutants and post-treatment systems	Overview Railway regulation Combustion in a diesel engine and formation of pollutants Tools available for reducing pollution Impact of standards and developments in technology Examples of applications at SNCF	2h
	Fuels: quality, regulation, environment	Fuels at SNCF: key figures and logistical mapping Refining crude: distillation and transformation Fuel at SNCF: what, why and specifications Issues in diesel quality: specifications and microbiological pollution Additives and derivatives: company position Alternative fuels	2h
Acceptance of vehicles	Regulatory issues	Review of current situation 4th railway package Technical Specifications for Interoperability (TSI) Application for SNCF Mobility The players	3h
	Role and mission of SNCF's rolling stock	Writing a definition notice Assessment of significance, substance and interoperability How CSM appraisals work (Common Safety Method) Roles of different players	3h
	Mass balance	Area of intervention / Regulatory context What is a mass balance? Obtaining a mass balance Acceptance of a vehicle Modification of a vehicle Actions to be guided by technicentres/depots Actions to be guided by serial life following modification CIM mass balance specialist works Loading condition: validation criteria	2h
	Registration of vehicles	Registration background Registration principles Different situations possible What does the future hold?	2h

**Electronics
and
connectivity**

**Electronics:
methods and
standards**

NF EN 50155 Electronic equipment used on vehicles
 NF EN 50121-3-1 Electromagnetic compatibility – rolling stock
 NF EN 50121- 3-2 Electromagnetic compatibility – Devices
 NF EN 50126-1 Railway applications– FMDS
 NF EN 50128 Software – signalling systems
 NF EN 50129 Electronic safety systems
 NF EN 50125-1 Environmental conditions for the vehicle
 NF EN 45545-2 Protection against fire in railway vehicles 3h
 STM-S-001 Particular specifications for
 45545-2 requirements for SNCF and RATP
 STME 001 Electronic equipment used on rolling stock
 STME 002 Marking of electronic equipment
 STME 011 Electronic equipment – rolling stock (testability of
 electronic equipment) FI 01 020 Technical dossiers of electronic
 equipment
 FI 01 015 Rules for writing vehicle notices
 MA 43200 MCO of electronic equipment

**Maintenance
engineering applied to
electronics and
electronic card appraisal**

Essential questions to ask before commencing an appraisal
 Different appraisal phases
 Essential tools 2h
 Lissajous measurements
 Appraisal fieldbus

**Onboard electro-magnetic
compatibility (CER)**

CEM principles
 Frequencies
 Origin of phenomena
 CEM applied to railway electronics 2h
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