Guide to conducting an effective incident investigation

Supporting HSEQ MS 05

Rev 1.0

28/06/2016
Revision Status:

<table>
<thead>
<tr>
<th>Rev</th>
<th>Date</th>
<th>Revision Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>10-23/8/12</td>
<td>Development of new document</td>
</tr>
</tbody>
</table>

Prepared by

Michael Jones
Hseqconsulting167@gmail.com
Table of Contents

Terms and abbreviations.................................................................................................................. 4
Compliance requirement references (Acts, Regulations and Codes of Practice) .................. 4
Schematic of incident investigation and analysis ............................................................................. 5
Introduction ....................................................................................................................................... 6
Objectives & definitions .................................................................................................................... 6
Conducting an investigation ............................................................................................................. 8
Appendix I: Worked examples ......................................................................................................... 18
Appendix II: Lessons Learned brief .................................................................................................. 21
Appendix III: Investigation Review / Rating Matrix ......................................................................... 22
Appendix IV: ‘Time Sequence Model’ – Summary ......................................................................... 23
Appendix V: Events and Causal Factors Chart for the Piper Alpha Explosion ............................ 24
### Terms and abbreviations

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>E&amp;CF</td>
<td>Events and Causal Factors</td>
</tr>
<tr>
<td>RCAF</td>
<td>Root Cause Analysis Flowchart</td>
</tr>
<tr>
<td>SMS</td>
<td>Safety Management System</td>
</tr>
</tbody>
</table>

### Compliance requirement references  
(Acts, Regulations and Codes of Practice)

<table>
<thead>
<tr>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health and Safety at Work Act 2015</td>
</tr>
<tr>
<td>Health and Safety at Work Regulations 2016</td>
</tr>
</tbody>
</table>
Scematic of incident investigation and analysis

Incident Investigation and Analysis

Incident Reporting
- What to report
  - When to report
    - Where to record
      - What to record
        - Injury Types

Incident Investigation
- Charter and team
  - Gather information/facts
  - Sequence of events
  - Events & causal factors
  - Root cause analysis
  - Recommendations

Lessons Learned
- Identify the lesson
  - Capture the lesson
    - Record the lesson
      - Distribute & share the lesson
        - Integrate into procedures
  - Build the corporate memory
Introduction
This guide has been prepared to help investigation team leaders to conduct successful incident investigations.
This guide supplements and does not replace the need for formal training in incident investigation techniques.
Investigations are to be led by experienced and trained employees, and the results communicated appropriately throughout the company.

Objectives & definitions

Objectives of an incident investigation
The objective of an incident investigation is to identify the failings in business systems, processes and procedures that lead to the incident and to recommend corrective actions to ensure that the incidents, or similar incidents, do not recur.
It is not the purpose of the investigation to apportion blame to any individuals for the incident.

Causes of incidents – definitions
i) Direct Cause(s)
Direct causes are also referred to as initiating events. These are events that happened just prior to the incident.

ii) Causal Factor(s)
Causal factors are ‘events’ and ‘conditions’ that could have resulted in an incident or had they not occurred would have prevented the incident. Causal factors must be screened and analysed to identify ‘root cause’.

iii) Root Cause(s)
Root causes are also referred to as systemic or elemental level causes. Root causes are generally management system failures that lead to an event (e.g. an unsafe act) or condition (e.g. unsafe equipment) culminating in an incident.

Traits of a root cause
Root causes by definition are something over which management generally has control. Root causes also:
- Indicate a safety management system weakness
- Influence other possible incident scenarios
- Represent an elemental level for which further analysis and resolution would be unproductive.

Why do we target root causes?
- To prevent recurrence of the same or similar incidents
- To prevent recurrence of even seemingly unrelated incidents involving the same root cause
- To enable more cost effective solutions to problems (in many instances)
- To enable trending analysis to identify issues symptomatic of larger organisational or cultural problems.
### The 10 Steps of an incident investigation

