

**Ministry of Transport,
Public Work and Water Management
Passenger Transport**

**Noise Innovation Programme
for
Road and Rail Traffic
2006 – 2007**

Revision of the programme

Imprint

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Summary

The Noise Innovation Programme (IPG) was launched three years ago and runs until the end of 2007. The programme focuses on national roads and railways and is intended to make more solutions available to tackle noise nuisance and to halve the costs of the necessary noise measures. A number of IPG projects have been very successful. Products such as two-layer porous asphalt, the rail damper, barrier tops and acoustic grinding were delivered in 2005. They are already being used by ProRail and the Rijkswaterstaat (RWS) [Directorate General for Public Works and Water Management], among others, in development projects and are producing cost savings and better social acceptance.

Not everything is going according to the original plan, and so the IPG is being revised. For some time now, there has been a capacity deficit at the RWS, resulting in a backlog. On the railways, because of the large scale, it has not been possible to start the programme to its full extent. In addition, there have been a number of developments which make some projects or parts of them appear less worthwhile. At the same time new opportunities are presenting themselves. Finally, the implementation of source measures in respect of vehicles has not taken off satisfactorily.

For road traffic, the revised IPG puts greater emphasis on road surfaces and tyres. For road surfaces, the main focus is on improving two-layer porous asphalt and the release of thin surface courses. International lobbying for quiet tyres is intensifying, and at national level we are operating closely with the leaders in the sector.

Following the revision, the main focus for rail traffic will be on the retrofitting of existing noisy rolling stock. In order to manage this, it is necessary to develop financial instruments in addition to legislation and technology. IPG resources will be used to develop and finance a noise-dependent user fee. In addition, two projects involving the recently released LL brake blocks are being added to the IPG. Because of the low retrofitting costs and the big reduction in noise, this brake block seems to be the solution for tackling the noisy fleet of freight wagons.

The revised IPG fits in with the available financial resources. As a result of the revision, the IPG is more effective because it focuses more strongly on the desired result in 2007. Some of the projects result in products which can be used immediately. Other projects result in products which still have to be developed further. The IPG is expected to achieve the targets, including the availability of measures which will lead to a halving of costs. This halving will only be achieved, however, if the process of implementing quiet tyres and the retrofitting of noisy trains actually take off. Even after the IPG, it is expected that further efforts will be necessary to achieve this. If the vehicles do not become quieter, there will still be a saving of 20 to 40%.

Summary

1 Introduction

2 The revision of the Noise Innovation Programme

- 2.1 The object of the Noise Innovation Programme
- 2.2 Project criteria
- 2.3 The relationship with policy
- 2.4 Progress and first results
- 2.5 Reason for revising the programme
- 2.6 Summary of the result of the revision of the programme for road traffic
 - 2.6.1 Overview of projects
 - 2.6.2 Tyres and vehicles
 - 2.6.3 Road surfaces
 - 2.6.4 Barriers
 - 2.6.5 Relationship between the IPG and other programmes such as the IPL
 - 2.6.6 Overview of anticipated results
- 2.7 Summary of the result of the revision of the programme for rail traffic
 - 2.7.1 Overview of projects
 - 2.7.2 New prospects for through-lines
 - 2.7.3 Overview of anticipated results
- 2.8 Communication
- 2.9 Financial overview of the entire 2006-2007 programme
- 2.10 Return from the IPG

Annex A. The revised IPG Road Traffic

- A.1 Developments and reason for revision
- A.2 Approach to the revision
- A.3 The broad outlines of the revision of the programme
- A.4 The projects of the revised programme
- A.5 The period after the IPG

Annex B. The revised IPG Rail Traffic

- B.1 Developments
- B.2 Approach to the revision
- B.3 Result of the prioritising
- B.4 The changes compared to the original programme
- B.5 The projects and financial data of the revised programme
- B.6 The period after the IPG

Annex C. Project plans for road traffic

Annex D. Changes for road traffic compared to the original programme

Annex E. Project plans for rail traffic

Annex F. Mile-post planning for road traffic

Annex G. Mile-post planning for rail traffic

1 Introduction

The Noise Innovation Programme for road and rail traffic was introduced and published in June 2002 by the Ministry of Transport, Public Work and Water Management (V&W), in cooperation with the Ministry of Housing, Spatial Planning and the Environment (VROM). This concluded the phase during which the innovation programme was drawn up. A few promising projects had already started before June 2002, and since then many more projects in the innovation programme are in progress. The programme runs until the end of 2007.

A great deal of experience of innovation has been acquired in the course of the programme. In addition, the world outside the programme has not stood still. Finally, there have been a number of things that, when implemented, went differently from what was anticipated. All this gives cause for revising the programme.

This report describes the revision of the Noise Innovation Programme. The IPG as a whole is described in chapter 2. Annex A sets out further details of the road traffic section, with annex B doing the same for the rail traffic section. The project plans for road and rail are set out in annexes C and E respectively. Annexes F and G provide the milestone planning for road and rail respectively. The difference compared to the original IPG is explained in detail in annex D with regard to road traffic. For further background, refer to the original plan from 2002. Furthermore, the financial data for 2006 and 2007 forecasts and for spending from the past are indicative figures. Details of the precise financial responsibility can be found in the progress reports on the IPG.

2 The Revision of the Noise Innovation Programme

2.1 The object of the Noise Innovation Programme

The reason for the Noise Innovation Programme is the awareness that the current means of reducing traffic noise are inadequate to cope with current and future noise standards. On the one hand, these means, which consist mainly of noise barriers and sometimes even tunnels, are so expensive that tackling the noise problem is threatening to become prohibitive. On the other hand, noise barriers are often undesirable in environmental terms because of the visual nuisance they cause.

The object of the Noise Innovation Programme is to introduce a series of new means and methods for reducing road and rail-borne noise. Together, these will result in a halving of the costs and less visual nuisance than the current arsenal of available measures¹.

Innovation means “introducing something new”. Consequently, the emphasis in this programme is on ensuring that new measures and methods are going to be used. The emphasis therefore is not on creating new inventions, but on inventions which, having already been created, are to be made ready for large-scale practical application.

2.2 Project criteria

The Noise Innovation Programme consists of a set of coherent and closely defined projects. It is not, therefore, an open subsidy programme. Nevertheless, there is some flexibility in the programme to make adjustments. This general revision of the IPG is an example of this. It is important that, when any change is made, the objects of the IPG should apply as preconditions. Accordingly, five criteria have been drawn up, which are closely related to the objective of the IPG outlined above. Two of these are concrete requirements and three are goals. The projects relating to new measures which are proposed in this revised IPG have been evaluated in this way². In addition, new ideas for amending projects are first examined in the light of these criteria. A project does not need to have a perfect score on all criteria. What is more, there may be other reasons for bringing a project within the IPG. Hence, the cohesion of the entire programme is very important. Finally, the IPG management consultation decides on the composition of and possible changes to the IPG.

Requirement 1: Cost-effectiveness: There must be solid evidence that the project will deliver a product that will result in a saving on the costs of noise measures which are necessary under the Noise Pollution Act for national roads and for main railways and railway yards.

Explanatory note: It relates particularly to measures which reduce the noise level in dwellings, determined in accordance with statutory methods, and which cost less than noise barriers which have a similar effect.

Requirement 2: Applicability: The product must be widely applicable. The intention is that it should be possible for the product to be used in at least 5% (expressed in kilometres infrastructure length) of all situations where noise measures are necessary³.

Explanatory note: The intention is that the products developed should not be for

¹ Measures at source in particular will lead to cost savings.

² In addition to projects on new measures, there are also a number of back-up projects. The criteria formulated here are not suitable for them. The value of these projects for the IPG must be assessed separately by examining what they deliver for the other IPG projects and how they contribute to the objects of the IPG.

³ In general, measures relating to vehicles such as private cars and trains have a noise-reducing effect on 100% of the network.

exceptional situations. For the aforementioned 5%, the product must be technically feasible and attractive compared to conventional barriers.

Goal 1: Application in practice: The product must already have been developed to a certain extent so that testing in a real situation on a road, railway or yard over a period of two years is possible within six months.

Explanatory note: This means that the laboratory phase is already over and prototypes must be available so that the product can be tested by the IPG in real life.

Goal 2: Release: It is desirable that the project result should provide information for reaching a decision about the release of the product for use on roads or railways.

It is preferable for the IPG to deliver end products, that is measures which can really be applied.

Goal 3: Social acceptance: The expectation must be that the product will be more acceptable socially than the current measures.

Explanatory note: This means that, unlike barriers, the product should not encounter major objections on the part of local inhabitants because they have a negative effect on the everyday environment.

2.3 The relationship with policy

The revised IPG fits in well with current national policy as expressed in the NMP [National Environmental Plan], the Memorandum on traffic emissions and the Memorandum on mobility, among others. It also fits in with EU policy, which is increasingly focussed on tackling the source.

Changes in the noise regulations will lead to different responsibilities for the managers of government sources. The possible introduction of noise production ceilings and implementation of the EU directive on environmental noise come to mind. Here, noise also becomes an aspect that plays a role in the orderly management of the infrastructure. The source managers will need the measures and methods delivered by the IPG in order to carry out these new tasks effectively.

2.4 Progress and first results

The first practical results from the IPG were presented in Breda on 18 April 2005 by the responsible government ministers, Minister Peijs and State Secretary van Geel. This was the presentation of four new measures aimed at making the infrastructure quieter. The measures concerned were two-layer porous asphalt, barrier tops, rail dampers and acoustic grinding. The two-layer porous asphalt and rail dampers have been used in the meantime⁴ as alternatives to noise barriers with the implementation of the Noise Pollution Act. All four are being used in the preparation of a large number of implementing projects⁵. It is also clear that these measures will lead to cost savings compared to the noise barriers, which would otherwise be required, and to greater acceptance on the part of local inhabitants.

