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Process Safety Culture - Making This a Reality

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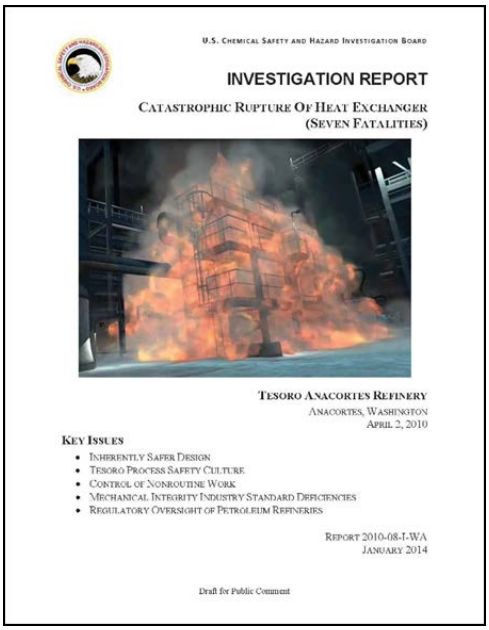
Abstract

Process Safety Culture (PSC) has received considerable attention recently. Many implementers see this as an intangible attribute of a company or site. Some workers see PSC as 'code words" for management not wanting to take responsibility for process safety management. Others see PSC as something that can be affected directly by the actions of management or by an active program targeted directly at the site culture. This paper shows what effects the true "culture" at a site. It shows what Contra Costa County (one regulator) is doing to encourage establishment and measurement of process safety culture. And it shows that tangible, real, activities within a site are what make safety culture a reality. The paper also reviews the approaches to direct and indirect measurement of process safety culture, and the value of these.

Background

On April 2, 2010, the Tesoro Anacortes (WA) refinery experienced a catastrophic rupture of a heat exchanger, causing fatally injuring seven Tesoro employees working in the immediate vicinity. The Draft Investigation Report (CSB, January, 2014) lists "Process Safety Culture" as a key issue and offers the following observations about Tesoro's culture at the time of the accident:

- "Refinery management had normalized the occurrences of hazardous conditions,"
- "The refinery process safety culture required proof of danger rather than proof of effective safety implementation."


U.S. Chemical Safety and Hazard Investigation Board

INVESTIGATION REPORT

CATASTROPHIC RUPTURE OF HEAT EXCHANGER
(SEVEN FATALITIES)

TESORO ANACORTES REFINERY
ANACORTES, WASHINGTON
APRIL 2, 2010

KEY ISSUES
- INHERENTLY SAFER DESIGN
- TESORO PROCESS SAFETY CULTURE
- CONTROL OF NONROUTINE WORK
- MECHANICAL INTEGRITY INDUSTRY STANDARD DEFICIENCIES
- REGULATORY OVERSIGHT OF PETROLEUM REFINERIES

REPORT 2010-08-I-WA
JANUARY 2014

Draft for Public Comment

On March 23, 2005, the BP Texas City (TX) refinery experienced the most serious U.S. workplace disaster of the past two decades, resulting in 15 deaths and more than 170 injuries. The Baker Panel reported that deficiencies in "BP's corporate safety culture, corporate oversight of process safety, and process safety management systems" were contributing factors to this and other incidents which had previously occurred at BP facilities.

On January 28, 1986, the space shuttle Challenger exploded killing all 7 astronauts on board. The Rogers Commission reported that NASA's organizational culture failed to prevent this accident. Seventeen years later, on February 1, 2003, the space shuttle Columbia disintegrated upon re-entry of the Earth's atmosphere killing all 7 astronauts on board. The Columbia Accident Investigation Board (CAIB) reported that "In our view, the NASA organizational culture had as much to do with this accident as the foam." The CAIB also found "disturbing parallels remaining" from seventeen years earlier, making the determination that "NASA had not learned from the lessons of Challenger."

Our collective history is filled with tragic accidents, life altering events, fatal injuries, and incidents affecting entire communities and industries. The origin of the root causes of many of these can be traced to a flawed leadership decisions which is exhibited as poor organizational culture.

