A Report Prepared by International Risk Management Services
On Behalf of: Error! Reference source not found.

A Review of Railway Safety in Ireland

In Association with:

Michael Hamlyn Associates

Carl Bro Rail

Merz and McLellan

International Risk Management Services (UK) Ltd
Unit A, Egerton Court
Haig Road, Parkgate Estate
Knutsford, Cheshire
WA16 8D X
England, UK
Tel: +(44) 1565 750257
Fax: +(44) 1565 750357
E-mail: IRMS_LTD @ compuserve.com

Report No: 2045.10
Issue No: 01
Date: October 1998
## CONTENTS

1. INTRODUCTION  

2. OBJECTIVES AND SCOPE  
   2.1 Background  
   2.2 Objectives  
   2.3 Scope  
   2.4 Remit  

3. APPROACH  
   3.1 Project Start Up  
   3.2 Risk Criteria  
   3.3 Operational Performance Review  
   3.4 Safety Management System (SMS) Review  
   3.5 Safety Adequacy of Infrastructure & Rolling Stock  
   3.6 Risk Assessment  
   3.7 Railway Inspecting Officer Review  
   3.8 EU Directives Implementation  
   3.9 Best Practice Forum  

4. RISK CRITERIA  
   4.1 Introduction  
   4.2 Safety Acceptance Criteria Principles  
   4.3 Fatalities and Equivalent Fatalities  
   4.4 Scientific Number Notation  
   4.5 Qualitative Criteria
# A Review of Railway Safety in Ireland

4.6 Quantified Criteria  
4.7 IE Safety Plan 1998  
4.8 Value of Life Indices  

## 5. IARNRÓD ÉIREANN SAFETY PERFORMANCE  
5.1 Introduction  
5.2 Results  

## 6. SAFETY ADEQUACY OF INFRASTRUCTURE & ROLLING STOCK  
6.1 Scope and Objectives  
6.2 Methodology  
6.3 Signalling, Telecommunications and Level Crossings  
6.4 Permanent Way  
6.5 Structures  
6.6 Electrification  
6.7 Rolling Stock  

## 7. RISK ASSESSMENT  
7.1 Introduction  
7.2 Results - Infrastructure Surveys (Safety Inadequacy)  
7.3 Results - Risk Model Assessment  
7.4 Summary of Results  
7.5 Risk Mitigation  
7.6 ‘Unreasonable’ Risks  
7.7 Infrastructure Improvement Recommendations  
7.8 Cost Benefit Analyses  
7.9 Recommendations  

## 8. SAFETY MANAGEMENT SYSTEMS  

---

Report No: 2045.10  
Issue No: 01  
Date: October 1998
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1 Management Issues Arising from Infrastructure &amp; Rolling Stock Review</td>
<td>54</td>
</tr>
<tr>
<td>8.2 Safety Management System Audit</td>
<td>65</td>
</tr>
<tr>
<td>8.3 Conclusions</td>
<td>81</td>
</tr>
<tr>
<td>8.4 Recommendations</td>
<td>84</td>
</tr>
<tr>
<td>8.5 SMS Recommendations Costs</td>
<td>87</td>
</tr>
<tr>
<td>9. RAILWAY SAFETY REGULATION</td>
<td>89</td>
</tr>
<tr>
<td>9.1 Introduction</td>
<td>89</td>
</tr>
<tr>
<td>9.2 The Railway Inspecting Officer (RIO)</td>
<td>89</td>
</tr>
<tr>
<td>9.3 The Impact of EU Legislation on the Regulation of Safety on IE.</td>
<td>104</td>
</tr>
<tr>
<td>10. SUMMARY OF CONCLUSIONS</td>
<td>116</td>
</tr>
<tr>
<td>10.1 Iarnród Éireann</td>
<td>116</td>
</tr>
<tr>
<td>10.2 Department of Public Enterprise</td>
<td>119</td>
</tr>
<tr>
<td>11. IMPLEMENTATION</td>
<td>121</td>
</tr>
<tr>
<td>12. SUMMARY OF RECOMMENDATIONS</td>
<td>123</td>
</tr>
<tr>
<td>12.1 Already Implemented</td>
<td>123</td>
</tr>
<tr>
<td>12.2 Immediate (within 3 months of publication)</td>
<td>123</td>
</tr>
<tr>
<td>12.3 First 6 Months</td>
<td>123</td>
</tr>
<tr>
<td>12.4 At End of 6 Months</td>
<td>123</td>
</tr>
<tr>
<td>12.5 6 - 12 Months</td>
<td>124</td>
</tr>
<tr>
<td>12.6 12 - 18 Months</td>
<td>126</td>
</tr>
<tr>
<td>12.7 Long Term (within 1 - 2 years)</td>
<td>128</td>
</tr>
<tr>
<td>12.8 After 18 months</td>
<td>129</td>
</tr>
<tr>
<td>12.9 Ongoing</td>
<td>129</td>
</tr>
<tr>
<td>13. REFERENCES</td>
<td>130</td>
</tr>
</tbody>
</table>
APPENDIX I - Remit
APPENDIX II - ALARP Principle
APPENDIX III - Definition Of Injury Levels
APPENDIX IV - CIE/IE Organisation Chart
APPENDIX V - IE Network Map
APPENDIX VI - Glossary of Terms
APPENDIX VII - Risk Assessment Section Information
APPENDIX VIII - Safety Inadequacy Scores
APPENDIX IX - Risk Assessment Results Summary
1. INTRODUCTION

International Risk Management Services (IRMS), in association with its partner consultants, have been commissioned by the Department of Public Enterprise (the Department) to conduct a Railway Safety Study of the Iarnród Éireann (IE) network. IRMS’ partners were Michael Hamlyn Associates, Carl Bro Rail and Merz and McLellan.

The Consultants wishes to acknowledge the assistance and co-operation given by the Department, Córas Iompar Éireann (CIE) and IE managers and staff throughout the various studies. Although many recommendations are made within this report to improve the management of safety on the Irish rail network, the Consultants acknowledge that many of the necessary changes had been recognised by IE itself and that steps were already in place in respect of some activities to institute the systems that will lead to improved safety performance and a reduction of risk to those using the railway.

It is also necessary to stress that historic IE safety performance is comparable with other national railway systems and is much better than that experienced on the Irish road network. However, because of a low level of investment in Ireland’s railways over many years, and the impact of changes in management roles, objectives and organisation in the current transport scene, it is necessary to make improvements in systems, methods and equipment that will not only maintain this safety record but which will help identify possible safety risks in the future and take proactive means to control them.

This report brings together the results, conclusions and recommendations from an analysis covering the recent safety performance of IE, the safety of existing physical assets, both infrastructure and rolling stock, the safety management systems (SMS) of IE and the impact and sufficiency of railway safety regulation imposed by the Irish Government.
2. OBJECTIVES AND SCOPE

2.1 Background

IE is a wholly owned subsidiary of the State owned public transport company CIE. IE operates a range of mainline and commuter passenger services, and freight services, and is responsible for the maintenance and renewal of the railway infrastructure. IE has statutory responsibility for the safe operation of the national railway system.

2.2 Objectives

The objective of this study was to carry out a strategic review of all aspects of the safety of IE's railway system. This study was commissioned to include a review of IE’s Safety Management System (SMS), the safety adequacy of its infrastructure and rolling stock, an assessment of the risks on the system and criteria by which their control should be judged, a review of the railway safety regulation system and an assessment of the implications for safety regulation from the implementation of EU Directives on railway open access.

The study was required to investigate the physical and management systems that existed to achieve acceptable standards of safety on the present IE network. It was not asked to establish the historical background for any deficiencies found but was required to focus recommendations on actions necessary to secure safety on the Irish railway system in the future.

2.3 Scope

The complete IE railway system was included in the study, together with aspects of Northern Ireland Railways (NIR), as necessary, related to cross border traffic. The DART suburban system and freight traffic were also included in the study.

Terrorism and security matters were excluded from the scope of these studies.

2.4 Remit

The Brief for the Railway Safety Study as written by the Department of Public Enterprise is shown in Appendix I.
3. APPROACH

An overview of the approach taken in completing the study is shown in Figure 3.1. Each aspect of this approach is now considered.

![Figure 3.1: Methodology Overview](image)

3.1 Project Start Up

Following a project start up meeting with the department and IE representatives, the first project task involved the collection and review of all pertinent project documentation available from IE, including any safety studies carried out to date, and relevant records. In addition, any IE documentation detailing their safety risk criteria (e.g. for dangerous goods), risk management system, safety plan/policy, rules and procedures, and Safety Management System (SMS) were requested and provided, where available.

3.2 Risk Criteria

The Consultants used appropriate international safety criteria benchmarks in assessing the safety of the railway system, adjusted where necessary to take account of particular features of the system. Based on these benchmarks, and extensive previous experience in deriving and defining operational safety risk criteria for railway operators, the Consultants made recommendations for quantitative safety 'adequacy' criteria.
3.3 **Operational Performance Review**

Before undertaking the review of operational safety adequacy and the quantified risk calculations, safety statistics related to the operation of the IE railway system were collected and analysed (for the last 5 years of operation). These included details of accidents and casualties that occurred to passengers, staff/contractors and the public as a result of railway operations as well as system failures (rolling stock, signalling, permanent way faults, etc.) and maintenance records.

3.4 **Safety Management System (SMS) Review**

The adequacy of IE’s safety policy, systems, rules and procedures as embodied in their SMS was assessed. The assessment was based upon previous experience of Safety Management Systems implementation in the railway industry, industry best practice, and relevant codes, standards and guidance documents.

Based on previous SMS audits carried out by the Consultants, an audit questionnaire was produced covering the scope of the management systems. Senior managers of CIE and IE were interviewed and audits were carried out at ground level through visits by consultants to depots, stations, installations and train riding throughout the system. In addition a safety questionnaire was developed to assess safety culture on the system and sent to every IE employee for completion.

3.5 **Safety Adequacy of Infrastructure & Rolling Stock**

Using data and information collected as part of the operational performance review, and from a series of site inspections, the adequacy from a safety viewpoint of the following railway systems and services, was reviewed: operations, design and maintenance aspects of railway infrastructure, permanent way, signalling/telecoms systems, rolling stock, stations, electrification (DART) and level crossings. All pertinent system design, operational and maintenance information was requested and obtained from IE and reviewed in their offices.

An integral part of this assessment was the undertaking of a comprehensive assessment of the risks arising in each of the above areas, as a result of the identified design, operations or maintenance deficiencies.

3.6 **Risk Assessment**

A key element of the strategic review was to provide clear, precise, quantified and objective advice on whether the overall level of railway safety is adequate. Furthermore, it was required to identify unreasonable risks, identify the principal options and the broad costs for addressing these risks,
and finally identify the time frame in which remedial action must be implemented.

The analysis was carried out on the signalling, telecomms, level crossings, rolling stock and permanent way systems to estimate the likelihood of personal injuries arising from equipment failures within these systems. The risk model develops the review of operating statistics and the infrastructure site surveys.

The number of casualties was predicted on a line by line basis for passengers, staff and public. Based on the typical number of passengers and staff, individual risk levels are calculated and compared to the acceptable limits.

The risk model allowed the condition and number of assets in each section to be considered, in addition to the specific train frequency and passenger loading data. Risks results were subsequently summarised according to the type of equipment giving rise to the risk and the line location.

3.7 Railway Inspecting Officer Review

A review of the roles, responsibilities, functions and reporting arrangements of the Department’s Railway Inspecting Officer was carried out.

3.8 EU Directives Implementation

The implications for safety regulation of the implementation of the EU Directives 91/440, 95/18 and 95/19 [1,2,3] were considered. These Directives relate to the promotion of combined goods transport, developing EU railways and the opening up of access to railways in Member States.

3.9 Best Practice Forum

Initial results from the above studies and interim papers were regularly considered by a team of transport safety experts from the IRMS led consortium and compared with their experience of good practice on other comparable railway systems. In this way, working papers were subject to peer review. The Department (as client) was given the early opportunity to attend and review this work.
4. RISK CRITERIA

4.1 Introduction

Initially a review was undertaken to establish criteria against which the consultants could judge the tolerability of risks to staff, passengers and members of the public arising from IE's operations. This was completed prior to the analysis of the safety performance record of the IE railway system, so that the determination of acceptance criteria was clearly independent of the assessment of the actual safety performance of the railway.

The review considered criteria which have been established for other railway operators, in addition to those in use within general industry. A key component of the review has been the consideration of the principles established within the draft European Norm prEN 50126 [4], which seeks to set a common framework for the establishment of risk criteria and assessment activities for the European railway industry. Consideration was also given to criteria established during previous IE safety studies and current objectives set out within the IE Safety Plan 1998[5].

The proposed criteria were developed with due consideration of apparent public acceptance of risk in Ireland, in addition to the relevant perceived benefits of a national railway network. This has involved a review of railway networks world wide and of other modes of transportation.

4.2 Safety Acceptance Criteria Principles

Adoption of the ALARP (As Low As Reasonably Practicable) principle was proposed for use in this study (see Appendix II). This concept originated in the UK and has subsequently been adopted by many countries world-wide. It postulates that there are certain levels of risk that are intolerable to employees, customers or public and that these risks must be reduced "as low as reasonably practicable" towards an acceptable level. Numerical values can be placed on the "intolerable" and "acceptable" levels from the view point of both the individual person and society as a whole. Between these levels (the ALARP area) the business must make every effort to reduce risk in so far as is reasonable, which may take economic arguments into account.

In order to assess what is "reasonable" in this context, some industries and organisations, including Government Departments, put a value on "preventing a fatality" (VPF). This technique is valid for planning purposes when identifying priorities and has been used widely by the UK railway systems and in setting policies for safety management during rail privatisation.
Based upon the foregoing, criteria for individual risk and equivalent values for preventing a fatality, have been proposed for use in this study.

4.3 Fatalities and Equivalent Fatalities

It is common practice in Quantified Risk Assessment (QRA) studies when setting criteria and calculating risk levels, to include the risk of injuries, as well as the risk of death. Risks are then expressed in terms of “equivalent fatalities”: factors are used which relate the severity of minor and major injuries to fatalities as shown below.

Equivalent Fatalities = (number of Fatalities + number of Major Injuries ÷ 10 + number of Minor Injuries ÷ 200)

The Equivalent Fatality factors combine comparable levels of casualty, i.e. 1 fatality is equivalent to 10 major injuries or 200 minor injuries in terms of seriousness. It is not related to the frequency with which these various types of casualty level may occur in railway accidents.

When considering the criteria discussed within this review, it must be borne in mind that some relate to fatalities only, whereas others relate to equivalent fatalities. For guidance, the use of equivalent fatalities will usually lead to measured risk levels some two or three times higher than for fatalities alone.

Definitions of injury levels are provided in Appendix III.

4.4 Scientific Number Notation

Risk calculations often involve the manipulation of numbers which are very much smaller than unity, and for convenience, it is common practice to express these in scientific notation, as follows:

1E-01 = 1x10^1 = 0.1 = 1 in ten
1E-02 = 1x10^2 = 0.01 = 1 in a hundred
1E-03 = 1x10^3 = 0.001 = 1 in a thousand
1E-04 = 1x10^4 = 0.0001 = 1 in ten thousand
1E-05 = 1x10^5 = 0.00001 = 1 in a hundred thousand
1E-06 = 1x10^6 = 0.000001 = 1 in a million

If the individual risk of fatality from a particular hazard was 1E-03 per annum, this would mean that in a population of 1,000 people at risk, on average 1 person would be killed due to that hazard every year.
4.5 Qualitative Criteria

The purpose of qualitative risk criteria is to provide a means of preparing initial risk estimates, based upon broad categories of hazard frequency and severity. The simplest manner of undertaking this process is through the use of a criticality matrix, where by plotting the frequency of a hazard against its severity, an overall risk category can be determined.

A number of matrices developed by different railway organisations were reviewed. It is a pre-requisite that risk criticality matrices need to be both straightforward to apply whilst at the same time addressing the entire range of all potential hazards. The attainment of this requirement ensures that all types of risk assessment could be conducted through the use of the same matrix, for example ranging from infrastructure assessments, evaluating relatively frequent component failures, to the consideration of extremely unlikely, catastrophic events, i.e. major station fires or high speed collisions or derailments.

The risk criticality matrix presented in Table 4.1 was proposed as the qualitative criteria to be adopted for the purposes of the IE infrastructure and equipment safety adequacy review. It should be noted that the consequence category definitions address both hazards (such as electric shock) which lead directly to accidents as well as those (such as the setting of a conflicting route by a signalman) which require additional coincidental failures in order for the hazard to be realised in terms of an adverse consequence.

It is important to note that this matrix should be used purely for coarse rating and prioritising purposes and can not be applied to absolute statements on the level of risk. For example, if a hazard has a severity 5 and a frequency 4 rating (therefore a ‘20’ rated risk), this does not imply that this hazard is twice as bad as one that is rated as a ‘10’, i.e. ‘scoring’ severity and frequency ratings of 5 and 2, respectively. The intention is that this first hazard represents a higher priority and that attempts should be made to control/reduce this before lower rated items.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Severity</th>
<th>8 Large no. of fatalities</th>
<th>7 Few fatalities</th>
<th>6 One fatality</th>
<th>5 Several injuries</th>
<th>4 One injury</th>
<th>3 Simultaneous failure required</th>
<th>2 During degraded mode operation</th>
<th>1 Undertake degraded mode operation</th>
<th>0 No potential for Safety Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily to Monthly</td>
<td>5</td>
<td>40</td>
<td>35</td>
<td>30</td>
<td>25</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Monthly to Yearly</td>
<td>4</td>
<td>32</td>
<td>28</td>
<td>24</td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>8</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Once every 1 to 10 yrs</td>
<td>3</td>
<td>24</td>
<td>21</td>
<td>18</td>
<td>15</td>
<td>12</td>
<td>9</td>
<td>6</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Once every 10 to 100 yrs</td>
<td>2</td>
<td>16</td>
<td>14</td>
<td>12</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Less than once every 100 yrs</td>
<td>1</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 4.1: Proposed Risk Criticality Matrix

4.6 Quantified Criteria

It is assumed that the Irish mortality rate for the least vulnerable members of society is in line with other European countries at approximately 1 fatality per 5,000 a year. Given that this is the case, prEN50126 recommends the upper limit of risk tolerance for new railways to be set at 1 fatality per 100,000 per annum and 1 equivalent fatality per 40,000 per annum. Given that the IE network represents an existing system, a less onerous value may be utilised, taking into account the grossly disproportionate sums of money that would be needed to retrofit the required safety improvements. It was therefore proposed that an intolerable individual risk limit for passengers and public of 1 fatality per 10,000 per annum or 1 equivalent fatality per 4,000 per annum be established for the purposes of this study. As it is general practice to set the broadly acceptable limit approximately 2 orders of magnitude below the intolerable level, it was further proposed that the broadly acceptable risk level be set at 1 fatality per million a year or 1 equivalent fatality per 400,000 per year.

In line with general international practice, it was suggested that the staff criteria be set at 1 fatality per 1,000 per year for the intolerable limit, with the broadly acceptable level at 1 fatality per million (i.e. the same as for passengers and public). For equivalent fatalities the upper limit was set at 1 per 400 per annum, with the broadly acceptable limit at 1 per 400,000 per annum.

The above criteria are also in line with UK Health & Safety Commission guidance on risk tolerability [6] and the values established by other existing world-wide railway operators.

Table 4.2 summarises the proposed individual risk criteria.

<table>
<thead>
<tr>
<th>Exposed Group</th>
<th>Equivalent Fatalities per annum</th>
<th>Fatalities per annum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper</td>
<td>Lower</td>
</tr>
<tr>
<td>Passengers</td>
<td>1 in 4,000</td>
<td>1 in 400,000</td>
</tr>
<tr>
<td>Staff</td>
<td>1 in 400</td>
<td>1 in 400,000</td>
</tr>
<tr>
<td>Public</td>
<td>1 in 4,000</td>
<td>1 in 400,000</td>
</tr>
</tbody>
</table>
4.7 IE Safety Plan 1998

The Safety Plan 1998, developed by IE, is committed to implementing the ALARP principle, with the following specific quantified objectives set:

- there is to be no more than one passenger fatality per 100 million passenger journeys;
- there is to be no more than one staff fatality every 2 years;
- there is to be no more than one public fatality every 2 years (for example level crossings).

All of these targets are to be compared with historical data utilising a rolling average of 5 years. It should be noted that these values relate to safety performance objectives, which are clearly different to the establishment of criteria for intolerable and broadly acceptable risk levels. Nevertheless, it is useful to compare these objectives with the criteria already discussed.

It was necessary to convert the objectives into per annum individual risk levels in order to compare them with the other criteria discussed in this review. It was therefore assumed that a DART passenger will undertake at most 500 journeys per annum (likely to be the most exposed passenger on the IE network), that the total number of IE staff is 4839 and that the entire Irish population (taken to be 3.64M ) are equally exposed to level crossing risk. This latter approach may be somewhat optimistic, i.e. assuming that an entire country’s population is equally exposed to level crossing risks. However, no information was available on actual level crossing usage by local communities and thus this relatively crude assumption had to be used.

The IE objectives, using the above assumptions, convert to:

- individual passenger risk shall be no more than 1 fatality per 200,000 per annum;
- individual staff risk shall be no more than 1 fatality per 10,000 per annum;
- individual public fatality risk at level crossings shall be no more than 1 per 10 million per annum.

These objectives fall within or are better than the criteria proposed in Table 4.2. However, it should be borne in mind that since these are objectives, it is appropriate that they are somewhat more stringent than risk levels which would be regarded as intolerable by IE.
4.8 **Value of Life Indices**

The Irish National Roads Authority (NRA) determined the following costs associated with fatal, serious injury and minor injury accidents [7] (updated in line with inflation). These values are based on the “Willingness to Pay” approach:

- fatality: Ir£908,000;
- serious injury: Ir£100,000;
- minor injury: Ir£12,000.

Based on the above, “Value for Preventing Fatality” (VPF) figures have been derived, addressing each of the following scenarios:

- accidents where IE has a prime duty of care (e.g., train accidents, employee fatalities, etc.);
- accidents where the victim has significant control (e.g., level crossing accidents, escalator accidents, etc.);
- illegal acts (e.g., trespass, vandalism, etc.).

The NRA fatality value (Ir£908,000) was applied to the second scenario where the victim has significant control over the hazard.

From a review of similar VPFs applied by other railway bodies, the values follow the pattern whereby the first scenario is approximately twice (2.3 times) that of the value applied where the victim has a certain level of control and the third value is approximately half of this value.

Following the application of these proportions, the following values were calculated:

- Ir£2.1m for accidents where IE has a prime duty of care;
- Ir£0.9m for accidents where the victim has significant control;
- Ir£0.45m for illegal acts.
5. IARNRÓD ÉIREANN SAFETY PERFORMANCE

5.1 Introduction

The review of statistical data formed the first part of the review of IE levels of safety. Historic risk levels to staff, passengers and public based on actual safety performance were calculated from the accident statistics collected. This process enabled a coarse level of risk to individual members of each exposed group to be calculated and compared against the tolerable and intolerable risk criteria included in Chapter 4. In addition, the asset failure statistics generated provided the opportunity for trends to be observed and problems areas to be highlighted.

This process has been achieved by reviewing:

- train accident (fires, collisions & derailments) statistics 1993-97;
- passenger, public & staff injury accident statistics 1993-97;
- accident listing 1996/97;
- Railway Inspecting Officer’s annual report 1995;
- equipment population data;
- daily incident report.

The following sections set out the results and conclusions arising from the review.

5.2 Results

5.2.1 Limitations of the Data

As the review progressed, it became apparent that there were major shortcomings associated with the data collected and collated by IE. These shortcomings related primarily to an absence of information as to the extent of injuries incurred, double counting of incidents across different databases and a failure to break down the data into meaningful categories. The results obtained from the analysis are thus subject to a large degree of statistical uncertainty.

It should also be noted that risk estimates from small data samples are naturally subject to statistical uncertainty, due to the absence of events which are unlikely but which have very severe consequences, such as high speed train collisions. Thus, the risk estimates provided from the data review have been supplemented by the Risk Assessment work described in Chapter 7 of this report, which calculates the additional implied levels of current risk arising from potential faults in the infrastructure. These give a measure of
5.2.2 IE Historical Accident Data

Table 5.1 summarises IE’s operating experience relating to multiple fatality events from 1955 to the present date.

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Circumstances</th>
<th>Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>21/12/55</td>
<td>Cahir Station</td>
<td>Train crashed through buffer stop and plunged into river Suire.</td>
<td>2 Staff (driver and fireman)</td>
</tr>
<tr>
<td>21/10/74</td>
<td>Gormanston Station</td>
<td>Rear-end collision followed by secondary collision.</td>
<td>2 Passengers</td>
</tr>
<tr>
<td>31/12/75</td>
<td>Near Gorey</td>
<td>Derailment on bridge and fall down embankment.</td>
<td>1 Staff 4 Passengers</td>
</tr>
<tr>
<td>1/8/80</td>
<td>Buttevant</td>
<td>Train derailment at speed.</td>
<td>2 Staff 16 Passengers</td>
</tr>
<tr>
<td>21/8/83</td>
<td>Cherryville Junction</td>
<td>Rear-end collision</td>
<td>7 Passengers</td>
</tr>
</tbody>
</table>

Table 5.1: Railway Accidents Resulting in Multiple Fatalities

This approximates to an average of 1 passenger fatality per year and 1 staff fatality every 7 years arising from multiple fatality train accidents on the IE network.

Table 5.2 provides a summary of IE’s historical data covering all accidents over the period 1993 to 1997 inclusive. The following list defines the hazard categories utilised in the statistics presented in Table 5.2:

- **Breakloose** - trains becoming uncoupled;
- **SPAD** - train driver passing a signal which is indicating that he should stop (Signal Passed At Danger);
- **Struck by** - struck by machine, moving vehicle or stationary or flying objects;
- **Other** - includes struck against, stepped on, together with vehicle movement incidents;
- **Injured while handling** - includes all types of manual handling injuries;
- **Slips, Trips and Fall** - includes falling on a level surface and from a height;
- **Exposure** - includes exposure to electricity, noise, fire or explosion, hot/harmful substances, assault and lack of oxygen;
- **Trapped** - includes being trapped under/in or by machine or door;
- **Miscellaneous** - includes all other types of incidents that have not been detailed in the above categories.

<table>
<thead>
<tr>
<th>Train Accidents</th>
<th>Other Accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident type</td>
<td>Total no. of Incidents</td>
</tr>
<tr>
<td></td>
<td>Staff</td>
</tr>
<tr>
<td>Derailments</td>
<td>460</td>
</tr>
<tr>
<td>Collision (all types)</td>
<td>90</td>
</tr>
<tr>
<td>Running into obstructions (all types)</td>
<td>102</td>
</tr>
<tr>
<td>Train fires</td>
<td>20</td>
</tr>
<tr>
<td>Breakloose</td>
<td>40</td>
</tr>
<tr>
<td>SPADs</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 5.2: IE Historical Accident Data 1993-97**

It should be noted that “Train Accidents” include many events which occur in sidings and depots and which therefore do not involve passengers.

The equivalent fatalities per annum calculated for each accident type are presented in Table 5.3. This highlights that for train accidents, “running into obstructions” leads to the highest level of equivalent fatalities for passengers, public and staff. With regard to accidents in stations, “slip, trip and falls” lead to highest level of equivalent fatalities for passengers, the public are most exposed to ‘other’ incidents and “struck by” incidents lead to the highest level of staff equivalent fatalities.
Table 5.3: Equivalent Fatalities per Annum for Each Incident Type

<table>
<thead>
<tr>
<th>Incident type</th>
<th>Equivalent Fatalities</th>
<th>Equivalent Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Derailments</td>
<td>Passengers 0.02</td>
<td>Public 0.02</td>
</tr>
<tr>
<td>Collision (all types)</td>
<td>Staff 0.02</td>
<td>Other 0.005</td>
</tr>
<tr>
<td>Running into obstructions (all types)</td>
<td>0.08</td>
<td>Other 0.008</td>
</tr>
<tr>
<td>Train fires</td>
<td></td>
<td>Slips, trips and falls 2.37</td>
</tr>
<tr>
<td>Breakloose</td>
<td></td>
<td>Trapped 0.14</td>
</tr>
<tr>
<td>SPADs</td>
<td></td>
<td>Exposure 0.07</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.2.3 Individual Risk Results

Individual risk levels were calculated from the data in Table 5.3. For example, the risk for an individual passenger is calculated based upon the number of journeys made by that person per annum compared with the total number of passenger journeys undertaken per annum. Thus the more journeys a person makes, the greater the risk of being involved in an incident.

The individual risk estimates for each exposed group (passengers, public, staff) can then be compared against the criteria in Chapter 4, in order for the overall risk tolerability to be determined.

Table 5.4 presents the individual risk results and shows the percentage of this value against the equivalent fatality based intolerable risk limit.
Table 5.4: Individual Equivalent Fatality Risk Estimates

Overall, the estimates provided in Table 5.4 suggest that risk to members of the public arising from IE operations are currently broadly acceptable. However, it should be noted that this is probably an optimistic estimate, since it has been assumed that public risks are uniformly shared across the entire Irish population, whereas in reality they tend to be more weighted towards certain individuals (such as regular level crossing users). Nevertheless, this result would tend to indicate that risk reduction measures for hazards affecting members of the public (as distinct from rail passengers or staff) should be accorded a low priority.

On the other hand, risks to passengers and staff are both estimated to be within the ALARP region, with staff risk currently running at 60% of the intolerable risk limit. Moreover, it is likely that certain high-risk staff groups, such as shunters and permanent way staff, may well experience intolerable risk levels. Clearly, the reduction of such risk levels should be regarded as a priority area for attention.

5.2.4 Societal Risk

In addition to monitoring individual risk, it is usual to assess the risk to society as a whole arising from accidents which have the potential to lead to multiple fatalities. Table 5.1 summarises IE’s experience of multiple fatality events since 1955 to the present date. A total of five events have occurred over this period, which is insufficient for meaningful statistical analysis. It is however noted that none of these accidents was directly caused by a technical defect.
6. SAFETY ADEQUACY OF INFRASTRUCTURE & ROLLING STOCK

6.1 Scope and Objectives

6.1.1 Scope

The objective of this review was to assess the safety adequacy of IE’s infrastructure and rolling stock, including:

- signalling (including telecommunications and level crossings);
- permanent way;
- rolling stock;
- electrification (on the DART system);
- structures/civil engineering.

A sample set of locations was agreed with IE for field visits by the consultants to inspect each aspect of the infrastructure and rolling stock.

6.1.2 Objectives

The overall objective of the Safety Adequacy Review was to determine whether the infrastructure, systems and equipment present an acceptably low level of risk to passengers, staff and the general public by virtue of:

- safe design which complies with legislative and technical standards;
- safe control of system modifications to, and replacement of equipment;
- effective technical documentary support;
- correct installation in accordance with legislation, regulations, Codes of Practice (COP) and general engineering practice;
- adequate maintenance and training;
- safe testing and acceptance criteria.

6.2 Methodology

6.2.1 General Methodology

The general approach taken was as follows:

1. Preparation -
   - development of an assessment sheet for each class of asset
   - development of sampling criteria
2. Site Assessment -
   - inspection of the infrastructure or rolling stock.
3. Analysis

- site assessment results weighted based on sample size
- results extrapolated for the entire IE system

6.2.2 Interviews

A series of interviews were held with key senior managers responsible for infrastructure and rolling stock safety. Managers were issued with a Strategic Technical Review Checklist for completion, the purpose of which was to support the review of site conditions. The material and documentary status of individual equipment/systems including operation and maintenance was established prior to the site assessment.

6.2.3 Site Visits/Inspections

Site assessments of the infrastructure and rolling stock were conducted during a number of visits each extending up to several days. The assessments were carried out by railway engineers with extensive professional experience of railway infrastructure renewal and maintenance.

