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PSM: Process Safety Management

Table of content:

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1. General Info:

- PSM system.
- Introduction to PSM
- Why PSM
- HHC
- Recent major Disaster
- Brazilian Oil Platform Sinking
- PSM is sub-sys of Safety
- PSM system Possible elements
- PSM around the worlds.

2. Targets and Failed on LOPA

3. PSM Elements:

- Process Safety Information
- Employee Involvement
- Process Hazard Analysis: What if, FMEA, HAZOP, FTA
- Operating Procedures
- Training
- Contractors
- Pre-Startup Safety Review
- Mechanical Integrity
- Hot Work
- Management of Change
- Incident Investigation
- Emergency Planning and Response
- Compliance Audits
- Trade Secrets

4. PSM Implementation: PSM, PSP, HSEMS, OHSAS18001

5. Document Needed

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General Information

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What is system safety?

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The system safety concept is the application of special technical and managerial skills to the systematic, forward-looking identification and control of hazards throughout the life cycle of a project, program, or activity. The concept calls for safety analyses and hazard control actions, beginning with the conceptual phase of a system and continuing through the design, production, testing, use, and disposal phases, until the activity is retired.

PSM is a system.

- What is system? Organization elements
- How system is work? PDCA
- For more inform. Look to HSE awareness Presentation.
- How to implement PSM?
- What are main problems?
- safety culture,
- Cost and budget,
- knowledge and experiences: Know Operation, Know procedures
- team work,
- define responsibilities,
- change organization.

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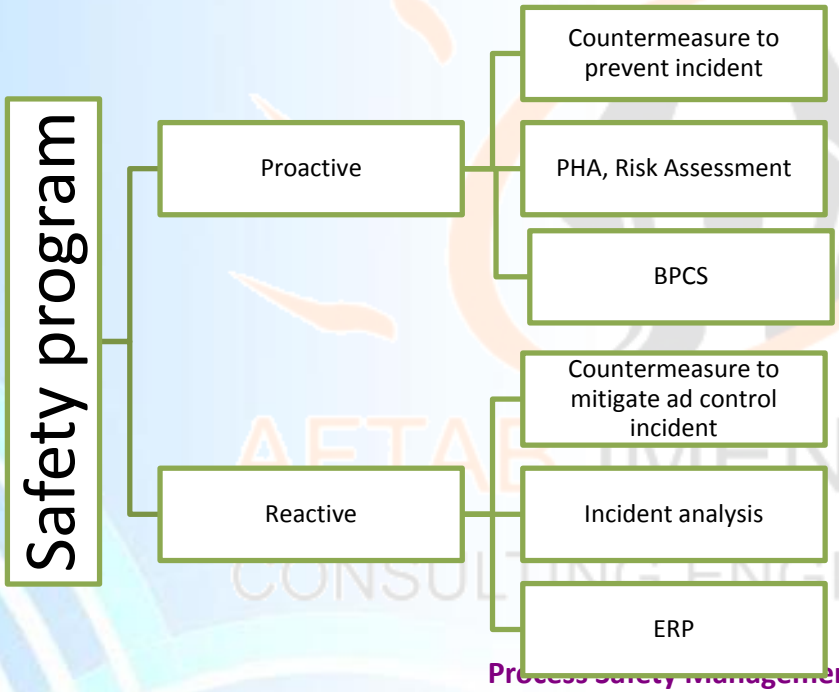
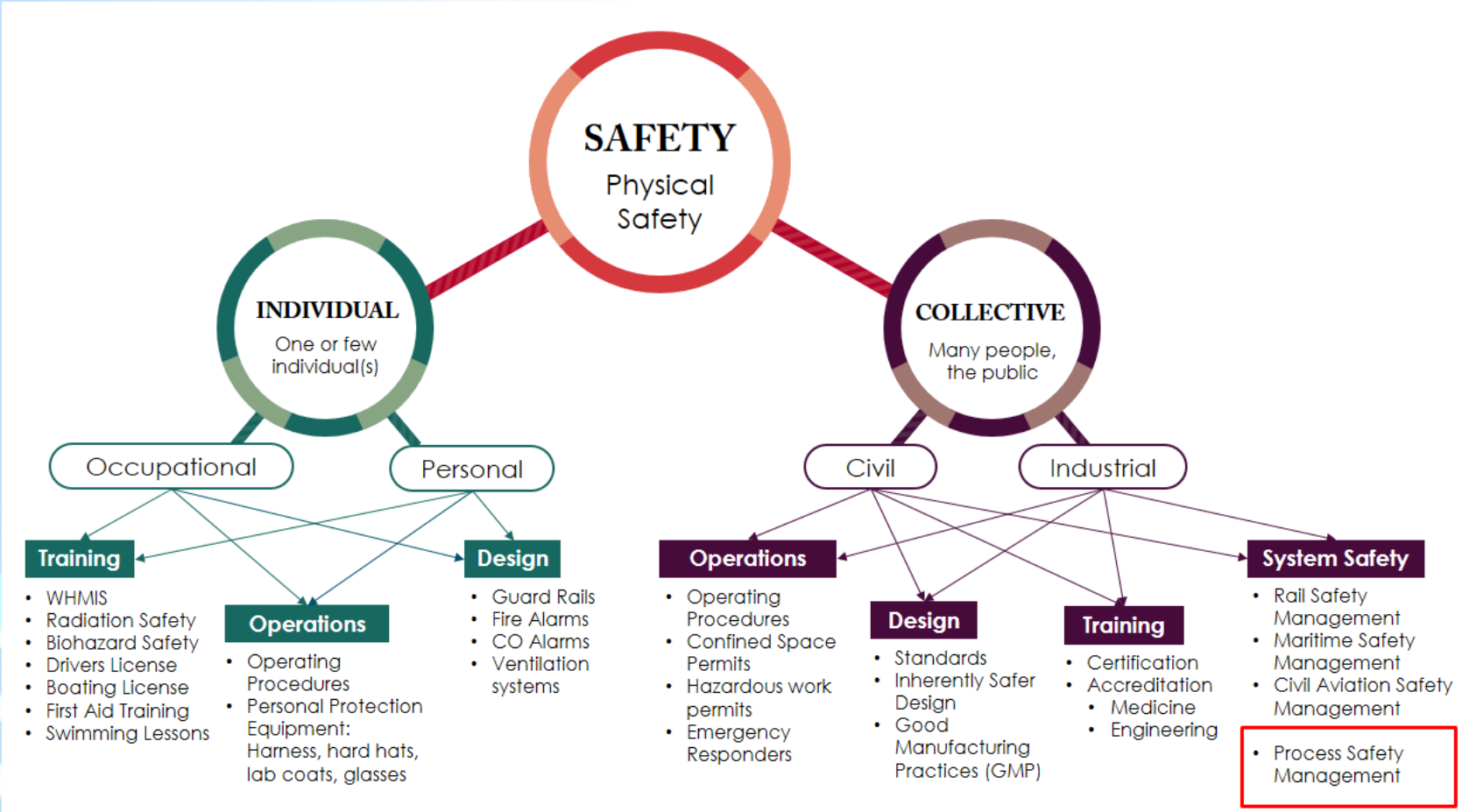
PSM is a Proactive Risk Based Approach

