FORMAL SAFETY ASSESSMENT & RESEARCH PROJECTS ON DOMESTIC PASSENGER VESSEL STANDARDS

A SYNOPSIS
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FORMAL SAFETY ASSESSMENT OF DOMESTIC PASSENGER SHIPS
FOLLOW UP TO THE MARCHIONESS/BOWBELLE FORMAL INVESTIGATION.

INTRODUCTION

Background

At the Formal Investigation into the MARCHIONESS/BOWBELLE Collision, the Department for Transport announced that it would carry out a comprehensive Formal Safety Assessment (FSA) of River Thames Class V passenger vessels, to cover every aspect of their safety including their encounter risk with large ships and bridges, fire risk, stability, subdivision, freeboard, visibility, life saving appliances, means of escape, manning, passenger numbers, trading areas and safety management.

Lord Justice Clarke welcomed this. Recommendation 12 of his report reads -

We wholeheartedly support this initiative by the Department to carry out a Formal Safety Assessment (FSA) to cover every aspect of the safety of Class V passenger vessels including their encounter risk with large ships and bridges, fire risk, stability, subdivision, freeboard, visibility, life saving appliances, means of escape, manning, passenger numbers, trading areas and safety management. We recommend that, in the course of what we understand will be a wide-ranging review, the FSA should include an extensive analysis of life-saving appliances and escape means in the light of the concerns expressed in this inquiry. We also recommend that the MCA should afford the highest priority to conducting the FSA on the older vessels.

It was later decided to extend the FSA to all operating environments for domestic passenger ships in the United Kingdom. The five operating environments studied are the tidal Thames, other tidal waters, coastal waters, lakes and lochs and inland (non-tidal) waters. The study was run by the Maritime and Coastguard Agency (MCA), who conducted the initial Hazard Identification exercise, and then employed Det Norske Veritas Maritime Solutions Limited (DNV) under Research

1 Class V passenger ship - a ship carrying more than 12 passengers, engaged only on voyages in Category A, B and C waters [formerly known as “smooth waters”]. Categories are defined in the Merchant Shipping (Categorisation of Waters) Regulations 1992 (S.I. No. 1992/2356) and waters are listed in Merchant Shipping Notice MSN 1776(M).

2 Published by The Stationery Office 2001: ISBN 0 11 702550 X

3 Domestic Passenger Ships are those of Classes IV, V, VI and VI(A) operating within the United Kingdom, not on international voyages; and ships of EU Classes A to D.
Project RP 514\textsuperscript{4} for the risk assessment, identification of Risk Control Measures and cost benefit analysis stages of the FSA (steps 2, 3 and 4 of the “Guidelines for Formal Safety Assessment for use in the IMO Rule Making Process”)\textsuperscript{5}.

\textbf{Purpose of the research}

The MCA’s purpose in conducting the study was to provide a base-line for future risk-based regulation of domestic passenger ships by highlighting any areas where the current regulatory framework could be improved to address the identified risks.

The overall finding of the Formal Safety Assessment was that risk levels on domestic passenger ships are within the “tolerable” range. This means that the level of risk is within that generally accepted by the public, provided that risks are demonstrated to be as low as reasonably practicable.

Lord Justice Clarke in his Interim Report on the Thames Safety Inquiry\textsuperscript{6} in 1999 had concluded that \textit{“the regulation of safety [on passenger ships on the River Thames] has improved almost beyond recognition since 1989”}. This study has shown that the safety regime is effective in all operating environments, while demonstrating the differences between them.

While reassured by these findings, the MCA, advised by DNV, took the view that this general conclusion, arrived at by averaging risk across all the vessels operating in each environment, may mask the vulnerability of certain vessels. In particular, there was concern about the survivability of certain vessels in the event of a major incident, and the likelihood in the rare event of an emergency evacuation of evacuating passengers within the available time.

It was therefore agreed that more specific research was required to look at the specific areas of vulnerability – stability, fire risk, means of escape, wheelhouse visibility and safety management - with particular emphasis on older vessels.

\textbf{Research projects}

Six projects were let, covering the areas of stability (RP 524), fire safety standards (RP 525), wheelhouse visibility (RP 528A and RP 528B), safety management (RP 527) and evacuation standards (RP 526). The reports were received between July 2004 and March 2005.

\begin{itemize}
  \item \textsuperscript{4} Research Project RP 514 FSA Study of Local Passenger Ships
  \item \textsuperscript{5} MSC Circular 1023/MEPC Circular 392 5 April 2002
  \item \textsuperscript{6} Published by The Stationery Office 1999 Cm 4530
\end{itemize}
The first project (RP 524) considered the behaviour of passenger ships of different hull forms and stability standards when in collision with a much larger vessel. This was conducted through modelling and tank trials.

For the other five, the consultants were contracted to undertake an independent assessment of safety standards for fire safety, wheelhouse visibility, safety management and evacuation standards using a risk based methodology on some pre-selected vessels determined by the MCA. The selection of vessels represented a good cross-section of the Thames fleet in relation to age, size, area of operation, usage, hull-form type and stability standard.

Specific vessel names and operating companies are not included within the reports, since the findings should be seen as representative of the domestic passenger ship fleet as a whole. In each case, vessels were assigned an alphanumeric code by the consultants which links them back to the various operators, but to maintain the confidentiality of the information provided these details have been protected.

Each of the vessels used for the research was certificated as a Class V passenger vessel, and so was deemed by the MCA to comply with the applicable safety regulations.

The aim of the assessments was to identify whether any significant hazards were present which application of the current regulations did not address. It was not the intention that the consultants should audit the application of the current regulations, as this is done routinely by an MCA Surveyor. Instead the aim was to assess whether hazards that constituted residual risk, after the requirements of the existing regulations had been met, should be subject to further regulation.

While most of the research was based around vessels on the tidal Thames, consultants were asked to consider the wider application of their recommendations. It was intended to use the study to inform improvements to the standards for all domestic passenger ships, against the background of information gathered in the Formal Safety Assessment for each operating environment.

Acknowledgements
The MCA acknowledges the valuable assistance with the Formal Safety Assessment provided by passenger ship operators, local navigation authorities and other stakeholders, through attendance at the Hazard Identification and Risk Control Workshops, in providing data and contributing their expert opinion. In particular we are grateful to the operators who made their passenger vessels and crews available for assessment as part of the research projects.

It should be stressed that, where recommendations are made in this report for tighter or more consistent application of standards, no criticism is implied of
passenger ship operators whose vessels were used for the research, who have been operating their ships under the Department's certification regime, and hold current passenger certificates.

Using the results of these studies, the MCA looks forward to continuing to work with operators and with other stakeholders on the further enhancement of a robust, risk-based standards regime for the passenger ship industry.

THE WAY FORWARD

Each of the research reports makes recommendations for strengthening the safety regime on passenger ships. The MCA’s responses to these individual recommendations are given in the management summary for each report. However, in addition to these recommendations, in considering the package of work as a whole there are three major pieces of work that the MCA proposes to take forward.

1. Review of regulations and guidance
All the research has highlighted that the regulations and guidance applying to domestic passenger ships in the UK are difficult to access and understand, even for “safety specialists”, let alone operators and skippers of vessels. It is also clear that some regulations have been developed by scaling down international maritime standards rather than starting with a small ship view. We therefore propose a substantial review of the regulations, with the objectives of making it easier for operators to find out and understand which requirements apply to them, and tailoring the regulations more effectively to small ships and non-seagoing operations.

2. Goal-setting approach to standards
The current Class V standards are prescriptive but go some way to recognising the different risks in different environments by setting different standards for the different categories of waters\(^7\). The research showed that in some areas the best way to improve safety would be to consider vessels on a case-by-case basis. In response to this, the MCA proposes to explore the scope for goal-setting regulations, taking into account the environment in which the vessel operates. It is envisaged that any goal-setting standards would be one option available to operators, and would sit alongside minimum prescriptive standards for fire protection, bridge visibility, stability and evacuation. It would be primarily a commercial decision for the operator which route to follow, since a certificate issued under goal-setting standards would by definition be tied to a particular area of operation and operating conditions. Compliance with prescriptive national or EC standards would allow the vessel to be moved more freely to different areas.

\(^7\) As footnote 1.
It will take considerable work to develop appropriate goal-setting standards and clear guidelines for both MCA surveyors and for operators on this new approach. However, we believe that this could result in more appropriate, risk-based safety standards on some vessels and bring a better appreciation by the industry of the reason for particular requirements.

3. Limiting key “grandfather clauses”

Although there is no recommendation in most of the research reports specific to older vessels, the consultants identified higher risks on such vessels in a number of areas. These older vessels are operating under what are known as “grandfather provisions”. These provisions, which have been common to all merchant shipping safety legislation internationally, allow vessels to continue operating without upgrading to “new ship” safety standards where the structural limitations of the vessel prevent this, and provided that the existing standards do not present a significantly increased risk – in UK domestic legislation, this may be conditional on additional safety measures being put into place.