The IPG has also seized upon new opportunities which have arisen. For example, the projects on thin surface courses, modular noise barriers, prefabricated rail dampers and the so-called LL brake blocks have been added to the IPG during the implementation phase.

⁴ The rail dampers in Breda and the two-layer porous asphalt on various national roads.

⁵ *Inter alia*, two-layer porous asphalt in the Emergency Act B projects, renovation with rail dampers in Twello, acoustic grinding on the High Speed Rail Link – South and rail dampers on the Zeeland line and in Rotterdam on the High Speed Rail Link – South.

It should be pointed out that the source reduction in vehicles, which is the aim of the IPG, has not got off the ground. This is worrying because it is precisely these measures that are the most cost-effective. The number of parties involved and the fact that the problems are not only of a technical nature mean that it is difficult to make rapid progress. The projects intended to lead to quieter tyres on cars on Dutch roads have, as yet, produced few results. As regards rail, while the IPG shows with the whispering train that the techniques are available, the rail operators and carriage owners do not have any incentive to make their stock quieter.

It is therefore possible that the necessary technical measures will be available at the end of the IPG, but the actual source reduction in vehicles will not have taken off. Nor will the desired halving of costs have been achieved, because there remain only the cost savings as a result of infrastructure-related measures. According to current expectations, there will only be a limited cost reduction of 20 to 40%. This forecast takes into account developments in the market with the take-up of the new measures in greater volumes. In addition, in the case of rail, the effectiveness of one of the measures, acoustic grinding, only works when measures are taken at source on the vehicles⁶. In the vehicle sector, potentially big cost reductions are possible. Scenario studies carried out by the Dutch railway network have revealed that savings of the order of € 500 million to € 1 billion are possible with retrofitting of rolling stock. In addition, savings of € 300 to 400 million appear to be possible with the use of quieter tyres.

Finally, the programme appears to be behind the initial planning. In the case of road traffic, there has for some time now been talk of a capacity deficit, which has led to some sections of the programme being deferred. The start has been difficult for rail traffic. This is partly because the financing of new structures which are still working has had to be shaped between the DGP [Directorate General for Passenger Transport] and the rail sector. In addition, it was a while before the IPG was actually able to attract the interest of operators. All in all, it was a very long time before applications for decisions regarding projects were submitted. This situation has since changed, and the rail sector is actively involved in implementing the IPG through, among other things, IPG-industry consultations.

2.5 Reason for revising the programme

The backlog built up compared to the original IPG is the reason for re-analysing the arrangement in relation to the objective. What is more, implementation of the IPG has reached the halfway stage which is a natural point at which to re-examine the programme. In addition, there are a number of new developments which give cause for revising or halting projects or for adding new ones. At the management consultation on 17 December 2004, therefore, the IPG was given the task of clarifying which projects should be given priority, what can be delivered in 2007 and what are the consequences of projects which are not being continued or are being continued in a different way. This task resulted in a proposal for revising the IPG, which was discussed at the management consultation on 9 September 2005. This revised IPG has been drawn up on the basis of that proposal.

2.6 Summary of the result of the revision of the programme for road traffic

2.6.1 Overview of projects

⁶ This acoustic grinding can only be used on railway lines on which only modern quiet passenger trains run.

The main layout of the programme has not been changed for road traffic. However, projects have been cancelled, added or re-organised on the basis of the criteria set out in section 2.2.

Knowledge and facilities, quiet road surfaces, quieter vehicles, screening and promoting implementation are the cornerstones of the programme. The figure below sets out all the projects within these cornerstones of the revised IPG Road Traffic.

Genuinely new subjects compared to the original IPG are:

- thin surface courses
- modular barriers

In addition, the following subjects have been dropped completely:

- dense surface courses
- the third-generation road surface “away with noise”
- innovative vehicle technology
- the anti-noise barrier
- a number of back-up activities which provide little for the IPG (see annex C).

Finally the activities concerning the third-generation road surface “modieslab” are being cut back.

Noise innovation programme – roads

cornerstones	up to 2005	projects	2006-2007
1. Knowledge and facilities		1.1 Knowledge management 1.2 Methodology for completion inspection of quiet road surfaces (robust CPX method) 1.3 Monitoring of quiet road surfaces	
2. Quiet road surfaces	2-layer porous asphalt thin surface courses third-generation road surfaces super-quiet road surface	2.1 Release of 2-layer porous asphalt for wide use 2.2 Improvement of 2-layer porous asphalt 2.5 Release of thin surface courses for wide use 2.6 Roll Pave demonstration 2.7 Modieslab demonstration 2.8 Quiet Transport demonstration 2.9 Acoustic optimisation of quiet road	
3. Vehicles		3.1 International regulations and type testing 3.2 National regulations and incentives	
4. Screening		4.2 T barrier tops 4.3 Central reservation and verge barriers 4.4 Modular barriers 4.5 Methodology for generic tops 4.1 Anti-noise barrier	
5. The policy promoting Communication implementation		5.1 Promotion of implementation. and dissemination of knowledge	

2.6.2 Tyres and vehicles

Tyres and vehicles have the potential to make a substantial contribution to reducing noise emissions from the national infrastructure. If the entire vehicle fleet ran on quieter tyres, the reduction could amount to 2-3 dB. This would result in a saving of 300 to 400 million euros on the cost of noise measures for national roads in the period 2010-2020. Quiet tyres are available in virtually all tyre sizes. What is more, they are not any more expensive and they perform just as well as other tyres in terms of safety. However, the said reduction of 2-3 decibels is not achievable within the term of the IPG. Nationally, the IPG is making every effort to promote quiet tyres and, internationally, to tighten up the relevant noise requirements and test methods. If this effort is continued after the IPG, this may result in the aforementioned reduction of 2 to 3 decibels being achieved by 2020.

It is well known that the EU and UN/ECE regulations relating to noise emissions from vehicles and tyres are not aimed as limiting noise emissions but focus more on harmonisation and interoperability. The efforts of the Netherlands must be to obtain more balance in the aims of the EU and UN/ECE working parties concerned so that noise reduction becomes a target in addition to harmonisation. This also applies to the testing procedures for establishing noise emissions. The IPG work in this field lies mainly in structuring and organising the Netherlands efforts in the relevant working parties and lobbying. Efforts here focus on making it clear that quiet tyres lead to big cost savings and environmental improvement. The result must be that the tightening-up of the noise standards announced in the tyres directive is actually going to take place.

National developments concerning the use of quiet tyres provide for an incentive. After it emerged that an industry-wide approach is not producing the desired result, it was decided to establish agreements with the 'leaders'. Firms which are involved in the replacement market are prepared to establish agreements concerning the sale and use of quiet tyres. Kwik-Fit, Profile, Euromaster and LeasePlan want to contribute to the wider use of quiet tyres in exchange for communication facilities. In addition, the Rijkswaterstaat (which controls government vehicles) wants to be involved in showing that the government uses the most environmentally friendly techniques. As yet, arrangements have been made for an agreement to be signed in March 2006 by the parties concerned and State Secretary van Geel and Minister Peijs. To this end, the aforementioned leaders presented a declaration of intent to the two Government ministers in November 2005. Over the coming period, efforts will focus on properly maintaining the list of tyres with noise performance, communication and monitoring of the available sales data. A comparable course is proposed for lorries.

2.6.3 Road surfaces

Quiet road surfaces are increasingly becoming the spearhead of the IPG road traffic programme, firstly because they are cost-effective source measures and, secondly, because it is possible in the short term to make these road surfaces ready for implementation on a large scale by means of targeted activities. For quiet road surfaces, the focal point is the improvement of two-layer porous asphalt and the release of thin surface courses.

The release of two-layer porous asphalt for use as a noise measure in the construction of new roads and the renovation of existing roads, which happened in spring 2005, gives potential savings of at least 200 million euros.

Currently, there are still a number of points on which two-layer porous asphalt can be improved. A further development phase for two-layer porous asphalt is essential in

order to realise the IPG objective. In the project on improved two-layer porous asphalt, efforts are being made to improve the following points:

- A. Initial skid resistance
- B. Life
- C. Obstacles to laying
- D. Acoustic life
- E. Overall evaluation of the state of affairs in 2007

Improving the life of two-layer porous asphalt will lead to lower costs for management and maintenance and thus to bigger savings. In addition, the improvement in laying possibilities will lead to wider use and hence possibly more savings. Acoustic optimisation of two-layer porous asphalt will be able to increase its cost-effectiveness even further.

Thin surface courses in particular have the potential to be a cheaper alternative to porous asphalt. After release in 2007, thin surface courses will be able to be used as an alternative to porous asphalt on a significant scale. Possibly, the best thin surface courses will be usable as an alternative to two-layer porous asphalt.

The third-generation quiet road surface Rollpave, which will be demonstrated in 2006 in the context of the IPG, is expected to become available for use in the period 2007-2010. After scaling-up, Rollpave is expected to have a cost-effectiveness which is slightly better than that of two-layer porous asphalt. Constant quality, lack of dependence on the weather and speed of construction in particular are expected to be able to meet a great many requirements. The introduction of Rollpave onto the market is expected to lead to a limited cost reduction at network level, as the measure is a substitute for two-layer porous asphalt.

Third-generation quiet road surfaces with reductions of 7 to 9 dB(A) are a stage quieter than two-layer porous asphalt in acoustic terms. These road surfaces cannot be used to any degree on a significant scale until about 2015. The IPG intends demonstrating such road surfaces at a test site, where there is at least one with a 9 dB(A) reduction. Linked to this, an acoustic road-surface design tool is being made available. Combined, this should lead to a greater initiative in the market for further development of these super-quiet road surfaces. These road surfaces with higher noise reductions also entail higher costs for laying and maintenance. Cost-effectiveness is expected to be at least the same or higher than with two-layer porous asphalt.