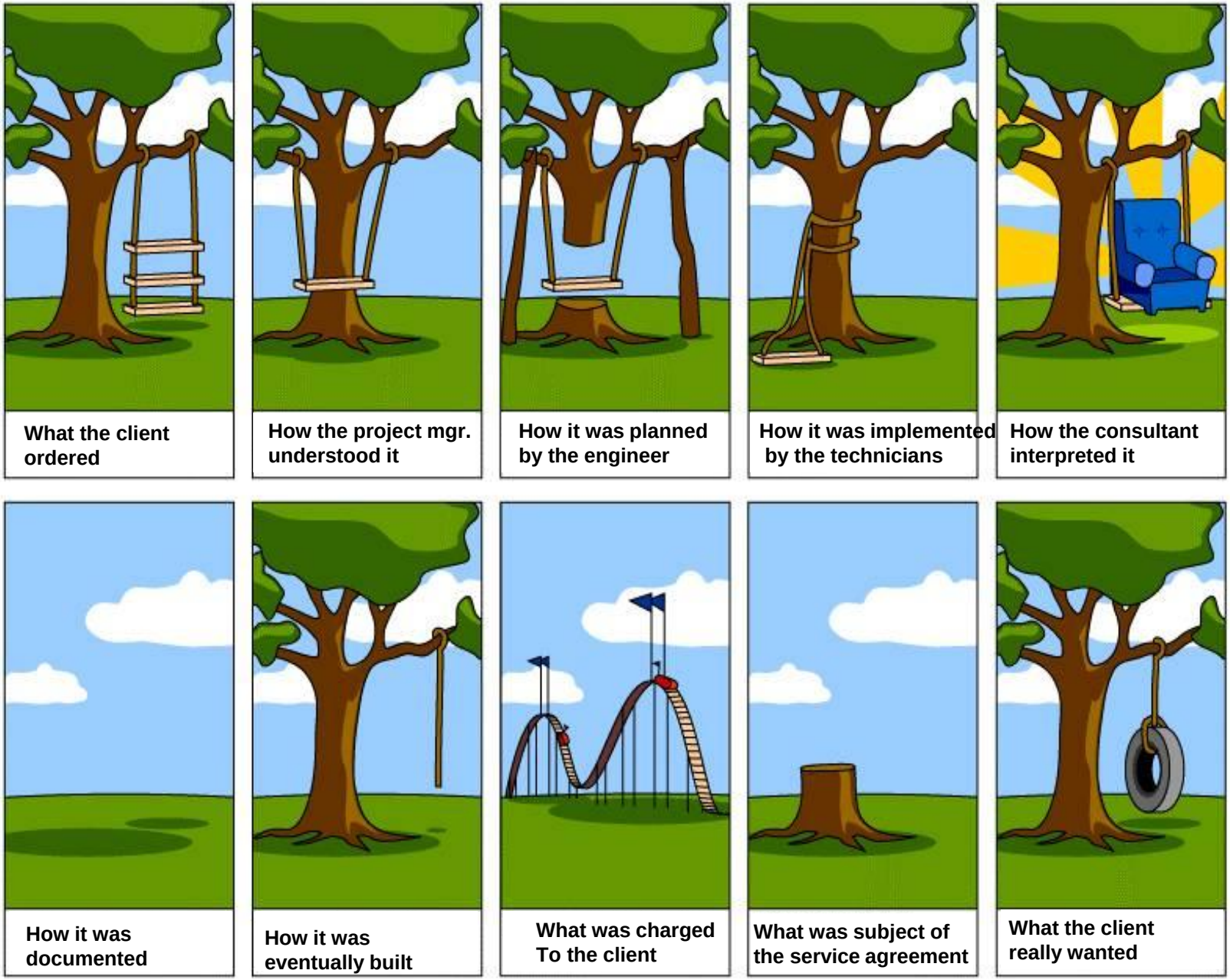
PROACTIVE	REACTIVE
• Implementing countermeasures to prevent an incident	• Implementing countermeasures after an incident has occurred
• Perform hazard analysis **(PHA)** and risk assessment	• Perform incident **investigation** and determine root cause
• Practice inherently (natural/ internal) **safer design**	• Design & install additional layers of protection after an incident **(part of LOPA)**



PSM is a subset of system safety



Design, Build and Operate



An Effective System

Simple, adequate and objetive

Very well trained HSE specialists and the entire team as well

Every single employee commitment

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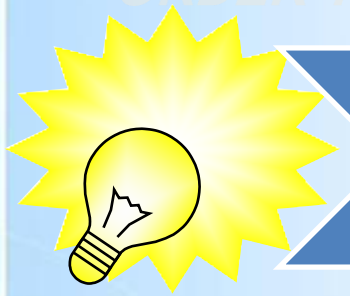
Thinking Safe...

- *THERE IS ALWAYS A SAFE WAY TO PERFORM ANY TASK IN ORDER TO AVOID ACCIDENTS.*



Smart Questions!!!

WHAT CAN HAPPEN IF THE "UNEXPECTED" SHOWS UP ?

IS THERE A BETTER WAY TO DO THIS... IN ORDER TO AVOID AN ACCIDENT?

Beliefs

- *EVERY SINGLE ACCIDENT CAN BE AVOIDED*
- *BECAUSE ACCIDENTS DON'T SIMPLY HAPPEN. THEY HAVE CAUSES!*
- *THEREFORE, THERE IS ALWAYS A SAFE WAY TO PERFORM ANY TASK IN ORDER TO AVOID ACCIDENTS.*

Introduction: PMS Establishment

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- July 17, 1990, OSHA published in the Federal Register (55 FR 29150) a proposed standard,—"PSM for HHC" containing requirements for the management of hazards associated with processes using highly hazardous chemicals to help assure safe and healthful workplaces.