It was intended that, given the strategic nature of the study, a small percentage of the IE system would be visited and reviewed. However, with the kind assistance of IE providing a railway inspection vehicle, it was possible to either visit, or travel over, a large percentage of the network (approximately 60-70%).

6.3 Signalling, Telecommunications and Level Crossings

6.3.1 Safety Adequacy Review

6.3.1.1 DART

A number of working installations were inspected on the DART, including the Dublin Centralised Traffic Control Centre (CTC).

An Automatic Train Protection (ATP) system which provides additional integrity over visual signals to the safety system is in use on the DART. There were, however, underlying weaknesses, including inadequate control of redundant wiring, and out of date working drawings which had been subject to alteration in an uncontrolled manner.

There was no planned servicing of signalling relays and other vital equipment. A number of examples of inadequate maintenance were also observed, including defective insulated joint detectors and dirty signal lenses.
6.3.1.2 Intercity and Passenger Lines with Multi-aspect Signalling

The Dublin CTC controls much of the colour light signalling on the network. A continuous automatic warning system provides cab signalling for the diesel fleet together with discrete train radio coverage. Again, however, there were underlying deficiencies. Inspection of colour light signalling equipment revealed a basic lack of maintenance similar to that found on the DART.

Operational telecommunications maintenance was also generally inadequate. There is no physical separation in the installation between telecommunication and signalling equipment, signalling being safety critical. The resulting intermixing of equipment has a detrimental effect on installation standards and maintenance.

Rail Clamp Point Locks (RCPL) mechanisms are used in a number of areas. Many were of the original Mark 1 type and require replacement on a prioritised basis due to failures found on other railway systems.

6.3.1.3 Intercity and Passenger Lines with Mechanical Signalling

Semaphore signalling on IE is of the lower quadrant type. Mechanically operated points are in general use and the Electric Train Staff (ETS) system is used for train protection on single lines.

Site inspections revealed that much of the mechanical signalling was in poor condition. On the signal box operating floor, the presentation of information to the signal man is inadequate. Many signal box diagrams are in poor condition and difficult to read or interpret. Signalling indicators are badly positioned - often on the window shelf or wall of the operating floor, obscured by the lever frame or other equipment.

Severe wear was found on most signal lever frames and associated interlocking examined. Slack nuts and bolts were found on facing points and locking mechanisms. Examples were found of worn and inadequate locking bars and connections.

The wiring of a number of signal boxes was in poor condition. Lever locks in general use did not have a force down feature and were susceptible to failure.

At Heuston and Claremorris signalboxes, the wiring was found to be in very bad condition. In the case of Claremorris the wiring was extremely brittle. Both installations are now more than 30 years old.

Relays are 'shelf type' with no detachable top. Wiring to the relays is run from above and there is no form of protection provided on the relay terminals. These are adjacent to relay and lever lock terminals and require extreme care to be exercised. Control of redundant wiring was also a safety issue.
6.3.1.4 Freight Lines

The safety issues concerning semaphore signalling on freight lines are the same as described in the section relating to mechanical signalling (see Section 6.3.1.3).

Signalling equipment was in very poor condition. Trespass was commonplace and the railway in general suffered from vandalism. Cable connections to trackside equipment were poor and many had also been subject to vandalism. In one case, a signal structure was found to be unstable. The under-part of certain signal boxes were hazardous to any one requiring access, were used as store rooms and also suffered from poor housekeeping.

6.3.1.5 Level Crossings

All types of level crossings were examined; Automatic Half Barriers, White Gates, Lights and Bells Crossings and Iron Gate Crossing. A number of crossings had poor road surfaces and poor signage, with lack of or poor instructions for the public.

Automatic Half Barriers (AHB)

Working drawings were frequently found to be in poor condition and not up to date. Inspection of the equipment being installed showed that there were no records of the safety critical relays having been reserviced. The relays were dated 1966-1970 and it would have been expected that they would have been serviced before now.

It is best practice that AHB and all level crossings are thoroughly tested on an annual basis. The results of these tests should be retained and reviewed. Follow up action should be mandatory. Planned maintenance is a safety critical requirement together with the annual tests. There was no evidence of these tests or planned maintenance being carried out.

White Gates

Certain of these crossings had hazardous road approaches, for example Clonsilla which has a severe left hand road bend and a canal bridge on the Up line side. It was also reported that a road vehicle had recently struck the gates.

This type of level crossing is normally protected by a signal controlled from a signal box. On the IE network, the gate, when closed across the railway is also considered to be a stop signal. In many cases the braking distance
between the gate and the protecting signal has little margin for driver error or poor rail conditions.

On some higher speed routes, an additional protecting stop signal is provided nearer the gates. It was found that an insufficient safety overlap was provided between the protecting signal and the gates in a high proportion of sites. The overlap is the safety margin for trains overrunning a signal when a brake has been applied too late. This requires further investigation.

**Lights and Bells Crossings**

It was found that, in one case, there was a mixture of wire types and that the telecommunications wiring had uninsulated bare wires. The maintenance quality was also poor.

Another crossing was recently subject to extensive road alterations. A four lane road had been provided replacing the former two lanes. The fitness for purpose of this crossing design may require to be revised as the original design intent has now been superseded by the four lane road.

**Iron Gates Crossings**

There is a high proportion of this type of level crossing on IE. Some are attended (operated by crossing keeper) and others are user worked with or without telephone. In total there are over 2000.

It was found that the public road signing was not satisfactory. Dual language signs in particular were difficult to read, with the letter size considered to be too small.

In many cases the road surface was poor and the road or train drivers’ sighting was obstructed or otherwise inadequate. A proportion of the crossings had been improved but mechanical fittings were in poor condition where upgrading had not been carried out. Many instances of road users ignoring crossing protection arrangements were witnessed on the inspection tours.

6.3.1.6 Telecom Éireann

Over 50% (or 1119 route km) of the IE network is semaphore signalling dating from the early days of the railway. This system is in use on most of the single line sections of the network.

Associated with the semaphore signalling is an Electric Train Staff (ETS) system which is a simple means of train movement protection on single line railways. The particular conditions of single line working, involve the
possibility of head-on collisions between trains travelling at speed. The ETS system is therefore a vital component of safety on the railway.

Under the terms of an agreement dating from 1957, Telecom Éireann (TE) provide and maintain the infrastructure for the ETS system on 90% of IE single lines. The exception is the infrastructure between Waterford and Wexford/Rosslare.

TE do not operate a quality system based on internationally accepted practice, such as ISO 9000. This is unusual in modern network providers. It is essential that the safety critical nature of ETS and other railway telecommunications services provided by TE is recognised.

TE provide specialist training for staff required to maintain the ETS system. This training equips the maintainer on the basic safety requirements of the system including the necessity to service the equipment on an annual basis. It was not clear whether the training is extended to all support groups likely to work on the infrastructure e.g. cable jointers.

Unfortunately, there was little evidence of adherence to the full safety critical requirements for the maintenance of the ETS system. Many instruments were in a poor state of repair with broken, missing or worn parts. No safety critical failure was found during the inspection. Nevertheless, the potential was there due to the lack of good maintenance standards, planned preventative maintenance and servicing.

6.3.2 Conclusions for Signalling, Communications and Level Crossings

A number of safety critical failures were exposed during the inspections (see Section 6.3.1.3). Normally, it is to be expected that no such failures would be revealed on this kind of inspection.

A high proportion of signalling and communications equipment on the IE network is not in good condition and much of the mechanical signalling is in an unacceptable condition.

This situation is principally due to:

- the lack of appropriate standards for the infrastructure;
- the lack of planned maintenance;
- the lack of regular safety critical tests, and;
- poor housekeeping.

6.3.3 Recommendations for Signalling, Communications and Level Crossings

A number of major deficiencies have been advised already to IE. Specific equipment recommendations are provided and costed in Chapter 7, with generic management issues considered in Chapter 8.
In addition, the following specific recommendations are made.

6.3.3.1 Immediate, Without Delay

- IE must ensure that rigorous measures are taken to ensure the security and fire safety of its staff and safety critical equipment in signal boxes;
- a detailed asset database and infrastructure fault monitoring system should be developed by IE;
- IE should implement an interim rigorous safe working system for route sections for which the signalling is in particularly poor condition, until essential investment takes place.

6.3.3.2 Medium Term

- Appropriate standards must be developed for all aspects of maintenance, design installation, modification and subsequent hand-over of safety critical equipment. This should include technical documentation, operating instructions and procedures for the production, issue and amendment of drawings;
- A planned maintenance regime with appropriate standards must be introduced for all safety critical work;
- Appropriate training and certification should be provided for all staff engaged on safety critical work;
- A system of independent technical audit should be developed for all safety critical systems;
- There must be rigorous implementation of the practice of cutting back redundant wires, insulating and securing them so that there is no risk of wires coming into contact with working circuitry;
- There should be a special exercise to replace or remove all defective and worn signalling, electrical and telecommunications equipment;
- Specifically, all mechanical interlocking frames should be tested and repaired where necessary;
- Level crossing signs, road marking, sighting for road users and trains, communication and signal protection should be improved where necessary;
- Iron gates level crossings should be provided with safety bays;
- A safe and ergonomically sound working environment should be provided in all signal boxes.
6.4 Permanent Way

6.4.1 Safety Adequacy Review

6.4.1.1 DART

Overall the condition was good but there were numerous examples of poor condition.

On the bull head type track between Sandy Cove and Glenageary the sleepers were becoming decayed with splits and loose chair screws (holding the rail to the sleepers) giving rise to gauge retention problems, severe in some locations. The track gauge defines the distance between the rails which is vital in maintaining the train on the track. The ballast was also choked (incapable of draining) and nearing the end of its useful life. Many fishbolts were missing and the absence of broken bolts in the vicinity indicated that this was of long standing.

Whilst the Continuously Welded Rail (CWR) track was generally of a high standard, there were a number of deficiencies which present a safety risk. For example ballast was not adequate over lengths up to 15m and track geometry was not reliably marked.

The slab (concrete bedded) track between Sandy Cove and Laoghaire had failed in several locations and was in the process of failing at several others. Repairs were found to be of variable quality.

6.4.2 Intercity and Passenger Lines

6.4.2.1 CWR Sections

The Dublin to Northern Ireland CWR section was generally of an excellent standard with a few problem locations needing re-ballasting.

On other areas the CWR track was of variable quality principally due to poor and slurried ballast. In some areas the gauge varies considerably with examples of multiple squats (depressions in the rail).

6.4.2.2 Non-CWR Sections

Generally the quality was very variable with numerous examples of poor maintenance standards. Due to the extent of the problems found only a sample is given below.

Between Leixlip Louisa Bridge and Blakestown Level Crossing the track is predominately 92lb and 95lb flat bottom rail supported on softwood sleepers by soleplates and fang bolts. A very high proportion of the joints (of the order of 50%) have only 3 bolts out of 4 installed. This was obviously of long standing and has been accepted as the norm.
Part of the route between Mullingar and Longford is over peat formation. Examples of locations where sleepers had required changing were inspected. The soleplates had deeply indented into the softwood, some 28 years old, giving rise to loss of grip by the fang bolt. The indentation was much more severe than would be expected on firmer formations, the track moves significantly under traffic and worked its way into the timber. Top and line (vertical and horizontal alignment of the track) are difficult to maintain and frequent tamping is necessary.

Sligo Station is awaiting a remodelling scheme and during this period the track conditions have been allowed to deteriorate in the expectation of the scheme's implementation. Drainage in the station area was very poor and this had a severe impact on the track conditions, in particular the departure platform. Here every joint was wet and moving up and down under traffic. The sleepers themselves were in very poor condition where visible, the majority being hidden under ballast. Overall there was a high risk of derailment although at very low speed. The present operational practice was for the passenger trains to be propelled into this platform and so the track never normally experienced the load of a locomotive. Should a locomotive need to use this stretch the chances of incident will be significantly higher.

Through Athlone (old) station the speed restriction is 25mph but a through train was observed travelling considerably in excess of this speed. The track through the old platform gave cause for concern even at the authorised speed. The track comprised 95lb flat bottom rail dating from 1902 supported on softwood sleepers by soleplates and fang bolts. As common elsewhere on track of this type, the ballast had failed and drainage through the old platforms was ineffective. Sleepers were decaying, splitting and voiding (gaps underneath the sleepers) badly due to the lack of effective support.

The Drogheda - Navan - Tara Mines branch is an example where ultrasonic flaw detection is not undertaken and there must be a high risk of unknown defects existing. The rail age and type would expect one to find a number of bolt hole, upper fillet and flame cut end problems. There has been one visit of the EM50 track recording car late in 1997 but little or no use has been made of the output because the inspector is overwhelmed and has filed it away in a drawer.

At Porterstown Level Crossing a very poor pair of insulated joints adjacent to this level crossing were seen. The supporting softwood sleepers were split and decaying, the soleplates were badly indented into the sleepers. The rail ends are badly matched giving rise to impact as a wheel passes over. The joint is out of square and the fishbolt holes in one rail have been incorrectly drilled. As a result it was not possible to fit one of the bolts and instead a fang bolt had been inserted but will perform little function.

At Clonsilla there was a level crossing whose surface is tarmac laid over the track components. Ballast conditions were poor and in consequence the top is also poor, the permanent nature of the road surfacing making repairs very
difficult indeed. There was a bull head crossover whose check rails were retained solely by conventional steel keys. With this arrangement there was a risk of the check becoming displaced with potential for a derailment in a passenger line.

The up line on the Dublin side of the Clonsilla crossing was laid with 95lb flat bottom rails dating from 1908 supported on softwood sleepers by soleplates and fang bolts. The rails were peppered with squat defects, many are multiple within one rail and adjacent to joints. The fishplates in the 95lb track were thin and worn and were not adequate for present day traffic and axleloads. Junction fishplates (with other rail sections) are no longer available and have to be fabricated by welding together two dissimilar sections. This is not good practice for long life. An example of this type of joint was present with one of the fishbolt holes incorrectly drilled and without lubrication. It is a stated proposal to re-rail this site shortly.

At Longford there were switch and crossing layouts in 92lb flat bottom rail. This rail section, and the older 85lb, differ from more modern designs of flat bottom rail (95lb, 50kg and UIC54) in having a different width of foot, only 5" compared to 5½". This means that the newer rails cannot be installed in the soleplates of the older ones. The layouts are in generally fair condition and some very good refurbishment work has been undertaken to extend the useful life. One rail joint, not lubricated, in 95lb rail was noted where part of the foot had broken away, probably some considerable time ago. In Britain this would have required replacement immediately because of the potential for the jagged edge to propagate a fatigue crack.

Several joints were in poor condition as a result of poor ballast conditions and sleepers becoming decayed and split. One joint was staggered with a mixture of 92lb and 95lb rail sections. The joint, not lubricated, was between 92lb and 95lb rail and the different foot width was clearly visible. This joint was in a state of collapse, the sleepers being unserviceable, founded on failed ballast, supporting badly matched rails with missing fishbolts.

6.4.3 Conclusions on Permanent Way

There are three elements to the overall condition of IE track:

1. Track Geometry. This is the design of the track and it needs to be adequate for a smooth ride to be possible. As speed rise its importance grows. Under 60 mph most track can be aligned by eye. At 90 mph designed curves and transitions are vital for good running. This aspect was not covered in any detail in the study, except for questioning about designs for track renewals. This is generally not a serious safety issue.

2. Track Quality. This is the smoothness of the track and its relation to absolute design. Although IE operate a track recording vehicle it was not possible to use the output to make conclusions about safety. The records produced are not measured against any standards and are different from
ones typically produced by other railways. To consider fully the implications of track quality there needs to be an understanding of how the vehicle fleet reacts with the track. Once again the lack of standards makes this task very difficult. The impression is that by comparison with best practice the macro track quality is adequate but some of the micro items (track twists and other isolated faults) need greater attention. This can be a serious safety issue.

3. Materials. The track system is made up of ballast, sleepers and rails together with a number of things to hold them together. This is where IE are most at risk. The modern track has been the subject of design for modern day traffic. However, the older track has not been confirmed as adequate for modern day traffic and runs on “grandfather rights” (ie, it is allowed to operate on the basis that it has done so in the past). No comparable railway with 18 or so ton axle loads runs with such lightweight rails. The 85lb and 92lb rails installed in the first half of the century are the main problems. Having a different foot width means that more modern rail sections cannot be installed on the same sleepers, complete renewal is the only solution. In all probability these rails are over-stressed and this shows in the large number of defective rails despite the low traffic levels.

Many of the main lines are laid with modern CWR that is undoubtedly fit for purpose. However there some problems in the maintenance of this, such as substandard ballast shoulders at many locations and a number of poor insulated joints. On the secondary, or radial, routes the newer jointed track with 50kg rail on softwood sleepers should be satisfactory, assuming a normal level of maintenance. The older and lighter rails are not generally considered satisfactory but even here conditions varied widely from satisfactory and maintainable to completely unserviceable.

In summary there are two categories:

1. CWR and newer jointed track. Largely safe and serviceable but in need of a system to ensure continuing safety.

2. Older jointed track. Largely safe for traffic but this may be at speeds below those existing when the study was undertaken. Not adequate for full line speed (60 mph or over) and modern locomotive axle loads. Once again this is in need of a system to ensure continuing safety.

During inspection 11 major deficiencies were noted indicating the unsatisfactory state of the majority of the track. The systems, procedures and training necessary to maintain the track were not in place. Replacing old and worn out track with new will not solve this problem in the long term but it may give some breathing space.
6.4.4 Recommendations for Permanent Way

A number of major deficiencies have been advised already to IE. Specific recommendations are provided and costed in Chapter 7, with generic management issues considered in Chapter 8.

The 11 major deficiencies noted should be rectified without delay. This should preferably be a long term solution, rather than a short term palliative. IE should embark on an urgent study which examines the adequacy of the track structure to continue to support the imposed loads. The trains on the IE railway network run at line speeds over rails of age and strength not replicated elsewhere. Thus it is necessary that track based risk is understood and can be managed.

6.5 Structures

6.5.1 Safety Adequacy Review

The structures review has been grouped by structure type rather than line.

6.5.1.1 Bridge Maintenance

There is no formal system of preventative maintenance. Maintenance on bridges is carried out when an observed defect becomes, in the opinion of the inspecting engineer, of serious concern. It then is proposed for the coming year’s maintenance budget.

For metal bridges the maintenance programme does not include very much painting although in one Division there is now a programme for painting bridges and it is having some effect.

On certain lines there has been painting of certain structures, apparently for aesthetic reasons. Paint has been applied over serious corrosion. This is a very short term measure and is of little value since it will be unlikely to curtail the rate of corrosion and will make monitoring the progress of the corrosion difficult. Indeed the paint could hide a major defect with disastrous consequences.

One bridge was observed which had paint applied to one side of the girders only. The side in public view was painted. The metal that is in public view is the least likely to suffer the most corrosion as it will be dried more easily by the prevailing winds.

In general, masonry bridges were found to be in a reasonable condition.

When the DART was constructed there was also a need to increase the height of some footbridges. In some cases the steel structure was cut and an additional length of steel welded in. Some of this work is very poor and should never have been accepted. The stresses in the steel are not able to
follow a proper flow path and there must be locally high stresses. An urgent evaluation is needed to determine the long term viability of the structures. Many of the welds are corroding and the connections are not easily painted.

6.5.1.2 Retaining Walls

There is no formal requirement to inspect retaining walls, or to record their condition, except when a problem is known to exist.

A wall collapsed in Dublin some years ago undermining the foundation of an overhead power supply line support mast. The support to the foundation of the mast has been temporarily reinstated but because of restrictions on track access and finances the wall has not been repaired. The exposed embankment is steep and vulnerable to further slippage.

6.5.1.3 Platforms

Many platforms are outside the normal tolerances for safe stepping distance between the platform and train. This is probably due to the fact that when the track ballast is maintained, the track is raised and the platforms cannot be raised at the same time. There are various reasons why this is the case:

- lack of funds;
- problems with the station layout. The platform cannot be raised without affecting other infrastructure;
- track access restrictions.

It is important when planning work that these matters are considered to prevent people falling between platforms and rolling stock.

Many platforms have surfaces which are not very level and there is a danger of tripping. This can result in a minor injury. However, if the trip is against the back edge of the cope, then it could result in someone falling onto the track with more serious consequences.

6.5.1.4 Public Access

Areas which are accessed by the public are generally the responsibility of the Building Maintenance Executive. There is a large variation in the standards of safety in the existing situation.

Many platforms have trip hazards. Stair flights have unequal steps. Ramps are steeper than the recommended grades. Many of these problems are being addressed when money becomes available.
6.5.1.5 Embankments and Cutting Slopes

When a bank slip occurs on the IE network, a repair is carried out, but generally no investigation is undertaken into the cause of the slip to establish if any remedial action is required.

One slip which was inspected and which had occurred some three years previously had not been cleared out of the side of the track. The banks were essentially too steep and the condition at the top could have been improved to help prevent a further slip in the future.

In the Phoenix Park area of Dublin there are near vertical sections of bank, and trenches have been cut at the bottom of the bank to install drainage or cables, this presents a serious risk of slippage.

6.5.1.6 Lineside Conditions

Under this heading the matters of concern are drainage, fences, and vegetation management.

Fencing appeared to be poorly maintained probably because of budget restrictions and because it is perceived as less important. Where problems with livestock are recognised, some fencing is being renewed.

There were several areas where the vegetation is becoming seriously overgrown.

6.5.1.7 Coastal and Estuarial Defences

Coastal defence works were inspected in the Dublin Division where they are fairly well managed in that there are particular sea defence squads who carry out this work on a full time basis. This at least means that sea defence works are under almost constant supervision and the likelihood of a failure is small. The philosophy is one of patch and repair. This is partly due to the difficult access both to the sites and on the track between trains.

It would be more cost effective in the long term if a properly prioritised programme of repairs was prepared, budgeted for, and implemented.

6.5.1.8 Scour

Inspections for scour (the undermining of bridge foundations by water) are not formalised except that they form part of the standard bridge inspection procedures. However, frequently, the danger areas are under water and cannot be easily inspected. There is a need for divers to go under the surface to carry out proper inspection.
6.5.1.9 Outside Parties

Outside parties in this respect are developers, frequently local authorities and state bodies, whose developments encroach onto the railway or affect the safe operation of the railway.

IE has a bridge agreement procedure and an agreement is reached with the local authority for each bridge which they wish to construct across the railway. This agreement contains a requirement for the approval of methods of working so that the railway personnel can vet the safety of the proposals.

Other works are not subject to the same type of agreement because the development does not actually encroach onto IE property. Nevertheless there can still be a danger to the safe operation of the railway from the works affecting the track or other infrastructure support or from mechanical equipment or plant coming into close proximity with the rail traffic, or collapsing.

During the inspections, hazardous practices were seen on a construction site where the local authority was constructing a bridge over the railway at Kilcock. The construction was too close to the track and could have affected the safety of passing trains. The safety precautions and communications in place were inadequate and were in any case being ignored by the local authority work force.

6.5.2 Conclusion on Structures

The safety of structures relies heavily on the competence and experience of the staff. There are few supporting procedures and processes to support the staff.

During the visits made there were major safety concerns relating to outside parties operating on or nearby the railway.

6.5.3 Structures Recommendations

A number of major deficiencies have been advised already to IE. Specific equipment recommendations are provided and costed in Chapter 7, with generic management issues considered in Chapter 8.

The following specific recommendations are made in addition:

- a risk based bridge inspections programme should be introduced, underpinned by a planned maintenance and/or repair programme;
- formal inspections and subsequent works programmes should be introduced for other structures;
- outside parties working on or near the railway must be better managed and should be educated in railway risks.
6.6 Electrification

This area relates solely to the DART electrification and associated power supply and switching equipment.

6.6.1 Safety Adequacy Review

6.6.1.1 Substations

Substation work was found to have a strong safety culture. The safety equipment originally provided was to a high standard, and the systems to prevent human error of the equipment provided a high degree of safety to maintenance personnel.

Maintenance staffing was adequate, but only barely so; cover during holiday periods, or during staff sickness, was not achievable.

6.6.1.2 Overhead Conductor line

The long-term safety (and reliability) prognosis for overhead conductor line gave cause for some concern. The equipment has reached that point in its life where initial problems have been solved, and the equipment has not yet suffered from severe wear or ageing problems. This period will not last for long. There is concern that the current high level of safety and reliability is on borrowed time, and that DART has neither the level of skilled manpower nor the safe access equipment for the maintenance staff to cope with a system as it degenerates with age. The key points are:

- the overhead line staffing arrangements are inadequate, and seem to be deteriorating. Mention has been made of inadequate shift cover;

- the maintenance access equipment available gives great cause for concern. The only access equipment available for use is the single converted passenger coach, for which a diesel shunting locomotive has to be provided. There are two problems of health and safety at issue here: fumes from the locomotive present an unacceptable health risk, and the practice of working from the roofs of wiring trains without protection against falls is no longer considered safe;

- as in the case of the substation staff, a programme of training should be initiated to cover the new Overhead Line Equipment for the two DART extensions;

- there is no formal Overhead Line Equipment inspection and maintenance programming system, nor are formal records kept;

- overhead line switching, isolation and earthing, and safety permit issue is in general safely practised, using well-established safety rules. The present safety documentation dates from the DART’s inception. A thorough revision of all DART electrification safety documentation against current legislation is therefore strongly recommended.
6.6.1.3 Electrical control

The training of control room operators was generally impressive as were the control procedures in operation. The degree of management checking carried out appeared satisfactory.

6.6.1.4 Depot isolations

The Depot Isolations procedure were generally satisfactory, as were the safety features provided within the DART Depot building.

6.6.2 Conclusion on Electrification

A substantial part of the electrification system is now approximately 16 years old. Generally the system is in good condition but at this stage in the life cycle major works will be required to keep the system running effectively.

There is a lack of formal maintenance procedures and records, and of the certification of levels of electrical competence.

The electrification system is relatively modern, was installed to a high standard, and is operated generally in accordance with rules and procedures well established and well proven elsewhere. Of the 10 risks identified as quantifiable, 9 were of a minor nature, and were simple and inexpensive to correct.

Specific attention is however drawn to the major risk, relating to overhead line access equipment. The continued use of a converted passenger coach presents a risk to staff which is now considered unacceptable elsewhere.

6.6.3 Recommendations for Electrification

Generic management issues are considered in Chapter 8.

In addition to the above, the overhead line access equipment should be replaced without delay.

6.7 Rolling Stock

6.7.1 Safety Adequacy Review

No specific safety concerns were noted during the rolling stock and depot inspections.

Generally most of the rolling stock inspected appeared in reasonable condition and no major concerns were noticed. A significant number of split pins, used to secure bolt nuts, were found to be incorrectly installed on an Arrow Diesel Multiple Unit. This should not be the case and an inspection of all stock should be made over time.
Brief cab rides were made on a Class 201 locomotive and Arrow DMU. The Class 201 had a bogie fault, still subject to modification, and the driver noted problems with the windscreen wiper motors, a safety problem which was also awaiting modification.

In contrast, the DMU rode very well, but had a performance problem at low speed.

IE would benefit from systems which listed safety modifications, prioritised by risk, and their implementation.

When procedures and processes were examined a number of deficiencies in documentation were found. Generally the experience of the responsible staff mitigated these shortfalls.

Due to the small market, IE have to buy rolling stock to a mix of international specifications. The specifications are written at a very high performance level. There was little evidence that any performance commitments made during the tender process by manufacturers are contractually made. There was little evidence of to verify performance tests. Many issues were resolved post delivery; a more formal specification and scrutiny process might have avoided some of these problems.

A more quantified approach to performance specification should lead to better quality, lower whole life cost, rolling stock. IE are heavily reliant on their suppliers meeting their "own" standards. Due to the relatively low volume of stock ordered, manufacturers use the relevant (in their opinion/ experience) international specifications. This is inevitable, but IE could do more to specify and build in facilities needed.

A whole systems approach is not always taken with rolling stock procurement. Thus the impact of rolling stock on the infrastructure may detract from the business case for the rolling stock on a stand alone basis. For example, heavy locomotives can cause unacceptable wear and tear on the track.

6.7.2 Conclusions on Rolling Stock

Due to the competence of the staff, and the fact that rolling stock returns each day to central depots, there were no safety concerns found related to rolling stock. There is however no formal method of logging and following up rolling stock safety related incidents and there are likely to be more outstanding safety issues than realised by the rolling stock team.

A number of gaps in procedures and processes were found. In addition, better value for money may be achievable by better specification and management procurement processes for the rolling stock.
6.7.3 Recommendation for Rolling Stock

A number of minor deficiencies have been advised already to IE. Specific equipment recommendations are provided and costed in Chapter 7, with generic management issues considered in Chapter 8.

In addition to the above, the following need to be undertaken immediately in the short term:

- the significant risk associated with defective windscreen wipers on Class 201 diesel locomotives should be closed out satisfactorily;
- a more detailed inspection of a 15% of the fleet should be undertaken to assess condition and maintenance quality;
- a review should be undertaken of the relationship between Operational Instructions and Rolling Stock documentation, bringing together all of the various “notes”, etc;
- rationalisation of the maintenance documentation should be undertaken to ensure frequencies and examination content are understood and controlled.

In the medium term, it is recommended that:

- independent inspections on major maintenance and repairs be started;
- requirements for the safety specification of new rolling stock should be included within performance based contracts.
7. **RISK ASSESSMENT**

7.1 **Introduction**

A key element of the strategic review was to assess the adequacy of the railway infrastructure, and thence to provide clear, precise, quantified and objective advice on whether the overall level of railway safety is adequate. Furthermore, it is required to identify unreasonable risks, identify the principal options and the broad costs for addressing these risks, and finally identify the time frame in which remedial action must be implemented.

This chapter details the risk assessment carried out on the signalling, telecommunications, level crossings, rolling stock and permanent way systems to estimate the likelihood of casualties arising from equipment failures within these systems. A risk model has been developed based upon infrastructure site surveys and scoring discussed in Chapter 6.

It should be noted that the risk model considers only infrastructure failures, and does not consider the possible risk from human error (e.g. driver passing signals at danger), or road user misuse of level crossings. Moreover, the risk model only considers train accidents on the main running lines (collisions and derailments) involving passengers or train crew, resulting from equipment failures. Derailments and collisions in sidings and depots are not considered. The model does not include injuries arising from occupational injuries to staff, station related accidents to passengers (e.g. slips and trips) or trespass/vandalism incidents. These areas are excluded from the model on the basis that they do not impact on infrastructure equipment renewals.

The number of casualties are predicted on a line by line basis for passengers, staff and public. Based on the typical number of passengers and staff, individual risk level are calculated and compared to the risk criteria documented in Chapter 4.

The risk model allowed the condition and number of assets in each section to be considered, in addition to the specific train frequency and passenger loading data. Risks results are subsequently summarised according to the type of equipment giving rise to the risk and the line location.

The risk model is based upon the existing level of train services in terms of train speeds, train frequency, passenger loading, etc. It assumes full timetabled train speeds on the various line Sub-sections and does not include any current temporary speed restrictions or other limited working. Should any of the base case assumptions vary, then the predicted levels of risk will change.

Passenger overcrowding on particular train services and routes is not explicitly modelled in the risk assessment. On the basis of total passenger
flows per year, and train frequencies averaged daily and weekly, it is not possible to include specific overcrowded trains. However, whilst excessive number of passengers will not cause train accidents, the consequence of an accident is directly proportional to the number of passengers on a train. If the number of passengers is doubled (e.g. during morning peak), the number of Equivalent Fatalities arising from an accident of that train is also doubled. This would be balanced in the model by the probability that it is the morning peak that actually suffers an accident, rather than a lightly loaded train at mid-day.

The consequences of the failure of structures (bridges, cuttings, embankments, etc.) are not quantified in the risk model. A representative sample of these structures was surveyed and scored, but because no definitive database exists of where these structures are located, they could not be included in the line by line model. DART electrification safety deficiencies were not predicted to result in train accidents. Therefore these items have not been included in the risk model.

