

Vehicle Standards and Engineering Research

Compendium of
Research Projects 2000

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Current vehicle safety research

Vehicle Safety Research covers the primary and secondary safety of vehicles, environmental pollution and measures which can be taken to influence these so as to promote greater safety. In addition to this it covers research funded by the DETR under the Foresight Vehicle programme of co-operative research.

Projects are grouped under a series of general themes. For each theme recently completed, ongoing, and new projects are listed. A total of one hundred and six projects are included.

Entries of recently completed projects include a list of outputs, mostly reports. Copies of TRL reports can be obtained direct from TRL on 01344 773131. For other reports contact either the contractor or project officer listed. All DETR staff have direct e-mail addresses of the form

firstname_surname@detr.gsi.gov.uk

The Vehicle Standards and Engineering Division can be contacted at the following address.

Mr M Shokat
VSE Research Administrator
2/06 Great Minster House
76 Marsham Street
London
SW1P 4DR

e-mail:
mohammed_shokat@detr.gsi.gov.uk

Department of the Environment, Transport and the Regions
Eland House
Bressenden Place
London SW1E 5DU
Telephone: 020 7944 3000
Fax: 020 7944 4242
Internet service <http://www.detr.gov.uk/>

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THEME 1

Car secondary safety

Car secondary safety offers the greatest potential for reducing the number and severity of casualties from accidents (especially deaths and serious injuries). Secondary safety can be defined “*as all structural and design features that reduce the consequences of accidents as far as possible*”. It covers specific topics such as the crashworthiness of cars, air bags, seat belts and fixings, seating, children safety seats and installation, interior fittings, the protection of pedestrians involved in accidents, motorcycle helmet construction, and much more. Included in this theme is the development of crash test dummies for use in regulatory testing.

Specific objectives in this theme are:

- the development of new test procedures for compatibility of vehicles in crashes – by 2004,
- participation in the EuroNCAP programme of information dissemination on the crashworthiness of new cars,
- the development of improved crash test dummies – on-going,
- reviewing legislation for side and front impact within the Europe – by 2001,
- evaluating car bull bars and reporting by early 2000,
- developing proposals for new European standards for the protection of pedestrians involved in road accidents –by 2000, and
- accident investigation and analyses – on going.

Recently completed projects

S071J/VF: ACCIDENT REPORT ANALYSES

This project analyses accident data compiled under other DETR projects, in particular the Co-operative Crash Injury Study database (Project S076B/VF). The project comprises several separate tasks and is ongoing.

This is the first task completed under this project, and will contribute to an international study of front and side accidents in collaboration with the European Commission's review of the corresponding directives.

The report concludes that for front impacts the test speed should be raised to provide wider coverage of accidents involving serious injury, that the neck injury criteria should be retained, and that all vans should be included within the scope of the directive. For side impact test speed, seating position derogation, barrier height and the need for a pole test were considered. However, the conclusions were less definite but identified where further analysis is required.

Future work is described under the same project title in the ongoing section.

<i>Contractor:</i>	TRL
<i>Report:</i>	TRL Consortium report PR/SE/499/99 on <i>Front and Side Impact Directive Review</i> (Publication by the European Commission expected)
<i>Contact:</i>	Adrian Fails at TRL. Tel. 01344 770 069 Jim Hand in VSE. Tel. 020 7944 2067

S077B/VC: OTS PROTOCOLS FOR PEDESTRIAN OR CYCLISTS ACCIDENTS AND ALL WITNESSES

OTS (On the Spot) accident research involves researchers being notified of an accident and getting to the scene to investigate before it is cleared. This is a complex activity to specify and so separate projects were let to prepare the protocols defining how and what information to collect. Four projects were let to investigate accidents involving different types of vehicles.

This project only considered accidents involving a vulnerable road user. Protocols and data collection forms were proposed for the range of data that could be collected and used in future analysis by government agencies and industry. The Birmingham Accidents Research Centre (BARC) also investigated what information could usefully be collected from the witnesses to an accident and proposed a protocol on how to do this most effectively whilst recognising the sensitivity.

<i>Contractor:</i>	BARC
<i>Report:</i>	<i>Protocols for pedestrian or cyclist accidents and all accident witnesses. March 1999. (Unpublished report although it has since been consolidated into a single protocol and report by the following project S078B/VC.)</i>
<i>Contact:</i>	Richard Cuerden at BARC. Tel. 0121 414 5159 Roger Worth in VSE. Tel. 020 7944 2115

S078B/VC: OTS PROTOCOLS FOR M1 AND N1 CARS AND VANS

This protocol project set out to propose the data to be collected when examining the largest user group of injury accidents. It builds upon the experience of the Co-operative Crash Injury Study (CCIS) data collection project S076B/VF and takes account of European Union funded research into harmonised accident injury data collection.

A second stage of this project has been to consolidate the individual protocols produced by this project and projects S077B/VC, S079B/VC and S101H/VD. This represents the experts' model of how the DETR should investigate accidents and forms the basis of the specification for a new three year OTS accident investigation project which was let May 2000.

<i>Contractor:</i>	ICE
<i>Reports:</i>	<i>Protocols for the investigation of crashes involving cars and light van. 1999. Unpublished. Integrated Protocols for Accident Research On The Scene (OTS). December 1999. Unpublished, but available in CD-ROM format from the contractors.</i>
<i>Contact:</i>	Julian Hill at ICE. Tel. 01509 283 359 Roger Worth in VSE. Tel. 020 7944 2115

S079B/VC: OTS PROTOCOLS FOR LARGE VEHICLES AND HIGHWAYS ISSUES

This protocol project contained three sections. The first two sections focused on accidents involving either a HGV or a PSV with the third focussed on highway issues. These large vehicles pose different risks and research needs. HGVs because of their risk to other road users and PSVs because of their multiple occupancy and predominantly urban operation.

The third section examined the role of the highway as a cause or influence on the outcome of the accident. Factors of interest are the design, construction, maintenance and use of the highway. It is principally aimed at the interests of the Highways Agency who are co-sponsors of the main data collection project. It could reasonably be anticipated that other road operators would also have a use for this data or even the protocol in order to standardise their own accident investigation methods.

Report: Unpublished TRL report PR/SE/531/99. *Protocols for large vehicles and highways issues*. 1999.
 This has since been consolidated into a single protocol and report by project, S078B/VC.

Contact: Nigel Byard at TRL. Tel. 01344 770 611
 Roger Worth in VSE. Tel.020 7944 2115

S080E/VF PROTECTION OF CHILDREN IN CARS

This project was originally set up to find improvements to the design and fixing of child seats and restraints, through laboratory tests and new design concepts. It has supported the development of ISOFIX, a universal system of attaching child restraint systems (CRS) to cars. The proposed system will require cars to be fitted with two anchorages at the seat bight, on to which the CRS will latch. It is anticipated that this system will significantly reduce the incorrect fitting of CRS, and offer improvements in the protection they provide to children. Draft amendments to the regulations controlling the performance of CRS have been produced.

The project supported the development of a new side impact test procedure for child restraints. This task was co-ordinated by International Standards Organisation (ISO) but will require further work before agreement can be reached.

In order to assess accurately the performance of CRSs it also explored how the Department could collect accident data on seriously injured child occupants. It was expected that this data would complement that already collected on slight and fatally injured child occupants and provide additional information on how children are injured. The contractor was unable, however, to collect sufficient cases to justify the continuation of this work and so alternative methodologies were explored and these will be taken up by the next phase of this project.

Contractor: TRL
Completion date: 1999
Reports: A Study of Seriously Injured Child Occupants in Cars (PR/SE/590/99)
 The protection of children in cars – Final Report (PR/SE/090/00)
Contact: Richard Lowne at TRL. Tel. 01344 770 617
 Jim Hand in VSE. Tel. 020 7944 2067

S091D/VF: NEW-CAR ASSESSMENT PROGRAMME

This is an ongoing project comprising several phases. The publication of the results from these phases secured substantial media coverage, positive industrial reaction and a high profile for the programme leading to the development of the Euro NCAP organisation. Current work is described in the next section concerning ongoing projects.

The project initially developed a test protocol to assess the comparative crashworthiness of cars based upon non-statutory European test procedures for frontal, side and pedestrian impacts. The test programme involves purchasing new cars, crash testing and publishing the results in vehicle groups. The first group to be tested were *super-minis* and these results were published in January 1997. Since then seven further groups of vehicles have been tested with the most recent tests being superminis.

Since starting the programme the UK has been joined by The Swedish, Dutch, French and German Governments, the European Commission, FIA, European consumer organisations and the AA. This collaborative approach has allowed fifty-three different car models to be tested and the results published. The results, along with the wide media coverage associated with publication of the test results, have greatly influenced vehicle manufacturers approach to safety with extra design improvements being introduced to new and existing models. Manufacturers are citing good NCAP results as part of their publicity.

Future plans include additional vehicle models from the above groups and new size groups not tested previously.

Reports: These take the form of consumer information publications dealing separately with each group of vehicles tested. These handouts are distributed widely at the press launch of the crashed vehicles and details are included in What Car magazine (monthly circulation ≈154,000). The timing of completed phases is as follows:

- Phase 1 Superminis – January 1997,
- Phase 2 Large family cars – July 1997,
- Phase 3 Small family cars – May 1998,
- Phase 4 Luxury cars – September 1998,
- Phase 5 Small family cars – January 1999,
- Phase 6 People carriers – June 1999.
- Phase 7a Superminis – February 2000
- Phase 7a 'plus' Updates, pole tests and gap filling models – March 2000

September 98. Conference papers have been presented to and published by ESV 96 & 98

Results and updates can also be obtained via the Euro-NCAP website
<http://www.euroncap.com/>

Contact: Lee Thompson at TRL. Tel. 01344 770 605
 Peter O'Reilly in VSE. Tel. 020 7944 2107
 or Roger Worth in VSE. Tel. 020 7944 2115

S095B/VF: COMPATIBILITY OF CARS IN CRASHES

Following the introduction of regulatory tests for frontal and side impacts, other studies have shown that improving the compatibility of cars could potentially deliver a one third reduction in the number of fatal and serious injuries sustained in car-to-car impacts. This project was commissioned to identify and understand the factors which influence compatibility in car-to-car frontal and side impacts, and to propose test methods that could be used to measure and control the compatibility of cars.

The report concludes that whilst sufficient knowledge has been gained to propose concepts for testing compatibility in frontal impacts, further research will be needed if test methods are to be proposed for side impact compatibility. For good compatibility in frontal impacts, car structures need to interact in a predictable manner, to absorb energy with minimal occupant compartment intrusion. This requires good structural engagement, stiffness matched so as to absorb energy in proportion to mass and minimal occupant compartment intrusion without excessive deceleration. For side impact compatibility neither mass nor global stiffness are seen to have a major effect homogeneity and geometry are important.

Three test methods are recommended for further consideration – a 64km/h 40% offset and a 56km/h full frontal test into a deformable barrier mounted on a high resolution load cell wall, and a 40% offset into a deformable barrier at a higher, but as yet, undefined speed. The test conditions, performance criteria and limit values are to be developed in the later new project S096B/VF which will provide the UK contribution to EU and UN work on future regulatory tests.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	1999 (follow on project contracted)
<i>Reports:</i>	TRL Project Report PR/SE/563/99 on Compatibility and Frontal Impact Test Procedures (Unpublished) Conference papers presented to and published at ESV 1998
<i>Contact:</i>	Julian Happian-Smith at TRL. Tel. 01344 770 050 Steve Gillingham in VSE. Tel. 020 7944 2084

S220C/VF PEDESTRIAN PROTECTION – TEST PROCEDURES & EQUIPMENT DESIGN

This project has developed a test procedure to reduce pedestrian injuries and is the basis for a draft Directive that is currently awaited. Much of the earlier work involved analysing pedestrian accident and accident reconstruction data to develop a test procedure to assess the likely injuries caused to pedestrians by car front designs. In particular, the project has developed test tools to represent pedestrian legs and thighs. Recent work has concentrated on refining test equipment with the greater experience having been gained in the New Car Assessment Programme. Presentations have been made to the EC and EEVC. The work is being continued under new project S222C/VF to provide scientific support during negotiations on the Directive and to contribute to international research in this area.

Contractor: TRL

Completion date: 1999

Published Reports: Lawrence GJL *et al* (1993). Bonnet leading edge sub-systems tests for cars to assess protection for pedestrians (*Proceedings Thirteenth International Technical Conference on Experimental Safety Vehicles, Paris, France.*)

Lawrence GJL and BJ Hardy. (1997) Development and use of pedestrian impactors to reduce the injury potential of cars. (*Paper C524/049/97, Autotech Congress, Birmingham UK, November 1997*)

Lawrence GJL and BJ Hardy (1998) Pedestrian safety testing using the EEVC pedestrian impactors. (*Proceedings Sixteenth International Technical Conference on the enhanced safety of vehicles, Windsor, Canada 1998.*)

Contact: Graham Lawrence at TRL. Tel. 01344 770 994
Ian Knowles in VSE. Tel. 020 7944 2095

S261I/VF POLICE FATAL ACCIDENT REPORTS

This was the second phase of a joint project with the Road Safety Division to collect, catalogue and store old police fatal accident reports between 1996 and 1999. The work is continuing in project S071H/VF.

These reports are a valuable source of data and can include information on how and why the accident happened and the resultant injuries. On receipt all personal details are removed rendering the database totally anonymous. The remaining details are entered on a database allowing preliminary analysis and the identification of files pertinent to a particular enquiry. Analysis of the reports has supported much of the Department's research including car rear seat occupants fatalities, a review of the effectiveness of the front and side impact standards for new cars and those Road Safety projects investigating speeding, drink driving, distraction and child injuries.

Contractor: TRL
Completion date: 1999
Reports: Police Fatal Road Accident Reports, Phase II Final report (PR/SE/597/99).
Contact: Roy Minton at TRL. Tel. 01344 770 599
Roger Worth in VSE. Tel. 020 7944 2115

S310C/CA: EFFECT OF CAR WEIGHT REDUCTION AND DOWNSIZING ON SAFETY

Vehicle manufacturers are constantly investigating ways to reduce vehicle mass and size to minimise fuel consumption and help comply with increasingly stringent regulation on pollutant emissions. While giving environmental gains it was possible that such changes could be detrimental to vehicle crash performance and thereby increase the number of fatal and serious injuries. This project investigated these concerns by analysing accident data to determine the influence of car mass on the number and severity of casualties and then used computer modelling to examine the significance of mass and stiffness on vehicle impact performance.

The analysis showed that a uniform downsizing across the car parc would result in a small reduction in the total number of fatal and serious injuries. However, further research would be needed to assess the effect of a non uniform downsizing.

Separate research is currently investigating compatibility of cars in accidents and it is hoped this will afford a greater understanding of these issues.

- Reports:
- (i) TRL unpublished report PR/SE/532/99: The Use of Simplified Generic Computer Models to Investigate the Safety Implications of a General Reduction in Vehicle Size.
 - (ii) TRL published report PR/SE/123/99: The Likely Effects of Downsizing on Casualties in Car Accidents.

Contact: Jeremy Broughton at TRL. Tel. 01344 770 879
Steve Gillingham in VSE. Tel. 020 7944 2084

Ongoing projects

S070Q/VF CAR FATALS: TRENDS, REAR SEAT USERS AND FIRES

This project has analysed the police fatal accident reports collected and stored by TRL to determine how rear seat passengers, pedestrians and cyclists are killed or injured. The objective being to identify how such casualties might be reduced and highlight areas for further research. Conclusions thus far indicate that:

- for cyclists, helmet use could result in a significant reduction in fatalities (as much as 43%),
- that the risk of ejection for belted occupants in crashes where at least one person was ejected was 15%, compared to 71% for unbelted occupants. Belt use is thus the single most effective method of preventing ejection,
- restraint effectiveness for centre rear seat occupants was about 26% as compared to 42% for rear seats generally. The report suggests that this could be improved by fitting lap/diagonal belts in this position, and
- in two thirds of pedestrian fatalities the pedestrian was considered primarily responsible for the accident.

It also studied fatal accidents involving fires in cars that are contained in Home Office statistics to determine if there are ways of reducing the number of lives lost. Factors include patterns of accidents, fuel leakage, the type of trim in the vehicle and the role played by smoke and poisonous fumes. It has also looked at the ability of victims to get out of vehicles, the potential for different designs to protect fuel systems and the possible benefits of fitting fire extinguishers.

<i>Contractor:</i>	TRL (FRS sub contracted to investigate fires)
<i>Completion date:</i>	2000
<i>Reports:</i>	Crash-collision car fires (PR/SE/533/98) An analysis of fatal accidents involving pedestrians, pedal cyclists, ejected occupants and rear seat occupants (PR/SE/533/99)
<i>Contact:</i>	Roy Minton at TRL. Tel. 01344 770 599 Peter O'Reilly in VSE. Tel. 020 7944 2107

S071H/VF POLICE FATAL ACCIDENT REPORTS

This is a joint project with the Road Safety Division to collect, catalogue and store old police fatal accident reports. This is the third phase and continues the work of projects S070H/VF (1992–1996) and S261I/VF (1996–1999). These reports are a valuable source of data and can include information on how and why the accident happened and the resultant injuries. Upon receipt the files are examined and basic details are entered on a database allowing preliminary analysis and the identification of files pertinent to a particular enquiry. S070Q/VF is an example of a project making use of this database.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	December 2002
<i>Contact:</i>	Roy Minton at TRL. Tel. 01344 770 599 Jim Hand in VSE. Tel. 020 7944 2067

S071J/VF ACCIDENT REPORT ANALYSES

The Department has majority funded the Co-operative Crash Injury Study (CCIS) compiling a database of car accidents. Each case investigated provides a detailed examination of the damaged vehicle which is correlated with the occupants injuries. Analysis of these data is normally carried out by specific projects whereas this project is designed to fund separate analyses of the database, focusing on areas that have seen recent technological change.

The first task completed under this project is detailed in Section I. The project is currently investigating:

- if real world injury patterns reflect those predicted by the Euro NCAP testing, and
- whether the structural performance of cars in real accidents reflects the NCAP tests.

