PtD Evolution – The Role of Safety/Health Professional In Moving PtD Forward

By: John H. Borowski, CIH, CSP
Director, Health, Safety, Security and Environment
WorleyParsons, Westerns Operations
Monrovia, California
27 Years Experience

10 Years with Black & Veatch (Large Engineering/Construction Firm)
  • Electric Power Generation, Transmission & Distribution
  • Municipal and Private Water/Waste Water Conveyance, Treatment & Distribution

Principal Investigator in Study to Determine Best Practices in Water Utilities Safety and Health
  • Funding by EPA & Water Research Foundation
  • 20 Water Utilities (Asia, Canadian, and US)

Recently moved to WorleyParsons (Design, Engineering and Construction Management)
  • Hydrocarbon Upstream (Exploration & Collection), Transport (pipelines) and Downstream (Refining)
  • Metals and Minerals
Session Goals

- Contrast Excellence with Lagging Performers
- Define PtD – The Engineer’s Definition!
- Define What PtD is *Not*
- Tools to Move PtD Forward
  - Goals & Tactics for Making a PtD Business Case
  - Common Mistakes for Safety/IH Approach to Influencing Projects
  - Best Practices in Prevention-through-Design (PtD)
    - Process
    - Best Practices
    - Future
Observing Evolution of PtD: Industry Sector Leaders

▶ Safety in Design
  - Prevent Injury/Illness
  - Improve Productivity & Quality
  - Largely Driven by Ergo and Human Factors Disciplines

▶ Use Risk Assessment Driven Process – Zero Harm to People/Environment
  - Use hierarchy of controls to achieve a tolerable level of risk
    - As Low As Reasonably Practicable (ALARP)
  - Risk Management/Assessment Practices Required – Mitigation

▶ Incident Investigation and Root Cause Analysis generate Lessons Learned that Drive Improved Understanding of Risk and Behaviors

▶ Behaviors Observed and Tracked (Leading Indicators)
▶ High Expectations are Vertically Integrated- Advanced Skill Set
Observing Evolution of PtD: Lagging Performers

- Sr. Managers and Engineers do not measure or track injury/illness performance
- Poor Incident Investigation & Root Cause Analysis - Do not understand affect of facility design on injury/illness
- Safety, operability, maintainability often not drivers in design process (low cost) – Engineering/Facilities not accountable
- Design process doesn’t ask the right questions
  - “Will this work?”….Instead of: “How will you access operate and maintain the process/equipment?”
  - Current contracts and specifications don’t provide detailed expectations for safety performance
What Is Prevention-Through-Design?

Designing Projects that Meet Technical/Commercial Requirements & Safe to Build and Operate

- Accounting for Intersection of Safe Behaviors and Human Factors
- Plan for O&M task risks/safety prior to and during design
- Alignment of Design and Engineering w/Operations and Maintenance
- Early Involvement of Safety
- Assess & Manage Risk
Philosophy of PtD

Ability to Influence Safety

- Planning
- Design
- Construction
- Commission
- Operation

Constructability

Start
Time
Complete
<table>
<thead>
<tr>
<th>Factor</th>
<th>Conceptual design</th>
<th>Final drawing</th>
<th>Field modifications</th>
<th>Start-up and debugging</th>
<th>After the process is running</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>10</td>
<td>100</td>
<td>1,000</td>
<td>10,000</td>
</tr>
</tbody>
</table>
Contrasting PtD w/ What it is Not

- **PtD:** Collaborate – Apply Lessons Learned to Improve Access, Lifting, Maintenance of Process
- **Not PtD:** Use Anecdotes to Complain

- **PtD:** Participate in Facilitated Process/Facility Risk Review & Assessment
- **Not PtD:** Opportunity to negotiate or air pet peeves

- **PtD:** Advancing Worker Safety (and productivity) by reducing Risk and Improving Access and Tools
- **Not PtD:** OSHA Compliance as Baseline

- **PtD:** Opportunity for Safety Seek to Understand Engineers and Operations (Offer Solutions)
- **Not PtD:** Means to Criticize or Erect Road Blocks w/out Solutions
Safe Behavior

• Attitude
• Knowledge
• System Design

Special thanks to Gary Larson!