The IE network was divided into a number of discreet sub-sections, as presented in Appendix VII. This division permitted the following factors to be explicitly modelled throughout the network for each sub section:

- line speed (km/hr);
- section length (km)
- passenger flow (thousands of journeys in both direction);
- expected passenger journeys per year for the most exposed groups;
- passenger train frequency (trains per day per direction);
- freight train frequency (trains per day per direction);
- double or single track;
- jointed track or continuous welded rail (CWR).

A number of risk reduction options, and the associated costs of these options, were identified by the infrastructure experts. Utilising the risk assessment results, the recommendations can be prioritised according to the equipment(s) and locations which should be addressed first, based on their contribution to the overall level of risk.

The risk model, costings and recommendations are predicated on the minimum requirements to make the railway acceptably safe for passengers, staff and the public, i.e. to rectify those infrastructure deficiencies identified. No consideration is given for options to improve, upgrade or enhance the railway, although the risk implications of the latter can be assessed in the model.

The principal use of the risk model is in calculating relative risk levels between different lines and from different causes, rather than absolute levels.
of risk. This enables prioritisation of risk mitigation, and ‘broad cost benefit analyses to be carried out.

7.2 Results - Infrastructure Surveys (Safety Inadequacy)

The scores arising from the Signalling, Telecommunications and Level Crossings, Permanent Way, Rolling Stock, Electrification and Structures site surveys are summarised in Appendix VIII. These results are presented as Safety Inadequacy scores for generic types of equipment.

A score of 0% (safe) is considered to be the ideal or the target, whereas 5% is considered to be ‘best practice’. A score in excess of this indicates a decrease in safety below that of ‘best practice’.

The inadequacy percentages for each of the categories are consistently very poor. The highest scores are from the permanent way (80%) and the second highest scores are from the signalling surveys (65%). The electrification and structures surveys both had worst scores of about 60%. Average inadequacy scores were permanent way (52%), signalling and telecommunications (34%), structures (33%), rolling stock (27%) and electrification (25%).

Whilst these scores provide indicative information as to the condition of the infrastructure and the deviation from Best Practice, they do not provide the objective quantified information as to the resultant level of safety of the railway network. For instance, whilst the permanent way score was very poor on some sub-sections, this tended to apply to tracks with low traffic density, whereas a mediocre signalling score on a highly utilised section of track will have worse safety consequences.

7.3 Results - Risk Model Assessment

7.3.1 Summary of Results

The annual accident frequencies and individual risks on a line by line basis are presented in Appendix IX.

It should be noted that all results presented below are calculated within the model and as described above for all QRA models, are subject to a degree of statistical uncertainty and inaccuracy. The model does not utilise any IE failure or accident statistics either as raw data, nor to validate the model results. However, the results have been reviewed against models produced for other railways and using engineering judgement to ensure they are of the correct order of magnitude.

For basic comparison, it can be noted that IE experience approximately 92 derailments and 18 collisions per year on average, although a large proportion (exact amount unknown) occur in sidings and depots at slow speed.
7.3.2 Annual Accident Frequency

The overall accident frequency is predicted to be 9.8 per annum, i.e. approximately 10 accidents (train collisions or derailments) per year.

The 7 Sub-sections with the highest predicted annual (train) accident frequency are as given in Table 7.1.
Table 7.1: Line Subsection - Percentage Contribution to Total Railway Train Accident Frequency

7.3.3 Collective Risk Predictions

The overall passenger collective risk is predicted to be approximately 7 Equivalent Fatalities per year due to collisions and derailments.

The overall staff collective risk is predicted to be approximately 0.5 Equivalent Fatalities per year due to collisions and derailments.

The overall public collective risk is predicted to be approximately 1.5 Equivalent Fatalities per year due to collisions at Level Crossings.

The 8 Sub-sections with the highest predicted annual passenger collective risk are as shown in Table 7.2.
7.3.4 Collective Risk Contributions

The equipment contributions to passenger risk are now considered. It should be noted for staff risks that whilst the specific numbers will change, the pattern will be the same as that for passenger risk. It should also be noted that public risks arise only at level crossings.

7.3.4.1 Equipment Contribution - Network Wide

The equipment contribution to the total passenger collective risks on all subsections are as given in Table 7.3.

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>% Contribution to Overall Collective Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signals</td>
<td>37.7</td>
</tr>
<tr>
<td>Interlocking</td>
<td>12.0</td>
</tr>
<tr>
<td>Points</td>
<td>27.7</td>
</tr>
<tr>
<td>Train Detection</td>
<td>12.0</td>
</tr>
<tr>
<td>Level Crossings</td>
<td>2.4</td>
</tr>
<tr>
<td>Swing Bridge</td>
<td>0.2</td>
</tr>
<tr>
<td>Permanent Way</td>
<td>7.9</td>
</tr>
<tr>
<td>Rolling Stock (Derailment)</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Table 7.3: Equipment Contribution to Collective Risk

It should be noted that although the overall contribution to collective risk of the permanent way is only 7.9%, it is considerably more than this value for sections of the network where the permanent way is in poor condition.

The key contributors to collective risk are listed below (in no particular order):

- electrical signals - due to bare wires and poor installation standards;
- mechanical signals - due to lack of electrical proving;
signalbox operating floor - due to poor change control and evidence of wrong side failures;

mechanical points - due to evidence of failure of facing point lock tests (wrong side failure);

relay interlocking - due to bare wires and poor control standards/drawings.

mechanical interlocking - due to poor condition;

DC track circuits - due to poor maintenance standards, lack of relay servicing, and out of date equipment;

permanent way - due to the very poor condition of the jointed track on some sub-sections.

7.3.4.2 Section by Section

The equipment contributions to the 8 Sub-sections with the highest predicted annual passenger collective risk, are as given in Table 7.4.

<table>
<thead>
<tr>
<th>Sub-Section</th>
<th>Route</th>
<th>P-Way</th>
<th>Signal</th>
<th>Interlocking</th>
<th>Points</th>
<th>Train Detect</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Ballybrophy - Limerick Jcn</td>
<td>1.23%</td>
<td>50.96%</td>
<td>15.92%</td>
<td>11.88%</td>
<td>18.83%</td>
</tr>
<tr>
<td>11</td>
<td>Portarlington - Ballybrophy</td>
<td>1.59%</td>
<td>45.71%</td>
<td>14.13%</td>
<td>20.99%</td>
<td>16.86%</td>
</tr>
<tr>
<td>13</td>
<td>Limerick Jcn - Mallow</td>
<td>1.60%</td>
<td>45.36%</td>
<td>14.16%</td>
<td>21.09%</td>
<td>16.75%</td>
</tr>
<tr>
<td>9</td>
<td>Heuston - Cherryville Junction</td>
<td>1.11%</td>
<td>45.98%</td>
<td>14.36%</td>
<td>18.92%</td>
<td>17.00%</td>
</tr>
<tr>
<td>34</td>
<td>Howth Jcn - Drogheda</td>
<td>1.27%</td>
<td>67.64%</td>
<td>12.61%</td>
<td>4.58%</td>
<td>10.05%</td>
</tr>
<tr>
<td>29</td>
<td>Connolly - Mullingar</td>
<td>10.33%</td>
<td>40.96%</td>
<td>19.14%</td>
<td>16.48%</td>
<td>4.46%</td>
</tr>
<tr>
<td>25</td>
<td>Athlone - Claremorris</td>
<td>33.04%</td>
<td>12.14%</td>
<td>6.00%</td>
<td>44.14%</td>
<td>1.44%</td>
</tr>
<tr>
<td>22</td>
<td>Port Arlington - Athlone</td>
<td>1.56%</td>
<td>34.23%</td>
<td>11.88%</td>
<td>36.29%</td>
<td>13.29%</td>
</tr>
</tbody>
</table>

Table 7.4: Equipment Type - Percentage Contribution to 8 Sub-Sections with Highest Collective Risk

7.3.5 Individual Risk

7.3.5.1 Passenger Individual Risks

As discussed previously, passenger individual risks are calculated for each sub-section, based on; the collective risk for that sub-section, the number of journeys per year in that sub-section, and the risk exposure of different passengers. Thus sub-sections with low collective risks may still have a high individual risk because a few passengers are making many journeys each on that line.
The five sub-sections with the highest individual risks are presented in Table 7.5, including all causes of equipment failure.
### Table 7.5: Line Sub-Sections with Highest Passenger Individual Risks (>1 in 10,000 per Year)

<table>
<thead>
<tr>
<th>Sub-Section</th>
<th>Route</th>
<th>Individual Risk per Year (Equivalent Fatalities)</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>Waterford - Rosslare</td>
<td>1 in 4,300</td>
</tr>
<tr>
<td></td>
<td>Europort</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Connolly - Mullingar</td>
<td>1 in 6,200</td>
</tr>
<tr>
<td>11</td>
<td>Portarlington - Ballybrophey</td>
<td>1 in 9,100</td>
</tr>
<tr>
<td>34</td>
<td>Howth Jcn - Drogheda</td>
<td>1 in 9,800</td>
</tr>
<tr>
<td>7</td>
<td>Cherryville Jcn - Kilkenny</td>
<td>1 in 10,000</td>
</tr>
</tbody>
</table>

7.3.5.2 Staff Individual Risks

Based on the previous assumptions relating to staff numbers, the staff individual risk is estimated to be 1 in 2,400 per year. Whilst this average level is less than the intolerable limit (1 in 400 per year) it is above the Broadly Acceptable Limit (1 in 400,000 per year) and requires urgent action because it is likely that the most exposed staff on key sub-sections will have individual risk levels above this value. This is due to the fact that staff are exposed to many occupational safety hazards in addition to train accidents.

7.3.5.3 Public Individual Risks

The public individual risk is estimated to be 1 in 2.5 million per year. This level is well below the Broadly Acceptable limit, however it is optimistic as previously noted, based on the previous assumptions relating to public exposure numbers which assumes that all the Irish population is equally exposed to the risk from the railway.
### 7.4 Summary of Results

Seventeen sub-sections of the IE railway network are predicted to pose individual risks to passengers that are above 1 in 40,000 per annum. These are shown in Table 7.6 in descending order of risk.

<table>
<thead>
<tr>
<th>Route</th>
<th>Sub Section</th>
<th>Predicted Train Accident Frequency (per year)</th>
<th>Passenger Collective Risk (EF per year)</th>
<th>Passenger Individual Risk (EF per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterford - Rosslare Europort</td>
<td>37</td>
<td>0.34</td>
<td>0.058</td>
<td>1 in 4,300</td>
</tr>
<tr>
<td>Connolly - Mullingar</td>
<td>29</td>
<td>1.16</td>
<td>0.40</td>
<td>1 in 6,200</td>
</tr>
<tr>
<td>Portarlington - Ballybrophy</td>
<td>11</td>
<td>0.27</td>
<td>0.80</td>
<td>1 in 9,100</td>
</tr>
<tr>
<td>Howth Jcn - Drogheda</td>
<td>34</td>
<td>0.49</td>
<td>0.49</td>
<td>1 in 9,800</td>
</tr>
<tr>
<td>Cherryville - Kilkenny</td>
<td>7</td>
<td>0.32</td>
<td>0.20</td>
<td>1 in 10,000</td>
</tr>
<tr>
<td>Bray - Arklow</td>
<td>3</td>
<td>0.20</td>
<td>0.13</td>
<td>1 in 11,900</td>
</tr>
<tr>
<td>Athlone - Claremorris</td>
<td>25</td>
<td>0.70</td>
<td>0.38</td>
<td>1 in 12,300</td>
</tr>
<tr>
<td>Portarlington - Claremorris</td>
<td>22</td>
<td>0.31</td>
<td>0.31</td>
<td>1 in 13,200</td>
</tr>
<tr>
<td>Limerick Jcn - Waterford</td>
<td>36</td>
<td>0.53</td>
<td>0.18</td>
<td>1 in 13,800</td>
</tr>
<tr>
<td>Ballybrophy - Limerick Jcn</td>
<td>12</td>
<td>0.62</td>
<td>1.36</td>
<td>1 in 20,800</td>
</tr>
<tr>
<td>Mallow - Tralee</td>
<td>16</td>
<td>0.98</td>
<td>0.28</td>
<td>1 in 21,600</td>
</tr>
<tr>
<td>Mullingar - Carrick on Shannon</td>
<td>30</td>
<td>0.50</td>
<td>0.23</td>
<td>1 in 21,900</td>
</tr>
<tr>
<td>Carrick on Shannon - Sligo</td>
<td>31</td>
<td>0.34</td>
<td>0.14</td>
<td>1 in 25,000</td>
</tr>
<tr>
<td>Limerick Jcn - Mallow</td>
<td>13</td>
<td>0.40</td>
<td>0.76</td>
<td>1 in 26,500</td>
</tr>
<tr>
<td>Drogheda - Dundalk</td>
<td>35</td>
<td>0.092</td>
<td>0.059</td>
<td>1 in 26,500</td>
</tr>
<tr>
<td>Mallow - Cork</td>
<td>14</td>
<td>0.15</td>
<td>0.15</td>
<td>1 in 28,900</td>
</tr>
<tr>
<td>Heuston - Cherryville Jcn</td>
<td>9</td>
<td>0.54</td>
<td>0.51</td>
<td>1 in 29,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7.95</strong></td>
<td><strong>6.44</strong></td>
<td><strong>n/a</strong></td>
<td><strong>n/a</strong></td>
</tr>
</tbody>
</table>

*Table 7.6: Sub-Sections with Passenger Individual Risks Greater Than 1 in 40,000*
These risks are at least an order of magnitude greater than the Broadly Acceptable Limit (1 in 400,000 per annum), with these 17 Sub-sections alone contributing 80% of the total Train Accident Frequency, and 90% of the total Collective Risk.

7.5 Risk Mitigation

Risk mitigation measures are designed to reduce the incidence and severity of casualties, which correspondingly reduces both the collective and thence individual risk.

If any of the individual risk levels were above the Intolerable Limit, then these should be addressed first, irrespective of the cost or the actual number of Equivalent Fatalities per year.

Given that there are no intolerable risks, it is recommended that the sections of line with the 5 highest individual risks are addressed first, followed by the remaining sections with high collective risks.

By addressing moderate risk mitigation measures on the 5 highest individual risk sections only, the overall collective risk will be reduced by 20%, with the highest individual risk on these 5 sub-sections being reduced to 1 in 26,600 per year (sub-section 29).

By addressing moderate risk mitigation measures on both the 5 highest passenger individual risk sections and the 5 remaining highest collective risk sections as well, the overall collective risk will be reduced by 55%.

Clearly, there is scope to address risk reduction measures on other sections of the railway network which will further reduce the collective and individual risk levels. The risk model can be utilised in the future to review the risk engineering options, assess the resultant risk reduction, and thus carry out a cost benefit analysis.

7.6 ‘Unreasonable’ Risks

The Consultants were required to identify “any matters which will give rise to an unreasonable risk and require urgent remedial action”. The Consultants were further required to “use their professional judgement to define unreasonable risk”.

The Risk Criteria outlined in Chapter 4 of this report derived quantitative definitions of ‘Broadly Acceptable Risks’, ‘Unacceptable Risks’, and ‘ALARP Risks’ based on the individual risk of fatality per annum for passengers, public and staff. However the numerical definition of an ‘unreasonable’ risk was not derived explicitly as it was felt to be a wider issue involving estimates of best practice and taking account of particular features of the IE system. ‘Unreasonable’ risks were broadly categorised as those items of the infrastructure, systems, or processes that either posed an immediate risk (of
During the site visits detailed in Chapter 6 of this report, a number of ‘unreasonable’ risks were identified associated with the condition of the infrastructure. All of these risks require to be addressed and mitigated immediately.

The list of ‘unreasonable’ risks includes both generic issues and also any specific unreasonable risks that were noted. It should be emphasised that this list is based on a necessarily small sample of the Irish Rail Network and should not, therefore, be viewed as a comprehensive list of all the ‘Unreasonable’ Risks within the network. In all cases, IE were either made aware of the findings verbally, or were present at the time of their discovery.

A list of these risks were transmitted directly to the Department.

7.7 Infrastructure Improvement Recommendations

7.7.1 Timescales

The technical/hardware recommendations are categorised across all disciplines as:

- immediate (short term);
- medium term (0-5 years) and;
- long term (5-10 years)

These timescales reflect the degree of urgency of the remedial measures, and the reality of the time span required to implement significant changes to the physical infrastructure in a managed and safe manner.

It is assumed that the programme commences from the date of publication of the Irish Rail Safety Study Report.

7.7.2 Specific Recommendations

A number of detailed recommendations have been advised to the Department and IE as follows:

1. Signalling, Electrical, Telecommunications and Level Crossings
   - 38 generic recommendations
   - 55 location specific

2. Permanent Way
   - 8 generic
   - 59 location specific

3. Rolling Stock
   - 11 generic
4. Electrification
   - 3 generic
   - 10 location specific

5. Structures
   - 16 generic
   - 5 location specific

7.7.3 Costs

For each recommendation, an indicative value has been estimated of the cost to implement the respective improvement measure. By inspection, the costs are either classified as system-wide costs or location specific, the costs for which will be multiplied by the number of appropriate locations. An estimation of the possible network wide rectification costs is made in Table 7.7.

It should be emphasised that these costs are the estimates of the expenditure required to rectify the Unreasonable Risks and make the railway acceptably safe. They will revert the equipment and systems to a fully functional or operational state. The systems can then be maintained in this functional state for an extended period, i.e. they are not considered as temporary fix costs. These costs encompass the additional expenditure required to are sufficient to make the railway acceptably safe. It excludes normal ongoing maintenance and renewal activity that IE are currently carrying out.

The risks considered were those only arising from failure of the infrastructure/equipment.

<table>
<thead>
<tr>
<th></th>
<th>On Going (Per Annum) Ir£M</th>
<th>Imm. (One-Off) Ir£M</th>
<th>0-5 Years (per 5 year) Ir£M</th>
<th>5-15 years (per 10 year) Ir£M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signalling, Electrical &amp; Telecommunications</td>
<td>1</td>
<td>5</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>Soft Costs (standards, specs, etc.)</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>Level Crossings</td>
<td>0.1</td>
<td>1.5</td>
<td>10</td>
<td>0.3</td>
</tr>
<tr>
<td>Permanent Way</td>
<td></td>
<td>8*</td>
<td>42*</td>
<td></td>
</tr>
<tr>
<td>P-Way Soft Costs</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>1.5</td>
</tr>
<tr>
<td>(standards, specs, etc.)</td>
<td></td>
<td></td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Rolling Stock</td>
<td>0.2</td>
<td>0.3</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Electrification</td>
<td></td>
<td>0.2</td>
<td>0.5</td>
<td>-</td>
</tr>
<tr>
<td>Structures General</td>
<td></td>
<td></td>
<td>16</td>
<td>13.5</td>
</tr>
<tr>
<td>Fencing</td>
<td>-</td>
<td>1.2</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td>Cast Iron Bridges Replace</td>
<td>-</td>
<td>0.5</td>
<td>8.5</td>
<td>-</td>
</tr>
</tbody>
</table>

Report No: 2045.10
Issue No: 01
Date: October 1998
<table>
<thead>
<tr>
<th></th>
<th>On Going (Per Annum)</th>
<th>Imm. (One-Off)</th>
<th>0-5 Years (per 5 year)</th>
<th>5-15 years (per 10 year)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ir£M</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Ir£231.1M</strong></td>
</tr>
</tbody>
</table>

* Assumes continuation of current underlying spend of Ir£20M per year on renewal

**Table 7.7: Summated Risk Reduction Recommendation Costs**
7.7.4 Assumptions

The following generic assumptions have been made in deriving the above costs:

- the strategic review of the infrastructure did not involve a detailed analysis of all infrastructure elements. The above costs thus reflect the limited amount of inspection that took place during the course of the study, extrapolated to encompass the entire railway;

- the costs have been estimated on the basis of bringing the infrastructure back up to a minimum acceptable level of safety without enhancement, as such they may differ from potential re-signalling costs or line renewals. For instance, improving the condition of level crossings has been considered, but not the cost of converting or upgrading the crossing;

- budget costs have generally been prepared on the basis that they are additional to annual revenue costs;

- on-going annual costs required the maintain the system in an ALARP state have been excluded, except where it is believed that as a result of the remedial works recommended, an additional maintenance cost will arise (e.g. improved maintenance of telephones);

- all costs are at 3Q98 price levels;

- the costs are notional broad costs and have been prepared for indicative purposes only;

- all estimates are within the range +50% to -0%;

- where estimates have had to be made as to the number of vulnerable locations, or the total number of items, I.E. should survey and confirm these assumptions;

- no allowance has been made of potential synergy in the investment process with the potential combination of similar work streams across engineering functions, or by a corporate lead solution by IE;

- soft issues have been defined as including such issues as standards, process and procedure development, fire prevention and security issues;

- any further cost expenditure beyond these recommendations should be justified based on a Cost Benefit Analysis approach.

7.8 Cost Benefit Analyses

7.8.1 Introduction

Using the Risk Model, individual Cost Benefit Analyses (CBA) can be carried out for every section, sub-section, for each item of equipment, and for a
variety of risk mitigation options to demonstrate risks to all exposed groups are ALARP.

If risks are above the Intolerable Limit, then the risks are unacceptable and must be mitigated or the action ceased, with no account taken of the expenditure involved. However, providing that risk levels are not above the Intolerable limit, cost benefit analyses can be used to balance the cost of risk mitigation measures, in terms of their capital and ongoing costs, against the benefit that the risk mitigation delivers in terms of reduced casualties on the railway. If the financial cost is not grossly disproportionate to the benefit received in terms of lives saved, then the risk mitigation is considered to be cost effective and should be adopted.

As documented in Chapter 4 of this report, the “Value for Preventing Fatality” (VPF) used for this study is Ir£2.1m for accidents where Iarnród Éireann has a prime duty of care. This figure has also been used conservatively as the VPF for Equivalent Fatalities.

7.8.2 Bounding Cost Benefit Analysis

On the basis of 7 Equivalent Fatalities per year (see Section 7.3.3. of this report), the cost benefit analyses would broadly indicate that it would not be cost effective to spend more than around Ir£15M per year (i.e. 2.1 x 7), or assuming a typical 30 year life for M&E equipment upgrades, a one-off sum of Ir£450M. However, this assumes that ALL of the Equivalent Fatalities would be eliminated.

When spending money on equipment repair, refurbishment, or renewal, there is likely to be a law of diminishing returns in terms of the resultant risk mitigation benefit derived. Initial expenditure on high risk items will produce commensurate high risk reduction. However, subsequent expenditure is likely to result in less risk reduction. Furthermore, zero risk is unattainable since every action has some level of associated risk.

Experience from similar railways with risk levels in the ALARP region, has shown that they can typically obtain a 50% reduction in risk levels without implementing excessive expenditure, i.e. those mitigation measures that are only cost effective at VPF’s well in excess of Ir£2.1M.

Assuming a nominal 50% mitigation in collective risk implies a carefully targeted one-off sum of Ir£225M could be justified on safety grounds alone, for risk mitigation measures.

Based on the equipment contribution to the Collective Risk, this overall sum can be divided as shown in Table 7.8.
<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Total Collective Risk (Equivalent Fatalities per Year)</th>
<th>%</th>
<th>Cost Ir£M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signals</td>
<td>2.67</td>
<td>37.70%</td>
<td>85</td>
</tr>
<tr>
<td>Interlocking</td>
<td>0.85</td>
<td>12.01%</td>
<td>27</td>
</tr>
<tr>
<td>Points</td>
<td>1.96</td>
<td>27.69%</td>
<td>62</td>
</tr>
<tr>
<td>Train Detection</td>
<td>0.85</td>
<td>11.94%</td>
<td>27</td>
</tr>
<tr>
<td>Level Crossings</td>
<td>0.17</td>
<td>2.43%</td>
<td>5.5</td>
</tr>
<tr>
<td>Swing Bridge</td>
<td>0.017</td>
<td>0.24%</td>
<td>0.5</td>
</tr>
<tr>
<td>Permanent Way</td>
<td>0.56</td>
<td>7.91%</td>
<td>18</td>
</tr>
<tr>
<td>Rolling Stock</td>
<td>0.0055</td>
<td>0.08%</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7.1</strong></td>
<td><strong>100%</strong></td>
<td><strong>225</strong></td>
</tr>
</tbody>
</table>

Table 7.8: Theoretical Cost Effective Risk Mitigation Costs (Collective Risk Reduction)

It should be noted that the above costs are justified on the grounds of mitigating the risks identified in the risk model, i.e. train accidents only. There are other systematic sources of risk to passengers, staff and public. These include occupational safety for staff, “slips, trips and falls” to passengers in stations, and risks from/to trespassing members of the public. Detailed risk analyses of these sources risk would indicate that expenditure in addition to Ir£225M would be justified to mitigate these hazards, including such aspects as improved training, improved footbridges and fencing respectively.

7.8.3 Risk Mitigation Measures Cost Benefit Analyses

Outwith the risk model predictions and CBA, a number of unreasonable risks were identified during the site surveys (see. Section 7.6 of this report). These risks gave rise to an immediate risk of fatality or injury to passengers, public and/or staff, or represented practice that was fell far short of that expected as ‘Best Practice. These risks should now be urgently addressed and eliminated.

The cost breakdowns for mitigating all the identified risks are included in the cost estimates summarised in Section 7.7.3 (extrapolated where necessary). The total summated cost is estimated to be of the order of Ir£230M. This figure is broadly in line with the bounding CBA estimate calculated as likely to prove cost effective in Section 7.8.2 above. Reasons for the differences include the addition of some items (such as fencing, bridges and
A large number of further risk mitigation measures are possible, each with an associated cost and resultant risk reduction. However it is recommended that the Risk Model should now be refined and used by the Department/IE to review proposed risk mitigation measures, carry out CBA, and to prioritise expenditure accordingly.

7.9 Recommendations

A number of recommendations on engineering processes were made at the end of Chapter 6. Other recommendations concerning Safety Management Systems in the Infrastructure and Rolling Stock Departments are addressed in Chapter 8 which deals with generic IE SMS issues.

A large number of equipment and infrastructure recommendations both generic and location specific have been separately advised to the Department and IE (see Section 7.7.2 of this report).

The key recommendations arising from the risk assessment work conducted are as follows:

1. IE should urgently implement the necessary remedial action to deal with all of the unreasonable risks already advised to the Department;

2. the Department, in conjunction with IE, should refine and agree the funding of the additional costs necessary to improve safety on the IE network, namely the Ir£231 million outlined in Table 7.7;

3. IE should consider developing the risk model used by the Consultants for this study to encompass a wider range of hazards than those arising solely from infrastructure and equipment failures, to include staff error, movement and non-movement accidents and occupational safety concerns.
8. SAFETY MANAGEMENT SYSTEMS

8.1 Management Issues Arising from Infrastructure & Rolling Stock Review

8.1.1 Introduction

The review of infrastructure and assets, as well as including inspection of physical conditions, also involved discussions with technical managers to consider organisation, systems, procedures and culture, and their influence on technical safety.

The interviews revealed a number of issues common to all Departments within IE and these issues are incorporated within Section 8.2 of this report.

However, there were also a number of issues that were particularly pertinent to the individual technical Departments, especially when considering technical and engineering professional standards issues which did not form a major element of the SMS Audit. These issues are considered in this section of the report, grouped by engineering discipline.

The context in which the infrastructure has operated needs to be understood to appreciate why the current position has been arrived at. Over the years there has been a need to reduce costs. This has resulted in short term measures being taken to keep the infrastructure operating. These measures have however been compounded on each other such that much of infrastructure is now in unacceptable condition. Short term measures do not work in the long term, when a different approach is needed.

The infrastructure has been kept operating and reasonably safe by the competence and hard work of IE’s engineers. This has been achieved despite the need to cut back on resources and the industrial relations climate.

Now the infrastructure is in poor condition and the engineers responsible have no acceptable way of knowing what the condition is. Standards are loose and documentation of condition is virtually non-existent.

The engineers already know what should be done to achieve best practice and in some areas work has already started. It cannot be over-emphasised that the implementation of rigorous processes are essential to ensure a safe and reliable infrastructure for the future of IE.

8.1.2 Signalling, Telecommunications and Level Crossings

8.1.2.1 Organisation

The day to day maintenance of the infrastructure is managed by three Divisional Engineers located at Pearse, Athlone and Limerick Junction. Signalling, electrical and telecommunications engineering are the
responsibility of the Assistant Chief Infrastructure Engineer at headquarters level. At divisional level the Assistant Signalling, Electrical and Telecommunications has the day to day responsibility. There are no job descriptions for posts other than the Assistant Chief Engineer, Infrastructure. There are no safety responsibility statements for any post.

The organisation is now being structured to ensure that professional responsibility for signal engineering, telecommunications engineering and electrical engineering will be clearly identified and rest with a named post at headquarters.

The organisation was, and still is, predominately comprised of civil engineering posts and personnel. These posts have responsibility for permanent way, structures (including overhead power supply line) and uncontrolled level crossings. The remainder of the infrastructure organisation has responsibility for signalling, telecommunications and electrical engineering together with controlled level crossings. It is under-resourced for the onerous responsibilities incumbent upon the post holders.

It was clear from interviews with management that there was a strong belief that financial constraints and overall transport policy since the mid 1980s had created the climate for staff reductions coupled with productivity improvements. This had led to the situation where scarce expertise had been permitted to leave the industry. Managers indicated concern that the safety of the railway may have been undermined by these factors. In the short term, those responsible for the safety of the signalling, electrical and telecommunications infrastructure have a very difficult task to address. The stress of this is telling on individuals and is a matter of concern.

Professional expertise is concentrated at headquarters level but throughout the present organisation, there is a lack of clear accountability. Roles and responsibilities of individual posts are not clear. The production of clear job descriptions and safety responsibility statements is essential to future safety improvements.

It is apparent that the current resource level is insufficient to deal with the multiplicity of safety issues on the railway and the diversity of technologies now in use. Sophisticated modern signalling, telecommunications and radio systems have been introduced throughout the network. The resources deployed do not match the technology or volume of equipment.

Headquarters management perform a ‘fire fighting’ role. Time is allocated on a day to day or crisis basis between major projects and emergencies or failures. Little or no time is available for strategic planning or vital work on fundamental requirements. Telecommunications resources are very scarce and signalling projects are not equipped to provide a quality service. No time is devoted to monitoring equipment failure trends or for their analysis.
At divisional level, the reality is that resources are combined for signalling and electrical, with no resource assigned for telecommunications. The time of the divisional staff is largely allocated in priority assistance to civil engineering or attending to signalling failures with no time for routine maintenance. No planned maintenance other than some essential tests is carried out. There is no training provided, consequently the competence of staff is dependent upon learning from seniors. This has become untenable as experienced staff leave the railway service.

The organisation is now facing the reality that professional lines of responsibility have almost disappeared. While the productivity gained by reducing staff levels improved the financial bottom line of IE, the loss in efficiency and the risk to safety now outweigh these financial benefits. Best practice in the industry is to provide clear lines of professional responsibility and accountability. Job descriptions and safety responsibility statements are essential. These matters are currently being addressed by IE.

Provision of adequate resources is essential if safety is to be ensured. This can be achieved through good recruitment policies provided the skilled resources are available within the industry. Historically however, this has not always been the case.

8.1.2.2 Systems

A review of the management systems in the signalling, telecommunications and level crossings area has indicated that there are few formal systems which are one of the essential elements of a sound safety system. Specifically, the following do not exist.

- ISO9000 Quality Management System.
- planned preventative maintenance;
- infrastructure fault monitoring and control;
- technical training and competence recording;
- management of wrongside failures & safety critical failures;
- technical audit and inspection regime;
- control of working drawings;
- control of technical documentation;
- production of engineering instructions;
- production of standard operating instructions;
- maintenance testing systems;
- safety approval and change control;
- hazard identification;
• safety planning and control;
• failure investigation;
• servicing of safety critical equipment;
• design review, the formalised review of a design as it evolves.

It is thus evident that the IE signalling, electrical and telecommunications engineering functions do not have the systems in place to ensure that safety is managed effectively.