The next phase of work that is to explore accident data in order to determine the injury priorities for car occupants and pedestrians in support of the new improved injury criteria project S086D/VF.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	2000
<i>Contact:</i>	Roy Minton at TRL. Tel. 01344 770 599 Jim Hand in VSE. Tel. 020 7944 2067

S071M/VF BULL BARS TEST PROCEDURE

This project has measured the aggressiveness to vulnerable road users of a range of bull bars and the vehicles to which they are typically fitted. The test procedures were based upon those developed for the draft proposal for a pedestrian protection directive with minor modifications to reflect the different construction of bull bars. The main objective was to determine a test procedure that would be appropriate to assess the aggressiveness of new bull bars. The feasibility of developing guidelines for a visual examination that could accurately estimate the aggressiveness of bull bars was also considered.

The project report is currently being finalised and is expected to be published during the summer.

<i>Contractors:</i>	TRL
<i>Completion date:</i>	2000
<i>Contact:</i>	Graham Lawrence at TRL. Tel. 01344 770 994 Lawrence Thatcher in VSE. Tel. 020 7944 2582

S075B/VF: ON THE SPOT ACCIDENT DATA COLLECTION

Accidents happen for a variety of reasons and many of the obvious problems have been researched and solutions implemented. The Co-operative Crash Injury Study (CCIS) S076B/VF into car accidents and project S076B/VF examining police reports into fatal accidents have contributed to achieving previous road safety targets over the last fifteen years or so.

Previous research has generally focussed on either the vehicle, the people, or the highway in isolation. VSE has joined with the Road Safety Division and the Highways Agency to research a range of issues. Primary safety factors, vulnerable road users, highway influences and driver impairment are currently of particular interest. This need cannot be met by the present accident investigation studies as they do not capture essential data from the accident scene, which is quickly lost.

This new programme differs by taking account of the complex interaction between highways, road users and vehicle design. It will examine the contributory factors and interactions, for example an inexperienced speeding driver on an unfamiliar icy road in a vehicle with faulty brakes has an accident. What is the cause?

The project team will investigate all aspects of this type of accident, identify the contributory causes and a group of experts will review the factors behind this complex accident. They will draw conclusions as to what benefit various measures could have achieved. Taken with other similar incidents and compared to the national accident population they will be able to make recommendations with estimates of the benefits.

Two fast reaction 'On The Spot Accident Investigation teams' will attend the scene of 1500 accidents over the next three years to collect relevant information on factors influencing accident causation and outcome alongside the emergency services. The investigation

covers all types of road accident involving cars, trucks, buses, motorcycle and pedestrians. Cases will be reviewed by a panel of experts to draw conclusions that will help support a range of policy initiatives contributing to the new road safety casualty reduction targets. For example, designers of the next generation of SMART seatbelts and airbags need accurate data on injuries for different seat positions. The risk in the CCIS programme is that the seat may have been adjusted before the car is inspected whereas such risks should be avoided by the OTS approach.

The first phase of this project examined the feasibility of this method of accident investigation, focusing on the cost-effective collection of at-the-scene data. Separate projects (S077B/VF, S078B/VF, S079B/VF and S101H/VD) prepared individual protocols for collecting data at the scene of different accident types. These protocols have then integrated into a single protocol and trialed in a separate study under project S078B/VF as reported on in the previous section addressing complete research. Contracts for the main three-year data collection programme were awarded May 2000.

<i>Contact:</i>	Roger Worth in VSE. Tel. 020 7944 2115
<i>Project No.</i>	S075i/VC
<i>Contractor:</i>	Research Institute for Consumer Economics
<i>Project Manager:</i>	Julian Hill. Tel. 01509 283 359
<i>Project No.</i>	S075T/VC
<i>Contractor:</i>	Transport Research Laboratory
<i>Project Manager:</i>	Nigel Byard. Tel. 01344 770611

S076B/VF CO-OPERATIVE CRASH INJURY STUDY (CCIS) PHASE VI

The Co-operative Crash Injury Study examines crashed cars and collects hospital data on injured occupants to determine how injuries are caused. It is used by the sponsors to identify which injuries they should be seeking to prevent and how this might be achieved. To maximise the value of the data we are seeking to increase the industrial co-sponsors who currently include four vehicle manufacturers: Ford, Toyota, Honda and Volvo.

The project has been running since 1983 and is now in its sixth phase. It continues to build on the experience of earlier phases and has recently introduced new reporting forms, and all electronic case output is provided to co-sponsors on CD-ROMs. It continues to be a detailed study of a statistically significant sample of accidents within the UK. Investigations will continue to include the performance of vehicle structures and occupant injury mechanisms. This project provides the baseline information, which underpins much of the secondary safety research programme. Close liaison and support from the Police forces and a number of hospitals is being maintained.

<i>Contractors:</i>	TRL, BARC and ICE
<i>Completion date:</i>	2001
<i>Contact:</i>	William John in VSE. Tel. 020 7944 2105

S082D/VF BIOMECHANICAL CRITERIA & NEW GENERATION DUMMY DEVELOPMENT

This project is the UK's contribution to the development and evaluation of new, improved crash test dummies for worldwide use. It includes assessment of new designs of frontal impact dummy chest, arm and leg. It also investigated ankle injuries, which can be difficult to repair and lead to long term impairment. This included accident analysis to identify common injuries, consultations with surgeons to determine the most important injury types and the mechanisms that cause them, computer modelling, and injury reconstruction using limbs from cadavers with ethical committee approval and under carefully controlled medical research conditions.

The work has been successful in increasing our understanding of the mechanisms of lower leg injury and the body's tolerance to them, and highlighting deficiencies in the current crash test dummies used for the design and regulatory testing of passenger cars. This work will be continued in a new project, "Improved Injury Criteria" (S086D/VF) that will correlate the forces measured in the dummy's legs with the risk of injury to human occupants. This work shall feed into future reviews of the Front and Side impact directives and the anticipated draft pedestrian protection directive.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	2000
<i>Reports:</i>	ESV paper presented at Windsor June 98
<i>Contact:</i>	Richard Lowne at TRL. Tel. 01344 770 617 Jim Hand in VSE. Tel. 020 7944 2067

S082E/VF PROTECTION OF CHILDREN IN CARS

This new phase of research will continue to investigate ways to improve the protection afforded to child occupants in cars. It will examine the available databases to determine the types of accident in which restrained children are injured, and the way in which they are injured. This analysis will highlight how child restraints may be improved to reduce further the likelihood and severity of such injuries.

The project will also support the UK's participation in the ISO working group developing a side impact test procedure for child restraint systems.

The Department will also use the research to support negotiations during the adoption of ISOFIX into International child restraint standards (UN-ECE Regulation 44) and final agreement of the side impact test procedure. The research is fundamental to help secure agreement for the universal ISOFIX system that we wish to see introduced.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	December 2002
<i>Contact:</i>	Marianne Le Claire. Tel. 01344 770 980 Jim Hand in VSE. Tel. 020 7944 2067

S083D/VF DUMMY DEVELOPMENT: TO EVALUATE SPINE INJURIES

This project will develop a dummy spine that behaves in a human like (biofidelic) manner and could be used to evaluate the protection offered by vehicle seats. It has built on the work of earlier accident studies, investigating the vehicle and accident features important in causing whiplash (S202H/VF) and lumbar (S202J/VF) injuries. The current design of crash test dummy has been modelled and validated against sled testing. The project is currently developing a computer model of the human spine that will be used to explore potential injury mechanisms. Once an understanding of the important mechanisms has been reached, alternative dummy spines and their responses during impacts will be modelled and refined. The most promising design will then be made and evaluated on the test sled, against the injury studies and understanding of the spinal injury mechanisms.

Progress of the project has just been reviewed and the completion date will be extended until December 2001.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	2001
<i>Contact:</i>	Phil Dixon at TRL. Tel. 01344 770 730 Jim Hand in VSE. Tel. 020 7944 2067

S084D/VF DUMMY DEVELOPMENT: BRAIN INJURY MODELLING

Brain injuries occur in all types of road accident. The current brain injury indicator, Head Injury Criterion (HIC), has significant limitations. In particular it is sensitive to the contact surface so that the same HIC might not indicate the same level of injury for different angles of impact or surface material. This project is developing a computer model that can accept head acceleration data, model the resultant stresses and pressures in the brain and provide an accurate indication of brain damage. This model would be used as the basis for a replacement for Head Impact Criteria (HIC) used in passenger car and motorcycle helmet type approval tests.

The first stage of this project determined that the data provided from a single mass dummy head that could not accurately predict the accelerations experienced by the human brain. A more complex, 3 dimensional dummy head and corresponding computer model have now been developed and this shall be assessed during a series of drop tests, in conjunction with a bi-mass head developed by Strasbourg University.

The project programme is currently being reviewed to allow much of this existing and future work to feed into an EU 5th framework project on head injury. It is anticipated that this will extend the completion date by upto 3 years.

<i>Contractors:</i>	TRL
<i>Completion date:</i>	2000 (subject to review)
<i>Contact:</i>	Charles Oakley at TRL. Tel. 01344 770 851 Jim Hand in VSE. Tel. 020 7944 2067

S085D/VF DUMMY DEVELOPMENT – MODELLING OF ABDOMINAL INJURIES

Studies of accident data have previously shown that a significant number of serious injuries to vehicle occupants occur to the abdomen and it was believed that incorrect positioning of the seatbelt across the stomach was the main cause of those injuries. Initial analysis of accident data revealed that the serious injuries to the abdomen occurred to the organs (liver, spleen, and kidneys) than the intestine and therefore modelling was focussed in this area. A model was developed to explore potential injury mechanisms and indicate how a dummy might be designed to replicate the likelihood of sustaining such injuries in crash tests.

The model gave good overall results but was limited by the lack of a material modelling option for soft biological materials. It was suggested that this model could provide a suitable mechanism for developing this methodology when such option become available.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	November 2000
<i>Report:</i>	Modelling of abdominal injuries sustained in road vehicle accidents (PR/SE/100/00)
<i>Contact:</i>	Tony Sampson at TRL. Tel. 01344 770 287 Jim Hand in VSE. Tel. 020 7944 2067

S088D/VC: AORTIC RUPTURE

The project will review existing studies of aortic rupture and available accident data to establish the current understanding and incidence of the injury. Using this data a computer model of the human heart and aorta function is planned. This model will be validated against existing information on heart function.

The project will make recommendations for using the model to develop an understanding of aortic rupture in automotive accidents and propose further work to explore the mechanisms, and tolerances to aortic rupture.

<i>Contractor:</i>	TRL in partnership with Nottingham City Hospital
<i>Completion date:</i>	2000
<i>Contact:</i>	Charles Oakley at TRL. Tel. 01344 770 851 Jim Hand in VSE. Tel. 020 7944 2067

S091D/VF NEW-CAR ASSESSMENT PROGRAMME

The seven earlier phases of this project have been included in the previous section addressing completed research. This project was originally to develop a satisfactory testing protocol that assesses the comparative crashworthiness of cars. The protocol was based on EEVC test procedures for frontal, side and pedestrian impacts. The current test programme covers a wide range of super mini sized cars with two press launches planned. A further launch is also scheduled to present the test results of new cars from various other market sectors. Future plans will include additional vehicles models from the above groups and new size groups not tested previously.

Since starting the programme the UK has been joined by The Swedish, Dutch, French and German Governments, the European Commission, FIA, European consumer organisations and the AA which pools their combined testing resources using common protocols developed at the start of the programme. The DETR and the other members are working together to improve the test and assessment procedures to improve the quality of the consumer information and assist manufacturers to bring safer products to the market. The project and its test programme have been extended until 2001.

<i>Contractor:</i>	TRL (for the DETR element)
<i>Completion date:</i>	2001 (for the current DETR element)
	Results and updates can also be obtained via the Euro-NCAP secretariat who are responsible for the planning and arrangements the testing process. This is partially funded by the Department through projects S095D/VC and S096D/VC.
<i>Contact:</i>	Lee Thompson at TRL. Tel. 01344 770 605
	Peter O'Reilly in VSE. Tel. 020 7944 2107
	<i>or</i> Roger Worth in VSE. Tel. 020 7944 2115

S092E/ VF REVIEW OF FRONTAL AND SIDE IMPACT DIRECTIVES

Improving the crash worthiness of vehicles so as to minimise occupant injuries has been shown to be one of the most effective means of reducing the level of injuries sustained in road accidents. This project sets out to maximise the benefits expected from the new EU Directives on Frontal and Side Impact by assessing their effectiveness, identifying any failings and putting forward recommendations for improvement. This task will be completed in 2000.

The project also funds UK participation in the international development of a more biofidelic side impact dummy (EUROSID2) and the UK contribution to the collaborative EC project SID 2000 Side Impact Dummy.

<i>Contractors:</i>	TRL
<i>Completion date:</i>	2001
<i>Contact:</i>	Mervyn Edwards at TRL. Tel. 01344 770 723 Steve Gillingham in VSE. Tel. 020 7944 2084

S095A/VF SIDE IMPACT BARRIER – DESIGN AND EVALUATION

The objectives of this project are related to the development of a side impact barrier for repeatable testing and various test methods to evaluate barrier performance, and to improve the barrier requirements and certification procedure set out in the EU side impact Directive. This work has culminated in a wide ranging barrier evaluation programme co-funded by the European Commission and participating member states including the UK. Early indications are that a design-based specification will be recommended to replace the current performance based requirement. The project has been extended to validate the recommendations with a series of full-scale vehicle tests.

<i>Contractors:</i>	TRL
<i>Completion date:</i>	2000
<i>Contact:</i>	Clare Owen at TRL. Tel. 01344 770 157 Steve Gillingham in VSE. Tel. 020 7944 2084

S095D/VC EURO NCAP MEMBERSHIP 2000 & 2001

This simple and low value project is the arrangement used to contribute to the funding of a central secretariat for the NCAP programme. Previously this had been fully funded by the UK whereas now all the members contribute. Euro NCAP manage the process of selecting car models, liaising with manufacturers, test centres and sponsors. Following analysis of the tests the secretariat work with media organisations to secure widespread dissemination of the results to consumers.

An ongoing support function is to continue development of the test and assessment protocols, which is required to keep up with technical developments such as head level

side impact airbags. A pole test can now be part of the EuroNCAP evaluation and the results reflected in the ratings.

Euro NCAP provide the focal point for the whole programme.

<i>Contact:</i>	Roger Worth in VSE.	Tel. 020 7944 2115
	Homepage	http://www.euro-ncap.com/
	Brussels office	00 322 286 8040
	E mail	Euroncap@popost.eunet.be

S096A/VF SIDE IMPACT HEAD IMPACT PROTECTION PHASES 2&3

The EU Directive on interior fittings dates from mid '70s and has obvious weaknesses in the light of the new designs and materials now available. An earlier project S094A/VF investigated possibilities for developing suitable test procedures to reduce the number of head injuries caused in accidents by contact with the roof and the pillars. The first phase of work selected an appropriate headform with which to conduct impact tests and the second phase compared methods of launching the headform against the vehicle interior surface. The third phase involves a combination of accident analysis and correlation work between the proposed test tool and Eurosid dummy data, which will lead to the development of a finalised head impact test procedure. The work is being carried out in collaboration with other European test houses under the guidance of European Experimental Vehicles Committee (EEVC) working Group 13. It also complements work in the USA.

It is anticipated that a further phase of work, under a new project, will validate the new procedure against actual cars. The results of this work are likely to feed into a revised version of UNECE Regulation 21 (interior fittings) and subsequently into a worldwide harmonised standard on interior protection.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	2000
<i>Published reports:</i>	P de Coo, AK Roberts, A Seeck. 'A review of the influence of guidance methods on the performance of the free motion headform for use in interior surface evaluation.' (EEVC WG13 Report – September 1999)
<i>Contact:</i>	Andrew Mellor at TRL. Tel. 01344 770 441 Ian Knowles in VSE. Tel. 020 7944 2095

S096B/VF: COMPATIBILITY OF CARS IN CRASHES

Compatibility and Frontal Impact

For cars to be compatible in accidents their structural, and energy absorbing elements should interact in such a way that the structures of both vehicles engage and dissipate their share of the impact forces in a controlled and predictable manner and with minimal intrusion of the occupant compartment. This should ensure that drivers and passengers are better protected, effectively improving the crashworthiness of all cars such that they minimise the injuries sustained by the occupants of both vehicles when involved in car-to-car collisions.

Three possible test procedures are being investigated which together could be used to assess and improve compatibility and frontal impact performance:

- A full width deformable barrier test at 56km/h with a load cell array behind the deformable element. This could control the distribution of horizontal and vertical forces and so encourage the development of frontal structures that behave in a more homogeneous manner. This should lead to an improvement in structural interaction in car-to-car impacts. The test would generate a “hard” deceleration pulse on the car and restraint systems.
- An offset deformable barrier (ODB) test at 64 km/h with a load cell array behind the deformable element. This could control the global stiffness of cars and limit the occupant compartment deceleration and restraint loading. The test would be a severe test of the structure but would generate a “soft” deceleration pulse on the car and restraint systems, and
- A second ODB test with a load cell wall at an elevated speed to control the overload behaviour of the passenger compartment. This test would not require instrumented dummies.

Side Impact

Three aspects are being investigated to improve further side impact performance:

- A new and potentially international harmonised side impact test procedure, based on experience in Europe, the US and Australasia. Consideration will be given to the development of a new deformable barrier design and possible test procedures to improve occupant protection, taking into account the anticipated introduction of side airbags,
- A pole test to evaluate the protection for all body regions against pole impacts based on an investigation and analysis of available accident data, and
- A test programme to compare the performance of European and US cars designed to meet their respective regional legislation so as to aid the development of a future harmonised test procedure.

The test conditions, performance criteria and limit values to be developed will provide the UK contribution to EU and UN work on future regulatory tests.