In view of the early introduction of two-layer porous asphalt and the development phase of the other quiet road surfaces, the intensive monitoring of quiet road surfaces still seems to particularly advisable. It is expected that, (partly) on the basis of the gradual insights resulting from this monitoring, it will be possible for the characteristic values for life, noise reduction and cost-effectiveness, which are applied for two-layer porous asphalt, to be favourably adjusted.

With the growing share of quiet road surfaces, the noise reduction aspect is becoming increasingly important in the acceptance testing. So that the acceptance testing of quiet road surfaces can be carried out in a satisfactory manner, it is necessary to have access to a robust CPX method. The CPX method allows the testing of noise performances without the need to close off roads (which disrupts traffic).

A number of back-up research and development activities appear to be marginal to the field which is relevant for the IPG. These are being stopped.

A very indicative estimate of the potential savings from quiet road surfaces is of the order of 500 million euros (in the period 2006-2020).

2.6.4 Barriers

The current projects on more effective screening will be wound up in the first quarter of 2006. These concern modular barriers, T-tops and central reservation and verge barriers. Expectations concerning cost-effectiveness and technical feasibility are very uncertain for anti-noise. The anti-noise project has been halted because of these uncertainties.

In order to stimulate innovation regarding barrier tops, a project is being started in 2006 which is intended to produce an evaluation method for generic barrier tops. A study of the cost-effectiveness of all barrier innovations is currently under way.

A very indicative estimate of the potential savings from more effective barriers is of the order of 100 million euros (in the period 2006-2020).

2.6.5 Relationship between the IPG and other programmes such as the IPL

In addition to noise nuisance, the IPG addresses the subjects of air pollution, innovation and road surface policy. There are a number of research programmes under way at the DWW [Roads and Hydraulic Engineering Agency] concerning these subjects, such as the Air Innovation Programme (IPL), Roads to the Future, the (normal) research and consultancy programme of the Rijkswaterstaat (National Executive Tasks – dry land).

In addition, programmes regarding noise on the secondary roads network, such as PIEK and the Incentive Scheme for Quiet Road Surfaces, are being run at the V&W and VROM Ministries respectively. At a European level, there are programmes such as Sylvia, Harmonoise, Imagine and Silence. In Germany meanwhile, the Leiser Verkehr programme I has been completed and Leiser Verkehr II is starting up. Research programmes regarding noise are under way in various other European countries on a more limited scale.

There are contacts between the IPG and the aforementioned programmes and projects, for example at conferences. Hence, the developments are being followed and compared with the activities of the IPG, and action is being taken when that is desirable for the IPG.

Cooperation with IPL and Roads to the Future (WnT) is closer than merely following developments. This is examined below.

The innovations resulting from the WnT programme, such as Modieslab, Rollpave and Quiet Transport and the Noise Barrier are being examined further as part of the IPG. The coordination between the IPG and the IPL concerns aspects such as rolling resistance, effects of barriers on air quality and the effects of cleaning porous road surfaces on fine dust.

The aspects are examined briefly below:

- The effect of quiet road surfaces on air quality as a result of any higher rolling resistance is being examined by the IPG. The study shows that the quiet road surfaces that have been developed and are being developed are not expected to have a higher rolling resistance than non-porous or porous asphalt.
- The effect of IPG barrier innovations on air quality is being examined as part of the IPL.
- If research currently being carried out within the IPL shows that barriers have a significant effect on air quality, then the question of whether possible joint follow-up studies by IPG and IPL are desirable will be examined.

- The effect of cleaning porous road surfaces on fine dust is being examined as part of the IPL.

2.6.6 Overview of anticipated results

The following table outlines for each project the result that is expected at the end of the IPG. Taken together, these results are expected to mean that the IPG targets will be achieved. The only uncertainty concerns the exact scale of the cost saving. The target was to halve costs. Now, however, the result of the projects concerning quiet tyres has been adjusted downwards. On the other hand, the savings resulting from thin surface courses had not been foreseen at the time, and the savings as a result of the two-layer porous asphalt are higher. A substantial cost saving is still expected, but this will possibly be less than a halving. The halving of costs will be achieved if the introduction of quiet tyres proceeds after the IPG, so that a two-decibel reduction is achieved by 2020 at the latest.

Table: Projects of the adjusted IPG Road Traffic and the anticipated results. The shaded projects are already finished before 2006.

project		result
1.1	Knowledge management	audits by the scientific board
1.2	Robust CPX method	methodology for evaluating quiet road surfaces (<i>inter alia</i> on completion and maintenance)
1.3	Monitoring of quiet road surfaces	monitoring data from quiet road surfaces
2.1	Release of 2-layer porous asphalt	release of 2-layer porous asphalt for use on national roads
2.2	Improvement of 2-layer porous asphalt	availability of improved products (skid resistance, life, durability of noise reduction, no longer any laying restrictions) on the market
2.5	Thin surface courses	release of thin surface courses for main roads
2.6	Roll Pave	demonstrable: 1 test section on a national road
2.7	Modieslab	demonstrable: 1 test section on a national road
2.8	Third-generation road surface Quiet Transport	demonstrable: 1 test section on a national road
2.9	Acoustic optimisation of quiet road surfaces	demonstrable: super-quiet road surface on test site
3.1	Quieter vehicles and tyres: International regulations	tightening-up of the noise requirements for tyres and vehicles
3.2	Quieter tyres: National encouragement	agreements with specific target groups about promoting quiet tyres
4.2	T barrier tops	release of T barrier tops for use along national roads
4.3	Central reservation and verge barriers	release of central reservation and verge barriers for use along national roads
4.4	Modular noise barriers	availability of modular barriers for use along national roads
4.5	Generic barrier tops	system for evaluating generic barrier tops suitable for calculation regulation
5	Promotion of implementation, communication and dissemination of knowledge	various activities to promote the use measures released by the IPG, including the newsletter, website, innovation platform

The table shows that a few products will not be finished by the end of 2007. If they offer sufficient attractive prospects, on the basis of IPG testing, they must be further developed before there can be any question of release for use on national roads. The following products are concerned: Roll Pave (project 2.3.2), quiet transport (project 2.3.1) acoustically optimised, super-quiet road surface (project 2.4.1), international encouragement for quiet tyres and vehicles (project 3.1), national encouragement for quiet tyres (project 3.1). In addition, a follow-up shot at improving two-layer porous asphalt is desirable.

2.7 Summary of the result of the revision of the programme for rail traffic

2.7.1 Overview of projects

During the revision of the programme for rail, no reason was found to change the structure of the programme. The revision of the programme consists mainly in cancelling and adding projects. To a considerable extent, these are motivated by new technical possibilities and the finding that insufficient rolling stock is being modified. Therefore, new projects are proposed for the 'Through rail traffic' and 'Promoting implementation' sections. The figure below shows the structure and the projects of the revised IPG for rail traffic.

Noise innovation programme – rail

cornerstones		projects	
		up to 2005	2006-2007
1. Knowledge management and facilities		1.1 Information centre	
		1.2 Noise registration from a fixed measuring post	
			1.3 Monitoring instrument for track roughness
2. The technical policy for through rail traffic	Phase 1: Acoustic renovation of noisy trains	2.1.1 Retrofitting of braking systems of noisy passenger trains	
		2.1.2 Retrofitting of braking systems of freight trains with K blocks: the Whispering train	
			2.1.3 Testing LL blocks on freight wagons
			2.1.4 Retrofitting of braking systems on freight train with LL blocks: the Auto-train
	Phase 2A: Promising measures on existing rail structures	2.2.1 Rail dampers (finished)	
		2.2.2 Reduction of rail roughness (finished)	
	Phase 2B: Supplementary measures on trains	2.3.1 Wheel dampers and skirts on freight trains (= section Whispering train 2.1.2)	
3. Yards		3.1 Integral design model yards: innovative yard	
			3.2 Lasting solutions for curve squeal noise
			3.3 Covering-over of diesel tracks
			3.4 Simultaneous implementation of processes
			3.5 Parking under cover
4. The policy promoting implementation		4.1 Test of prefabricated rail dampers	
			4.2 Incentives for use of quiet stock
		4.3 European lobby	
		4.4 Cyclical study of freight stock	

New subjects compared to the original IPG are:

- testing of LL blocks
- monitoring instrument for track roughness
- test of prefabricated rail dampers
- cyclical study of freight stock

- financing of a noise-dependent tax on infrastructure use

The following subjects and projects have been cancelled:

- active damping of steel railway bridges
- wheel dampers and skirts for passenger trains
- phase 3 measures (extra smooth wheels and track as well as mini-barriers and skirts)
- loc 6400 ED brakes to zero
- perceptions study for railway yards

2.7.2 New prospects for through-lines

Technical developments have created a new outlook on phase 1 of the section 'Through rail traffic'. A relatively large part of the available budget in the revised programme is intended for this section. These are projects where the use of so-called LL brake blocks is tested by means of life tests with regard to life-cycle costs, possible defects, safety aspects and, of course, limiting noise emissions. The LL brake blocks can be used on existing freight stock and give a noise reduction of approximately 7 dB(A). It is expected that large-scale use can be implemented on a cost-neutral basis or at low additional cost. If this measure is released, it is not only a very cost-effective measure but also a very effective measure in terms of noise.

The projects provide information which will be used in the follow-up stages for the release of the LL brake blocks at the authorisation bodies. It is important here to ensure that the information is contributed to international railway organisations such as the UIC and the ERA⁷. If necessary, these activities will be continued after completion of the IPG programme at the end of 2007.