8.1.2.3 Procedures

There are few procedures in place in the IE signalling, electrical and telecommunications engineering functions. Those which are available do not meet the requirements of best practice in a sophisticated modern railway system. Where procedures do exist there are not always the processes to ensure they are applied. For instance, IE have produced some maintenance specifications, but there is no planned maintenance process to apply them, nor is there an inspection process to verify their application.

The performance and functional requirements of specific elements of the SET function are not formally defined in IE documentation and therefore cannot be assessed.

The documentation provided for evaluation of equipment varied in quality since no formal system of documentation review is in use.

8.1.2.4 Culture

The culture in the IE signalling, electrical and telecommunications engineering area is one which varies from a strong safety ethos at headquarters to one which has significant weaknesses at divisional level. The safety culture at headquarters is stultified by the nature of the organisation. The safety culture at divisional level was tangible but staff felt a lack of empowerment to achieve what was known to be necessary. They were also inhibited by a lack of competence, resources and formalised regulations.

The lack of an effective occupational safety culture at divisional level is typified by the situation whereby SET technicians work on the track without formal “Lookout” qualifications which ensure safety whilst staff are operating trackside. This is apparently due to a culture that sees the provision of the “Lookout Man” as the responsibility of the permanent way department. The situation thus arises that SET technicians work without formal “Lookout” protection, and even without formal training in such arrangements. This form of institutionalised risk poses an unacceptable hazard in terms of occupational safety.
8.1.3 Permanent Way

8.1.3.1 Organisation

At Divisional level the permanent way organisation is very flat and has a direct line of responsibility from the Divisional Engineer (DE) to the Permanent Way Inspectors (PWIs) and track maintenance staff. The Assistant Divisional Engineers’ line responsibility and their safety of line responsibilities are unclear. The Chief Inspector (CPWI), who in practice manages the PWIs, is also charted out of the line responsibilities. The conclusion is that the organisation does not reflect reality of operations.

The staffing levels under each PWI appear to take no account of track age and condition. As an example, the freight branch PWI at Navan had only one mobile gang and 2 patrol gangers for some 35 miles of track whereas its condition is demanding of a continuous heavy maintenance gang of six to eight personnel. It would appear that no exercise of matching resources to needs has been undertaken and that staffing levels have remained basically unchanged for many years. The effect of this is that the benefit of reduced staffing levels is not being obtained by the heavy investment in new track over significant parts of the network. Sections not receiving investment, which are consequently in a state of continuous decline, have not been allocated the additional resource necessary for their task.

The overall level of staffing under the DEs for track maintenance appears to be of the correct order. However, the resources are not used to best effect. For example there are heavy requirements for the provision of lookout men which is outside the control of the PWI but which he must still supply. The inspection regime is also wasteful of resources as the number of significant defects means excessive safety inspections are required.

Job descriptions for the key safety posts of DE and PWI were not available. Staff were unclear as to where responsibility for the safety of the line lay.

There are several key staff, particularly at HQ level, whose experience is unique and whose loss would create great difficulty. There does not however appear to be a system of deputies or any form of succession planning.

8.1.3.2 Systems

The strategic technical review of permanent way activity examined whether the systems for maintenance were present and adequate. With few exceptions those that exist are lacking in formality and those who need to know have a poor knowledge of them.

There is no system for the issue and control of documents, instructions, procedures etc. related to the permanent way. Staff work to a variety of documents and letters from the Chief Engineer but they have no means of knowing if they are up to date.
No evidence was found of any form of analysis of the risks involved in the management of the permanent way. As a consequence the control measures in place are mainly those which have existed historically, together with those imported from other railway administrations as examples of best practice.

8.1.3.3 Procedures

The documented procedures relating to permanent way exist at two levels:

1. national procedures from the Chief Engineer;
2. local procedures from the DE.

Overall there are standards for many of the items which are expected of a permanent way organisation. However, these are not in a controlled form, have not been reviewed for some 15 years and are not in the format necessary for mandatory instructions.

The procedures for data capture on permanent way related incidents are not effective. The information that is gathered and analysed is valid but is not the complete picture. The records are not validated in any way by reference to systems in other departments or those operated locally by Divisional Engineers. As a result no meaningful conclusions can be drawn. A good example is the reporting of broken fishplates. The data showed a huge increase in the early 1990s, of the order of threefold. Questioned as to why this had occurred, the universal answer was that staff had been reminded of the requirement to report failures at that time. Even so it was evident that reporting of this element is still very patchy.

The basic foundation for effective maintenance of permanent way is to have a robust inspection system that identifies and reports defects for attention. There is no one clear definition of what a patrol ganger should report other than section O.1 of the rule book and this is only a very brief resume.

8.1.3.4 Culture

The absence of widely known, understood and controlled written instructions has not led to potentially dangerous situations developing as quickly as might be expected. This is because experienced engineers, competent in their sphere of activity, are employed by IE. Many examples of excellent local practice were found which could be spread across the network as "best practice." However this just serves to provide a veneer over the actual conditions on the ground, which in many locations are unacceptable.

Staff work very hard to "keep things going" and in doing so are taking risks with safety that will lead to incidents. No member of staff wishes to be the one to put up a red flag for safety's sake only to find that as a result the line may be closed permanently, with the engineers being made the scapegoat.
The culture of safety has not taken root in the staff at ground level. They work in hazardous conditions on the trackside with relatively primitive protection arrangements. Comfort is gained from the fact that accidents are very rare. Risks are not understood and therefore not controlled.

8.1.4 Rolling Stock

8.1.4.1 Organisation

The organisation is functionally based under the Chief Mechanical Engineer.

The management and staff encountered appeared to be well informed and competent. Due to the lack of processes and procedures much reliance is placed on the experience of staff. This may not be possible in the future when the next generation of staff may be more mobile, requiring the support of more formal systems.

8.1.4.2 Systems

Whilst there are elements of a formal system for engineering change control in place, the elements are generally managed independently with little cross reference. There is no formal process to ensure that all impacts of a change are formally assessed and controlled appropriately. Significant gaps were found within the existing informal procedures; the introduction of an ISO 9000 based quality management system would identify gaps and ensure an integrated process was put in place and that it functioned adequately.

Rolling stock has a considerable interface with the railway system, particularly infrastructure and operations. There however appears to be a very informal process for considering the system effects of any change and indeed gaps were found. The impact on the track and on wear and derailment risk in particular needs review.

Engineers had a good appreciation of the objectives of the corporate Safety Management System. Little progress has been made in translating the corporate objectives into a workable process. This is often the case when a formal Safety Management System is being introduced for the first time.

Safety and other incidents are shown on the daily log and informally closed out by the responsible engineer. There is no attempt to log problems or near misses and use them as a forecasting system. Hazards are reported through incident books in depots and inspections by the engineers and managers. A detailed incident data base with formal allocation of responsibility for dealing with problems would provide a powerful risk management tool.

There is no system for recording staff competence and training records may be held in a number of areas, but generally not on the employee’s file. Supervisors review performance but there is no record of the review, action
taken or training recommended. The apprentice training scheme is much more formally recorded and should provide a firm base for future staff.

8.1.4.3 Procedures

Three sample items of rolling stock were traced from the original specification, through supplier's maintenance recommendations to the IE maintenance specification. Generally traceability was good.

As each item of rolling stock is designed to different standards, it is stand alone, except for the interface with the IE infrastructure and other IE vehicles. There was no structured way to establish the current physical configuration of the stock and trace the history of modifications and changes through drawings and documents.

Generally the drawing control system is well understood, but is not documented. At the very minimum, formal authorised signatures for sign off for changes must be documented.

Requests for change to rolling stock and notifications of problems are recorded centrally in log books. There is no formal prioritisation based on the safety importance of a change, however the managers informally take this into account. Once a change is instigated there is no method to ensure that all implications of the change are accounted for.

Master manuals and spares listings are held centrally. Original manuals are distributed with the new rolling stock, thereafter there is no re-issue. There is no evidence of controlled issue. Spares listings are reviewed by the relevant engineer, who decides on the spares holding (by experience) and arranges a stock number and holding. Where new spares are subsequently identified the spares listing is manually annotated.

Whilst the current system is very informal it works, because:

- each engineer has limited stock to look after and knows it well;
- the responsible engineer is the "fountain of knowledge" for his stock so he is consulted by the maintenance staff. The introduction of IE's new database (SAP) may weaken these informal processes.

Operating instructions are written into the various railway "Appendices". Generally they can be traced back to the manufacturer's recommendation or custom and practice and seem reasonable. A problem was encountered when a trace was attempted on the DART procedure for brake isolation. Whilst all parties understood the rule it was not documented in any Appendix.

The maintenance inspection plans for all stock are contained in a document which is controlled and well respected. The frequencies of the examinations are contained in a separate procedures manual, issued in 1995, which is not controlled.
The examination content of rolling stock maintenance is generally traceable to the manufacturer's original recommendations in the maintenance manuals. Frequency of examinations is generally based on current existing practice and is probably sound, or possibly too frequent.

Many examinations also refer to other documentation, such as "shed" notices, which call for modification to a frequency or process, or refer to generic practices, such as ultrasonic axle tests. There is no one document which brings together all information for a particular item of rolling stock (a "configuration" document) and several examples were found where it was not possible to trace documents through.

8.1.5 Electrification

8.1.5.1 Organisation

The safety operation and maintenance of electrification equipment is the responsibility of staff reporting to the Divisional Engineer. The control of electrification equipment is the responsibility of the shift Electrical Control Operator (ECO) reporting to the Manager of the Central Traffic Control (CTC), except for the switching and safety of the DART overhead power supply lines within the Depot building, which is the responsibility of the Depot Supervisor, under a local power isolation procedure, reporting to the Manager - DART Depot.

The substation organisation appears adequate and no changes are required. Both overhead line and electrical control staffing and organisation also appear to be adequate.

8.1.5.2 Systems

Adequate systems exist for substation, overhead line and electrical control work. Apart from a few minor items, no changes are required.

8.1.5.3 Procedures

Adequate procedures exist for substation, overhead line and electrical conduit work. Apart from a few minor items, no changes are required.

The DART electrical control procedures are comprehensive and well-managed. The Engineering Change Request Instructions are in A4 book form, the current issue being dated February 1991. DART has had no electrocution accidents.

DART enjoys a good relationship with the emergency services. There are regular visits, liaison meetings and training sessions with all four (Fire, Ambulance, Garda, and the Defence Forces).
8.1.5.4 Culture

The impression gained from the discussion interviews and inspection visits was very positive in relation to electrical safety from the hazards of the 1500 V dc traction electrification system. This impression is borne out by the excellent electrical safety record of DART.

There is a clear and genuine respect for electricity at this voltage and power. This respect has clearly been passed on to later employees who have become involved in the electrical operation of the system. Despite detectable industrial relations difficulties, the over-riding impression is one of a friendly operation and, in our experience, a friendly operation is a safe one. There seem to be three threats to this situation:

- the present safety documentation dates from the system’s inception in 1982; little updating has been undertaken since;
- the DART system is being extended, at both ends, using equipment which is of different manufacture from existing equipment;
- there is a grave concern that the reliability and safety of the DART overhead power supply line system, although of a high standard at present, are on borrowed time. The electrification system, at 16 years old, is over its teething problems, and is at a high point in its reliability. Regrettably this reliability will start to fall, as the equipment ages and wears. Equally regrettably, this process seems to be coinciding with a dilution of manpower available to maintain the equipment, and a grave lack of safe modern access equipment.

8.1.6 Structures

8.1.6.1 Organisation

Responsibility for the infrastructure is split. Buildings and stations including the platforms up to, but excluding the edge coping stones are the responsibility of the Buildings Maintenance Executive. The other structures including the platform copes are the responsibility of the Civil Engineer’s Department.

8.1.6.2 Safety

There is a basic understanding of safety needs and the staff are conscientious about safety. However there is little training in safety matters apart from personal track safety. This means that the understanding of the safety needs in work procedures varies throughout the department, and there is sometimes a lack of awareness of potentially dangerous occurrences and situations.

Staff members are responsible for keeping themselves up to date with innovation and modern thinking within their own field, including safety matters.
8.1.6.3 Training

The management systems that exist tend to have evolved over the years and are generally informal. The system operates because the staff have served in the area for a long time and have been trained on the job. Apart from basic safety, there is very little formal training. This leads to variations across the network.

Training is generally informal and on the job. Experience is passed down from one generation to the next. Work procedures and standards therefore are dependant on the individual staff member involved.

8.1.6.4 Bridges

Bridges are the only part of the infrastructure which have a documented procedure for inspection and maintenance. This relates to the inspection of these structures only and the system is less formal thereafter (the procedure does not cover all culverts, for example). The translation of the result of an inspection into an action for repair or maintenance is left to the individual engineer who carried out the inspection.

All structures, which are classified as bridges, are inspected once in every two years. The inspection is visual only and does not involve any special access equipment.

There is no formal system for converting the results of the inspection into actions for work. There is no formal prioritisation system. Some engineers operate a prioritisation system but it is interpreted differently. Thus similar problems will be given different priorities between engineers.

The decision to take remedial action is subjective, as indeed it must be at least in part. However there should be a specified standard to which all the inspecting engineers adhere as a basic principle before applying their subjective engineering judgement. The prioritisation of remedial work in practice appears to have only two stages, this year’s programme or in the future.

The system is working because of the capabilities and experience of the existing staff. The inspections are carried out by the Assistant Divisional Engineer personally who does not have the time amongst his other duties to perform this task properly.

8.1.6.5 Other Structures

There is no formal system or requirement to inspect other structures. They are only inspected when a defect is noticed and reported.
8.1.6.6 Procedures and Standards

Standards such as British Standards Specifications are used where appropriate, particularly in civil engineering and structural design.

Procedures exist for the control of new bridge works and for the inspection of bridge structures.

Procedures and standards do not appear to exist for the inspection of other structures or for maintenance.

8.1.6.7 Outside Parties

Outside Parties are agencies, independent of IE, who can affect the safety of the railway when working in close proximity to the railway. It is essential to establish relationships with outside developers at an early stage and to ensure that they consider their methods of working carefully to ensure that safety is not compromised, and that the cost of ensuring the safety is not borne by the railway but by the beneficiaries of the development.

IE must take a strong stance on this issue or there could be serious consequences because developers, even local authorities and state agencies, and contractors, are not experienced enough in railway matters to foresee the full consequences of a lack of forward planning when work affects the operation of the railway.

It is essential that this work be properly controlled. In IE at present there is a notification procedure which depends on the local authority physical planning procedures to notify the railway of any work of this nature.

8.2 Safety Management System Audit

8.2.1 Introduction

The objective of the SMS audit was to examine the systems in place within IE to organise, implement, monitor and review railway operational safety and occupational health and safety initiatives. This audit was thus intended to identify the strengths and weaknesses of these systems in order to aid continuous improvement in this field.

The SMS audit encompassed the whole of the IE and included relationships with, and the safety management roles of, the CIE Group. Relevant senior management and Board personnel (both CIE and IE) were selected, based upon their role and responsibilities within the organisation, for interview. These interviews covered general management, finance, human resources, planning and investment and safety management. The audit also included samples from functional management (Operations, Mechanical & Electrical Engineering, Infrastructure Engineering), which built on the discussions about technical management covered in the previous section.
Ground level observations were undertaken during two separate weeks of visits to the railway system encompassing travel around Dublin (mainline and DART) and to Limerick, Cork, Tralee, Waterford, Sligo, Dundalk, Ballina, Westport and Galway by IRMS personnel. This included examination of stations, depots, signal cabins, sidings, level crossings and engineering possessions.

In addition a questionnaire were issued to all IE personnel to investigate the opinions of staff with respect to safety within IE. The purpose of this questionnaire was to gain further insight as to ground level perceptions as to the strengths and weaknesses of IE’s SMS.

650 staff (representing 13% of the total requested to respond) returned questionnaires for subsequent analysis. This response represents an acceptable sample to reach conclusions, especially as it was drawn fairly evenly across grades and departments.

A number of activities contributed towards the assessment encompassed in the SMS audit. These included an evaluation of SMS documentation, formal management interviews, informal conversations with staff, observation and inspection of the operating railway and the issue of questionnaires. The information obtained was assessed against an audit questionnaire developed by IRMS, providing a score for ten discrete elements of the SMS.

During the analysis it was found that there were two distinct pictures emerging. For this reason it was decided to score the audit twice in order to compare these pictures:

- **Management Audit (MA) Score** - this score represents the findings from the management interviews and examination of the documents that support the SMS, i.e. the structure of the SMS;

- **Ground Level Audit (GLA) Score** - this score represents the findings from two weeks of observations undertaken on the railway, informal conversations with staff and examination of documentation on site, i.e. the implementation of the SMS.

Scoring both of the above aspects against the IRMS audit model allowed strengths and weaknesses to be identified in the formal system and a comparison to be made between the documented system and its implementation.

### 8.2.2 Overall Results

Audit scores reflect safety management maturity and experience in different industrial contexts and industries, but can be used in a very general comparative sense for benchmarking. A score of 0 - 25% would indicate a low regard for safety, poorly maintained or absence of systems, a low status or absence of a safety function and avoidance of regulatory standards. A score of 25 - 50% represents a traditional largely reactive approach to safety,
where its importance is recognised, but there is a tendency to rely on rules and standards, focus on hardware safety rather than human behaviour, and learn from accidents rather than adopting a proactive approach to identify risks and control them. A score of 50 - 75% is indicative of a positive approach to safety management, where safety is seen as an important objective, there are safety improvement programmes and the company strives to exceed the minimum regulatory standards. Above 75% is only achieved when safety is recognised as a prime business objective, its management is integrated with other key business management systems and a safety dimension is sought for every activity.

The IE SMS Management Audit score assessed from the review of IE documentation and management interviews was 64%, reflecting an organisation which is making strides to improve its safety management from the more traditional reactive approach, but has scope for further improvement.

The Ground Level Audit score resulting from observation, inspection and conversation on the railway was 42%. This suggests that while an adequate structure is in place for the management of safety, there are currently problems associated with implementation.

In the case of IE, the scoring is very uneven, both between the ten SMS elements and within the elements themselves, indicating that whilst there are many procedures and activities in which safety management is excellent, there are others where the expected structures or systems require much more attention.

A breakdown of the overall audit scores is presented in Figure 8.1. This Figure also presents a comparison between the scores obtained from the Management Audit and Ground Level Audit. The difference in results between the two audit scores can be seen quite clearly. However, it should also be noted that the overall profile of the histogram is the same for both scores. This suggests that whilst there may be a difference of scale, there is overall agreement as to the strengths and weaknesses of the SMS. The scoring of each section is weighted to give emphasis to the most important aspects of the SMS as indicated in Table 8.1.
Figure 8.1: Overall Percentage Scores for Each Element of the SMS Audit

There are a number of factors (interlinked to a degree) which may contribute to these differences. These include:

- relative infancy of the SMS - the SMS has only relatively recently been introduced and thus more time is required for the effects of change to filter through to ground level

- management implementation - the systems are in place, but the funding, training and manpower to implement them is not necessarily available

- perception - the two audit scores reflect to a degree the differences between management and staff perception, reported low morale amongst certain staff groups and a lack of belief in the systems being implemented which could in turn adversely affect their success.
Table 8.1: Weighting of the Elements of the Safety Management Audit System

<table>
<thead>
<tr>
<th>Element</th>
<th>% Weighting Management Questionnaire</th>
<th>% Weighting Ground Level Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Commitment</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Communications</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>Safety Arrangements</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Safety Policy &amp; Procedures</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Safety Systems</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>Training &amp; Development</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>Emergency Planning</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Contractor Safety</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Purchasing</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Regulatory Interface</td>
<td>5</td>
<td>-</td>
</tr>
</tbody>
</table>

8.2.3 Particular Results

A discussion of the SMS Audit findings, for each of the safety management elements, is given here. It should be noted that in the following text, MA refers to Management Audit, GLA to Ground Level Audit.

8.2.3.1 Management Commitment (MA = 69%  GLA = 47%)

This element of the audit examined the management commitment to safety at various levels within the organisation, including that of the parent company, CIE. Evidence of commitment was sought with respect to safety performance monitoring, setting of safety targets, allocation of safety budgets, discussion of safety at Board meetings, participation in safety tours and discussions, preparation of annual safety plans etc.
Documented evidence was produced to support this element of the audit, including the following:

- Safety Management System (SMS) document dated 2.4.98, (encapsulating policies and procedures implemented during recent months);
- International Safety Rating System auditing systems and manuals;
- Group Safety Committee minutes;
- Annual Safety Plan with numerate risk-based safety objectives that was distributed to all staff.

There were, however, areas in which the audit scores were low in this element. The CIE Group Board and managers are committed to safety improvement, but a number of senior IE managers and staff do not perceive this commitment or did not until the recent accidents had occurred. Past policy edicts emanating from top CIE and IE management over a number of years have created an environment in which senior engineering managers sometimes ceased to bid for essential finance for infrastructure renewal on the basis that there were known to be no funds available. Coping with less than adequate resources became accepted as the norm.

This has led to a weakness in the IE planning process, in that certain managers have refrained from preparing long term investment and maintenance plans on the basis that future funding (including EU) is uncertain. This in turn means that CIE officers do not have the detailed and appropriate investment plans backed by engineering evidence to put to government departments for consideration. (It is understood that this problem has been addressed recently through IE’s response to the safety study by Halcrow Transmark/ AD Little commissioned by IE [8]).

Safety investment decisions are made in isolation as there is no process to integrate safety objectives with financial, manpower, marketing or other key objectives, although evidence was given that no critical safety investment proposals had been rejected.

The CIE Group has a Safety Committee chaired by a non-executive Board member. The current occupant of this role is a highly experienced industrialist with safety management experience and the retention of such expertise within the CIE Board to fulfil this important role must be recognised when Board members are being selected for appointment. This Committee is active and covers many safety issues. However, there was evidence that its powers of executive action were ambiguous and differences of view existed over the process by which its recommendations are implemented, including concerns that key line management committees and managers can become by-passed.

Safety performance statistics and accident descriptions are provided to the CIE and other Safety Committees, but the statistical trends are not easily
apparent and the existing database format makes it difficult to analyse the statistics in a meaningful way. This issue is critical to a proper understanding of safety performance and is a necessary precursor to rational and focused improvement strategies.

Staff at ground level generally were not aware that safety - especially occupational safety - was a concern for top CIE and IE management. An almost constant message was a perceived lack of interest by senior management in the safety of the railway and its staff. There was a belief that safety levels had improved in the last couple of years, but that this had been forced on management by events. Local functional managers were perceived to be doing their best within the constraints laid on them but were apparently becoming engulfed by operational and occupational safety issues, a position worsened by equipment reliability and staff morale problems.

There was an acceptance that many of the good IE SMS procedures and policies had not yet filtered through to ground level in any consistent way, and that local systems for rectifying safety complaints and giving feedback were in disrepute. There were particular problems in obtaining the support of supervisors in the drive for safety, though some were doing their best within their resources.

8.2.3.2 Communications (MA = 55%   GLA = 35%)

Systems for the upward and downward communication of safety concerns and performance are addressed in this element. In addition to formal arenas for discussion, such as safety committees and tool box talks (ie regular discussions on safety and local safety systems between supervisors and their gangs), means of informal communication are also reviewed.

It was found that formal systems for communication were structured, there were systems for dissemination of documents, for safety committees and for spreading information through the organisation. However, it has been found, as indicated in the previous audit element, that communication on safety issues between CIE Group managers and IE senior managers has not always been effective, allowing misconceptions and assumptions to inhibit the development of safety investment issues.

There were particularly weaknesses at local level in carrying out regular and comprehensive safety briefings and tool box talks, generally aggravated by a lack of training of management and supervisors in this important aspect of their duties. There was a lack of consistency in setting and applying standards and a clear weakness in taking suggestions and complaints on board and giving feedback. These problems were further aggravated by a perceived lack of time and resources to invest in these activities by local management.
8.2.3.3 Safety Arrangements (MA = 56% GLA = 31%)

The management structure and allocation of safety responsibilities - i.e. how the organisation to deliver safety is structured - were assessed by this part of the SMS audit. Roles and responsibilities of key personnel in the safety management structure are examined and the means of issuing standards, job descriptions and measuring performance are also appraised.

There is a Corporate Safety Department responsible for advising and supporting line management in executing their safety responsibilities. Its role and status in the organisation is strong and appropriate, and relevant job descriptions are in place.

Line managers recognise their duties in relation to safety, however while guidance in the form of Job Descriptions is fairly complete, there are gaps in the provision Safety Responsibility Statements.

The International Safety Rating System (ISRS) is a safety management audit system developed by industrial safety consultants that measures performance, mainly of occupational safety, in up to 20 different safety management elements. ISRS has been adopted and implemented by the Operating, Mechanical Engineering and Infrastructure Departments. ISRS can be used as a basis for a Safety Management System, although service industries with public safety responsibilities in particular find that it provides only an element of the required overall SMS.

However, few other supporting structures or processes are documented, particularly in the description of individual or organisational roles and responsibilities for safety. There are no systems in place to appraise performance against standards or to assess safety performance objectives by departments, managers or supervisors.

At ground level weaknesses were found with the application of ISRS, where sometimes there was over concentration on compliance with the system (i.e. it was in danger of becoming a routine bureaucratic exercise) rather than observing the wider picture of safety culture in the workplace.

8.2.3.4 Safety Policy and Procedures (MA = 87% GLA = 57%)

This element examined the systems in place for the development, issue and review of safety policy and procedures.

The Management Audit scored highly on the quality of the safety policy and the systems in place for developing, monitoring and reviewing working procedures and safety rules. Although the various Departments Functions have not produced separate policies, they do endorse the Corporate Policy.

The Ground Level Audit suggested that although this were one of the stronger and more traditional areas of safety management, there are
weaknesses in the implementation of safety rules, working procedures and statutory health and safety regulations with variable performance on compliance found throughout the railway. This indicates that training and audit of this activity needs strengthening.

8.2.3.5 Safety Systems (MA = 73%   GLA = 47%)

The systems considered by this element of the audit include some of the main techniques for identifying safety issues and monitoring their control, including management of change, hazard analysis and risk assessment, accident investigation, auditing and inspections.

There has been a tendency to rely on qualitative rather than quantitative methods for safety analysis, for normal management activity. External consultants are used to undertake Quantitative Risk Assessment for areas of particular concern to management although until now there has been no strategic review of risks.

Systems to address the safety implications of change (both technical and organisational) exist but require improvement. Safety validation of significant organisational change is conducted, but it should not be retrospective and should assure management that the safety implications of such change have been successfully addressed before implementation. For technical change a total systems approach needs to be adopted to ensure proper consultation with all parties that may be involved, consideration of interfaces and identification of training requirements, with some sign off by an authorising review body.

Accidents are investigated and attempts are made in most cases to establish root causes, but these often stop short of identifying the underlying system or organisational weaknesses that created the condition that allowed the error or other trigger action to occur. Increasing legal pressures and the public “blame culture” aroused by media publicity on accidents are creating a defensive management culture that will make it harder to obtain the necessary openness of accident investigation that will go to the heart of things.

More collection of important “near miss” incident data and investigation of these trends and of the more significant incidents could be of value. From data supplied, there would appear to be under-reporting of minor occupational safety incidents.

The ISRS safety management audit system is widely used within IE and a regular and virtually comprehensive programme of audits by trained auditors is undertaken. There were some reservations as to the use of the system in the Permanent Way part of the Infrastructure Department, there are ground level comments that some managers use the ISRS as a narrow and routine “check list” which can reduce its value as a real safety audit.
8.2.3.6 Training and Development (MA = 32%  GLA = 20%)

The assessment of the training and development element was based on the systems in place for the identification of training needs, provision of training and assessment of adequacy with respect to safety. It examined the systems in place for different levels of management, industrial staff and safety advisers.

Skill training for staff to undertake their jobs is performed adequately in most functions (especially Operations and Mechanical & Electrical Engineering). However, there is a lack of training needs analysis and the absence of general safety awareness and responsibilities in staff selection and recruitment, setting of job objectives and staff appraisal. Training of supervisors is particularly inadequate. Training in communication skills is also lacking.

One area of particular need is management skills for engineering managers. A common issue in all industries with a high technical content is the transition from technical management to person and resource management in a technical department. Explicit training support needs to be given to make the transition successfully. There is little support in IE, which is exacerbated by the lack of personnel management resources within the Infrastructure function except at HQ level.

It has been recognised by IE management that there has been a lack of investment in this area over past years and IR£2 million has been allocated in this year’s budget. In view of previous neglect in this area, a much higher budget provision for training would appear to be good practice. This budget provision will have to cover the costs of releasing staff for training, which in resourcing terms can be higher than the cost of providing the training itself.

Ground level observations confirmed the weaknesses exposed in this part of the audit. In some activities there was a lack of competency testing and accreditation even for safety critical activities.

Although this section of the audit scored the lowest overall, it was apparent that management had recognised and were trying to overcome past deficiencies in this area, but it will take time and increased resources to bring about significant change and for this to be reflected in improved safety awareness and performance.

8.2.3.7 Emergency Planning (MA = 71%  GLA = 60%)

The Emergency Planning element examined whether plans are in place to cover foreseeable emergencies including environmental accidents. Communications facilities for emergency use are also examined.

Emergency plans and instructions are available and in place. At ground level, examination of the emergency plans showed that they were variable in quality and did not consistently provide a description and prioritisation of
actions to be taken, but sometimes were just a checklist of issues and contacts. Emergency drills seen monitored response times of personnel but did not test understanding and practice of the tasks to be undertaken.

IE trains have radio and there are back up Signal Post Telephones (SPTs), with further emergency signal box and mobile phones are available to contact IE and emergency authority staff in case of need. Also arrangements exist to man special communications centres from office staff in the aftermath of major incidents to communicate with the public.

8.2.3.8 Contractor Safety (MA = 64% GLA = 31%)

The element on contractor safety examined the procedures in place for identifying legislative requirements with respect to contractors and the processes in place for their selection, briefing and monitoring during work.

New policies and procedures within the CIE Group for the procurement of goods, supplies and contractors were approved by the CIE Board in May 1998. These are much more comprehensive than previous procedures that operated from February 1996. Included in the new procedures is a three stage contractor/supplier qualification process which demands increasingly stringent conditions for different levels of contract value. The procedures include sections on safety policy, systems and performance which a would-be contractor has to satisfy. IE produced copies of model contracts covering a wide range of services and contractor activities ranging from consultancy to on site work, both short and long-term.

There is, however, no explicit requirement for feedback on contractor safety performance (only by exception) and there is no requirement for the contractor to audit his own systems and performance when undertaking work for the CIE.

As the new policies and procedures were only approved in May 1998, it was impossible to see if they had made any significant improvement in the procedures adopted by contractors in practice. CIE management rely on local IE supervision for the control of contractors on site and indicated that this was appropriate for the responsibility placed on IE. The ground level audit found that this control was variable and often poor, and that there was a lack of clarity of responsibility between IE staff and the contractors, leading to low confidence in the safety of contractors and their work when on site.

8.2.3.9 Purchasing (MA = 76% GLA = not scored)

The purchasing element of the SMS audit was intended to examine the systems which govern the selection of suppliers to IE and whether the consideration of safety issues was incorporated into these systems. This element was not scored for the Ground Level Audit as awareness of these systems is not necessary for the majority of staff.
Purchasing policy is also covered by the new policies and procedures adopted by the CIE Board in May 1998 referred to in the previous paragraph. The processes for selecting and monitoring suppliers and inspection of products seem robust, with full cognisance given to the essential safety elements when appropriate.

The only significant area of weakness seems to be the lack of a procedure requiring a formal sign-off by the engineering and operating functions affected when new equipment is introduced (see previous comments on management of change).

The new procedures have not yet been in use long enough to form any opinion as to their effectiveness in practice.

8.2.3.10 Regulatory Interface (MA = 63% GLA = not scored)

The audit tested the extent to which the organisation understands legislative requirements and has allocated appropriate staff responsible for their implementation and monitoring, has contact with the regulatory bodies and complies with reporting responsibilities. This element was not scored for the Ground Level Audit.