In fact OSHA Established a comprehensive management program that integrated technologies, procedures, and management practices.

- On November 1, 1990, OSHA published a Federal Register notice (55 FR 46074) scheduling a second hearing to begin on February 26, 1991, in Houston, TX, enumerating additional issues, and extending the written comment period until January 22, 1991.
- OSHA received 175 comments and almost 4,000 pages of testimony and almost 60 post-hearing comments and briefs.
- CAAA stablished in 1967 and completed in 1990, The CAAA requires that the standard include a list of highly hazardous chemicals which includes toxic, flammable, highly reactive, and explosive substances

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Introduction: PMS Establishment

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- The CAAA (Clean Air Act Amendment) also specified minimum elements that the OSHA standard must require employers to do, as follows:
- (1) Develop and maintain written safety information: Workplace Process: HAZID, Equipment& Technology.
- (2) Accident sources, Previous accidents resulted/ may resulted to catastrophic, estimation of workplace effects of a range of releases, and estimation of the H& S effects of such a range on employees;
- (3) Consult for conduct and develop hazard assessment, develop to prevent chemical accident plan, and access to records.
- (4) System for hazard assess. Finding to prevent, mitigate and emergency responses.
- (5) Review periodically the workplace hazard assessment and response system;
- (6) Develop and implement procedures for each operating phase, operating limitations, and safety and health considerations.
- (7) provide information and training by focusing on hazards and safe practices.
- (8) contractors control
- (9) ERP: Train and Educate
- (10) Stablish QA: Process equipment, Maintenance Material, spare parts
- (11) Establish maintenance systems for critical equipment, including: procedures, training, inspections, and testing to ensure ongoing **mechanical integrity;**
- (12) PSSER
- (13) MOC to process chemicals, technology, equipment and facilities;
- (14) Incident/ Accident Investigation, Reporting, analysis, corrective action.
- Also the CAAA, identifies specific duties for EPA relative to the prevention of accidental,
- Generally, EPA must develop a list of chemicals and a Risk Management Plan.

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Please see: OSHA3132

Please see Presentation: PSM 29CFR1910.119
(CFR: Code of Federal Regulation)
Clearly Understanding the Standard

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Why PSM??

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- PSM is important because loss of containment events in the process industries can have **DIRE** consequences for employees, the public, and the company.
- Several major chemical catastrophes have demonstrated the need for effective PSM and the potential devastation of a dysfunctional system

❖ The key provision of PSM is process hazard analysis (PHA):
what could go wrong and what safeguards??

✓PSM clarifies the responsibilities of employers and contractors

❖ Process means any activity involving a highly hazardous chemical including using, storing, manufacturing, handling, or moving such chemicals at the site, or any combination of these activities.

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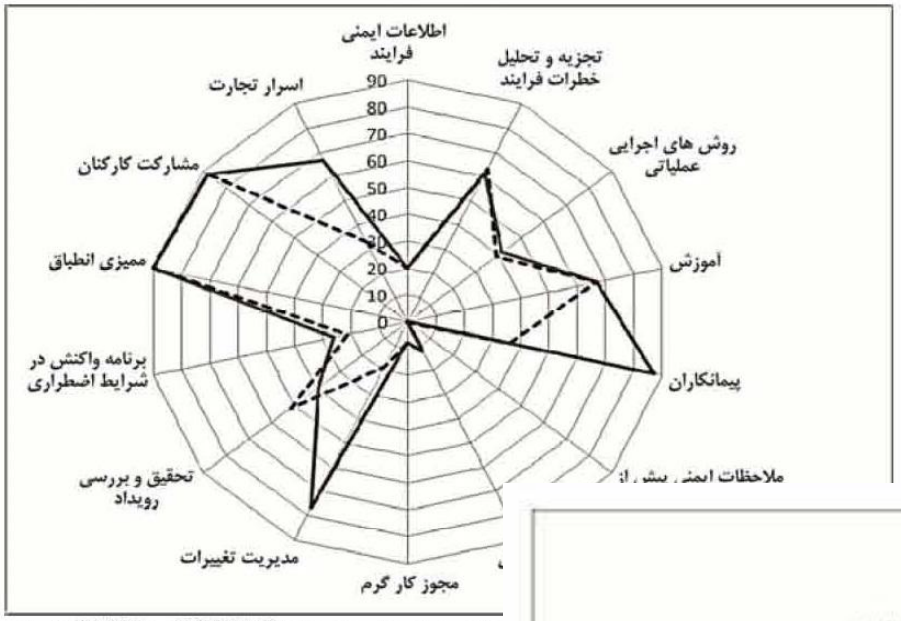
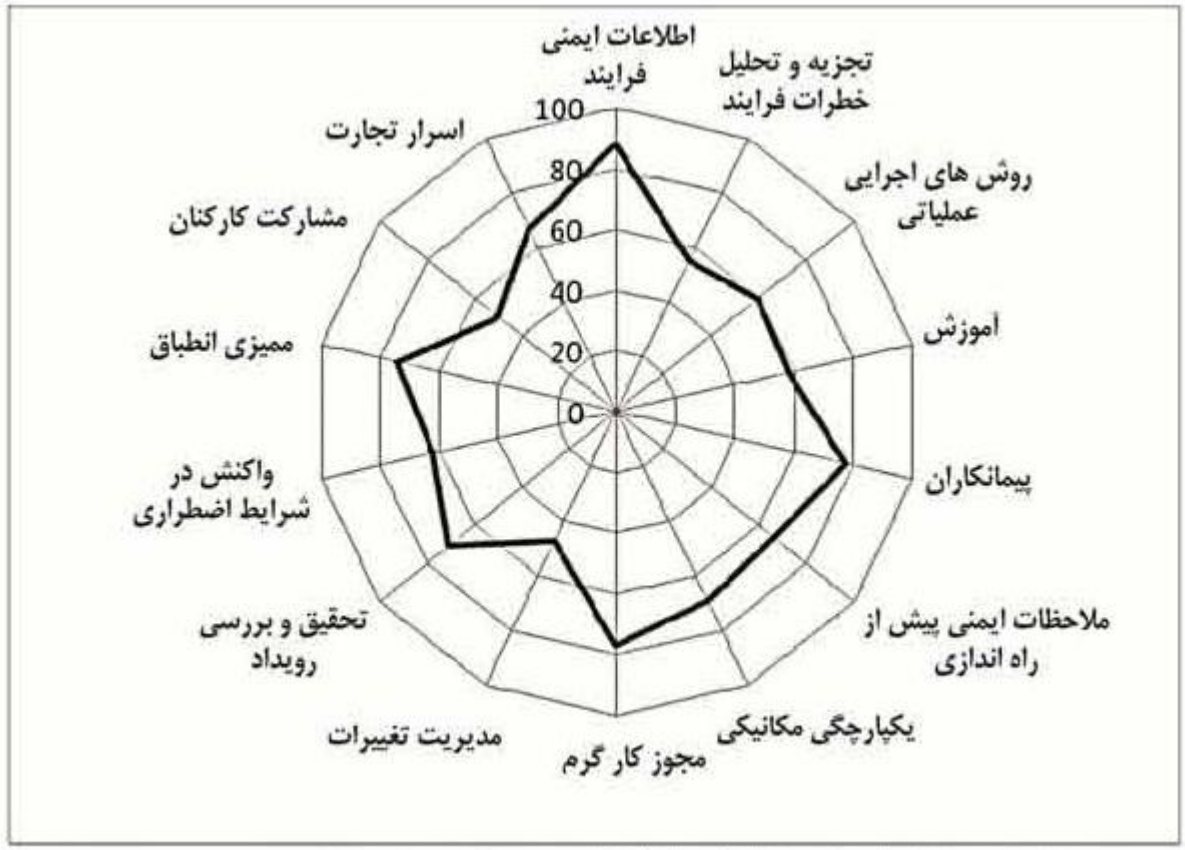
جدول ۳: وضعیت انطباق الزامات سیستم‌های مدیریتی OHSAS ۱۸۰۰۱ و HSE با سیستم PSM