The second priority of the revised programme for rail follows from the finding that the retrofitting of rolling stock, in particular, is not being implemented satisfactorily. In addition to legislation and (international) regulations, it is necessary to develop financial instruments. For this reason, the section on 'Promoting implementation' has been extended with a project in which financial instruments are developed. The project consists in providing the foundations for the effectiveness of price incentives, the control mechanisms and instruments, the statutory preconditions and such like. The project will produce an implementation plan for the introduction of a noise-dependent user fee. This project requires close cooperation between the Ministries of V&E and VROM and ProRail. If an effective noise-dependent user fee is introduced, a part of the IPG budget will be used via the user fee to promote the use of quiet stock. Price differentiation in the user fee on the basis of noise aspects cannot be introduced before 2007.

The IPG for rail traffic has been modified further in sections with some projects being cancelled, some projects having already been completed and a large part still being implemented. The figure below indicates which sections of the original plan have been completed in the meantime, which are being implemented and which have been cancelled.

knowledge management	
knowledge infrastructure	permanent measuring posts

⁷ European Railway Agency, for more information see http://europa.eu.int/comm/transport/rail/era/index_en.htm. The UIC is the International Union of Railways, for more information see <http://www.uic.asso.fr>

through rail traffic				yards
noise approx. 6 dB(A)	approx. 100 diesel trains	class 1		
	approx. 1200 passenger trains and all freight trains	class 2	Phase 1: modify braking systems of noisy trains	integral design of model yards
	approx. 1200 passenger trains and prototype freight trains	class 3	Phase 2A: reduce rail roughness and rail dampers	
	a few prototypes	class 4	Phase 2B: skirts on trains and wheel dampers	tackling yards in practice
	no trains	class 5	Phase 3: option 1: further reduction in rail and wheel roughness; option 2: skirts combined with mini-barriers	perceptions study of yards
	active damping of steel railway bridges		speed factual booklet ballast-less track	Loc6400; ED brakes to zero
Promoting implementation				
legislation and regulations		capacity management		European lobby

- Section has been completed
- Section is being implemented
- Section has been cancelled

2.7.3 Overview of anticipated results

The following table sets out for each project the result that is expected at the end of the IPG. Taken together, these results are expected to mean that the IPG targets will be achieved. The only uncertainty concerns the exact scale of the cost saving. The target was to halve costs. Now, however, it appears that the actual introduction of quiet technologies on the existing noisy train stock is not being implemented satisfactorily. On the other hand, projects with the cheap LL brake blocks and a project intended to lead to a noise-dependent user fee have been added to the revised IPG. If these projects result in the retrofitting of the braking systems of all noisy passenger trains and all noisy freight wagons, a saving of approximately 80% is expected. That would be a saving of € 500 million to € 1 billion on installation and maintenance costs for noise barriers. To achieve this, it is very important to invest in the development of new policy instruments, such as a noise-dependent user fee. If the introduction of this modification does not get off the ground, the savings will remain stuck at approximately 20%

Table: Projects of the revised IPG for rail traffic and the anticipated results. The shaded projects are already finished before 2006.

Project		Result
1.1	information centre	data bank on noise available for authorities, consultancies and railway operators
1.2	measuring posts	operational network of five measuring posts and monitoring data collected by this means from the IPG trains, among others
1.3	monitoring instrument for track roughness	availability of a monitoring instrument for acoustically ground track
2.1.1	retrofitting of braking systems of noisy passenger trains	release of a technique to make noisy passenger trains 7 decibels quieter; a few trains with which this is demonstrated (7 decibel reduction)
2.1.2	the Whispering train (K-blocks)	one train in commercial service with K blocks (7 decibel reduction)
2.1.3	Test of LL blocks on freight wagons	testing of LL blocks, supply of information for release of LL blocks (7 decibel reduction)
2.1.4	the Auto-train (LL blocks)	testing of LL blocks, supply of information for release of LL blocks (7 decibel reduction)
2.2.1	rail dampers	release of rail dampers (3 dB)
2.2.2	acoustic grinding	release of acoustic grinding (3 dB)
2.3.1	Skirts and other secondary measures	demonstrated once on prototype
3.1	innovative yard	agency research into quiet yard
3.2	curve squeal noise	testing of new type of rail for curves, supply of data for release
3.3	covering-over of diesel tracks	testing of covering-over of a yard as a noise measure
3.4	simultaneous implementation of processes	experience with modifications to work and logistical processes as a noise measure
3.5	parking under cover	experience with modifications to work and logistical processes as a noise measure
4.1	prefabricated rail dampers	reduction of cost price of rail damper
4.2	promoting the use of quiet stock	proposal for and financing of noise-dependent user fee; when introduced, a new instrument will be available for noise policy
4.3	European lobby	knowledge of and access to European decision-making and lobbying channels, official informal network of noise specialists from abroad
4.4	cyclical study of freight stock	examination of deployment of wagons by the freight transport market on the railways

The activities aimed at promoting quiet stock will have to be continued after 2007. If the aim is successful implementation of source measures on the stock, it is advisable to reconsider the R&D work for phase 3 (even smoother track and wheels as well as skirts and mini-barriers).

2.8 Communication

The starting points for communication concerning the IPG are described in the communication plan of the Noise Innovation Programme, as set out in the second progress report. There have been a large number of developments since (for these, see the progress reports).

The following things have been implemented and will be continued:

- The production of means of communication is largely undertaken by the individual organisation (VROM, DWW, ProRail, V&W policy centre).

- ‘Umbrella’ means of communication have been introduced: house style, newsletter, working visits, the Oscars days, standard text (see box) and the website.
- The IPG is actively presented as a cohesive set of projects for rail and road traffic to various target groups, including through the state-of-the-art booklet with all IPG innovations and at trade fairs and conferences.
- The CIPG (communication consultation) looks after planning, coordination and filling in the details of the communication campaigns. The content of the CIPG is directed by the core team.
- Presentation of the results at conferences at home and abroad and at various international organisations
- Working visits by government ministers and high-ranking officials, such as the working visits by van Geel on 16 February (A30 two-layer porous asphalt) and 16 March (rail dampers at Veenendaal), the visit by Peijs and van Geel to Breda (presentation of IPG successes) and the fitting of quiet tyres to van Geel’s official car under his supervision in November 2005, at which the industry leaders presented a declaration of intent.

*Standard IPG framework wording for use in external documents:

‘The quality of life in densely populated areas is under pressure, in part because of the increasingly intensive use of our infrastructure. In addition, economic growth and population increase have created a great need for new infrastructure. In order to protect the quality of life in residential districts, the Netherlands has established noise standards. Even managers of national roads and railways have to comply with these. This has far-reaching consequences for the development of new residential districts and infrastructure in an inhabited region. The installation of more noise barriers is gradually becoming prohibitive, and society’s resistance to them is increasing. Therefore, alternatives are being sought. The IPG is responsible for practical testing and implementation of source measures. These concern the reduction of noise from motor vehicles, trains and infrastructure. The challenge for the IPG is to introduce a set of source measures which will produce a halving of the costs for noise measures and a substantial reduction in noise nuisance.’

The activities concentrate on regular information for (in particular) four target groups on the progress of the IPG, namely government members, internal organisation (management, policy workers, project leaders), market operators and the national press (selection of journalists). The aim is to retain and strengthen their commitment and positive attitude towards the IPG. Communication regarding the technical aspects of the innovations to various other target groups is taken care of within the projects themselves.

The first four IPG products were released for large-scale application in spring 2005. More products are expected to follow in 2006 and 2007. This is another good reason to make the successes of the IPG widely known. Over the next two years it is important to continue to promote the results with the (market) operators concerned.

The Ministries of Transport, Public Work and Water Management and of Housing, Spatial Planning and the Environment have expressed the ambition to follow up the successful working visit of the government ministers on 18 April 2005. It was successful because the ministers took an enthusiastic interest in positive news concerning four IPG projects – hence the attention of the national media (radio/TV/newspapers), which meant that a wide public was informed of the aims and the first successes of the IPG.

New elements to supplement communication are:

- Increase the working visits and PR events to, possibly, three or four a year
- The monthly publication of news clips under the name “IPG highlights”; these are a kind of “mini press reports” of short and small news items. The implementing organisations are responsible for production. It takes the form of an email newsletter (also as the “latest news” page on the IPG website), possibly with a link to geluidsnieuws.nl.
- Regular briefing of a group of journalists and press officers by the government ministers.
- To have an interactive model made with IPG products (the showroom) and to use this at demonstrations and meetings.
- Final demonstration in 2007 with market operators and road management and rail sector to promote use of the IPG measures and to provide a worthy conclusion to the programme.

2.9 Financial overview of the entire 2006-2007 programme

The following table sets out the financial overview for 2006 and 2007 and the available IPG funds.

section	2006		2007		2008		Total 2006-2007	
	fore-cast	available	fore-cast	available	fore-cast	available	fore-cast	available
general DGP: communication and project management								
RWS road traffic								
road traffic tyres and vehicles								
rail								

The available funds are in the budgets of DGP, DGTL and RWS. The table shows that the revised IPG fits into the total available budget. It is only necessary to shift money from RWS to DGP and VROM and from 2007/2008 to 2006/2007 both for road and for rail. At the same time, there is still some limited financial room to absorb risks, for example.

The total amount of the IPG for road and rail is therefore approximately 50 and 40 million euros respectively.