Contractor: TRL
Completion date: 2002
Contact: Clare Owen at TRL. Tel. 01344 770157
Steve Gillingham in VSE. Tel. 020 7944 2084

S096D/VC EURO NCAP LAUNCH FEES

This simple and low value project is the arrangement used to contribute to the central funding of the media launches. The crash tested cars are brought together and the results are presented to the invited international media. Previously this cost had been borne by a single host but under this arrangement the cost is proportionate to the number of models each sponsor funds. The Euro NCAP secretariat undertakes the planning and arrangements.

Contact: Roger Worth in VSE. Tel. 020 7944 2115

S202J/VF LOWER BACK INJURIES RESULTING FROM ROAD ACCIDENTS

This is a combined project with Road Safety Division (RSD) and follows the work done under project S093A/VF. That project assessed the levels of disability associated with whiplash injuries presented at Hope Hospital in Manchester over an 18-month period. The patient's vehicles were examined in order to identify the design features that influenced the injury. The work highlighted the presence of lumbar injuries in patients and this project is now using the same methodology to assess these.

The project has recently been extended for one year to allow continued follow-up of the 45% of patients that are still suffering from their injuries. The final report is expected in September 2000.

Contractor: TRL
Completion date: September 2000
Contact: Roy Minton at TRL. Tel. 01344 770 599
Jim Hand in VSE. Tel. 020 7944 2067

S221B/VC: KNEE INJURY FOR PEDESTRIANS

The project is not directly related to our other projects but might lead to further research on knee injury mechanisms and human tolerances similar to that conducted on the ankle under S082D/VF. It is investigating:

- frequency of injuries to the knee in pedestrian adults involved in road accidents,
- type of knee injuries and their long term effects,
- likely mechanisms of the most significant injuries which do occur, and
- potential for future research to explore the proposed injury mechanisms and human tolerances.

After obtaining ethical committee approval for the study, the data on approximately 6,000 pedestrians presenting to the A&E department at Queen's Medical Centre, Nottingham over the last ten years is being reviewed. Those pedestrians with knee injuries caused by a road traffic accident will be identified and their files studied.

The type of injury, possible injury mechanism, human tolerance to such injuries and the level of disability after 6 months will be determined and categorised. This will then provide support, validated by data, for forthcoming Pedestrian Protection directive negotiations.

Through this project, Queen's Medical Centre should also gain valuable knowledge on repair techniques for similarly injured knees.

<i>Contractor:</i>	University of Nottingham
<i>Completion date:</i>	2000
<i>Contact:</i>	Jim Hand in VSE. Tel. 020 7944 2067

S222C/VF: PEDESTRIAN PROTECTION

The project continues from the recently completed project S220C/VF which, in conjunction with the EEVC, developed the test tools and protocols for a future EU Directive to reduce the aggressivity of car bonnets and bumpers towards pedestrians. The principle task for this project is to provide further support during forthcoming negotiations on an expected commission proposal for an EU Directive and to contribute to international research in this area.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	2002
<i>Contact:</i>	Graham Lawrence at TRL. Tel. 01344 770 994 Ian Knowles in VSE. Tel. 020 7944 2095

S310B/VF ADVANCED ACTIVE/ADAPTIVE SECONDARY SAFETY ASSESSMENT

This research is to determine whether casualty levels could be further reduced by the use of “intelligent” safety features. Restraint systems which could change their settings to the most suitable ones by measuring the size and weight of the occupant or by predicting the severity of an impending accident is the most likely example. The first stage identified many other suitable systems for evaluation. This was followed by a cost benefit analysis based on current technology to determine whether these ideas could produce worthwhile improvements to casualty rates. As a result of this analysis, three advanced systems, covering frontal impact, side impact and pedestrian protection respectively were shortlisted for a programme of physical testing. The front and side impact systems include occupant sensing and pre-crash sensing which deploys adaptive airbags and moves the seats away from the immediate danger zone. The pedestrian protection system involves bumper and bonnet airbags in combination with pedestrian sensors using both infra-red and radar technology.

Results so far have indicated that significant occupant casualty savings are possible from the front and side impact systems. Effective pedestrian systems may be further away, but the use of advanced sensor technology, which can distinguish between pedestrians and other objects, could yield significant pedestrian casualty savings in future years.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	2000
<i>Published papers (proposed):</i>	I C P Simmonds, ‘Advanced Pedestrian Protection for Passenger Cars’ <i>Vehicle Electronics Systems 2000 Conference, June 2000.</i>
<i>Contact:</i>	Brian Chinn at TRL. Tel. 01344 770 613 Ian Knowles in VSE. Tel. 020 7944 2095

New projects

S0010/VF EU WHIPLASH/NECK INJURY MODEL

This project will support both the UK's participation in a European consortium examining whiplash injuries (mainly front and side) and additional, possibly independent, work to ensure that potential evaluation procedures for rear whiplash injury are sufficiently robust. The European consortium will include Chalmers University Sweden which has developed theoretical injury mechanisms, the crash test dummy manufacturer TNO and seat manufacturers. The objectives will focus on front and side impact as sources of whiplash injuries. The additional work would focus on rear impact which has already been subject of a considerable amount of research effort in the international community and some dummy development work. Earlier DETR research has focussed on the understanding and modelling of this complex injury in rear impact and it is important that this helps in the further development and choices of evaluation procedures.

Ultimately this work could contribute to a standard to provide protection against whiplash injuries and so bring about significant reductions in the number of such injuries seen in the real world.

Contact: Roger Worth in VSE. Tel. 020 7944 2115

S0011/VF ASSESSMENT OF AIRBAG EFFECTIVENESS

Although airbags are acknowledged to improve the protection offered to car occupants in accidents there have been claims that in some cases they have caused injuries. This project will focus on obtaining a better understanding of the overall benefits and any risks involved with airbag deployments. This shall be achieved by the selection and review of available in-depth accident investigations and any relevant reports. The analysis will identify any differences in injury patterns between airbag and non-airbag equipped cars and so help determine future priorities for occupant protection in airbag equipped cars. This research will help guide policy and possibly lead to regulatory and advisory amendments.

Contact: Roger Worth in VSE. Tel. 020 7944 2115

S0012/VF THE EFFECT OF FRONT/SIDE AIRBAGS ON CHILDREN AND OUT OF POSITION PASSENGERS

It has been shown that the use of airbags in vehicles can help prevent fatal and serious injuries. The majority of current airbag designs are tailored for average height adults (about 5'8") sitting in a "typical" positions and may offer lower levels of protection for small adults and children. There are also potential risks for these categories when sitting very close to the airbag or leaning forward. Children are at possible risk with side airbags (e.g., through sleeping against the airbag module). This project will review accident information from the UK and elsewhere in Europe, and determine the important performance aspects for improved airbag design and consider what further measures could be introduced.

Contact: Roger Worth in VSE. Tel. 020 7944 2115

S0013/VF INTERIOR HEADFORM TESTS

A current DETR research project (S096A/VF) has been contributing to EU work to develop an instrumented headform test to assess the probable injury pattern for a human head striking the interior of a vehicle during an accident. This new project will validate the new test procedure to ensure that it reflects true accident conditions. There is the possibility of matching funding from the European Commission's 5th Framework programme. Once agreement has been reached in Europe on the test procedure, it is expected that discussions will be undertaken in order to develop a harmonised world standard for head protection in cars.

Contact: Roger Worth in VSE. Tel. 020 7944 2115

S0014/VF EVALUATION OF CHILD DUMMIES

Improving the protection offered to child occupants in cars during accidents is an important area. Limitations in the capabilities of child dummies have hampered the assessment of potential injuries and therefore held back advances in child restraint design. A new and more sophisticated dummy which behaves in a more human like manner, and has enhanced measuring capabilities, is now available. This project will seek to evaluate and calibrate the new dummy for use in regulatory testing and the Euro-NCAP programme. Its introduction in the latter programme is anticipated to bring about improved protection for children – which has been highlighted in the published test results as an area for further improvement.

Contact: Roger Worth in VSE. Tel. 020 7944 2115

S0015/VF SIDE IMPACT DUMMY DEVELOPMENT

This project will support the UK's contribution to the development of a new advanced side impact dummy "WorldSID" as part of a collaborative programme under the European Commission's 5th Framework programme. The work is expected to include accident analysis to determine the most important types of injury and their mechanisms. The mechanism and human tolerance to these injuries will also be explored using computer modelling.

This project will focus on the changes in injury pattern that have resulted from developments in vehicle design. Relatively recent improvements including side impact bars and airbags will receive particular attention. Body areas of greatest concern include arm, shoulder, and hip, and the results will feed into international discussions leading to improved regulation and better vehicle design.

Contact: Roger Worth in VSE. Tel. 020 7944 2115

S0017/VF AN ASSESSMENT OF CARS FOR SMALL DRIVERS

Cars are generally designed around 'average' male occupants. This can cause difficulties for the smallest of drivers in operating the vehicle controls and possibly reduce the protection offered by the vehicle's safety systems. The closeness of such drivers to the steering wheel and its airbag is of particular concern. This research project will assess the problems encountered by small drivers before exploring how vehicle design could deliver improvements to make vehicles more acceptable and safer for small drivers. The research will also consider the scope for providing after-market kits for adapting existing vehicles. The objective being to ensure that all drivers are well protected and are able to drive their vehicle safely, taking into account their size or seating position.

Contact: Roger Worth in VSE. Tel. 020 7944 2115

S071D/VF IDENTIFICATION OF ACCIDENT INJURY REDUCTIONS FOLLOWING THE INTRODUCTION OF EURO-NCAP

Results from tests show that Euro-NCAP is having a major effect on the safety design of cars. However, if it is being effective in reducing injuries, these effects should start to become identifiable in accident studies and as more cars perform well in the Euro-NCAP tests, so their better protection should start to become apparent in Stats 19 and CCIS. An analysis of these accident databases should provide information about the benefits being derived and give useful feedback for technical and policy considerations.

Contact: Roger Worth in VSE. Tel. 020 7944 2115

S071E/VF “BLACK BOX” ACCIDENT DATA RECORDER DATA COLLECTION

Assessment and the understanding of crash severity is a fundamental element of all vehicle safety programmes. In accident investigations crash severity is assessed and it is used in most analyses of the data collected. This information forms the basis upon which the severities of test procedures are decided. For many years, “delta V” has been the preferred variable, but in many accidents can not be calculated and so Equivalent Test Energy or Speed is used and this is inherently flawed. In the case of side impact, however, impact speed may be more appropriate than delta v. It is becoming increasingly clear that the algorithms used to calculate delta V produce increasingly inaccurate values as impact overlap decreases. Further to this, the stiffness coefficients are becoming more rapidly outdated.

With the increased sophistication of restraint systems so more sophisticated ways of describing impact severity are needed. For some time, mean acceleration has been used by car manufacturers to describe frontal impacts but even this is too crude to describe the impact adequately for restraint system triggering.

The fitting of “Black Box” data recorders, either in all cars or in fleets, has been considered for many years but cost or inadequate technology has generally stopped their development. With current technology, it should be possible to develop purpose built recorders or to use the data recorded by airbag triggering systems to provide a complete deceleration time history for the car during the accident. This could then be used to compute a wide range of severity parameters. With this information, injury risk could be related to more appropriate measures of severity which could then be used in the design of future test procedures. It would also provide sound data on which to base future decisions on regulatory test speeds.

This project would look at the feasibility of obtaining crash severity data from special or currently existing equipment. It would go on to trial the equipment in one or more fleets of vehicles and analyse the data in relation to the injuries suffered.

Contact: Roger Worth in VSE. Tel. 020 7944 2115

S082F/VF AIRBAG DEPLOYMENT CHARACTERISTICS AND ADVANCED SYSTEMS

This project will gather and analyse the data about a vehicle’s accident that its electronic control systems already measure and record. It is anticipated that this data will include pre impact speed and crash severity and would be used by the vehicle’s systems to determine exposure to risk and which safety systems should be activated to provide the best protection to occupants. Vehicle manufacturers and safety system suppliers will analyse this information and the resultant injuries which will enable them to determine the optimum conditions for the operation of advanced safety systems such as two stage airbags and seatbelt pretensioners.

The department will use it to gain an accurate understanding of real accident severity. Historically we measured skid-marks to determine vehicle speed but vehicles fitted with anti-lock brakes do not skid. We therefore need to measure injury severity and be able to

correlate this to accident severity to gauge the success or failure of safety systems. This will assist us in assessing them in Euro-NCAP tests and if appropriate draw up new regulations catering for these and similar improvements entering the market in the near term.

A further element of the project would build on the existing DETR research into more advanced active adaptive systems (S310B/CA) which predict and react to the severity of the accident and their potential to reduce casualties. The work would explore a broad range of accident scenarios, including European data, than was possible with the original work; it would use modelling and some testing to evaluate the extra benefits of such systems using anticipated practicable technology. This should both foster a wide European consensus, encourage the take up of such technologies in robust form by industry and lead to the development and acceptance of test standards for such advanced systems.

This element of the project would be part of an EC project on occupant protection.

Contact: Roger Worth in VSE. Tel. 020 7944 2115

S083F/VF OPTIMISED OCCUPANT PROTECTION SYSTEMS

The Euro-NCAP Consortium regularly assesses the safety performance of new cars and makes the results widely available to the public so that they can take safety into consideration when buying a new car. The overall effect of this has undoubtedly been beneficial, as several manufacturers have improved structural performance and safety equipment levels before testing.

There is some concern, however, that some manufacturers could tune their vehicle safety systems to extract the best performance in the Euro-NCAP or legislative tests with less emphasis on their performance in other accident circumstances. This could have implications for occupant safety if gains are made at the detriment of performance elsewhere.

This project will investigate whether vehicle restraint systems are being optimised for particular impacts and will also follow international restraint system developments to maximise the protection offered to short and elderly drivers. It will make recommendations to ensure that occupant restraint systems are optimised for all occupants in all accident situations.

Contact: Ian Knowles in VSE. Tel. 020 7944 2095

S086D/VF IMPROVED INJURY CRITERIA

The objective of this research would be to improve current knowledge on injury mechanisms and the estimates of human tolerance to types and level of injury. The potential for vehicle occupant injuries is currently assessed with dummies that are commonly accepted to be in need of improvement both in terms of achieving a more human like response and in relating the measurements to injuries. The Department is already involved in the development of dummies including the lower leg and spine.

This project will continue that work in other areas and will again include the measurement of human tissue properties. This will be particularly beneficial for existing work including the knee injury criteria for the pedestrian protection proposal and to support the modelling of injury mechanisms in other projects on spine and abdomen. It could also be extended to consider other body areas that are identified by accident analysis as not being adequately protected by the current dummy and injury criteria, such as arms.

Contact: William John in VSE. Tel. 020 7944 2105

S087D/VF NON LIFE THREATENING INJURY – IMPAIRMENT SCALES

Recent improvements in vehicle structure and restraint systems (such as the introduction of airbags and seat belt pretensioners) have resulted in a decrease in fatal and serious injuries to vehicle occupants. Attention is therefore now focusing on non life threatening injuries, typically AIS 1 to AIS 3, that may result in short or even long term impairment. Common examples of such injuries are whiplash and ankle injuries. These injuries are high in medical cost and affect lifetime mobility and employment. This project will investigate the feasibility of developing an Impairment Scale that would enable cost benefit analysis to target more effectively the most important safety issues. Vehicle manufacturers and legislators are expected to consider more of the non life threatening injuries that may result in high levels of impairment. The development of a classification scale will enable the identification of such injuries in accident studies and allow the Department to target future priorities more accurately.

Contact: William John in VSE. Tel. 020 7944 2105

S093E/VF SEAT TEST PROCEDURE

The Department is already working with Hope Hospital in Manchester to investigate lumbar spine injuries, and in a separate project to develop a dummy spine with a more human like response that could be used to assess and control these injuries (project S083D/VF). This project will first use other accident and injury databases such as CCIS to explore in detail the accident circumstances that lead to spine injuries. This data will be combined with that from the whiplash and lumbar studies at Hope Hospital to determine the circumstance that should be replicated in a seat test procedure. As soon as the dummy spine is available this project will proceed with the development and evaluation of a test procedure for seats. Spine injuries, particularly whiplash that can lead to long term disability are one of the most expensive road accident injuries to the nation. Previous research (S202/VF) suggested that the design of the whole seat, rather than just the head restraint is important in reducing whiplash injuries.

Contact: William John in VSE. Tel. 020 7944 2105

S094E/VF ADDITIONAL VEHICLE ASSESSMENT PROCEDURES

The full scale frontal and side impact tests that are specified for new vehicles are expensive and so preclude the testing of more than one model variant and more than one test orientation (50th percentile male dummy, in the mid seating position, at 56 km/h). There is a need to ensure that the same degree of protection is offered by all model variants to all occupant sizes, and to assess the effects of minor changes to vehicle design. To some degree this has already been recognised by the provision of sub-systems tests to assess the performance of components and/or parts of the vehicle structure, without recourse to full scale testing, in the existing regulations. Unfortunately these procedures are far from technically satisfactory for impact testing.

This project will assess the feasibility of using computer modelling as part of the type approval process to assess the whole range of protection offered. The most important part of this research is the development of methods to evaluate the accuracy of the model. Current models are typically validated against data from full scale crash tests, which is largely acceleration data from various points on the vehicle. The performance of key structures is evaluated from this data and not measured directly. An alternative approach would be to measure the behaviour of specific components, which are important to the vehicle's performance, and use the data to improve and validate the model. Development tests would include small scale laboratory tests, component tests and full scale crash tests. The possibility of using any of these tests as a sub-systems test as an interim measure would also be evaluated.

This project's goals may be best achieved through the collaboration of manufacturers in allowing us access to their computer models.

Contact: William John in VSE. Tel. 020 7944 2105

THEME 2

Vision/conspicuity safety

Vehicle lighting plays a crucial role in preventing accidents and therefore falls within the general description of primary safety (defined as “*all factors which as far as possible reduce the risk of an accident occurring*”). Headlamps illuminate the road ahead allowing the driver to identify his path and any obstacles upon it. But poorly adjusted or over powerful lights can cause glare for oncoming drivers and reduce vision significantly. Other lights, such as rear fog lamps and direction indicators, identify the vehicle position or the driver’s intentions.