الزام	PSM* تعداد سئوالات	حداکثر امتیاز	جمع امتیازات	OHSAS ۱۸۰۰۱** درصد انطباق	جمع امتیازات	HSE-MS*** درصد انطباق
اطلاعات ایمنی فرایند	۵	۱۵	۳	۲۰/۰۰	۳	۲۰
تجزیه و تحلیل خطرات فرایند	۱۹	۵۷	۳۶	۶۳/۱۵	۳۵	۶۱/۴۰
روش‌های اجرایی عملیاتی	۱۲	۳۶	۱۴	۳۸/۸۸	۱۵	۴۱/۶۶
آموزش	۶	۱۸	۱۲	۶۶/۶۶	۱۲	۶۶/۶۶
پیمانکاران	۱۳	۳۹	۱۴	۳۵/۸۹	۳۴	۸۷/۱۷
ملاحظات ایمنی پیش از راه‌اندازی	۴	۱۲	۰	۰/۰۰	۰	۰
یکپارچگی مکانیکی	۱۱	۳۳	۴	۱۲/۱۲	۴	۱۲/۱۲
مجوز کار گرم	۳۴	۱۰۲	۸	۷/۸۴	۸	۷/۸۴
مدیریت تغییرات	۹	۲۷	۵	۱۸/۵۰	۲۱	۷۷/۰۰
تحقیق و بررسی رویداد	۱۱	۳۳	۱۷	۵۱/۵۰	۱۳	۳۹/۳۹
برنامه واکنش در شرایط اضطراری	۳۳	۹۹	۲۱	۲۱/۲۱	۲۶	۲۶/۲۶
ممیزی انطباق	۷	۲۱	۱۹	۹۰/۰۰	۱۹	۹۰/۰۰
مشارکت کارکنان	۳	۹	۸	۸۸/۰۰	۸	۸۸/۰۰
اسرار تجارت	۵	۱۵	۵	۳۳/۰۰	۱۰	۶۶/۶۶
جمع کلی امتیازات	۱۷۲	۵۱۶	۱۶۶	۳۲/۱۷	۲۰۸	۴۰/۳۱

*Process safety management; **Occupational health and safety assessment series
***Health safety and environment



های مدیریتی ۱۸۰۰۱ OHSAS و HSE با سیستم PSM



نمودار ۲: میزان اجرای الزامات PSM در صنعت پتروشیمی مورد بررسی

جدول ۴: نتایج بررسی میزان اجرای الزامات PSM در صنعت پتروشیمی مورد بررسی

بند/ الزام	تعداد سؤالات	امتیاز کسب شده	حداکثر امتیاز*	درصد
اطلاعات ایمنی فرایند	۱۲	۳۰	۳۶	۸۸/۳۳
تجزیه و تحلیل خطرات فرایند	۱۵	۲۵	۴۵	۵۵/۵۵
روش‌های اجرایی عملیاتی	۲۴	۴۳	۷۲	۵۹/۷۲
آموزش	۸	۱۴	۲۴	۵۸/۳۳
پیمانکاران	۲۱	۴۹	۶۳	۷۷/۷۷
ملاحظات ایمنی پیش از راه‌اندازی	۱۲	۲۴	۳۶	۶۶/۶۶
یکپارچگی مکانیکی	۲۵	۵۲	۷۵	۶۹/۳۳
مجوز کار گرم	۵۲	۱۲۰	۱۵۶	۷۶/۹۲
مدیریت تغییرات	۱۲	۱۷	۳۶	۴۷/۲۲
تحقیق و بررسی رویداد	۱۷	۳۶	۵۱	۷۰/۵۸
برنامه واکنش در شرایط اضطراری	۴۸	۸۹	۱۴۴	۶۱/۸۰
ممیزی انطباق	۹	۲۰	۲۷	۷۴/۰۰
مشارکت کارکنان	۶	۹	۱۸	۵۰/۰۰
اسرار تجارت	۱۰	۲۰	۳۰	۶۶/۶۶
جمع امتیازات		۵۴۸	۸۱۳	۶۷/۴۰

* حداکثر امتیاز بر اساس راهنمای ممیزی PSM، OSHA مشخص شده است.

