Process Safety Journey
Agenda

• The Status in early 2000s

• The Journey to improvement in Process Safety management

• Managing risks and barriers

• How has this impacted Kwinana?
The Status in early 2000s

• Focus was on personal safety
  − RIF rates, DAFW etc

• Process safety was driven by the regulator

• There were some pockets working on process safety
  − Hazops, inspection teams etc

• Management focus was on (personal) safety, efficient operation and reducing cost
Significant Incidents
• Senior management more mindful that big incidents can happen and we need to do something about them

  − first step was to consistently define risk
  − rank the risks
  − set an acceptability criteria for the risks
Define Risk

What is Risk?

- Risk = Severity * Frequency

- Severity is number of injuries or fatalities, how bad the environmental or societal damage or how much it costs

- Frequency is how often

- Therefore – a big explosion may have the same risk level as falling over twisting your ankle on gravel
Ranking the Risks

BP confidential – These risks positioned on the matrix reflect an internal risk process intended to provide a relative understanding of risks for the purpose of business prioritization and risk reduction. It is intended to be read in conjunction with GDP3.1-00001 and RM-P 3.1-0101 and RM-P 3.1-0103 for the year to which this S&O Risk Process document relates, which underpin the process and provide further context.

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<tr>
<th>Severity</th>
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<tr>
<td>Many Fatalities, huge cost</td>
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<td>Injury, small cost</td>
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Colours in Matrix determines at what level in company needs to endorsed continued operation eg Purple = CEO
Determination of the Risk

- We then used a model (QRA type) to define significant events and their severity and frequency

- Using a standardised procedure we mapped these onto the 8*8 matrix

- We also set up an independent organisation to assure conformance of expectations and that we ensured visibility and control of how we managed our risks. Three key concepts:
  - Standardized Systems
  - Third Party Inspection (“You don’t get what you expect...you get what you inspect”)
  - Developing the Skills and Attitudes of Individuals - “The guts to suspend operations when necessary”

- You need to respect even the smallest amount of risk and evaluate the risk constantly. Risk management is a process...not an event
### The Risk Matrix - A Balance of Scenarios

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- **Low frequency**
- **Higher consequence**
- **High frequency**
- **Lower consequence**
• **We reviewed our risks** (locally and with the corporate organisation) and started focusing on purple level risks

• **We then started designing them out**
  
  − Put lots of Investment into many projects in many entities around the world

  − Shutdown some high risk facilities (eg HF alky plant at Bulwer in Queensland)
Ongoing Risk

- The oil industry is a high risk industry (we boil oil up to 700 deg c!!)

- A lot can be designed out however we will always have to manage residual risk

- This is done by understanding and managing the barriers we have to protect us
Original Barriers
- TEXAS CITY ISOM FAILURE

Hierarchy of control – Bias towards hardware/inherent safety & reducing the scope for human error – multi barrier defence

HAZARD
Normal Hydrocarbon Inventory in Raffinate Splitter

• Inventory increased
• Proximity of non-essential personnel to hazard
• Fire not used

• Operate outside envelope
• No fail-safe shutdown
• No mass balance or attention to other data
• Lost process control

• Faulty high level alarm not reported

• Previous incidents & upsets not reported
• Admin. rather than ISD solutions
• Inadequacy of control not applied

• Failure to recognize hazard to trailers from start-up
• People not notified of start-up
• Multiple sources of ignition in adjacent areas

• Inadequate HAZID skills
• Lack of underpinning knowledge
• Failure to follow procedures

• Confusion over who was in charge
• No verification on procedures in use
• Absent from unit at critical times

• Pre-start-up review not performed
• Procedural compliance not checked
• Supervisor offline
• No interventions
• Inadequate KPI’s for process safety

• No / incomplete MOC’s for trailer siting
• Blowdown drum modified without rigorous MOC

• No effective handover between shifts
• Unit alarm not sounded

• Active & passive fire protection

• Emergency response by site and external authorities
• Hospitalization

• Access & escape route diversity
• Access to scene

• No up to date relief study - design basis unclear
• Capacity of blowdown drum exceeded

• No effective communication between shifts
• Unit alarm not sounded

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HAZARD REALIZATION
↓
• Loss of containment
• Ignition
• Explosion
• Multiple fatalities and injuries

Communication

Active & Passive Fire Protection

Audit & Self Regulation

Training & Competency

Effective Supervision / Leadership

Operations Procedures

Maintenance & Inspection

Control, Alarm & Shutdown System

Inherent Design Plant Layout

Relief and Blowdown System

Learning from the Past

Management of Change

Escape / Access

Support to Next of Kin & Injured

Investigation & Lessons Learned

Effective Supervision / Leadership
- We started to understand and recognise barriers and how they prevented and mitigated incidents.