Projects included within the theme cover advanced second generation lighting technology (including ultra-violet headlamps), infra-red enhancement systems and a study of the reasons for the poor performance of rear lamps on commercial vehicles. Many subjects in this area are taken forward at international level and can involve lengthy negotiation.

Specific objectives in this theme are:

- examining the effectiveness of retro reflective markings, warning beacons and flashing lights on pedal cycles – by 2000,
- investigating the poor performance of rear lamps on heavy vehicles – by 2000,
- providing supporting evidence for EU discussions on glare – by 2000,
- investigating the automatic illumination of stop lamps – by 2001, and
- implement a call-off contract to assess (at short notice) new vehicle lighting.

Recently completed projects

S270F/VC MOTOR VEHICLE AND PEDAL CYCLE CONSPICUITY

This project has examined three particular conspicuity issues; warning beacons, retro-reflective contour markings as conspicuity aids on motor vehicles and flashing lights on pedal cycles.

Warning beacons by definition need to be conspicuous so this project investigated the effect of three common variables; flash rate, colour and position. The research also highlighted problems with glare from certain combinations and applications. Retro-reflective markings on trucks were found to have benefits and problems. This work has already contributed to a change in the UN ECE regulations, which will allow a wider range of colours to be used. Flashing lights for pedal cycles have been studied for their effectiveness in making cyclists conspicuous to other road users. The conclusions were that the flashing front lights were not very effective whilst the flashing red rear lights were as conspicuous as conventional rear lights.

Consideration was given to the installation and performance of such aids so as to maximise their conspicuity benefit without producing excessive glare and to ensure that the appropriate signal is given to other road users in coherent and consistent ways. The report includes recommendations for amendments to domestic and European legislation regarding these devices so as to improve vehicle conspicuity.

<i>Contractor:</i>	ICE
<i>Completion date:</i>	2000
<i>Report:</i>	Available from ICE (summer 2000)
<i>Contact:</i>	Neil Bowerman in VSE. Tel. 020 7944 2066 Dean Southall at ICE. Tel. 01509 236161

S320E/VE DRIVER'S FIELD OF VISION IN LARGE VEHICLES

Accident studies have shown that some accidents are caused because drivers of large HGVs and PSVs do not notice vulnerable road users. This project therefore aimed to research the scope, causation and possible solutions to the problem of a large vehicle driver's vision.

Relevant accident data was analysed to identify the extent to which the driver's vision was a contributory factor to the accident. Then to ascertain the physical causes of ineffective vision, a modelling and reconstruction technique was adapted. This method was also used as the means to assess potential field of view improvement strategies and to generate graphic representations of the results.

The report concludes that the most cost effective means for improvement to the driver's field of vision entailed a combination of additional, modified and repositioned mirrors. It also recommends that any future evaluation work on this topic would require the

involvement of manufacturers of large vehicles to investigate the cost effectiveness of any proposed solutions.

DETR is in the process of initiating a small scale trial of the proposed amendments to the driver's field of vision in order to assess the feasibility of the recommendations of the research.

<i>Contractor:</i>	ICE Ergonomics Ltd
<i>Completion date:</i>	November 1999
<i>Report:</i>	S320E/VE: Unpublished report. <i>Drivers' field of view from large vehicles</i> . November 1999
<i>Contact:</i>	William John in VSE. Tel. 020 7944 2105 Dean Southall at ICE Ergonomics. Tel. 01509 236161

Ongoing projects

S270D/VD REAR SIGNAL LIGHTS, CV POOR PERFORMANCE

This project is investigating the causes of poor performance of rear signal lamps on commercial vehicles and whether it is feasible to establish a test of the performance as part of the annual roadworthiness test.

The poor performance of rear signal lamps on large vehicles is well recognised as a problem that compromises safety. Large, slower moving vehicles present a real hazard to other road users if the rear lights are difficult to see. Previous studies have indicated that, even when approved lamps are fitted to vehicles, they may not satisfy the minimum performance requirements when installed. In some countries, checks on the intensity of lamps are carried out as part of the annual roadworthiness test.

This project has confirmed that the in-service performance of the rear lamps on a significant number of vehicles is still below even the minimum requirement for the components at the time of approval. A brief investigation of these lamps on vehicles in-service indicated that low voltage at the lamp holder was the most significant reason for poor performance.

The research is now investigating the causes of that low voltage, to determine whether this is a design or maintenance issue and whether it is feasible to check lamp performance as part of the MOT scheme. Consideration will have to be given to the cause of low performance, the availability of suitable equipment and the pass criteria.

<i>Contractor:</i>	BSI Testing
<i>Completion date:</i>	2000
<i>Contact:</i>	Neil Bowerman in VSE. Tel. 020 7944 2066 David Price at BSI. Tel. 01442 230 442

S270J/VD VEHICLE LIGHTING: IMPROVING LAMP PERFORMANCE AND REDUCING GLARE

This project is investigating the fundamental principles behind drivers' perception of glare with the objective of establishing a basis against which future headlamp performance requirements might be assessed, as well as determining whether headlamps manufactured to current regulations provide adequate control of glare.

The project will also investigate the potential of new technologies, such as ultra-violet (UV) headlamps, near infra-red and far infra-red vision enhancement systems, have the potential to improve the range of drivers' vision without increased glare to on-coming drivers. However, such technologies will not show all road features and may cause drivers to drive faster in the perception that they have better visibility. This could result in a reduction in road safety.

Initial conclusions are that a significant proportion of people experience glare problems from current technology lighting, even when headlamps are correctly aligned.

The project has been extended to also investigate concerns about the possible glaring effects of coloured filament lamps in headlamps and potential problems with the alignment of HGV headlamps and the reasons for their high failure rate in the annual roadworthiness test.

<i>Contractor:</i>	ICE Ergonomics Ltd
<i>Completion date</i>	2000
<i>Contact:</i>	Neil Bowerman in VSE. Tel. 020 7944 2066 Dean Southall at ICE. Tel. 01509 236161

S321E/VE AGRICULTURAL VEHICLES – CONSPICUITY & REAR VISION

Previous research into agricultural vehicle accidents highlighted the fact that these vehicles have an increased accident risk when turning right, and also with vehicles colliding with them that are approaching from the rear. Restricted driver vision to the rear of the vehicle and poor frontal and rearward conspicuity were believed to be contributory factors in these accidents.

This project examined the issues affecting the drivers rear vision from agricultural vehicles by assessing the field of view available to the driver during the 'typical' use of the vehicle. This included the view from the vehicle during the use of trailed implements, tools and trailers of different shapes, sizes and configurations. An assessment of the condition and view from mirrors fitted to the vehicle was also carried out which considered their adequacy for the task.

The general condition of the lights on the vehicles and trailers was examined by the use of a farm survey that visited 21 farms selected at random in the Leicestershire and Nottinghamshire areas. At each of the farms the vehicles and trailers that are used on public roads were examined for compliance to legal requirements. A questionnaire was given to the drivers of the vehicles for completion or was completed by the researcher with answers received from the driver of the vehicle.

Other factors examined studied if:

- reflective materials could aid the conspicuity of vehicles and trailers and improve the detection and identification times for other road users,
- additional lights fitted to the vehicle would inform other road users more quickly of an intended change in the speed or direction of the vehicle, and
- changes in the use of the amber flashing beacon would aid identification of these vehicles.

The conclusions of this research indicate that the drivers' vision and conspicuity of agricultural vehicles and trailers could be significantly improved. Recommendations included:

- Vehicle side view mirrors should be width adjustable and remotely controlled to allow the driver of the vehicle to be able to see other vehicles around any projecting load,
- High level indicators should be fitted to vehicles to allow other road users to see signals made by the driver in anticipation of a manoeuvre even when the vehicle is carrying a load,
- Outline marking be fitted to the tractor to allow other road users quicker and easier visual identification of the vehicle,
- The yellow warning beacon is used at all times when the vehicle is on a public road and prohibited from use in an 'off road' environment to aid recognition of a slow moving vehicle. (It is also suggested that the beacon be connected to a visual tell tale lamp in the drivers cab),
- Vehicle indicators should be self-cancelling, have a tell tale lamp fitted in the drivers vision and also have an audible warning to prevent 'false signalling' to other road users, and
- A system of time based roadworthiness inspections should be implemented that will examine the lighting, markings and mirrors of agricultural vehicles, trailers and implements to ensure that these aspects conform with legal minimum requirements.

Several other areas have been identified for further research.

<i>Contractor:</i>	Open Ergonomics
<i>Completion date:</i>	2000
<i>Contact:</i>	William John in VSE. Tel. 020 7944 2105 Nigel Robertson at Open Ergonomics. Tel. 01509 218 333

S322E/VF QUALITY AND FIELD OF VISION – A REVIEW

This project is reviewing the influence of optical effects on the perception of drivers and riders and the adequacy of existing controls on the quality and field of vision in light duty vehicles and protective headgear. This includes tinting, windscreen condition and the use and positioning of wider structural members to improve crash worthiness, aerodynamics and rigidity.

Firstly, the project will review available research to highlight any problem areas or those areas which need further investigation. Following on from this will be interviews with riders and drivers to ascertain their views and experiences and a test programme to fill any gaps and quantify the risks and benefits of various factors. The project will then identify any differences between the ideal, legislated and actual vision and if any significant discrepancies arise it will propose possible means of improvements.

Contractor: ICE Ergonomics
Completion date: 2000
Contact: Steve Gillingham in VSE. Tel. 020 7944 2084
Sharon Cook at ICE. Tel. 01509 283 337

New projects

S0020/VD CRITERIA FOR THE AUTOMATIC ILLUMINATION OF STOP LAMPS

Advanced vehicle systems have been developed that either apply the brakes for purposes other than retardation, (e.g. traction control, or stability control systems), or cause a significant deceleration, but without necessarily applying the brakes (e.g. adaptive cruise control or intelligent speed adaptation). With the advent of these modern vehicle control systems, consideration needs to be given to when the following driver ought to be informed that the vehicle is being slowed. If illumination of the stop lamp is not to be reliant upon the operation of the brake pedal, what criteria should be used? The project will help formulate policy in this area and make recommendations for common requirements for the automatic illumination of stop lamps.

Contact: Neil Bowerman in VSE. Tel. 020 7944 2066

S0021/VD CALL-OFF CONTRACT FOR VEHICLE LIGHTING

There is a need for DETR to be able to respond to international negotiations by carrying out one-off tests on new lighting products to inform and support its policy. These tests will deal mainly with lamps for cars/LGVs but may also include system installation tests. They provide essential scientific information. We currently assess these products on an ad-hoc basis using low value single tenders and the use of a call-off contract will reduce the administrative burden of this procedure and provide test results quicker.

Contact: Neil Bowerman in VSE. Tel. 020 7944 2066

S271B/VD DAYTIME RUNNING LAMPS – MINIMISING SIDE EFFECTS

To give detailed consideration to the benefits and risks of the various methods of providing a DRL function and to determine which should be the preferred in the short, medium and long term. This will largely be a literature review, but could link into the project on glare from headlamps. The EC is considering supporting the implementation of DRLs on all vehicles so it is necessary to evaluate which method of achieving this end would be the most desirable.

The European Commission previously funded a review of the current information on the effectiveness of DRLs by a Netherlands research organisation SWOV. VSE funded TRL to analyse and comment on the resulting SWOV report. Discussions are continuing on the benefits of DRLs. At this point it is necessary for the UK to understand the alternative methods of implementing DRLs. Different technical solutions will have different transitional risks, benefits and needs. Some estimates of the benefits have been very significant. However, some estimates of the running costs and increases in CO2 emissions possible through different technical solutions need examining. This research will assist in this understanding.

Contact: Neil Bowerman in VSE. Tel. 020 7944 2066

THEME 3

Bus/coach safety

In general terms large passenger vehicles in the UK have a good occupant safety record, but there is always the potential for a large number of casualties in a single accident. There is significant regulatory activity both nationally in response to targeted concerns on child safety, and within the EU on initiatives to achieve a single market for these vehicles. Research on PSV safety guides policy and assists in the negotiation of appropriate safety standards for these vehicles.

Specific objectives in this theme are:

- investigating the scope for better design of buses to reduce occupant injuries and to make recommendations in support of policy development and EU negotiations – by 2000/2001,
- identifying fire risks in buses and coaches and to propose alternative designs, leading to the implementation of an EU directive and possible amendment – by 2001,
- investigating the scope for a new bus assessment programme seeking to provide consumer-type information to vehicle operators and users – by 2004
- considering the effect of seat belts on the roll-over protection for buses – by 2001, and
- researching the effect of vehicle fires on passengers – leading to a policy review in advance of UK legislation implementing an EU directive – by 2001; and possibly seeking amendments to European legislation in the longer term – by 2004.

Recently completed projects

S070P/VE IMPROVING PERSONAL CASUALTY DATA FOR BUS AND COACH ACCIDENTS

This project was undertaken to identify patterns and trends amongst accidents involving passenger-carrying vehicles and to identify vehicle-based and other counter measures that could help to prevent accidents or reduce injury levels. The project looked at police accident reports and other data to ascertain the location and nature of all casualties and to establish whether modifications to vehicle design or construction could reduce the number or severity of accidents.

The project concluded that between 1986 and 1996, the numbers of passenger carrying vehicles with more than 16 seats involved in fatal accidents fell from about 200 per year to 140 per year, a drop of 30 percent. The numbers involved in fatal or serious injury accidents fell by 24 percent from 2,100 to 1,600 per year over the same period. For occupants, PSV travel is much safer than other forms of road transport, having much lower risks of death or serious injury per unit of distance travelled. Unlike other vehicle types, however, the risks of death or serious injury for PSV occupants do not seem to have fallen over the course of the last decade or so. The project reviewed the data gathered from the different sources and concluded that the most effective vehicle design changes were the fitting of anti lock or electronic braking systems, the use of pedestrian friendly front structures and the use of seat belts by PSV occupants.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	1999
<i>Report:</i>	Improving Personal Casualty Data for Bus and Coach Accidents (un-published) Summary report to be published late 2000
<i>Contact:</i>	Daniel Elford in VSE. Tel. 020 7944 2082 Barry Fenn at TRL. Tel. 01344 770 681

S082H/VE ASSESSMENT OF THE SAFETY OF PASSENGERS IN URBAN BUSES

This project aimed to provide information on the safety of seated, standing and wheelchair passengers in urban buses. The first step was to review accident data concerning injuries to passengers and assess current safety on buses, both of which highlighted that the more significant injuries are caused to adults and the elderly.

One issue identified in the report was that improvements in the performance of the buses required to help integrate them into the traffic flow could also have a detrimental effect on the safety of passengers due to higher levels of acceleration and deceleration possible. It was also identified that passengers moving around in the bus, moving to or from seats, were more at risk to injury than those seated. The issue of driver workload and environmental conditions may also be a contributory factor in the number of accidents.

The report also made several internal design recommendations to help increase safety for passengers but realised that moving around on a moving bus would always carry some risk. The report therefore proposed that a passenger safety leaflet is formulated to provide advice for passengers and studies are undertaken to see the effect of passengers remaining in their seats until the bus is stationary.

<i>Contractor:</i>	ICE Ergonomics Completion date: 1999
<i>Report:</i>	Assessment of the safety of passengers in urban buses (un-published) Summary report to be published late 2000
<i>Contact:</i>	Daniel Elford in VSE. Tel. 020 7944 2082 Richard Bird at ICE. Tel. 01509 283 360

S170A/VE RISK ASSESSMENT OF BUS SAFETY FEATURES IN THE DRAFT EU DIRECTIVE

The European Commission proposed a new directive on buses and coaches but there were concerns that this may have safety and economic implications for the UK and it was against this backdrop that this project was undertaken. This project reviewed the proposed directive against existing UK regulations, made assessments of current casualty patterns and looked at the issues arising out of the proposed legislation.

The report highlighted areas where the current text of the directive did not align with current UK requirements and attempted to qualify the likely effect of these differences. On the basis of the safety analysis and industry consultation the following amendments to the Directive were recommended:

- the technical provisions of proposed Disability Discrimination Act (DDA) regulations be used as the basis for improvement of the accessibility provisions of the Directive,
- the mandatory requirement for Class I vehicles to be accessible be limited to vehicles over 7.5 tonnes or more than 30 seats,
- that a minimum seat width be specified for all vehicles in line with existing UK regulations such that there is no need for a derogation for narrower seats in narrow vehicles or that there be no time limit on the derogation,
- seat spacing be a minimum of 650 mm for all public transport vehicles to meet the needs of accessibility whilst minimising the reduction in seating capacity. The Directive permits a 600 mm seat spacing for small vehicles which should be retained as the majority of these vehicles in the UK are used other than for public transport,
- the number of service doors be limited to avoid any requirement which would result in the fitment of centre exit doors on a mandatory basis,

- emergency doors be permitted on the off-side and that such doors may be made mandatory in the UK to maintain current safety provisions with which passengers are familiar,
- a minimum separation of 40% of the passenger compartment length of at least two doors be maintained regardless of which side the doors are fitted and whether or not the doors be service or emergency doors,
- the emergency door step height be a maximum of 1000 mm for single deck buses and the lower deck of double deck buses. Since many coaches are used outside the UK where the continental exit is used as a service door consideration should be given to the application of service door requirements,
- the minimum height of the emergency door aperture should not be less than 1370 mm as specified in existing UK regulations,
- gangway and floor slopes be limited to 8% maximum thus avoiding the need to restrict the areas in which passengers may stand and assisting with the needs of mobility impaired passengers,
- the area in which passengers may stand is no further forward than the rear or centre of the driver's seat, and
- handrail provision for Class I, II or A vehicles should be throughout the vehicle and not be limited to areas where passengers may stand. Particular attention should be paid to wheelchair area and the access to that area.

<i>Contractor:</i>	Sian Thornwaite Consultants
<i>Completion date:</i>	1998
<i>Report:</i>	S170A/VC; <i>Risk Assessment of the bus directive safety features.</i>
<i>Contact:</i>	Danny Elford in VSE. Tel. 020 7944 2082

S300A/VC ROLL STABILITY OF LARGE PASSENGER VEHICLES

Proposed European legislation did not include the need for a tilt test and this project sought to determine if tilt testing was necessary or whether an analytical method represented a satisfactory alternative. The work involved comparing practical tilt tests on three different vehicles against computer simulations, taking account of a range of vehicle types, axle configurations and suspension features.

