Memo

To : Members Front-Office

From F. Kuperus, E. Elich

Copy S. Sytsma

Subject Command, Control, Communication systems (ERTMS)
Position paper

Introduction

The several consultation rounds indicate some doubts around the application of ERTMS systems. The main risks identified by the candidate IP's are:

1. European specifications on ERTMS will not be finished in time. No ERTMS-2 systems are actually build. ERTMS-2 projects are cancelled.
2. RAMS figures for ERTMS systems are not known and may cause financial risks in the performance regime.
3. No industrial components are timely available.
4. Reasons 1-4 mean that according to the Banking Institute, an ERTMS solution can not be financed
5. Reasons 1-4 give rise to penalties during operation, which means no money!
6. ERTMS systems should interface to VPT+ (not recognised by all candidates!!!)

This paper summarises some facts and prepares alternative strategies for finalising the ITT.

Date
9 September 1999
Our reference
RAS/.
Your reference

Contact
E. Elich
Tel
030 - 2728 305
E-mail
eric.elich@hslzuid.com

Why ERTMS

Back to the basics. Why do we want ERTMS? There are four main reasons:

1. Enabling cheaper and faster traffic within Europe:
   - Easy cross bordering
   - High speeds, shorter travel times
   - Easy access and competition for Traffic Operating Companies
2. Minimise Life Cycle Cost of the overall transport system
3. Increase competitive edge of the rail industry. The European rail market is too small for all kind of different signalling and train control systems, as is currently a fact. Standardisation enables a realistic rail market for industry.
4. Legal: EC directive 96/48/EG

ERTMS-systems provide the required command- and control systems. VPT(+) provide the required traffic management functions. Together these systems perform the essential nerve function. Without nerves no train will run!

Specific for the HSL-South is the 25 years fixed contract. Not all performance requirements and potential revenues can be foreseen. The world will change in 25 years. ERTMS enables these opportunities better then conventional command and control systems.

When is ERTMS available?

Specifications.
ERTMS-2 Class-P specification is finalised. Class P is for the use on pilot projects.
ERTMS-2 Class-1 specification is under development. Class 1 specifies the basic (interoperability) functions. Planning for class 1 is as follows:

October 1999	Delivery documents by industry
December 1999	Review of documents finished by ECSAG group
December 2000	A decision is to be taken by the General Assembly (a.o. P. Wilms); decision before 31-12-2000 seems to be feasible.
December 2001	Standardisation of specifications and TSI via CENELEC

Key-issue in finalising the specifications is the inclusion of some extra functions: e.g. banking of trains and automatic loading of train data via the radio systems.

Key milestones:

- Latest date to freeze ERTMS-2 class 1 and class p specifications
- Latest date to finish development and start the safety case and test phase
- Latest date to start realising/building systems

Opgeslagen door JoKok
Opslagdatum 9/9/1999 11:27
Bestand C:\TEMP\ERTMS position paper.doc

- Latest date to freeze interface specifications with task organisations

A new ERTMS masterplan by the European Economic Interest Group, consisting of the main signalling industry companies and the main European railways companies, (also called the "Usergroup") is expected very soon. This masterplan will address the key milestones.

European projects
Appendix III shows the status of the projects in which ERTMS is to be realised.
The DB cancelled on two lines the realisation of ERTMS sytems. The reason is the fact that the lines are put into service in 2002. At this moment it is rather uncertain whether a commercial ERTMS system will be available at that time.

Planning BB-21
NS Railinfrabeheer has signed a contract with ADtranz and Alstom for development of a new signalling system for the Dutch railinfrastructure. This system, called BB21, includes an ERTMS system for both level 2 and 3. The planning of both companies is shown in appendix I. These plans show that both companies foresee having an ERTMS level 2 system available by the middle of 2002. This is well in time for usage on the HSL track (See appendix II).