- We developed centrally an OMS (operating management system) which systematically defined how we should operate our facilities and hence manage our barriers.
Example of Standard Barriers in 2015

--- Prevention ---

- P1 - Plant Layout
- P4 - Mechanical integrity
- P5 - Relief systems
- P6 - BPCS
- P7 - SISs
- P8 - Safety Related Alarms
- P10 - Conformance to critical procedures (S/U, S/D, Cracker Pro.
- P13 - Isolation, intervention and reinstatement (Control of Work)
- P13 - Task Risk Assessment (CoW)

--- Mitigation ---

- M2 - Fire, Explosion, and Toxic Gas Protection
- M3 - Emergency response
- M4 - Ignition prevention
- M6 - Fire and gas detection and shutdown
- M7 - Active fire protection
Maintaining Barriers

- Next Step is the health of barriers
  - Over time everything degrades
- Need Self verification/audit/assurance

- Focus began on monitoring leading KPIs as well as the existing lagging KPIs for both Personal and Process safety (e.g. “Orange Book” reporting across Group)
Orange Book Metrics Review - Kwinana

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples of KPIs reported to head office tracking personal and process safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Incidents and HiPo's</td>
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<tr>
<td>Workforce Fatalities</td>
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<tr>
<td>MIA's - Levels A-E</td>
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<tr>
<td>HiPo's - Levels A-E</td>
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<tr>
<td>Process Safety Events</td>
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<tr>
<td>PSE Tier 1 Incidents</td>
<td></td>
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<tr>
<td>PSE Tier 2 Incidents</td>
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<tr>
<td>Operations Integrity</td>
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<tr>
<td>Loss of Primary Containment (Levels A-G)</td>
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<tr>
<td>Fires and Explosions - All Severities</td>
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<tr>
<td>Number of Oil Spills &gt; 1bbl</td>
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<tr>
<td>Volume of Oil Spills &gt; 1bbl total volume</td>
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<td>Health and Safety</td>
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<td>DAFWCF</td>
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<td>Recordable Injury Frequency (RIF) (per month)</td>
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<tr>
<td>Number of Injuries (Recordable)</td>
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<td>Severe Vehicle Accident Rate (SVAR)</td>
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<td>First Aid Injuries</td>
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<td>Assets</td>
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<td>Overdue Plant Inspections &amp; Tests</td>
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<td>Priviledge to Operate</td>
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<td>Compliance Notices</td>
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<td>Government Reportables</td>
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<td>Action Tracking</td>
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<td>Number of Purple &amp; Blue C+ Risks - No of Overdue Actions</td>
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<td>Group Audit - No of Delinquent Actions</td>
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<td>Incident Investigations (A-E) - No Overdue Open Actions</td>
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<td>Incident Investigations (F) - No Overdue Open Actions</td>
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<td>Plant Inspections &amp; Tests - Overdue Corrective Actions</td>
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<tr>
<td>HVL's - Overdue Actions</td>
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</table>
Performance Showing real Improvements

**All LOPC by Severity (A-H)**

- **# of Releases**

  - 2010
  - 2011
  - 2012
  - 2013
  - 2014
  - 2015 YTD

**API Tier 1 & 2 PS Events 2010 - 3Q 2015**

- 2010
- 2011
- 2012
- 2013
- 2014
- 2015 YTD
Process Safety Management Steps in 2015

• Understand your risks

• Evaluate your risks (severity & frequency)

• Eliminate or minimise your risks by design

• Manage your remaining risks
  ¬ Ensure your understand your barriers
  ¬ Put adequate barriers in place
  ¬ Verify and assure your barriers are still strong (KPIs)
How Has this impacted Kwinana

- **Spent lots of Investment on mitigation of risks, some examples are**
  - New/strengthened buildings
  - Water sprays on toxic plants to knock toxics
  - Fire fighting equipment, mobile and fixed on tanks
  - (this is all on top of a very good (BP best in class) system previously)

- **Improved our barriers, some examples are**
  - Implemented the grouped defined OMS (operating management system) to ensure greater systemisation in operation and hence barrier control
  - Significant costs on improving our inspection
  - Improved our understanding of criticality of equipment
  - Implement many self verification and audit programs on test health of barriers
How Has this impacted Kwinana

- This change in culture has significantly impacted the performance at Kwinana
  - Process safety incidents and near misses have significantly reduced
  - Operational Availability and Reliability has increased
  - However.....At a cost we’re still recovering from:
    - Majority of Investment on Safety / Compliance vs Commercial
    - Severe damage to our reputation
    - Cost was rarely in the conversation for a number of years and...
    - while competitors were getting more efficient and increasing capability

“Why must each generation have to re-learn the lessons of the previous one?”