In the emerging EC Directive on technical standards for inland waterway vessels, based on the regime already in place on the Rhine, each time a provision is revised, a transitional period is set for its implementation, at the end of which, if a vessel does not comply, its certificate is withdrawn. The transitional period is determined on the basis of risk and cost – so in some instances it may only be one or two years, but for new standards which would require major structural modifications to the vessel it may be longer – currently some of the transitional arrangements extend up to 40 years, but this is under review.

There are also moves away from “grandfather clauses” of indefinite duration in international shipping legislation. A good example of this is the introduction of double-hulled tankers for international operations.

In the light of this, and the research findings, the MCA proposes to review the prescriptive regime with a view to limiting “grandfather clauses” in key areas of safety regulation, and to introduce expiry dates (transitional arrangements) in domestic legislation.

Where these “grandfather clauses” are limited, the goal-setting regime referred to above may however provide scope for such vessels to continue to operate in more restricted conditions.

Data collection

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8 Draft Directive amending 82/714/EC on technical standards for inland waterway vessels, Annex II. The current draft is on MCA’s website [www.mcga.gov.uk](http://www.mcga.gov.uk) under Guidance and Regulations/Inland Waterways.
The data gathering exercise carried out during the Formal Safety Assessment process highlighted the need for more robust data collection across the industry. Potential areas of under-reporting included the reporting of near misses and minor accidents. It became clear also at the risk control measures workshops that the causation of reported accidents was not always analysed and recorded. This makes it difficult to establish which risk control measures will be most effective.

The MCA is discussing how this issue can be addressed through the Domestic Passenger Ship Steering Group, which is the national consultative forum for the industry in its dealings with the MCA.

**Consultation**

All the proposals for regulatory change arising from these reports will be subject to consultation with the domestic passenger ship industry and other stakeholders. While we are formulating the details of the proposals, this consultation will be primarily through the Domestic Passenger Ship Steering Group. Under normal regulatory procedures, there will be formal public consultation on any proposed statutory changes, once these are drafted.

**EC standards**

Some domestic vessels in the United Kingdom operate under EC rather than UK standards. Where the findings of the Formal Safety Assessment and research are relevant for EC (as well as UK) standards, the UK will take these up at a European level, making proposals for change to EC standards where necessary.

**Conclusion**

The following pages present summaries of the seven individual research projects, based on the Executive Summaries provided by the consultants, but with additional background and including MCA’s comments and response.

The original summaries are available in the electronic versions of the reports, available on the MCA website – [www.mcga.gov.uk](http://www.mcga.gov.uk).
Introduction

Research Project RP 514 was conducted by Det Norske Veritas Maritime Solutions Ltd (DNV) between 2002 and 2004. It covers stages two, three and four of the Formal Safety Assessment process as laid down by “Guidelines for Formal Safety Assessment for use in the IMO Rule Making Process”. The stages are set out at the end of this section.

The Research Project produced six reports.


This model will be useful for analysing risk on domestic passenger ships in the different operating environments in the United Kingdom. It will help the MCA to target safety regulations in the areas of greatest risk, and to evaluate the effectiveness of any new safety standards introduced.

The MCA will maintain the risk model by updating it on a regular basis as more data is collected. The interval to the first review is five years.

Results of RP 514

The risk model for domestic passenger ships was initially evaluated for four working environments (tidal waters, lochs and lakes, coastal and non-tidal inland waterways) with the data inputs for each environment based upon a typical vessel.

The original model created in 2002 was updated in 2004 to reflect further data, and the risk model results updated accordingly. These updated results are the ones on which the Cost Benefit Analysis of risk control measures was based. This time the tidal Thames was treated separately from other tidal waters. The risks were calculated per passenger per voyage, and for a passenger commuting regularly on a passenger ship – based on an estimated 400 trips per year.

The results are shown in the table below.
### Operating Environment

<table>
<thead>
<tr>
<th>Operating Environment</th>
<th>Individual Risk of fatality for passenger per voyage $^9$</th>
<th>Individual risk of fatality – commuter</th>
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<tbody>
<tr>
<td>Tidal Thames</td>
<td>$1.3 \times 10^{-7}$</td>
<td>$5.3 \times 10^{-5}$</td>
</tr>
<tr>
<td>Tidal /estuaries</td>
<td>$1.4 \times 10^{-8}$</td>
<td>$5.5 \times 10^{-7}$</td>
</tr>
<tr>
<td>Lochs and lakes</td>
<td>$6.4 \times 10^{-9}$</td>
<td>$2.6 \times 10^{-8}$</td>
</tr>
<tr>
<td>Coastal waters</td>
<td>$5.43 \times 10^{-8}$</td>
<td>$2.17 \times 10^{-9}$</td>
</tr>
<tr>
<td>Inland waters</td>
<td>$4.26 \times 10^{-9}$</td>
<td>$1.7 \times 10^{-9}$</td>
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The risk model indicates that the worst case commuter risk on domestic passenger ships is still within the HSE’s “tolerable” criteria$^{10}$, provided that the risks are made as low as reasonably practicable.

This study highlighted the poor levels of data collection, particularly on minor incidents and “near misses”. If use of the risk model is to bring maximum benefits, more robust data collection is needed across the industry. This issue was endorsed at the risk control measures workshop. The data gathering exercise also indicated a range of threshold levels for the reporting of accidental damage from incidents such as collision – demonstrating a need for clearer definitions of what is meant by “accident”, “incident” and “near miss”, and a better understanding of the reasons for collecting this data.

The MCA is discussing how this can be addressed through the industry’s national consultative group, the Domestic Passenger Ship Steering Group (DPSSG). The wider question of data about water related incidents is being considered by the Information Advisory Group of the National Water Safety Forum.$^{11}$

Separate reports cover the **Cost Benefit Analysis** stage of the FSA for the five operating environments – the tidal Thames, other tidal waters, coastal waters, lochs and lakes and (non-tidal) inland waterways.

The Cost Benefit Analysis reports for each operating environment list a range of Risk Control Measures that could be cost effective in reducing incidents. These fall into a range of hazard categories – collision, fire, flooding, evacuation, alcohol, human factors, pier safety, berthing and grounding.

Where relevant, the Risk Control Measures identified as cost effective for each operating environment will be considered in the context of the recommendations from the research reports. Others which fall within MCA’s remit will be considered

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$^9$ $1 \times 10^{-5}$ is 1 in one hundred thousand  
$1 \times 10^{-7}$ is 1 in 10 million

$^{10}$ This is from the Health and Safety Executive (HSE) framework for risk tolerability in “Reducing Risks, Protecting People” (HSE, 2001)

$^{11}$ See [www.nationalwatersafety.org.uk](http://www.nationalwatersafety.org.uk)
as part of the review of regulations and guidance applying to domestic passenger ships.

Risk Control Measures which fall outside MCA’s area of responsibility will, where appropriate, be referred to relevant organisations, or to District Marine Safety Committees for consideration.

Other measures are identified for which the benefits are shown by the report to be more marginal or not cost effective, but may nevertheless be worth consideration. These will be kept under review as recommended measures are taken forward to see whether they can be incorporated.

**SUMMARY OF FSA PROCESS**

**Stage 1 – Hazard Identification Oct - Nov 2001**

For each of the initial four operating environments (tidal rivers including the River Thames, estuaries, lochs and lakes, inland waterways and coastal) meetings were held with operators and regulatory authorities. A typical voyage scenario was used to maintain consistency of response. The five steps considered were:

1. Passengers on pontoon/pier
2. Vessel alongside
3. Vessel on voyage
4. Vessel returning alongside
5. Water categories and parameters influencing risk

Risks identified were listed as generic or specific to each operational area. This process is called the Hazard Identification (HAZ-ID) process.

**Stage 2 – Risk Analysis 2002**

Consultants were engaged to develop a risk model. The aims of the model were:
- to quantify the individual and group risks of fatalities among passengers and crew on local passenger vessels (Class IV, V, VI and VIA)
- to show how these risks vary according to vessel type and operational environment
- to illustrate the risk contributors, influencing factors and potential risk control measures
- to provide a means of quantifying the benefits of various risk control options

The hazards identified within Stage 1 highlighted a range of potential accidents to both crew and passengers. These specific types of hazards are best suited to qualitative analysis rather than quantitative analysis. The quantitative risk model
developed in Stage 2 therefore focussed on the underlying generic hazard categories that lead to loss of life.

The data used to develop the risk model was collected from representatives from each of the operating environments, as well as through a review of both the Marine Accident Investigation Branch (MAIB) accident database and for the tidal region of the Thames, the Port of London Authority (PLA) accident database. Generic data was used to supplement the local passenger specific data, where data gaps or reliability issues were identified.

The risk model has been formulated in a manner to provide maximum flexibility. Fault trees and event trees were used to determine the frequency and consequences of possible incidents in the accident categories of collision, grounding, contact, fire/explosion, flooding (for reasons other than collision) and personal accidents. The risk model was evaluated for each of the four working environments, with the data inputs for each environment based upon a typical vessel.