Conclusion
The next years different ERTMS-like systems will arise. The strongest supplier (or two) will survive. Migration of ERTMS-systems is inevitable to reach final compliance to EEC/96/48/EG. The chance that an interoperable ERTMS-system will be available for the HSL-Zuid is estimated between 40-80%.

Problem Statement

How can we adapt the ITT in such way that the operation of the HSL-Z per 6-2005 is guaranteed whilst preserving long term compatibility with ERTMS?

Development risk:
ERTMS specifications (Both TSI's and requirement specifications) are not fixed. There are different opinions on the completion dates. If specifications are not fixed before 31-12-2001, it is hard to complete designing, testing and building ERTMS systems before 6-2005 (including the safety case)
Pending issues on the specifications are related to the use and operation of the railways (harmonisation of procedures). It merely is a political issue. Pressure to reveal specifications is increased by EEC after 10 years of talking about interoperability.

There are no major technology risks. ERTMS uses existing technology with new applications. Few issues are left. Currently radio coverage by GSM-r is under test. It is expected that radio coverage won't be a problem in 2005.

ERTMS systems should interface with traffic management systems (NSVL/RIB VPT+). Depending on the choice of ERTMS and fall-back options, additional interface developments are necessary. The impact of the VPT+ interface is underestimated by the candidates. Only the ZRG-group recently came up with some important questions and suggestions. It is not simply providing a connector with a bunch of information bits, it is about operational procedures and definitions.

Industry:
The European signalling industry encounters hard times. Profitability is declining. Alstom and Adtranz are forced to reduce staffing as a consequence of the delayed progress of the WMCL. Siemens is looking for joint ventures. A shake out inevitably will occur.

Conclusions:
- The timely specifications are causing a risk; different opinions on timing. Critical milestone is 31-12-2001.
- Because ERTMS does use existing technology, getting RAMS figures is a matter of professional engineering
- Industrial components are available, but the composition of systems depends on the timely specification.
- Interface with VPT+ remains a critical interface. Strong interface procedure and clear milestones are required (team Railway Organisations).

Opgeslagen door JoKok
Opslagdatum 9/9/1999 11:27
Bestand C:\TEMP\ERTMS position paper.doc

Proposed solutions

Roughly we distinguish 4 possible solutions:

1. Leave the ITC unchanged
2. Evolution of ERTMS
3. Fall back option
4. Leave ERTMS to the market

Scenario 1: leave the ITC unchanged

- Stick to ERTMS
- The ITC remains unchanged
- There is no doubt about ERTMS, suppliers introduce extra risk in order to increase the price

Subject	Evaluation
TOC's	All TOC's have more or less the same starting position Those TOC's (3 of 13) who own already PBKA have little advantage for the HSL in Belgium, France
Rolling Stock	Rolling stock must be equipped once with ERTMS (200 k €/train)
Infrastructure	Comply with VPT+ interface spec.
Negotiation	Risk is transferred to candidates, resulting in a higher price or non bankability. No fall back option allowed. Candidates are forced to offer ERTMS, and show their utmost capability to supply ERTMS. Candidates might deliberately choose to be non-compliant.

Scenario 2: ERTMS evolution

- stick to ERTMS compliance
- it is likely that ERTMS developments are timely available
- don't exclude the risk before issuing the ITT, but introduce an emergency procedure:
  - go along with ERTMS class 1 specification as available per 31-12-2001
  - ask for a migration scenario to comply with final/updated version in due time

Subject	Evaluation
TOC's	• All TOC's have more or less the same starting position Those TOC's (3 of 13) who own already PBKA have little advantage for the HSL in Belgium, France.
Rolling Stock	• Rolling stock must be ERTMS compatible and probably needs updating later on. Initial 200k €/train, update 100k €/train
Infrastructure	• VPT+ systems/interface must be adapted to fit fall-back option

Negotiation	• If ERTMS is feasible, strengthens the position of the State: states choice is leading, no supplier-specific fall back option. Open competition.
	• If ERTMS doesn't look like the final version on 31-12-2001, you need an emergency procedure (like DB/LZB).
	  • The State may ask for the fall back option of the given supplier at that moment. Basically development efforts need to be done twice (10-20%) of the investment, about 10-20 mio €.
	  Costs may increase if the supplier abuses the State's urgency for reaching a timely solution.
	  • The State may ask to build ERTMS on preliminary specifications, which needs updating later on.