جدول ۲: مقایسه الزامات PSM با OHSAS ۱۸۰۰۱ و HSE-MS

الزام مندرج در PSM*	OHSAS ۱۸۰۰۱**	HSE***
اطلاعات ایمنی فرایند	—	—
تجزیه و تحلیل خطرات فرایند	√	√
روش‌های اجرایی عملیاتی	√	√
آموزش	√	√
پیمانکاران	√	√
ملاحظات ایمنی پیش از راه‌اندازی	—	—
یکپارچگی مکانیکی	—	—
مجوز کار گرم	—	—
مدیریت تغییرات	—	√
تحقیق و بررسی رویداد	√	√
برنامه واکنش در شرایط اضطراری	√	√
ممیزی انطباق	√	√
مشارکت کارکنان	√	√
اسرار تجارت	—	—
تعداد کل الزامات	۸	۹
درصد انطباق کلی	۵۷/۱۴	۶۴/۲۸

*Process safety management; **Occupational health and safety assessment series
***Health safety and environment

- Examples of HHCs include:
  - Anhydrous ammonia
  - Hydrogen sulfide
  - Chlorine

- When released, HHCs have the potential to cause catastrophic incidents resulting in injury/ death

- Incident due to unexpected release of highly hazardous chemicals give disasters.
- Losses due to incidents: Direct& Indirect Human, Properties, material, Environment, Media (national and international), reputation,

Example of Environment: Acid Rain, OZON Layer, Air pollution in winter…..

Highly hazardous chemicals **(HHCs)** may be: **toxic, reactive, flammable, or explosive, or may exhibit a combination**.

- In each industry, PSM: 130 specific toxic and reactive; flammable liquids and gases in quantities of 10,000 pounds (4,535.9 Kg) or more.

What's Covered

- Listed Chemicals in Appendix A
- > 10,000 pounds of Flammable Liquids or Gases

Chemical hazards

Type of chemical hazards

- **Material hazard :** Hazardous nature of chemicals like Inflammable, explosive, toxic, corrosive, reactive, radioactive, reducing, oxidizing, decomposing or incompatible**.**

- **Process hazards :** In process, chemical and physical change, chemical reaction, pressure, temperature, level, flow, quantity and other parameters create.

- **Vessel hazards :** The vessels and equipments in which the chemicals are stored, handled or reacted pose**.**

Chemical hazards

Type of chemical hazards

- **Control hazards :** The inadequate, defective, under design or wrongly modified control devices or their of failure cause**.**
- **Fire hazards : Fire or explosion**
- **Toxic hazards :** Affluent disposal and gaseous emissions bring pollution and toxic hazards.
- **Handling hazards :** Leaks, spills and splashes cause.

Chemical hazards

Physical hazards or health hazards

- **Physical Hazards :** Corrosives, Explosives etc.
- **Health Hazards :** Toxic, Irritants and Oxides.

Accident and emergency hazard

- Absence, nonuse or failure of fire fighting equipments, personal protective equipments, emergency control devices

Recent major disasters:

INCIDENT	EFFECTS
Bhopal, India, 1984 Union Carbide Methyl Isocyanate Release	>3800 fatalities, >100 000 injuries, severe damage to area livestock and crops, long term health effects, $470 M compensation
Chernobyl, USSR, 1986 Nuclear Reactor Meltdown	30 acute fatalities, >130 000 people exposed to harmful radiation, long term health affects, permanent evacuation of the city
Gulf Oil Spill. USA, 2010 British Petroleum Deepwater Horizon Oil Platform Explosion and Spill	11 fatalities from the explosion Extensive environmental damage, extensive damage to regional fishing and tourism industry, >$4.5 B USD in fines, >$42 B in civil settlements
Challenger Disaster, USA, 1986 NASA Explosion	Loss of crew (7 fatalities), loss of space shuttle (>$8 B USD), recovery of debris

- Pasadena, TX (1989)
  - 23 deaths, 132 injuries
  - Petroleum explosion
- Cincinnati, OH (1990)
  - 2 deaths
  - Explosion
- Sterlington, LA (1991)
  - 8 deaths, 128 injuries
  - Chemical release

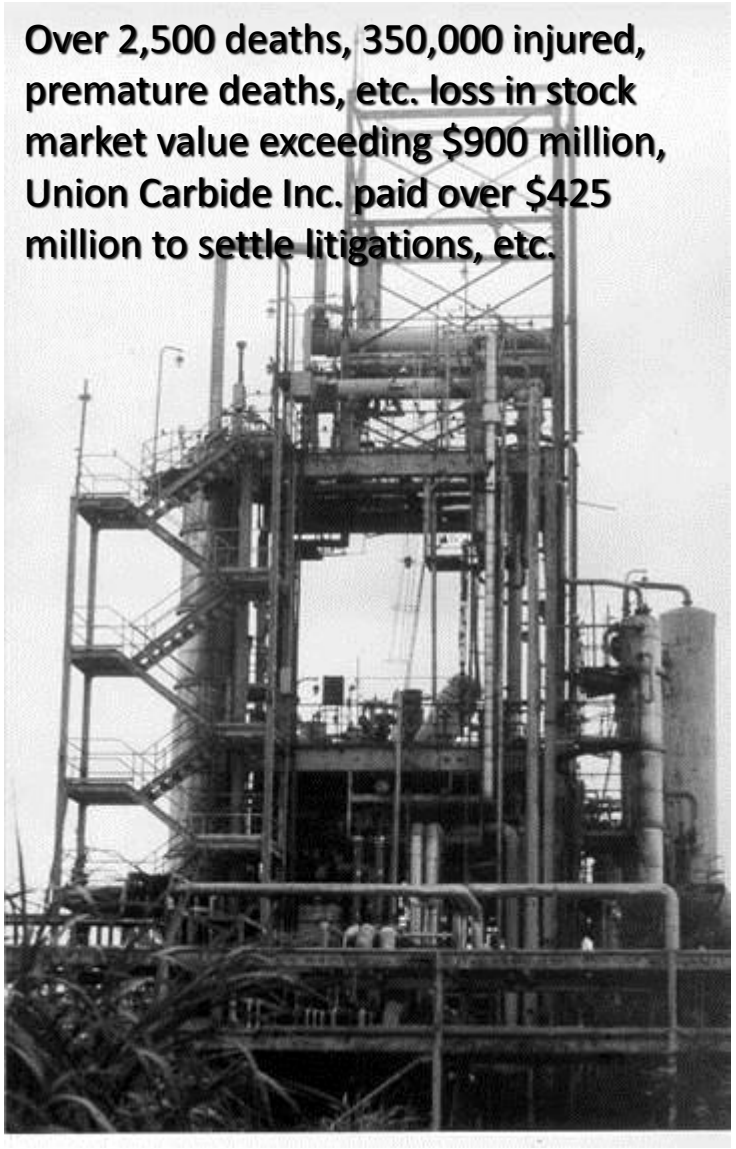
		Deaths	Injuries
1989	Pasadena, TX	23	130
1990	Houston, TX	17	--
1991	Lake Charles, LA	5	--
1991	Charleston, SC	6	33
1991	Seadrift, TX	1	32
1984	Mexico City	650	--
1984	Chicago area	17	17
1985	West Virginia	--	135
1988	New Orleans	5	23
1988	Henderson, NV	2	350