In June 2006, the Contra County Board of Supervisors recognized the importance of a strong process safety culture in minimizing accidents. An amendment was adopted to the Contra Costa County and City of Richmond Industrial Safety Ordinances requiring that all covered facilities perform an initial Safety Culture Assessment within one year, and at least once every five years thereafter.

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Defining Process Safety Culture

Culture is defined by Merriam-Webster as "the set of shared attitudes, value, goals, and practices that characterizes an institution or organization." Process safety culture is defined by the Center for Chemical Process Safety (CCPS) as "How we do things around here." "What we expect here." And "How we behave when no one is watching."

Culture exists and is influenced on many levels. Individuals within an organization have their own set of beliefs and values based on their personal biases and experiences. Leaders within an organization have their own set of individual beliefs and values as well, but they also have a broader accountability for the organization's well-being. Leaders influence others on a daily basis through their conversations, their decisions, their behaviors, and their actions. Collectively, groups within an organization shape their own cultural identity through the perceptions, interactions, and behaviors of their group members. Individual values may be suspended in certain circumstances in order to maintain favor, status, and even membership within the group. Organizational culture may reflect the collective values of individuals and groups, the personalities of charismatic leaders, shifting priorities based on the perceived scarcity of resources or actions necessary for survival, or a long storied history of successes, behaviors, myths, and legends.

In short, culture is a very complex concept, and it can be very difficult to measure, influence, and manage. Most would agree that it is difficult to assign an absolute, quantitative measure of good or bad Culture. However, it is possible to identify, measure, analyze, and improve certain activities and characteristics that are recognized as key components of a positive process safety culture.

In studying the NASA Space Shuttle Disasters, the CCPS (March, 2007) identified six core principles necessary to maintain a positive safety culture. These are:

- Maintain a Sense of Vulnerability
- Combat Normalization of Deviance
- Establish an Imperative for Safety
- Perform Valid/Timely Hazard/Risk Assessments
- Ensure Open and Frank Communications
- Learn and Advance the Culture

The Baker Panel report organized their findings into slightly different, and perhaps more measurable, categories for evaluating process safety culture. These are:

- Process Safety Leadership
- Employee Empowerment
- Resources and Positioning of Process Safety Capabilities
- Incorporation of Process Safety into Management Decision-Making

Regardless of the model structure chosen or the descriptions assigned to different categories, rest assured that process safety culture is a very real, finite, and tangible concept which can be measured, monitored, and improved over time. Proactively working toward a more positive process safety culture will minimize process safety incidents, and this will save lives.

Examples of Process Safety Culture

Process Safety Leadership

Some organizations choose to develop their leaders through broad but brief exposure to many different business situations and challenges. While this may create successful leaders conversant in a wide variety of disciplines and business models, it may not create leaders who are connected with the people they lead and who are committed to long-term, sustainable process safety goals. It also may not give them time to build a core competency or appreciation for process safety. Their rapid fire, goal oriented decisions may yield strong quarter to quarter results, but too often these leaders have moved on to their next challenge long before the true impact of short-term thinking has been realized.

> ***Example:*** A management decision to reduce costs (staffing, maintenance, and capital budgets). While this may increase near-term profits, what are the longer range impacts of neglected equipment, deferred investments, and lost human talent? To paraphrase a renowned process reliability expert, there has never been a case where cutting critical talent has saved an organization; in fact it speeds its demise. (7)

Rapid management turnover may also create a frenetic “programs of the day,” characterized by slogans, banners, key chains, and revised individual goals and objectives. As revolving managers compete for boardroom attention, scarce organizational resources are redeployed on the latest management fads. An overloaded and confused workforce is left with minimal guidance and no long term direction; given enough changes like these, workers distrust any new initiative. Both

short-term thinking and frequent site management changes (every 10 months on average) were listed as safety culture deficiencies at BP Texas City in the Baker Panel report (10) and CSB investigation (9).

