Overview

- Managing risks
- What are critical tasks?
- A systematic criticality ranking
- Using the output.

Risk management

Hierarchy of control
1. Remove hazard
2. Reduce hazard
3. Hardware control
4. Software control + Mitigation

As Low As Reasonably Practicable
Hazard

- Source or situation with a potential for harm
- This can include:
  - Errors and violations
  - Also, the causes of errors and violations
  - Need a structured method to identify.

HSE’s 7 steps to managing human failure

1. Consider main site hazards
2. Identify human activities that affect these hazards
3. Outline key steps in these activities
4. Identify potential human failures
5. Identify factors that make these failures more likely
6. Manage the failures using the hierarchy of control
7. Manage error recovery

Bow-Tie diagrams
Critical tasks

- Hazard present when the task is carried out
- Breaking into the pressure envelope
- Introducing sources of energy
- Potential to exceed equipment design specifications
- Overriding safety functions
- Reliance on communication.

Critical operating tasks

- Potential consequences are high
- Design of the plant minimises the likelihood
- Vulnerable times include:
  - Start up and shut down
  - Bulk loading and unloading
  - Complex manifolds and line ups
  - Continuing to operate whilst some elements are inoperable
  - Responding to emergencies.

Critical maintenance tasks

- Work on live systems
- Intrusive work
- Reassembly of items critical to pressure envelope
- Resetting of safety critical elements.
Hypothetical Gas Terminal – St Barton

A systematic approach

- Define the system
- Define the system goals
- Identify the functions to achieve the goals
- Identify the ancillary functions
- Identify safety critical elements requiring maintenance
- Identify tasks

Simple and very effective

Ref: ISO 11064

St Barton

- System definition
  - The plant and equipment between inlet and outlet isolation valves
- System’s goals
  - Supply gas to customer at required specification
  - Manage risks to safety, health and the environment
  - Achieve nomination
  - Operate profitably.
St Barton - Main Functions

- Receive gas from pipeline
- Remove liquids and particles
- Heat gas to achieve specification
- Inject nitrogen to achieve WOBBE
- Control flow rate to achieve nomination
- Meter gas for contractual purposes.

St Barton utilities/ancillaries

- Fuel gas
- Nitrogen
- Instrument air
- Fire fighting capability
- Fire/gas detection
- Emergency shutdown
- Emergency depressurisation
- Electrical power
- Drainage.

St Barton Operations Task List

1. Start-up/Shutdown tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Criticality</th>
</tr>
</thead>
</table>
| 1.1 Whole terminal
   - 1.1.1 Return terminal to service after maint.
   - 1.1.2 Prepare terminal for maintenance
   - 1.1.3 Return to service after blowdown | High, High, High |
| 1.2 Processing trains
   - 1.2.1 Return train to service after maint.
   - 1.2.2 Prepare train for maintenance
   - 1.2.3 Increase number of trains online
   - 1.2.3 Reduce number of online trains | High, High, Med, Med |
| 1.3 Heaters
   - 1.3.1 Start additional heater
   - 1.3.2 Stop a heater | Med, Med |
Assigning criticality

- Can be very subjective
- Everything is critical

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardousness of system</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Ignition/energy sources</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Changing line-up</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Impact of task deviation</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Overriding safety devices</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Overall criticality</td>
<td>0-3</td>
<td>4-8</td>
<td>9-15</td>
</tr>
</tbody>
</table>

St Barton – Task Criticality

1. Start-up/Shutdown tasks

1.1 Whole terminal
   - 1.1.1 Return terminal to service after maint
   - 1.1.2 Prepare terminal for maintenance
   - 1.1.3 Return to service after blowdown

1.2 Processing trains
   - 1.2.1 Return train to service after maint
   - 1.2.2 Prepare train for maintenance
   - 1.2.3 Increase number of trains online
   - 1.2.4 Reduce number of online trains

1.3 Heaters
   - 1.3.1 Start additional heater
   - 1.3.2 Stop a heater

What has this achieved?