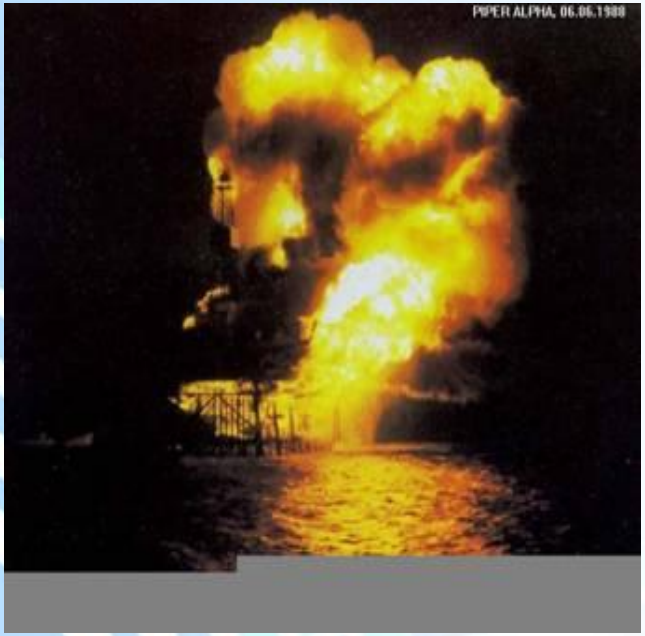
Note: Major disasters involving highly hazardous chemicals drew national attention

Geco Seismic Vessel

Bhopal Union Carbide Plant Accident 1984

Over 2,500 deaths, 350,000 injured, premature deaths, etc. loss in stock market value exceeding $900 million, Union Carbide Inc. paid over $425 million to settle litigations, etc.





Piper Alpha 1988: Over 167 people dead, estimated loss over $3 Billion

Petrobras P-36 Sinking 2001

•Brazil, March 16, 2001 - The world's biggest offshore oil rig, owned by Brazil's state oil giant, Petrobras, sank into the ocean spilling crude oil, a day after an explosion that killed 10 people.

Zauliyah-16 Blow Out (August 2001)

Blow-out, leading to loss of Well Pulling Hoist, Well, Facilities, Environmental damage, but luckily no fatality

Cost of Accidents at Work

Some Major Accidents

1979 - THREE MILE ISLAND NUCLEAR PLANT	-	US $ 1.3 billion
1984 – BHOPAL UNION CARBIDE PLANT	-	US $ 1.4 billion
1986 - CHERNOBYL NUCLEAR PLANT	-	US $ 5.5 billion
1988 - PIPER ALPHA OIL PLATFORM	-	US $ 3.0 billion
1989 - EXXON VALDEZ (clean-up costs only)	-	US $ 2.5 billion
1998 - Esso Longford gas plant explosion	-	US $ 4.8 billion

Good HSE is Good Business

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Analysis of Sinking P-36

Process Safety Management Course
Prepared by ??

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The Elements of PSM

PSM systems are typically centered around four themes [4]:

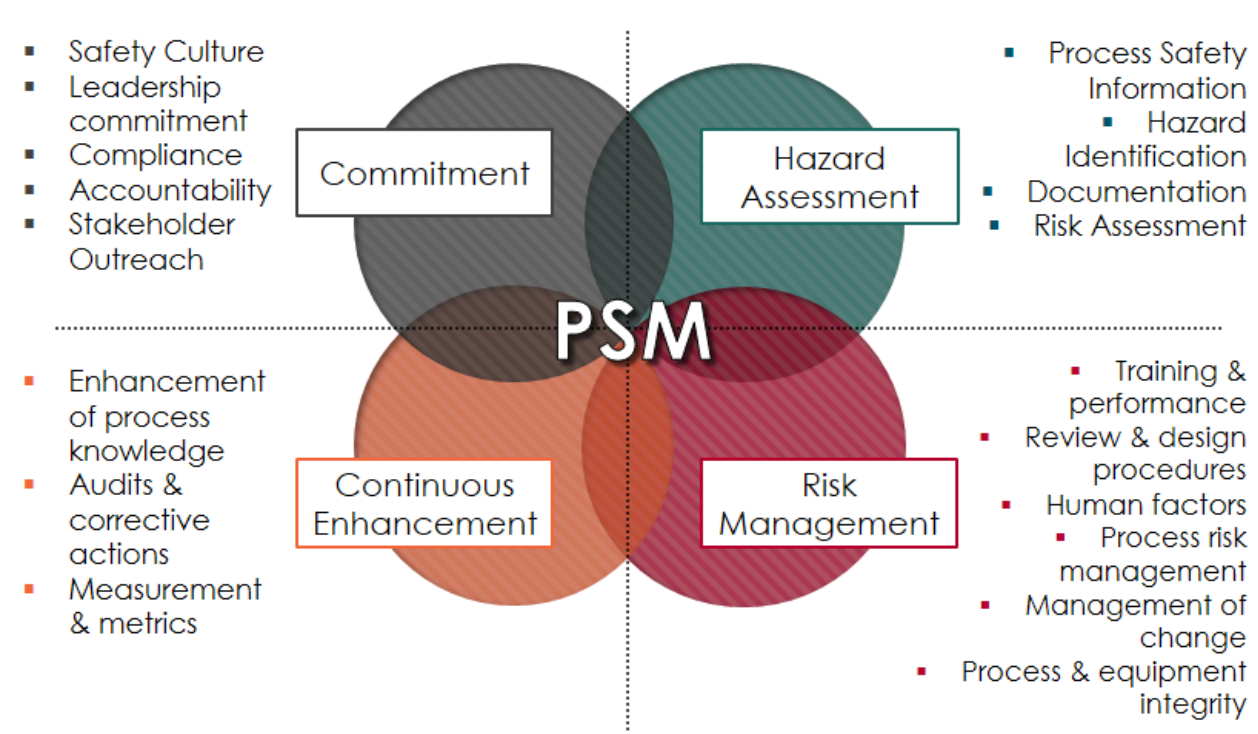
i. ***Commitment*** of management and corporate objectives to PSM

ii. ***Hazard assessment***, including process knowledge and hazard identification

iii. ***Risk management*** such as managing change in the process and change in personnel

iv. ***Continuous enhancement*** such as furthering employee education and enhancing process knowledge

PSM System Possible Elements



Risk is never zero.