Effective leadership seeks to understand true root causes and permanently resolve issues with solid solutions, not temporary and ineffective "bandaids". CSB concluded that at Tesoro (11), management complacency had normalized the routine occurrence of hazardous conditions by using steam to mitigate heat exchanger leaks rather than investigating and resolving their root cause. Leaks and other mechanical issues had become so common that additional operators were routinely assigned to assist with leak detection and leak management during startup of the unit. "This past practice contributed to the presence of the six additional workers in the unit during the April 2010 incident."

> ***Example:*** *Effective management would take these lessons learned and turn them into concrete key performance indicators. In the Tesoro example this could include measuring and monitoring Temporary Leak Repairs (TLR), those repairs that are not permanent, with an overall target of zero TLRs that are older than one month. Then, one category of TLR would be heat exchanger leaks, another clamps on lines, and another clamps on flanges.*

Effective management is committed to the underlying health and well-being of the organization. Slogans and banners are replaced by high standards, shared values, and core-beliefs which sustain the organization regardless of who is in charge. Safety, quality, and efficiency become the cornerstone upon which all decisions rest. Effective management leads by asking the questions that matter about the things that matter, by recognizing, rewarding, and engaging those who uphold the right values and beliefs, and by setting the example for others to follow through their actions, deeds, and decisions.

Employee Empowerment

The term "empowerment" may be a favorite buzzword of Dilbert's pointy haired boss, but it remains a critical component of a positive safety culture in spite of the word's overuse. Front line employees are already heavily invested in process safety since they are the people with the highest potential for exposure and the greatest personal risk. Involving employees at all levels of the organization in process safety management ensures that it is widely understood and supported. This has the added benefit of recruiting additional resources (with intelligent minds and experienced hands) to support the often overwhelming multitude of tasks that must be completed, such as hazard evaluations, incident investigations, procedure validation, and training. Spread the wealth, share the knowledge, release the reins (allow workers to be in charge of key activities/programs), and reap the benefits.

In a positive process safety culture, empowerment often begins with instilling the authority in EVERYONE to question decisions which are being made about process safety.

> ***Example:*** *At one refinery, one of the most widely supported initiatives is called "Stop Work Authority" (SWA). Every employee has the right to call time-out whenever they are uncomfortable with the safety of anything that might be going on. Work is immediately stopped, a meeting of knowledgeable people is convened, the concerns are discussed, and work proceeds only when everyone agrees that appropriate measures have been taken and it is safe to move ahead. There are no repercussions to invoking SWA and in fact, favorable stories are frequently shared where the worker is cast as hero by preventing a potential incident from occurring. Unfortunately, the implementation of SWA for maintenance tasks (typically related to occupational safety impacts) has worked great while the implementation of SWA for operational issues (typically related to process safety impacts) may not be as effective. Management will sometimes start, restart, or fail to stop a process even when workers are very concerned over the lack of adequate safeguards for the current situation. In the eyes of the employees, management's unwavering support of SWA appears to wane as the financial consequences of stopping work (i.e. halting production) increase.*

Some less effective organizations embraced a "whatever works" approach where the ends justify the means. Standard operating and maintenance procedures and stop work policies were ignored in the interest of saving time or money (short-term). Errors and failures went unreported because doing so will get a worker or their friend in trouble. Supervisors looked the other way when shortcuts are taken, reacting only when required to do so because a poor result, an injury, or a loss event could no longer be hidden.

> ***Example:*** *Operations has a chattering high level alarm. Some individuals might shelve or disable the alarm for now, deferring action for as long as possible, hoping it will either go away or at least wait until the next shift arrives. Unfortunately, deferred action often increases the potential process risks (eliminating an independent protective layer) and results in even greater losses, since the real issue (a failed bottom's pump for example) continues undetected until it can no longer be ignored.*

In a positive process safety culture, individuals acknowledge the problem immediately, manage the risks appropriately, investigate the potential causes, and take corrective action to restore the system to a safe operating posture. **They know that timely and permanent fixes are less expensive and less hazardous than temporary measures**, and they don't need a supervisor to tell them to follow procedures and rules. They hold themselves and each other accountable because it is the right thing to do. They value the training they receive, they freely share their knowledge and experience with new colleagues, and they proactively take action to resolve any problems they encounter.

