Defining Operational Integrity

To secure a process plants integrity is to reduce the risk to its people, its process and its assets; to maximize performance and to minimize the impact of abnormal situations.
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Unlocking Operational Integrity

• Alarm Management is structured and well defined (ISA, EEMUA, ASM, IEC, API)
• From Alarm Capture, to Alarm Reporting, to Alarm Management, to Situational Awareness

• But there is more to this story.
Unlocking Operational Integrity

• Alarm Management is structured and well defined (ISA, EEMUA, ASM, IEC, API)
• From Alarm Capture, to Alarm Reporting, to Alarm Management, to Situational Awareness

• But there is more to this story. More potential to unlock greater Safety and Performance.
Operational Integrity Building Blocks
Industries Approach to Operational Integrity
Backed by Research from Global Industry Experts

• 40% of Abnormal Situations caused by Human Error

• 40% caused by Process Violations
  - Operating outside process limits
  - Equipment Failure (75% attributed to above)
  - API Required Practice 584 for Integrity Operating Windows
Backed by Insights from Global Industry Analysts

By integrating alarm management with operations management reduces one of largest causes of incidents in the process industry today:

*abnormal situations*
Honeywell’s Approach to Operational Integrity

DynAMo® Suite

Alarm Management

Reducing alarm noise and operator error through effective alarm management

Operations Management

Driving informed decisions and operational compliance through safe operating practices

Process Safety Analytics
Identify the Problem
Identify the Problem

• Eliminate Areas of Weakness and Greatest Risk
  • Operator Role Complexity Analysis (ORCA)

• Operator Interviews and Observations
  • Control System Interaction
  • Ergonomic Environment
  • Operator Workflow
  • Process Complexity

  • “To help operators make safe decisions in a timely manner”

• Results of ORCA Identify Areas of Improvement
  • ASM Graphics, Reduction in Control Room Noise, Lighting
  • Improved Alarm Management Practices and Operational Workflow
    • Safety Bypass Management, Shift Handover Processes
Impact of Good Alarm Management

- Poor Alarm Management
- Good Alarm Management
- Alarm and Operations Management

Operator Role Complexity Attainment = (4-Score)/3

Low productivity - operator could handle larger span of control

Higher risk of operator overload during abnormal situations
Alarm Management
Risk Reduction
Alarm Management Risk Reduction

Primary Risk
• 1250 alarms per day
• Alarms that aren’t really alarms
• What does ‘LC728-1A FAIL’ actually mean?

Secondary Risk
• Non-compliance
• Unplanned downtime
• Slow recovery from abnormal situations

Objective
• Reduce Alarms Noise by 60-80%
• Provide real-time Alarm Help and Operator Guidance
• Provide Situational Awareness and real-time Collaboration
• Give advanced warning of Abnormal Situations
### Step 1: Benchmark and track alarm performance

<table>
<thead>
<tr>
<th>Alarm Status</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overloaded</td>
<td>2</td>
</tr>
<tr>
<td>Reactive</td>
<td>0</td>
</tr>
<tr>
<td>Stable</td>
<td>4</td>
</tr>
<tr>
<td>Robust</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alarm Status</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>41</td>
</tr>
<tr>
<td>Jured</td>
<td>32</td>
</tr>
<tr>
<td>Urgent</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KPI</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Alarms</td>
<td>4,963</td>
</tr>
<tr>
<td>Average Alarms (Day)</td>
<td>451.18</td>
</tr>
<tr>
<td>Average Alarms (10 min)</td>
<td>52</td>
</tr>
<tr>
<td>Average Alarms (1 hr)</td>
<td>1,875</td>
</tr>
<tr>
<td>Average Alarms (1 hr)</td>
<td>76.34</td>
</tr>
<tr>
<td>Average Alarms (10 min)</td>
<td>12.18</td>
</tr>
<tr>
<td>Average Alarms (5 min)</td>
<td>15.91</td>
</tr>
</tbody>
</table>

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Step 2: Identify assets most at risk from alarm flooding
### Step 3: Assess operator console workload