- Two of the most important features of a PSM system are participation and communication
  - Although PSM systems are typically designed by management they require input from operators and commitment from corporate executives to be implemented properly
- PSM systems are ***non-prescriptive***
  - They must be based on performance indicators to measure the success of the PSM system
  - Guidelines can be implemented in many ways as long as the objectives are met
- Finally, PSM systems are not created once and implemented once.
  - They are an on-going process that involves auditing and revaluation of the management system to continually enhance the effectiveness of the PSM system.

OCCUPATIONAL HEALTH & SAFETY

- Individual-oriented & controlled
- Focused on direct interaction between individual and equipment or structures
- Specific impact
- Work place rules & safety equipment
- Worker training & supervision

PROCESS SAFETY

- Cooperative
- Broad impact
- Systems
- Little individual control

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Examples of Possible Incidents

- Fall
- Spill
- Electrocution
- Asphyxiation
- Hearing Impairment and other chronic injuries
- Minor injuries (pinch, banged knee, etc.)

Examples of Possible Incidents

- Explosion
- Release of hazardous chemical
- Fire
- Release of hazardous energy

Examples of Safeguards

- Hazardous Work Permits
- Personal Protective Equipment
- Ventilation systems, confined space entry
- Guardrails, equipment guards

Examples of Safeguards

DESIGN	OPERATIONS
• Pressure Safety Valves	• Maintenance
• Inherently Safer Design	• Inspections
• Equipment Interlocks	• Training
• Process Alarms	• Procedures

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Process Safety Management Systems from around the world

- American Occupational Health and Safety Administration Process Safety Management Rule enacted in 1994
- 14 Elements - CSChE – The Canadian Society for Chemical Engineering
- 20 Elements - AIChE CCPS – The American Institute for Chemical Engineers Center for Chemical Process Safety
- 12 Elements – OSHA – US Occupational Health and Safety Administration PSM Rule 1910.119
- 20 Elements – EU Energy Institute
- Some large corporations may also sell their custom systems or services for implementing PSM

PSM around the world

Two major international drivers of PSM:

US OSHA PSM Standard 1910.119

With the US OSHA levying hefty fines in the past few years, the need for functional PSM systems is increasing

While no fines will be levied for failure to possess a functional PSM system in Canada, there are still legal requirements for all people directing work to take reasonable steps to ensure worker and public safety

EU Seveso II Directive

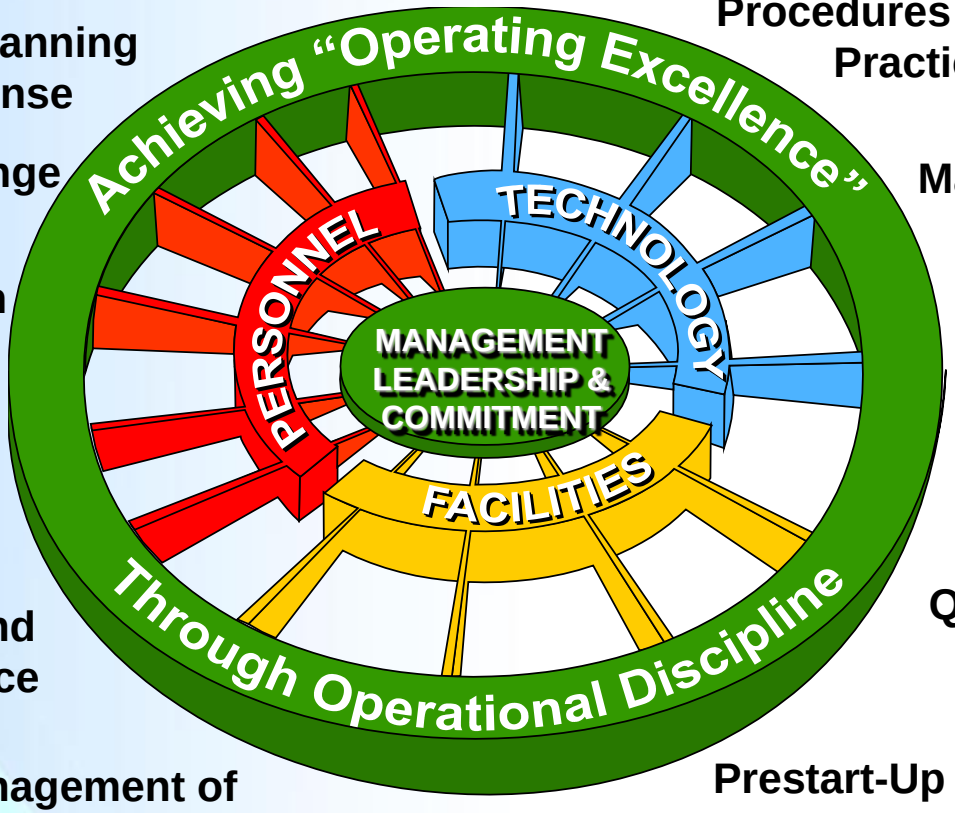
Directive II was a revision of the original directive which increased the requirement to include a safety management system, as well as emergency and land-use planning