Some less effective organizations were characterized by a culture of making excuses and assigning blame. An unhealthy climate existed where the first question asked was "who is responsible" and the automatic response was "not me, I didn't see a thing." In this environment people lacked trust in each other and in their leaders. Real issues were hidden as long as possible, people were afraid to show weakness by asking for help, and people were hesitant to accept positions of accountability. Leaders were often the first ones blamed when things inevitably went wrong

> ***Example:*** *An incident occurs which appears to be caused by a shortcut taken from the written procedures. The individual is disciplined, the entire work group is retrained in the correct procedure, and management gets to show how tough they are on enforcing adherence to procedures and on quick correction of poor safety performance. Never mind the fact that 25% of the procedure steps are inaccurate so no one uses the written procedure anymore, and/or a missing tool has been on back order for two months, and/or the supervisor himself had taken the same shortcut last month when he thought no one was looking.*

In a positive process safety culture, the first questions following an incident are what and why, not who. Those are followed by asking how we can improve the procedures, task design, practices, equipment, and management systems to prevent this from ever happening again. All incidents are reported and investigated without blame. Root causes (management system failures) are identified and corrective measures are taken to implement sustainable and permanent solutions. Trust and collaboration are high because the ***culture*** is blame free when it comes to mistakes. People ask for help when they need it and give help without being asked.

One of the keys is for Management to commit to a blame free ***culture*** for near misses reported and for investigation findings (except for sabotage, of course). If this is set and management sticks to it, then near miss reporting will go up and empowerment to fix problems will go up, because people are no longer ducking for cover knowing someone will be blamed for every human error. Management needs to learn and teach to all workers that Errors cannot be avoided when humans are involved and that not recognizing and reporting errors and failures will simply increase the overall risk. If errors and failures are reported, then the root causes of the human errors can be found and the error rates lowered or the human errors mitigated in some way.

Resources and Positioning of Process Safety Capabilities

Almost all organizations talk about their commitment to maintain a safe workplace. Their walls are covered with banners that say “Safety First”, “Zero Incidents”, and “Think Before You Act”.

One true test of organizational culture lies in the meaningful commitment of time and resources necessary to make those slogans mean something. Do they “put their money where their mouth is?”

In a strong process safety culture, accountability for process safety is assigned in a direct line that runs from the CEO through the unit managers and straight to the process operator. An unwavering commitment is made to develop and provide expertise at every level of the organization, decisions are consistently guided by their potential impact on process safety, and individual goals incorporate process safety metrics (leading indicators, not lagging indicators like number of losses and injuries) as a primary measure of performance. Promotions and rewards are unquestionably connected to demonstrated commitment to process safety.

Weaker organizations might commit resources on paper, but then fill those roles with ineffective or incompetent people. For example, trainers may show up on the organizational chart as a full time position. In reality though, trainers are often used as utility staff, handling special projects, greeting visitors, leading tours, and working on new initiatives. Training materials become obsolete, drills and training sessions get delayed, CBT's replace instructor led classes in the interest of "efficiency," and over time the knowledge and preparedness of staff at all levels erodes. Stronger cultures understand the importance of training and they invest in developing and maintaining the skills of their people.

Strong organizations will measure resources and financial investment as a leading indicator of process safety culture. Examples are inspection, testing and preventive maintenance (ITPM), maintenance budgets, capital investment, operating procedures, and emergency preparedness. A quick walk around the plant can give some measure of process safety culture. Are fences in good repair? Are tanks and lines labelled and painted? Are pipe supports clearly intact and maintained? If not, first impressions are often a good early indicator of a crumbling infrastructure and deterioration within. Of course, for a deeper measure of culture, an in-depth audit of the ITPM plans, programs, and procedures is necessary. Measure the timeliness of correcting deficiencies, adherence to ITPM schedules/procedures, and the expansion of problems detected in one area to investigate similar applications in other areas.