The report concluded that the current UK tilt test had contributed to maintaining the relatively low numbers of bus and coach rollover accidents in the UK and that tilt testing is a much safer and more accurate option. The report, however, stated that current legislation governing tilt tests was outdated and needed amending to reflect with present day technology.

<i>Contractor:</i>	Anthony Best Dynamics
<i>Completion date:</i>	1998
<i>Reports:</i>	Roll Stability of Large Passenger Vehicles. 1998
<i>Contact:</i>	Danny Elford in VSE. Tel. 020 7944 0282 Anthony Best at Anthony Best Dynamics. Tel. 01225 867575

Ongoing projects

S081G/VC MINIBUS/COACH SEAT BELT SYSTEMS, AND BUS SECONDARY SAFETY FEATURES

The project opened with a review of data on accidents and previously published work together with information on the construction of seats and vehicles. The aim was to provide improved test procedures for minibus and coach seat belts, seats and anchorage's.

The accident review established a revised 'crash pulse' which was considered more appropriate for certain sizes of minibus. The second phase of the project involved testing seat belt systems in vehicle bodysells to establish the feasibility of designing such systems to meet the revised pulse. The project went on to consider the problems with some common retrofitted seatbelt installations. A number were tested to provide advice for the Vehicle Inspectorate (VI) examiners who assess these vehicles during a mandatory installation test of their seat belts. The VI is now using the results of that task.

The research testing element of this project is complete and the final report is being prepared.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	2000
<i>Contact:</i>	Ian Knowles in VSE. Tel. 020 7944 2095 Graham Lawrence at TRL. Tel. 01344 770 994

S111D/VE FIRE RISKS AND PREVENTION IN LARGE PASSENGER VEHICLES

This project aims to provide information on vehicle fires, causes, associated risks and the potential to minimise their effect. The Vehicle Inspectorate receives notification of approximately 70 vehicle fires each year, many of which result from defects, rather than collisions. However, whilst collision fires are rare, evidence shows that they can result in a high numbers of fatalities.

The project will examine the tests and procedures required by the European Directive 95/28/EC, concerning the flammability of interior materials and report on its suitability as a domestic standard.

The incidence of fire in large passenger vehicles is low and there is a common view, between industry and the Government, that the most effective solution was passenger evacuation rather than attempting to extinguish the fire. There has been little incentive, therefore, to develop and fit systems designed to protect against fire by vehicle manufacturers. Reviews of experimental research, however, showed that escape times from buses and coaches in some circumstances, for example when the bus was on its side, were somewhat longer than the time taken for the fire to spread and become harmful. Smoke generation in the passenger compartment was found to be particularly rapid and caused breathing problems.

It was found that whilst fires were most likely to start in the engine compartment, the seat material was the most flammable component and the most likely to cause the fire to spread. Compartmentalisation of the engine bay was thought to be the best way to reduce the risk of the fire reaching the passenger area. This could be achieved with the use of intumescent sealing materials and better protection and routing of cables and fuel lines.

The examination of the performance of fire extinguishers showed that powder extinguishers should not be used in the passenger compartment because the large quantity of particles emitted can cause breathing difficulties for passengers whilst evacuating the vehicle. Water based systems work well in the passenger compartment but are not as effective as powder systems in extinguishing engine fires. Automatic systems were found to be ideal for engine compartments but were not suitable for the passenger compartment because there is no control over the extent and direction of the spray. Conversely, manual systems were judged to be effective only if the operating staff were trained in their use.

Overall, it was concluded that solutions could and should be implemented. It was recommended that the following could be introduced:

- engine compartmentalisation,
- reduce the flammability of certain components, especially seat materials,
- develop and fit improved extinguishing systems,
- train staff in the use of extinguishing systems,
- train staff in evacuation procedures for a range of circumstances, and
- improve signs for instructing passengers in the event of an emergency.

<i>Contractor:</i>	TRL
<i>Completion:</i>	2000
<i>Contact:</i>	Daniel Elford in VSE. Tel. 020 7944 2082 Barry Fenn at TRL. Tel. 01344 770 681

New projects

S0016/VF SEAT BELT RESTRAINTS: SPECIFIC REQUIREMENTS FOR MINIBUSES & COACHES

Current seat belts in mini buses and coaches are designed around an average adult occupant. Although these provide valuable protection for child occupants they are not optimised for children in the same way as child restraints used in cars. This project will review accident data and explore the degree by which protection for children could be improved.

It is also essential that seat belt anchorages are properly assessed to ensure maximum protection is provided for passengers. The project will also, therefore, research and develop a low-volume type approval system for seat belts and anchorages in these vehicles. The destructive nature of anchorage testing applied to cars is high cost and would be uneconomic for the low volumes associated with bus and coach manufacture.

Contact: Ian Knowles in VSE. Tel. 020 7944 2095

S0022/VE SAFETY AND PASSENGER FRIENDLY ASSESSMENT OF NEW BUSES

Recently the EuroNCAP programme has demonstrated that alternative non-regulatory approaches can deliver noticeable safety benefits to motorists and road users. A similar general concept could be developed which may offer purchasers and users of buses & coaches benefits in both the safety and the comfort of vehicles. This work could underpin the Quality Partnership concept outlined in the Integrated Transport White Paper between local authorities and bus operators. The project will consist of two phases; a scoping study and a follow-up development phase. Areas of interest include, for example, key safety features such as driver accommodation, access and exits, road holding and ride comfort, construction safety. The International Road Transport Union already operates a similar system for coaches, which is used for vehicle classification in many countries throughout the world.

Contact: Daniel Elford in VSE. Tel. 020 7944 2802

S0023/VE THE EFFECTS OF BELTED PASSENGERS ON ROLL-OVER PROTECTION IN BUSES

Roll-over protection for buses has been a mandatory legislative requirement for several years. However, this international (UN-ECE) regulation pre-dates the widespread introduction of seat belts in buses and coaches. While the regulation allows for survival space in the event of vehicle roll-over, it does not take account of the changed dynamics due to the fixed passenger mass resulting from seat belt wearing. This research will investigate the effect of seat belts on the roll dynamic and consider whether regulatory amendments are appropriate.

Contact: Daniel Elford in VSE. Tel. 020 7944 2802

S0024/VE PASSENGERS AND THE FLAMMABILITY OF BUS & COACH INTERIORS

Directive 95/28/EC sets maximum flammability requirements for materials used in the construction of passenger accommodation in buses and coaches. The directive does not, however, consider the effects of burning or smouldering material on passengers. This research will examine aspects associated with flammability such as the smoke toxicity, ignition temperatures, flame propagation and its effect on passenger vision, etc. It will also consider vehicle factors which influence fire propagation and what improvements could be incorporated in good vehicle design. The results of this research will feed into a policy review and possibly to the UK seeking amendments to European Legislation to ensure better passenger safety. Although similar work has been carried out for car interiors, this project will focus on materials that are specific to bus and coach construction.

Contact: Daniel Elford in VSE. Tel. 020 7944 2802

S083H/VE PREVENTING PASSENGER EJECTION FROM BUSES, COACHES AND MINIBUSES

Rollover accidents, inadvertent operation of exits and overbalancing of passengers in vehicles result in a consistent number of passenger ejections each year. The increasing provision of seat belts in coaches and minibuses will go some way towards reducing these. However, seat belts on their own cannot prevent partial ejection, which often results in severing of limbs. There is still a need to protect bus passengers and others who do not wear belts.

Pre-tender discussion identified substantial elements of relevant previous work from the US which needs to be analysed. Consequently the work content is being revised and is likely to involve a detailed literature search to identify the current depth of knowledge in this area. The project will then look at applying this technology to the large passenger carrying vehicle industry. An invitation to tender is expected late 2000.

Contact: Daniel Elford in VSE. Tel. 020 7944 2802

THEME 4

Braking/stability safety

This theme concerns the main primary safety issues relating to the dynamic characteristics of a vehicle and its controls. These controls are fundamental to the safe use of vehicles on the highway and cover diverse issues such as the roll stability of cars during cornering to the electronic systems underpinning advanced braking designs. Research in this area is often in response to technological development and is necessary to ensure that minimum standards are met and vehicle safety is ensured.

Specific objectives in this theme are:

- evaluating a new internationally harmonised braking regulation – by 2000,
- developing the possibilities for a primary new car assessment procedure (PNCAP); initial scoping study completed by early 2000 with main phase completing 2004/5,
- examining the influence of anti-lock brake systems on driver behaviour – by 2000,
- reviewing braking systems on agricultural vehicles – by 2001,
- the development of on-board diagnostics and instrumentation for HGV braking systems – by 2004,
- investigating driver awareness of secondary brake systems and to propose solutions – by 2003, and
- examining the feasibility of improved motorcycle brake testing – by 2002.

Recently completed projects

S280B/VD R13-H EVALUATION OF HARMONISATION

The United Nations Economic Commission for Europe (UNECE) developed an international Regulation (Regulation 13) for braking systems many years ago. This regulation has been accepted throughout Europe since being first implemented in the 1960s but has not been adopted by the USA. In the pursuit of international harmonisation and free trade, the UNECE has developed an alternative harmonised standard for passenger cars entitled Regulation 13-H.

This project was aimed at evaluating the significant differences between these regulations and to compare with the USA Federal braking standard FMVSS 135. Testing was completed using a modern passenger car from which it became apparent that some of the differences had little impact on the test results. It also highlighted that the test results were not repeatable and therefore precluded testing at other locations to compare the reproducibility.

Amongst the conclusions many good aspects of the new Regulation were identified. Limits on the brake temperature at particular stages of the test sequence and tests of the recovery of performance, following a hot test were particularly good. Practical difficulties were encountered in tests using fifth wheels and in controlling brake pedal force consistently, which may have caused the poor repeatability. A mechanical actuator was suggested.

The project highlighted noticeable differences between Regulation 13-H and FMVSS 135, which could prompt further discussions in the UN-ECE. The final report on the findings has been circulated to both national and international parties concerned with vehicle braking.

<i>Contractor:</i>	Vehicle Certification Agency
<i>Completion date:</i>	1999
<i>Report:</i>	Evaluation of harmonised braking Regulation (R13-H)
<i>Contact:</i>	Alan Mendelson in VSE. Tel. 020 7944 2083 Tony Stenning at VCA. Tel. 0117 952 4111

S280D/VD ANTILOCK BRAKES: THEIR INFLUENCE ON ACCIDENTS

Eighty thousand owners of 'P' registration cars were sent a questionnaire and twenty one thousand completed questionnaires were returned. Initial analysis showed that drivers of ABS equipped cars reported about 10% fewer accidents but other car, use and driver factors needed to be considered. A more sophisticated model was developed to allow the benefits of ABS to be established free of bias. The results showed that driving an ABS car was associated with:

- 16% fewer accidents among men upto 55 years old,
- 10% more accidents among older men, and
- 18% fewer accidents among women.

However, only the first of these was statistically significant. The results for injury accidents are generally less precise although the increase for older men was more marked and statistically significant.

The responses showed a poor level of knowledge about ABS, but younger men did tend to score higher than older men who scored higher than women. It emerged that the number of accidents reported fell as a drivers knowledge rose. There were significant differences:

- among men upto 55 years old, drivers ignorant of ABS reported the same number of accidents as drivers of non ABS vehicles, ie knowledge reduced accidents,
- among older men, drivers of ABS cars reported more accidents than those of non-ABS cars. This effect was greater than the benefit of greater knowledge in the previous point, and
- among women, drivers of ABS cars reported more accidents than drivers of non-ABS cars. The reduction in accidents as knowledge improved meant that the drivers with most knowledge of ABS reported as many accidents as drivers of non-ABS cars.

The study has shown that ABS has the potential to reduce the number of accidents but that this potential is not fully realised. This is in part due to many drivers having little or no knowledge of the method of operation of ABS or being unaware whether their vehicle is actually equipped with such a system. The lack of knowledge may have contributed to the increase in accident risk amongst older men and women.

The results of this project will support future discussions with Road Safety Division and the Driving Standards Agency regarding driver training on the use and understanding of ABS.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	1999
<i>Report:</i>	A survey of the effectiveness of ABS in reducing accidents Report PR/SE/623/99 by J Broughton
<i>Contact:</i>	Alan Mendelson in VSE. Tel. 020 7944 2083 Brian Chinn at TRL. Tel. 01344 770 613

Ongoing projects

S092D/VD PRIMARY SAFETY EVALUATION OF NEW VEHICLE

The European New Car Assessment Programme (EuroNCAP) was developed to encourage manufacturers to increase the secondary safety performance of their cars. The Japanese authorities already incorporate some primary safety features in their domestic NCAP programme and so this feasibility study is being undertaken to provide the Department with information on the potential for assessing primary safety features of new cars, in addition to the EuroNCAP tests, and the costs.

There have been several visits to manufacturer sites in different countries and information obtained points to some suitable test methods and concepts that could be adopted by a PNCAP scheme. All of the information gathered will be collated into a published report summarising the findings and giving recommendations on what forms of primary safety tests are feasible and how they might be best presented to the consumer.

Additional follow-up visits with vehicle manufacturers are scheduled for completion during summer 2000. The draft main report was circulated to tenderers for the new project S095D/VD which will PNCAP a number of vehicles and evaluate the process.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	2000
<i>Contact:</i>	Geoff Harvey in VSE. Tel. 020 7944 2086 Ian Simmons at TRL. Tel. 01344 770 912

S280E/VE AGRICULTURAL VEHICLES – BRAKING SYSTEMS

This project is investigating the current performance levels of agricultural vehicle braking systems. An accident study by the Institute of Agricultural Medicine (AGMED) for the Department highlighted that the in-service braking performance of tractors and trailers may be inadequate. It also emphasised that little is known about the tyre to road adhesion capability of agricultural vehicles.

There has been a growth in ‘high-speed tractors’, with design speeds as high as 65 kph, but these are often used with trailers with inadequate braking systems for this application.

Preliminary results indicate that the braking performance of agricultural tractors meets legal requirements at the time of manufacture. A series of tests were conducted with two different tractors and two different trailers. These included Type “O” performance tests in accordance with European Directive 76/432/EEC (Agricultural Vehicles) and Directive 98/12/EC (Motor Vehicles), parking brake assessment, a lane change manoeuvre and a subjective handling assessment on various terrain. A brake fade test was also carried out. However, the in-service performance is not always maintained and leads to some vehicles braking performance being substantially less effective than the type approval requirements.

The results also highlighted that the in-service braking performance of a considerable number of agricultural trailers failed to meet legal minimum requirements.

<i>Contractor:</i>	DERA
<i>Completion:</i>	2000
<i>Contact:</i>	William John in VSE. Tel. 020 7944 2105 Ross Molay at DERA. Tel. 01344 633575

S291B/VD BRAKE COMPATIBILITY OF VEHICLE COMBINATIONS

Brakes on HGV articulated tractors, vehicles and trailer units are type approved to various EU and UN-ECE standards. However, compatibility problems between vehicles and trailers prompted this project. Poor compatibility results in premature degradation of the braking system, which in turn affects stability, efficiency and safety. The introduction of a new trailer brake fade test may compound this by reducing the whole life performance and running costs of the brakes as well as reducing compatibility between the tractor and trailer.

This project involved many miles on a standard route to simulate normal use. The braking system on the test vehicle was set at differing levels of threshold pressure within the envelope permitted by current legislation. Interspersed with this the brake performance was monitored by means of static brake tests and the lining wear was measured on each axle. Analysis of this data is being used to establish the ideal condition for balanced and stable braking, with an acceptable level of lining wear. Once this ideal condition has been established new performance corridors will be defined that are more precise to share braking effort in order to improve vehicle to trailer compatibility and as a consequence improve vehicle stability.

It is expected that the output will be used to define new compatibility requirements, which would serve as the basis for amendment to the relevant UNECE and EU legislation.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	2000
<i>Contact:</i>	Alan Mendelson in VSE. Tel. 020 7944 2083 Brian Chinn at TRL. Tel. 01344 770 613

New projects

S0025/VD DRIVER PERCEPTION AND SECONDARY BRAKE SYSTEMS

Modern vehicle braking systems include an emergency “secondary” braking system to ensure that the driver can brake the vehicle in the event of a failure in the main braking system. Reports are being received, however, that drivers are not taking advantage of this secondary braking system; with drivers appearing to believe that they have no brakes in the event of main system failure. This perception may be due to a number of issues including the feel of the brake pedal, the lower deceleration possible with the secondary brake system, or simply a lack of understanding of these systems. This research will investigate the extent of the problem and offer solutions, including alternative vehicle/brake system construction and how drivers may be informed of the safety feature.

Contact: Alan Mendelson in VSE. Tel. 020 7944 2083

S0032/VD LOAD SIMULATION FOR MOTORCYCLE ROLLER BRAKE TESTING

There is concern about the quality of motorcycle brake testing at annual roadworthiness inspections (MOT). During normal braking weight transfers onto the front wheels and increases the braking force which can be developed at the front brakes without the wheel locking and skidding. In the case of motorcycles, the weight transfer is particularly significant but cannot be easily replicated during the stationary brake testing in the annual test. Load simulation would overcome this problem and when used in conjunction with roller brake testing could improve the standard of in-service testing of motorcycle brakes. Such a test could also be used in SVA assessment of imported motorcycles. This project will investigate a practical method of using load simulation for motorcycle roller brake testing and consider the range of motorcycle types and designs.

Contact: Gordon Burford in VSE. Tel. 020 7944 2072

S072L/VD STUDY OF ROAD ACCIDENTS INVOLVING VEHICLE “JACK-KNIFE”

This study would seek to establish if there is a need to amend international regulations so as to improve the stability of trucks with trailers during braking in order to reduce the incidence of the condition often known as jack-knifing.