2.10 Return from the IPG

The return from the IPG can be expressed in environmental effect and cost reduction. A distinction is made here between the measures on the infrastructure and the measures on vehicles:

1. In many cases the IPG measures **on the infrastructure** mainly have a cost-reducing effect because they are used in situations where statutory standards must be achieved. These IPG measures thus ensure that the same standards are met but at a lower cost than with conventional barriers. Nevertheless, there will often be a favourable environmental effect locally because
 - Source measures on the infrastructure reduce noise levels for dwellings on the other side of the source and for high-rise buildings, whereas conventional barriers do not.
 - Source measures on the infrastructure may be regarded as cost-effective sooner than a barrier, and therefore can be used in situations where a conventional barrier is found to be too expensive.

2. The IPG measures **on vehicles** have a cost-reducing effect and an environmental effect throughout the country. These measures produce a reduction in noise levels even in places where there is no statutory requirement for a reduction. In places where conventional barriers would otherwise have to be used, these can now be lower or be omitted entirely.

In addition to the above, the IPG also results in changes in the laws and regulations and in the working method of organisations. These include, among others:

- Making calculation methods suitable for determining the effects of new noise measures.
- Adapting subsidy schemes for noise improvement measures and criteria for assessment of noise measures, so that the new noise measures are also included.
- The way in which ProRail uses financial instruments to influence the noise performance of operators.
- Making the test method stricter and tightening up international noise requirements for vehicles.

The following table gives rough estimates of the cost return and environmental return from the various sections of the IPG. The figures are based on recent research into the effects of noise production ceilings. The return from the IPG measures on yards cannot be properly quantified at present because of the complexity of this subject. However, in terms of quality it can be said that a cost benefit and favourable environmental effect are expected here too.

Section	Indication of maximum cost saving in the period 2008-2020	noise effect	environmental effect (on number of dwellings above preferred value in 2020)
<i>Measures on vehicles</i>			
tyres and vehicles	300 to 400 million	2 dB(A) per vehicle	25% reduction in number of dwellings above preferred value
retrofitting of noisy trains	500 million to 1 billion	7-8 dB(A) per vehicle	50% reduction in number of dwellings above preferred value
<i>Measures on the infrastructure</i>			
road surfaces	500 million	2-4 dB(A) compared to existing road surface (single-layer porous asphalt)	local improvement in affected situations with lower costs and greater acceptance
barriers	100 million	additional effect of 1-2 dB(A) compared to conventional barrier	local improvement in affected situations with lower costs and greater acceptance
rail dampers and/or grinding	200 million	approx. 2-4 dB(A) compared to existing track (continuous with concrete sleepers in ballast)	local improvement in affected situations with lower costs and greater acceptance

Annex A. The revised IPG Road Traffic

A.1 Developments and reason for revision

The first pleasing results of the IPG Road Traffic were 'reaped' in 2005. Since then the T-barrier tops have been extensively tested, and calculation rules for determining the acoustic effect are available and have been included in the Calculation and Measurement Regulation (RMV), and the release of two-layer porous asphalt for practical application on the national road network is a fact. In a short time other barrier innovations will be available for use at suitable sites along the road network.

So far a sum of about 16 million euros has been invested in research, development and testing within the road traffic IPG. The forecasts of the return from this investment look very good. In particular, the release of two-layer porous asphalt for use on the national road network where it is cost-effective will lead to a saving of several hundreds of millions of euros on the cost of noise measures. With barrier tops, modular noise barriers, central reservation and verge barriers becoming available, the number of available, cost-effective and socially acceptable solutions to the problems of noise is increasing. The progress on vehicles and tyres is more limited (see box). The difference between a very noisy and a very quiet tyre can amount to 7 decibels. On the basis of the current promises from market operators, a reduction of 0.1-0.5 dB is estimated by the end of 2007 for the entire road network. If the entire vehicle fleet were to run on quieter tyres, the reduction could reach the earlier target of 2-3 dB.

Developments regarding quiet tyres and vehicles

Little progress has been made on the desired developments at international level to raise the limits for (components of) vehicles and testing methods to an adequate level. The working parties concerned have focussed on harmonisation and interoperability and not on reducing noise emissions. In addition, the Dutch contribution has not been unequivocal. This concerns the input in working parties (ordinary and ad hoc) under the auspices of the EU, UN/ECE and ISO.

In addition to an undiminished contribution in the various working parties, the IPG will concentrate on lobbying to give more weight to the IPG targets in the working parties and to achieve a tightening-up of the noise requirements for tyres and vehicles. T&E will do this lobbying. However, it is also a matter of organising the Dutch contribution better. This means better direction for the Dutch representatives so that the IPG wealth of ideas is also spread in the international committees. Specifically, this means that the employees/representatives of V&W (including RDW), EZ [Ministry of Economic Affairs] and VROM must periodically discuss the input of the Netherlands in advance.

At national level, the efforts are focussed on establishing agreements with market operators. In July 2004 the industry promised the State Secretary for VROM that it wanted to conclude an agreement on promoting the use of quiet tyres. In the end this proved to be a set of arrangements without specific, quantitative data. The industry does not want to hand over any sales figures for monitoring the possible change in the use of quiet tyres. The industry expected vigorous efforts from the government to provide courses and publicity. In the end, a number of 'leaders' have been found who are prepared to establish arrangements with the government on the basis of sales figures. Kwik-Fit, Profile, Euromaster and Leaseplan will record that the use of quiet tyres will be promoted. The intention is to set down the arrangements in an agreement at the beginning of 2006. In November 2005 these parties handed over a declaration of intent on this to van Geel and Peijs. By way of follow-up, a plan is being drawn up for the national incentive programme. The plan will quantify the activities and the intended result in more detail and will outline the budgetary consequences. This plan will be presented to the IPG management consultation. In 2006 and 2007 efforts will concentrate on properly maintaining the list of tyres and the noise performance, communication and monitoring of the available sales data.

Progress on the IPG programme as well as increasing understanding based on research results, market developments (availability of thin surface courses as an alternative to porous asphalt), policy developments (the possibilities of using innovations in the context of boosting investment in the management and maintenance of road surfaces) and changing implementing organisations all provide reasons for evaluating the approach and projects of the IPG and adjusting them where necessary. The evaluation provides the reason for revising the IPG Road Traffic⁸ so that the objective can be achieved in 2007 with pleasing results.

A.2 Approach to the revision

The revision of the programme is based on a sounding of customer requirements (among the sponsors of the IPG; DGP and VROM). A brainstorming session was held on this on 3 February 2005 with participants from DGP, VROM and DWW to determine the priority of the IPG road traffic innovations. The starting point of the discussion was provided by the IPG milestones plan (from summer 2004). That milestones plan indicates the specific products of the IPG Road Traffic. This session resulted in a fairly unambiguous list. The projects relating to quiet vehicles and tyres have followed separate courses.

⁸ It had already been decided to re-define the IPG Rail Traffic at an earlier stage.

The starting points for revising the IPG Road Traffic are:

- the available funds for the IPG for Road Traffic⁹
- the scope (targets) of the original programme
- the conclusion of the programme at the end of 2007
- the feasibility of the programme
- the policy requirement for tangible, quickly applicable, source-targeted noise measures

To achieve the objective of the IPG, it is important to have access to cost-effective, widely applicable noise measures in as short a time as possible. Therefore, the following criteria were applied in the revision:

- Effectiveness: How many decibels of noise reduction does the measure provide?
- Cost-effectiveness: What are the costs per decibel of noise reduction?
- Applicability: To what extent is the measure widely applicable?
- Availability: At what point will the measure be suitable for use on or along the national road network?

The brainstorming session on 3 February 2005 produced a fairly unambiguous list. The order of importance of the various products is indicated below:

Product	Priority
Completion of release course for traditional 2-layer porous asphalt	PRIORITY 1: (VERY HIGH)
Optimisation of acoustic performance of 2-layer porous asphalt	
Pilot and release of thin surface courses	
Monitoring of quiet road surfaces	
Barrier top (T-Top variant)	PRIORITY 2:
Improvement of the life of 2-layer porous asphalt	
Improvement of the techniques for laying 2-layer porous asphalt	
The knowledge platform of the IPG Road Traffic	
Development and demonstration of road surfaces with 7-9 dB(A) reduction	PRIORITY 3:
Modular noise barriers	
Central reservation barriers	
Verge barriers	
Third-generation road surfaces: Rollpave	PRIORITY 4:
Third-generation road surfaces: Quiet transport	
Generic top	PRIORITY 5: (VERY LOW)
Third-generation road surface: Away with noise	
Third-generation road surface: Modieslab	
V&W noise model	
Anti-noise	

There are hardly any differences between policy (DGP and VROM) and implementation (RWS DWW). Traditional two-layer porous asphalt, thin surface courses, improvement of two-layer porous asphalt, acoustically optimised road surface and the T-Top score highly. Anti-noise, third-generation road surfaces and the V&W road-noise model are relatively low.

The revision also provides an opportunity to look at the usefulness of and need for the original IPG projects. The core team has the following picture of the priority of the IPG Road Traffic projects¹⁰:

- The products should be divided into groups with priority 1 to 5, where highest priority is given to the products in group 1 and the lowest to those in group 5.
- The products in the groups with priority 1, 2, 3 and 4 are necessary for achieving the objective of the IPG. The products with priority 4 will only be able to produce results in the longer term and so require further development after 2007. The products with priority 1 to 3 inclusive produce immediately usable results in 2007.
- The score of the products in the group with priority 5 is very low. This means that the contribution of these products to achieving the IPG targets in 2007 is expected to be negligible or very low.

For the three IPG projects relating to tyres and vehicles it has already been established that:

- the project on innovative vehicle technology has too many technical uncertainties and offers too little chance of actual implementation.
- the projects on national and international incentives for quiet tyres and vehicles have high priority in view of the availability of quiet technology and particularly high cost-effectiveness.