Incorporation of Process Safety into Management Decision-Making

Weaker organizations focus primarily on lagging indicators of safety performance, without considering how results are achieved. Loss of containment events, occupational injuries, and regulatory citations are used to measure performance and reward success. Safety prizes are handed out whenever a new milestone is achieved. Compliance with the regulations is considered to be good enough. They may be reluctant to conduct safety audits because audits find things that need to be fixed and fixing things costs money. Training is done only when required, it is done as expediently as possible and always with an eye on the costs. Programs that focus on employee behaviors are popular because they cost very little to implement and they may be effective in the short term in reducing some types of injuries. Unfortunately, these also inadvertently and wrongly blame error rates on "individual behaviors and attitudes" rather than management systems and controls designed to minimize human error rates. Each individual is responsible for their own behavior, right? Well in a general sense, this is true enough; but the statement is often misused to imply that perfect control of human error is a possibility and even a valid expectation. Zero human error rates are NOT a possibility. That is why we need multiple layers of protection against major accidents.

***Example**: The lowest measured limits for human error rates are in the airline industry. Pilots performing routine tasks multiple times per day with excellent control of human factors have demonstrated error rates as low as 1/200 (0.5%). In the process industry it is generally believed that error rates as low as 1/100 (1%) are achievable with excellent control of human factors, although this has not been demonstrated. The actual error rate increases with the influence of human factors such as high task complexity (up to 5 times), low experience and training (up to 10 times), or high fatigue (up to 20 times). Fortunately, both airplanes and process units have multiple layers of protection which limit the probability that a single human error will become a major loss event. These layers of protection must include effective control of human factors to allow humans to perform as close as possible to optimum levels.*

In a positive process safety culture, organizations understand that the "process" (the path) is inseparable from the "product" (the result); if they do the right things right, then the results will follow. They monitor leading performance indicators through periodic audits of compliance and ongoing measurement of activities – and they tie individual promotions, recognitions, and rewards to achieving these goals. They evaluate the accuracy of procedures, the completeness of permits, and the condition of the workplace. They measure completeness, timeliness, and effectiveness of training, preventative maintenance tasks, action items and repairs, and hazard evaluations. They make sure that inherently safer, long term fixes are expedited rather than continuing to rely on temporary measures. They measure the level of employee engagement, the number of safety meetings held, the ratio of near loss to loss incidents reported, and the number of investigations completed. When an accident does occur, they don't panic and run for cover – they learn from their failures and they strengthen their defenses.

Example: Process Safety Metrics - leading indicators of a positive PSC

Mechanical Integrity

- *Timely completion of ITPMs including documentation/analysis/follow-up on "as found" data*
- *Backlog of process safety and process integrity work orders*
- *Maintenance emergency repairs and break-in work versus planned maintenance*
- *Temporary leak repairs*
- *PMI inspections performed*
- *Effective "bad actors" program*

Action Item Follow-up

- *Timely completion of recommendations and action items (from all sources including PHAs, IIs, PSSRs, MOCs, Compliance Audits)*
- *Audit of closure process for completeness and effectiveness*

Management of Change

- *Timely completion of temporary and permanent MOCs*
- *Audit/review of maintenance and project work orders for proper use of MOC system*
- *Audit/review of DCS programming changes fort proper use of MOC system*

Process Safety Competence

- *Timely completion of process safety trainings*
- *Evaluation of operator response to process safety events*
- *Field verification and validation of operating and maintenance procedures*
- *Reporting ratio of near loss incidents to loss incidents (NLI/LI)*
- *Timely completion of incident investigations*
- *Analysis (trends) and follow-up on incident investigation results*
- *Contractor compliance audits*

Human Factors Control

- *Compliance with fatigue management guidelines (overtime hours, consecutive days worked)*
- *Observation of pre-job planning activities, shift turnovers, and radio transmissions (communications)*
- *Evaluation of Human Machine Interfaces (HMI)*
- *Staffing, vacancies, absenteeism*
- *Job experience, certifications, and training levels*
- *Effective use of "Management of Organizational Change" processes*

Real Examples of GREAT Process Safety Culture

Kemya (Al-Jubail Petrochemical Company; SABIC affiliate, partnered with 50/50 with Exxon) - example of GREAT culture from day one, continuity; sustainability … stemming from initial and continued excellent leadership.