Fumbling for his recline button, Ted unwittingly instigates a disaster.
PtD Process

- Risk Register
- Risk Assessment (HAZID/HAZOPS)
- Performance Requirements
- Special Constraints

- Alignment of Operations & Engineering
- Project Specification and Design Instructions

Intermediate design review @ 50 - 60% Complete

90% Review

Commissioning & Inspection

- Prior to detailed design
- In Time for Procurement and Permitting

Prior to Bidding & Construction

Optimize O&M (Safety) Procedures

PtD Carried through by Small Team PtD Leader (Facilitator), Representatives of Engineering, and Facility Operations and Maintenance
PtD Process Example
Alignment & Planning

- Written Procedure
- Alignment – Seek to Understand Customers Culture
  - Risk Management
  - HSE Goals
  - Lessons Learned
  - Programs, Practices & Procedures
- Identify Specific HSE requirements & Goals
  - Access
  - Lifting
  - Chemical Handling
  - Maintainability
- Pre-Plan & Track
  - Stop Points
  - PtD Session Dates
  - Deliverables
PtD Process Example
Facilitated Review Process

► Identify Participants
  • Operations/Maintenance
  • Project Management
  • Design/Engineering Leads
  • Risk Management/Safety

► Communicate and Train Design Team
  • Human Factors for All Participants
  • Relevant Project Documentation
  • Goals and Strategies for Hazard Management

► Identify Opportunities, Hazards and Assess Risks

► HAZID (Hazard Identification) Procedure
  • Develop Risk Register
  • Record Options/Directions for Risk Reduction Measures
PtD Process Example Verification

- Review at Pre-Determined Stop-Points (Minimum 60 %, 90%, and During Commissioning)
  - Prepare for Review Session by Reviewing Specific HSE requirements & Goals
  - Actively Participate & Collaboration
  - 3D Modeling and Other Risk Assessment Software
- Demonstration that asset lifecycle hazards and associated risks have been identified and mitigated
- Existence of processes and tools for identification/assessment of hazards (design through to field execution)
- Risk Reduction Measures implemented in a timely fashion
- Records of the Actions “Closed Out”
Common Mistakes: Implementing PtD

- Depending on “OSHA Compliance” or a “Catastrophe” as primary driver
- Failure to align Project Management & Design/Engineering with Operations and Maintenance
- Failure to Understand and Address key Commercial/Risk Management Challenges
- Failure to Get Involved Early in Project - Construction/Start-Up is too Late!
- Lack of Understanding of “Currency” for Project/Challenge
  - Quality
  - Cost
  - Risk Management
- Failure to Offer Solutions – Only Bring Up Problems
Making a Business Case for PtD

- Identify and Leverage Key Metrics/Drivers
  - Safety as a driver is **Good** – Attention to return-on-investment (ROI) is **Better**
  - Understand “Currency of Change” of the Organization/Project
  - Cast improvements in terms of ROI

- Seek to Align Safety w/ Operations & Engineering
  - Identify Internal Best Practices and Benchmark with Similar Organizations for Best Practices
  - “Own” ROI - commercial (production/reliability) or risk management
Section 1  Walkways, Workspace and Access to Equipment and Materials
Section 2  Railings
Section 3  Stairways, Ramps, Stiles, Walkways and Platforms
Section 4  Ladders
Section 5  Guards: Mechanical, Hot Surface and Chemical Spray
Section 6  Electrical Equipment
Section 7  Access for Physically Disabled Employees
Section 8  Safety Shower/Eyewash Units and Chemical Hazards
Section 9  Occupational Environment
Section 10 Safe Design for Maintenance and Equipment/Material Handling
Section 11 Offshore Facilities
Section 12 Construction Activities
Short Walkways & Access Around Equipment – 30” (762 mm) wide

Main Walkway – 48” (1219 mm) wide

Secondary Walkways 36” (914 mm) wide

Main Egress In & Out of Plant or Deck - 36” (914 mm) wide

Equipment (Including Valves, Handwheels, etc.)

Main Walkway – 48” (1219 mm) wide

Main Walkway – 48” (1219 mm) wide

Short Walkways & Access Around Equipment – 30” (762 mm) wide

Main Walkway – 48” (1219 mm) wide

Equipment

Main Egress In & Out of Plant or Deck - 36” (914 mm) wide
Valves are classified into three categories:

- **Category 1** – Valves and instruments critical for safety or operations. These valves and instruments are also used during frequent and routine maintenance.

- **Category 2** – Valves and instruments not critical for operations but required for routine maintenance.

- **Category 3** – Valves and instruments not critical for operations or routine maintenance and are infrequently used for particular tasks like commissioning, start-up, shutdown, or rarely performed maintenance tasks.
Guidelines for Installation of Valves

(Valves Stem - Vertical Preferred Orientation)
Guidelines for Installation of Valves

(Valve Stem Horizontal Preferred Orientation)