A.3 The broad outlines of the revision of the programme

The brainstorming session and thorough discussion in the core team and the contribution of the management consultation resulted in a revised programme. The main layout of the programme has not been changed for road traffic, but projects have been cancelled or added. Knowledge and facilities, quiet road surfaces, quieter vehicles, screening and promotion of implementation are the cornerstones of the programme. The broad outlines of all the projects in the revised IPG are set out in the following section.

The emphases have been shifted within the main structure, which has remained virtually the same. In the 2002 programme, research activities regarding the innovations were rather fragmented, and there was a relatively heavy emphasis on basic knowledge, development of methodology and procedural framework. The emphases have been shifted more to projects in which the work undertaken is entirely on the release and/or demonstration of innovative noise measures and to activities relating to the dissemination of knowledge, communication and promotion of implementation, which are necessary ultimately to get the innovations implemented. In this way all development of knowledge and methodology (still) being worked on within the IPG is directly related to the development, demonstration and/or implementation of the innovative noise measures. There are now clearer milestones for each of these projects (in accordance with the system of the milestone planning from summer 2004).

Changes regarding projects with a very low priority:

With generic barrier tops it is desirable to opt for an approach which puts the initiative on the market. The IPG is confined to establishing a calculation and measurement method, which can be used for every type of top, by analogy with the road surface types.

- Anti-noise has been halted because of the uncertainty regarding technical feasibility and cost-effectiveness.

¹⁰ As a result of this picture, the core team sent a letter to the members of the Management Consultation with a proposal for revising the programme and called on the members to submit comments through the members of the core team.

- Because of its minor relevance for the IPG, it is proposed to discontinue IPG support for development of the V&W road-noise model and thus to end it as an IPG project.
- In view of the uncertainties about the noise reduction and cost-effectiveness it is proposed the IPG should no longer continue to develop and/or test the third-generation road surface “Away with noise”.
- The research work for the third-generation road-surface design “Modieslab” is being cut back because there is little prospect of large-scale application as a noise measure. A test by developers at the Rijkswaterstaat in Utrecht is still being financed from the IPG because of current obligations, but limited manpower is being put on this. It is proposed that no responsibility should be taken for further development and implementation after the test. The research results will be available for the IPG.

A4. The projects of the revised programme

The following diagram shows all the projects within these cornerstones of the revised IPG for road traffic.

cornerstones		Noise innovation programme – roads	
		up to 2005	projects 2006-2007
1. Knowledge and facilities		1.1 Knowledge management	
		1.2 Methodology for completion inspection of quiet road surfaces (robust CPX method)	
		1.3 Monitoring of quiet road surfaces	
2. Quiet road surfaces	2-layer porous asphalt	2.1 Release of 2-layer porous asphalt for wide use	
		2.2 Improvement of 2-layer porous asphalt	
	thin surface courses	2.5 Release of thin surface courses for wide use	
	third-generation road surfaces	2.6 Roll Pave demonstration 2.7 Modieslab demonstration 2.8 Quiet Transport demonstration	
surfaces	super-quiet road surface	2.9 Acoustic optimisation of quiet road	
3. Vehicles		3.1 International regulations and type testing	
		3.2 National regulations and incentives	
4. Screening		4.2 T barrier tops	
		4.3 Central reservation and verge barriers	
		4.4 Modular barriers	
		4.5 Methodology for generic tops	
		4.1 Anti-noise screen	
5. The policy promoting Communication implementation		5.1 Promotion of implementation.	
		and dissemination of knowledge	

Cluster 1 Knowledge and facilities:

The 'Knowledge and facilities' cluster guarantees the quality of the information and results which are made available as a result of sections of the Innovation Programme and ensures back-up activities regarding monitoring and measuring methods.

- **1.1 Knowledge management:** periodic updating and testing of the scientific strategy of the IPG Road Traffic by the Scientific Board with a view to ensuring that the best possible result in scientific terms is achieved, which is properly documented, by making the best possible use of the available knowledge.
- **1.4 Methodology for completion inspection of quiet road surfaces (robust CPX method):** This project concerns the development of instruments which are necessary for implementing the measures on a wide scale.
- **1.5 Monitoring of quieter road surfaces:** This project covers all monitoring activities which are necessary for obtaining unambiguous factual material about the performances of quiet road surfaces in terms of life, costs, maintenance, safety and noise reduction. The results of these measurements are recorded in a database.

Cluster 2 Quiet road surfaces:

The objective of the 'quiet road surfaces' cluster is to develop road surfaces with a higher noise reduction in such a way that they can be implemented, and also to improve the durability of these road surfaces.

- **2.1 Release of two-layer porous asphalt for wide use:** The main purpose of this project is to test 2-layer porous asphalt in order to determine the initial noise reduction (how this reduction develops over time), life, laying costs and the annual maintenance costs in order to clarify the possibilities for using it, in consultation with the implementing organisation, the Rijkswaterstaat, and to obtain a better understanding of any risks associated with its use, so that effective measures can be adopted to discuss them.
- **2.2 Improvement of two-layer porous asphalt:** Currently there are still a number of points on which two-layer porous asphalt can be improved. A further course of development for two-layer porous asphalt is essential in order to realise the objective of the IPG. In the project on improved two-layer porous asphalt, efforts are being made to achieve an improvement on the following points:
 - F. Initial skid resistance
 - G. Life
 - H. Obstacles to laying
 - I. Acoustic life
 - J. Overall evaluation of the state of affairs in 2007
- **2.5 Release of thin surface courses for wide use:** Advice about possible use of thin surface courses on the main road network.
- **2.6 Third-generation road surface Rollpave:** Demonstrable road surface with a substantially higher laying speed than conventional road surfaces (50% faster than porous asphalt and 100% faster than two-layer porous asphalt) and a noise reduction that is equal to or slightly better than two-layer porous asphalt. In addition, cost-effectiveness is the same as or better than two-layer porous asphalt.
- **2.7 Third-generation road surface Modieslab:** Demonstrable road surface with a noise reduction of 6-7 dB(A) which has been developed especially for areas susceptible to settlement and which can be used cost-effectively.
- **2.8 Third-generation road surface Quiet Transport:** Road surface that has been especially developed to achieve a considerably higher noise reduction than two-layer porous asphalt with goods traffic and which can be used cost-effectively.

- **2.9 Acoustic optimisation of quieter road surfaces:** Development and demonstration of very quiet road surfaces which, in due course, can achieve a noise reduction of 7 to 9 dB(A) in a cost-effective way. The aim is to demonstrate at least one road surface with a 9 dB(A) reduction.

Cluster 3 Vehicles

Tyres and vehicles have the potential to make a major contribution to reducing noise emissions from the national infrastructure. Efforts are continuing both internationally and nationally to promote quiet tyres.

- **3.1 International regulations and type testing**
Among other things, this is being strengthened by the hiring of T&E to undertake lobbying regarding noise.
- **3.2 National regulations and incentives**
Together with leaders from the industry, promoting the use of quiet tyres, including for the fleet of government cars.

Cluster 4 Screening

The section on more effective screening focuses mainly on possibilities for increasing the effect of existing noise barriers or on developing noise barriers which give a better performance at the same height.

- **4.2 T-barrier tops:** The objective of the project is to develop, validate and implement barrier-top designs with which an additional noise reduction of at least 2 dB(A) can be achieved in an area of a significant size in the screened part of the noise zone of a road.
- **4.3 Central reservation and verge barriers:** The development of alternatives to the installation of noise barriers in order to achieve an improvement of at least 1 dB(A) in the screening effect. These alternatives may involve installing noise barriers in the central reservation (both the conventional and the integrated types) and installing a noise barrier on the verge.
- **4.4 Modular noise barriers:** The aim of this project is the release and wide application of modular noise barriers with a view to achieving a cost reduction of 20% and offering the possibility of easily moving or raising the barriers or fitting a T-top later on.
- **4.5 Assessment method for generic tops:** In order to provide an incentive for innovation regarding barrier tops, a project is being started in 2006 which is intended to result in a generic assessment method for barrier tops.

Cluster 5 Policy promoting implementation

The activities aimed at promoting implementation and communication activities will be carried out within this cluster. Without clear activities focussed on implementation at an early stage of an innovation project, the task of putting an innovation on the market will be difficult. An important point for consideration in the implementation process is that there is a supply and demand side. On the demand side there are the purchasers of the innovations, such as regional services, acoustic consultancies, provinces and municipalities. The supply side is the market which the innovations are meant to be going to supply, such as contractors and producers.

A5. The period after the IPG

It is necessary to be thinking about the situation in the period after the investment boost from the IPG. Not all IPG products are fully developed yet and widely applicable, so that consideration must be given to follow-up.

First and foremost, of course, activities to promote implementation of quiet tyres still require attention.

In addition, after 2007 it will still be necessary to devote attention to developing and testing innovations which have been given a boost by the IPG but which are still not ready for implementation in 2007. Thought should be given to:

- a follow-up stage for improving two-layer porous asphalt with an improved life (using new material technologies);
- further development of demonstrated third-generation quiet road surfaces.

The milestones planning includes scaling-up plans for the innovations which have been demonstrated within the IPG but which cannot yet be implemented. This concerns:

Finally, attention must be paid to:

- Monitoring of the use of IPG innovations
- Accompanying advice about acoustics and asphalt technology for the purpose of implementing IPG innovations.

It is important for the IPG Management Consultation to state that these elements merit continuing attention and that they will have to be taken up in the regular work of the organisation, for example, because this will not happen automatically.