- Operating since 1985. Petrochemical process in Jubail, Saudi Arabia, makes ethylene, polyethylene
- Established strong process safety culture in first year(s) and maintained consistent management vision from the initial startup
- PSM designed around Exxon Operating Integrity Management System (OIMS)
- Invested in strong initial process safety engineering and process safety management competencies
- Invested (continual) in empowering workers to take leads on writing procedures, helping to manage changes, investigations, near miss reporting, etc.
- New workers immediately begin build competencies in process safety.
- Workers help train each other to "fix" a procedure or task instruction rather than "oh, let's not follow that because the steps are not correct in it"
- Thorough risk review of all hazards and tasks

- Leadership today sustains the SAME vision as was established originally; no-one has come in and slashed the programs that sustain the equipment and competencies and maintain the equipment (but that could happen; it has happened in other sites we have been to that went from great PSM to poor PSM
- They score high on process safety competencies and PS culture on interviews
- Same for occupational competencies (workers learn to do JSA in their first few months onsite)
- Their 29 year record in safety is best in class!

BP Cherry Point Refinery - example of GREAT culture from day one, continuity; sustainability … stemming from initial and continued excellent leadership.

- Cherry Point, WA, USA
- 800 workers onsite; produces gasoline, diesel, and other fuel products from crude oil
- Operating since 1971
- Establish strong process safety culture early (24 years ago, under Arco) and maintained consistent management vision since then
- Refinery management did not compromise on budgets for critical competencies and activities
- PSM designed initially around WISHA (Washington State, USA) PSM standard
- Invested 12-7 years (continual) in empowering workers to take leads on writing procedures, helping to manage changes, investigations, near miss reporting, manage changes; provided skill training and coaching on all topics for the workers involved in these activities
- One operator from each refinery unit rotates every two years into a process safety group that manages process safety day-to-day (MOCs, risk reviews for MOCs, investigations, procedure updates, human factors evaluations, etc.)
- Provided training to all staff at levels on process safety, human factors, tailored to each group:
  - Process engineering
  - Management/Leadership
  - Operators
  - Maintenance
- New workers immediately begin build competencies in process safety.
- Workers help train each other to “fix” a procedure or task instruction rather than “oh, let’s not follow that because the steps are not correct in it”
- Thorough risk review of all hazards and tasks
- Leadership today sustains the SAME vision as the past 15 years; no-one has come in and slashed the programs that sustain the equipment and competencies and maintain

the equipment (but that could happen; it has happened in other sites we have been to that went from great PSM to poor PSM)
- They score high on process safety competencies and PS culture on surveys (highest scores on PS Culture during the Baker Panel surveys across all of BP USA)
- Their process safety performance in the past 15 years is best in class!

Process Safety Culture Qualitative Assessment

Some quantitative measures of process safety performance, such as the process safety leading indicators discussed earlier, are also indicators an organization's process safety culture. Often, these can be compared across different facilities and even across different industries to establish standards and gauge the relative effectiveness of organizations. However, many of the more qualitative elements of culture may be unique to an individual facility or even to a specific work group within the facility. It is very difficult to compare results and establish qualitative standards across different work units, but it is still possible to establish a baseline and measure progress over time within the same (or similar) work units.