Putting together the results for each accident category, the model was used to calculate the individual risk of fatality for a passenger travelling on every voyage of a typical passenger ship per year. For all of the operating environments the risks fell within the “tolerable” safety region on the HSE Framework for the Tolerability of Risk. Within this region risks are tolerable provided that they are made as low as reasonably practicable.

In addition, influence diagrams were used to show the areas of influence within the risk model. For example, the level of crew competency would affect the actions taken in the event of an emergency, so affecting its outcome. Where possible these effects have been quantified and added to the model, but this is often not possible, because only the most serious incidents are subject to analysis of underlying causes by the authorities. The influence diagrams were also therefore used to provoke discussion in the Risk Control Workshops.

\[12\] The risks ranged from $1.0 \times 10^{-4}$ to $4.9 \times 10^{-4}$ for the individual risk of fatality for passengers per year, and $2.0 \times 10^{-4}$ to $9.5 \times 10^{-4}$ for the individual risk of fatality for crew per year. These represent the individual risk of fatality for both passengers and crew from travelling on every voyage of a typical passenger ship per year, within each of the operating environments and are useful for calculation purposes only.

In terms of risk per passenger voyage the figures range from $9.1 \times 10^{-8}$ to $1.5 \times 10^{-7}$.

The upper limit of the “Tolerable” region for passenger risk is $1 \times 10^{-6}$ or one in a million.
Stage 3 – Risk Control Options  Jan – May 2002

A risk control workshop was held, attended by representatives from industry and the regulator from across all the operating areas who had been involved in the original hazard identification stage. Hazards from both the original HAZ-ID and the developed risk model were considered. Taking account of existing mitigating factors, additional risk control measures were identified for further consideration. The differences between different operating environments were highlighted.

A further workshop (2 sessions) was held specifically for the tidal Thames, involving both operators and regulators, to identify existing measures exceeding regulatory requirements, and further recommendations.

DNV advise that that they would expect the Risk Control Measures (RCMs) identified would affect the risk model, but this cannot be demonstrated because there is very little information available on the underlying causes of reported incidents. It was therefore not possible, using data, to update the Risk Model to show the impact of the proposed RCMs.

Instead expert judgement was used for the Cost Benefit Analysis stage.


At this stage, current MAIB accident records were used to update the risk model, and the risk levels re-calculated – per passenger per voyage, and for a passenger commuting regularly, based on 400 trips per year.

Workshops were used to review the proposed RCMs against the risk model, and to identify the parameters within the model which may be affected by implementation of the RCMs. Expert judgement was used to consider the effects of the proposed measures, using a standard set of questions. This was considered the most appropriate method, because of the limited availability of data relating to the causes of accidents and near misses, and effectiveness of current measures.

Cost data for implementation of the RCMs was gathered from the judgements of operators and regulators. Using the net costs (cost of implementation minus cost of benefits) and the change in the group risk of fatality, an Implied Cost of Averting a Fatality (ICAF) was calculated for each RCM.

An ICAF is a measure used to compare the cost effectiveness of risk control measures. For the purposes of this study, the MCA has used values for prevented fatalities as £1m per crew member and £2.5m per passenger, based on views taken by the HSE and Department for Transport on this issue.
For each operating environment, a number of measures were identified as cost effective in improving safety (ie with an ICAF value of less than £2.5m). Other measures which are shown to be more marginal or not cost effective are also listed.
THE PARAMETERS AFFECTING
THE SURVIVABILITY OF
SMALL PASSENGER VESSELS IN COLLISIONS

Introduction

Research Project RP 524, undertaken by the Wolfson Unit at Southampton University, studied the parameters affecting the survivability of small passenger vessels in collisions.

The stability standards for passenger ships were reviewed and amended as a result of Marine Accident Investigation Branch recommendations following the sinking of the MARCHIONESS\(^{13}\).

Lord Justice Clarke concluded in his report from the Formal Investigation into the MARCHIONESS / BOWBELLE collision that, although the MARCHIONESS was not required to meet any standard of subdivision, and could not withstand the flooding of the lower saloon, this was not a factor in the catastrophic outcome. One of the objectives of the study was to provide a basis for a response to this conclusion.

Earlier, in his Interim Report on the Thames Safety Inquiry\(^{14}\), Lord Justice Clarke commented on the continuing power to exempt vessels from certain requirements where modification would be unreasonable or impracticable (recommendation 9.18). He took the view that vessels should comply with current standards or provide an equivalent level of safety, regardless of age (recommendation 27.02).

The principle of an equivalent level of safety was reinforced by the MCA within internal and external guidance following the Thames Safety Inquiry report, but it has long underpinned the MCA’s application of standards. From 1992, passenger ships which could not comply with the new intact stability and damage stability standards, were limited as to their area of operation and passenger numbers and required to carry additional Life Saving Appliances for the protection of passengers.

One of the issues that the Department was therefore keen to clarify as part of this research was whether a vessel complying with the standards in force in 1989,

\(^{13}\) The current standards are contained in the Merchant Shipping (Passenger Ship Construction: Ships of III to VI(A)) Regulations S.I. No. 1998/2515.

\(^{14}\) As footnote 6.
discounting the other mitigating factors in place, provided “an equivalent level of safety” in a collision with a vessel built to new ships standards.

The objectives included the assessment of the collision resistance of two types of Class V vessel, in the scenario of a passive vessel in collision with a much larger vessel, like the MARCHIONESS/BOWBELLE collision. The first type resembled the MARCHIONESS, typically an older partially decked heel test vessel, and hence unable to comply with either one or two compartment damage standards. The second type was a more modern fully decked vessel complying with one compartment standards. The former generally have comparatively low angles of downflooding, effectively restricting their stability to a smaller range than that of decked vessels.

To address this objective two models were constructed, one representing the MARCHIONESS and another more modern, wider, monohull vessel. As the project progressed it was agreed to extend the remit to test a modern catamaran hull form that is in common operation.

The tests provided a good understanding of the behaviour of a passive vessel subject to a collision with a larger vessel, and the capsize mechanisms that might result. As a measure of collision resistance, a critical capsize speed was determined for each of the models, with a number of different configurations of impact location, deck, superstructure and stability standard. The critical speed is the minimum speed at which a colliding vessel may cause capsize.

Evidence was found to support the view that the critical speed is dependent on the stability and freeboard of the vessel. It was also determined that the critical speed for the MARCHIONESS corresponded approximately to the relative closing speed at which the collision with the BOWBELLE took place. The tests indicated that, if the MARCHIONESS had been fully decked, or retained an intact superstructure, the collision might not have resulted in capsize at the speed at which it occurred, but the increase in critical speed was modest (from 4.25 knots to 4.5 to 5 knots with the deck fully watertight, and to 5.5 knots with the forward and aft superstructures assumed watertight).

The results also indicated differences in the speed of capsize of each of the hull-form types. It was shown that the modern hull-form meeting higher stability standards would have capsized in the same manner, but the critical speed would be higher.

The third objective of the study was to contribute to the development of national safety levels for existing ships, equivalent to the enhanced levels being introduced in the draft EC Directive on inland waterway standards. These standards are a two compartment or an enhanced one compartment damage stability standard for vessels over 45m or carrying more than 250 passengers.

\[15\] As footnote 8.
Smaller vessels are required to comply with a one compartment standard or (under 15m) a buoyancy test standard.

Whilst the study has provided a better understanding of capsize mechanisms, and has demonstrated a dependence of critical speed on the stability or freeboard for specific vessels, it has not enabled such dependence to be quantified for a range of vessel types. There were two reasons for this:

- the limited range of model configurations, whilst including a range of stability characteristics, did not form a parametric series; and
- the results did not indicate clear trends that were consistent across the range of model configurations.

It has not been possible, therefore, to make general recommendations for the minimum levels of stability or freeboard required to ensure a particular level of safety from capsize in the event of a collision. It is clear however that substantial changes to the model’s configuration generally led to a modest increase in the critical speed.

The report does provide further evidence of the importance of collision avoidance, since it cannot be assumed that any vessel will withstand a collision with a larger vessel, regardless of the perceived adequacy of its structure and stability.

**MCA response to results**

The results of the trials are useful, adding to our understanding of the behaviour of a vessel in a collision from another comparatively large vessel.

This research shows that in the circumstances of the MARCHIONESS – BOWBELLE collision, when a small vessel was hit by a much larger vessel, the crucial factor in capsize was the speed of down-flooding through deck openings, rather than damage to the hull. Therefore a fully decked vessel may have survived that collision at the speed it actually occurred.