The interface between IE, the Railway Inspecting Officer and the Health & Safety Authority is considered in Chapter 9 of this report. Communications with the Railway Inspectorate are good on a personal basis but formal relationships need improvement and there is little liaison with the Health and Safety Authority.

Liaison between IE and the fire authorities is not much in evidence although the relevant departments claim to work to fire authority standards. There is no clear management focus on fire safety matters. During the ground level audit a lack of such focus was also evident.

8.2.4 Staff Questionnaire Results

8.2.4.1 Breakdown of Responses

The questionnaire was issued to a total of 4,839 staff. There were a total of 650 questionnaires returned, of which 26 were completed incorrectly and could not be included in the analysis. This represents a response rate of 13% which is acceptable and an adequate sample for voluntary self completion questionnaires. The breakdown of respondents was as given in Table 8.2, the percentage response for the different staff grades is also given.

8.2.4.2 Questionnaire Results

The following section gives a summary of the results found in relation to relevant SMS Audit elements.
The response to the question asking opinion on general IE safety as experienced by the individual found that overall 60% felt that safety in their job and department was good, although this result was reduced to 50% amongst Operative Grades. The difference in views found in the SMS Audit was reflected in the questionnaire, with Management Grades submitting more positive responses than Operative Grades.

The Signalling and Electrical Engineering Department scored only 45% with respect to satisfaction with safety in their department. There was a consistent message from the data which found that, when the accident report data was normalised, this department reported the most accidents. In addition, it was found that they reported a greater expectation to cut corners, less likelihood to report safety problems to managers, least satisfaction with the safety representative system and least awareness of safety policies, objectives and targets.
Staff Grade | No. | % response | Department | No.  
---|---|---|---|---  
Executive | 53 | 20 | Operations | 242  
 | | | Civil Engineering | 77  
Supervisors | 50 | 17 | Mechanical Engineering | 109  
Clerical Grades | 126 | 25 | Signal & Electrical Engineering | 43  
Operative Grades | 395 | 11 | ‘Other’ | 133  
Breakdown of Operative Grades: | | | Not Given | 20  
Line Managers | 21 | 55 | |  
Drivers | 25 | | |  
Plate Layers | 25 | | |  
Fitters | 25 | | |  
Electricians | 16 | | |  
Coach Builders & Boiler Makers | 57 | | |  
Depot men | 30 | | |  
Others | | | |  
Grade Not Given | | | | 20

Table 8.2: Breakdown of Questionnaire Respondents

8.2.4.3 Management Commitment

For the accidents and near misses that were reported in this questionnaire, Insufficient Time, Poor Housekeeping, Wrong Equipment/Tools and Not Enough People were the most frequently cited contributory factors. Three of these factors are potentially related and reflect problems with resources identified in the SMS Audit.

Over a third of Operative Grades reported that they were not encouraged to work safely by their Managers/Supervisors and that they were sometimes (or more frequently) encouraged to cut corners. Supervisors were the only level of management reporting any pressure to cut corners frequently. 10% of Executive Grades and 5% of Managers reported that they felt this pressure ‘Sometimes’.
8.2.4.4 Communications

The questionnaire indicates that downward communication systems appear to be reasonably effective with 80% of people reporting awareness of safety policies, objectives and targets.

Upward communications systems regarding safety do not, however, appear to be working. Less than 30% of Operatives felt that they can report safety matters to their managers and expect to see action as a result. Another 30% reported that they did not feel that they can report safety concerns to anyone. This again may be related to resources - where managers have no resources they may not take action. This lack of action then brings the reporting systems into disrepute.

8.2.4.5 Safety Systems

The effectiveness of the Safety Representative system was tested in the questionnaire. Of all the questions asked, this one received the most ambiguous response, with the selection of the response categories being almost evenly distributed. This indicates that the effectiveness of the Safety Representative system would appear to be quite variable. 15% of people did not know who their Safety Representative was. This rose to 21% in the Civil Engineering Department, which seemed to have the least confidence in this system.

8.2.4.6 Training

Training was found to be the least selected factor contributing to accidents and second to last in the case of near misses. This result may seem surprising given that training was identified in the SMS audit as an area requiring serious attention. However, all the other factors listed in the question were more immediate causes whereas training is more of a secondary cause and harder for individuals to identify with respect to themselves.

8.2.4.7 Summary of Comments

Further comments on safety were made by 234 people (6% of the workforce), some of whom took the trouble to write more than 4 pages of detailed notes. The comments were reviewed and statements summarising the salient points have been grouped under the headings used in the audit.

It might be expected that only those with ‘an axe to grind’ might be motivated to provide additional comments on the questionnaires. However, there were a number of positive statements made and two further responses which explained how safety worked in IE. The most frequent positive comment was that there had been a big improvement in safety over recent years, which was attributed by some to the introduction of ISRS.
Many of the comments reflected frustrations of staff with upward communications within the organisation. Hazards or safety issues are reported either to Managers, Supervisors, Safety Representatives or through Hazard Report books, but typically no action is taken and no reasons are given to those who made the reports. Whilst it is recognised, by staff, that a lack of funding is often behind management inaction, failure to respond leads to accusations of a poor management attitude to safety and a lowering of staff morale - the feeling that it is not worth reporting anything because nothing gets done. The other major contributor to this view of management and supervisors is the conflict between safety and getting the job done. Managers and Supervisors were reported to be more interested in getting the job done than in safety, accused of turning a blind eye to unsafe practices and not enforcing standards, rules and procedures. This form of non-verbal communication can be very powerful in shaping people’s attitudes.

The issue of low staff morale was raised specifically by 14 people, but comments relating to working conditions (21 specifically on long working hours with inadequate rest periods), pay and promotion prospects also relate directly to morale.

Numerous specific examples were given by staff of:

- poor housekeeping on the permanent way, stations, offices and depots;
- safety hazards associated with equipment, trains and the public;
- occupational health issues.

A couple of people were concerned that the systems concentrated on safety and that occupational health was not adequately covered. Particular concerns about human waste on the permanent way, air pollution from diesel fumes in a terminal station and one report with respect to exposure to asbestos in the coach building workshop were raised.

Training was another issue which received much comment, reflecting the findings of the SMS audit. Generally it was felt that more training was required and that the adequacy of the training given should be evaluated. Specific training was requested on subjects including rules and procedures, manual handling, first aid, fire fighting. Counselling was requested for drivers involved in accidents / suicides. (IE state that such training is available but the respondents are either unaware of this or it is not available in their locality or department.)

The use of the questionnaire to investigate staff opinions was welcomed by three people, who requested that this form of consultation be repeated annually.
8.3 Conclusions

8.3.1 Safety Management Systems in the Technical Departments

There was evidence of the technical departments operating on the strength of the experience and technical knowledge of the staff, inadequately supported by documented systems and procedures. A lack of planned maintenance and a consistent application of standards was also evident, especially in the Signalling, Permanent Way and Structures Departments. The inadequacies of such systems, structures and procedures were confirmed, but not so starkly, in the SMS Audit which concentrated on general operational and occupational safety rather than technical management.

An organisational weakness in the way the Signalling and Telecommunication management has been structured - and which was now being corrected - had led to a number of major weaknesses in that Department described in Chapter 6 and Section 8.1.2.1 of this report.

8.3.2 Meaning of the SMS Audit Scores

The overall audit score from the examination of IE’s SMS was 64%. As stated earlier, this score indicates an organisation that is starting to manage safety proactively, although the wide variations in the scoring of the different audit sections shows that some elements of the SMS need more attention than others. The ground level observations carried out during two weeks’ visits to the system indicate an overall score which is lower (42%). The profile of the Ground Level Audit follows a very similar pattern to the Management Audit. This is consistent with the main findings, but reflects a situation where more emphasis is required on the effective implementation of management systems.

8.3.3 Implementation of the SMS

A picture emerged of an organisation that had learned much in the recent past about safety management best practices that were being applied by some other European national railway systems; IE has selected and adapted a number of these good practices for implementation on the Irish system. However, much of the change was of recent origin, and in some areas was taking time to percolate down to the front line managers, supervisors and staff. This meant that there was little sign on the ground of a strong safety culture based on the latest thinking on human behaviour, communications and staff involvement - the traditional railway safety culture based on strict rule compliance and a hierarchical authoritarian structure was still in position. Even here, however, there was a danger that the current reshaping of the business, and losses of experienced staff through retirement and downsizing, were weakening the strengths of the traditional approach before new safety cultures had become ingrained in managers and staff.
8.3.4 Safety Investment

During the interviews and visits a number of issues affecting safety on IE became apparent which were specific to the Irish railways and not easily identified in a generic safety management audit. The most frequently mentioned concern at all levels was the history of low investment in the IE system, particularly in the infrastructure. Past policies of very restricted investment, tight budget controls and limited borrowing facilities had created a situation in which only the Belfast-Dublin-Cork main lines and the Dublin suburban area had received sufficient funding to enable modernisation while other trunk and secondary lines had received only sufficient resources for limited maintenance. Safety was assured by placing restrictions on speed but there were public pressures to increase train speeds to reduce journey times which in some areas put additional pressure on IE. It must be remembered, however, that such restrictions and special arrangements to cope with sub-standard railway conditions create the environment in which it is more heavily dependent on human judgement. There is much evidence on other railways and in other safety critical industries that accidents occur in abnormal and degraded conditions when people rely on human judgements rather than technical safeguards.

8.3.5 Strategic Safety Planning

Earlier chapters have commented upon the safety of assets and infrastructure, but it was noted that there was a reluctance to plan for infrastructure renewal in the long term because of funding uncertainties and the poor communication upwards of the evidence to support infrastructure investment that would enable the CIE and Government to face the options that are available. There are no mechanisms in place for cost benefit analysis, safety/risk assessment as part of the investment process, appraisal of investment schemes from a safety viewpoint or their prioritisation. The goal to be sought is to integrate safety management and objectives with other key business (eg financial and product quality) objectives at the highest levels of CIE and IE decision-making.

8.3.6 Occupational Health and Safety

Not all safety improvement requires substantial sums of money. One of the key findings of the ground level visits and questionnaires, is the cynicism of staff over management’s desire to meet health and safety commitments. Many staff facilities and conditions are poor leading to health and safety risks, and these concerns are often not addressed with urgency because of other priorities such as the apparent track condition. When complaints or suggestions are made, feedback is lacking in many cases. Part of the problem is that managers responsible for the activities in which the hazards occur did not, until very recently, hold budgeted resources to put them right but relied on the engineering functions which had other railway operational safety priorities. A huge improvement in performance and morale should be achieved with relatively low allocations of funds to local depot and station.
managers to enable them to deal with bad conditions prioritised in conjunction with local supervisors and staff safety representatives.

8.3.7 Morale, Pay, Conditions and Safety

It is not the role of this report to examine problems of government/state industry/trade union relations, but it is necessary to say that existing industrial relations tensions and problems are not conducive to tackling some important safety issues. Some grades of staff are working long hours on a regular basis and the questionnaire replies indicated that fatigue was a cause of accidents or near misses. Staff express the view that low basic wages encourage employees to seek overtime to make up wages to an adequate level. Managers feel that Trade Unions are not supportive in actions required to achieve safety, either in the adherence to the disciplinary standards required to uphold safety or in supporting initiatives like introducing a drugs and alcohol policy or using technology to check train overspeeding. Safety policy and improvements should be an issue on which both managers and staff should have a joint interest and should strive to work together and not allow the subject to become part of wider industrial relations issues and attitudes. Morale is also affected by the continuing uncertainty over the future of the railway routes which require urgent investment, and poor morale is bad for safety.

There could be an opportunity now for IE management and Trade Unions to work together to explore how aspirations on both sides to improve safety for the workforce and the public could be promoted by joint action. The issues of long hours and low basic wages for some staff, and poor physical working conditions could be coupled with a review of other agreements (such as discipline and grievance procedures, alcohol and drugs policies, negotiation and consultation on safety issues) which fail to address the safety requirements of a modern railway system. This will require co-operation from all the parties involved - government, railway management and the trade unions.

8.3.8 Safety Management Training

More requires to be done to improve the effectiveness of managers and supervisors. At all levels their enthusiasm came over strongly and they displayed a professional knowledge of their respective disciplines. Support is needed through individual development programmes particularly in safety management, communications and management/supervisory techniques. This is most urgently needed in the Infrastructure Departments. Training and development is an activity that can be easily reduced in order to aid achievement of financial targets and eventually the lack of such training is reflected in the results that are being seen. It is now necessary to ensure that staff and the railway benefit by an increased level of training in safety, communication and management/supervisory techniques as part of individual development programmes.
8.3.9 Safety Culture

Improvement is necessary in matters such as the standards of housekeeping, the prevention of unsafe conditions rather than the clearing up afterwards, the demonstration of a commitment to safety by supervisors and managers and the continuing consideration by managers of work practices and health and hygiene issues at the workplace. While staff spoke of improvements that had been made in safety over recent years there still remains much to be done. In these circumstances it is necessary to engage the workforce in frank and honest discussions about safety working practices and behaviour in a non-threatening atmosphere. Only when managers and staff can raise weaknesses and errors (eg by discussing frankly “near misses”) can potential precursors of serious accidents be identified and their causes tackled. This requires a “blame free” culture when encouraging employees to admit and discuss problems (but note that it does not apply to situations after the event when wilful negligence or incompetence is uncovered).

8.3.10 Implementation of Improved SMS

To conclude, whilst it has been demonstrated that senior management appears to have a strong degree of commitment to safety, there has yet to be seen a corresponding improvement in working conditions at the ground level. Implementation of the safety systems relies on the co-operation of everyone in the company. Consequently much must be done to address staff morale in order that staff, supervisors and middle management believe in the commitment of senior management and develop the motivation to put the safety systems into practice. Staff need to see evidence of this commitment within their own workplaces. This requires funding and systems for prioritising investments, so that managers can respond effectively to the hazard reports that are made by staff. Investment in training, not only in technical disciplines but also interpersonal, communication and leadership skills, will not only make people feel valued by the company, but enable those receiving training to start to change culture by their actions rather than by their words.

8.4 Recommendations

The recommendations are divided into immediate, medium term and long term to indicate the opinion of IRMS that these recommendations should be considered and action initiated within a given time frame, starting from the date at which the report is published. It is not intended to indicate the time frame for completion of the recommendation as the work involved will vary considerably, but the parties involved (DPE, CIE, IE) should agree action plans within the first 6 months which identify the party responsible for initiating action and the timescales for completion. IRMS has indicated its opinion at the end of each recommendation regarding responsibility for implementation.
8.4.1 Short Term (Immediate - Within 6 - 12 Months of Report's Publication)

1. Revise the terms of reference of the CIE Safety Committee concerning its authorities and accountability and clarify the route by which CIE decisions with safety implications are discussed with or delegated to IE. (CIE)

2. Review the structure, resources and technical skills available, and their deployment, in all the engineering functions, so that the achievement of robust maintenance standards can support the value of investment and upgrading of infrastructure on an ongoing basis. (IE)


4. 5 year plans should be prepared (with a further 5 year outline estimate) for the infrastructure investment necessary to maintain a safe railway at the line speeds required for optimum business results to identify strategic options for CIE/Government decision-making, taking recent IE studies and the findings of this study into account. (IE)

5. Maintain resources available at local station/depot management level for the correction of health and safety hazards, in conjunction with priorities agreed with local supervisors and safety representatives. (IE)

6. Strengthen the arrangements for giving staff feedback on their safety complaints and suggestions to improve confidence of the staff in existing systems. (IE)

7. Extend the provision of Job Descriptions and Safety Responsibility Statements to all safety critical management and supervisory posts and update these on a stipulated regular basis. (IE)

8. Given the current standard of the existing infrastructure and the frequency of failures, undertake a risk assessment to identify whether the human factors risks associated with abnormal or degraded operating conditions (both planned and emergency) will be tolerable, until essential investment is implemented. (IE)

9. Review the safety management of contractors' staff undertaking work on the IE system, clarifying IE and contractor responsibilities and their effective implementation. (IE)

8.4.2 Medium Term (Within 12 - 18 Months of Report's Publication)

10. Develop a system for integrating and prioritising safety objectives with other key business objectives, incorporating safety cost benefit analysis. (CIE)

11. Develop and install suitable computer software to maintain a full database of accidents and incidents that can be quickly and easily analysed for CIE and IE senior management, functional management
and ground level managers, supervisors and staff, and revise reporting instructions to include “near miss” data. (IE)

12. Develop and install a performance and fault database for all infrastructure and rolling stock equipment (IE)

13. Develop a programme to improve safety culture and supervisory/staff commitment to safety and audit its implementation. (IE)

14. Strengthen and consistently maintain a system of briefing all staff at ground level on safety matters on a regular basis by their supervisors/local managers, encouraging two-way communication and the upwards progressing of safety improvement suggestions. (IE)

15. After carrying out a training needs analysis, prepare individually tailored training plans for all IE management and supervisory staff, which will incorporate the safety management and communication skills required, which can be costed and budget provision made. (IE)

16. Supplement the regular existing ISRS safety audits with compliance audits against the requirements of the IE SMS issued 2.4.98 and IE operating rules and engineering standards, throughout the organisation including ground level. (IE)

17. Implement a formal process (Safety Case or Plan) for the management of change at the appropriate level of detail for all organisational and technical changes of significance - either to the existing system or new works. (IE)

18. Implement the recently approved procurement safety policies and performance procedures as necessary criteria in the selection of IE contractors and suppliers and strengthen the requirements for feedback and audit.(CIE/IE)

19. Develop a performance based procurement process for all engineering equipment (IE)

8.4.3 Long Term (Within 1 - 2 Years of Report’s Publication)

20. Develop and introduce a Performance Appraisal Process for all senior and middle managers, incorporating safety performance against targets where relevant, and develop a simplified appraisal system against safety objectives for other managers and supervisors in safety critical posts. (CIE/IE)

21. Strategic safety objectives should be set for IE in conjunction with the CIE and IE Boards, with a full awareness of the financial and service consequences. (DPE)

22. Institute a Quality Assurance (QA) regime, such as IS 9000, for all systems and procedures that impact on safety in all engineering functions (IE).
23. Establish regular research into staff morale and the underlying reasons for trends and changes, in respect of all activities and grades of staff that impact on safety. (IE)

24. The pay and productivity structure, hours of duty and conditions of service, for staff grades that are safety critical, and outstanding issues between the Trade Unions and management on safety discipline and techniques to ensure public and staff safety, should be reviewed with a view to joint action that will benefit both and lead towards a common and agreed approach on safety issues. (CIE/IE/Trade Unions, facilitated by Government)

8.5 SMS Recommendations Costs

The recommendations in Section 8.4 above will require either start-up or development costs and/or ongoing costs. These costs are over and above existing budgets/resources, thus where a recommendation can be met within existing budgets no cost is indicated.

These costs are estimated in Table 8.3 and may be summarised as follows:

<table>
<thead>
<tr>
<th></th>
<th>On-going (per annum) IR£m</th>
<th>Immediate (One-off) IR£m</th>
<th>0-5 Years (per 5 Years) IR£m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Management Systems Improvements</td>
<td>3.5</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>
## Table 8.3: Estimated Costs of SMS Recommendations

<table>
<thead>
<tr>
<th>Recommendation No.</th>
<th>Start-up Costs (Ir£ 000)</th>
<th>Ongoing Annual Costs (Ir£ 000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
<td>250</td>
</tr>
<tr>
<td>3</td>
<td>Cover in Engineering costs in Table 7.7</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>50</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>11</td>
<td>500</td>
<td>100</td>
</tr>
<tr>
<td>12</td>
<td>500</td>
<td>100</td>
</tr>
<tr>
<td>13</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td>-</td>
<td>200</td>
</tr>
<tr>
<td>15</td>
<td>Covered in existing IE budget*</td>
<td>3 - 4,000 initially 2,000 after 3-5 years</td>
</tr>
<tr>
<td>16</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td>17</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td>18</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>19</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>21</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>22</td>
<td>250</td>
<td>100</td>
</tr>
<tr>
<td>23</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>24</td>
<td>-</td>
<td>Impossible to estimate</td>
</tr>
</tbody>
</table>

* - existing budget of Ir£2M already allocated for 1998
9. RAILWAY SAFETY REGULATION

9.1 Introduction

The consultants were asked to consider two issues concerning the structure and organisation of railway safety. These were the role and capacity of the Railway Inspecting Officer (RIO) and the impact of European Union Council Directives on the safety of IE and what legislation and procedures may be necessary to implement these. This chapter addresses these issues and recommends ways forward.

9.2 The Railway Inspecting Officer (RIO)

9.2.1 Objectives

The objectives of the review were to:

- describe the principal issues stemming from railway legislation which guide or govern safety and the potential work of government regulators of railway safety;
- describe the principal issues stemming from employment legislation which are relevant to railway safety and the role of government regulators;
- describe the regulatory regime at present in place under the statutes described;
- identify shortcomings in the present arrangements;
- make recommendations for the future, identifying the strengths and weaknesses of various options.

The starting point was to review the legislation which regulates railway safety in Ireland and which underpins the rights and responsibilities of the Railway Inspecting Officer (RIO). Investigations were also made as to the role and policy of the Health & Safety Authority (HSA) in relation to IE and the relevance to railway safety of the Safety, Health and Welfare at Work Act 1989 (SHWA) [9] and subsequent regulations made under it. This review was then supplemented by a series of interviews with relevant personnel from the Department, IE and the HSA.

9.2.2 Railway Safety Legislation

9.2.2.1 New Railway Works

In accordance with clauses in the regulation of Railways Acts of 1842 and 1871, further entered in the Railway Act of 1924, the railways have a duty to
submit for consideration to Government their proposals to build a new line, station, bridge, level crossing etc. The Government Department responsible for railways may then direct an Inspector to inspect the works before use, and the works may not be taken into use unless the Department (strictly in the person of the Minister) so allows after receiving the advice of the Inspector.

The arrangements for independent inspection of new railway works stem from the 19th century legislation mentioned above. The duties still exist in law but are not now well understood by all the duty holders. An attempt to modify, but also clarify the needs by exchange of correspondence in 1977 is not now well known or respected. These shortcomings, and suggestions for the future, are amplified below.

No matter what the source of funding, nor what the legal status of IE might be in the future, the railways will remain an important utility subject to considerable public interest. As such there will reasonably be a public expectation of Government overview and approval as to the safety of their operations. This should include checks to ensure that railway works are always designed and constructed with proper regard for safety and that any railway investment funded from the public purse pays proper regard to safety issues arising from that investment.

However there are some issues of definition and procedure in the current system, relating to the approvals procedure for new works which deserve to be re-examined.

The law initially referred to new lines (and other works); it later was extended to include additions to an existing railway. But nowhere in law is there a requirement to submit for this consideration significant changes, such as a new method of signalling, which is clearly within the spirit and intention of the law, but not within its letter.

In 1977 the RIO reached an understanding with CIE such that the procedure would be applied in practice, even if not in law, to significant changes to the infrastructure. A comprehensive memorandum listing works to be submitted, including those clearly within the law and those within its spirit, was agreed and circulated [10]. This arrangement does not appear now to be well known or understood, and since it extends the railways' duty beyond that within the statutes it may well be open to abuse or disregard with no penalty being available. It must be concluded that if this monitoring procedure is to exist at all, its scope must be completely clear in law.

In relation to scope, it is important to remark that this system does not include rolling stock at all. Apparently when the law was drafted fixed engineering works gave the most cause for concern, but now the omission of locomotives, carriages and wagons from a system of independent assessment of railway safety is quite illogical, and should be corrected.
Finally as to the actual administration of the system, this has fallen into a ‘custom and practice’ regime, rather than following the law, probably because the law is too cumbersome to suit modern conditions. It would appear from the current legislation that strictly the Inspector should only go out to inspect new works if directed by the Department; he does not have a direct and personal power of veto but instead reports back his recommendations to the Department, and ultimately only the Minister has powers of veto or direction over the railways’ actions. These formalities are now less rigidly applied, no doubt for entirely practical and pragmatic reasons, but again the actual current practices are almost certainly outside the law and the opportunity should be taken to overhaul and up-date them.

The last ten years have seen major changes in the licensing of railway developments world-wide, with an increasing emphasis on requiring operators to demonstrate proactively safety acceptability to the regulatory bodies. Methods of the systematic prediction and assessment of safety performance are now routinely applied both to existing railway operations and to the design of new works projects.

It is strongly recommended that any revised legislation requires IE to use such concepts in the preparation of a documented proof of safety or safety report for all new works proposals. This would both require IE to apply modern analytical techniques and enable the RIO to make better informed judgements as to the risks presented. It also has the potential to enable a logical and efficient sequential approval procedure to be adopted, from principles at the concept stage through to evidence of safe commissioning on completion.

Arrangements such as those outlined above would give the Department the satisfaction of knowing that the latest analysis and demonstration techniques of railway safety were being applied. The RIO may however need training opportunities to enhance competence in these new skills and may also at times need to call upon additional resources.

9.2.2.2 Accident Reporting

The railways have a duty in law to report to the Department a wide range of accidents on the railway, including all classes of fatality and personal injury related accidents to members of the public and accidents to employees involving more than one day’s absence. The basic duties originate in the Act of 1871 [11] and were last specified in detail in a direction of the Board of Trade of 1906, adopted into Irish law in 1922.

However, much more recently a common duty to report accidents and dangerous occurrences throughout the whole of industry and commerce has been specified within the Health and Safety (General Application) Regulations 1993. These regulations involve however much coarser thresholds to trigger a report than the railway legislation specifies.
In practice, the result of this is that accidents to railway employees are reportable to the Department if only one day’s absence results and then to the HSA additionally if three days’ absence results. Making this division is a quite unnecessary burden on IE, and it means that any conclusions made by the Department about railway employee safety bear no comparison whatsoever with the rest of industry where a different threshold applies.

Similarly for accidents to the public, a different reporting trigger applies to those on the railway notifiable under the old railway legislation and those notifiable to the HSA under the Irish health and safety legislation. In such cases IE does not report them to both regulatory bodies, only to the Department, but this means there will be an inconsistency between public safety data on the railway and any derived from other sources.

It would be entirely logical to align the reporting threshold for accidents on the railway with that applying in all other fields of industry.

9.2.2.3 Accident Investigation

From early days RIOs have undertaken various levels of investigation of railway accidents, sometimes with scant or uncertain powers to do so and in others with very full and formal powers conferred by the Minister under the 1871 Act procedures. These high-level procedures are still available but, due to the rare nature of serious railway accidents, seldom needed.

The day-to-day powers of the RIO to investigate some of the 400 or so per year notified railway accidents in his own right are probably more important, although in practice the present RIO can rarely set aside enough time from other duties to personally investigate an accident and largely must accept a scrutiny, and if necessary a challenge to, IE’s own investigation reports.

The 19th century legislation apparently gave Inspectors quite wide powers of entry, inspection, investigation, etc, although one interpretation is that these powers are only available for purposes directed by the Minister, that is to inspect specific new works or to investigate a specific accident. In practice RIOs have used these powers as if they are always available to them personally. Generally this approach has not been challenged by the railways but the fact that there is potential ambiguity suggests that this aspect also deserves to be further considered and put on a proper footing.

What is clear from the 1871 Act is that the RIO does not have powers to direct any alteration or improvement to be made for safety, but later legislation (the 1924 Act) makes it clear that the Minister may direct a railway to adopt certain safety measures, normally as a result of recommendations from an Inspector.

This is a potentially powerful sanction but perhaps a cumbersome one for day-to-day use in the monitoring and regulation of railway safety. It is also
in contrast to the powers of Inspectors appointed under the SHWA who can personally issue Enforcement Notices to secure safety improvements, with the precaution against unreasonable use that the recipient has access to an appeal procedure. This difference in powers will be considered again later in the development of recommendations for the future.

9.2.2.4 Matters not Within the RIO’s Duties

The previous paragraphs describe the intention behind the legislation governing the RIO’s duties. They primarily involve inspection of completely new facilities before use and the investigation of accidents after something has gone wrong.

For various reasons, Irish RIO’s have never routinely gone out to investigate the current state of the railways. This may be partly due to the lack of clarity regarding routine powers of entry in the 19th century legislation, partly due to the clear prohibition on an Inspector directing the affairs of the railway also in the old (and still current) legislation, and partly due to the fact that sufficient manpower to do so has never been provided. After a safe system has been devised and installed the designed safety levels can only be achieved long-term both by adequate maintenance of the physical assets and by rigorous maintenance of safety management systems by which deviations from an adequate standard can be identified and corrected.

So, with the limited resources and limited powers vested in its RIO at present, the Department is left vulnerable in that it does not have the knowledge which it might wish for as to the current state of safety on the railways, since the RIO is not equipped in law or in manpower to provide an independent, current and continuing assessment of such issues. It further has no basis upon which to approve significant alterations to the network or its equipment, such as rolling stock.

9.2.3 Safety and Health Legislation

9.2.3.1 Current Legislation

The key item of health and safety legislation in Irish law is the SHWA [9] supported by Regulations made under its powers, all of which predominantly, but not exclusively, place duties on employers to keep their workers free from harm arising from their work activities. Both this Irish Act and the similar one of 1974 in the UK [12] include a section which says:

“It shall be the duty of every employer to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that persons not in his employment who may be affected thereby are not exposed to risks to their safety or health.”

A huge difference of interpretation of this clause however exists between the two countries. In the UK the persons protected by this clause are taken to include all members of the public who may be endangered by the railway,
including passengers on its trains and persons using level crossings. There have been several prosecutions of the railways using this clause, ranging from failures which led to a multi-fatality train accident, through to the fall of a person through the deck of a foot-bridge which had been left unsafe during repairs. But in Ireland everyone interviewed during this study considered that this clause does not apply to passengers and other members of the public on the railway. This is a fundamental difference of interpretation which leads to other anomalies, described in the next section.

9.2.3.2 Enforcement of SHWA

Enforcement of the safety and health legislation on the railways is carried out by Inspectors of the Health and Safety Authority (HSA). This means that safety matters on IE are being overseen by two different regulators, the HSA and the RIO.

This would not matter so much if employee safety and welfare could be completely divorced from public safety, but it cannot always and even when it can, it may be inefficient to maintain the distinction. For instance, an inspector from either department may have travelled for a considerable time and distance to examine an issue at a remote station. If during his visit another matter is brought to his attention which belongs to the ‘other’ Inspectorate, it would clearly be inefficient for that particular inspector not to deal with the matter immediately.

In some cases, there is an indivisible linkage between employee and public safety. In most cases they may both be advanced by the same measures but sometimes a change to the benefit of one may be adverse to the other. An example is the safe working of manual gates at level crossings, an issue which was current at the time of this study following a fatal accident to a level crossing keeper.

These are issues in which it is hardly possible, and certainly not desirable, to operate as if employee and public safety are completely different problems demanding different approaches. They may differ as to the hazard in some areas but the systems to promote and maintain safety are fundamentally the same. Leading industries world-wide now adopt the concept of ‘Total Safety’, that is all risks of harm generated by their business are managed in a unified way. All this tends towards the conclusion that one inspection body only should monitor railway safety.

Furthermore, because of the limitations in the RIO’s role and the limited interpretation of SHWA it is the case that the HSA may act in a pro-active or preventive way with regard to employee safety but no independent body currently acts in this way with regard to public safety. This appears to be an illogical position which is now hard to defend.
9.2.3.3 Accident and Incident Reporting

It is a reiteration, but important enough to warrant it, that under the existing health and safety legislation certain employee accidents are reported to the HSA, whilst others, starting from a different threshold are reported to the RIO. The RIO, but not the HSA, also receives reports of railway accidents e.g. collisions and derailments in which employees, the public, or both may have been injured.

It is to the credit of those working this system that they seem to understand it but it is inefficient for those administering it and can only lead to risks of double-counting casualties and a host of other potential confusions in the use of the accident data reported to the two government bodies.

9.2.4 The Way Ahead

9.2.4.1 An Overview

The simple conclusion to be drawn from all this is that there should be a high level of liaison between the two regulatory regimes. In the short term the two Inspectorates must talk to each other - they have not done so hitherto. It would also be useful if a Memorandum of Understanding could be drawn up to aid liaison and mutual understanding between them.