When conducting a culture assessment, data is best collected in a variety of ways designed to encourage complete and accurate disclosure while minimizing any bias imposed by the collection process. Result can then be compared to eliminate (or explain) inconsistencies. Various collection methods consist of:

- Written surveys
- Focus Group Interviews
- Individual Interviews
- Field Observations

Written surveys, such as the Baker Panel Survey Instrument, are useful for comparing and measuring shifts in employee perceptions over time. Written surveys are easy to administer and analyze, and they can be useful in measuring perceptions. However, written surveys are limited by their impersonal nature, the limited scope of the questions, and the inability to follow up with additional questions to better understand why people feel the way they do.

EXAMPLE: Example Questions from the Baker Panel Written Survey

- *I have received training on hazard identification, control and reporting in the last 12 months.*
- *I believe a culture exists as this facility that encourages raising process safety concerns.*
- *Management puts a high priority on process safety through actions and not just empty slogans.*
- *There is usually sufficient staff in my work group to perform my job safely.*
- *In my work group, process safety concerns are secondary to achieving production goals.*
- *Written operating procedures (or checklists/job aids) are regularly followed.*
- *Interlocks, alarms, and other process safety-related devices are regularly maintained.*

- *Workers sometimes work around process safety concerns rather than report them.*
- *The process safety training that I have received allows me to recognize when a process should be shut down if safety critical interlocks, alarms or other process-safety devices fail or become unavailable during operation.*

Focus group interviews are a potentially valuable tool for obtaining qualitative clues and insights into how people feel or think about an issue or concept. The participants are selected because of a common relationship to the topic being analyzed. For example, people with similar organizational roles (supervisors, mechanics, or operators) or people within a common work group (a common process unit or department). The moderator's role is very important in guiding the discussion, asking open-ended questions, staying on task, encouraging full engagement, avoiding dominance, and seeking alternate perspectives. Participants often build on each other's ideas bringing issues to the table which might otherwise lay dormant, but some individuals may not be as forthcoming with conflicting or sensitive information in this setting.

Individual interviews often provide more candid and concrete examples of behaviors, actions, events, and stories that support individual perceptions and feelings. The moderator must be able to establish rapport, assure confidentiality, ask open-ended questions, and avoid judgmental or leading responses. A sufficient number of interviews are necessary to ensure that the findings are representative of the work group being studied and to help protect the identity of individuals. A sample size of 10-15% is usually necessary to establish statistically significant results.

When conducting safety culture interviews, it is useful to provide the moderator with an interview guide to help keep the conversation flowing on relevant topics. Following is an example of an interview guide developed by PII for use with a specific client:

EXAMPLE: Question Categories for Individual Safety Culture Interviews

- *Accountability (Responsibilities well defined, challenges for meeting them?)*
- *Learning (Competence, time allocated to training, too much, too little, cancellations?*
- *Corrective action program (Issues are addressed, timely appropriate?)*
- *Commitment (Management support, importance of safety, personal involvement?)*
- *Reporting and environment for raising concerns (Near misses, Willingness, practices, hesitation, and retaliation?)*
- *Change Management (reorganization, organizational changes preparedness, effectiveness)*
- *Work control, work practices (empowerment, being able to stop processes, direct instructions, procedure quality)*

Field observations are another source of data for evaluating an organization's process safety culture. These may be performed as a general walk through of a unit, observing behaviors, human factors, and the work environment – but the best data is collected with a specific purpose in mind such as an evaluation of operating procedures, human machine interfaces, shift exchange processes, or operator response to critical alarms. PII has developed and used a variety of guidelines and checklists to assist in the collection of field data.

Process safety culture can be qualitatively measured through a combination of methodologies such as surveys, interviews, and observations. However, it is important to note that the perceptions and opinions are NOT always reflective of the culture itself. Attempts to compare perception data across different organizations may be misleading. However, culture assessments conducted over time within an organization can identify trends and relative changes in perception which point to successes and improvement opportunities. Process safety culture perception measurements coupled with a strong set of process safety metrics will (especially those metrics targeted on investments and leadership), over time, establish a solid baseline for monitoring and improving organizational performance.