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
</table>
| 1    | Confirm investigation charter with incident owner | - The charter, or purpose, of the investigation needs to be confirmed prior to commencement.  
- Determine if legal advice and involvement is required. |
| 2    | Select and train investigation team members | - Selecting the right team to include the necessary technical and business knowledge as well as having investigation skills. |
| 3    | Agree on the peer reviewers | - Experienced and independent peer reviewers are needed to help ensure that the investigation results are correct. |
| 4    | Gather information:  
- Physical  
- People  
- Documentation | - Physical evidence may need to be collected quickly from the scene of the incident.  
- Witness interviews and physical evidence provide the facts on which the investigation must be based.  
- Documents(records) can verify the information gathered. |
| 5    | Prepare the sequence of events | - Outlines what happened and when.  
- Be sure to verify the events where possible. |
| 6    | Develop the Events and Causal Factors (E&CF) chart | - Events and Causal Factors (E&CF) chart:  
- Identifies the key causal factors for further analysis  
- Provides a useful management summary of the events and conditions leading to the incident  
- Provides the focal point for applying root cause analysis  
- Guides the collection of information and helps to identify gaps in gathered information |
| 7    | Apply root cause analysis methodology:  
- TapRoot®  
- 'Why Tree'  
- Root Cause Analysis Flowchart (RCAF) | - Use RCAF from the Loss Prevention System™ in conjunction with either, 'Why Tree' or TapRoot®.  
- Summarise the 'root causes' being sure to identify the systemic failures linking them to SMS where possible. |
| 8    | Develop recommendations to correct root causes | - Recommendations to address identified systems failures i.e. root causes.  
- Recommendations need to be clear and achievable within a defined timeframe. |
| 9    | Prepare draft report | - Report to contain:  
- Incident description and definition  
- Investigation charter  
- List of team members and peer reviewers  
- E&CF chart  
- Summary of root causes  
- Recommendations  
- Appendices |
| 10   | Validate and finalise the report and share the learnings | - Validate with:  
- Peer reviewers  
- Champion  
- People nominated to complete recommendations  
- Distribute final report and post any associated lessons learned bulletins on the intranet |
Conducting an investigation

Step 1: Confirm the charter

The “charter” of the investigation is the statement that describes the objective of the investigation and is usually set by the incident owner (champion) who initiated the investigation.

The charter is best if kept short and specific, such as:

- The investigation is aimed at finding the reason the employee was injured.
- The investigation team is asked to identify the cause of the fire and subsequent loss of life.

The focus of the investigation should be consistent with the complexity of the incident as described in the ‘Time Sequence Model’, summarised in Appendix IV.

The circumstances of incidents are generally complex; the charter provides the investigation team with clear guidance in what they should, and shouldn’t be involved.

It is the responsibility of the investigation team leader to confirm the charter with the champion (preferably in writing) prior to the investigation commencing.

Refer to functional HSE SMS Investigation and Analysis procedures and confirm with the champion if legal advice/involvement is required before commencing the investigation.

Step 2: Selecting and training the investigation team

It is the responsibility of the Investigation Team Leader to appoint members of the investigation team. Ideally, the investigation team should contain between three and five members including the Team Leader.

The team should be selected after the investigation charter is finalised because the charter may influence the skills and experience required on the team.

Team members should be selected to provide the team with:

- A general understanding of the business or operation in which the incident occurred;
- The technical knowledge necessary to understand equipment or process failure modes (if applicable);
- An understanding of any applicable procedures, standards or regulation; and,
- Incident investigation and communication skills.

Maximise the “independence” of the team by not selecting people from the work group around whom the incident occurred. These people will, no doubt, need to be interviewed; but do not necessarily need to part of the incident investigation team.

Step 3: Peer reviewers

Peer reviewers provide an independent validation of an investigation’s findings and recommendations prior to its finalisations.

Generally two or three peer reviewers are needed.

Peer reviewers are not members of the investigation team, nor should they be part of the organisation in which the incident occurred.

It is the responsibility of the investigation Team Leader to select peer reviewers; but this should be done in consultation with the whole investigation team.

The role of the peer reviewers is to review the draft final report and recommendations. Peer reviewers therefore need to have a good understanding of the business or operation in which the incident occurred.

Peer reviewers should refer to Appendix III as relevant guidance.
Step 4: Gathering information and collecting evidence

There are three key sources of information to gather and analyse:

i) physical evidence
ii) people/eye witness accounts
iii) documents/records

Physical evidence

Physical evidence may be subject to rapid change, obliteration or loss. For this reason, the collection of physical evidence from the scene of an incident needs to be an early, high priority of the investigation team.