In the longer term it seems logical for all the reasons given above to combine the two inspection regimes into one, a Railway Inspectorate (RI), within which all these differences could be resolved and a co-ordinated policy be presented to the railways by the regulator.

9.2.4.2 Hurdles Towards a Merger

A simple merger of inspection resources under one management would still leave anomalies which would need to be resolved. Firstly the revision of ‘railway’ legislation is still important. But even more important is the resolution of the powers of inspectors which differ between the two regimes.

The whole issue could be conveniently and swiftly resolved if it were decided in law that Section 7 of the Safety & Health at Work Act does apply to the railways duty of care to the public, including its passengers. Then an inspector granted powers of enforcement under the SHWA would have personal powers to look into all aspects of safety on the railway. Without that interpretation an inspector can only, on his own initiative, look into matters of employee safety. This surely cannot be the wish or intention of either the Department of Enterprise, Trade and Environment or of the Department of Public Enterprise. If this wider interpretation of Section 7 is not acceptable in Irish law then the matter could also be regularised by drafting into the new railway law a set of powers of inspectors comparable to those in the SHWA.
Clearly the accident reporting duties would also need to be revised, preferably towards the standards for the rest of industry but with a special schedule of ‘railway unique’ accidents like derailments.

9.2.4.3 Other Duties to Consider

The preceding sections have emphasised the duties in law of the parties involved. The present RIO is, or might be, involved in other matters not underpinned by law but worthwhile nonetheless. The present RIO did not have a current, personal Job Description or set of objectives listing these additional duties, but from a draft Job Description produced in 1991 and the interviews, the following additions to the core functions already described were suggested:

- chair a multi-party committee on the transport of Dangerous Goods (DG) (this is probably a valuable function but it also overlooks any liaison with HSA who deal with transport of Dangerous Goods by road and handling of such material at terminals);
- chair a multi-party committee on safety at level crossings (note the current interest, described above, of the HSA in the working of level crossings, potentially conflicting);
- chair a multi-party committee on low-bridge strikes by road vehicles (actually an extended remit from the level crossing group, but a very important one);
- chair a co-ordination meeting concerning the technical safety aspects of the proposed Dublin Light Rail Transport scheme;
- produce an annual report on railway safety. This is potentially a very important document which could, if developed, report publicly on trends and the actions in hand to better regulate railway safety. At present it seems to have little impact or value. The last one produced was for 1995; its circulation seems to have been very limited and it contained a serious warning of major risk which has not been addressed (from the striking of a low railway bridge by a high road vehicle) which appears not to have been addressed within the Department;
- provide urgent briefings to Ministers on railway safety issues (e.g. in response to a serious or potentially serious accident);
- provide expert advice to Ministers on railway technical and operational issues (e.g. in relation to investment proposals);
- provide expert advice to the Department on any proposed large capital works programmes;
- a need to manage a railway operator licensing scheme, derived from EU Directives can now be foreseen. (see Section 9.3 of this report).
9.2.5 Schedule of Options

This section lists the options for the way forward which are apparent from this study and considers their respective merits.

9.2.5.1 Option A: Dispense with the RIO; The ‘Zero Option’

This implies that maintenance of adequate safety standards for passengers would be entirely entrusted to the management of IE/CIE. Ministers would not have any expert independent advice on hand. HSA would continue to independently monitor employee safety and health standards on the railways.

Advantages: 1. Reduction in Civil Service numbers by one (the RIO) and consequent cost saving.

Disadvantages: 1. Ministers have no immediate advice or other effective response in the event of a serious accident.

2. The Department has no access to expert advice on investment submissions of a technical nature; potential mis-spending of public money.

3. The Department has no means on hand of monitoring railway safety and may stay in ignorance of serious deterioration.


5. Ministers open to the allegation of risking public money and public safety to make minor cost savings.

6. No independent review and approval of the safety of IE.

7. Provides no foundation for a licensing scheme required under EU Directives.

9.2.5.2 Option B: Maintain the Status Quo

This option implies that a Railway Inspectorate remains with the Department dealing with railway operational issues whilst railway employee safety issues remain with the HSA.

Advantages: 1. Simplicity; least changes needed.

2. Maintains a potential base for a licensing scheme under EU Directives.
Disadvantages

1. IE. still overseen by two regulators.
2. Potential waste of public funds, conflict between differing objectives.
3. RIO still with less powers than HSA inspector.

Essential Enhancements

1. Clear Job Description and Objectives for RIO(s).
2. Memorandum of Understanding between the Department and HSA.
3. Systems for formal and informal liaison between RIO and HSA inspectors.
4. Revise policy on the handling of new works submissions to ensure clarity and understanding of the purpose and the method by all duty holders.

Desirable Enhancements

1. Revise railway accident reporting requirements to same thresholds as SHWA one.
2. Tidy up plethora of old Railway Acts.
3. Consider ‘right of entry etc.’ powers for RIO(s) - comparable to HSA inspectors.

9.2.5.3 Option C: Form One Railway Inspectorate, within HSA

This implies that the Department transfers to HSA its RIO, and possibly its regulatory powers under the Railways Acts. It would be expected that HSA would maintain a dedicated, and hence expert, team to oversee railway safety.

Advantages:
1. IE. only ‘sees’ one safety regulator; more efficient, more consistent.
2. RIO(s) could have wider career opportunities.
3. RIO(s) acquire wider vision, expert advice on safety law etc.
4. RIO(s) seen to be beyond influence of the Department (re investment funds etc.).
5. Possible base for safety certification procedure, but not all required elements, of EU Directives.

Disadvantages
1. Represents, from the Department’s standpoint, the most radical change.
2. The Department loses ready access to railway safety and technical advice.

3. RIO(s) more remote from knowledge available within DPE of forward plans and policy for IE.

4. Risk of RIO ‘expert’ qualities being diluted within HSA ‘by placement of general inspectors of occupational health & safety in its number’.

5. Risk of absorption of a very small unit such as RI into the generality of HSA inspection, losing quality, expertise and respect in the industry.

**Essential Enhancements:**

1. Clear and mutually satisfactory conditions for transfer to be prepared.

2. Job Description & Objectives for RIO(s) needed.

3. Revision of new works procedures, and an Agency Agreement for HSA to discharge some duties which in law will still be DPE responsibility.

**Desirable Enhancements:**

1. Revise railway accident reporting requirements to same threshold as HSWA.

2. Revise plethora of Railway Acts.

3. By revised policy, or if necessary by new legislation, arrange that matters of public safety on the railway can be regulated by RIO using powers comparable to those applicable to employee safety. Decide applicability of SHWA Section 7 to public or arrange other powers for RIOs.

**9.2.5.4 Option D: Form One Railway Inspectorate within Department but with HSA Powers Added**

This implies that the RIO(s) stay within the Department but take over those tasks currently done on the railway by HSA inspectors who would then have no further involvement with the railways.

**Advantages:**

1. Relatively simple changes to manage.

2. IE ‘sees’ one safety regulator, expert in its field.

3. Ministers and Department retain ready access to railway expertise.

4. Better value-for-money by co-ordination of railway
safety issues.

5. Creates a natural base for managing a licensing scheme under EU Directives.

Disadvantages:

1. Possible perception that staff safety efforts diluted by merger.
2. Any ‘conflict of interest’ perception of RIO within Department is retained.

Essential Enhancements:

1. Accident reporting duties to be made coincident.
2. HSA-type powers to be given to RIO(s).
3. Fresh Job Descriptions and Objectives to be drawn up.
4. Revision of agreement for handling New Works.

Desirable Enhancements:

1. By revised policy, or if necessary by new legislation, arrange that matters of public safety on the railway can be regulated by RIO using powers comparable to those applicable to employee safety. Decide applicability of SHWA Section 7 to public or arrange other powers for RIOs.
2. Tidy up plethora of Railway Acts.

9.2.5.5 Option E: Place the Railway Inspectorate Within a Transport Safety Agency

This implies that the Railway Inspectorate would operate in an organisation outside of direct Government Departmental jurisdiction. Such an organisation might, from the viewpoint of efficiency and consistency, include all bodies which deal with safety issues on the various modes of transport.

Advantages:

1. Public confidence in the independence of safety regulators.

Disadvantages:

1. Most radical change from present position, hence most difficult to implement.

Essential Enhancements:

1. New legislation needed to create a Transport Safety Agency.
2. Revision of all legislative changes as outlined in all other options.
3. Fresh Job Descriptions and Objectives to be drawn up.

Desirable Enhancements:

1. By revised policy, or if necessary by new legislation, arrange that matters of public safety on the railway can be regulated by RIO using powers comparable to those applicable to employee safety. Decide applicability of SHWA Section 7 to public or arrange other powers for RIOs.

2. Tidy up plethora of Railway Acts.

9.2.6 Conclusion

It is concluded that there is at present a balance of advantage in favour of Option D, namely that the RIO(s) remain with the Department but take over HSA delegated powers additionally. There is an argument that Option E may become a more logical choice should there be a growth in the size and scope of work of the Railway Inspectorate. It would however need to be accompanied by all of the legislative changes recommended for the other options, in addition to further law to create a legal constitution and to transfer other safety regulators into the Agency. Option D is therefore regarded as the more logical choice in the short term.

The remainder of this section of the report will therefore deal with other issues requiring consideration in implementing Option D.

9.2.7 RIO Resourcing

The scope of this study does not allow an in-depth review of potential workloads in the present regime, far less the proposed one. It is however clear that the sole RIO at present employed is overloaded with a heavy backlog of work he is unlikely to overcome.

In addition he is the sole recipient of those accident reports which are telephoned in by the railway, including out of office hours, and the sole official able to give entirely independent advice on railway technical matters. This both places a heavy burden on the individual and leaves the Department quite vulnerable to a lack of this type of expertise during the inspector's absences.

The study team considered, even from this simple examination of the situation, that the appointment now of at least two other Inspectors would be entirely justified. First of all this would remove the current risk to the Department of not being able to deal effectively with a rail safety emergency during one of the sole Inspector's legitimate absences. Secondly it would allow more Inspector time to be spent out on the railway system, thus more continuously and pro-actively identifying issues presenting risk and advising.
on appropriate levels of control, for the information of the Department and to the benefit of IE.

It was considered whether staffing-level comparisons could be made directly with HM Railway Inspectorate in the UK, which currently numbers over 50 inspectors. But the team concluded that there was not sufficient common ground to draw valid conclusions and make sound recommendations in this way. Firmer recommendations as to staffing levels can only be made following more detailed studies. In particular these would depend on an initial response from the Department to the other recommendations in this section, such the proposed revision of railway safety legislation and the enforcement regime.

Related to workload and efficiency, it was found that there was no dedicated administrative support to assist the work of the RIO who consequently carried out a lot of tasks which could be done at a lower grade. The potential for administrative support and hence getting the best value from the highly-qualified professionals also deserves serious consideration. Experience elsewhere suggests that efficiency is best served by dedicated support staff who can become totally familiar with the issues, the jargon and other unusual features of this specialised task.

9.2.8 Location of the RIO Within the Department

Although this study, on balance, favours the retention of an Inspectorate within Department, the exact positioning of that unit also deserves further consideration. If the RIOs are linked in the managerial line of command to the same officials who deal with railway investment, then there can be suspicions that their recommendations regarding railway safety might be improperly influenced by the Department’s spending limits.

As a relatively small team of experts in a transport field, the RIOs could well find more rapport, more technical support, and a clearer focus on the issues they address if they were linked managerially to some other technical group within the Department.

Both the foregoing issues would be resolved to a large degree if the RIO team were amalgamated within the Department to be part of the present Air Accident Investigation and Technical Unit and it is recommended that consideration should be given to such a move.

9.2.9 RIO Ranking and Career Prospects

The study team is diffident about commenting on these issues which may be considered out of the remit, but the subject was raised spontaneously in more than one interview and so justifies brief inclusion.

To some extent, the position of an official within the civil service hierarchy will affect the respect he is afforded and the notice taken of him both within and without the service. The present RIO could also be regarded as ‘Chief
RIO' since there is no other, and he is the Government's primary custodian of and advisor on railway safety. But his position in the department's management structure does not seem to reflect such a potentially important and high-profile role.

In addition there appear to be few career opportunities nearby in his present position. It may be that both these issues could be eased by the suggested move to the Air Accident Investigation and Technical Unit branch, but this report does not develop these ideas further than putting them forward for consideration.

9.2.10 Recommendations

The following recommendations are made as a result of the findings of this study:

1. Strengthen the capabilities of the present sole Inspecting Officer, by recruiting two more Inspectors and one dedicated administrative support person now.

2. Reconsider the interpretation of the public safety clause in the SHW Act, or draft new legislation such that inspection of public safety issues on railways can be conducted with similar powers to those available under the SHWA the inspection of employee safety issues.

3. Make one Railway Inspectorate within the Department responsible for monitoring all railway safety issues, including those concerning employees as well as passengers and the public.

4. Prepare a new mandate for the Railway Inspectorate from which its optimal size, structure and position within the Department can be decided (Ultimately this will be dependent on new legislation, but there will be natural phases en-route).

5. Ensure that a programme of continuing professional development for the RIOs provides the technical knowledge necessary to understand and interpret modern safety assessment and management techniques, with the ability for them to call upon independent advice as and when necessary.

6. Require railway investment proposals to include a statement of the safety implications.

7. Revise existing railway safety legislation to provide that which is relevant to the late 20th century and beyond.

8. Within such revised legislation, address the scope of New Works safety assessment, including rolling stock, ensuring also that the duties and responsibilities on the railway remain entirely clear. In particular, the legislation should require IE to submit a formal safety justification for any significant amendments or additions to the network for RIO approval.
9. Revise railway accident and dangerous occurrence reporting legislation to ensure common reporting thresholds between railway and other industries.

10. The Department should allocate the necessary resources to achieve, within a reasonable time-frame, the necessary revision of railway safety legislation, including the introduction of the railway licensing procedure, demanded by EU Directives and described in detail in Section 9.3.

The cost of implementing these recommendations is estimated at around £100,000 per annum.

9.3 The Impact of EU Legislation on the Regulation of Safety on IE.

9.3.1 Introduction

This study was also asked to consider the impact of European Union (EU) legislation pertaining to, or with implications for, railway safety on the IE system and to consider how this legislation might be applied in practice by the Department and IE.

The objectives were to:

- examine EU Directives with implications for railway safety and consider their implications for IE;
- consider the railway undertakings and traffics that might make use of this legislation;
- consider the types of safety issues that would have to be addressed;

The impact and implications of the following EU legislation have been considered:


Only the safety implications of these Directives have been considered. The organisational or commercial implications and requirements are outside the scope of this report unless their implementation could impact on IE safety.
9.3.2 The European Union Council Directives


This Directive on the development of the Community’s railways was adopted on 29th July 1991. It came into force on January 1993 and has been translated into Irish law by Statutory Instrument 204 of 1996 in July 1996.

The purpose of the Directive was to develop the Community’s railways by encouraging railway operators to operate in a commercial manner, to adapt to market needs and to grant the right of access to state systems to independent or state railway systems working in other EU countries. Railway undertakings are free to form groupings with railway undertakings in other member states and should have access to other member state railway systems for the international transport of goods.

Member states retain the general responsibility for the development of appropriate railway infrastructure.

9.3.2.2 Safety Implications

Aspects of this Directive which could impact on the safety of a railway system are:

- separation of infrastructure from train service management
- application of commercial principles and culture to railway management
- independence of railway management from state authorities
- open access to the system for other train service providers
- requirement for no discrimination in agreements including safety provisions

9.3.2.3 Council Directive 95/18/EC

Council Directive 95/18/EC was adopted on 19th June 1995 and concerned the licensing of railway undertakings providing the services referred to in Article 10 of Directive 91/440/EEC. It came into force in June 1997 but has not yet been transposed into Irish law.

It sets out the broad principles of a licensing system for railway undertakings to be administered by member state.

The licensing body should ensure the railway undertaking has the necessary good repute, financial fitness and professional competence and, to protect its customers and third parties, have sufficient insurance to cover its liability risks. It will also be necessary to comply with national and Community rules that intend to ensure it can carry out its activity “in complete safety” on specific sections of track.
9.3.2.4 Safety Implications

Aspects of this Directive which are relevant to this report are:

- the licensing process is designed to ensure that Railway undertakings have the necessary professional competence and ability to manage safety of personnel, rolling stock and organisation;
- application of national health & safety legislation on workers and consumers;
- provision of sufficient insurance cover;
- appointment of a body to manage the licensing system;
- need for that body to regulate and audit safety compliance with licence conditions;
- ability of licensing body to specify type of service or geographic constraints in licence;
- implementation of Directive to be non-discriminatory between railway undertakings.

9.3.2.5 Council Directive 95/19/ EC

Council Directive 95/ 19/ EC was adopted on 19th June 1995 and concerns the allocation of railway infrastructure capacity and the charging of infrastructure fees. It came into force in June 1997 but has not been transposed into Irish law.

The purpose is to set up a fair and non-discriminatory regime for managing access to infrastructure. One key paragraph in the Directive states:

"Whereas, in the interests of traffic safety, railway undertakings must, in order to have access to a particular infrastructure, hold a certificate of safety based on certain common criteria and on national provisions, issued by the body competent for the infrastructure used; ......."

9.3.2.6 Safety Implications

Aspects of Directive 95/ 19/ EC which are relevant to this report are:

- the need to issue a safety certificate;
- the specifying of minimum requirements that a safety certificate should cover;
- the obligations of the government body designated to administer the process of certification to;
- the implicit requirement for the infrastructure manager to set charges to allow for safety investment in track and structure renewals.
9.3.3 The Potential Users of the European Directive 91/440/EEC on the IE System

Clearly the most frequent use of the Directive's provisions will be in mainland Europe where physical impediments to through working of trains is minimal. With the opening of the Channel Tunnel, this now applies increasingly to much of the UK also.

The IE system has two characteristics which will limit severely the probable exploitation of this “open access” directive, namely the fact that Ireland is an island without a permanent physical bridge or tunnel link and the railway gauge difference between the IE system and the rest of the EU railways. This limits train access to transits from Northern Ireland, with the Dublin - Belfast route being the only route with the same track gauge at the Irish national border.

Within the provisions of the present Directive, this would appear to limit likely potential users to railway undertakings in Northern Ireland (Northern Ireland Railways (NIR) or any other future privatised railway) for train movement or other UK/European freight operators involved in sea/land container movements who wish to use the IE rail network for collection or delivery of their containers to Irish customers as part of a through transit to or from elsewhere in the EU.

The implications of this limited likely use are that IE or the Irish Government appointed regulator will have only to consider the following safety aspects of those traffics:

- through running of NIR or possible private Northern Ireland rolling stock and drivers over IE tracks via the Dundalk border;
- adequacy of containers for IE rolling stock;
- the acceptance of locomotives or rolling stock built or hired by an outside party purely for running on the IE system (or Dundalk - Belfast);
- terminal safety (cranage and securing arrangements etc.) where the undertaking’s company and IE staff interact and where actions taken outside the IE system could cause accidents on the network;
- the competence of drivers and other staff employed by undertakings for use on IE system;
- the organisational competence of the applying undertaking in managing safety and the adequacy of insurance arrangements.

9.3.4 The Safety Issues to be Addressed in a Safety Certificate

9.3.4.1 Management Organisation

The professional competence of those managers responsible for the activities to be certificated as safe will need to be demonstrated, with clear
accountability for setting and maintenance of engineering and operating standards compatible with those of the Infrastructure Controller (the organisation responsible for the Irish rail network safety, IE). The Railway undertaking will need to give evidence of its safety management systems (SMS) and their applicability to the activity under scrutiny.

Arrangements for reporting incidents and accidents compatible with IE systems will need to be made and audit procedures agreed by both the Railway undertaking and IE as “infrastructure manager”. Procedures for accident investigation where the railway undertaking is fully or partially involved will need to be agreed.

9.3.4.2 Personnel Competence

The Railway undertaking will need to identify all safety critical staff who will interact with IE and assure the body responsible for certification of the appropriateness of selection, training, supervision and discipline procedures for these personnel. Relevant qualifications or accreditation should be provided.

Systems for managing these staff on a day to day basis should be examined, especially the systems for obtaining feedback and passing on information relevant to operational and occupational safety.

9.3.4.3 Rolling Stock

Any locomotives, rolling stock, containers or other equipment to be used by the railway undertaking on the IE network should be approved for use on specified route sections. Equipment used should meet appropriate technical standards for gauge, kinetic envelope, axle loads, braking performance, stability, construction strength, noise, compatibility with signalling and track.

The railway undertaking must also submit all maintenance procedures and demonstrate responsibilities and the adequacy of the arrangements.

9.3.4.4 Interfaces

The railway undertaking should identify all system interfaces where the applicant’s staff need to communicate and interact with IE, such as driver/signalman, terminal supervisor/signalman or IE train driver/guard, driver/operating control, driver/maintenance staff, railway undertaking management/IE Safety Department, railway undertaking maintenance manager/IE standards engineers etc. Clear roles and responsibilities regarding safety management for those involved at the interface should be identified and explicit to all.

9.3.4.5 Insurance

The railway undertaking seeking safety certification must show that it has adequate insurance arrangements for the risks for which it could have
liability towards consumers, IE staff, or infrastructure, or any other third parties which it may affect.

9.3.5 Options and Models for Safety Regulation

9.3.5.1 USA Federal Railroad Authority (FRA)

The USA has a regulatory body that is outside the railroad industry but sets the standards and investigates all accidents, modifying operating rules and engineering standards to take into account lessons from events or new technology.

The rules and standards are highly prescriptive and have been criticised by the railroad industry as being too inflexible and obstructive to innovative change. They are in this format, however, as the industry is very fragmented with over 600 private companies, many of which are very small and do not have the capability of maintaining a professional safety organisation.

Such a system develops the culture of strong reliance on the regulator and instils in the companies an attitude of minimum adherence to regulatory stipulations which are seen as burdensome. The FRA itself has not commended its system where the number of companies is small and they can be encouraged to develop and maintain the resources necessary for self-regulation. Some of the larger US railroads are pushing for a greater freedom of action so that they can take the initiative through positive occupational health and safety policies and adoption of risk management.

9.3.5.2 European Standard prEN 50126 (CENELEC)

Safety in mainland European railways has been maintained historically through the adoption of national and European standards applicable to the railway industry which has enabled through working of locomotives and rolling stock between many European state railway systems. European standards or norms (EN) are in place for many pieces of equipment (both infrastructure and rolling stock) and safety certification of some traffic flows under Directive 91/440/EEC will be tested by some state railway authorities using these norms as a means of judging safety adequacy.

The development of the EU and pressures to adopt common transport policies and, in particular, a European high speed rail network, have led to working groups which have investigated ways of achieving further interoperability.

Further pressures to open up the networks through “open access” agreements have led to more attempts to define standards that can be commonly used by the European national rail systems embracing management systems and procedures as well as hardware. The European Committee for Electrotechnical Standardisation (CENELEC) has published a draft standard
prEN 50126 which addresses reliability, availability, maintainability and safety (RAMS) and their interaction [4].

The resultant standard is seen as a useful ingredient in the specification design and maintenance of complex railway equipment and systems. Appropriate documentation based on its principles could demonstrate that specific system and technical safety performance could be assured.

The standard is claimed to be applicable to the specification and demonstration of dependability for all railway applications and at all levels, from complete railway routes to major operating or technical systems within a railway route, and to individual and combined sub-systems and components within these major systems and to be of use by railway authorities and the railway support industry.

9.3.5.3 The Safety Case Approach

The Safety Case was developed in the UK nuclear industry and adopted by other high tech industries, in which rare but catastrophic accidents could occur, as a means of demonstrating proof of safety to regulatory authorities. Although it developed as a highly complex and very thorough system, often running to documentation of several volumes, in theory it was a very simple concept that required the management of the undertaking to identify the tasks necessary to carry out its activities, to identify the risks inherent in these and to show that it had adequate means of controlling these risks to an acceptable level.

The process was adopted by the UK chemical and oil industries and by the off-shore oil industry after the Piper Alpha oil-rig fire disaster in the late 1980s. It became then a widespread means of testing safety acceptability by the UK Health and Safety Executive (HSE). Following the Kings Cross underground system fire in 1987 and the Clapham Junction train collision in 1988, and with the impending privatisation of the UK railway system, the HSE, with support from British Rail, proposed the Safety Case approach as the basis for the rail safety regulation system for the privatised railway. The recommendations were accepted by Government and enacted in law in 1993 and 1994. [13, 14, 15, 16]

Whilst the legislation requires a series of issues incorporated in Safety Cases, in practice they are very flexible and permit a company seeking Safety Case approval to adopt innovative approaches where it can demonstrate that the resultant safety will meet the acceptance criteria. In developing the system of safety management, the level and complexity of risk assessment should be appropriate to the scale of risk identified.

The UK railway systems also use the safety case approach for new project approval, reorganisation, the introduction of new traffic flows, operating methods or new technology. These safety cases may relate to totally new situations (e.g. the Heathrow Airport - London new rail link) or be
incremental on existing systems (e.g. the introduction of a new type of rolling stock to an existing train service). Some safety cases may be straightforward and concise where the activity reviewed is simple or the risks are known and controlled by well-tested measures.

In recent years, the UK safety case approach has been adopted in various (often simplified) formats by railway regulatory authorities or railway undertakings in New Zealand, Australia, Canada and Hong Kong. These applications tend to refer to the need for a “Safety Plan” for approval by the railway company Board, or the Safety Regulator, but the requirement for a description of activity, risks and control measures is the same. The process is very flexible and can be easily adapted to different conditions, and leaves the initiative and responsibility firmly in the railway undertaking’s hands. The HSE has stated publicly that it does not anticipate significant difficulties in the UK implementing Directive 91/440/EEC as the safety regulatory regime now in place on Britain’s railways has in essence all the controls being demanded.

9.3.5.4 Applicability to the Irish Railway Scenario

The most probable use of the EU directives in the Irish context was described earlier in paragraph 9.3.3. The type of limited operation described requires only a review of “incremental” changes affecting safety, e.g. the compatibility of railway equipment & systems accepted elsewhere with IE’s own infrastructure, rules & standards. The management and personnel competencies are likely to be as important as the technical issues.

The USA FRA approach is clearly inapplicable to the IE situation as it works prescriptively from standards long used in that country only. It may be of relevance in ensuring the safety of components in USA built equipment (e.g. the General Motors built IE Class 201 locomotives).

The EU CENELEC Standard prEN 50126 is a very useful standard for complex new signalling or infrastructure or new train projects, but it appears to be biased towards complex technical projects. It may well be that railway undertakings wishing to obtain access to the IE system will be able to demonstrate that their equipment has been “proven” in by application of the CENELEC standard, and that this has been accepted by another European railway authority, but it is unlikely that this evidence alone will demonstrate compatibility with the IE network unless a new study takes place. Equally the demonstration that rolling stock to be used meets European Norms (ENs) will be an ingredient in the certification process but it will not itself fully demonstrate compatibility with the Irish rail network or IE safety management systems.

The flexibility and adaptability of the safety case or safety plan seems more suited to the Irish need to test incremental activities and risks, and puts the obligation on the applicant railway undertaking to demonstrate that its plans are compatible with the Irish railway system in respect of the proposed
activity and on the routes that are relevant. This safety case or plan is then tested by experts in IE and/or the Department against agreed safety performance criteria.

9.3.6 Safety Acceptance Criteria

The European Directives make it very clear that there must be no discrimination between state railway companies and any other railway undertaking which has the right to access to the system under 91/440/EEC. This applies to financial agreements and also to the safety rules to be met by the applicant railway undertaking. This means that the certification process must be judged on the same criteria as applied to IE as an existing user of Irish railway network.

Recommendations have already been made in Chapter 4 of this report for safety criteria for this study based on the “ALARP” principle. If these or similar criteria are adopted for this report and by the Department and IE, they could form the basis against which applications for access to the railway network under Directive 91/440/EEC could be appraised.

9.3.7 Issuing and Maintenance of Safety Certificates

If the recommendation that the Department should adopt the Safety Case or Plan approach is accepted, then there are a number of options for its implementation. The Directives require the member state to appoint a body to issue and manage the licensing process and three possibilities are discussed here.

9.3.7.1 IE with Department Approval

The Infrastructure Controller (IE) has responsibility for the safe running of the Irish rail network and has the technical and organisational expertise over a wide range of specialist railway technical and operational issues. It also manages the systems (e.g., safety incident reporting) with which any new entrant railway undertaking will have to comply.

There is therefore a strong case to argue that IE should undertake the assessment of an applicant’s safety case using its professional expertise to appraise the case against the risk criteria laid down by the Department. There might be objections on the grounds that IE is an interested party and might wish to discourage entry of other railway undertakings on to its network by imposing too stringent conditions regarding safety. However if the Department is the final arbiter and also acts as a court of appeal, this objection can be overcome.

A further way of minimising this objection would be to place responsibility for the appraisal with CIE, giving some independence from the IE day to day management, but in reality the CIE officers would need to lean heavily on IE engineers and operators for professional expert opinion. The involvement of
the non-executive CIE Board Member who chairs the CIE Group Safety Committee might be a suitable check to ensure robust and fair assessments are made by the IE specialists, or the involvement of an external safety consultant, as is the case in the process Railtrack set up for reviewing the Safety Cases of privatised train companies in the UK.

The role of the Department (through the RIO or whatever regulatory body for the railway is accepted) would be to ensure that a robust process of appraisal has been carried out by IE, that all relevant issues pertaining to the applicant's proposed activity have been addressed, that no undue or unnecessary condition has been imposed by IE, and the issuing of the Certificate of Safety if the appraisal indicates that the Safety Case is acceptable.

9.3.7.2 The Department of Public Enterprise

The member state is ultimately responsible for instituting and managing the system of Safety Certification to meet the EU Directives on open access and licensing of railway undertakings. There is therefore a case that the Department should not just be the ultimate approver but also be directly involved in the applicant's safety appraisal.

The existing organisation (the Railway Inspectorate) which is closest to the required body does not have the resources or the spread of technical and operational knowledge to perform this role, so would have to be augmented by seconded resources from IE, or be supported by a safety consultancy or another experienced agency or railway (such as the UK HSE or Railtrack Safety and Standards Division). The workload would be infrequent but heavy when an application is made, so it is unlikely that permanent strengthening of the Department for this role alone could be justified. In such circumstances, funding for consultancy assistance would be required.

As IE would, still responsible for management of safety on the network, its views would need to be sought and they would have weight in the deliberation process. If it had no power of veto, IE could claim that its responsibility for safety had been assumed by the Department. There would also be no further point of appeal if the Department undertook the appraisal role unless Government set up a mechanism for appeal to a different Government Department (e.g. in the Department that is responsible for the Health and Safety Authority).

9.3.7.3 An Independent Safety Authority.

The responsibility for Safety Certification could be undertaken by a separate Safety Authority set up by Government for this purpose or in accord with options discussed in Section 9.2 of this report, but the arguments for or against an independent authority undertaking this role are similar to the discussion regarding the Department fulfilling this role.
9.3.8 Monitoring the Safety Case or Plan’s Implementation

IE would be the only organisation in day to day contact with the new railway undertaking and would have direct responsibility for monitoring the arrangements through the accident and incident reporting mechanism.

Safety audits would be essential and could be carried out by the Department if it had the necessary resources, or undertaken by the IE Safety Audit team with sample overview and check audits by the Department’s Inspectorate and HSA. If the Safety Case/Plan is appraised by IE, then the initial audit should also be by the IE, possibly at the new undertaking’s expense if their own audit was not sufficient to demonstrate adequate safety management to IE.

The Department, or an independent Safety Authority if established, should have the right to undertake its own audits and must be the body that takes the ultimate action of Safety Certificate/Licence revocation if safety performance becomes unacceptable and cannot be rectified by the undertaking within an adequate timescale.

9.3.9 Recommendations

1. Government should nominate as soon as possible an appropriate body to issue and manage Safety Certificates and Licences to railway undertakings requiring access to the Irish railway network. This should be the Department (Railway Inspectorate) on the assumption that the Consultant’s recommendations in Section 9.2 are accepted.