- A human factors risk assessment
- Only a means to an end, but what is the end?
- Human factors risk management
  - Engineer out – beware of risk transferral
  - Hardware controls – beware of ironies of automation
  - Software controls – procedures, training and competence
St Barton - Procedures Required

1. Start-up/Shutdown tasks
   1.1 Whole terminal
      1.1.1 Return terminal to service after maint. Yes
      1.1.2 Prepare terminal for maintenance Yes
      1.1.3 Return to service after blowdown Yes
   1.2 Processing trains
      1.2.1 Return train to service after maint. Yes
      1.2.2 Prepare train for maintenance Yes
      1.2.3 Increase number of trains online No
      1.2.3 Reduce number of online trains No
   1.3 Heaters
      1.3.1 Start additional heater Yes
      1.3.2 Stop a heater Yes

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Better procedure systems

- One size does not fit all
- Different types of procedure
  - Full step-by-step Aide memoir
  - Flow chart Checklist
  - Sign or label on plant
  - Training procedure
  - None
- Requirements depend on the task's:
  - Criticality
  - Complexity
  - Frequency it is performed (by an individual).

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St Barton – Type of Procedure

1. Start-up/Shutdown
   1.1.1 Return terminal to service after maint. Full procedure + Checklist

2. Routine operations
   2.1 Field operator routines
      2.1.1 Plant patrol Checklist (training) Guide + shift log
      2.1.2 Receive shift handover

3. Materials handling
   3.1 Receive bulk materials
      3.1.1 Receive diesel from tanker Full procedure + signs on plant

5. Respond to operational events
   5.1 Respond to high pressures
      5.1.1 Respond to high pressure at inlet Flow chart
Training

- Required for all tasks
- Timing is important
  - Order tasks are learnt when starting a new job
  - Prior to infrequent task being performed
- Method of training is important
  - Class room - theory
  - Workshop – practical skills
  - On the job – most tasks
  - Simulation – infrequent tasks.

St Barton – Training Method

<table>
<thead>
<tr>
<th></th>
<th>Pre-task briefing</th>
<th>On the job</th>
<th>On the job &amp; class</th>
<th>Simulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Start-up/Shutdown</td>
<td></td>
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<tr>
<td>1.1 Return terminal to service after maint</td>
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<tr>
<td>2. Routine operations</td>
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<tr>
<td>2.1 Field operator routines</td>
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<td>2.1.1 Plant patrol</td>
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<tr>
<td>2.1.2 Receive shift handover</td>
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<tr>
<td>3 Materials handling</td>
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<tr>
<td>3.1 Receive bulk materials</td>
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<tr>
<td>3.1.1 Receive diesel in tanker</td>
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<tr>
<td>5 Respond to operational events</td>
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<tr>
<td>5.1 Respond to high pressures</td>
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<tr>
<td>5.1.1 Respond to high pressure at inlet</td>
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Competency assessment

- A lot of training fails to achieve its objectives
- Need to assess the skills, knowledge and understanding required
- Level of assessment depends on nature of task
  - Peer
  - Observation
  - Line manager
  - Discussion
  - Internal assessor
  - Question and answer
  - External assessor
  - Written test.
St Barton – Competence Assessment

2. Routine operations
   2.1 Field operator routines
      2.1.1 Plant patrol
      2.1.2 Receive shift handover
   2.2 Receive bulk materials
      3.1.1 Receive diesel in tanker

3. Materials handling
   3.1 Receive bulk materials
      3.1.1 Receive diesel in tanker

4. Respond to operational events
   4.1 Respond to high pressures
      4.1.1 Respond to high pressure at inlet

5. Respond to emergencies
   5.3 Respond to major incidents
      5.3.1 Respond to propane tank BLEVE

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Refresher training/assessment

- Repeating the same training on a regular basis is rarely effective
- Method and timing depends on nature of task and frequency it is performed.

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St Barton Task List

<table>
<thead>
<tr>
<th>Task</th>
<th>Critical level</th>
<th>Pre-resource required</th>
<th>Training method</th>
</tr>
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<tbody>
<tr>
<td>1.1</td>
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A Risk
Benefits of this approach

- Theme and terminology familiar to the end user
- Quick and simple
- Focuses effort according to process risk
- Explains why full blown procedures are not provided for every task
- Emphasises the role of on the job training
- Makes competence assessment less threatening

Provides a good demonstration of human factors risk management

Quantified human risk assessment

- Avoid if possible!
- Main problem is lack of data
- In theory, human failures are covered in equipment reliability data
- Generic error rates should not be used
- HSE only expect qualitative assessments
  - Identifying what can go wrong and putting in controls.

Common pitfalls in risk assessment

- Assessment to justify a decision already made
- Too many generic assessments
- Only considering one activity at a time
- Not involving a team in the assessment
- Failure to identify all hazards
- Failure to consider all possible outcomes
- Not doing anything with the results
- Not linking hazards with risk controls

Ineffective use of consultants???