#### Alarm Performance Indicator

<table>
<thead>
<tr>
<th>Operator Position</th>
<th>Performance</th>
<th>Average Alarm Rate (15 min)</th>
<th>% Time &gt; 5 Alarms</th>
<th>Peak Alarm Rate (10 min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDC Console</td>
<td>Robust</td>
<td>0.62</td>
<td>80.0 %</td>
<td>257.00</td>
</tr>
<tr>
<td>T&amp;D Console</td>
<td>Robust</td>
<td>0.13</td>
<td>0.10 %</td>
<td>0.80</td>
</tr>
<tr>
<td>HS Console</td>
<td>Robust</td>
<td>0.07</td>
<td>1.56 %</td>
<td>0.06</td>
</tr>
<tr>
<td>Hours</td>
<td>Robust</td>
<td>0.04</td>
<td>5.02 %</td>
<td>0.06</td>
</tr>
<tr>
<td>A/DOT Console</td>
<td>Robust</td>
<td>0.05</td>
<td>1.26 %</td>
<td>22.00</td>
</tr>
<tr>
<td>D2H Console</td>
<td>Robust</td>
<td>0.77</td>
<td>4.78 %</td>
<td>16.00</td>
</tr>
<tr>
<td>Grid Console</td>
<td>Stable</td>
<td>7.51</td>
<td>22.32 %</td>
<td>125.60</td>
</tr>
<tr>
<td>Pro Console</td>
<td>Overloaded</td>
<td>0.07</td>
<td>58.23 %</td>
<td>40.00</td>
</tr>
<tr>
<td>Energy Console</td>
<td>Robust</td>
<td>0.30</td>
<td>0.46 %</td>
<td>1.30</td>
</tr>
<tr>
<td>Dry Console</td>
<td>Robust</td>
<td>0.50</td>
<td>33.33 %</td>
<td>61.00</td>
</tr>
<tr>
<td>Tank Farm</td>
<td>Robust</td>
<td>0.19</td>
<td>0.25 %</td>
<td>7.90</td>
</tr>
</tbody>
</table>

#### Graphs

- **Peak Alarm Rate (10 min):**
  - 10/10/2015 12:30 AM to 10/10/2015 10:00 AM
  - Peak range: 200 to 300

- **% Time > 5 Alarms:**
  - 10/10/2015 10:00 AM to 10/10/2015 12:30 AM
  - Peak range: 40 to 120

- **Average Alarm Rate (15 min):**
  - 10/10/2015 12:30 AM to 10/10/2015 10:00 AM
  - Average range: 0 to 5
Step 3: Assess operator console workload
Step 4: Unlock the knowledge and drive the improvement
Step 4: Unlock the knowledge and drive the improvement
Step 5: Don’t forget the last 20-40%. They make all the difference
Operator Guidance
Risk Reduction++
Embedded Operator Guidance

Document (or pre-load) detailed Alarm Help and Operator Guidance to assist the Operators decision making process. More thinking time equals safer operations.

<table>
<thead>
<tr>
<th>Asset</th>
<th>Service</th>
<th>Type</th>
<th>Setting</th>
<th>Causes</th>
<th>Consequence</th>
<th>Corrective action</th>
<th>Time to Respond</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFE</td>
<td>Charge Pump A Suction Strainer</td>
<td>PDAH</td>
<td>10kPa</td>
<td>Suction strainer plugged</td>
<td>Reduced flow, possible pump damage</td>
<td>Switch to standby pump, initiate strainer cleaning procedure</td>
<td>&gt; 15 min</td>
</tr>
<tr>
<td>FSD</td>
<td>Feed Surge Drum</td>
<td>LAL</td>
<td>20%</td>
<td>FIC set incorrectly down stream feeding the unit above available feed quantity, feed upset in upstream unit</td>
<td>Unit trip</td>
<td>Confirm flow of fresh feed from upstream and flow to the reactors. Correct imbalance to stabilize and restore level</td>
<td>&lt; 5 min</td>
</tr>
<tr>
<td>FSD</td>
<td>Feed Surge Drum</td>
<td>LAH</td>
<td>80%</td>
<td>Upsream unit feed increased without increasing NHT feed rate, decreased NHT reactor charge</td>
<td>Full Feed Surge Drum</td>
<td>Reduce flow into FSD from upstream unit or increase feed to NHT after Feed Surge Drum</td>
<td>5 - 15 min</td>
</tr>
<tr>
<td>CFE</td>
<td>Charge Pump B Suction Strainer</td>
<td>PDAH</td>
<td>10kPa</td>
<td>Suction strainer plugged</td>
<td>Reduced flow, possible pump damage</td>
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Embedded Operator Guidance

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<tr>
<td>FSD</td>
<td>Feed Surge Drum</td>
<td>LAL</td>
<td>20%</td>
<td>FIC set incorrectly downstream</td>
<td>Feed upset in upstream unit</td>
<td>Confirm flow of fresh feed from upstream and flow to the reactors. Correct imbalance to stabilize and restore level</td>
<td>&lt; 5 min</td>
</tr>
<tr>
<td>FSD</td>
<td>Feed Surge Drum</td>
<td>LAH</td>
<td>80%</td>
<td>Upstream unit feed increased</td>
<td>Feed Surge Drum feed rate, decreased, decreased NHT reactor charge</td>
<td>Reduce flow into FSD from upstream unit or increase feed to NHT after Feed Surge Drum</td>
<td>5 - 15 min</td>
</tr>
<tr>
<td>CFE</td>
<td>Charge Pump B Suction Strainer</td>
<td>PDAH</td>
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</tr>
</tbody>
</table>
Deliver it Directly to the Operator