The vessel could not have resisted the rolling effect of the collision, nor could the same vessel if subdivided, or indeed any of the vessel types tested. This is due to the nature of the process of the collision and the hydrostatic forces involved. However, it is clear that the ability to retain positive buoyancy is directly affected by the inbuilt survivability standard. If the MARCHIONESS had been a buoyancy test or subdivided ship it would probably not have sunk. The nature of the survival of a vessel in these circumstances depends upon whether it comes back upright or inverts, and the extent of flooding through immersed openings in the rollover. The research does not address the issue of post striking survival.
The research concludes that the one-compartment vessel or catamaran would not always survive this type of collision – speed is the critical factor. As the contractor points out, this underlines again the importance of collision avoidance, and robust traffic management to avoid conflicts between large and small vessels – lessons which have been applied on the tidal Thames since 1989, with additional controls placed on vessels the size of the BOWBELLE if operated on the Thames above Tower Bridge.
Introduction

The Merchant Shipping (Fire Protection) (Small Ships) Regulations date from 1998, but the standards for fire safety on domestic passenger ships have not been comprehensively reviewed for about 20 years. They are based around the requirements of the International Convention on the Safety of Life at Sea (SOLAS)\textsuperscript{16}, which have been scaled down to be practicable on smaller vessels.

For Research Project RP 525, BMT Reliability Consultants Limited (BMT) was contracted to undertake an independent Fire Safety Assessment using a risk based methodology on 30 pre-selected vessels determined by the MCA.

On each vessel, the contractor reviewed major equipment and systems, portable, fixed and external extinguishing systems, structural insulation and sources of ignition. The report also comments on fire detection, gas tightness of engine spaces, training of crew, emergency procedures including fire drills, electrical installations and galleys and other catering equipment, vessel furnishings and general bilge cleanliness.

The MCA welcomes this report which considers fire hazards on small passenger vessels from first principles.

Results

Overall conclusions are that whilst there are a number of common areas that can be improved and therefore some degree of risk reduction achieved, the overall level of fire risk is low and is managed in a pragmatic and reasonable fashion. This is borne out by studying the synopsis of MAIB reports which reveal that in the majority of cases all passengers have been rescued without injury.

The MCA is reassured by these findings. However the consequences of a fire on board could be very severe and we will therefore be implementing the report’s recommendations.

\textsuperscript{16} SOLAS 1974 as amended applies to ships of 500gt and over, operating on international voyages.
The surveys and related research concluded that amendments to the following statutory requirements would be appropriate in order to further reduce the residual risk present on Class V vessels:

- Merchant Shipping (Fire Protection: Small Ships) Regulations S.I. No. 1998/1011. Regulations 3 and 6 - Fire pumps, fire main, water service pipes, hydrants, hoses and nozzles;

The MCA accepts the recommendation that the above requirements should be reviewed. One of the objectives that we will adopt in taking forward these amendments will be to ensure that the standards applied are tailored to small vessels both in terms of the risks addressed and the measures proposed, taking account of the operating environment.

**Recommendations**

The recommended changes would ensure that:

- in the event of a main machinery space fire every vessel would have at least 30 minutes in which to evacuate;
- methods of fire fighting would be appropriate to the vessels’ area of operations and manning levels; and
- the risks identified in using portable appliances would be reduced.

The recommendations are that:

1. Improved emergency and contingency procedures specifically relating to fire should be included in the Domestic Safety Management (DSM) system and be promulgated to all crew and staff

The MCA will review guidance supporting the Domestic Safety Management (DSM) Code to stress the need for clear emergency procedures for the range of scenarios resulting from an engine room fire, including sealing the engine space. It is already a requirement for crew to be familiar with emergency procedures on board. (See Research Project RP 527 on Safety Management).

2. Consideration should be given to improving machinery space insulation, detection and suppression
The MCA accepts that machinery spaces should be fitted with structural fire protection which would contain an uncontrolled fire for sufficient time to allow the passengers to be evacuated safely from the vessel. The MCA proposes to apply the same principle also to Class IV, VI and VI(A) ships, operating in Category D waters and to sea, although existing regulations are already tighter for these Classes.

The proposed minimum time of 30 minutes was given to the consultants as a “rule of thumb” based on the likely availability of a safe refuge or assistance from another vessel within that time, but needs to be considered against the findings of RP 526 on Evacuation Standards.

The installation of detection and suppression systems and appropriate crew training to support these will also be encouraged where appropriate. The marking of emergency operating positions, gas tightness of engine rooms, extinguisher injection points, and hot surfaces in engine rooms will all be considered in the review of the regulations.

We will also take into account the standards for fire protection on passenger ships in the new EC technical standards for inland waterway vessels17.

3. Location, type and quantity of fire extinguishers should be validated by risk assessment on individual vessels

We will review the requirements for fire fighting equipment (including fire pumps, hoses and portable fire extinguishers) in the light of this report, to ensure that they are appropriate to the fire risks, the operating environment and to the manning levels on board. For smaller vessels, we will consider extinguisher injection valves into the engine space.

4. Changes should be made to the DSM Code to control machinery space cleanliness/ husbandry especially with respect to bilges

The MCA will also promulgate guidance on good housekeeping in engine spaces and galleys, which are the highest risk areas for the outbreak of fire, and on the fire risk from accumulated rubbish, and the need for disposal procedures.

5. Crew training should be improved and regulated with emergency drills being regularly practised

Manning regulations already require that crew must be trained in all emergency procedures, and the DSM Code requires drills to be carried out to test these procedures, and for staff training purposes. The Formal Safety Assessment reports highlight some concerns from operators about lack of support from

17 As footnote 8.
emergency services for drills, and the MCA will issue new guidance on different types of drills and practical exercises (eg communications exercises) that can usefully be undertaken on board without the involvement of outside organisations such as the Police, Fire and Rescue Services or the Coastguard. We have asked the UK Search and Rescue (SAR) Inland Consultative Group to consider the scope for inter-agency drills and other exercises involving passenger ships.

6. Use of domestic electrical appliances and fittings should be controlled by enforcement of existing regulations applicable to other Classes of vessels.

We accept that the use of domestic appliances on board domestic passenger ships for catering and entertainment is largely unregulated, and we will reinforce guidance and if necessary introduce legislation covering all aspects of electrical installation and testing.

These recommendations support the case for goal-setting regulations, taking into account the environment in which the vessel operates, as discussed in the introductory section to this document.

Although there is no recommendation relating to older vessels, the report highlights a number of areas where the consultants identified higher risks on such vessels—although the consultants do not suggest that this is a cause for immediate serious concern. In the light of this, as explained in the introductory section to this document, the MCA proposes to review the prescriptive regime with a view to limiting “grandfather clauses” for fire safety regulations.
Background

The current requirements applying to Class V passenger ships relating to evacuation standards are found primarily in the Merchant Shipping (Life Saving Appliances for Ships of Classes III to VI(A)) Regulations S.I. No. 1999/2723 and the Merchant Shipping (Fire Protection)(Small Ships) Regulations S.I. No. 1998/1011. The requirements for life saving appliances are prescriptive, based on the number of passengers, the stability standard of the vessel and the Category of water in which it operates\textsuperscript{18}. Those for emergency escapes are essentially goal-setting. Lord Justice Clarke in his Interim report from the Thames Safety Inquiry\textsuperscript{19} picked out four specific areas relevant to this report for further consideration:

\textit{Recommendation 27.5:} The Department should consider whether the requirements in the Merchant Shipping (Fire Protection: Small Ships) Regulations 1998, relating to the minimum number of escape windows or doors, are sufficient.

\textit{Recommendation 27.6} The Department should take steps to ensure that furniture on board Class V passenger vessels on the Thames is secured in accordance with the requirements of the Merchant Shipping (Fire Protection: Small Ships) Regulations 1998, having regard to the guidelines issued by the Department in September 1994.

\textit{Recommendation 27.7} The Department should consider introducing an express requirement that emergency exit lights should be able to operate in the event of immersion in water and be able to operate for a minimum period.

\textit{Recommendation 27.8:} The Department should review the minimum stairway width requirements of the Merchant Shipping (Fire Protection: Small Ships) Regulations 1998 and their application to Class V passenger vessels in the Inquiry area.

In response to 27.7, it was considered that emergency lighting systems which would work under water were in excess of requirements for large international vessels. The emergency power supply is intended to last for 30 minutes, but it is not expected to work under water. A trial was carried out which showed that, although photoluminescent signs would remain illuminated for a considerable
time under water, they would be of little use because the human eye could not see them even through clear water.

In response to recommendations 27.5 and 27.8, earlier work carried out by BMT Reliability Consultants Limited developed a simple model using the software tool ProModel to test the adequacy of current evacuation standards, by modelling a sample vessel and then carrying out a series of live evacuation trials to validate the results of the model. The rationale for this approach was that, where a vessel could be evacuated quickly, this would demonstrate that emergency escape arrangements were adequate. The live evacuation trials were also witnessed by academics from the University of Greenwich who were developing the maritimeEXODUS Evacuation Model. They used maritimeEXODUS to simulate the evacuations and came up with very similar results to the live trials. In addition, using the model they were able significantly to improve the evacuation time for the vessel modelled and to propose changes to the vessel’s evacuation procedures, including location of lifejackets and crew locations.

None of that work shed any significant light on the adequacy of the current standards for emergency exits. Rather it seemed to emphasise that on a small vessel the human factor (e.g. demographics of the passengers, level of crew training and therefore passenger supervision) has a far more significant effect on the speed of evacuation than the structure and layout of the vessel. That project was therefore not carried forward to a further stage at that time.