Guidelines for Installation of Valves With Horizontal Valve Stem

- Height Refers to Center of Handwheel (Except as Noted)
- Maximum Elevation Bottom of Handwheel
  7'0" (2134 mm) Min. Head Clearance
- Req'd. Minimum Clearance Zone
  30" Min. (762 mm)
- Face Hazard Elevation
- Tripping Hazard Elevation
- Operating or Emergency
  - Chain-Wheel or Other Offset Drive Required - Elevation Is Undesirable for Valves (Note 2 Below)
  - Valves Are Permissible if Accessible by Portable Platform and Outside of Clearance Zone
- Maintenance
  - 6'3" (1905 mm)
  - 5'10" (1778 mm)
  - Third Choice
  - Third Choice
  - 4'6" (1372 mm)
  - First Choice
  - First Choice
  - 42" (1067 mm)
  - Second Choice
  - Second Choice
  - 24" (610 mm)
  - 10" (254 mm)
- Actual Grade or Platform
  - Acceptable for 4" (102 mm) and Smaller Valves
  - Acceptable for 1-1/2" (38 mm) and Smaller Maintenance Valves

NOTE 1: Protruding Valve Stems Shall Be Guarded by Equipment, Piping, Posts, Railings, Etc.

NOTE 2: Chain Should be Smooth Link - Crimp Link Chains May be Used if They Are Trimmed and Barrel-Tumbled to Remove Sharp Edges - Chain Shall Not Hang in Minimum Clearance Zone - Local Conditions May Prohibit Use of Chain-Wheels
### Figure 6.1: Working Space Requirements

#### Minimum Depth of Clear Working Space in Front of Electric Equipment

<table>
<thead>
<tr>
<th>Condition</th>
<th>Nominal Voltage to Ground</th>
<th>Feet (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Condition 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposed Live Parts on One Side and No Live or Grounded Parts on the Other Side of the Working Space or Exposed Live Parts on Both Sides Effectively Guarded By Suitable Wood or Other Insulating Materials – Insulated Wire or Insulated Busbars Operating at Not Over 300 Volts Shall Not Be Considered Live Parts</td>
<td>0-2,500</td>
<td>3 (914)</td>
</tr>
<tr>
<td></td>
<td>2,501-9,000</td>
<td>4 (1219)</td>
</tr>
<tr>
<td></td>
<td>9,001-25,000</td>
<td>5 (1524)</td>
</tr>
<tr>
<td></td>
<td>25,001-75 kV</td>
<td>6 (1829)</td>
</tr>
<tr>
<td></td>
<td>Above 75 kV</td>
<td>8 (2438)</td>
</tr>
<tr>
<td><strong>Condition 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposed Live Parts on One Side and Grounded Parts on the Other Side – Concrete, Brick, or Tile Walls Will Be Considered as Grounded Surfaces</td>
<td>0-150</td>
<td>3 (914)</td>
</tr>
<tr>
<td></td>
<td>151-600</td>
<td>3-1/2 (1067)</td>
</tr>
<tr>
<td></td>
<td>601-2,500</td>
<td>4 (1219)</td>
</tr>
<tr>
<td></td>
<td>2,501-9,000</td>
<td>5 (1524)</td>
</tr>
<tr>
<td></td>
<td>9,001-25,000</td>
<td>6 (1829)</td>
</tr>
<tr>
<td></td>
<td>25,001-75 kV</td>
<td>8 (2438)</td>
</tr>
<tr>
<td></td>
<td>Above 75 kV</td>
<td>10 (3048)</td>
</tr>
<tr>
<td><strong>Condition 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposed Live Parts on Both Sides of the Working Space (Not Guarded as Provided in Condition 1) With the Operator Between</td>
<td>0-150</td>
<td>3 (914)</td>
</tr>
<tr>
<td></td>
<td>151-600</td>
<td>4 (1219)</td>
</tr>
<tr>
<td></td>
<td>601-2,500</td>
<td>5 (1524)</td>
</tr>
<tr>
<td></td>
<td>2,501-9,000</td>
<td>6 (1829)</td>
</tr>
<tr>
<td></td>
<td>9,001-25,000</td>
<td>9 (2743)</td>
</tr>
<tr>
<td></td>
<td>25,001-75 kV</td>
<td>10 (3048)</td>
</tr>
<tr>
<td></td>
<td>Above 75 kV</td>
<td>12 (3658)</td>
</tr>
</tbody>
</table>
PtD Development Areas

- Safety Coordinators need technical training to be able to interact effectively with engineers
  - Understand How to Read and Interpret Plans/Specifications
  - Better Understanding of Risk Assessment & Human Factors

- O&M workers participating in design reviews need basic training in how to read and understand engineering drawings

- Ergonomics/Human Factors Training for Project Managers, Engineers and Safety Professionals

- Use of 3-dimensional (3-D) simulation software to create virtual facilities that enable viewers to “tour” the planned project

- Systematic tracking of PtD process, Outcomes
John H. Borowski, CIH, CSP
Director, Health, Safety, Security and Environment
WorleyParsons, Westerns Operations
Arcadia, California