Records and evidence should be collected to include:

• The location of injured workers at the time of the incident (if applicable)
• The equipment in use (layout, spacing, etc.)
• Safety devices or control measures in use
• Position of appropriate guards, restraining devices, warning signs, isolation tags etc.
• Position of controls on machinery
• Damage to equipment
• Housekeeping in the vicinity of the incident scene
• Weather and other environmental conditions
• Lighting levels, and
• Noise levels.

Photographs should be taken, both of the general area of the incident, and of specific items. Careful study of photographs sometimes reveals conditions or information missed at the scene. Sketches of the scene, including detailed measurement, can also assist in incident analysis. Broken equipment, debris or samples of material involved should also be collected for technical analysis by experts – especially when materials failure is a potential cause of the incident. The permission of Department of Labour inspectors may be needed before physical evidence can be removed from the scene for analysis.

People evidence

Interviews with people involved, knowledgeable others and eye witnesses provide an important source of information.

Every effort should be made to interview all witnesses to an incident. Witnesses should be interviewed as soon as possible after the incident has occurred. Interviews should be undertaken individually, rather than in a group, so as not to lose individual perceptions of what happened. Interviews may be conducted at the scene, where it may be easier to describe the occurrence, or in the quiet of an office.

When interviewing witnesses:

• Try to put the witness, who may be upset, at ease;
• Emphasise the reason for the investigation (to prevent recurrence and identify underlying causes, not to apportion blame to individuals);
• Ask open question such as “please, describe in your words what happened next”;
• Approach the interview as a friendly discussion rather than an interrogation;
• Let the witness talk freely – do not interrupt, prompt or ask leading questions;
• Gently challenge the witness where necessary to ensure that they are presenting facts and not perceptions;
• Make short notes during the interview – do not take lengthy notes while the witness is talking;
• Confirm your understanding of their account of what happened and have the witness confirm your notes; and,
• Thank the witness for their input at the conclusion of the interview – but leave the opportunity open to talk to them again if it becomes necessary; and,
• If witnesses have stayed back after hours, or are tired or upset don’t let them drive home.
The actual questions asked of the witness will vary with the circumstances of the incident, but there are some general questions which cover most incidents. These are:

- Could you please confirm your name, your job title and tell me how long you have been doing your current job?
- Could you please tell us where you were and what you were doing at the time of the incident?
- Could you please describe, in your own words, what you saw or heard?
- Has anything like this happened before?
- In your opinion, what are the key issues associated with this incident?

**Documentation**

Another source of information which should be checked are documents such as technical data sheets, maintenance reports, unit operating logs, computer control read-outs, alarm summaries, past reports of inspections, procedures, training records, inventory records etc. Documents often provide a means of verification of the events and conditions.

Any relevant documents should be retained for analysis and inclusion in the investigation file.

Note: All time related data should be verified and crosschecked in chronological order.

**Step 5: Sequence of events**

The sequence of events should be prepared following completion of witness interviews and collection and analysis of physical data and relevant documentation.

The Sequence of Events table is simply a means of sorting the collected information into a chronological statement of what happened and when it happened.

The sequence of events needs to be reasonably detailed and should include, in tabular form:

- What happened
- When it happened, and
- The supporting evidence or verification.

Note: To ensure a high degree of factual certainty in the sequence of events strive to obtain two or more points (sources) of verification.

Appendix I, Part A, to this guide provides an example of a Sequence of Events in tabular form.

**Step 6: Events & Causal Factors (E&CF) Chart**

The investigation team should capture the key events and any ‘conditions’ or issues of concern surrounding the key events i.e. capture all potential causal factors. These causal factors are best summarised and represented as an Events and Causal Factors (E&CF) chart.

The E&CF chart should be drawn using a rectangular box to represent each key event leading to the incident – which should be represented as a circle. If the team is uncertain about a particular event having occurred, the team may conclude the event occurred based on the available evidence but should signify this uncertainty by making the event box with a dashed outline.

Each event box should be annotated to include all potentially unsafe conditions or safety management issues relating to the respective event as shown in Figure 1.

The conditions or safety management issues captured on the E&CF chart represent the causal factors against which the team will apply root cause analysis.