Scenario 3: account for fall back option

- stick to ERTMS compliance
- it is very likely that ERTMS developments are not timely available
- exclude the development risk before issuing the ITT
- ask for a variant bid comprising:
  - latest date to choose for variant

Opgeslagen door JoKok
Opslagdatum 9/9/1999 11:27
Bestand C:\TEMP\ERTMS position paper.doc

- description of the variant
- variant bid must remain compliant with the VPT+ interface!
- migration plan to ERTMS compliance (final migration date)

Subject	Evaluation
TOC's	• Three of 13 candidate TOC's already own PBKA compatible rolling stock and thus have an initial advantage.
Rolling Stock	• Rolling stock must be updated in a later stage (200k€ /train)
Infrastructure	• VPT+ systems/interface must be adapted to fit fall-back option • If TBL is chosen as fall back option, the cross bordering with Belgium might by smooth (If Belgium also choose for TBL).
Negotiation	• The IP candidate will increase the price for the base bid and lower the price for the variant. Migration might be expensive. • Those who think ERTMS is key-element of their competitive edge will stick to ERTMS.

Scenario 4: leave ERTMS to the market

- Leave the introduction of ERTMS to the balancing power of candidate IP's and TOC's. If ERTMS becomes commercially attractive, it will be introduced automatically.
- Introduce requirement: the command, control, and communication systems shall stimulate the lowest price per traveller/kilometer.

Subject	Evaluation
TOC's	TOC's have to provide PBKA equipment to exploit the line Asd-Brussels, Paris, London; Investment in ERTMS equipment, will be on top of. More countries must apply ERTMS before they change over. May delay introduction of ERTMS
Rolling Stock	Negotiation between IP and TOC
Infrastructure	-
Negotiation	Maximise competition; Little control on the final result Reduces price for initial bid, but might introduce rigid systems during 25 years.

Key questions for Candidates

All

1. To what extent does your fall back option complies with the requirements from the ITC (use table in Appendix IV to indicate explicitly compliance/non-compliance)?
2. What kind of development effort (qualitative, quantitative) is needed to fit your command, control, communication solution within the Dutch traffic control environment?

Alstom

3. What are the risks of using the ERTMS- system, ready mid 2002, developed within the BB-21 contract?

Siemens

4. What are the results of the Berlin-Halle-Jutenborg pilot? To what extent these results can be used for our case?

Adtranz

5. How do you cope with changing European ERTMS specifications (TSI's and requirement specifications)?

ZRG

6. What are the consequences of updating TVM-430 for mixed traffic, dutch landscaping, VPT+ interfacing?

Opgeslagen door JoKok
Opslagdatum 9/9/1999 11:27
Bestand C:\TEMP\ERTMS position paper.doc