It was decided instead to await the FSA, which then led to the commissioning of RP 526 - a first principles look at evacuation standards on Class V vessels – which was intended to incorporate the findings of the other five research reports.

**Introduction**

For Research Project RP 526 on evacuation standards, Det Norske Veritas Maritime Solutions Ltd (DNV) was contracted to undertake an independent assessment of Class V evacuation standards using a risk based methodology on some pre-selected vessels determined by the MCA.

A sample of 30 vessels from the pre-selected list was visited by the consultants within this project. During each vessel visit an assessment was carried out of the standards for escape, assembly (muster) and evacuation as well as conducting a number of interviews with a range of personnel.

A requirement of this study was to adopt a “first principles” approach to the issue of evacuation. Accordingly the contractors decided not to develop a protocol directly from the various statutory requirements that exist for Class V vessels. Rather their intention was to look at higher level documentation or best practice studies to produce a protocol of relevant applicable standards. The sources of
information used were considered the most relevant outside of the MCA’s existing requirements.

Most of these sources apply to much larger vessels in the deep-sea environment. For example, the protocol includes elements from the International Convention for the Safety of Life at Sea (SOLAS) which applies to vessels over 500gt operating on international voyages. Such standards are designed to ensure that, in the event of fire or collision, the ship remains a safe platform for a considerable time, and is entirely self-sufficient, even in the event of abandonment. On a large ship, the width of corridors and doorways is intended to allow for contraflow. The assumption for a Class V vessel is that it will be able to reach a place of safety within a limited time, and may also have outside assistance available, and in the event of evacuation, all the passengers are expected to be travelling in the same direction. Compliance levels with the protocol should be seen in that context. Specifically, the report does not recommend the adoption of the protocol for application to Class V vessels.

Results

The table shows how each individual vessel complied with the evacuation protocol. The following points should be noted when viewing the information contained in the table:

- Each area of agreement with the protocol has been given equal weighting when calculating the total across the four areas. This is not necessarily representative of the significance of the risk.
- Non-compliance of a vessel with the evacuation protocol does not indicate that the vessel does not comply with the statutory requirements for Class V vessels.

**Table 1: Individual Vessel Compliance against the Evacuation Protocol**

<table>
<thead>
<tr>
<th>Vessel ID No.</th>
<th>Noise /Lighting</th>
<th>Structural</th>
<th>Signage</th>
<th>LSAs</th>
<th>Total Compliance Across Four Areas</th>
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</tbody>
</table>

**Conclusions**

Overall the level of compliance with the evacuation protocol is relatively high, particularly with regard to noise & lighting and life saving appliances. Compliance is also high against the draft EC Directive on technical standards for inland waterways vessels which is perhaps the most appropriate standard used in the protocol. However, looking vessel by vessel, compliance levels indicated that five vessels scored lower than two thirds compliance. Of these five vessels, four of them were built before 1940 (i.e. in the ten oldest vessels of those surveyed) and three of these four operate on the tidal stretch of the River Thames.

The report concludes that the various standards developed for evacuation have served a purpose for designers in considering primarily the physical issues associated with evacuation. This is evident in that the more modern vessels have more open spaces and wider access routes. It recommends that the focus should now be on the human factor, such as how to manage passengers and how to handle a “real” evacuation, both in terms of the strategy to be taken and maintaining crew preparedness through the conduct of regular emergency drills.

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As footnote 8.
Although the training given to staff was generally found to comply with the MCA’s guidance on crew training in Marine Guidance Note 203(M), it was noted that training is lacking for controlling passengers in corridors, stairways and passageways. The contractors advise that on the larger vessels this may be extremely important.

The report states that, overall, the issues identified are minor and vessel specific, but will have the overall effect of extending evacuation time. It points out that it is difficult when considering Class Vs as a whole to determine how critical a specific issue is, without detailed modelling.

One of the objectives of the research was to consider a standard evacuation time, but the report concludes that this may not be necessary. The research took into account the 30 minute period used as a “rule of thumb”, taking account of the likely availability of a safe refuge or assistance from other vessels. The analysis suggests that although it may prove possible to evacuate passengers within 30 minutes, achieving this would be subject to the vessel receiving very quick assistance from a suitable vessel or else reaching a suitable and safe point of disembarkation very quickly.

**Recommendations**

The contractors report that it became apparent, during all stages of the project, that due to the wide variation in Class V Passenger Vessels in terms of function, size, age and operating environment, specific issues associated with evacuation should be considered on a case-by-case basis.

In the light of this and the other research reports, the MCA will not be pursuing work to determine a maximum evacuation time. It is clear that there are many variables not only in different areas of operation but also on different individual vessels.

However at a higher level the contractors identified a number of common elements applicable to the domestic passenger ship fleet as a whole.

1. The main recommendation is for the development or enhancement of emergency plans for vessel evacuation on the River Thames. This recommendation needs to be implemented at a number of levels. Firstly evacuation strategies need to be developed for individual vessels. It is recommended that these are developed from the current risk assessments carried out by operators to cover a range of potential emergency scenarios such as the need to carry out a vessel-to-vessel transfer of a significant number of passengers and vessel-to-shore evacuation. This should then be extended to an inter-company level, where a strategy for each company or across a range of operators needs to be developed.
All Class V Passenger Vessels are required to carry emergency plans under the Domestic Safety Management (DSM) Code and also have plans for co-operation with the relevant SAR (Search and Rescue) services. In addition to these, or within these existing emergency plans, the following issues should be considered for individual companies and vessels:

(a) use of the International Maritime Organization’s MSC\Circ 1033, or some other suitable means, to carry out simple vessel evacuation calculations to identify areas of potential congestion and queuing. The effort spent should be proportionate to passenger numbers and the size and layout of the vessel;

(b) awareness of the importance of skipper-crew communication during these evacuation scenarios; and

(c) clarification of when passengers will be instructed to don lifejackets within an evacuation scenario, and confirmation that the skipper will take this decision.

The MCA accepts these recommendations. Emergency procedures are contained in the vessels’ Domestic Safety Management (DSM) Code, and should be kept under continual review. However, the report highlights useful areas for attention, which will be brought to the notice of operators through revised guidance on the DSM Code.

The report recommends, where appropriate, company-wide or inter-company plans. In practice, when a vessel gets into difficulty on the River Thames, other operators will make their vessels available to assist with the transfer of passengers. However, there are no formal arrangements that we are aware of, and as the volume of leisure activity on the river continues to grow, we accept that there may be advantages in documenting and formalising the current arrangements. The MCA will explore this further with operators, and consider its application to other areas. If appropriate, we will provide new guidance on this aspect of the DSM Code.

It should be noted that in the Cumbrian Lakes and the Solent, operators have for some years co-operated to produce area emergency plans. In any event when the emergency services (on the tidal Thames, HM Coastguard) are made aware of an incident they will respond and co-ordinate any necessary assistance to the vessel using declared facilities under the UK Search and Rescue Framework.

Part of the review of procedures will be to ensure that the likely scenarios identified are built into regular drills and training exercises for the master and crew. The MCA will work through Local Search and Rescue Committees and District Marine Safety Committees to promote inter-company and inter-agency exercises.
DNV’s other recommendations are: -

2. The location of lifejackets should be reviewed to confirm that they are readily accessible to passengers along primary evacuation routes or stored in a suitable location. This should be assessed on a vessel by vessel basis.

The MCA will review the guidance on emergency procedures in the DSM Code and the relevant aspects of the Life Saving Appliances Regulations to highlight the importance of lifejackets being readily available to passengers at strategic points on evacuation routes. This will relate to both the type and location of storage.

The accessibility of lifejackets has been included in guidance for MCA surveyors, drawn up to help to develop a consistent interpretation of the standards. This guidance is being used on a national basis during the normal mid-term inspections of passenger ships that are already underway.

3. A clear policy is required on disabled passengers to ensure that consideration is given to the disabled within any evacuation plans and the crew should receive any necessary training.

In the light of this recommendation, the MCA proposes to review guidance on the DSM Code to include a specific reference to the needs of disabled people. This will take account of the MGN (currently in preparation) which will implement the requirements of Directive 2003/24/EC which relate to provision for disabled passengers.

4. Improved signage is required on many vessels to highlight evacuation routes and assembly points across the fleet. Suitable standards should be applied retrospectively to ensure that all signs are of a suitable size and prominence. Checks could be incorporated into the surveyor’s annual surveys and audits.

The MCA accepts the recommendation for an improved standard of safety signage on passenger ships, and will also review its requirements for information for passengers about emergency procedures.

5. Emergency drills should be carried out covering passenger evacuation, including vessel-to-pier and vessel-to-vessel evacuation.

The DSM Code already requires emergency drills to be conducted but the MCA proposes to strengthen the guidance on this aspect of the DSM Code.
6. Alarms should be considered, on a vessel by vessel basis, on all doors that open directly to the River, without platform or deck area between doorway and water.