The E&CF chart provides a useful management summary of what happened. Refer to Appendix V for an E&CF chart summarising a complex incident that occurred on an offshore platform, Piper Alpha.
A worked example Events and Causal Factors chart is provided in Appendix I, Part B.

**Step 7: Root Cause Analysis**

Root cause analysis is not applied to the incident itself but applied to the events and conditions leading to the incident.

There are three recommended root cause analysis methodologies: RCAF, 'Why Tree’, and TapRooT®.

The investigation team should analyse the Causal factors to determine root causes using one, or a combination of these root cause analysis methodologies:

**i) RCAF**

The Root Cause Analysis Flowchart (RCAF) is taken from the Loss Prevention System™. It is a flowchart that targets human/personal factors in addition to facilities and other factors (refer to Figure 2).

The RCAF is a simple and effective root cause analysis technique for analysing unsafe acts. It is also effective for some simple incidents and near misses.

For more complex incidents in which equipment and facilities aspects, systems and infrastructure aspects or emergency response and shutdown systems require investigation the use of TapRooT® or 'Why Tree’ in combination with the RCAF is recommended.

The RCAF technique alone is not recommended for use on complex incidents spanning multiple time periods; refer to Appendix IV, Time Sequence Model.
Event occurs. Why?

Personal factor
- Lack of skill or knowledge
- Attitude or lack of motivation
  - Correct way takes more time and/or requires more effort
  - Shortcutting standard procedures is accepted or rewarded
  - Person thinks that doing the job correctly 100% of the time doesn’t matter

Job factor
- Lack of operational procedures or work standards
  - Inadequate communication of expectations regarding procedures or standards
  - Inadequate tools or equipment

External factor

Solution/recommendation

Implementation of solution/recommendation

Figure 2: Sample RCAF
RCAF courtesy of the Loss Prevention System™ (LPS) by Dr James D. Bennett, 1997
ii) ‘Why Tree’ analysis

The ‘Why Tree’ technique is easy to use in conjunction with the RCAF methodology. It is flexible enough to provide direct linkage to HSE MS deficiencies but requires judgement and experience to use effectively.

Refer below for a generic sample flowchart for the Why Tree process.

To use the ‘Why Tree’ technique, start by selecting one causal factor associated with the incident. Ask why this causal factor occurred. Then solicit an answer(s) to this question. The answer may identify more than one sub-event or condition as causes.

For each sub-event or cause, ask why it occurred.

Then repeat this process three to five times until a root cause is reached, i.e. a cause directly attributable to a deficiency in management systems or supervisory controls and procedures.

![Sample Why Tree diagram](image-url)

Figure 3: Sample Why Tree
iii) Applying TapRooT® or ICAM® methodology

TapRooT® and ICAM® are commercially available incident investigation tools that are normally utilised for serious and/or more complex incidents. Before applying the TapRooT® or ICAM® methodologies staff leading the investigation process must be formally trained by a licensed TapRooT® or ICAM® trainer.

Recommended approach for most incidents

For the majority of incidents and near misses a combination of RCAF and ‘Why Tree’ is recommended.

After completing the E&CF chart undertake the root cause analysis as follows:

I. Use RCAF initially as a screening tool for analysis of all causal factors. For approximately 80% of the causal factors analysed the RCAF should be sufficient to identify a root cause

II. If required, some job factors, equipment and facilities aspects and skills and knowledge aspects should be explored further using ‘Why Tree’ in order to identify root causes. Using RCAF in combination with ‘Why Tree’ will enable systemic failings to be identified (refer to Figure 4)

III. Make certain that each root cause is clearly identified and that they meet the basic definition and traits of a root cause described on page 7 of this guide.

Summarise the root causes and list them as a separate section of the final investigation report. Then make sure to link the root causes directly to HSE Elements, Expectations, Guidelines or Management Systems.

Refer to Appendix 1, Part D for a worked example.

Most incidents should have between two and five identifiable root causes. For each root cause there should be a corresponding number of recommendations to prevent a recurrence of the incident.
Analyse causal factors for root cause using LPS RCAF

Personal factor?

Job factor

Lack of skill or knowledge

Attitude or lack of motivation

Systemic training issue?