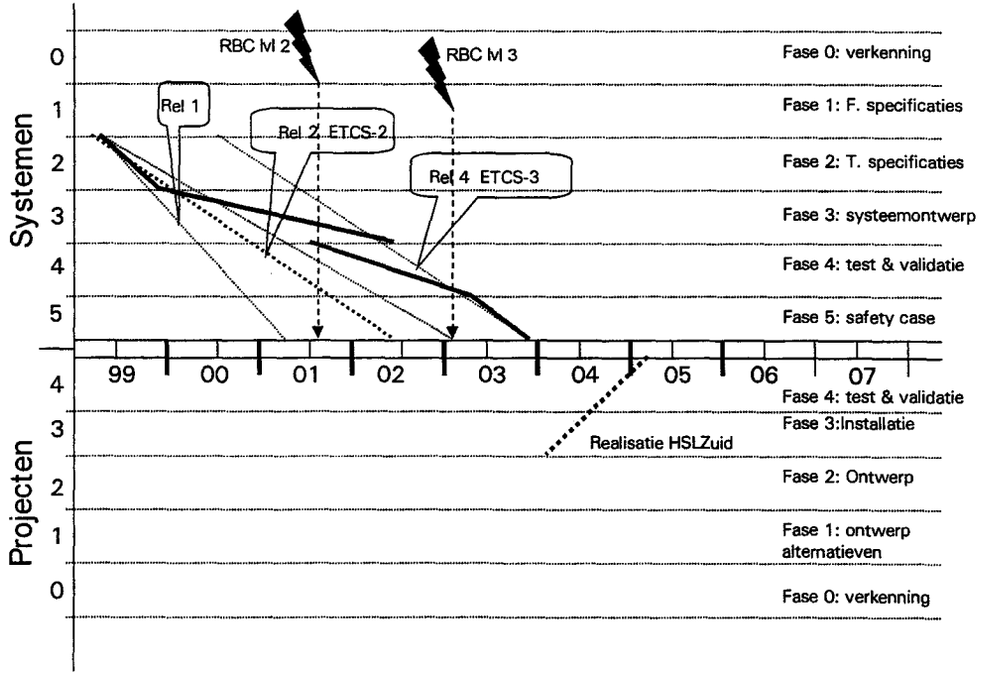
Appendix I: Summary changes ITT

1. Fs Ch3: Compliance with ERTMS. Add text:
   The command, control and communication system shall be compliant with ERTMS *(comply with TSI's – Technical Specifications Interoperability)*
2. FS Ch3: The command, control and communication systems shall support the functions undertaken by the Traffic Controller.
   To strengthen the compliance with Traffic Control , change to:
   The command, control and communication systems shall allow the Traffic Controller to perform its functions, as defined in the operational concept definitionl VPT+ (Operationele Concept Definitie (OCD) VPT+, V1.2 28 juli 1999).
3. FS Ch 3: Add the following text to stimulate candidate IP to design open en flexible systems:
   The use of CCC-systems will vary during 25 years. Therefor we challenge the candidate IP's to demonstrate explicitly their capability of designing flexible and open system concepts".
4. FS Ch3.2.3 Clarify "one train in tunnel between emergency exits". What is an emergency exist: any door (every 300m) or escape "schachten". Letter case might influence seriously the headways by minutes. Delete this requirement?? (Action by R. Houben/M. Braskamp/R. Wijnands)
5. SHS p7.17 Reference to RRV is not applicable. RRV is not applicable to HSL-lines and only mentions the responsibility NS organisations. Add text:
   (for information only, will be replaced under new railway act)
6. Scenario's: text to be defined