Annex B. The revised IPG Rail Traffic

B.1 Developments

Progress of the IPG

The IPG Rail Traffic has been in progress since 2002 and is aimed at the development and implementation of measures which limit rail noise at source and are cost-effective. The programme consists of projects focussing on vehicles as well as infrastructure. In addition, the programme is made up of phases, where the effects of the various measures are inter-dependent. The effect of the phase-3 measures occurs only if the measures from phases 1 and 2 have already been implemented. Substantive results so far have been the release of the rail damper and acoustic grinding as new measures to limit noise. In addition, the “innovative yard” study has been completed, and this is being used as a basis for shaping the approach to yards in practice. The ‘Whispering train’ project is providing experience of new braking systems on freight wagons. Sound measurements show that, after retrofitting, the train has an average sound radiation of 84 dB(A). Before retrofitting it was 93 dB(A), and so a reduction of 9 dB(A) has been achieved. To the human ear this means instinctively a halving of the amount of noise. This is the first solid result achieved with vehicles.

Implementation of the programme made further progress in 2004 and 2005. During this period, rail operators were active in working on filling in the details of the rest of the programme, and new projects have been started and prepared. A large part of the programme is now under way.

The important step towards implementation of measures regarding stock has not been made satisfactorily. It is a question of actually getting the various available measures into the toolbox of the users, so that the correct measures can be applied as the occasion arises. It is essential to prevent these solutions from being shelved.

International

The European regulation TSI Noise (technical specification of interoperability) will come into effect in 2005. This regulation lays down requirements for the noise emission from new passenger and freight rolling stock and locomotives which operate in Europe. For the first time, a maximum value for noise emissions is laid down for rail vehicles. The standards established are based on the current state of the art. New (freight) stock complies with these noise requirements if they make use of quiet braking techniques which limit the noise emission by 7-8 dB(A) compared to the current stock. However, the TSI does not look at existing (freight) stock. As this stock has a life of more than 40 years, the effects of the TSI Noise will not be heard within the foreseeable future. The TSI Noise is evaluated periodically and, where possible, tightened up in line with the state of the art. The IPG can contribute to this process by supplying information on quiet techniques. This fits in well with the new development on European rail involving the interim release of LL blocks for life tests on freight wagons by the UIC¹¹ in spring 2005. These brake blocks offer the prospect of a cost-neutral retrofitting of the existing freight stock and, thus, represent an alternative to the available solutions which are too expensive for use on existing stock.

ProRail organised an international workshop on 13 October 2005 from the Information Centre for Railway Noise with representatives of railway companies and governments from Germany, Austria and Switzerland. The subject was promoting the use of quiet rolling stock. It was agreed to continue these contacts in order to remain properly informed of international developments and projects in this policy area.

¹¹ The UIC is the International Union of Railways, more information on <http://www.uic.asso.fr>.

Policy

Concern about noise nuisance as a result of traffic remains as great as ever. Studies from 2004 and 2005 have again pointed to the link between noise pollution and health and sleep, and also to the reading performances of children. The policy of the national government is aimed at limiting the nuisance and inconvenience caused by noise pollution. To this end, the government included noise targets in the Memorandum on Mobility and the Memorandum on Space. A large number of activities were laid down in the Memorandum on traffic emissions presented in 2004. This memorandum is aimed at limiting harmful emissions of substances and noise and forms the Government's policy programme for combating noise pollution and air pollution and limiting the emission of greenhouse gases. This memorandum prioritises a number of activities which are directly linked with the implementation of the IPG. The target for rail is that by 2010 trains should mainly operate with a noise production which is at least 7 dB(A) lower. In any case by 2015 only quiet trains should still be running during the night on all sections. In the long term the aim is for rail traffic to achieve a reduction of 10 to 12 dB(A) compared to the conventional stock with cast-iron brake blocks.

The European regulations can help to achieve these targets for rail traffic in the long term. The Netherlands must lobby to support this. In the short and medium term, the government will have to act itself in order to achieve the targets set. This is because the policy means that NSR will have to convert a large part of the rolling stock. In addition, the vast majority of the freight wagons which are used in the Netherlands will have to be modified. Technical solutions are available for both types of stock, but for both there is no incentive for the operators to justify the – additional – investment in business terms. In other words, the operators have no direct interest in their noise performance.

As the European noise requirements for stock will not lead to the modification of existing stock in the short to medium term, financial instruments are fundamentally important for achieving the policy targets. The IPG is necessary in the establishment and implementation of the required measures and instruments to achieve this policy target.

B.2 Approach to the revision

This revision is being made with a view to achieving the objectives of the IPG and is based on the experience obtained from the current projects. Relatively few projects were started in the first few years, and so the start can be described as slow. Halfway through the term of the IPG it is possible to draw up a balance of what has been achieved and implementation can be adjusted in order to optimise the result of the programme.

In addition to this practical consideration, there are a few technical developments and new government policy, and a number of modifications have already been made during the course of the IPG. To achieve transparency in the implementation of the IPG, it has been decided to revise the programme and to re-define it.

In addition to the original wording of the programme, the following information has been used as input for this revision:

- the 5th IPG progress report
 - this records what progress has been made on the projects as well as where the problems have occurred, which sections have not developed or have developed unsatisfactorily, which sections have, on

- closer inspection, contributed insufficiently to the objectives which were set.
- policy views laid down since 2002 (in particular the Memorandum on traffic emissions)
 - this gives direction to the government's policy on noise pollution for the short and medium term
 - technical developments after 2002, including those originating from the UIC
 - technical developments offer opportunities for the remaining term of the IPG
 - the rail spending plan as laid down in the 3rd IPG progress report
 - in 2004 and 2005 the rail operators worked intensively to implement various sections of the IPG, on the basis of the aforementioned spending plan.

B.3 Result of the prioritising

The key aim of the IPG is the source-oriented and cost-effective tackling of noise nuisance. The projects in the revised programme will at least contribute to this aim. No new programme sections have been developed in the revised programme. The revision of the programme consists mainly of emphasising sections of the programme. New projects are planned for the sections on 'through rail traffic' and 'promoting implementation'.

Technical developments have created a new prospect for phase 1 of the section on through rail traffic. Consequently, a relatively large part of the available budget is intended for this section. The projects concerned are ones where life tests are used to test the use of LL brake blocks in terms of life cycle costs, possible defects, safety aspects and, of course, the limiting of noise emissions. One of the priorities of the revised programme is to implement the projects with the LL brake blocks.

The information which these projects supply will be used in the follow-up stages prior to the release of the LL brake blocks at the authorising agencies. It is important here to ensure that the information is contributed to the international railway organisations such as the UIC and the ERA¹². These activities will be carried out during the term of the IPG and, if necessary, after the conclusion of the IPG programme.

The second priority of the revised programme follows from the finding that, in particular, the retrofitting of rolling stock has not been implemented satisfactorily. It is necessary to develop financial instruments in addition to legislation and (international) regulations. The 'promoting implementation' section is being expanded for this reason with a project in which financial instruments are developed. The Information Centre on Rail Noise, which was started in 2005, will be used in this.

B.4 The changes compared to the original programme

The changes compared to the original programme are set out in this section. For each programme section, it is indicated which projects have been cancelled, amended or expanded.

¹² European Railway Agency, for more information see http://europa.eu.int/comm/transport/rail/era/index_en.htm.

Through rail traffic

The phase 3 measures for through rail traffic have been cancelled. This is because these measures can only be effective when the measures from phases 1 and 2 have been implemented successfully. It has been established that the measures which have been and are being developed under phases 1 and 2 are not being applied on a large scale. The phase 2 measures are being applied in so far as the measures relate to the infrastructure and a satisfactory effect is being achieved with used rolling stock. The measures relating to rolling stock which are developed in phases 1 and 2 are not getting off the ground, and so there is no prospect of large-scale application of measures for rolling stock in the short or medium term. Because the introduction of the phase 1 and 2 measures is not progressing satisfactorily, it has been decided not to start the phase 3 projects.

Likewise, the project on the 'active damping of steel railway bridges' is not being continued. This is because the cost-effectiveness has been estimated to be too low. The costs of developing and adopting measures were very high compared to the number of people inconvenienced. Thus, this section does not appear to contribute to the objective of a cost-effective approach to noise problems.

The projects on the 'retrofitting of braking systems on noisy passenger trains' and the 'retrofitting of braking systems on noisy freight trains' are being continued. These are in the process of being implemented, and the first substantive results have been delivered in the meantime. The project has been re-defined for noisy passenger trains. This is because practical trials showed that the intended solution does not meet the safety requirements laid down. The recently developed LL brake blocks will be tested for noisy passenger trains as well.

The "Whispering train" project, which is aimed at tackling noisy freight trains, is running and will be completed. However, the costs of large-scale application of the K brake blocks seems to be very high for existing stock, and as a result the existing stock is not being modified. This disadvantage does not appear to exist for a new type of brake block, the LL brake block. Therefore, two projects to test LL brake blocks have been added to the programme. Since 20 March 2005 these brake blocks have been released by the UIC for a period of 2 years. As much data as possible is being collected in this period in the field of noise reduction, costs and wear of the various wagon components. The trains in question are being used intensively in terms of number of kilometres and circumstances of use. The pilots are making a big contribution to collecting the necessary practical data which are important in the assessment for final release.

Yards

The "Loc6400; ED brakes to zero" in the section on yards has been halted. The reasons for this include the fact that the owners and users of the locomotives in question have shown insufficient enthusiasm for starting a project and the fact that the noise problem that would be resolved is relatively small.

The project involving the perceptions study of yards has been removed from the IPG. Yards are regarded in legislation as industrial establishments to which the preferential limits for industrial noise apply. This means a strict assessment of, among other things, peak noise and a strict division between the noise from shunting trains and through trains. In practice, this leads to noise bottlenecks. The purpose of the IPG perceptions study was to examine whether the noise standard for yards does match up with the perception of the noise. In the meantime, there has been a broad discussion about the noise standard for yards, based in part on a TNO report on perception. This has led to relaxation of a number of standards with the Circular on peak noise. Together with the implementing programme laid down in this, this has

reduced the problems involved with tackling noise from yards as far as possible. The IPG makes a further contribution to reducing these problems by testing new noise-reduction solutions in practice. In view of the above developments, the IPG Management Consultation has decided that a perceptions study of yard noise is no longer desirable within the scope of the IPG.