Since 1982 the Department has promoted the use of anti-lock braking systems as an effective means of reducing the risk of jack-knife accidents occurring. Despite the increasing proportion of the fleet equipped with anti-lock braking systems, there are continued reports of jack-knifed vehicles in accidents. This project would first seek to get a clearer picture of the incidence of jack-knifing, perhaps through police surveys. If there is evidence of a significant problem, the project would go on in a second stage to investigate a sample of accidents and to establish the factors contributing to accidents involving jack-knifed vehicles. The output from this sample may be considered with that of the other

project, Brake Compatibility of Vehicle Combinations S291B/VD to establish whether new stability standards or other measures could reduce vehicle jack-knifing.

Contact: Geoff Harvey in VSE. Tel. 020 7944 2086

S095D/VD PRIMARY SAFETY EVALUATION OF NEW VEHICLE

Euro NCAP provides comparative consumer information about the relative protection provided by new cars to occupants in front and side impact collisions, and to pedestrians. It has encouraged and rewarded manufacturers who introduce significant improvements in vehicle crashworthiness.

Publication of the assessment results for such safety features, as braking, handling, lighting and visibility could bring about similarly rapid progress in these areas of vehicle performance. Project S092D/VD was a feasibility study to provide the Department with information on the potential for assessing primary safety features of new cars, in addition to the EuroNCAP tests, and the costs. The contractor will assess the proposed test procedures on a small range of vehicles. Particular emphasis will be placed on the need to have objective, consistent results, and the ability to differentiate between cars.

Once the test procedures have been finalised the contractor will prepare detailed protocols describing the test procedure and equipment. The contractor will also develop suitable methods for presenting the results for each test.

The final report will include a presentation of the results of the cars used to assess the test procedures.

Contact: Geoff Harvey in VSE. Tel. 020 7944 2086

S280F/VD EFFECT ON SAFETY OF EC MANDATORY FITMENT OF ABS

In a rolling programme the EU will introduce mandatory anti-lock braking (ABS) requirements for all passenger carrying vehicles with more than 8 seats in addition to the driver and goods vehicles and trailers over 3500kg concluding in 2001. The effects of changes in primary safety are not easy to identify, but one method of assessment is to compare accident profiles before and after a change. This initial phase of this project will create the base data for the study. Vehicles without ABS will be used as a control sample.

Project S280D/VD has identified that car drivers' lack knowledge and understanding of ABS. With this in mind the second phase of this project will look at accidents involving categories of vehicles that have been built with ABS as a mandatory feature to identify whether the number or severity of the accidents has been reduced.

A prime objective of the project will be to consider the case for extending the mandatory requirement for ABS to the remaining categories of vehicles.

Contact: Alan Mendelson in VSE. Tel. 020 7944 2083

S281A/VD DEVELOPMENT OF ON-BOARD DIAGNOSTIC (OBD) SYSTEM FOR INTERROGATION OF THE ISO 11992 DATABUS ON HGV BRAKING SYSTEMS

This project is directed at trucks employing electronic brake control (EBS). These systems are now commercially available and hold many potential road safety benefits through quicker reaction times and computer optimised braking. However, there is some concern over the integrity of these systems. The operating protocol has been defined in the ISO 11992 standard, which lists the functions that can be communicated via the databus. Also a procedure has been introduced into UNECE Regulation 13 to assess the compatibility, between vehicles, of the EBS. This research would develop a specification for an interrogation device for the databus that could be used as part of the type approval process. Such a device could be suited to road-side spot checks, annual roadworthiness inspections and possibly as an aid for technicians doing routine maintenance.

This project is closely related to S282C/VD and S350C/VD in theme 7 Electronics/IT safety.

Contact: Alan Mendelson in VSE. Tel. 020 7944 2083

S282C/VD ON-BOARD DIAGNOSTIC (OBD) SYSTEM FOR HGV BRAKE PERFORMANCE

Large numbers of vehicles fail their annual roadworthiness test because of brake defects. Developments in vehicle electronics for HGVs means there is potential for an OBD system to maintain braking performance. Such a system would provide a warning to the driver when the vehicle's braking performance deteriorates or malfunctions.

This project would first carry out a literature search of latest technological developments in this field to establish what OBD system might be feasible in conjunction with existing on-board electronic systems. If this proves successful, the next stage would be collaboration with a vehicle manufacturer in adding such an OBD system to an existing vehicle on an experimental basis.

The aim of the project would be to provide advice on the feasibility and usefulness of the general application of such a system, with a view to proposing appropriate EU/UNECE regulations to require the fitment of such systems.

Contact: Alan Mendelson in VSE. Tel. 020 7944 2083

S340D/VD DEVELOPMENT OF A TEST PROCEDURE FOR MEASUREMENT OF VEHICLE TYRE GRIP

This project will develop a test procedure to assess tyre grip to help the UK secure the inclusion of standards on tyre grip within existing UN-ECE Tyre Regulations and EC Tyre Directives.

At present EC and UN-ECE technical requirements for vehicle tyres do not include any test procedures or limits for tyre to road grip. This important safety aspect is left to the discretion of the tyre manufacturers. The UK is arguing strongly in Europe that to guard against tyre manufacturers compromising grip, particularly wet-road grip, regulations should include standards for tyre to road grip. But other member states have been highlighting difficulties due to the lack of a recognised test procedure. This research would therefore aim at strengthening the UK understanding and overcoming other states' doubts. Ultimately it is hoped that this work will lead to a Global Technical Regulation through the UK's work in the UN-ECE.

The research may involve co-operation with other member states of the EC or contracting parties to the UN-ECE with a view to sharing the burden of testing.

Contact: Gordon Burford in VSE. Tel. 020 7944 2072

THEME 5

HGV/agricultural vehicle safety

Heavy vehicles can be perceived by other road users as aggressive and intimidating. Accident rates for heavy goods vehicles are much less than those for cars but involve higher risk of fatal injury to those involved. Accident investigation continues to be an effective guide to the safety performance of large vehicles and provides continued monitoring of vehicle designs and effects of changes in legislation.

Specific objectives in this theme are:

- researching improvements to driver's field of vision – by 2000
- investigating energy absorbing front under-run protection system – by 2004,
- accident investigation and analyses – on going,
- researching and developing roadside weigh testing equipment – by 2003,
- researching and developing a database for heavy-load routes – by 2003.

Recently completed projects

S050E/VE: ASSESSMENT OF HGV LOAD SECURITY DATA

The objective of this project was to collect historic data on commercial vehicle load shedding incidents and to determine the extent of the problem and the principle factors involved. The DETR's STATS 19 database, police records of injury accidents and police motorway control centre records were used as sources for the data.

The report estimated that HGVs are involved in about 53,800 load shedding incidents each year and the annual cost of these accidents is £8.1 million. It concluded that in 77% of injury accidents involving load shed from HGVs there was no evidence that the HGV was involved in any sudden manoeuvre which could account for the loss of the load. The report stated that many of the accidents were due, at least in part, to the way in which other drivers reacted to the debris.

The next stage of the project involves surveys of commercial vehicles. These surveys will provide information on (a) commodities being carried, (b) goods vehicle body types and (c) the numbers and types of commercial vehicle which have insecure loads.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	1998
<i>Report:</i>	S050E/VE; Load Shedding Incidents
<i>Contact:</i>	Andrew Cook in VSE. Tel. 020 7944 2074 Ian Simmons at TRL. Tel. 01344 770912

S050H/VE: HGV CAB STRENGTH

This project examined the risk to occupants of heavy duty vehicles. By reviewing two hundred accident reports involving fatal injury to truck occupants the researchers considered options to mitigate the fatal injury. In 32% of cases seat belts alone could have prevented the fatal injury and with cab strengthening a further 9% could have been helped.

Having identified four common accident scenarios a test procedure was developed, based upon existing tests from around the world, and subsequently refined using computer modelling. Two tests to simulate rollover and frontal impact were recommended and full scale tests of three different HGV cab designs, each constructed of different materials, validated the computer simulations. A simplified cost benefit analysis showed that over a five-year period the benefits outweighed the cost by 4:1.

Policy branches are now considering proposals to amend international regulations in line with the recommendations of this project.

Contractor: Cranfield Impact Centre
Completion date: 1999
Report: *Safety of Heavy Goods Vehicle Cabs* by Cranfield Impact centre.
Contact: Jim Anderson at the Cranfield Impact Centre. Tel. 01234 751 361
Rodney Timms in VSE. Tel. 020 7944 2092

S051B/VE: ACCIDENT DATA BASE: ENHANCED VI

The Vehicle Inspectorate database, which is assembled nationally from accident forms completed by vehicle examiners, was thought to be under utilised mainly because of the difficulties of getting meaningful analyses done. This project was therefore undertaken to improve the database and assess customer interests in the data.

The report concluded that there were several improvements that could be made to the database to make it more accurate and user friendly, ie. it being subject to much tighter management control. A customer survey was also carried out through this project to identify their specific needs and interests. This survey concluded that the majority of customers would wish to have direct access to the database and felt that the data and lacked credibility and the system was user unfriendly.

Contractor: TRL
Completed: 1998
Final Report: *Improved Vehicle Inspectorate (VI) vehicle accident database.*
Contact: Adrian Fails at TRL. Tel. 01344 770 069
Andrew Cook in VSE. Tel. 020 7944 2074

Ongoing projects

S050J/VE: DEVELOPMENT OF A TEST PROCEDURE FOR ENERGY-ABSORBING FRONT UNDERRUN PROTECTION SYSTEMS FOR TRUCKS

Incompatibility between the different types of vehicle used on the road has been identified as one of the major problems in today's traffic conditions. In the case of car to heavy goods vehicle (HGV) frontal collisions, incompatibility is at its most extreme. This frequently leads to severe or fatal injuries to the car occupants.

To counter this incompatibility, it has been proposed to fit rigid front underrun devices to HGVs from 2003. Earlier cost benefit studies have indicated that about 80 car occupant fatalities per year could be saved in the UK by this measure alone.

Further casualty reductions might be achieved by introducing deformable front underrun devices to absorb impact energy during an accident and reduce the injury potential. It will allow the crash energy to be shared by both vehicles, which is especially beneficial to car occupants.

The European Experimental Vehicle Committee (EEVC) is currently considering the advantages and construction of these devices in a collaborative study with the European Commission. This could lead to an improved standard for front underrun devices.

This project funds the attendance of an expert at the technical EEVC meetings to discuss and agree a test procedure and European Standard for Energy absorbing front underrun devices.

<i>Contractor:</i>	Brian Riley
<i>Completion date:</i>	2000
<i>Contact:</i>	William John in VSE. Tel. 020 7944 2105

S052B/VE: COMMERCIAL VEHICLE SAFETY ACCIDENT STUDIES

This is the renewal of an ongoing project which involves TRL collecting and analysing police reports on all fatal and many non-fatal accidents involving heavy goods vehicles and other commercial and agricultural vehicles. TRL studies the accident reports in order to determine what vehicle safety measures might have prevented casualties. The results of the research are used to develop legislative changes to the design, construction or use of commercial vehicles, to identify areas for further engineering research and to assess the benefits of previous legislative measures.

At present a database containing fatal HGV accidents is being prepared and analysed in readiness for a draft project report.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	2002
<i>Contact:</i>	Andrew Cook in VSE. Tel 020 7944 2074 Iain Knight at TRL. Tel. 01344 770 079

New projects

S0018/VF FUEL TANK STANDARDS FOR LARGE VEHICLES

A recent amendment to the vehicle fuel tank Directive (70/221/EEC) enhances the safety provisions in a number of ways, including requirements for a more secure fuel cap attachment to prevent fuel spillage, and new mechanical and fire test procedures for plastic fuel tanks. This directive is currently applied to cars and small vans in the UK and this project will determine the potential benefits of introducing it for buses and HGVs. This work will include accident analysis to determine the potential reduction in casualties due to reduced fuel spillage, and more robust fuel tanks, resulting from applying the Directive to buses and HGVs. The project will also examine the costs of implementing the Directive to these vehicles.

Contact: Ian Knowles in VSE. Tel. 020 7944 2095

S0026/VC DEVELOPMENT OF THE VI VEHICLE ACCIDENT & DEFECTS DATABASE

The Vehicle Inspectorate currently manages an accidents and defects database on behalf of the Department. The data is used to guide and inform researchers on DETR research projects and provide data for vehicle defect recalls, and to the police and other enforcement agencies. The data is heavily biased in favour of heavy goods and public service vehicles with only a small amount of information held on passenger cars and other vehicles.

This new research is intended to review the data capture mechanism and to explore how data for passenger cars can be increased. Consideration will be given to the end-user requirements and will offer advice on the best structure for any revised database structure. This project will be in two phases; a review/scoping study followed by a main database development/data phase.

Contact: William John in VSE. Tel. 020 7944 2105

S0027/VE EEVC FRONT UNDERRUN PROTECTION SYSTEMS

This is an extension to an existing project S310G/VE that is investigating front underrun protection devices. The mandatory fitment of rigid underrun devices on all new large goods vehicles in 2003 is expected to save 70-80 fatal injuries each year in the UK. But more can be done and further casualty reductions might be achieved by introducing energy absorbing underrun devices.

The UK as part of the European Experimental Vehicle Committee (EEVC) is considering these devices in a collaborative study with the European Commission. It is important for the UK to continue its participation in this work to ensure that the maximum benefit is achieved from the research.

Contact: Rodney Timms in VSE. Tel. 020 7944 2092

S0028/VE ROADSIDE WEIGHT TESTING OF VERY HEAVY VEHICLES CARRYING ABNORMAL AND INDIVISIBLE LOADS

The movement of very large vehicles – in excess of 150 tonnes – is subject to specific route planning and authorisation so as to protect the road infrastructure and to ensure that bridges are not damaged due to excessive loading. There is concern, however, that some loads may exceed the gross vehicle weight, axle specific weights, or both. The solution to this is a straightforward enforcement issue but the difficulty is that portable weighing equipment capable of assessing the extreme axle loads on these vehicles does not exist.

This project will explore the feasibility for a suitable device and to consider the implications for transporting the device between check sites/locations.

Contact: Andrew Cook in VSE. Tel. 020 7944 2074

S0029/VE DEVELOPMENT OF A DATABASE FACILITY FOR ROUTE PLANNING OF HEAVY LOAD MOVEMENTS

The movement of very large transformers and generators for the power supply industry is subject to authorisation by the department. As the electricity generators meet a statutory obligation in maintaining power supplies it is necessary to authorise routes at very short notice in the event of a power station failure. To meet this demand the department must have access to an up-to-date heavy load road network. The current network plan used for this work was designed in the 1970s and has been overtaken by the major network changes seen during the intervening period. This research will investigate the current situation and develop a new computer based system. Such a system will allow the department to improve

efficiency by responding with greater speed and accuracy, and possibly help to minimise disturbance to local residents and reduce the environmental impact during the movement of these large loads.

Contact: Andrew Cook in VSE. Tel. 020 7944 2074

S051G/VE ASSESSMENT OF REAR UNDERRUN GUARDS FOR HGVS

This project will investigate whether current designs of rear underrun guards offer the most practical and cost effective protection to car occupants. This will be done through a review of recent accident data, through rig tests of current designs, computer simulation of typical impacts and a short programme of full-scale impact tests to validate the computer models and demonstrate the limitations of current designs and benefits of the suggested design changes.

The project would consider the strength of current guards and whether lower guards would be more cost effective in saving lives by preventing cars underrunning the guard itself.

Contact: Ian Corfield in VSE. Tel. 020 7944 2075

S341C/VD DEVELOPMENT OF A COMMERCIAL VEHICLE WHEEL RETENTION PERFORMANCE REGULATION

With the continuing problem of wheel loss from commercial vehicles – with the attendant risk of accidents and deaths – it is necessary to conduct research in this area. This project will consider the current range of wheel types and fixings and develop test procedures to minimise the possibility of wheel detachment. Test procedures will be developed and may form the basis of a proposal to the UN ECE for a new Regulation. This could, in turn, be used as part of an EC type approval procedure for new vehicles. Germany has expressed an interest in including this topic in their general standards/Regulations for wheels and their may be some scope for collaborative work.

THEME 6

Motorcycle safety

Motorcyclists are the most at risk category of road user to fatal or serious injury. In 1998 motorcyclists were involved in 6 times more injury accidents per 100 million kilometres than cars. Against this background it is important for the Department to investigate measures to reduce the risk by ensuring the new machines are safe and that machines in use are well maintained and serviceable. Exposure of riders to risk should also be reduced to a minimum by improved equipment such as helmets and clothing.

Specific objectives in this theme are:

- researching new and improved designs of motorcyclist helmets – by 2001,
- to support international collaborative research for harmonised accident investigation protocols for motorcycles – by 2001
- researching standards of unofficially imported motorcycles – by 2001/2, and
- assessing the construction standards of motorised skateboards and scooter-type vehicles – by 2001.

Ongoing projects

S100L/VF PROTECTIVE HELMETS: MOTORCYCLE, PEDAL CYCLE AND HUMAN HEAD TOLERANCE

Significant improvements to UN-ECE Regulation 22 have been achieved and more enter into force June 2000. Developments of standards for the longer term are being co-ordinated initially through a COST project. This project brings together the combined research efforts of France, Germany, Hungary, Italy, the Netherlands, Switzerland and the United Kingdom. Although not a signatory, Finland is also participating. The main objective is to establish the tolerance of the human head and neck to the main injuries sustained by motorcyclists and, based on this, to propose a specification for testing the next generation of motorcycle helmets. The project is to establish the tolerance of the head to impact so that helmet design can be optimised.

During the past year the Action was extended in order to cover physiological and ergonomic aspects such as comfort, noise and ventilation.

It has been estimated that if the findings of the research are taken up it should be possible to reduce motorcyclist fatalities by 20% (approximately 940 riders per annum across the EU).