This need for passenger protection in these circumstances has been included in guidance for MCA surveyors, drawn up to help to develop a consistent interpretation of the standards. This guidance is being used on a national basis during the normal mid-term inspections of passenger ships that are already underway.

Examples are given in the report where the doors are fitted with warning signs, but this would provide an additional safeguard – e.g. alerting the crew if the door is opened. The MCA proposes to revise the appropriate requirements.

7. Means should be provided to ensure that there is sufficient residual charge left in the emergency lighting prior to commencing a passenger voyage.

This issue has been included as best practice in the guidance for MCA surveyors referred to above. The MCA will review and enhance the requirements and guidance where necessary.

8. Consideration should be given to determining a recommended maximum evacuation time by more detailed modelling, if this is believed to be required.

In the light of this and the other research reports, the MCA will not pursue further work to determine a maximum evacuation time. It is clear that there are many variations not only in different areas of operation but also on different individual vessels. However, the issue of evacuation times on individual vessels will be addressed in the development of goal-setting standards, discussed in the introductory section to this document.

It is interesting to see that, as with earlier research, the results of this research also steer us away from prescriptive standards for emergency routes, and towards a vessel by vessel consideration of the requirements, and “soft” issues like preparation of emergency procedures, crew training and information for passengers. Overall, the evidence and recommendations in the report support the case for goal-setting regulations, taking into account also the environment in which the vessel operates, as discussed in the introductory section to this document.

Although there is no recommendation relating to older vessels, the report highlights that it is the oldest vessels which are most likely to fall short of the standards in the evacuation protocol. There are also a number of areas where the consultants identified higher risks on such vessels. In the light of this, as
explained in the introductory section to this document, the MCA proposes to review the prescriptive regime with a view to limiting “grandfather clauses” in certain key areas of safety regulation.

Lord Justice Clarke raised the question of loose furniture in passenger spaces, and commended the internal MCA guidelines which have been in use on the River Thames for many years. In the absence of any recommendations from this research on this issue, the MCA will continue to enforce its informal guidelines.
RESEARCH PROJECT RP 527

ASSESSMENT OF STANDARDS OF SAFETY MANAGEMENT ON CLASS V VESSELS ON THE RIVER THAMES

Background

The International Safety Management (ISM) Code was introduced progressively between 1998 and 2002 for ships over 500gt operating internationally. In his Interim Report on the Thames Safety Inquiry\textsuperscript{21}, Lord Justice Clarke welcomed the development of a Domestic Safety Management (DSM) Code applying to domestic passenger ships, and recommended that it should be introduced at the earliest opportunity. The DSM Code is a UK initiative, not driven by EC or international standards, although it is now under consideration by the EC as a model for community requirements. It was developed as a basic safety management tool for use by small companies, including owner operators, and was not intended to emulate the more complex ISM Code.

The DSM Code was introduced in November 2001, and has been in force for four operating seasons. Guidance was issued to MCA surveyors in January 2005 on stepping up implementation of the Code, after a period during which the MCA has taken a more educational approach with operators. Research Project RP 527 was designed to establish what effect the Code is having on the safety culture of Class V passenger ships, and if appropriate to recommend ways to increase its effectiveness.

This report coincides with an internal review of the implementation of the Domestic Safety Management Code by the MCA. Our response to the recommendations of RP 527 will be reviewed in the light of the findings of the internal review.

Introduction

For Research Project RP 527 on safety management, Det Norske Veritas Maritime Solutions Limited (DNV) was contracted to undertake an independent assessment of Class V safety management standards using a risk based methodology on some pre-selected vessels determined by the MCA.

Thirty vessels from the pre-selected list were visited by DNV within this project. During each vessel visit, an assessment of the vessel or company’s safety

\textsuperscript{21} As footnote 6.
system was carried out against an audit protocol based on the Domestic Safety Management (DSM) Code as well as conducting 41 interviews with a range of personnel. The interviews were used to carry out an assessment of the safety culture on the River Thames using the Health and Safety Executive’s (HSE) Climate Survey Tool (CST).

The aims were:
- to assess the standard of safety management, by identifying gaps leading to unacceptable levels of operational risk to crew and passengers;
- to assess the prevailing attitude to safety at all levels, including gauging the impact of the DSM Code; and
- to identify strategies for improvement.

Results

A number of conclusions were made in the following areas based upon the findings from the DSM audit and the CST:

Compliance with the requirements of the DSM Code was found to be good. However, there were concerns in the following areas.

- Health and Safety Protection Policy
- Procedures to Ensure Safe Operation
- Communication
- Accident and Incident Reporting
- Procedures for Responding to Emergency Situations
- Training

In particular, DNV found that in most cases the Safety Management System was viewed as an exercise in compliance with regulations, rather than being integrated into, and therefore informing company safety systems. This means that companies do not have a culture of continual improvement of safety standards, which is the intended outcome of a safety management system.

The MCA is reassured by the overall finding that operators are complying with the Domestic Safety Management Code. We believe that the integration of safety management into the day to day operation of passenger vessels will come in time, as operators understand better the role of the Code and realise the benefits as well as the costs involved.

Recommendations

A number of recommendations were identified and are listed below:
1. Move the MCA Surveyor audit away from a compliance based documentation approach towards a more targeted audit. This can be done in stages by conducting a part normal audit and part themed audit, for example with particular topics such as accident investigation or achievement of objectives being example themes. This will provide an element of continual improvement;

We recognise the importance of encouraging continual improvement in company safety systems. However, we do not fully accept that the MCA should adopt in-depth, themed audits for DSM audits. The vast majority of the operations concerned are small companies with very simple management structures and safety procedures, and themed audits are unlikely to uncover more than can be achieved in a general audit.

2. Determine where the gaps lie in the Health and Safety Protection Policy and assist operators to develop achievable key objectives and targets. Encourage MCA Surveyors to audit against these.

We accept that the MCA has a role to play in assisting operators to develop integrated Safety Management Systems, and the recommendations on targeted inspections, discussing weaknesses in the current health and safety policy and guidance on incident and near miss reporting will be taken forward in that context. Training in risk assessment and safety management is included in the syllabus for the proposed new national Boatmaster’s licence.

3. Provide more training for MCA Auditors and Designated Persons about safety management systems and risk assessment. Use of these techniques can assist in the development of appropriate rules/procedures that assist all parties in conducting their duties.

The MCA does not fully accept this recommendation. MCA Auditors who carry out DSM audits are fully trained in these areas, under ISM procedures. However, there is an issue about how to apply these techniques, which are designed for large operations, to the domestic passenger ship scene. We do intend to explore the need for a short course to adapt ISM auditing techniques to the wide range of small vessels covered by the DSM Code.

4. Improve communications between operators about H&S performance on the River Thames. Using either the Domestic Passenger Ship Steering Group (DPSSG) or some other means to report back to shipboard personnel so they are aware of lessons learnt or success for other operations (see also recommendation 6).

The MCA accepts that there would be benefits in improved communications between operators on safety issues. Individual MCA Marine Offices issue
bulletins and circular letters on safety issues to operators and others affected from time to time.

The operators’ associations are already proactive in this area and District Marine Safety Committees and the Domestic Passenger Ship Steering Group provide further opportunities. However, there are undoubtedly many operators who are not affiliated to any association, and so do not have the opportunity to participate in such discussions.

The MCA will continue to promote the benefits for operators of working together, (e.g. through operators’ associations) to ensure that their views are represented and to share information and guidance on safety issues.

5. Expand the checklist system currently in place to include additional management system items which will regularly check the status of the Domestic Safety Management System, as a means of carrying out an internal audit.

We accept that check-lists can form a useful part of a vessel’s safety management system, and under existing guidance it is open to operators to develop them where appropriate. It is not considered appropriate for the MCA to develop further standard checklists, as this would be contrary to the need, identified elsewhere in the report, for each operator to have a system tailored to their operation and vessels. We will discuss this issue with DPSSG and consider additional guidance on company management systems which will help operators to check the operation of their safety management systems.

6. Educate operators about definitions and recording systems for accident and near miss reporting. Encourage reporting within a ‘just culture’\textsuperscript{22}. Use early successes to feedback between operators about reporting to raise awareness that the safety standards are fair and equitable for all operators. One option could be the promotion of systems such as CHIRPS (Confidential Hazardous Incident Reporting System\textsuperscript{23});

The MCA agrees that internal reporting of incidents is an important component of any safety management system. Internal investigation of incidents is a good way of informing continual improvement of safety systems. We discussed accident reporting with DPSSG members in March 2005 and operators have been asked to consider ways to improve reporting.

\textsuperscript{22} A ‘just culture’ is an atmosphere of trust in which people are encouraged, even rewarded, for providing essential safety-related information – but in which they are also clear about where the line must be drawn between acceptable and unacceptable behaviour.

\textsuperscript{23} \url{www.chirp.co.uk}
7. Consider issuing a Document of Compliance (DOC) to separate the DSM audit process from the current Passenger Certificate.