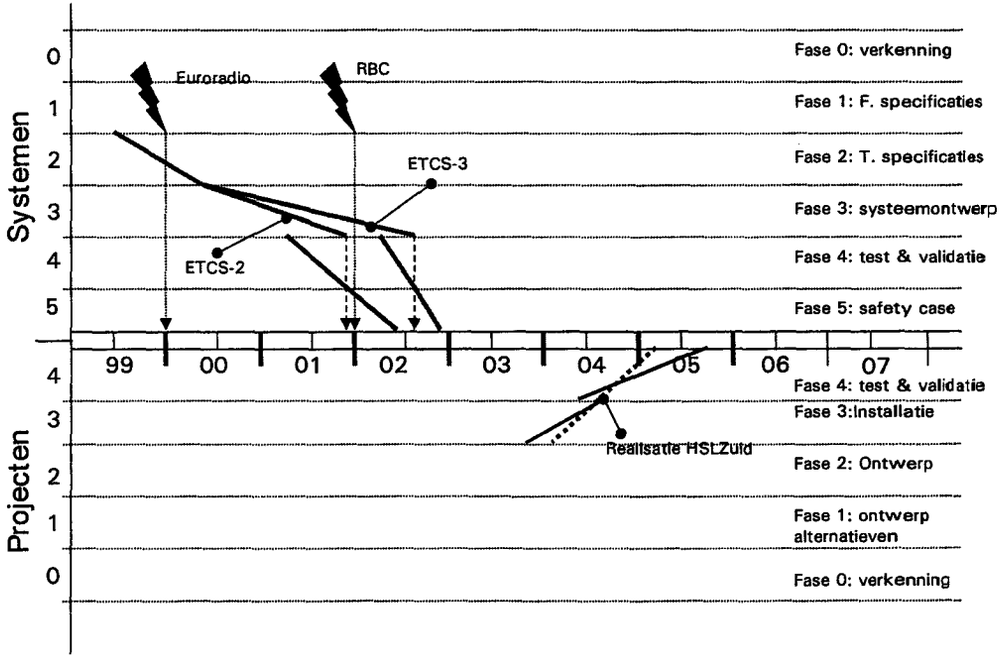
FS = Functional Specification
SHS = Safety Health Specification

Appendix II: Planning

Planning ERTMS **Alstom** BB21



Planning ERTMS **ADtranz** BB21



Appendix III: ERTMS Projects

ERTMS ETCS	Location/line	Supplier	Realisation	Notes
2	Switzerland Olten-Luzern	Adtranz	~~June 2000~~ 12-2000	35 km, 200 balises ERTMS-2 but not yet class-1
2&3	West-Coast-Main-Line/Great Britain	Transig-Adtranz GASL-Alstom/Siemens	2003	
2&3	BB21/The Netherlands	Alstom/Adtranz	2001/2004	Development contract
3-	Sweden[1]			
	Sweden-Denmark fixed link	Siemens-Denmark Adtranz-Sweden	Early 2000	
LZB	Germany: Köln – Rhine Main		2000/2001	Timing 2002 is not feasible anymore; In combination with FFB they should also give a tremendous reduction of staff. Mr. Schultze Halberg, as responsible manager, has been released from his duties. Both operation and financial requirements are not met before 2002 → fall back to LZB.
2	Germany: Jutenborg – Halle/Leipzig Jutenborg – Berlin	Siemens		Remains ERTMS-2 pilot based ERTMS-2 SRS v4.a Different philosophies among different Siemens organisations: Siemens-Braunschweig (development): in favour of ERTMS Siemens-Berlin (contract): hesitating about ERTMS If Class-1 is finalised all balises along the line must be updated with class-1 software, due to differences in radio transmitted messages.
LZB	Germany: Nürnberg-Ingolstadt	Adtranz		Formerly level-2, see also Köln-Main; 120 mio DM control+TES
4	Germany: adjacent lines [2] FFB			
	Germany GSM-r net	Mannesman Arcor	2002	27000 km; 2800 send stations; 3.000 mio DM
	Paris- Strasbourg			
1	Vienna – Budapest	Alcatel		10 ¢mio
	Italy: Rome-Naples			
	Florence-Arezzo			
	Turin-Venice			
	Madrid-Barcelona			
	Madrid-Sevilla			EMSET, first pilot with Class-p functions
	Zaragoza-S. Sebastian			

[1] Implementation comparable to level-3 (radio communication instead of track equipment) but not compatible with the ERTMS/ETCS specifications)
[2] Implementation of level 4, comparable to level 3, but the train drives the interlocking. It concerns a decentralised system for longer routes with a low set occupancy.

Appendix IV: Comparison fall back options

(This table is still under construction. Purpose: to get an idea of consequences of choosing for a specific fall back option. To reveal eventually extra requirements for the ITT. In this stage it can not be concluded whether fall back options comply with requirements from the ITC. Ask candidates!)