<i>Contractor:</i>	TRL
<i>Completion date:</i>	2000
<i>Reports:</i>	Motorcycle Safety Helmets -A Literature Review (1997) Accident data collection and analysis 1999, ARU Hannover (also available on CD-ROM)

A number of conference paper have also been presented at the following events:

- Road Infrastructure and Safety Conference, Brussels, June 1997
- STAPP Car Crash Safety Conference, Florida, November 1997
- Motorcycle Safety Conference, Munich, September 1998
- 2nd European Road Research Conference, Brussels, June 1999

<i>Contact:</i>	Steve Gillingham in VSE. Tel. 020 7944 2084 Bryan Chinn at TRL. Tel. 01344 770 613
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S101H/VD REVIEW OF OECD MOTORCYCLE ACCIDENT DATA COLLECTION

This project has been extended to cover further tasks identified by the OECD technical expert group on the development of a methodology for a world-wide harmonised method of investigating motorcycle accidents. Early reports from this project have focussed on providing a common structure for data recording around the world allowing accident sample sizes to be increased by pooling data from several countries.

A task was added to prepare the protocols for motorcycle accidents being investigated in the 'On the Spot project' in theme 1. This has subsequently formed part of the work specification for the two 'On the Spot Accident Data Collection' projects, S075i/VC and S075T/VC. It is expected that a number of motorcycle accidents will be investigated under that project using protocols based on the earlier work of this project. The cases will then be used by this project as a UK contribution to the data base allowing later analysis to be undertaken.

<i>Contractor:</i>	TRL
<i>Completion date:</i>	2000
<i>Reports:</i>	PR/SE/544/99. Review of OECD Motorcycle accident data
<i>Contact:</i>	Geoff Harvey in VSE. Tel. 020 7944 2086 Bryan Chinn at TRL. Tel. 01344 770 613

New projects

S0030/VD OECD MOTORCYCLE ACCIDENT DATA

The Organisation for Economic Co-operation and Development (OECD) is co-ordinating an international group developing common protocols for the collection and storing of motorcycle accident data. Once agreed the protocol will allow the pooling of motorcycle accident data to provide a larger database for analysis. The On The Spot accident data collection project (S075i/VC AND S075T/VC) will collect data using the OECD specification. The UK will contribute these to the OECD database.

In the future, the UK and others will undertake detailed analyses of the OECD database. Ways to reduce the casualties from motorcycle accidents can then be identified and prioritised more accurately. This project will support the UK's continued participation in these meetings and consideration of their proposals.

Contact: Geoff Harvey in VSE. Tel. 020 7944 2086

S0031/VD CONSTRUCTION STANDARDS OF UNOFFICIALLY IMPORTED MOPEDS AND MOTORCYCLES

There is concern that unofficially imported motorcycles may be circumventing EU construction standards to which machines imported via official channels must comply. Figures show that 30 to 35% of all new motorcycle/moped registrations in the UK are of machines which have been imported other than by the official importer – so called grey imports.

One way of addressing this potential inconsistency would be to introduce a Single Vehicle Approval (SVA) scheme for grey imports (and the few amateur built vehicles registered each year). Before embarking on the development of a new SVA system, however, we must first determine the safety and environmental performance of these machines and the level of non-compliance with minimum EU standards. The results of the research will inform policy on the introduction of an SVA system for motorcycles.

Contact: Gordon Burford in VSE. Tel. 020 7944 2072

S0033/VD CONSTRUCTION STANDARDS OF 'GO-PEDS' AND SIMILAR VEHICLES

A number of motorised skateboards and scooter-type vehicles have entered the market in recent years. Although these vehicles are not designed primarily for road use, a number of enquiries have been received about their legality for such. It is believed that these vehicles fall well below the Construction & Use standards applicable to small motorcycles. Research is required to determine where and by how much these machines fail to meet the required standards for road vehicles. This will enable the Department to offer informed comment, with evidence, on the suitability of these vehicles for road use.

Contact: Gordon Burford in VSE. Tel. 020 7944 2072

THEME 7

Electronics safety

Road vehicles are increasingly using complex electronic control and driver information systems. Modern systems offer many advantages to the driver from route navigation to vehicle braking (via ABS) and to enhanced stability and cornering assistance. System failure needs to be properly managed, however, to ensure both “fail-safe” operation and to give appropriate warnings to the driver. The method of presenting information to the driver is also an important area where clear and simple instructions should be used to avoid distracting or overloading the driver.

Specific objectives in this theme are:

- researching the development and implementation of the external control of vehicle speed – on going;
- investigating safety concepts for complex electronic systems – by 2002
- supporting collaborative research on intelligent speed adaptation (ISA) both nationally and internationally – on-going; and
- development of a standard intelligent speed adaptation (ISA) interface and protocol for communication of speed limit information – by 2002.

Ongoing projects

S180A/VD EXTERNAL CONTROL OF VEHICLE SPEED

This project has investigated the feasibility and the potential safety benefits of automatically limiting the maximum speed of a vehicle to the limit for the road or lower if conditions dictate. Consideration was also given to the potential side effects of EVSC, e.g. fuel consumption, journey time, etc. and the legal implication of such systems being introduced. Similar projects are taking place in Sweden and the Netherlands and close liaison has been established with these. This project involved simulator and on-road trials in addition to traffic modelling taking special account of a mixed fleet. The final report is likely to include suggestions for a possible implementation strategy.

Phase I of the project considered the attitude of drivers and residents to EVSC, established links with similar research projects and made estimates regarding the potential reduction in road accidents. The conclusions from this Phase of the project were that EVSC could be expected to reduce all injury accidents by about over one third and fatal accidents by over one half. Although most people would prefer not to be speed limited, especially if other drivers were not, EVSC was considered to be the most effect way to reduce speeds.

Phase II of the project studied driver behaviour through user trials, and simulation modelling on network effects. The report for this phase concluded that, with EVSC the driving speeds were better adapted to the posted speed limits. From the simulator trials there was some suggestion that drivers might adopt a more risky style of driving, but this was not borne out in the on-road trials. Generally, drivers were more favourable towards the system after they had experienced it than before. From network modelling, it was demonstrated that the vast majority of the effects of EVSC are achieved when 60% of the vehicle fleet are equipped. EVSC had a negligible effect on congestion or journey time, whilst fuel consumption could be reduced by up to 8%

Phase III of the project considered the potential implementation path of EVSC and reviewed the costs and benefits of EVSC into mass production. A final integration report has been drafted and is expected to confirm the benefits estimated in Phase I. It is also likely to conclude that a 20 year time scale might be required before EVSC could be mandated, but that many of the necessary features will be increasingly fitted to vehicles over that period reducing the costs and therefore improving the cost/benefits ratio of EVSC.

<i>Contractor:</i>	University of Leeds
<i>Completion:</i>	2000
<i>Contact:</i>	Neil Bowerman in VSE. Tel. 020 7944 2066 Oliver Carsten at University of Leeds. Tel. 0113 233 5348

S350C/VD ELECTRICAL & ELECTRONIC COMPONENTS IN VEHICLES

Electronics are used increasingly in vehicles for safety critical items. However, there are few regulations at present on the general safety, of the electronic control of such critical systems, e.g. braking, steering and suspension. It is necessary to consider creating safety concept and design strategies that can be evaluated as part of a type approval quality assessment.

This call-off contract was set up to provide expert technical support to the UK delegation during the period of development of new UNECE procedures for the assessment of the safety concept of automotive complex electronic systems.

<i>Contractor:</i>	TRL
<i>Completion:</i>	2001
<i>Contact:</i>	Geoff Harvey in VSE. Tel. 020 7944 2086 Ian Simmons at TRL. Tel. 01344 770 912

New projects

S0019/VF ELECTRIC VEHICLE SAFETY STANDARDS

Electrically powered vehicles have a very limited presence on the road in the UK, but increasing environmental pressure to reduce emissions is forcing development rapidly. New advanced designs of electric motors and batteries are appearing and increasing the practicality of electrically driven cars. We anticipate that these vehicles will soon be present on the road in more significant numbers and therefore need to examine urgently their crash-worthiness and the injury potential of a large mass of batteries in a crash. This will include conventional battery powered vehicles and those fitted with advanced fuel cell systems.

This research will take the form of a literature review and risk analysis. It will consider what standards currently exist and those which might potentially be needed. The objective will be to ensure that as new generations of vehicles are introduced into the vehicle fleet that appropriate safety standards controlling their design and construction exist.

Contact: Neil Bowerman in VSE. Tel. 020 7944 2066

S0034/VD INTELLIGENT SPEED ADAPTATION (ISA) – COLLABORATIVE RESEARCH (NATIONAL)

Certain local authorities are expressing interest in Intelligent Speed Adaptation (ISA) and either wish to carry out trials or to implement the technology in certain circumstances. This project will run in parallel to another project (S181A/VD) continuing the development of an ISA system. It will allow researchers working for DETR to provide technical advice to local authorities regarding the implementation of ISA and to monitor the effectiveness of the various trials. The information from these trials will provide essential information which will help guide the main project, and future policy.

Contact: Neil Bowerman in VSE. Tel. 020 7944 2066

S0035/VD INTELLIGENT SPEED ADAPTATION (ISA) – COLLABORATIVE RESEARCH (INTERNATIONAL)

It is important to establish international collaboration in support of on-going research in this area. France have expressed particular interest in developing collaborative research programmes and this could offer significant benefits to the UK in advancing the implementation and acceptance of ISA. This project would cover the administrative costs of such a collaborative project, with the DETR researchers acting as the technical advisors and project managers. European Commission funding might also be possible.

Contact: Neil Bowerman in VSE. Tel. 020 7944 2066

S0036/VD DEVELOPMENT OF A STANDARD INTELLIGENT SPEED ADAPTATION (ISA) INTERFACE

ISA consists of three basic functions: speed limitation; communication of speed limits; and speed limit display. The core function is speed limitation which, whilst being built into the vehicle as a standard feature, would only become effective when the speed limit was communicated to the vehicle. There are a number of ways in which this information can be communicated to the vehicle depending upon the technology used. It is important, therefore, to establish at an early stage a common interface protocol to ensure that the information is received and interpreted correctly by the vehicle's on-board systems regardless of how it is transmitted. Failure to develop a common interface could result in the development of incompatible technologies that would hamper the widespread adoption of ISA.

Contact: Neil Bowerman in VSE. Tel. 020 7944 2066

THEME 8

Foresight vehicle programme

The Foresight Vehicle Programme has been recently established to bring together UK resources and expertise to create components and systems for the vehicles of the future. Over 250 different organisations are actively involved, including vehicle and component manufacturers, universities, industrial research organisations, national and local government, trade associations and user groups such as those representing passengers, pedestrians, logistics and networks.

The main aim of this programme is to develop, demonstrate and promote technology for vehicles that will be available to the mass market by 2020. This new technology will work towards targets that include:

- reducing congestion,
- increasing safety, and
- improving air quality.

DETR is at present contributing £1.5 million to this programme over three years. Two projects under this programme have been started so far. A group of further projects have received technical approval from a project management panel (PMP) consisting of industrialists, researcher scientists and academics. Grants awards are expected soon for a number of further projects mainly in the area of advanced safety systems. Enquiries and negotiations are continuing regarding the financial viability of consortia members, co-operation agreements and arrangements for intellectual property rights.

The programme is co-ordinated by:

Dr Mike Sporton
Grentek Ltd
Saxfeld
Hoo Lane
Chipping Camden
Gloucestershire
GL55 6AZ

01386 841 637

The Foresight Vehicle website contains additional details and can be found at
<http://www.foresightvehicle.org.uk/>

Ongoing projects

C2/P6: FORESIGHT VEHICLE; SUPERC

The cost and weight of batteries have hampered the development of electric vehicles (EV) for many years. This project aims to overcome this by developing a new range of super capacitors for electric vehicles. The project is being led by HILtech Developments with other organisations such as Reading University, DERA and LEXCEL Technology also involved.

At present the development of such capacitors is hampered by the cost of production. This project will allow the production of a state of the art electro-chemical capacitor which would be lighter, capable of storing more energy and have a much longer life span than the average lead acid battery. This would all be available for a price that would make them an economically viable option for mass production electric vehicles.

<i>Contractor:</i>	Hiltech Developments Ltd
<i>Completion date:</i>	2002
<i>Contact:</i>	Roger Worth in VSE. Tel. 020 7944 2115 John Holden at Hiltech. Tel. 0191 488 6258

C2/P21: FORESIGHT VEHICLE; GASPART

There has been significant activity in recent years to understand and reduce particulate emission from diesel engines. Little work has been done on petrol engines and this project aims to develop an after treatment system capable of reducing particulate emissions from the exhaust gas of petrol engines. The project is being led by Johnson Matthey plc, the world leader in emissions control technology and inventor of the much heralded diesel particulate trap – CRT.

The project will investigate and report the potential of each available technology for the control of particulate emissions and through these findings produce a prototype device that will trap and destroy such particulates. This prototype will be tested under both laboratory and real driving conditions and is hoped will reduce levels of particulate emissions almost to zero.

<i>Contractor:</i>	Johnson Matthey
<i>Completion date:</i>	2001
<i>Contact:</i>	Roger Worth in VSE. Tel. 020 7944 2115 Stan Golunski at Johnson Matthey. Tel. 0118 924 2186

Annex A

ROAME statement for Vehicle Standards and Engineering division (VSE)

INTRODUCTION

This ROAME statement establishes the justification for VSE's research programme. It links the programme to DETR's broad objectives, to those of the Road Safety and Environment Directorate and, in turn, to the divisional objectives. The document considers;

- the rationale for public funding of the programme,
- the objectives of the programme,
- the procedures for appraisal
- the arrangements for monitoring the progress and delivery of work under the programme, and
- the arrangements for evaluation of the programme.

This document is intended to represent the current situation only. It is acknowledged that the document will be updated routinely to reflect Departmental objectives and shifting emphasis both here in the UK and within Europe upon which much of the programme impacts.

RATIONALE

The Department of the Environment, Transport and the Regions is one of the major Departments of State within Government. The Department has an extremely broad remit and in highlighting this diversity has set itself 10 separate objectives each one of which reflects a significant element of the British economy and life in Britain.

Within the Planning, Roads and Local Transport Group, the Road Safety and Environment Directorate (RSED) is responsible for road safety policy. In this context, road safety policy includes the development of the post 2000 targets for reducing road casualties and the implementation of strategic initiatives to deliver the target reductions; policy and negotiations in European and world-wide fora on the rules for the construction and use of vehicles to achieve safety objectives; policy on enforcement of roadworthiness requirements (including MOTs) for all types of road vehicles; and policy on driver licensing and vehicle

licensing & registration. RSED also works closely with, and is the main policy customer for, the Driver and Vehicle licensing agency, the Vehicle Inspectorate, the Vehicle Certification Agency and the Driving Standards Agency and leads a major project to modernise services to customers of these organisations.

Reporting to the Minister of State for Transport, the directorate contributes to the Department's transport objectives through continuous improvement to road and vehicle safety. The three objectives to which this relates are:

Objective 3: *To promote efficient and integrated transport services across different modes and reduce road traffic growth, in order better to meet the mobility needs of the travelling public and industry.*

Objective 4: *To deliver regulatory and other transport services to the public and industry and to collect taxes efficiently and fairly.*

Objective 10: *To improve health and safety by reducing risks from work activity, travel and the environment.*

The directorate includes four separate policy divisions and within this group lies Vehicle Standards and Engineering Division. VSE contributes to the directorate objectives by seeking to minimise road accidents and their casualties by the continuous improvement of vehicle standards and their application; and to contribute towards the Government objectives of improved mobility, vehicle security and animal welfare through vehicle standards setting.

VSE is directly responsible for the construction standards of road vehicles. This responsibility is broadly based and incorporates passengers cars, trucks, trailers, buses, coaches, motorcycles, pedal cycles, agricultural and other types of industrial vehicles using the roads. The division also issues special movement licences to vehicles carrying exceptionally heavy or abnormally large loads and for route planning such loads; and issues exemptions for vehicles that do not comply with current legislation (e.g. prototype vehicles).

In administering these responsibilities VSE develops policy relating to vehicle safety and provides advice and information to Ministers in support of their policies. The work of VSE involves representing the UK at international fora in Brussels, Geneva, Paris, and other countries throughout the world. This involves negotiating technical standards in organisations such as:

- European Union (EU);
- United Nations Economic Commission for Europe (UN-ECE);
- Organisation for Economic Co-operation and Development (OECD);
- European Co-operation in the Field of Scientific and Technical Research (COST);
- European Enhanced Vehicles Committee (EEVC);
- International Standards Organisation (ISO);
- International Harmonised Research Association (IHRA).

VSE also has close working relations with four of the department's agencies; the Vehicle Inspectorate (VI), the Vehicle Certification Agency (VCA), the Health and Safety Executive (HSE) and the Highways Agency (HA).

In delivering Government policy and departmental objectives, VSE has an extensive research programme covering the diversity of its responsibilities. The programme is defined by a thematic structure as follows:

- car secondary safety,
- bus/coach safety,
- vehicle braking/stability,
- large goods vehicle/agricultural tractor safety,
- vision/conspicuity,
- motorcycle/motorcyclist safety, and
- on-board electronics safety.

One of the key Government targets is to reduce road accident casualties. In 1998 there were approximately 240,000 road accidents from which 3,581 people died and a further 40,000 people were seriously injured. A further 300,000 road users suffered minor injuries from these same accidents. As significant as these casualty rates are, they represent a considerable improvement on the situation which existed 10 years earlier. In 1987, when casualty reduction targets were first set, road deaths and serious injuries were much higher and today's figures represent a reduction in road deaths of 39% and for serious injuries by 45%. The significance of these reductions is further highlighted when set against a 25% increase in cars on our roads with a corresponding increase in kilometres travelled across the same period.

In achieving these reductions a number of separate strategies have been implemented by the Department. Among these are improved highway design, better roadside furniture, improved driver training schemes, better enforcement by the police and improved vehicle safety through better design and enhanced routine inspection regimes. Of these, vehicle safety is widely held to have delivered many of the savings by improvements in both primary safety and secondary safety.

Primary safety can be loosely defined as accident avoidance. It includes a wide range of issues from vehicle lighting and rider conspicuity to improved braking systems and tyre to road surface adhesion. Secondary safety is concerned with minimising the effects of accidents on those involved. It includes many different road user groups such as drivers and passengers, motorcyclists, pedal cyclists and pedestrians.