Yes

No

Lack of operational procedures or work standards

Inadequate communication of expectations regarding procedures or standards

Inadequate tools or equipment

Continue RCAF

Link root causes back to organisation’s management system

Recommendations and report

Figure 4: Combining ‘Why Tree’ and RCAF for root cause analysis
Step 8: Recommendations

The “Recommendations” from the investigation need to target each identified root cause of the incident.

Before developing the recommendations the team should consider the following question:

Is this a repeat incident? If so, why was the corrective action ineffective last time?

Recommendations need to include:

- A clear statement of what is proposed and a link to the systemic failing it is aimed at correcting
- Identification of who has accountability for completing the recommendation
- A proposed deadline for completing the recommendation, and
- An estimate of the cost of completing the recommendation – including direct and indirect manpower costs.

Agreement from the person nominated to complete each recommendation should be sought prior to the recommendation being finalised as part of the validation process.

The investigation team should also ask three “acid questions” on each recommendation prior to finalising them:

- Is the recommendation actually do-able?
- Is the recommendation really going to stop this type of incident happening again – here and at other locations?
- How failsafe is the recommendation?

Consider where it fits in the risk based control hierarchy e.g. does the recommendation eliminate, substitute, isolate or rely on administrative minimisation control of hazards.

As a guide most incident investigations should result in between two and five recommendations. Appendix I, Part E, contains some example recommendations.

Step 9: Drafting the Investigation Report

The investigation report must contain seven sections plus appendices:

Section 1 Title
Section 2 Description of the Incident
Section 3 List of Investigation Team Members
Section 4 The Investigation Charter
Section 5 Events and Causal Factors (E&CF) Chart
Section 6 Summary of Root Causes
Section 7 Recommendations
Appendix I Sequence of Events
Appendix II Other Information
Step 10: Validate, finalise the report & share the learnings

Prior to finalisation, seek validation of the report, its findings and recommendations from the nominated peer reviewers, the investigation champion, and those who are assigned any corrective actions.

Be willing to take advice and modify the report, findings and recommendations as necessary.

Once finalised and validated, the copies of the report should be forwarded under limited distribution to the following (subject to legal advice):

- The investigation champion;
- The manager of the facility at which the incident occurred.

The investigation team leader should retain a file copy. Once the report is distributed and the learning’s shared, the investigation team’s job is complete.

The final step for the Incident Investigation team is to prepare a ‘Lessons Learned Brief’. Refer to Appendix II for a sample format.

Sharing the lessons (Refer Appendix II)

The purpose of the ‘Lessons Learned Brief’ is to ensure that:

- The results of the investigation are communicated and shared with the appropriate audience to raise awareness and prevent recurrence; and
- The data is input to information systems to facilitate trending and analysis to identify common improvement opportunities.

In broad terms the following roles and responsibilities shall apply with respect to the sharing of lessons learned.

Site/Line Operations Personnel:

- Conduct adequate investigations designed to identify root causes for incidents
- Provide incident and associated root cause information to embedded HSE Advisor for analysis and sharing

Group HSE Manager:

- Coordinate sharing of root cause/lessons learned across HSE Functional Networks and posting on the intranet.
- Conduct analyses on Business Line root cause data and linkages to HSE SMS systems
- Review incident/action/close-out during HSE SMS assessments

Manager HSE:

- Facilitate up-line reporting and analysis of incident information across the organisation
- Communicate requirements to Business Lines
- Gather/compile incident information and root causes
- Assist in data analyses for Business Lines
### Appendix I: Worked examples

The following provides worked examples in the development of an incident investigation report. The examples are based on a fictitious incident where a worker inadvertently stepped into an uncovered storm water drain and broke his ankle. The investigation team interviewed a number of people at the site and developed the investigation as follows:

#### Part A: Sequence of events

<table>
<thead>
<tr>
<th>Event</th>
<th>Date/Time</th>
<th>Supporting Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant commissioned</td>
<td>2 June 2010</td>
<td>1. Plant manager 2. As-built drawings</td>
</tr>
<tr>
<td>Uncovered storm water drains identified</td>
<td>6 October 2010</td>
<td>1. Co-worker project request form</td>
</tr>
<tr>
<td>Worker commences at plant</td>
<td>1 February 2011</td>
<td>1. Worker’s employment record 2. Worker statement</td>
</tr>
<tr>
<td>Worker commences duties as vaporiser unit operator</td>
<td>3 February 2011</td>
<td>1. Worker interview 2. Supervisor interview</td>
</tr>
<tr>
<td>Worker visits vaporiser unit</td>
<td>6 February 2011 at approx. 0830 hrs.</td>
<td>1. Worker interview</td>
</tr>
<tr>
<td>Worker starts return trip to control room</td>
<td>6 February 2011 at approx. 1000 hrs.</td>
<td>1. Worker interview</td>
</tr>
<tr>
<td>Worker steps into storm water drain while talking to co-worker B and breaks his ankle</td>
<td>6 February 2012 at approx. 1005 hrs.</td>
<td>1. Worker interview 2. Interview with co-worker B</td>
</tr>
</tbody>
</table>
Part B: Sample – Events & Causal Factors (E&CF)

Part C: Sample – Root Cause Analysis

The investigation team screened each of the causal factors (issues) identified on the E&CF chart before applying root cause analysis techniques. The following list of priority causal factors was analysed for root cause:

- Engineering design standards (why weren’t the storm water covers included?);
- HAZOP of the vaporiser unit (was one completed, what was the scope, why wasn’t the lack of storm water covers identified as a hazard?);
- The prioritisation, tracking and follow-up of safety audit corrective actions;
- Lack of warning signs/barricades or temporary risk reduction actions such as designated walkways;
- Vaporiser unit specific hazard training and/or personal safety planning.

Utilising the RCAF and ‘Why-Tree’ analysis techniques in combination will ensure that all behavioural, procedural, equipment and facilities aspects, communications, skill and knowledge aspects are adequately explored for root causes.
Part D: Sample – Root Cause Summary

Link the root causes of the incident back to your Health, Safety and Environmental Management System – for example:

1. The engineering design guide was deficient in its requirements for the installation of storm water drain covers. Reference HSE MS Expectations 14.3 – 14.6 for ‘Safe design, procurement and disposal of assets’.

2. A project HAZOP was completed. The HAZOP methodology was however deficient in not requiring the storm water drainage system to be included in the scope of the analysis. Reference HSE MS Expectation 14.5 for ‘Safe design, procurement and disposal of assets’ and HSE MS Expectations 4.1 and 4.2 for ‘HSE hazard identification, risk assessment and management’.

3. The corrective action request system was deficient because it did not require, or allow for, specific prioritisation of safety related risks. Reference HSE MS Expectation 3.6 for ‘Assessment and improvement’.

4. An interim/temporary standing order had been established for all unit employees to follow designated safe walkways in the absence of the storm water drain covers. The unit supervisor had failed to communicate and adequately reinforce this expectation with employees. Reference HSE MS Expectation 4.14 ‘HSE hazard identification, risk assessment and management’. and HSE MS Expectation 6.4 for ‘HSE training and competency’.

Part E: Sample – Recommendations

<table>
<thead>
<tr>
<th>Recommendation 1</th>
<th>Update the Engineering Design Guides requiring covers be installed on all storm water sewers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsibility</td>
<td>Engineering Manager</td>
</tr>
<tr>
<td>Deadline</td>
<td>June 30, 2012</td>
</tr>
<tr>
<td>Cost</td>
<td>$1000 to re-issue Guides</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendation 2</th>
<th>Update the HAZOP methodology to ensure that all utility systems, including storm water systems, are included in all HAZOP reviews.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsibility</td>
<td>Engineering Manager</td>
</tr>
<tr>
<td>Deadline</td>
<td>July 30, 2012</td>
</tr>
<tr>
<td>Cost</td>
<td>$2000 to revise and reprint HAZOP manual</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendation 3</th>
<th>Modify the Corrective Action Request System and input forms to include a prioritisation process for safety related requests.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsibility</td>
<td>System Administrator for assessment and corrective action</td>
</tr>
<tr>
<td>Deadline</td>
<td>June 30, 2012</td>
</tr>
<tr>
<td>Cost</td>
<td>$1000 to reprint Work Request Forms Half hour training for all employees on revised system and form</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendation 4</th>
<th>Update the unit specific induction program to include a session where supervisors highlight specific hazards in their work area and compliance with the associated controls to be included and reinforced as part of the job observations program.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsibility</td>
<td>Site HSE Advisor</td>
</tr>
<tr>
<td>Deadline</td>
<td>May 15, 2012</td>
</tr>
</tbody>
</table>
Cost

2 man-days for HSE Advisor to update induction program. Extra 2 hours on duration of inductions 1/2 man-day to modify the job observations program.