2. Railway undertakings wishing to obtain access to the Irish railway network should submit a Safety Case or Plan to the Railway Infrastructure Controller (IE).

3. IE should submit approved Safety Cases or Plans to the Department (or nominated body) for acceptance and issue of Safety Certificates and Licences.

4. Safety Cases or Plans should be limited to a satisfactory demonstration of the safety of the specific activity and route and its compatibility with IE infrastructure and SMS.

5. Safety Cases or Plans should be appraised against safety criteria agreed with the Department for the national railway system.

6. Safety Cases or Plans should address relevant safety issues concerning competence of personnel and organisation and the applicant railway undertaking’s SMS, rolling stock, insurance and interface arrangements with IE.

7. The IE should be required to audit compliance by the railway undertaking with its Safety Case or Plan, and the Department (or nominated body) should have the powers to undertaken its own
independent check audit, and to revoke an undertaking’s Safety Certificate and Licences in certain specified circumstances.

8. The Department should check that EU legislation in the pipeline does not impact on the proposals for safety regulation of rail traffic that could access the existing IE network.

The cost of implementing these recommendations is incorporated in the estimate of Ir£100,000 provided in Section 9.2 of this report, with the proviso that if there is a heavy workload created by the implementation of EU Directive 91/440/EEC, additional consultancy support may be required.
10. SUMMARY OF CONCLUSIONS

10.1 Iarnród Éireann

Historically the IE network has been a safe railway, with reportable accidents and levels of casualties that are comparable with other European railway networks. However, there has been a shortfall in investment in recent years which is now impacting on safety and the reliance of IE on the skill and experience of individual staff members is being undermined as many of the older generation leave the service through retirement or company downsizing.

Because of this, it is necessary to introduce more formal systems and processes to maintain the IE safety record. This has been recognised in many departments of IE and over the last two years steps to develop and introduce formal Safety Management Systems (SMS) have been taken, and the development of training programmes and manpower planning has begun.

The reviews undertaken as part of this study broadly fall into three categories - the physical condition of infrastructure and assets and their safety, the existence and robustness of safety management systems, processes and procedures (the “soft” issues) and the role and strength of rail regulation in Ireland. They are, however, closely interrelated and interdependent. In particular, there is a very strong reliance on the proposed improvements in the management processes and systems of engineering management if the investment in infrastructure recommended is to be effective and provide longer term safety assurance.

Without adequate and documented common standards, maintenance programmes and sufficient and controlled resources to put them into practice, investment results will be transitory. The costs of these management recommendations - although significant at an estimated initial expenditure of around Ir£2 million and ongoing running costs of around Ir£3 - 4 million - are small in comparison with the costs necessary to tackle the physical safety risks, and the implications of not facing these “soft” costs are even higher expenditure on the infrastructure at regular intervals to restore to adequate condition and the greater probability of serious accidents.

Taking the results of physical inspections of the infrastructure first, these indicate that the condition of track, signalling and structures is generally poor, but the condition of rolling stock is on the whole satisfactory. The consultants have compared the condition of the infrastructure against good practice elsewhere and have developed a numerate assessment of percentage shortfall from best practice. The scores from this assessment can be summarised as follows (where 0% represents best practice):
• signalling and telecommunications - 34% shortfall (average), 65% (worst case);
• permanent way - 52% shortfall (average), 80% (worst case);
• structures - 33% shortfall (average), 60% (worst case);
• rolling stock - 27% shortfall (average), 63% (worst case);
• electrification - 25% shortfall (average), 60% (worst case).

The risk analysis model developed by the consultants predicts that:

• there is a potential risk of about 10 train accidents (collisions or derailments) in fare-paying passenger service per year for trains in the short term if no improvements are made (see Section 7.3.2);
• these risks could potentially result in about 7 equivalent fatalities on average per year (see Section 7.3.3);
• the highest contributions to these risks come from failures associated with the points, their detection systems to ensure they are safe for trains to pass over them and their adequate maintenance (40%), signals and their wiring (38%), and rail failures (e.g., fractures, buckles, sleeper and ballast poor conditions) (8%) (see Section 7.3.4.1);
• the sections where the signalling systems contribute to the highest risk are Ballybrophy - Limerick Junction, Heuston - Cherryville Junction, Portarlington - Ballybrophy and Limerick Junction - Mallow (influenced mainly by the old signalling installations around key locations and junctions such as Heuston and Limerick Junction) (see Section 7.3.4.2);
• the sections where the track condition contributes the highest risk are Connolly - Mullingar and Athlone - Claremorris (see Section 7.3.4.2);
• the five routes that presently pose the highest individual risk to regular passengers (i.e., commuters travelling daily) are Waterford - Rosslare Europort, Connolly - Mullingar, Portarlington - Ballybrophy, Howth Junction - Drogheda and Cherryville Junction - Kilkenny (see Section 7.3.5.1);
• combined risks to IE staff from train and occupational accidents are above the upper limit of tolerability criteria agreed for this study and require urgent attention (see Sections 5.2.3 and 7.3.5.2);
• risk to the general public from rail activities is very low, on the assumption that risk exposure to all individuals in Ireland is evenly spread. However, it has not been possible to assess the exposure of individuals to such risks as those incurred by level crossing use or trespass on the track, and risk to individual members of the public prone or choosing to take risks through careless or illegal acts have not been estimated (see Section 5.2.3);
Preliminary cost benefit analysis indicates that an expenditure, carefully targeted, of some Ir£225 million would be justified if it could be demonstrated to reduce train accident risk by some 50% on the system over a thirty year life of renewed infrastructure or equipment. A risk model is available to evaluate different cost and benefit levels higher or lower than this example. The sum of money required to bring the present IE network into a safe condition without speed restrictions or other measures used to ensure adequate safety in the current circumstances is of a similar order (Ir£231 million). This sum does not include any provision for infrastructure enhancement to meet higher train speeds or more or heavier trains, which would require new assessments using the risk assessment model. It also makes no provision for costs to reduce risks other than train accidents, such as those associated with passengers falling from train doors, station accidents, risks imported by road users at level crossings or trespass or suicide.

To obtain the benefit of this investment, however, it is necessary to implement the changes required in safety and engineering management systems and procedures, as already stated. Money spent without improvements in these areas and improvement in safety culture at ground level will be largely wasted as existing shortcomings would quickly resurface.

The SMS audit results and findings from interviews and inspections at management and ground levels indicate a need to achieve significant change in the system and procedural areas to complement the infrastructure and asset improvements required. The audit scored 64% on management systems and procedures, which indicates that some necessary and good safety procedures are in place, but the ground level audit only scored 42% indicating that the SMS has not yet been implemented sufficiently to make an impact on the safety culture. In particular, therefore, the following are seen as inadequate to ensure the hardware improvements are effective:

- the lack of implementation of the recently developed SMS throughout the railway system so that it affects the behaviour and attitudes of all employees towards safety; (see Section 8.3.3);
- the absence or poor quality of engineering management standards, maintenance procedures and their documentation, and inability to meet or match resource requirements and their deployment (see Chapter 6 and Section 8.1);
- poor occupational safety culture, particularly lack of real staff involvement and feedback (see Sections 8.3.6 and 8.3.9);
- the absence or insufficiency of training of employees in engineering maintenance standards and practices, safety management, communication and management/ supervisory techniques (see Sections 8.1 and 8.3.8);
• the absence of effective databases to monitor and analyse trends in accidents, incidents, equipment performance, faults and failures (see Sections 8.1.2.2, 8.1.3.3, 8.1.4.2, 8.2.3.1 and 8.2.3.5).

It is estimated that the initial costs of developing and implementing systems and processes to address these inadequacies would be around Ir£1.5 million (excluding IE's existing 1998 budget of Ir£2 million for training) and the ongoing annual running costs would be of the order of Ir£1 million, plus a major investment in training that could be justified at around Ir£3.4 million for a couple of years, levelling out at around a Ir£2 million annual budget.

There are a number of other management system and procedural weaknesses that need important consideration to achieve system safety improvement, although they are not so essentially linked to the effectiveness of the infrastructure investment on the existing system. They include:

• the lack of integration of safety management objectives with other key business objectives (eg financial and product quality) at the highest levels of CIE and IE decision-making (see Section 8.3.5);

• the need for development of investment planning to achieve safety improvements in line with business needs and the management of operational safety during the infrastructure renewals or until it takes place (see Sections 8.3.4 and 8.3.5);

• the absence of a joint management/trade union commitment to the way in which safety issues are discussed and negotiated and the development of a set of priorities which address the safety concerns of both management and staff (see Section 8.3.7);

• the need for improvement in some specific procedures concerning Safety Committees, safety roles of individuals, safety of contractor activities, management of change and some specific risk evaluations.

To resolve these issues would require around Ir£200,000 in initial costs and a similar sum on a continuing annual basis, although the possible costs from the outcome of any long term investment review or joint management/trade union safety review are impossible to forecast at this stage.

10.2 Department of Public Enterprise

The study has found that the existing roles of the Railway Inspecting Officer are imprecise and often by informal agreement rather than underpinned by legislation and that there is an absence of liaison with the Health & Safety Authority's Inspectorate. The existing Railway Inspector is under-resourced to carry out his existing roles and cannot undertake any proactive work or meet any of the enhanced roles recommended in this study.

The Irish Government is also required to implement the provisions of European Union Directives 91/440, 95/18 and 95/19 (all of which are well beyond the deadlines set by the EU) and it has further been recommended
that the Railway Inspecting Officer should be the Safety Certification Body approving Safety Cases submitted to IE as the Infrastructure Controller.

Key areas in the present situation which need addressing to meet these challenges are:

- the lack of resource and inevitable lack of breadth of skill of the present Railway Inspectorate to encompass the recommended roles;
- the weakness in interpretation of the existing SHW Act and/or the need for new legislation to empower the RIO to fulfil the recommended roles, including New Works approval;
- the separation and lack of liaison between the Railway Inspectorate and the HSA Inspectorate in regard to railway activities;
- how to consider Safety Cases from operators applying for access to the Irish rail network, which have been vetted by IE;
- how to ensure that the Infrastructure Controller is applying robust and relevant scrutiny to applicants’ Safety Cases and that approved Licence Holders are subsequently audited on an appropriate basis to ensure compliance;
- the need to review EU legislation with potential to affect rail safety on a continuing basis.

It is estimated that additional staffing costs of the order of Ir£100,000 annually will be necessary to properly sustain adequate Government regulation of the railways in Ireland.
11. IMPLEMENTATION

In view of the number of recommendations and workload involved in progressing them, it is necessary at this stage to consider specially what steps may be necessary and realistic to implement them.

Clearly the client (the Department) will need initially to discuss the report’s conclusions and recommendations with CIE and IE management and agree which recommendations are accepted and are to be implemented.

The parties concerned (DPE, CIE and IE) will need to allocate responsibility for developing and implementing each agreed recommendation and the timescales to be achieved.

The scale and scope of what is proposed will require IE management to allocate specific resources or project teams to tackle groups of related proposals outside the normal routines of managing the business. These teams will in some cases need external expertise in the form of consultants experienced in the particular specialist areas under review. The teams will need to work closely with managers in appropriate departments (indeed, some such managers will be part time members of the project teams) in order to ensure understanding and ownership of the changes that are to be implemented.

Based on the recommendations identified in this report, the Consultants suggest that a full time Implementation Project Manager will be required to lead the implementation plans, supported by project teams covering the following subject areas:

- Engineering Organisations, Systems, Standards & Documentation
- Safety Culture/ Occupational Safety
- Accident & Equipment Performance Information Systems
- Human Resource Systems & Training
- Management of Contractors & Third Parties.

Other recommendations will need to be carried through by existing general and functional line management, overseen by the Implementation Project Manager.

It is suggested that implementation plans are formulated and agreed between the Department, CIE and IE within three months and that the necessary resources are allocated and freed from other duties to commence work within six months of the report’s acceptance.

An initial audit of the completion of these implementation plans should be established immediately at the end of that six months’ period and a further
audit of progress should be undertaken a year later, ie eighteen months from acceptance of this report.

The scale of costs for the additional resources necessary to implement the recommendations are estimated at around Ir£200,000 per year for project team management and resources and around Ir£100,000 for the two audits after 6 and 18 months.

On the assumption that such an implementation programme is deemed necessary, the recommendations from each section of the report have been brought together under the appropriate timescales and suggested topic areas and are shown in the next chapter of this report.
12. SUMMARY OF RECOMMENDATIONS

Detailed recommendations have been proposed at the end of each chapter of this report. These need to be addressed with different priorities and they will, of necessity, involve varying resources and timescales to achieve their objectives. Action on the proposed recommendations should commence within the timeframe shown below, but the duration of the work before objectives can be achieved will vary - though these should be targeted in the implementation planning process. The timescales suggested start from the date at which the Report is published.

The recommendations are grouped by subject area in accordance with the suggested project themes in Chapter 11 of this report.

12.1 Already Implemented

1. Correction of infrastructure faults needing urgent remedial action discovered during inspection (Sections 6.3.1.3, 6.3.3, 6.4.4, 7.6 and 7.9).

12.2 Immediate (within 3 months of publication)

1. Agreement between DPE, CIE, IE on Action Plans and responsibilities to implement (Chapter 11);

2. Agreement between DPE, CIE, IE on capital and revenue costs necessary to make the railway acceptably safe (Table 7.7, Section 7.9) and to put in place the required underpinning management systems (Section 8.5).

12.3 First 6 Months

1. Repair or renew infrastructure and assets where risks have been established as unreasonable, and/or establish documented safe working practices until the necessary investment can be undertaken (Sections 6.3.3, 6.4.4, 6.5.3, 6.6.3 and 6.7.3);

2. Set up project teams to review and develop key areas of proposals and recommendations (Chapter 11);

3. Strengthen the capabilities of the present sole Inspecting Officer, by recruiting two more Inspectors and one dedicated administrative support person now (see Section 9.2.7).

12.4 At End of 6 Months

12.5  6 - 12 Months

12.5.1 Engineering Systems, Standards & Documentation

1. Review the structure, resources and technical skills available, and their deployment, in all the engineering functions, so that the achievement of robust maintenance standards can support the value of investment and upgrading of infrastructure on an ongoing basis (IE) (see Chapter 6 and Section 8.1);

2. Develop and document engineering standards, planned maintenance and inspection programmes, and equipment testing regimes in all engineering departments (IE) (see Chapter 6 and Section 8.1);

3. 5 year plans should be prepared (with a further 5 year outline estimate) for the infrastructure investment necessary to maintain a safe railway at the lines speeds required for optimum business results to identify strategic options for CIE/Government decision-making, taking recent IE studies and the findings elsewhere in this DPE Railway Safety Study into account (IE) (see Section 8.3.5);

4. Given the current standard of existing infrastructure and the frequency of failures, undertake a risk assessment to identify whether the human factors risks associated with abnormal or degraded operating conditions (both planned and emergency) will be tolerable, until essential investment is implemented (IE) (see Section 8.3.4).

12.5.2 Safety Culture & Occupational Safety

1. Maintain resources available at local station/depot management level for the correction of health and safety hazards, in conjunction with priorities agreed with local supervisors and safety representatives (IE) (see Section 8.3.6);

2. Strengthen the arrangements for giving staff feedback on safety complaints and suggestions to improve confidence of the staff in existing systems (IE) (see Section 8.3.6).

12.5.3 Management of Contractors

1. Review the safety management of contractors’ staff undertaking work on the IE system, clarifying IE and contractor responsibilities and their effective implementation (IE) (see Sections 6.5.1.9 and 8.2.3.8).

12.5.4 Within Normal Organisational Resources

1. Revise the terms of reference of the CIE Safety Committee concerning its authorities and accountability and clarify the route by which CIE decisions with safety implications are discussed with or delegated to IE (CIE) (see Section 8.2.3.1);

2. Extend the provision of Job Descriptions and Safety Responsibility Statements to all safety critical management and supervisory posts and
update these on a stipulated regular basis (IE) (see Sections 8.1 and 8.2.3.3).

12.5.5 Department of Public Enterprise

1. Ensure that a programme of Continuing Professional Development for the RIOs provides the technical knowledge necessary to understand and interpret modern safety assessment and management techniques, with the ability for them to call upon independent advice as and when necessary (see Sections 9.2.7 and 9.2.9);

2. Government should nominate as soon as possible an appropriate body to issue and manage Safety Certificates and Licences to railway undertakings requiring access to the Irish railway network. This should be the DPE (Railway Inspectorate) (see Sections 9.3.2.4 and 9.3.7.1);

3. Railway undertakings wishing for access to the Irish railway network should be required to submit a Safety Case or Plan to the Railway Infrastructure Controller (currently IE) (see Section 9.3.7.1);

4. IE should be required to submit approved Safety Cases or Plans to the DPE for acceptance and issue of Safety Certificates and Licences (see Section 9.3.7.1);

5. Legislation should be prepared which implements the requirement of undertakings applying for access to the IE network to:
   - demonstrate safety of the specific activity and route and its compatibility with IE infrastructure and SMS;
   - be appraised against safety criteria agreed with the DPE for the national railway system;
   - address relevant safety issues concerning competence of personnel and organisation, the company’s SMS, rolling stock, insurance and interface arrangements with the Infrastructure Controller. (see Sections 9.3.4 and 9.3.6);

6. The Infrastructure Controller should be required to audit compliance by the undertaking with its Safety Case or Plan, and the DPE (or appointed Government Authority) should have the powers to enact its own independent check audit, with further powers to revoke an undertaking’s Safety Certificate and Licence (see Section 9.3.8);

7. The Department should check that EC legislation in the pipeline does not impact on the proposals for safety regulation of rail traffic that could access the existing IE network.
12.6  12 - 18 Months

12.6.1  Engineering Systems, Standards & Documentation

1. Implement a formal process (Safety Case or Plan) for the management of change at the appropriate level of detail for all organisational and technical changes of significance - either to the existing system or new works (IE) (see Section 8.2.3.5);

2. Institute a further 15% sample inspection of rolling stock condition and maintenance standards (IE) (see Section 6.7.3);

12.6.2  Safety Culture & Occupational Safety

1. Develop a programme to improve safety culture and supervisory/staff commitment to safety and audit its implementation. (IE) (see Sections 8.3.6 and 8.3.10)

2. Strengthen and consistently maintain a system of briefing all staff at ground level on safety matters on a regular basis by their supervisors/local managers, encouraging two-way communication and the upwards progressing of safety improvement suggestions. (IE) (see Section 8.3.6)

12.6.3  Accident & Equipment Performance Information Systems

1. Develop and install suitable software to maintain a full database of accidents and incidents that can be quickly and easily analysed for CIE and IE senior management, functional management and ground level managers, supervisors and staff, and revise reporting instructions to include “near miss” data (IE) (see Section 8.2.3.1);

2. Develop and install a performance and fault database for all infrastructure and rolling stock equipment (IE) (see Chapter 6);

3. Develop the risk model prepared by the consultants to encompass a wider range of hazards than those arising solely from infrastructure and equipment failures, to include staff error, movement and non-movement accidents and occupational safety concerns (IE) (see Section 7.9).

12.6.4  Human Resource Systems & Training

1. Prepare individually tailored Training Plans for all IE management and supervisory staff, after carrying out a training needs analysis, which will incorporate the safety management and communication skills required, which can be costed and budget provision made (IE) (see Section 8.3.8).

12.6.5  Management of Contractors & Third Parties

1. Implement the recently approved procurement safety policies and performance procedures as necessary criteria in the selection of IE
contractors and suppliers and strengthen the requirements for feedback and audit (CIE/IE) (see Section 8.2.3.9)

2. Develop a performance based procurement process for all engineering equipment (IE) (see Section 6.7.3).

12.6.6 Within Normal Organisational Resources

1. Develop a system for integrating and prioritising safety objectives with other key business objectives, incorporating safety cost benefit analysis (CIE) (see Section 8.3.5);

2. Supplement the regular existing ISRS safety audits with compliance audits against the requirements of the IE SMS issued 2.4.98 and IE operating rules and engineering standards, at all strata of the organisation including ground level (IE) (see Section 8.2.3.4).

12.6.7 Department of Public Enterprise

1. Reconsider the interpretation of the public safety clause in the SHW Act, or draft new legislation such that inspection of public safety issues on railways can be conducted with similar powers to the inspection of employee safety issues (see Section 9.2.3.1);

2. Require railway investment proposals to include a statement of the safety implications (see Section 9.2.2.1);

3. Revise existing railway safety legislation to provide that which is relevant to the late 20th century and beyond (see Sections 9.2.2.1/2/3);

4. Within such revised legislation, address the scope of New Works safety assessment, including rolling stock, ensuring also that the duties and responsibilities on the railway remain entirely clear. In particular, the legislation should require IE to submit a formal safety justification for any significant amendments or additions to the network for RIO approval (see Section 9.2.2.1);

5. Revise railway accident and dangerous occurrence reporting legislation to ensure common standards between railway and other industries (see Section 9.2.2.3);

6. The Department should allocate the necessary funds to achieve the necessary revision of railway safety legislation, including the provision of the railway licensing procedure, demanded by EU Directives (see Section 9.3).
12.7 Long Term (within 1 - 2 years)

12.7.1 Engineering Systems, Standards & Documentation

1. Institute an ISO9000 Quality Assurance regime for all systems and procedures that impact on safety in all engineering functions (IE) (see Chapter 6 and Section 8.1).

12.7.2 Safety Culture & Occupational Safety

1. Establish regular research into staff morale, and underlying reasons for trends and changes, in respect of activities and grades of staff that impact on safety (IE) (see Sections 8.3.7 and 8.3.10).

12.7.3 Human Resource Systems & Training

1. Develop and introduce a Performance Appraisal Process for all senior and middle managers, incorporating safety performance against targets where relevant, and develop a simplified appraisal system against safety objectives for other managers and supervisors in safety critical posts (CIE/IE) (see Sections 8.2.3.3 and 8.3.8).

12.7.4 Special Joint Project Team

1. The pay and productivity structure, hours of duty and conditions of service, for staff grades that are safety critical, and outstanding issues between the Trade Unions and management on safety discipline and techniques to ensure public and staff safety, should be reviewed with a view to joint action that will benefit both and lead towards a common and agreed approach on safety issues (CIE/IE/Trade Unions, facilitated by Government) (see Section 8.3.7).

12.7.5 Within Normal Organisational Resources

1. Strategic safety objectives should be set for IE in conjunction with the CIE and IE Boards, with awareness of the financial and service consequences (DPE) (see Section 8.2.3.1).

12.7.6 Department of Public Enterprise

1. Make one Railway Inspectorate within the Department responsible for monitoring all railway safety issues, including those concerning employees as well as passengers and other public (see Section 9.2.5.4);

2. Prepare a new mandate for the Railway Inspectorate from which its optimal size, structure and position within the Department can be decided (Ultimately this will be dependent on new legislation, but there will be natural phases en-route) (see Sections 9.2.7 and 9.2.8).
12.8 After 18 months

1. External audit of progress.

12.9 Ongoing

1. The Department to ensure sufficient resources remain in place to monitor satisfactory continuation or, where appropriate, “closing-off” procedures for longer-term actions.
13. REFERENCES

2. EU Directive 95/18/EC, dated 19 June 1995
3. EU Directive 95/19/EC, dated 19 June 1995
11. Regulation of Railways Act 1871, HMSO UK.
Appendix I

The Remit
Appendix II

The ALARP Principle
The ALARP principle is the fundamental basis of all UK Health and Safety legislation, including that applicable to railway operations.

This principle states that there are generally three levels of risk to be determined in any risk assessment process. These risk levels are represented in Figure 1:

![ALARP Triangle Diagram](image)

**Figure 1: ALARP Triangle**

The legal principle in the UK is that all industrial risks should be reduced to levels which are 'As Low As Reasonably Practicable'. The ALARP principle allows cost to be taken into account, with the English case law definition to interpret the meaning of ‘reasonably practicable’ as used in the Health and Safety at Work Act 1974.

If a risk lies in the Broadly Acceptable region then there is no requirement to reduce the risk further, as the risk is already so low that strenuous efforts to reduce it could not be justified. If however the risk lies in the Intolerable region, risk reduction measures must be taken, regardless of the cost and complexity, in order to reduce the risk as far as is practicable towards the Broadly Acceptable region. If the level of risk cannot be reduced below the Intolerable limit, then the activity should cease.
The area between the upper and lower limits is called the ALARP region. If the risk lies within these two extremes, then cost/benefit calculations should be conducted to determine the cost effectiveness of options for further risk reduction. If these analyses show that the benefit of a particular risk reduction measure outweighs the cost of its implementation, then it must be undertaken. If on the other hand, the cost of its implementation is grossly disproportionate to the benefit gained, then there is no requirement to proceed with the risk reduction measure, or alternative lower cost risk reduction measures should be sought.
Appendix III

Definition of Injury Levels
Different organisations have varying definitions for the relative seriousness of injuries/casualties. It is important that the extent of these casualties are appreciated when assimilating and analysing data. Varying definitions are listed below from the IE incident reporting system, the Irish National Roads Authority and the UK RIDDOR (Reporting of Injuries, Diseases and Dangerous Occurrences) Regulations 1995.

1. **IE Definitions**

   **Superficial** Requires first aid treatment only, but does not prevent a person from going about their normal business.

   **Minor** Is not severe or major, yet requires medical attention, or (in the case of an employee or contractors employee), causes the injured person to be absent for at least one whole day from his ordinary work.

   **Major (severe)** Fracture of major bone (skull, spine, pelvis, arm, leg, wrist or ankle), but not a bone in the hand or foot; or any amputation of any bone of hand or foot; or internal bleeding; or loss of sight, penetrating or burn injury to an eye; or electric shock or burn requiring medical treatment; or loss of consciousness due to electricity, lack of oxygen, concussion or poisoning; or immediate admission to hospital and detention for more than 24 hours; or paralysis or permanent disability; or occupational illness or disorder.

2. **NRA Definitions**

   **Minor injury** Where there are no deaths or serious injuries. The definition of a minor injury is an injury of a minor character such as a sprain or bruise.

   **Serious injury** Where there are no deaths, but a person or persons are seriously injured. The definition of a serious injury is an injury for which the person is detained in hospital as an ‘in-patient’, or any of the following injuries whether or not detained in hospital: fractures, concussion, internal injuries, crushings, severe cuts and lacerations, severe general shock requiring medical treatment.

   **Fatal accident** Where at least one person is killed as a result of the accident and death occurs within 30 days.
3. **RIDDOR Definitions**

Incapacity for work  If a person is incapacitated, or is unable to perform the full range of their normal duties, for more than three days, then these injuries must be reported.

Major injury  All fractures of bones, including bones in the hand or foot but excluding fingers or toes; Dislocations of major joints, i.e. knee, spine, shoulder and hip; Temporary loss of sight; Loss of consciousness for whatever cause and for however short a period.

Death  The death of any person, whether or not they are at work, must be reported if it results from an accident arising out of or in conjunction with work. Death from natural causes is not reportable unless it can be shown that there is a good reason to suppose that the death arose out of or in connection with work.
Appendix IV