PSC Measurements Required by CCHMP

The **Contra Costa County Hazardous Materials Program** (CCHMP) is considered to be one of the elite regulatory agencies in the United States. Located in a densely populated and environmentally sensitive region on the Northeastern shores of the San Francisco Bay, CCHMP is charged with the mission of protecting "human health and the environment by promoting pollution prevention, increasing process safety knowledge and environmental awareness, responding to incidents, and implementing consistent regulatory compliance and enforcement programs."

CCHMP oversees compliance with both the Contra Costa County Industrial Safety Ordinance (ISO) and the Richmond Industrial Safety Ordinance (RISO). These require regulated facilities to implement programs to prevent chemical accidents from occurring that could have a detrimental impact to the surrounding communities.

Recognizing the importance of PSC in preventing process accidents, ISO was amended in June 2006 to include the requirement that facilities conduct an initial Safety Culture Assessment, and then at least once every five years thereafter. The amendment also allows CCHMP to "perform its own Safety Culture Assessment after a Major Chemical Accident or Release or the occurrence of any incident that could reasonably have led to a Major Chemical Accident or release, or based on CCHMP audit results."

The Contra County Guidance Document for Safety Culture Assessment (Section F, June 15, 2011) allows a great deal of latitude to facilities in selecting an assessment methodology, as long as the following attributes are assessed:

- Management Commitment and Leadership
- Individual Performance and Accountability
- Peer Perception and Accountability
- Safety Program Performance

The first three components (leadership, individual, and peer-to-peer) can be measured qualitatively through interviews, surveys, and observations of the organization. The fourth component (performance) can be measured directly through leading and lagging performance metrics such as timely closure of process safety recommendations and action items, completion of scheduled

inspections, tests, and preventative maintenance tasks, the ratio of near loss incidents to loss incidents reported and investigated, and the number of process safety related events.

ISO/RISO Covered Facilities

- *Shell Martinez Refinery*
- *Tesoro Golden Eagle Refinery*
- *Phillips 66 Rodeo Refinery*
- *Air Products at Shell*
- *Air Products at Tesoro*
- *Air Liquide Large Industries at Phillips 66*
- *General Chemical Bay Point (now Chemtrade)*
- *Chevron Richmond Refinery*
- *General Chemical Richmond (now Chemtrade)*

Early Results and Future Plans at CCHMP for PSC

It is still too early to tell what impact the ISO PSC assessment requirements will ultimately have in preventing chemical process accidents.

All of the regulated facilities have completed their initial PSC assessments, but most were already conducting periodic assessments on their own. Written surveys are the norm with the Baker Panel survey serving as the model for most. Some companies have developed their own corporate instruments. None have reported the use of focus groups, individual interviews, or observations for their PSC assessments.

All companies have also developed both leading and lagging process safety metrics based primarily on data they were already collecting. They are measuring and monitoring this data internally to identify improvement opportunities and measure the success of their process safety initiatives.

CCHMP is continuing to work with our facilities to develop better process safety metrics, better PSC assessment tools, and a deeper understanding of the dynamic relationship between workers and management which helps explain why some prevention programs are more successful than others. Continued measurable success will encourage facilities to further expand their process safety improvement ideas and extend their programs beyond the minimum regulatory requirements.

Acronyms Used

AIChE – American Institute of Chemical Engineers
CCHSD -- Health Services Division of Contra Costa County, California, USA
CCHMP – Contra County Hazardous Materials Program, California, USA

CCPS – Center for Chemical Process Safety (of AIChE)
CFR – Code of Federal Regulations
EPA – Environmental Protection Agency (USA)
ITPM – Inspection, Testing, and Preventive Maintenance
LOPA – Layer of Protection Analysis
MOC – Management of Change
PHA – Process Hazard Analysis
P&ID – Piping & Instrumentation Diagram
PSI – Process Safety Information
PSM – Process Safety Management
RAGAGEP – Recognized and Generally Accepted Good Engineering Practice
RBPS – Risk-Based Process Safety
RCA – Root Cause Analysis
US EPA – United States Environmental Protection Agency
US OSHA – United States Department of Labor, Occupational Safety and Health Administation

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