Requirements (ITC)	TBL	TVM 430	LZB	ATB (ATB NG)
Perfromance				
Min headway 3 min	3 min (300 km/h)	3 min (300 km/h)	3 min (300 km/h)	2 min (160 km/h) ATB NG 3 min
Max speed 300 km/hr (rolling stock)	300 km/h	360 km/h (New TGV)	280 ? km/h	160 km/h (ATN NG: 360 km/h)
Max capacity 16 trains/hr				
Breaking Profile	5800m (300 km/h)	5800m (300 km/h) 9000m (360 km/h)	5400m (ICE 300 km/h)	1370m (160 km/h) ATB-NG 5800m (300 km/h)
Block properties	Fixed blocks	• Length 1500m (fixed) • Fixed profile (up, down, flat) • Max speed	Fixed blocks	Fixed blocks, however variable length.
Functions • Support Traffic Control • VPT+ interface • Interlocking • Trackside assets • Rolling stock data system • Rout map generator • Recording assets • Trackside train monitoring devices • Operation of the emergency cross passage door locks in tunnels • 1 train in tunnel between emergency exits • interlocking with floodgate doors • operation of power phase locks • operation at traction voltage changeover locations • train borne functions e.g. air vents when entering tunnesl • limitation of number of trains on structures • intrusion detection • emergency stop facilities • point set and locked indicators • rolling stock UIC 660 • STIs EEC 96/48/EC • Train detection UIC512/ UIC533	• Point transmission of speed profile • Closing air conditioning vents on entering a tunnel • Raising/lowering pantographs • Switching supply voltages	• Continuous transmission of speed profile • Indicating entry/exit HSL • Closing air conditioning vents on entering a tunnel • Raising/lowering pantographs • Switching supply voltages	• Continuous transmission of speed profile	• See TBL
Interoperability EUD 96/48/EC	N	N	N	N
Use	• Belgium-Germany (TBL2/3 in service 2002) • Use for Brussels-Dutch border under discussion	• Nord-Europe LN3 Paris-Lille • Rhône-Alpes (plan)	• Hannover-Würzberg (280 km/h?) • Mannheim-Stuttgart (280	

Requirements (ERC)	TBL	TVM 430	LZB	ATB 1 (ATB-NG)
	• Brussels-Lembeek (june-2000)	• Channel Tunnel • New Sud-Est (construction)	km/h?) • Köln-Frankfurt (300 km/h)	
Finance[3]				
Investment costs/km				
Maintenance costs/km				
Investment costs train devices				
Safety Level				
• Train-train collisions, points: $2x10^{-10}$/year • Unavailability point <0.001 • Defective points leading in the wrong direction <0.03				
Technology				
Signalling		• Inductive loop • Frequencies: 1700 + 2300Hz (tr1), 2000 + 2600Hz (tr2) • 27 separate audio frequencies • UM71 track circuits, electrically separated	• Inductive loop	
Systems		• Motorola 68020 • ADA • Trackside boxes every 15 km		
Con's	- Little use, small market - Not EEC interoperable - No experience with 300 km/h	- strong relation between train characteristics and control of infrastructure; only one braking curve - not optimised for mixed traffic, trains, speeds. - Not EEC interoperable - Technology	- Not EEC interoperable - No experience with 300 km/h - Introduces extra transition with Belgium	- Not EEC interoperable - ATB 1e not suited for high speeds. ATB-NG no experience with high speeds, limited command set.
Pro's	+ technology comparable to EEC + Already needed for trains Paris-Asd + Might smoothen the	+ Extensive experience + Already needed for trains Paris-Asd		+ technology comparable to EEC + combination with TBL possible (ATBL).

[3] Financing and risks not accounted for

Requirements (ITO)	TBL	TVM 430	LZB	ATB / ATB NG
	transition at the border if choosen at both sides + Combination with ATB possible (ATBL)			