CIE/IE Organisation Chart
Appendix VI

Glossary
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Parties</td>
<td>Party outwith any contract with the railway</td>
</tr>
<tr>
<td>AHB</td>
<td>Automatic Half Barrier (Level Crossing)</td>
</tr>
<tr>
<td>ALARP</td>
<td>As Low As Reasonably Practicable</td>
</tr>
<tr>
<td>Arrow DMU</td>
<td>Arrow Diesel Multiple Unit</td>
</tr>
<tr>
<td>ATP</td>
<td>Automatic Train Protection</td>
</tr>
<tr>
<td>Bells Crossing</td>
<td>A type of level crossing utilised by IE</td>
</tr>
<tr>
<td>Broadly Acceptable Risk</td>
<td>A level of risk below which further risk reduction is unlikely to be cost effective</td>
</tr>
<tr>
<td>Building Executive</td>
<td>Buildings Maintenance Executive (who also look after the infrastructure for the Bus Company)</td>
</tr>
<tr>
<td>Bull Head Track</td>
<td>An obsolete rail section that has a head and foot of similar shape</td>
</tr>
<tr>
<td>CCTV</td>
<td>Closed Circuit Television</td>
</tr>
<tr>
<td>CENELEC</td>
<td>European Electrical Standards Committee</td>
</tr>
<tr>
<td>Cess</td>
<td>The space alongside the railway line</td>
</tr>
<tr>
<td>Chair</td>
<td>A cast or fabricated support for bullhead rail</td>
</tr>
<tr>
<td>Change Request</td>
<td>A documentary method of seeking a change to a procedure</td>
</tr>
<tr>
<td>Choked (ballast)</td>
<td>Insufficient drainage of ballast</td>
</tr>
<tr>
<td>CIE</td>
<td>Córas Iompar Éireann</td>
</tr>
<tr>
<td>Configuration Control</td>
<td>Structured method for undertaking engineering changes</td>
</tr>
<tr>
<td>Controlled (Document)</td>
<td>Document issued under strictly</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>controlled conditions</td>
<td></td>
</tr>
<tr>
<td>Copes</td>
<td>Capping to edge of platform</td>
</tr>
<tr>
<td>Coping</td>
<td>As above</td>
</tr>
<tr>
<td>Cross Functional</td>
<td>Items that cover more than one engineering discipline</td>
</tr>
<tr>
<td>CTC</td>
<td>Centralised Train Control</td>
</tr>
<tr>
<td>CWR</td>
<td>Continuously Welded Rail</td>
</tr>
<tr>
<td>Depot Isolation</td>
<td>Local OLE Isolation Procedure Practised in Depot</td>
</tr>
<tr>
<td>ECR</td>
<td>Electrical Control Room</td>
</tr>
<tr>
<td>ETS</td>
<td>Electric Train Staff</td>
</tr>
<tr>
<td>Engineering Possession</td>
<td>The complete stoppage of trains on a particular line to enable engineering</td>
</tr>
<tr>
<td></td>
<td>works to proceed safely.</td>
</tr>
<tr>
<td>Equivalent Fatality</td>
<td>A method of combining deaths and injuries into a single measure</td>
</tr>
<tr>
<td>Facing Point</td>
<td>Points where the routes diverge</td>
</tr>
<tr>
<td>Facing Point Lock</td>
<td>Equipment that physically locks points so that they cannot move</td>
</tr>
<tr>
<td>Fangbolt</td>
<td>A through bolt for chairs and timber sleepers that has a spiked washer plate fitted under the bolthead to prevent rotation of the nut</td>
</tr>
<tr>
<td>Fishplate</td>
<td>A plate used to connect together two rails at a rail joint</td>
</tr>
<tr>
<td>Fishbolt</td>
<td>Bolts used to secure fishplates at a rail joint</td>
</tr>
<tr>
<td>Flat Bottom</td>
<td>A rail section in which the foot of the rail has a flat base</td>
</tr>
<tr>
<td>FRA</td>
<td>US Federal Railroad Authority</td>
</tr>
<tr>
<td>Gauge Retention</td>
<td>Maintenance of the designed track gauge between the gauge faces of the</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>running rails</td>
<td></td>
</tr>
<tr>
<td>GLA</td>
<td>Ground Level Audit</td>
</tr>
<tr>
<td>IE</td>
<td>Iarnród Éireann</td>
</tr>
<tr>
<td>Infrastructure Controller</td>
<td>The organisation that has control of the railway track, signalling system &amp; associated infrastructure</td>
</tr>
<tr>
<td>Insulated Joint (track)</td>
<td>A joint between two rails, separated by an electrical insulator</td>
</tr>
<tr>
<td>Interlocking</td>
<td>Equipment which prevents unsafe conditions arising with the movement, setting and releasing of signals &amp; points</td>
</tr>
<tr>
<td>Intolerable Risk</td>
<td>A risk which must be reduced irrespective of cost</td>
</tr>
<tr>
<td>Iron Gate Crossing</td>
<td>A type of level crossing utilised by IE</td>
</tr>
<tr>
<td>ISO 9000</td>
<td>A formal Quality Management System conforming to the requirements of the International Standards Organisation</td>
</tr>
<tr>
<td>Pumping</td>
<td>The forcing of materials upwards through track ballast caused by the vertical movement of track supports</td>
</tr>
<tr>
<td>Local Isolation</td>
<td>A locally controlled &amp; managed isolation</td>
</tr>
<tr>
<td>Locking bar</td>
<td>A mechanical device used to detect the presence of a train on a section of the railway</td>
</tr>
<tr>
<td>Lower Quadrant Signalling</td>
<td>A type of signalling whereby a proceed signal is indicated by a mechanical arm pivoting downwards</td>
</tr>
<tr>
<td>MA</td>
<td>Management Audit</td>
</tr>
<tr>
<td>Multiple Aspect Signalling</td>
<td>A system of signalling using colour light signals and track circuits</td>
</tr>
<tr>
<td>Outside Parties</td>
<td>Parties working on or near the</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>railway who are not employed by the railway</td>
<td>A section of line beyond the stop signal which must be unoccupied before a signalled move can take place towards the signal.</td>
</tr>
<tr>
<td>OLE</td>
<td>(Electrical) Overhead Line Equipment</td>
</tr>
<tr>
<td>Overlap (signalling)</td>
<td>An overlapping of the ends of 2 lengths of OLE</td>
</tr>
<tr>
<td>Overlap (Electrical) Overhead Line Equipment</td>
<td>All the materials (including rails, sleepers and ballast) that make up the guidance and support system for rail vehicles.</td>
</tr>
<tr>
<td>Permanent Way</td>
<td>Permanent Way Inspector</td>
</tr>
<tr>
<td>PWI</td>
<td>Quantified Risk Assessment</td>
</tr>
<tr>
<td>QRA</td>
<td>Reliability Availability, Maintainability and Safety</td>
</tr>
<tr>
<td>Rail Clamp Point Lock</td>
<td>A point operating mechanism that locks the points by clamping the switch rail to the stock rail</td>
</tr>
<tr>
<td>RAMS</td>
<td>Redundancy (in Engineering section)</td>
</tr>
<tr>
<td>RAMS</td>
<td>The provision of duplicate equipment to perform a task, to ensure reliability and safety</td>
</tr>
<tr>
<td>Relay</td>
<td>An electro-mechanical switching device</td>
</tr>
<tr>
<td>RIO</td>
<td>Railway Inspecting Officer</td>
</tr>
<tr>
<td>Safety Critical Failure</td>
<td>See Wrongside Failure</td>
</tr>
<tr>
<td>Safety Responsibility Statements (SRS)</td>
<td>Statements of delegated safety responsibilities for an individual post</td>
</tr>
<tr>
<td>SAP</td>
<td>Senior Authorised Person (for switching, earthing &amp; permit to work issuing &amp; cancellation).</td>
</tr>
<tr>
<td>Scour</td>
<td>Wash out of supporting material from underneath foundations.</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SCADA</td>
<td>Supervisory, Control &amp; Data Acquisition (System)</td>
</tr>
<tr>
<td>Semaphore Signalling</td>
<td>A system of signalling using mechanical operation and control of signals and points</td>
</tr>
<tr>
<td>SET</td>
<td>Signalling, Electrical and Telecommunications</td>
</tr>
<tr>
<td>SHWA</td>
<td>Safety Health and Welfare Act</td>
</tr>
<tr>
<td>Slab track</td>
<td>Track where ballast has been replaced with concrete</td>
</tr>
<tr>
<td>Voiding</td>
<td>The creation of a space below a sleeper due to the displacement of the supporting ballast</td>
</tr>
<tr>
<td>SMS</td>
<td>Safety Management System</td>
</tr>
<tr>
<td>Sole plates</td>
<td>A metal plate placed on the upper surface of the sleeper at a set of points to provide additional gauge retention</td>
</tr>
<tr>
<td>SPAD</td>
<td>Signal Passed at Danger</td>
</tr>
<tr>
<td>Split Pins</td>
<td>A device used to secure a mechanical joint</td>
</tr>
<tr>
<td>Squats</td>
<td>A rolling contact fatigue defect resulting from the action of the wheel on the rail</td>
</tr>
<tr>
<td>Tamping</td>
<td>Using a machine to force ballast under the sleepers of a track</td>
</tr>
<tr>
<td>TE</td>
<td>Telecom Eireann</td>
</tr>
<tr>
<td>Track Geometry</td>
<td>The top and alignment of the track</td>
</tr>
<tr>
<td>VPF</td>
<td>Value for Preventing Fatality</td>
</tr>
<tr>
<td>White Gate Crossing</td>
<td>A type of crossing utilised by IE</td>
</tr>
<tr>
<td>Wrong Side Failure</td>
<td>A failure which results in the protection normally provided by the</td>
</tr>
</tbody>
</table>
signalling system being reduced
Appendix VII
Risk Assessment Section Information
<table>
<thead>
<tr>
<th>Route</th>
<th>Sub-Section</th>
</tr>
</thead>
</table>
| 1 Dublin to Rosslare Europort | 1 Dublin Pearse - Dun Laoghaire  
2 Dun Laoghaire - Bray  
3 Bray - Greystones - Kilcock - Wicklow - Rathdrum - Shelton Abbey - Arklow  
4 Arklow - Gorey - Enniscorthy - Wexford  
5 Wexford - Rosslare Strand  
6 Rosslare Strand - Rosslare Europort |
| 2 Cherryville Jcn. to Waterford | 7 Cherryville Jcn. - Athy - Carlow - Muine Bheag - Kilkenny  
8 Kilkenny - Thomastown - Waterford |
| 3 Dublin to Cobh     | 9 Heuston - Hazelhatch - Sallins - Newbridge - Kildare - Cherryville Jcn  
10 Cherryville Jcn. - Portarlington  
11 Portarlington - Portlaoise - Ballybrophy  
12 Ballybrophy - Lisduff - Templemore - Thurles - Limerick Jcn.  
13 Limerick Jcn. - Charleville - Mallow  
14 Mallow - Rathpeacon - Cork  
15 Cork - Cobh |
<p>| 4 Mallow to Tralee   | 16 Mallow - Banteer - Millstreet - Rathmore - Killarney - Farranfore - Tralee |</p>
<table>
<thead>
<tr>
<th><strong>Route</strong></th>
<th><strong>Sub-Section</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Limerick Jcn. to Ennis</td>
<td>17 Limerick Jcn. - Dronkeen - Killonan</td>
</tr>
<tr>
<td></td>
<td>18 Killonan - Limerick</td>
</tr>
<tr>
<td></td>
<td>19 Limerick - Ennis</td>
</tr>
<tr>
<td>6 Ballybrophy to Killonan</td>
<td>20 Ballybrophy - Roscrea - Cloughjordan - Nenagh</td>
</tr>
<tr>
<td></td>
<td>21 Nenagh - Birdhill - Castleconnell - Killonan</td>
</tr>
<tr>
<td>7 Portarlington to Galway</td>
<td>22 Portarlington - Geashill - Tullamore - Clara - Clonrydonna - Athlone</td>
</tr>
<tr>
<td></td>
<td>23 Athlone - Ballinasloe - Woodlawn - Attymon - Athenry</td>
</tr>
<tr>
<td></td>
<td>24 Athenry - Galway</td>
</tr>
<tr>
<td>8 Athlone to Westport</td>
<td>25 Athlone - Knockcrochery - Roscommon - Castlerea - Ballyhaunis - Claremorris</td>
</tr>
<tr>
<td></td>
<td>26 Claremorris - Manulla Jcn</td>
</tr>
<tr>
<td></td>
<td>27 Manulla Jcn. - Castlebar - Westport</td>
</tr>
<tr>
<td>9 Manulla Jcn. to Ballina</td>
<td>28 Manulla Jcn. - Foxford - Ballina</td>
</tr>
<tr>
<td>10 Dublin to Sligo</td>
<td>29 Connolly - Clonsilla - Maynooth - Enfield - Killucan - Mullingar</td>
</tr>
<tr>
<td></td>
<td>30 Mullingar - Edgeworthstown - Longford - Dromod - Carrick on Shannon</td>
</tr>
<tr>
<td></td>
<td>31 Carrick on Shannon - Boyle - Ballymote - Collooney - Sligo</td>
</tr>
</tbody>
</table>

**Table 1: Network Section Information (cont'd)**
<table>
<thead>
<tr>
<th>Route</th>
<th>Sub-Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Dublin to Northern Ireland</td>
<td>32 Connolly - Howth Jcn.</td>
</tr>
<tr>
<td></td>
<td>33 Howth Jcn - Howth</td>
</tr>
<tr>
<td></td>
<td>35 Drogheda - Dunleer - Dundalk</td>
</tr>
<tr>
<td>12 Limerick Junction to Rosslare Europort</td>
<td>36 Limerick Junction - Tipperary - Cahir - Clonmel - Carrick on Suir - Waterford</td>
</tr>
<tr>
<td></td>
<td>37 Waterford - Belview - Campile - Ballycullane - Wellington Bridge - Bridgetown - Rosslare Strand - Rosslare Europort</td>
</tr>
</tbody>
</table>

Table 1: Network Section Information (cont'd)
Appendix VIII

Safety Inadequacy Scores
Safety Inadequacy

The safety inadequacy rating is based upon the scores assigned as part of the infrastructure site surveys. It is a measure of the safety score assigned as a percentage of the maximum score possible.

A score of 0% (safe) is considered to be the ideal or the target, whereas 5% is considered to be ‘best practice’. A score in excess of this indicates a decrease in safety below that of ‘best practice’.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Safety Inadequacy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swing Bridge</td>
<td>65</td>
</tr>
<tr>
<td>Interlocking - Mechanical (Heuston and Claremorris)</td>
<td>51</td>
</tr>
<tr>
<td>Level Crossings - Iron Gates</td>
<td>49</td>
</tr>
<tr>
<td>Interlocking - Mechanical (general)</td>
<td>49</td>
</tr>
<tr>
<td>Power Supplies</td>
<td>46</td>
</tr>
<tr>
<td>Interlocking - Relay</td>
<td>44</td>
</tr>
<tr>
<td>Signals - mechanical (general)</td>
<td>43</td>
</tr>
<tr>
<td>Interlocking - Mechanical (Limerick South)</td>
<td>42</td>
</tr>
<tr>
<td>Interlocking - Block instruments</td>
<td>40</td>
</tr>
<tr>
<td>Level Crossings - White Gates</td>
<td>35</td>
</tr>
<tr>
<td>Signalling Operating Floor</td>
<td>35</td>
</tr>
<tr>
<td>Signals - mechanical (Boyle)</td>
<td>34</td>
</tr>
<tr>
<td>Signalling Control Panel</td>
<td>33</td>
</tr>
<tr>
<td>Interlocking - Electronic (Drogheda and Waterford)</td>
<td>32</td>
</tr>
<tr>
<td>Interlocking - Mechanical (Sligo signal box)</td>
<td>32</td>
</tr>
<tr>
<td>Cab radio</td>
<td>32</td>
</tr>
<tr>
<td>Track Circuits - d.c.</td>
<td>31</td>
</tr>
<tr>
<td>Signals - electrical</td>
<td>31</td>
</tr>
<tr>
<td>Points - Clamp Locks</td>
<td>29</td>
</tr>
<tr>
<td>Level Crossings - Lights &amp; Bells (Wexford)</td>
<td>29</td>
</tr>
<tr>
<td>Operational Telecommunications</td>
<td>29</td>
</tr>
<tr>
<td>Points - Mechanical (Sligo)</td>
<td>29</td>
</tr>
<tr>
<td>Level Crossings - AHB</td>
<td>25</td>
</tr>
<tr>
<td>Points - Mechanical (general)</td>
<td>25</td>
</tr>
<tr>
<td>Level Crossings - Lights &amp; Bells (Frenchfort)</td>
<td>24</td>
</tr>
<tr>
<td>Track Circuits - Coded</td>
<td>23</td>
</tr>
<tr>
<td>Level Crossings - CCTV</td>
<td>23</td>
</tr>
<tr>
<td>Points - Electrical</td>
<td>19</td>
</tr>
<tr>
<td>Points - Electro-pneumatic</td>
<td>18</td>
</tr>
<tr>
<td>Cab signalling</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 1: Signalling Safety Inadequacy Scores
<table>
<thead>
<tr>
<th>Location or route section</th>
<th>Safety Inadequacy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porterstown Level Crossing</td>
<td>80</td>
</tr>
<tr>
<td>Porterstown Level Crossing to Clonsilla</td>
<td>80</td>
</tr>
<tr>
<td>Clonsilla (level crossing)</td>
<td>80</td>
</tr>
<tr>
<td>Clonsilla (general PW)</td>
<td>80</td>
</tr>
<tr>
<td>Longford to Mullingar (Lake planned patching site)</td>
<td>80</td>
</tr>
<tr>
<td>Culleen Level Crossing</td>
<td>80</td>
</tr>
<tr>
<td>Claremorris Permanent Way Section</td>
<td>80</td>
</tr>
<tr>
<td>Castlerea to Claremorris (planned patching item)</td>
<td>80</td>
</tr>
<tr>
<td>Liffey Bridge Junction (Freight / Passenger) (Liffey Bridge)</td>
<td>80</td>
</tr>
<tr>
<td>Liffey Bridge Junction (Freight / Passenger) (Switches &amp; crossings)</td>
<td>80</td>
</tr>
<tr>
<td>Longford (collapsed joint)</td>
<td>75</td>
</tr>
<tr>
<td>Claremorris (54 points)</td>
<td>75</td>
</tr>
<tr>
<td>Drogheda – Navan - Tara Mines</td>
<td>75</td>
</tr>
<tr>
<td>Kildare</td>
<td>60</td>
</tr>
<tr>
<td>Limerick Junction</td>
<td>60</td>
</tr>
<tr>
<td>Leixlip Louisa Bridge to Blakestown Level Crossing</td>
<td>60</td>
</tr>
<tr>
<td>Maynooth</td>
<td>60</td>
</tr>
<tr>
<td>Fenzs Lock Level Crossing</td>
<td>60</td>
</tr>
<tr>
<td>Athlone (old) Station</td>
<td>60</td>
</tr>
<tr>
<td>Knockcroghery</td>
<td>60</td>
</tr>
<tr>
<td>River Suck Bridge, Castlerea</td>
<td>60</td>
</tr>
<tr>
<td>Sligo yard (passenger and freight)</td>
<td>60</td>
</tr>
<tr>
<td>Sligo yard (freight only)</td>
<td>60</td>
</tr>
<tr>
<td>Boyle station</td>
<td>60</td>
</tr>
<tr>
<td>Carrick on Shannon</td>
<td>60</td>
</tr>
<tr>
<td>Dromond</td>
<td>60</td>
</tr>
<tr>
<td>Church Road Junction to East Wall Junction (ultrasonic defects)</td>
<td>60</td>
</tr>
<tr>
<td>Church Road Junction to East Wall Junction (open underbridge)</td>
<td>60</td>
</tr>
<tr>
<td>Church Road Junction to East Wall Junction (unballasted timbers)</td>
<td>60</td>
</tr>
<tr>
<td>Church Road Junction to East Wall Junction (Switches &amp; Crossings)</td>
<td>50</td>
</tr>
<tr>
<td>Glaisnevin Junction to Islandbridge Junction (Freight / Passenger) (route)</td>
<td>50</td>
</tr>
<tr>
<td>Longford (broken rail)</td>
<td>45</td>
</tr>
<tr>
<td>Church Road Junction to East Wall Junction (sleeper condition)</td>
<td>45</td>
</tr>
<tr>
<td>Church Road Junction to East Wall Junction (Missing fishbolts)</td>
<td>45</td>
</tr>
<tr>
<td>Longford to Mullingar (bog formation)</td>
<td>40</td>
</tr>
<tr>
<td>Sligo (station)</td>
<td>40</td>
</tr>
<tr>
<td>Islandbridge Junction (check rail wear to sidings)</td>
<td>40</td>
</tr>
<tr>
<td>Woodfield Level Crossing</td>
<td>40</td>
</tr>
<tr>
<td>East Wall Yard (general)</td>
<td>40</td>
</tr>
<tr>
<td>East Wall Yard (sidewear)</td>
<td>40</td>
</tr>
<tr>
<td>Islandbridge Junction (Passenger) (Check rail wear to sidings)</td>
<td>40</td>
</tr>
<tr>
<td>Drogheda to Northern Ireland border via Dundalk (Dromiskin LC)</td>
<td>30</td>
</tr>
<tr>
<td>Sallins</td>
<td>30</td>
</tr>
<tr>
<td>Lisduff (North) (defective Vossloh sleepers)</td>
<td>30</td>
</tr>
<tr>
<td>*Claremorris (double junction with line to Athenry)</td>
<td>30</td>
</tr>
<tr>
<td>Islandbridge Junction (main lines)</td>
<td>30</td>
</tr>
</tbody>
</table>

Report No: 2045.10
Issue No: 01
Date: October 1998
### Table 2: Permanent Way Safety Inadequacy Scores

<table>
<thead>
<tr>
<th>Location</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Church Road Junction to East Wall Junction (East Wall Junction)</td>
<td>30</td>
</tr>
<tr>
<td>Islandbridge Junction (Passenger) (Main lines)</td>
<td>30</td>
</tr>
<tr>
<td>Lisduff (North) (Switches &amp; Crossings</td>
<td>20</td>
</tr>
<tr>
<td>Near to Stonepark Level Crossing</td>
<td>20</td>
</tr>
<tr>
<td>Shannon Bridge</td>
<td>20</td>
</tr>
<tr>
<td>Drogheda to Northern Ireland border via Dundalk (ballast provision)</td>
<td>10</td>
</tr>
<tr>
<td>Dundalk</td>
<td>10</td>
</tr>
<tr>
<td>Grange Level Crossing (AHB)</td>
<td>0</td>
</tr>
</tbody>
</table>
### Table 3: Rolling Stock Safety Inadequacy Score

<table>
<thead>
<tr>
<th>Rolling Stock Hazard</th>
<th>Safety Inadequacy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive Noise levels</td>
<td>63%</td>
</tr>
<tr>
<td>Loss of Visibility</td>
<td>40%</td>
</tr>
<tr>
<td>Loss of Communication</td>
<td>40%</td>
</tr>
<tr>
<td>Slipping</td>
<td>40%</td>
</tr>
<tr>
<td>Falling</td>
<td>40%</td>
</tr>
<tr>
<td>Collision</td>
<td>23%</td>
</tr>
<tr>
<td>Derailment</td>
<td>23%</td>
</tr>
<tr>
<td>Door Incidents</td>
<td>23%</td>
</tr>
<tr>
<td>Internal Loose Objects</td>
<td>23%</td>
</tr>
<tr>
<td>Electrocution</td>
<td>23%</td>
</tr>
<tr>
<td>Burns</td>
<td>23%</td>
</tr>
<tr>
<td>Fire</td>
<td>10%</td>
</tr>
<tr>
<td>Explosion</td>
<td>10%</td>
</tr>
<tr>
<td>Unable to evacuate</td>
<td>10%</td>
</tr>
<tr>
<td>Asphyxiation</td>
<td>10%</td>
</tr>
<tr>
<td>Toxic Fumes</td>
<td>10%</td>
</tr>
<tr>
<td>External Flying Objects</td>
<td>10%</td>
</tr>
<tr>
<td>Passenger Ejection</td>
<td>10%</td>
</tr>
</tbody>
</table>
### Table 4: Electrification Safety Inadequacy Scores

<table>
<thead>
<tr>
<th>Safety Issue</th>
<th>Safety Inadequacy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New OLE maintenance/repair access equipment and plant</td>
<td>60</td>
</tr>
<tr>
<td>Familiarise staff with new electrification equipment on Graystones and Malahide DART extension</td>
<td>38</td>
</tr>
<tr>
<td>Prove voltage testing devices before and after each verification</td>
<td>30</td>
</tr>
<tr>
<td>Log in and out of substations with Control</td>
<td>20</td>
</tr>
<tr>
<td>Prove OLE sections dead before earthing</td>
<td>20</td>
</tr>
<tr>
<td>Use ‘caution notices’ at locked-off points of isolation</td>
<td>20</td>
</tr>
<tr>
<td>Provide delineation of safe working limits at Depot centre walkway for half-road isolations</td>
<td>20</td>
</tr>
<tr>
<td>Use multiple padlocking facility on Depot OLE lock-off boxes</td>
<td>15</td>
</tr>
<tr>
<td>Provide and use ‘open door key release’ interlock key on Depot high-level access gantry</td>
<td>15</td>
</tr>
<tr>
<td>Add ‘limits of isolation’ graphics to DART signalling mimics</td>
<td>8</td>
</tr>
<tr>
<td>Location</td>
<td>Element</td>
</tr>
<tr>
<td>----------</td>
<td>---------</td>
</tr>
<tr>
<td>Dublin - Belfast main line. Between Killiney and Dalkey (9 M.P.)</td>
<td>Cutting slopes</td>
</tr>
<tr>
<td>Malahide Viaduct North End</td>
<td>Embankments Causeway across bay – 3m high</td>
</tr>
<tr>
<td>North of Malahide Viaduct</td>
<td>Embankments West (Down) Side</td>
</tr>
<tr>
<td>Dublin - Belfast main line, North of Booterstown</td>
<td>Sea defences</td>
</tr>
<tr>
<td>Dublin - Belfast Main line O/ B 97</td>
<td>Footbridges</td>
</tr>
<tr>
<td>Dublin – Rosslare main line. 4.5 – 5.5 M.P. North of Rosslare Strand.</td>
<td>Formation</td>
</tr>
<tr>
<td>Dublin - Belfast main line. O/ B 99, Sth of Sandy Cove and Glasthule station</td>
<td>Overbridges</td>
</tr>
<tr>
<td>Dublin Connolly</td>
<td>Platforms</td>
</tr>
<tr>
<td>Dublin Connolly</td>
<td>Platforms</td>
</tr>
<tr>
<td>Dublin - Rosslare main line. Wicklow station</td>
<td>Platforms</td>
</tr>
<tr>
<td>Dublin – Rosslare Main Line. 91.5MP</td>
<td>Tunnels</td>
</tr>
<tr>
<td>Between Dublin Connolly and Heuston</td>
<td>Cutting slopes</td>
</tr>
<tr>
<td>Dublin - Belfast Line, Up side (East), North of Malahide Viaduct</td>
<td>Embankments</td>
</tr>
<tr>
<td>Dublin - Belfast main line.</td>
<td>Formation</td>
</tr>
<tr>
<td>Dublin - Belfast main line, between Booterstown and Seapoint</td>
<td>Formation</td>
</tr>
<tr>
<td>Dublin - Belfast main line O/ B 98 at over disused branch.</td>
<td>Over bridge</td>
</tr>
<tr>
<td>Between Rosslare and Rosslare Europort. Overbridge no. 223</td>
<td>Over bridges</td>
</tr>
<tr>
<td>White Rock between Kiliney and Dalkey</td>
<td>Sea Defences</td>
</tr>
<tr>
<td>Between Greystones and Bray Tunnel No.1 Dublin end</td>
<td>Sea defences</td>
</tr>
<tr>
<td>Malahide</td>
<td>Viaducts - Over Water</td>
</tr>
<tr>
<td>Dublin – Rosslare Main Line 89M P</td>
<td>Embankments</td>
</tr>
<tr>
<td>Dublin Connolly Control centre Ground floor</td>
<td>Offices (staff)</td>
</tr>
<tr>
<td>Dublin – Rosslare main line Gorey Station 59.5 M P</td>
<td>Public access areas (General)</td>
</tr>
<tr>
<td>Bray Station</td>
<td>Footbridge- North End</td>
</tr>
<tr>
<td>Dublin - Rosslare Main Line Arklow Station 49MP.</td>
<td>Footbridges</td>
</tr>
<tr>
<td>Dublin Rosslare main line Enniscarthy Station Up platform</td>
<td>Platforms</td>
</tr>
<tr>
<td>Dublin To Rosslare main line Rosslare Strand</td>
<td>Platforms</td>
</tr>
<tr>
<td>Dublin To Rosslare main line Rosslare Strand</td>
<td>Platforms</td>
</tr>
<tr>
<td>Malahide Station</td>
<td>Platforms No. 1 (Upside)</td>
</tr>
<tr>
<td>Location Description</td>
<td>Inadequacy Score</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Malahide Station</td>
<td>30</td>
</tr>
<tr>
<td>Platforms No. 2 (Downside)</td>
<td>30</td>
</tr>
<tr>
<td>Dublin- Rosslare Main line</td>
<td>30</td>
</tr>
<tr>
<td>Enniscorthy Station</td>
<td>30</td>
</tr>
<tr>
<td>Public access areas (General)</td>
<td>30</td>
</tr>
<tr>
<td>Dublin To Rosslare main line</td>
<td>30</td>
</tr>
<tr>
<td>Rosslare Strand</td>
<td>30</td>
</tr>
<tr>
<td>Public access areas (General)</td>
<td>30</td>
</tr>
<tr>
<td>Dublin – Rosslare main line. Rosslare Strand</td>
<td>30</td>
</tr>
<tr>
<td>Signal Box</td>
<td>30</td>
</tr>
<tr>
<td>Dublin – Rosslare Main Line 77.75 MP Tunnels</td>
<td>30</td>
</tr>
<tr>
<td>Dublin Connolly DART entrance</td>
<td>30</td>
</tr>
<tr>
<td>Underpasses</td>
<td>30</td>
</tr>
<tr>
<td>Dublin – Rosslare Main line. Enniscorthy Viaduct.</td>
<td>30</td>
</tr>
<tr>
<td>Viaducts</td>
<td>30</td>
</tr>
<tr>
<td>Dublin : Barrow St.</td>
<td>30</td>
</tr>
<tr>
<td>Workshops</td>
<td>30</td>
</tr>
<tr>
<td>Dublin - Rosslaire main line. Wicklow station</td>
<td>29</td>
</tr>
<tr>
<td>Footbridge</td>
<td>27</td>
</tr>
<tr>
<td>Dublin To Rosslare Rossllare Strand</td>
<td>27</td>
</tr>
<tr>
<td>Dublin Connolly</td>
<td>27</td>
</tr>
<tr>
<td>Workshop</td>
<td>27</td>
</tr>
<tr>
<td>Dublin Connolly</td>
<td>27</td>
</tr>
<tr>
<td>Workshop</td>
<td>27</td>
</tr>
<tr>
<td>Dublin - Belfast main line. Sandy Cove and Glasthule Station</td>
<td>25</td>
</tr>
<tr>
<td>Platforms</td>
<td>25</td>
</tr>
<tr>
<td>Dalkey Tunnel</td>
<td>25</td>
</tr>
<tr>
<td>Tunnels</td>
<td>25</td>
</tr>
<tr>
<td>Malahide Station</td>
<td>22</td>
</tr>
<tr>
<td>Footbridge at South End</td>
<td>22</td>
</tr>
<tr>
<td>Between Killiney and Dalkey</td>
<td>22</td>
</tr>
<tr>
<td>Overbridge (118)</td>
<td>22</td>
</tr>
<tr>
<td>White Rock between ? and ? Embankments</td>
<td>20</td>
</tr>
<tr>
<td>Dublin – Rosslare main line Enniscorthy station</td>
<td>20</td>
</tr>
<tr>
<td>Footbridges</td>
<td>20</td>
</tr>
<tr>
<td>Dublin Connolly</td>
<td>20</td>
</tr>
<tr>
<td>Offices</td>
<td>20</td>
</tr>
<tr>
<td>Dublin Connolly</td>
<td>20</td>
</tr>
<tr>
<td>Offices (Staff)</td>
<td>20</td>
</tr>
<tr>
<td>Malahide</td>
<td>20</td>
</tr>
<tr>
<td>Offices (staff)</td>
<td>20</td>
</tr>
<tr>
<td>Pearse St. Station</td>
<td>20</td>
</tr>
<tr>
<td>Offices (staff)</td>
<td>20</td>
</tr>
<tr>
<td>Bray Station</td>
<td>20</td>
</tr>
<tr>
<td>Platforms</td>
<td>20</td>
</tr>
<tr>
<td>Malahide up Platform</td>
<td>20</td>
</tr>
<tr>
<td>Public Access Area (General)</td>
<td>20</td>
</tr>
<tr>
<td>Malahide up Platform</td>
<td>20</td>
</tr>
<tr>
<td>Public Access Areas (General)</td>
<td>20</td>
</tr>
<tr>
<td>Killiney Station</td>
<td>15</td>
</tr>
<tr>
<td>Underpasses</td>
<td>15</td>
</tr>
<tr>
<td>Dublin Connolly Control Centre</td>
<td>10</td>
</tr>
<tr>
<td>Offices (staff) CTC BDC (Upstairs)</td>
<td>10</td>
</tr>
</tbody>
</table>

**Table 5: Structures Safety Inadequacy Scores**
Appendix IX

Risk Assessment Results Summary
### Table 1: Annual Accident Frequency and Individual Risk Results (by Section)

(Predicted annual train accident frequencies and Individual Risks on a line by line basis)
<table>
<thead>
<tr>
<th>Sub Section</th>
<th>Predicted Accident Frequency (per year)</th>
<th>Collective Risk (EF per year)</th>
<th>Individual Risk (per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Passenger</td>
<td>Public</td>
</tr>
<tr>
<td>20</td>
<td>8.33E-02</td>
<td>1.14E-02</td>
<td>1.77E-03</td>
</tr>
<tr>
<td>21</td>
<td>7.37E-02</td>
<td>4.26E-03</td>
<td>5.45E-03</td>
</tr>
<tr>
<td>22</td>
<td>3.14E-01</td>
<td>3.05E-01</td>
<td>6.60E-02</td>
</tr>
<tr>
<td>23</td>
<td>1.73E-01</td>
<td>1.24E-01</td>
<td>1.74E-02</td>
</tr>
<tr>
<td>24</td>
<td>5.02E-02</td>
<td>3.12E-02</td>
<td>9.72E-04</td>
</tr>
<tr>
<td>25</td>
<td>7.03E-01</td>
<td>3.83E-01</td>
<td>1.00E-01</td>
</tr>
<tr>
<td>26</td>
<td>9.21E-02</td>
<td>2.92E-02</td>
<td>6.80E-04</td>
</tr>
<tr>
<td>27</td>
<td>1.32E-01</td>
<td>2.88E-02</td>
<td>7.26E-04</td>
</tr>
<tr>
<td>28</td>
<td>9.67E-02</td>
<td>1.02E-02</td>
<td>4.38E-03</td>
</tr>
<tr>
<td>29</td>
<td>1.16E+00</td>
<td>4.00E-01</td>
<td>2.82E-01</td>
</tr>
<tr>
<td>30</td>
<td>4.97E-01</td>
<td>2.30E-01</td>
<td>3.34E-02</td>
</tr>
<tr>
<td>31</td>
<td>3.42E-01</td>
<td>1.40E-01</td>
<td>1.05E-02</td>
</tr>
<tr>
<td>32</td>
<td>1.41E-01</td>
<td>4.75E-02</td>
<td>1.20E-02</td>
</tr>
<tr>
<td>33</td>
<td>7.66E-02</td>
<td>6.84E-03</td>
<td>1.82E-03</td>
</tr>
<tr>
<td>34</td>
<td>4.85E-01</td>
<td>4.92E-01</td>
<td>1.50E-01</td>
</tr>
<tr>
<td>35</td>
<td>9.17E-02</td>
<td>5.94E-02</td>
<td>2.14E-02</td>
</tr>
<tr>
<td>36</td>
<td>5.34E-01</td>
<td>1.81E-01</td>
<td>3.25E-03</td>
</tr>
<tr>
<td>37</td>
<td>3.44E-01</td>
<td>5.82E-02</td>
<td>4.07E-03</td>
</tr>
<tr>
<td>TOT.</td>
<td>9.84E+00</td>
<td>7.17E+00</td>
<td>1.42E+00</td>
</tr>
</tbody>
</table>

Table 1: Annual Accident Frequency and Individual Risk Results (by Section) cont'd

(Predicted annual train accident frequencies and Individual Risks on a line by line basis)