New casualty reduction targets were published recently to be achieved by 2010. These targets require a 40% reduction in the number of people killed or seriously injured; 50% reduction in the number of children killed or seriously injured; and a 10% reduction in slightly injured casualties. It is anticipated that a range of separate policy measures will be required to achieve the targets and not least among these is the contribution which vehicle engineering can again deliver.

While VSE retains responsibility for national regulations for the construction of vehicles, the mechanism of developing/amending vehicle regulation and rule making is now truly European, and is increasingly world-wide. It is in these fora that the major benefits are to be secured and as a result we must look beyond local or national measures to secure UK objectives for casualty reduction by improved vehicle safety.

In seeking to influence vehicle design on such a world-wide basis, however, we must be prepared to convince our partners of the benefits. The UK has a good track record in this and is highly regarded within the world-wide community. This high standing among our peer nations has helped secure the improved vehicle design which contributed to achieving the 2000 casualty reduction target.

Vehicle manufacturers also have a major role to play in achieving these objectives, but we must first convince them of the need to change. Manufacturers, in general, are reluctant to change vehicle designs and invariably demand comprehensive justification to support proposals for new regulation or modification of existing rules. Given the highly competitive marketplace within which they operate this is only to be expected and the UK has a strong history of providing coherent policy arguments founded upon sound and comprehensive scientific evidence. This approach has proved highly effective in delivering the Government's objectives efficiently.

Where possible we seek to work collaboratively and some research projects lend themselves more readily to this than others. We have experience of working closely with manufacturers where this has shown to provide worthwhile benefits for both parties. Usually their involvement takes the form of loan vehicles or design tools but the very fact that they are involved can help to secure ownership and possibly help ease the implementation process and agreement internationally. But manufacturers generally need to see a commercial advantage in collaborative research and this needs to be borne in mind when first establishing the linkage.

An additional element of the VSE research programme is a contribution to the DTI Foresight Vehicle programme. This is a high profile and collaborative vehicle technology programme which is actively supported by DETR Ministers. Its aims and objectives overlay many of the Department's interests by seeking to provide safer, cleaner and more efficient forms of road transport. The programme also supports continuing Ministerial interest in future transport technology. The Department has undertaken publicly to fund the programme and allocated resources accordingly.

Many of the improvements aimed at delivering the Road Safety Strategy objectives are based upon the medium term, and do not focus on longer term technologies i.e. 15–20 years hence. The Foresight Vehicle programme provides one mechanism for the Department to take such a longer term view and to contribute to technological development of future road safety/transport systems. The limitations of a competitively based industrial programme such as Foresight mean that it can only complement the Department's core research programme on vehicle safety. Nevertheless, it does provide the opportunity to link advanced future technological development with current and emerging transport policies. It is for this reason that Foresight provides such excellent opportunities for DETR.

OBJECTIVES

Many of the objectives for the VSE research programme are to support achievement of the new casualty reduction targets. The majority of projects will provide the fundamental information upon which policy will be formulated, and from which new and improved regulatory standards will be based.

Other research provides information necessary to develop policies which, while pursuing the common theme of improved vehicle safety, are not directly related to the casualty targets. These projects may provide information that updates a previous understanding (possibly in the light of research elsewhere), be used to advance areas already under consideration but for which policy is not yet fully defined, or areas where standards exist but for which a new approach could yield benefits. In describing the objectives more clearly it is necessary to consider the programme in its thematic structure.

THEME S1: CAR SECONDARY SAFETY

Car secondary safety offers the greatest potential for reducing the number and severity of casualties from accidents (especially deaths and serious injuries). Secondary safety can be defined "*as all structural and design features that reduce the consequences of accidents as far as possible*". It covers specific topics such as the crashworthiness of cars, air bags, seat belts & fixings, seating, children safety seats and installation, interior fittings, the protection of pedestrians involved in accidents, motorcycle helmet construction, and much more. Included in this theme is the development of crash test dummies for use in regulatory testing.

Specific objectives in this theme are:

- the development of new test procedures for compatibility of vehicles in crashes – by 2004
- participation in the EuroNCAP programme of information dissemination on the crashworthiness of new cars,
- the development of improved crash test dummies – on-going,
- reviewing legislation for side and front impact within the Europe – by 2001,
- evaluating car bull bars and reporting by early 2000,
- developing proposals for new European standards for the protection of pedestrians involved in road accidents –by 2000, and
- accident investigation and analyses – on going.

THEME S2: VISION/CONSPICUITY SAFETY

Vehicle lighting plays a crucial role in preventing accidents and therefore falls within the general description of primary safety (defined as “*all factors which as far as possible reduce the risk of an accident occurring*”). Headlights illuminate the road ahead allowing the driver to identify his path and any obstacles upon it. But poorly adjusted or over powerful lights can cause glare for oncoming drivers and reduce vision significantly. Other lights, such as rear fog lights and direction indicators, identify the vehicle position or the driver’s intentions.

Projects included within the theme cover advanced second generation lighting technology (including ultra-violet headlamps), infra-red enhancement systems and a study of the reasons for the poor performance of rear lamps on commercial vehicles. Many subjects in this area are taken forward at international level and can involve lengthy negotiation.

Specific objectives in this theme are:

- examining the effectiveness of retro reflective markings, warning beacons and flashing lights on pedal cycles – by 2000,
- investigating the poor performance of rear lamps on heavy vehicles – by 2000,
- providing supporting evidence for EU discussions on glare – by 2000,
- investigating the automatic illumination of stop lamps – by 2001, and
- implement a call-off contract to assess (at short notice) new vehicle lighting.

THEME S3: BUS/COACH SAFETY

In general terms large passenger vehicles in the UK have a good occupant safety record, but there is always the potential for a large number of casualties in a single accident. There is significant regulatory activity both nationally in response to targeted concerns on child safety, and within the EU on initiatives to achieve a single market for these vehicles. Research on PSV safety guides policy and assists in the negotiation of appropriate safety standards for these vehicles.

Specific objectives in this theme are:

- investigating the scope for better design of buses to reduce occupant injuries – by 2000/2001,
- identifying fire risks in buses and coaches and propose alternatives – by 2001,
- investigating the scope for a new bus assessment programme – by 2004
- considering the effect of seat belts on the roll-over protection for buses – by 2001,
- researching the effect of vehicle fires on passengers – by 2001.

THEME S4: BRAKING/STABILITY SAFETY

This theme concerns the main primary safety issues relating to the dynamic characteristics of a vehicle and its controls. These controls are fundamental to the safe use of vehicles on the highway and cover diverse issues such as the roll stability of cars during cornering to the electronic systems underpinning advanced braking designs. Research in this area is often in response to technological development and is necessary to ensure that minimum standards are met and vehicle safety is ensured.

Specific objectives in this theme are:

- evaluating a new internationally harmonised braking regulation – by 2000,
- developing the possibilities for a primary new car assessment procedure (PNCAP); initial scoping study completed by early 2000 with main phase completing 2004/5,
- examining the influence of anti-lock brake systems on driver behaviour – by 2000,
- reviewing braking systems on agricultural vehicles – by 2001,
- the development of on-board diagnostics and instrumentation for HGV braking systems – by 2004,
- investigating driver awareness of secondary brake systems and to propose solutions – by 2003, and
- examining the feasibility of improved motorcycle brake testing – by 2002.

THEME S5: HGV/AGRICULTURAL VEHICLE SAFETY

Heavy vehicles can be perceived by other road users as aggressive and intimidating. Accident rates for heavy goods vehicles are much less than those for cars but involve higher risk of fatal injury to those involved. Accident investigation continues to be an effective guide to the safety performance of large vehicles and provides continued monitoring of vehicle designs and effects of changes in legislation.

Specific objectives in this theme are:

- researching improvements to driver's field of vision – by 2000
- investigating energy absorbing front under-run protection system – by 2004,
- accident investigation and analyses – on going,
- researching and developing roadside weigh testing equipment – by 2003,
- researching and developing a database for heavy-load routes – by 2003.

THEME S6: MOTORCYCLE SAFETY

Motorcyclists are the most at risk category of road user to fatal or serious injury. In 1998 motorcyclists were involved in 6 times more injury accidents per 100 million kilometres than cars. Against this background it is important for the Department to investigate measures to reduce the risk by ensuring the new machines are safe and that machines in use are well maintained and serviceable. Exposure of riders to risk should also be reduced to a minimum by improved equipment such as helmets and clothing.

Specific objectives in this theme are:

- researching new and improved designs of motorcyclist helmets – by 2001,
- to support international collaborative research for harmonised accident investigation protocols for motorcycles – by 2001
- researching standards of unofficially imported motorcycles – by 2001/2, and
- assessing the construction standards of motorised skateboards and scooter-type vehicles – by 2001.

THEME S7: ELECTRONICS SAFETY

Road vehicles are increasingly using complex electronic control and driver information systems. Modern systems offer many advantages to the driver from route navigation to vehicle braking (via ABS) and to enhanced stability and cornering assistance. System failure needs to be properly managed, however, to ensure both “fail-safe” operation and to give appropriate warnings to the driver. The method of presenting information to the driver is also an important area where clear and simple instructions should be used to avoid distracting or overloading the driver.

Specific objectives in this theme are:

- researching the development and implementation of the external control of vehicle speed – on going;
- investigating safety concepts for complex electronic systems – by 2002
- supporting collaborative research on intelligent speed adaptation (ISA) both nationally and internationally – on-going; and
- development of a standard intelligent speed adaptation (ISA) interface and protocol for communication of speed limit information – by 2002.

APPRAISAL

The term appraisal in the context of ROAME relates to the manner in which the individual projects that make up the VSE programme are generated and selected.

The VSE research programme is the direct responsibility of the Head of Division from whom the delegation is passed to a Research Programme Manager (RPM). The RPM is responsible for the day to day management of the programme, including the correct payment of invoices, financial planning and administration.

The VSE research programme is subject to the same rigorous assessment as those of Road Safety Division and the specialist projects of the Chief Medical Adviser through the Directorate Research Committee (DRC) and the External Research Advisers meetings (ERA). Both committees are chaired by the head of RSED and meet twice yearly.

The DRC brings together the Heads of Division, RPMs, representatives of associated DRCs from within DETR, members of DETR agencies (VI, VCA, HA), representatives from central Science and Technical policy division and from other Government departments. The ERA comprises a broad range of advisers collectively bringing industrial, academic, research, policy, local government and NGO experience.

In taking account of Ministerial priorities and Departmental objectives, a number of sources are used to formulate new research ideas, as follows.

FROM WITHIN THE DIVISION/DIRECTORATE

Annual meeting. The formal process of developing new research ideas begins with an annual review meeting between each policy branch and the research management team. The Head of Division and deputy Head of Division attend and the policy branch normally includes its senior staff. The meeting considers;

- the current programme,
- new projects in the current programme but not yet started, including their relevance and continuation in the programme, and
- new projects for future years.

Experience from managing these meetings suggests that it is useful to have a broad base of knowledge.

- Policy engineers bring to these meetings their detailed knowledge of the subject and, with the head of branch, contribute the core of the new research programme.
- The Head of Division reflects the views of Ministers and senior officials, and contributes a strategic vision of developments in Europe from high level groups in Brussels and Geneva.

Ad-hoc new ideas. On occasions, policy branches will require specific issues to be addressed quickly. These are often in response to questions which arise during negotiations or in

response to issues which arise from time to time. Wherever possible these are dealt with by call-off contracts but if necessary then special one-off contracts can be implemented. These are subjected to a less rigorous vetting process but always include the Head of Division and the RPM.

EXTERNAL RESEARCH ADVISORS

There are two ERA meetings each year and these are usually scheduled early in the financial year and then again about three quarters through. The first meeting confirms the new programme – as agreed by Ministers, and seeks initial views on new areas for consideration. By consulting early in the year on the future programme we develop a constructive dialogue with the advisers which helps promulgate new ideas and project proposals – the intention being at this time to prompt the advisers to offer new emerging ideas/areas in their specialist areas. From these discussions we start to compile general areas of interest and these are used during discussions with the policy branches. Advisors are requested to provide further written ideas and comments following the initial meeting.

Research Organisations

Ideas and new proposals are received from existing and prospective contractors;

Other Programmes

Foresight Vehicle. Ideas can be promulgated through separate programmes such as Foresight Vehicle. These are specific one-off projects and can receive up to 50% funding from the Department. Projects are judged on their merits and relevance to DETR policy, and undergo thorough examination by the Foresight project panel upon which VSE is represented.

EU Framework Ideas can also be proposed by contractors seeking to participate in collaborative research with others in the EU.

Once Ministers have agreed the new programme, projects are ranked according to their priority. This is necessary as the programme costs invariably exceed available funds and for this reason priorities must be established. The Head of Division will consider with the RPM and the heads of branch each research project and allocate a rating according to:

- Ministerial policies,
- relevance to Departmental objectives,
- emerging national priorities (e.g. casualty targets),
- developments internationally, and
- divisional priorities.

Project specifications are drafted by the research branch in conjunction with the policy branch. Where appropriate, draft specifications are circulated to other policy interests in the Department and to collaborative partners in the case of co-sponsored projects. Once finalised, the specification will normally be agreed by the head of branch and the RPM. The head of division would not normally be involved in the process.

Upon completion of the specification, tendering commences. The presumption is that competitive tendering will be used other than where exceptional and well justified circumstances are approved by the RPM and accepted by the procurement division. This policy applies equally to proposals received from prospective contractors. Where appropriate, consideration is given to tender publication in the EU journal.

Tenders are invited from those organisations known to the division. The expertise required is often specialised with only a few contractors able to offer services in any given area. However, the research branch and specialist policy engineers often discuss with new or potential contractors the content of the programme to explore available expertise and suitability. Wherever possible new contractors are invited to tender on specific projects.

Upon receipt of tenders a tender review panel is convened incorporating at least three officers and a representative of any co-sponsors, as necessary. On occasions, where several diverse interests are concerned, a project steering committee may be formed and it is this group that considers tenders. A standard criteria is used to evaluate tenders and this is notified to contractors at the time of invitation. As follows:

- comprehension of requirements,
- the methodology proposed,
- competitive rates and the value for money offered,
- the expertise and experience of the staff used,
- ability to meet the timetable,
- status of the organisation and facilities, and
- overall cost.

Unsuccessful tenderers are notified at the earliest opportunity and feedback is offered. Occasionally this offer is taken up.

MONITORING

Projects within VSE are managed by the policy branches in order to maintain the link with policy development. The research management team provides help and advice to project officers as required.

Officers are advised to maintain regular contact with contractors and as a minimum undertake quarterly liaison visits and formal management meetings. Meeting reports form the basis of a quarterly report which is linked to invoice payment by the research branch. This provides a further management check. The report is retained by the research team and the policy branch.

Monthly invoicing provides added incentive to project officers to liaise with contractors in order to certify invoice value accurately.

The research branch routinely monitors expenditure against budget through the year and reports to the Head of Division and the DRC. The Departmental financial system also establishes the expected spend profile at the project start.

Amendments to projects are formalised through the usual DETR contract process. Tenders will be sought from the contractor or by competitive tender, as appropriate, in consultation with the procurement division. Routine adjustments to the project are the responsibility of the project officer. Only occasionally will the RPM become involved.

Reports are prepared to the DRC and the ERA meetings and separately to Ministers. This latter reporting system is based upon a quarterly report which outlines progress with the programme.

Research results are disseminated by presenting scientific papers at conferences and seminars, both within UK and internationally, by publishing final project reports and making widely available, and by presenting the results to policy engineers and senior officials within the Department.

EVALUATION

Programme evaluation is on-going and involves the policy branch, the division, directorate, DRC, ERA, international peer review, national and international research contractors.

The process of evaluation commences immediately the project starts with the project officer undertaking the divisional project management role. This process of evaluation and monitoring ensures that the project remains on schedule with the objectives being met or on target to be met. The head of policy branch will also be involved in this process as will the RPM. Upon completion of the project, the DETR assessment form PR4 will be completed and considered by the divisional management team. Year-on reports complete this process.

Research is mostly evaluated in-house and this has proved to be a suitable system to date. It is acknowledged, however, that separate peer review provides a useful additional check and, while no specific procedures exist for this to be undertaken, it is routinely carried out by the dissemination of results to the international scientific communities of Europe

and beyond. The programme is also reviewed by the DRC and again by the ERA. Reports are prepared twice yearly for these meetings and form a fundamental element of the evaluation process.

A large element of the programme concerns international standards setting. To be successful in these fora, the research must stand the rigours of peer review and international investigation. Often specific projects will be linked to other collaborative work and this helps to ensure that the research follows common approaches.

National and international research contractors consider our programme as part of their own programmes of work and put forward speculative proposals in order to help focus attention in certain areas (see section 3).

VSE3

29 February 2000

Annex B – Contractor addresses

BARC
University of Birmingham
Edgbaston
Birmingham
B15 2TT

Anthony Best Dynamics
Holt Road
Bradford-on-Avon
Wiltshire
BA15 1AJ

BSI Testing
Maylands Avenue
Hemel Hempstead
Herts
HP2 4SQ

Cranfield Impact Centre
Wharley End
Cranfield
Bedford
MK43 0JR

Defence Evaluation and Research Agency
(DERA)
Chobham Lane
Chertsey
Surrey, KT16 0EE

Hiltech Developments
22 Larbre Crescent
Whickham
Newcastle Upon Tyne
Tyne and Wear
NE16 5YG

Institute for Transport Studies
University of Leeds
Leeds
LS2 9JT

ICE
Holywell Building
Holywell Way
Loughborough
Leicestershire, LE11 3UZ

Johnson Matthey Technology Centre
Blount's Court
Sonning Common
Reading
RG4 9NH

Millbrook Proving Ground
Millbrook
Nr. Ampthill
Bedford
MK45 2JQ

MIRA
Motor Industry Research Association
Watling Street
Nuneaton
Warwickshire, CV10 0TU

Open Ergonomics
Loughborough Technology Centre
Epinal Way
Loughborough
LE11 3GE

Transport Research Laboratory
(TRL)
Old Wokingham Road
Crowthorne
Berkshire
RG45 6AU

Vehicle Certification Agency
1 Eastgate Office Centre
Bristol
BS5 6XX