### Alarms Table

<table>
<thead>
<tr>
<th>Date &amp; Time</th>
<th>Location Tag</th>
<th>Source</th>
<th>Condition</th>
<th>Priority</th>
<th>Description</th>
<th>Unit</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/9/2017 13:56:21</td>
<td>DTower</td>
<td>03RC2031</td>
<td>PVHIGH</td>
<td>L 0</td>
<td>Steam Ratio</td>
<td>Ratio</td>
<td></td>
</tr>
<tr>
<td>5/9/2017 13:56:20</td>
<td>DTower</td>
<td>03RC2031</td>
<td>PVLOW</td>
<td>L 0</td>
<td>Steam Ratio</td>
<td>Ratio</td>
<td></td>
</tr>
<tr>
<td>5/9/2017 13:56:11</td>
<td>DTower</td>
<td>03RC2041</td>
<td>PVHIGH</td>
<td>L 0</td>
<td>Steam Ratio</td>
<td>Ratio</td>
<td></td>
</tr>
<tr>
<td>5/9/2017 13:56:10</td>
<td>DTower</td>
<td>03RC2041</td>
<td>PVLOW</td>
<td>H 0</td>
<td>Steam Ratio</td>
<td>Ratio</td>
<td></td>
</tr>
</tbody>
</table>

### Alarm Details

**TC_002**

- **Block:** DACA
- **Boundary:** TIER-2-Hi
- **Time To Respond:** 15 min to 45 min
- **Alarm Limit:** $25
- **Reason:** Drop in consumption
- **Action:** Reduce Fuel
- **Consequence:** MODERATE
- **Condition:** PVHIGH
- **Shutdown Pre Alarm:** False
- **Mode:** Normal
- **Impact:** Reduced Efficiency
- **Additional Info:** Check Downstream consumption

**Unacknowledged alarms:** 4 of 4
**Acknowledged alarms:** 16 of 16
**Shelved alarms:** 0 of 0
**Suppressed alarms:** 0 of 0
Next Step to Operational Integrity

![Diagram showing ORCA Score and Operator Role Complexity Attainment]

- **Alarm and Operations Management**
  - Position Score:
    - High risk of operator overload during abnormal situations
    - Low productivity - operator could handle larger span of control

- **Good Alarm Management**
  - Operator Role Complexity Attainment = (4 - Score) / 3
Operations Management
Securing Integrity through Safe Operations
The Building Blocks of Operations Management

Console Operation Planning
Ensuring operations know exactly what planners, schedulers and optimizers need for that shift.
Effective communication of operating plans to produce what the business actually needs

Operating within Safe and Defined Limits
Ensuring Operations deliver on the plan and operate to that plan within safe operating limits.
Protecting the people, the equipment, and the process

Tracking and Validation of the Operating Plan
Track shift performance against defined plans. Highlight and document deviations from operating plans.
Deviations lead to process risk, damaged equipment, and poor performance

Secure Shift Handover Process
Adopting a best practice for automated shift handover and takeover processes.
Ensuring all deviations, critical alarms, safety bypasses etc. are effectively captured and communicated
A Typical Shift Trend
Operating between the alarm limits
What About Those Other Limits
How safe are we really operating?
Before Alarm and Operations Management

How safe are we really operating?

- High Risk of Safety Incidents, Equipment Damage and Abnormal Situations
- 35% Safe Zone Operation
- Sub-optimal Performance
After Alarm and Operations Management
Stay within the plants limits for safer operations
After Alarm and Operations Management
Stay within the plants limits for increased safety and production

- High Risk of Safety Incidents, Equipment Damage and Abnormal Situations
- 95% Safe Zone Operation
- Sub-optimal Performance
Step 1: Operate within safe limits. On every shift.
Step 2: Identify excursions from safe operating windows
Step 3: Document Deviations and Secure Shift Handover Processes
The Power of Integration
The Power of Integration

Reduce Alarms
- Stale and Standing Alarms
- Safety Bypasses and Inhibits
- Critical Alarm Limits
- Boundaries and Constraints

Secure Integrity
- Secure Shift Handover Process

Reduce Risk
- Limit Deviations
- Excursions from Safe Operations
- Windows
The Power of Integration

Alarm and Limit Documentation Visualized in Experion

Direct to Where the Operator Needs It
The Story So Far..