While for larger companies, with a number of vessels, there may be a case for a company certificate for Safety Management separate from the individual passenger ship certificate, a combined system was introduced to reduce the paperwork and administration involved – this is of particular importance for owner operators with maybe one or two vessels. A passenger ship cannot operate without a valid DSM certificate, so it makes sense to keep the DSM and passenger certificate running concurrently. However, we will be reviewing our audit procedures in the light of the MCA review of the DSM Code.

8. Consider regular (bi-annual/annual) large scale inter-company safety/emergency drills to improve crew awareness.

We have discussed the need for company and inter-company drills in our response to Research Project RP 526 on Evacuation Standards. We will strengthen the guidance on emergency procedures and training within the DSM Code.

Conclusion

In the Introduction to this document, the MCA has suggested that goal-setting regulations, taking into account the environment in which the vessel operates, should be an alternative to the current prescriptive regime available to operators.

The MCA expects that the operator’s DSM Code would be a key feature of any goal-setting regime, since this would be how the operator would demonstrate that the vessel, and the measures in place on board, provided an adequate level of safety for the operating environment.
WHEELHOUSE VISIBILITY ON CLASS V PASSENGER VESSELS ON THE RIVER THAMES

Introduction

The standards for wheelhouse visibility which are enforced for Class V passenger ships were put in place as a direct response to the MARCHIONESS disaster. The ability for the helmsman to have a good all-round view ("wheelhouse visibility") is a key safety requirement on any vessel, and is not in dispute. However defining what is meant by “good all-round view” is more difficult. This research project and RP 528B were commissioned to help the MCA to establish whether current standards achieved the desired objective.

The question of wheelhouse visibility standards is under negotiation at a European level, in the working group of Technical Experts developing new EC technical standards for inland waterway vessels\(^{24}\), where many of the same points are being debated as are discussed in these reports. The MCA is participating actively in these discussions and will not make any final decision on changes to the UK standards until we know what the EC standard will be. The EC standards are expected to be agreed by the end of 2006.

Common themes

Two contracts were let – Research Project RP 528A and Research Project RP 528B. Both reports highlight that the current regulations are difficult to understand and interpret. The MCA accepts this as a valid criticism. One of the outcomes of the package of work undertaken in connection with the FSA of domestic passenger ships will be a thorough review of all regulations applying to domestic passenger ships, with a view to making them easier to locate, understand and interpret. For wheelhouse visibility in particular, we will consider an approach which makes clear not only the letter, but the intent of the legislation.

As part of this review, the MCA will consider any operational differences in tidal and non-tidal waters, and will take account of the developing EC inland waterway standards in this area and the European Norm EN 1864.

The reports also found that the current standards are not being applied consistently, or that they are open to a wide range of interpretations.

\(^{24}\) As footnote 8
This is a cause for concern, and the MCA has produced guidance for its surveyors, drawing attention to the areas of concern highlighted in the reports and helping to develop a consistent interpretation of the standards. This guidance is being used on a national basis during the normal mid-term inspections of passenger ships that are already underway.

Among others, we will address the following issues highlighted in these reports:
- provision for clearing an adequate portion of the forward facing windows;
- aft lines of sight through passenger areas;
- communications between helmsman and dedicated lookout (where used);
- minimising glare and reflections.

The guidance will be reviewed in the light of feedback from this year’s mid-term inspections.

The MCA welcomes the light shed by these reports on the strengths and weaknesses in current standards. These may have an impact also on international standards\textsuperscript{25} which are similar in many respects to the UK standards.

RESEARCH PROJECT RP 528A

ASSESSMENT OF STANDARDS OF WHEELHOUSE VISIBILITY ON CLASS V PASSENGER VESSELS ON THE RIVER THAMES

For Research Project RP 528A, the Maritime and Coastguard Agency (MCA) commissioned BMT Reliability Consultants Limited (BMT) to undertake an independent assessment of the effectiveness of existing regulations\textsuperscript{26} for wheelhouse visibility on Class V Thames vessels. The consultants visited 32 vessels from the pre-selected list provided by the MCA.

This report should be read in conjunction with RP 528B Assessment of Wheelhouse Visibility at Night, carried out by Det Norske Veritas Maritime


\textsuperscript{26} Current requirements, in response to the recommendations of the Marine Accident Investigation Branch following the MARCHIONESS disaster, were implemented in the Merchant Shipping (Wheelhouse Visibility)(Ships of Classes IV, V, VI and VI(A)) Regulations 1992 S.I No. 1992/2357 and the Merchant Shipping (Navigation Bridge Visibility) Regulations 1998 S.I. No. 1998/1419.
Solutions Ltd (DNV) who studied wheelhouse visibility standards with particular reference to night time operations, using a small sample of vessels.

Methodology

The contractors analysed existing regulations and the potential need to supplement or improve them through interviews with crews and surveys of a representative number of Class V River Thames vessels. The analysis was based on detailed consideration of the wide range of potential reasons for loss of visibility under both operational and emergency conditions, distilled into a list of “Visibility Failure Factors”.

37 surveys were undertaken on the tidal and non-tidal Thames. In each case, the potential for viewing failure under all potentially applicable circumstances was determined by physical inspection of the vessels and interviews with their crews, also by consideration of external factors such as shore lighting and presence of other river traffic. The full scope of potential circumstances and conditions that were considered are listed below:

- vessel alongside or underway;
- vessel mooring;
- vessel casting off;
- vessel Embarking/Disembarking passengers;
- number of passengers carried;
- operation in day, night, dawn or dusk;
- the numbers and types of other river users present;
- any visibility issues specific to particular geographical areas of operation visited by individual vessels (such as lights on shore or specific obstructions such as bridges, moored vessels etc);
- the wide range of possible weather conditions that directly influence wheelhouse visibility (light, dark, fog, mist, precipitation etc);
- the wide range of possible environmental conditions that influence wheelhouse visibility (such as the presence of ice or condensation on windows or mirrors etc); and
- the variety of operations taking place on vessels, such as sightseeing, discos, barbecues etc.

Recognising the need to gain the clearest possible understanding of the specific circumstances that can influence a helmsman’s view at night, a number of surveys were undertaken on vessels under night-time operational conditions, with passengers on board.
Results

The study found that the following problems exist:

1. The regulations could be more simply stated, to assist assessment of compliance.

The contractors considered that the current regulations are worded in a manner which can be difficult to understand, and could be stated more clearly. An example of this is the way in which the requirements for the minimum arc of visibility is defined, which would benefit from the use of a clear, easy to follow diagram.

The MCA accepts this as a valid criticism. As outlined in the introductory section to this document, one of the outcomes of the package of work undertaken in connection with the FSA of domestic passenger ships will be a thorough review of all regulations applying to domestic passenger ships, with a view to making them easier to locate, understand and interpret. For wheelhouse visibility in particular, we will consider an approach which makes clear not only the letter, but the intent of the legislation.

2. The regulations do not appear to be consistently enforced for vessels of similar age, size and category of waters operated in.

The contractors perceived several breaches of visibility regulations, the majority of which could be regarded as relatively minor, but nevertheless each having the potential to contribute to circumstances leading to an accident. Some examples are:

   a) sight lines being obstructed by standing passengers; the statutory requirement is for sight lines via an external passenger area to be over the heads of seated passengers; if the activities of standing passengers cause a serious obstruction to visibility then a dedicated look out should be used. Sight lines must not pass through any enclosed passenger space; and

   b) the absence of adequate provision for the removal of spray, rain or misting from the forward facing windows on some vessels.

The report also highlights the following concerns –

(a) arc of visibility limited by the small size of windows and wide window surrounds;

(b) the use of transparent materials which are easily scratched instead of safety glass or laminated glass;
(c) visibility obscured by internal reflections (sight lines via enclosed areas with multiple glazing);

(d) poor lighting of static objects and river traffic; and

(e) the need for supplementary lighting (e.g. search lights) on board the vessel for occasional and emergency use.

The MCA is concerned that the report finds that standards are not being consistently enforced (although in applying and enforcing standards surveyors are expected to make judgements in a particular context to achieve an equivalent level of safety to the prescriptive standards). The guidance for MCA surveyors referred to in the introduction to this section is intended in part to address this problem, and this will be reviewed in the light of feedback from this year’s mid-term inspections.

3. The report concludes that there is potential for strengthening regulations in some areas. Specific points of concern include:

   a) consideration of vessel manoeuvrability in defining the minimum requirements for visibility; to include turning circle, stopping distance and closing speed;

The MCA does not necessarily agree with the view that visibility requirements should be linked to the manoeuvrability of the vessel. There are too many variables involved – including the strength of the current, the effects of wind and the speed of other vessels. The influence of all the factors involved may prove complex and so the idea will be investigated further within the consideration of goal-setting standards.

   b) the need to provide the helmsman with a clear view of the sides of the vessel, including the areas where crew are working during mooring/casting-off operations and the points of passenger embarkation and disembarkation.

This is addressed in the draft EC technical standards for inland waterway vessels but is not addressed in the UK statutory requirements. In order of preference, this should be achieved by direct lines of sight, a dedicated lookout, convex mirrors, or CCTV cameras. The suggestion in the report is for a minimum requirement for two independent, regularly tested systems if a clear direct view is not available.