Appendix II: Lessons Learned brief

Sample Format for Lessons Learned brief

HSE Lessons Learnt

Title: <Enter>  Date of event: <dd/mm/yyyy>

Summary of event:

Key learning:

Recommendations:

For further information please contact:
<table>
<thead>
<tr>
<th>Rating</th>
<th>1</th>
<th>3</th>
<th>5</th>
<th>7</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence of Events</td>
<td>Loose incident description – what happened</td>
<td>Incident and event description – what happened in order of events</td>
<td>What happened and when is clearly identified</td>
<td>What happened and when is verified</td>
<td>5 / 7</td>
</tr>
<tr>
<td>Events &amp; Casual Factors (E&amp;CF)</td>
<td>Re-statement of what happened</td>
<td>Re-statement of key events but few causal factors identified</td>
<td>Key events and causal factors identified</td>
<td>Clear summary of the key events and causal factors. Logical progression and linking of events and conditions</td>
<td>5 / 7</td>
</tr>
<tr>
<td>Root Cause Analysis, Identification and Linkage to Management Systems</td>
<td>No statement or summary of the identified root causes</td>
<td>Statement of causal factors and direct causes, i.e. intermediate level events and conditions</td>
<td>Root causes clearly stated consistent with the definition of root cause</td>
<td>Root causes clearly stated consistent with the definition of root cause. Proven methodology utilized in root cause analysis. No linkage of root causes to SMS Elements, Expectations or Systems</td>
<td>5 / 7</td>
</tr>
<tr>
<td>Recommended Corrective Actions</td>
<td>Single level of information provided, e.g. what is to be done. Actions do not address root causes</td>
<td>Actions address root causes. Single level of information provided, e.g. what is to be done by whom and the estimated cost. Agreement by the actioner to the recommendation</td>
<td>Actions address root causes. Two levels of information provided, e.g. what is to be done by whom and the estimated cost. Agreement by the actioner to the recommendation</td>
<td>Actions address root causes. Three levels of information, e.g. what is to be done by whom and the estimated cost. Agreement by the actioner to the recommendation</td>
<td>5 / 7</td>
</tr>
</tbody>
</table>

Total: 20 / 28 (Quality = 71%)
Appendix IV: ‘Time Sequence Model’ – Summary

Investigation team leaders and champions should refer to this model when assessing the complexity of an incident and determining the focus or charter of the investigation.

This model can also assist in determining the appropriate root cause analysis methodology to apply in the investigation in keeping with the guidance in this pocket guide.

<table>
<thead>
<tr>
<th>Description of time period</th>
<th>Period 1</th>
<th>Period 2</th>
<th>Period 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial/background situation:</td>
<td>Conditions, circumstances, infrastructure and controls</td>
<td>Occurrence: Initiating events and causal factors</td>
<td>Consequence: Propagating events, Effect of mitigating controls, Factors contributing to incident severity level</td>
</tr>
<tr>
<td>The bigger picture</td>
<td>Direct (or initiating) cause occurs in this period</td>
<td>Linkages between cause and effect are clearly understood</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Complexity of incident</th>
<th>Period 1</th>
<th>Period 2</th>
<th>Period 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple incident or unsafe act</td>
<td>Moderately complex</td>
<td>Complex incident</td>
<td></td>
</tr>
<tr>
<td>Direct linkage between cause and effect</td>
<td>Linkages between cause and effect that are difficult to establish</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application of root cause analysis methodology</th>
<th>Period 1</th>
<th>Period 2</th>
<th>Period 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPS RCAF</td>
<td>LPS RCAF and Why Tree</td>
<td>TapRooT®</td>
<td></td>
</tr>
</tbody>
</table>
Appendix V: Events and Causal Factors Chart for the Piper Alpha Explosion