<table>
<thead>
<tr>
<th>Alarm Management</th>
<th>Combined Value</th>
<th>Operations Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce alarm noise</td>
<td>Compliance to industry standards and best practices</td>
<td>Defining safe operating limits</td>
</tr>
<tr>
<td>Clarity to operators for real alarms</td>
<td>Predict abnormal situations</td>
<td>Staying within those operating limits</td>
</tr>
<tr>
<td>Guiding operations through abnormal situations</td>
<td>Understand the cause of an upset to return to normal, safe control - faster</td>
<td>Elevating communication for safer operations</td>
</tr>
<tr>
<td>De-risking the process</td>
<td></td>
<td>Protecting people, process and assets</td>
</tr>
</tbody>
</table>

**DynAMo®**
- Alarm Management
- Alarm and Operations
- Operations Management
Process Safety
Continuous Innovation
Introducing Process Safety Analytics

DynAMo® Suite

Alarm Management
Reducing alarm noise and operator error through effective alarm management

Operations Management
Driving informed decisions and operational compliance through safe and profitable operating practices

Process Safety Analytics
Introducing Process Safety Analytics

DynAMo® Suite

Alarm Management
Reducing alarm noise and operator error through effective alarm management

Operations Management
Driving informed decisions and operational compliance through safe and profitable operating practices

Process Safety Analytics
Process Safety Analytics

Latest addition to the DynAMo Suite. Deployed with or without DynAMo. Leverages any Alarm and Event Database.
Process Safety Analytics

1. Shutdown Cause and Effect Analysis
2. Safety Valve Integrity Analysis
3. SIL Analytics for Demand Rate Assessments
<table>
<thead>
<tr>
<th>Time Stamp</th>
<th>Safety Element</th>
<th>Operation</th>
<th>Group</th>
<th>Is To Safe State</th>
<th>Description</th>
<th>Operation Status</th>
<th>Travel Time (ms)</th>
<th>Max Travel Time (ms)</th>
<th>Note</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/14/2015 3:00:00 AM</td>
<td>990550007</td>
<td>PCSO Open</td>
<td>Process</td>
<td>0881Y9V01 Typical...</td>
<td>OK</td>
<td>4000.0</td>
<td>30000.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/14/2015 1:05:16 AM</td>
<td>990550007</td>
<td>PDSO Close</td>
<td>Process</td>
<td>0881Y9V01 Typical...</td>
<td>OK</td>
<td>11000.0</td>
<td>15000.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/15/2015 12:05:01 AM</td>
<td>990550002</td>
<td>Return to Nominal</td>
<td>FireGas</td>
<td>08803M (Delegated)</td>
<td>OK</td>
<td>1000.0</td>
<td>45000.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/15/2015 12:05:01 AM</td>
<td>990550002</td>
<td>Return to Nominal</td>
<td>FireGas</td>
<td>0881Y9V01 (Fix)</td>
<td>OK</td>
<td>1000.0</td>
<td>45000.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/15/2015 12:05:01 AM</td>
<td>990550002</td>
<td>PCSO Open</td>
<td>Process</td>
<td>0881Y9V00 FS Type</td>
<td>OK</td>
<td>8000.0</td>
<td>30000.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/15/2015 12:05:01 AM</td>
<td>990550001</td>
<td>Return to Nominal</td>
<td>FireGas</td>
<td>0881Y9B (Bleedoff)</td>
<td>OK</td>
<td>1000.0</td>
<td>45000.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/15/2015 12:05:01 AM</td>
<td>990550001</td>
<td>Return to Nominal</td>
<td>FireGas</td>
<td>0881Y9V01 (Fix)</td>
<td>OK</td>
<td>1000.0</td>
<td>45000.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/15/2015 12:05:01 AM</td>
<td>990550001</td>
<td>PCSO Close</td>
<td>Blowdown</td>
<td>08820B02 Typical...</td>
<td>OK</td>
<td>8000.0</td>
<td>30000.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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</tr>
</tbody>
</table>
### SIL Analytics for Demand Rate Assessments (Safety Instrumented Functions)

**Screen Shot:**
- **Title:** SIL Analytics for Demand Rate Assessments (Safety Instrumented Functions)
- **Content:**
  - **Cause:** Analysis of SIL (Safety Instrumented Function) events.
  - **Effect:** Detailed analysis of events, including timestamps, cause, status, and operator comments.

**Table Preview:**
- **Columns:** Tagname, Description, Timestamp, Cause Status, Effect Status, Operator Comments, and Engineer Comments.
- **Rows:**
  - **Tagname:** Confirmed_Fire_1, Confirmed_Fire_2, etc.
  - **Description:** Specific details of each event.
  - **Timestamp:** Date and time of the event.
  - **Cause Status:** Conditions leading to the event.
  - **Effect Status:** Impact of the event.
  - **Operator Comments:** Actions taken by operators.
  - **Engineer Comments:** Additional insights or observations.

**Notes:**
- The data is presented in a detailed format to help in assessing the demand rate for SIL functions effectively.
- Each event is thoroughly analyzed to ensure accurate and safe operations.

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