The MCA accepts that the current standards for ships under 45m do not require a view of the side of the vessel – since the focus of those

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27 As footnote 8.
regulations is safe navigation, rather than berthing and passenger operations. However, we agree that it should be incorporated in future UK regulations.

c) the need to eliminate potentially confusing and distracting coloured lighting aboard the vessel, and on shore;

The MCA agrees that lighting on board the vessel should not distract the helmsman or confuse his or her interpretation of navigation lights on other vessels. This issue has been covered in the guidance for surveyors referred to under “Common themes” at the start of this section. We will also consider lighting levels within the wheelhouse, taking account of developments on the European Norm for wheelhouses on inland waterway vessels (EN 1864).

Neither the MCA nor the Department for Transport is in a position to prevent the installation of distracting lighting on shore or on bridges – although we are interested to note that there are conflicting views on shore and bridge lighting between this report and RP 528B; some operators found it helpful to steer by; others found it distracting. There were particular instances where operators found bridge lighting dazzling. The Department will consider what opportunities may arise to raise this issue with port and highway authorities and any other relevant bodies.

d) the need to prevent distraction of the helmsman by passengers by ensuring the wheelhouse is kept separate and secure from the passenger area. This is addressed in the draft EC technical standards for inland waterway vessels but is not addressed in UK statutory requirements;

We will consider measures to ensure the helmsman is not distracted by activity on board. This may be addressed through on-board procedures and signage as well as through the physical separation of the wheelhouse.

e) the need to ensure that all river users are clearly visible at night and in low light conditions.

The proposal that all river users, large or small, commercial or private, should be clearly visible at all times, reinforces current best practice. Government policy remains to educate rather than regulate pleasure users. The MCA will draw this recommendation to the attention of the national sports governing bodies through the National Water Safety Forum Water Sports Advisory Group.

28 As footnote 8.
Recommendations

1. The Study identified a range of practical risk reduction options as a basis for the evolution of a strategy for any revised Regulations of Bridge Visibility. Recommendations for regulatory change are ranked according to their viability (high, medium or low), as established through the application of a qualitative Cost Benefit Analysis where the impacts of potential changes on the main stakeholders are considered. MCA should consider the high viability options as the basis for development of policy for further regulations.

The MCA will consider the high viability risk reduction options identified in the report in developing its policy for any revised regulations or supporting guidance.

2. Where future updates of applicable regulations are being considered, MCA should also consider the incorporation of medium and lower viability options, where these would add value to any proposed changes.

Medium and low viability options will be considered as the opportunity arises.

3. Specific proposals for regulatory change should be subject to Cost Benefit Analysis.

This is standard practice for all regulations, following Cabinet Office guidelines. A Regulatory Impact Assessment, which includes Cost Benefit Analysis, is published in draft as part of the public consultation on proposed regulations, and in final form when the regulations are made.

4. The planned introduction of the formal version of the EC technical standards for inland waterway vessels\(^29\) should be the basis for Class V visibility standards, rather than reviewing the UK standards.

As previously stated, the EC standards for wheelhouse visibility on inland waterway vessels are still under discussion. MCA will continue to participate actively in the discussions, to ensure that UK standards are not undermined. We will use the findings of this report to inform our negotiating position.

5. MCA should consider prescriptive minimum standards for Class V visibility, supplemented by a risk based approach for areas likely to show the highest variations between vessels.

This supports the case for goal-setting regulations, taking into account the environment in which the vessel operates, as discussed in the introductory section to this document.

\(^{29}\) As footnote 8.
ASSESSMENT OF WHEELHOUSE VISIBILITY AT NIGHT

Introduction

For Research Project RP 528B, the MCA commissioned Det Norske Veritas Maritime Solutions Limited (DNV) to conduct a study of standards of wheelhouse visibility on Class V passenger vessels operating at night on the River Thames. Eight vessels from the pre-selected sample were assessed in this study.

This was a supplementary report and should be read in conjunction with RP 528A Assessment of standards of wheelhouse visibility on Class V passenger Vessels on the River Thames, carried out by British Marine Technology Reliability Consultants Ltd (BMT). However, the DNV Report is treated as an independent document, not as an Annex to the BMT report.

The contractors used the list of Visibility Failure Factors developed for RP 528A by BMT, but augmented these with some relating to ergonomic design, lighting and glare and visual capabilities of the helmsman. This protocol was used to record the assessments, with photographic evidence being collected in support.

Results

Within the small sample of vessels assessed, only one vessel complied with all applicable requirements within the Regulations. However, a vessel that may be considered to have “good visibility” did not fully comply with all the applicable requirements. This would suggest that the 1992 Regulations do not cover many of the key visibility issues that are pertinent at night. The regulations are only mandatory for vessels operating within tidal waters.

The contractors drew the following conclusions based upon the findings from the small sample of Class V’s that were assessed:-

- as they are currently applied, the 1992 requirements for wheelhouse visibility of Class V vessels do not ensure that the helmsman can see all navigational elements within his operating environment.

- the current specifications fall short of general industry best practice and other guidance for sea going vessels; and

- some elements of the 1992 requirements appear to conflict with good practice.
Recommendations

The report makes a number of recommendations. Key target areas are:

1. Determine the operational visibility requirements for Class V vessels operating on the Thames and make recommendations to update the 1992 specifications accordingly. The regulatory requirements should reflect what the helmsman needs to be able to see given the operating environment, vessel speed, traffic density and manning levels. It will be important to take into account the differences between the operational visibility requirements for the tidal and non-tidal stretches of the River Thames.

The MCA accepts that it is not clear from the regulations what the helmsman needs to be able to see. This is a question that is being discussed at EC level in connection with the development of new wheelhouse visibility standards in the EC Directive on technical standards for inland waterway vessels. The UK is taking an active part in these discussions to ensure that UK safety standards are not undermined, and will use the findings to inform revised UK regulations.

This may support goal-setting regulations taking into account the environment in which the vessel operates.

2. Following the revision, review how the specifications within the 1992 regulations are applied. Once completed, the distinction between old and “new” post-1992 vessels should no longer be applied since the operational visibility requirements will be the same for both.

The MCA will seriously consider the need for removing the distinction between “old” and “new” vessels in the regulations for wheelhouse visibility, as part of our review of “grandfather clauses”.

3. Provide additional guidance and criteria to support the specifications in the current regulations. It would be beneficial to determine exactly what is “adequate” and “good” so as to provide guidance to the operators and surveyors. Guidance on the maximum width of vertical window partitions etc would remove subjectivity.

This is linked to recommendation 1 above. MCA will seek to ensure that the revised regulations and guidance make clear the intent as well as the letter of the regulations.

4. Consider changing the specification regarding the use of tinted glass. This appears to be advantageous on some of the vessels surveyed yet the regulations specify it should not be used. Tinting could be permitted

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As footnote 8.
providing the chromaticity of the light is not affected as it passes through the window.

5. Ensure that glare is minimised by reducing reflective surfaces within the wheelhouse and reducing the number of light sources from instrumentation and equipment. Where instrumentation indicator lights are required, either coloured lights, low level lights or dimming functions should be made available.

6. Ambient lighting in the wheelhouse should not impair dark adaptation. Therefore, lighting should be either fitted with dimming facilities to allow them to be adjusted for both daytime and night-time conditions or alternatively low level red lighting should be provided for night-time operations (providing this does not impact on the ability to distinguish navigation lights).

In response to recommendations 4 to 6, the MCA will consider lighting levels and the options for reducing sources of glare and reflection within the wheelhouse, taking account of developments on the European Norm for wheelhouses on inland waterway vessels (EN 1864). This is in line with the high viability options for risk reduction identified in RP 528A.

7. External light sources which impair night time visibility should be modified. Consider whether the introduction of shore lighting along very dark stretches would assist the helmsmen.

Neither the MCA nor the Department for Transport is in a position to install shore lighting on dark stretches of river to assist the helmsman - although we are interested to note that there are conflicting views on shore and bridge lighting between the two reports; some operators found it helpful to steer by; others found it distracting. There were particular instances where operators found bridge lighting dazzling. The Department will consider what opportunities may arise to raise this issue with port and highway authorities and any other relevant bodies.

8. In cases where a dedicated lookout is required, a VHF radio link should be available between the helmsman and crew beyond the wheelhouse. This should be mandatory within the tidal section and is recommended within the non-tidal section of the Thames.

The current requirement is for a wire telecommunication link between the helmsman and any dedicated lookout crew outside the wheelhouse. This issue is covered in the guidance for mid-term inspections, referred to in the response to RP 528A.
9. Helmsman vision requirements should be more carefully specified and assessed as part of the medical assessment process. Advice should be sought from a suitably qualified person.

This recommendation relates primarily to dark adaptation. The MCA has been advised that there are at present no suitable tests for routine assessment of visual capabilities in a relevant way under low lighting conditions. Should such tests become available and be well validated, they could possibly be used in future.