One project has been added to the section on yards, namely 'Lasting solutions to curve squeal noise'. This project is a follow-up to the Infrastar project within the EU 5th framework programme, which concentrates on the Dutch situation. Infrastar was aimed at preventing crack formation in rails in curves as a result of "rolling contact fatigue". The project involves testing the combination of two modifications to the rail. An alloy with specific qualities is applied to the railhead by means of laser cladding. This measure resulted in a product with which the standing time of rails in curves can be substantially increased and the frequency of grinding can be reduced. With the two-material rail technique it is also possible to influence the wear and friction properties of the rail, which can limit the curve squeal noise. The grinding of an asymmetric rail profile is regarded as a cost-effective measure to control curve squeal noise both nationally and internationally. The strength of the two-material rail and an asymmetric rail profile lies in the combination of these measures. Curve squeal noise is eliminated by optimum material properties and contact geometry, while the measure is also long-lasting as a result of the wear resistance of the rail.

Promoting implementation

This section consists of three parts: European lobby, legislation and regulations and capacity management. Two new projects have already been started in this section on the basis of experience acquired.

Performance of the section on promoting implementation follows the original layout of the IPG. However, implementation of cost-effective measures regarding rolling stock, in particular, does not seem to be happening on a satisfactory scale. Therefore, promotion of implementation is being expanded in the revised IPG with a project that focuses on setting up financial policy instruments which mean that operators are given business-economic arguments for investing in quiet stock. It provides big financial benefits for the rail sector and the State (€ 500 million - € 1 billion). This is demonstrated in various documents.

However, so far not enough practicable projects have been defined for promoting the use of quiet stock. The biggest problem appears to be the danger of state aid in the direct financing of source measures regarding noisy trains. Because of these circumstances, the section on promoting implementation has delivered unsatisfactory results.

At ProRail a re-orientation, starting from the Capacity Management directorate, is currently taking place regarding the use of the user fee to promote the utilisation of quiet stock, among other things. One of the reasons for this re-orientation is the recent development of the LL brake block, creating a new prospect of a cost-effective, source-oriented approach to noise nuisance. Over the next few months ProRail will prepare a project for stimulating the use of quiet stock. The familiar policy instruments will be given a chance here: regulations, finances and communication. Unlike the project proposals made so far, this project will not be aimed at testing a method or application on a small section of the rail network, but will be intended to lead to the introduction of financial incentives in the user fee.

ProRail will take a decision on this project in autumn 2005. After this, the IPG can play a part by offering support for setting up the financial instruments. If a price distinction is made between noisy and quiet stock, the freight operators can be encouraged to change to quiet braking techniques with LL brake blocks, and passenger operators in the Netherlands will be given business arguments to modify

equipment. Here, the IPG can provide (some of) the financing for a discount for quiet stock. Space has been set aside in the redefined programme for promoting implementation. It is proposed to fill in the specific details at the end of 2005.

In addition to this, two projects have been started in the meantime, which are aimed at promoting implementation. The first project, 'Cyclical study of freight', concerns a study of the deployment of freight wagons in the Netherlands. This study is intended to provide data on the number of freight wagons which are used in the Netherlands and the way in which they are deployed. The information can be used to determine further the possibilities of implementing modifications to stock.

The second project is the development of a new machining method for rail dampers, with which the cost of fitting rail dampers can be reduced further. Rail dampers can already be used cost-effectively in various situations, but require labour-intensive machining. The 'Prefabricated rail dampers' project consists of acquiring experience of rail replacement in which the new rail is fitted with rail dampers when delivered. The prefabricated rail damper will be used on the Zeeuw line where there is already provision for this measure in conjunction with the planned development concerning the Sloe line

Knowledge management and facilities

Implementation of this section has been changed slightly. The content of the original programme consisted of the setting up of an information centre for rail noise at ProRail and the implementation of the 'Noise registration from a fixed measuring post' project. The development of a monitoring instrument for acoustically ground rails has been added.

The monitoring instrument for acoustically ground rails is intended to produce a measuring system which can be used to determine whether the acoustically ground rail complies with the requirements laid down in the Calculation and Measurement Regulations for rail traffic noise. When the rail roughness has increased to more than the stated threshold value the rail must undergo acoustic grinding again in order to guarantee the noise reduction. Currently, no such instrument is available for measuring rail roughness. It is expected that a link will be established with measures in Germany, which are suitable for the Dutch railway network with limited modification.

The figure below shows which sections of the original plan have been completed in the meantime, which are being implemented and which have been cancelled.

knowledge management				
knowledge infrastructure			permanent measuring posts	
through rail traffic				yards
noise	approx. 100 diesel trains	class 1		
approx. 6 dB(A)	approx. 1200 passenger trains and all freight trains	class 2	Phase 1: modify braking systems of noisy trains	integral design of model yards
	approx. 1200 passenger trains and prototype freight trains	class 3	Phase 2A: reduce rail roughness and rail dampers	

	a few prototypes	class 4	Phase 2B: skirts on trains and wheel dampers	tackling yards in practice
	no trains	class 5	Phase 3: option 1: further reduction in rail and wheel roughness; option 2: skirts combined with mini-barriers	perceptions study of yards
	active damping of steel railway bridges		speed factual booklet ballast-less track	Loc6400; ED brakes to zero
Promoting implementation				
	legislation and regulations		capacity management	European lobby

- Section has been completed
- Section is being implemented
- Section has been cancelled

B.5 The projects and financial data of the revised programme

Noise innovation programme – rail

cornerstones		projects	
		up to 2005	2006-2007
1. Knowledge management and facilities		1.1 Information centre	
		1.2 Noise registration from a fixed measuring post	
			1.3 Monitoring instrument for track roughness
2. The technical policy for through rail traffic	Phase 1: Acoustic renovation of noisy trains	2.1.1 Retrofitting of braking systems of noisy passenger trains	
		2.1.2 Retrofitting of braking systems of freight trains with K blocks: the Whispering train	
			2.1.3 Testing LL blocks on freight wagons
			2.1.4 Retrofitting of braking systems on freight train with LL blocks: the Auto-train
	Phase 2A: Promising measures on existing rail structures	2.2.1 Rail dampers (finished)	
		2.2.2 Reduction of rail roughness (finished)	
Phase 2B: Supplementary measures on trains	2.3.1 Wheel dampers and skirts on freight trains (= section Whispering train 2.1.2)		
3. Yards		3.1 Integral design model yards: innovative yard	
			3.2 Lasting solutions for curve squeal noise
			3.3 Covering-over of diesel tracks
			3.4 Simultaneous implementation of processes
			3.5 Parking under cover
4. The policy promoting implementation		4.1 Test of prefabricated rail dampers	
			4.2 Incentives for use of quiet stock
		4.3 European lobby	
		4.4 Cyclical study of freight stock	

B.6 The period after the IPG

The introduction states that successful implementation of IPG measures depends on the ability to apply a well-directed mix of policy instruments. It will then be possible to achieve the effects of this policy in the medium term (up to 2015). It is therefore necessary for the development and application of financial instruments to promote quiet stock to be continued after the IPG. Cooperation between the authorities and ProRail and other rail companies is important in the deployment of financial instruments, since ProRail, as controller of the railways, is responsible for allocating transport capacity and noise capacity and for enforcing the user fee on the railway. Cooperation between the authorities and ProRail is also very important for a successful policy. It is proposed that it should be decided in 2007 whether there should be cooperation between the authorities and railway companies after the IPG and, if so, what form it should take.

The knowledge and information acquired and gathered with the IPG will have to be made available for future use. The Information Centre for Rail Noise can play a part here. At the same time, this knowledge will be important in evaluating the TSI Noise (Technical Specification of Interoperability) which is taking place after the term of the IPG. This provides the opportunity to revise the established standards, in which case the TSI will be adapted on the basis of the latest opinions and analyses of life-cycle costs, available technology, cost/benefits etc. The Netherlands is concerned to see strong and well-founded standards. Here too cooperation between the authorities and rail operators is necessary in order to be able to influence this process effectively. The IPG supplies a considerable part of the required information. ProRail will decide in 2007 whether and, if so, how this information centre for rail noise will be continued. The same applies to the network of noise-measuring posts along the Dutch rail network.

Finally, it is pointed out that after 2007 it may be necessary to consider starting R&D work followed by innovation work for the so-called phase 3 measures. These measures are only worthwhile if the retrofitting of noisy railway stock has been carried out first. If it subsequently appears that this is not in fact getting off the ground, it is advisable to start the development and innovation work for the phase 3 measures.

B.11 References

- Fifth IPG progress report
- Memorandum on traffic emissions
- Rail spending plan as included in the third IPG progress report
- Draft Technical Specification for Interoperability, Subsystem: Conventional Rail Rolling Stock, Scope: Noise, Aspect: Noise Emitted by Freight Wagons, Locomotives, Multiple Units and Coaches, dated 23 November 2004
- Report “Financial funds for source measures” dated 5 October 2004, dBvision
- Report “The effect of noise on sleep and health” by the Health Council from 2004
- Report “The effect of noise from air and road traffic on cognition, nuisance perception and the blood pressure of primary school children” by the RIVM [Dutch National Institute for Public Health and Environmental Protection], report 44152002 from 2005
- Report “Growth within environmental limits”, ProRail dated 20 January 2004 (note these documents are available in Dutch only)