Table 1-1 Comparison of Process Safety Management Elements

CCPS Risk-Based 20 PSM Elements [1] (2007)	OSHA PSM *(EPA RMP)* Required 14 Elements [2]	ILO 16 Recommended Elements of a PSM Programme [3]	CSChE PSM Guide 4th Ed. 2012 12 Recommended Elements [4]
Pillar 1: Commit to Process Safety			
1. Process Safety Culture			1. Accountability: Objectives and Goals
2. Compliance with Standards	2. Process Safety Information (PSI)	15. Standards & Regulations	10. Company Standards, Codes & Regulations
3. Process Safety Competency			8. Training & Performance
4. Workforce Involvement	4. Employee Participation	2. Employee Involvement	
5. Stakeholder Outreach			
Pillar 2: Understand Hazards and Risk			
6. Process Knowledge Management	1. Process Safety Information (PSI)	1. Process Safety Information	2. Process Knowledge & Documentation
7. Hazard Identification & Risk Analysis	2. Process Hazard Analysis	3. Process Hazard Analysis	4. Process Risk Management 7. Human Factors
Pillar 3: Manage Risk			
8. Operating Procedures	3. Operating Procedures	5. Operating Procedures	6. Process & Equipment Integrity
9. Safe Work Practices	3. Operating Procedures 9. Hot Work Permit	6. Safe Work Practices & Permits 10. Design Quality Assurance	3. Capital Project Review and Design Procedures
10. Asset Integrity & Reliability	8. Mechanical Integrity	10. Design Quality Assurance 11. Maintenance & Mechanical Integrity	6. Process & Equipment Integrity
11. Contractor Management	6. Contractors	8. Contractor Personnel	
12. Training & Performance Assurance	5. Training	7. Employee Information & Training	8. Training & Performance
13. Management of Change	10. Management of Change (MOC)	4. Management of Change	5. Management of Change
14. Operational Readiness	7. Pre-startup Safety Review	9. Pre-startup Safety Reviews	
15. Conduct of Operations			
16. Emergency Management	12. Emergency Planning & Response	12. Emergency Response	4. Process Risk Management
Pillar 4: Learn from Experience			
17. Incident Investigation	11. Incident Investigation	14. Process Incident Investigation	9. Incident Investigation
18. Measurement & Metrics			
19. Auditing	13. Compliance Audits	13. Periodic Safety Audits	11. Audits & Corrective Action
20. Management Review & Continuous Improvement			12. Enhancement of Process Safety Knowledge
	14. Trade Secrets	16. Trade Secrets	

1 Based on Table 1.8 from AIChE Guidelines for Risk Based Process Safety, Center for Chemical Process Safety, 2007 (p.13)
2 Based on US Department of Labour Publication OSHA 3132 Process Safety Management, 2000
3 http://www.ilo.org/oshenc/part-xii/chemical-processing/item/377-developing-a-process-safety-management-programme?tmpl=component&print=1
4 Based on the 2012 CSChE's PSM Guide which is based on the original 1989 AIChE PSM recommendations.

DuPont
Process Safety and Risk Management Model



Process Technology

Auditing

Operating Procedures and Safe Practices

Emergency Planning and Response

Management of Change

Management of Change

Incident Investigation and Reporting

Process Hazards Analysis

Contractor Safety and Performance

Quality Assurance

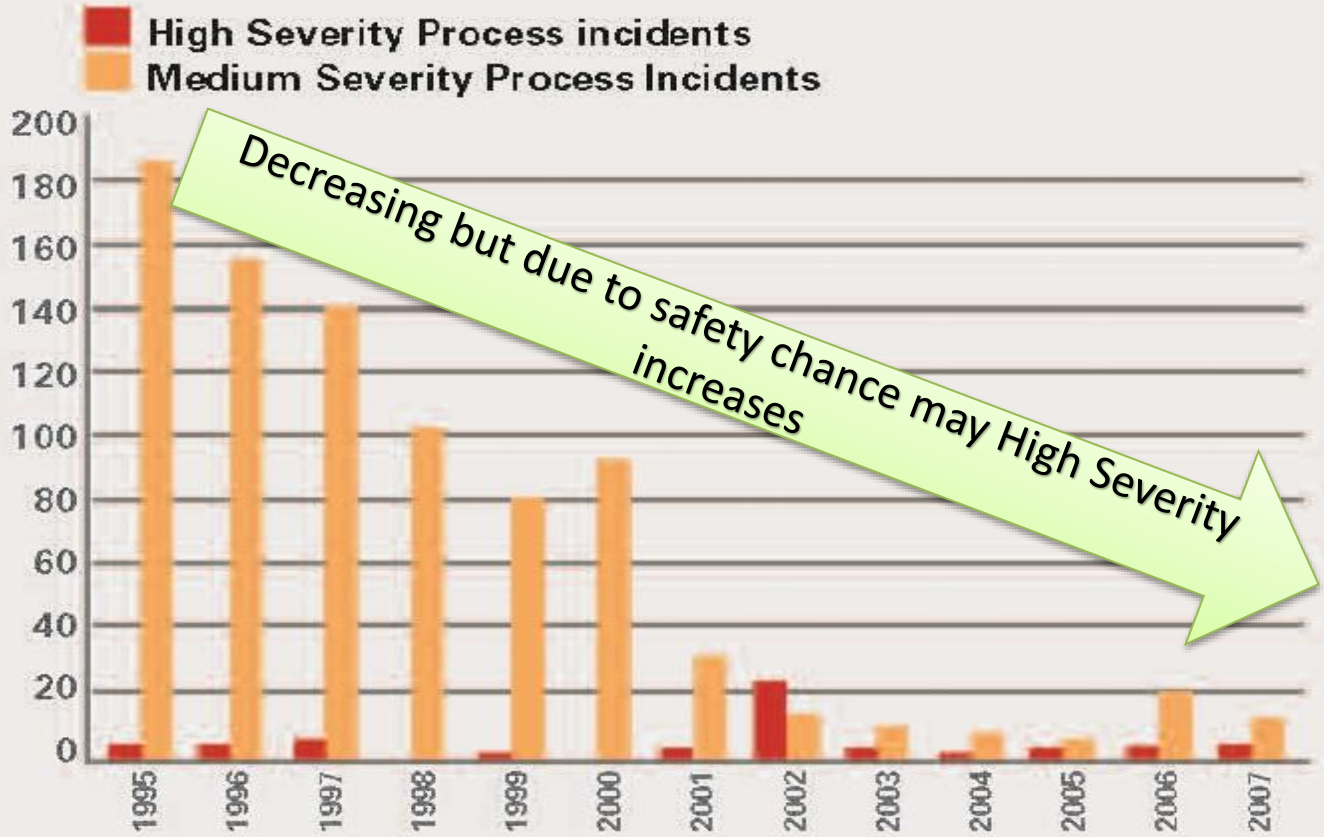
Training and Performance

Prestart-Up Safety Reviews

Management of "Subtle" Change

Mechanical Integrity

DuPont Process Safety Incident History 1995-2007



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PSM Target prevent. It is proactive

Reasons of HHC Releases

Failed in LOPA

LOPA?? Describe LOPA, Give example

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PSM Elements

Process Safety Management Course
Prepared by ??

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What's Covered by PSM?

- Process Safety Information
- Employee Involvement
- Process Hazard Analysis
- Operating Procedures
- Training
- Contractors
- Pre-Startup Safety Review
- Mechanical Integrity
- Hot Work
- Management of Change
- Incident Investigation
- Emergency Planning and Response
- Compliance Audits
- Trade Secrets

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Employee Participation

- Purpose
  - One of the Most Essential Elements for a Successful Program
  - People at Working Level Know Most about Operations
  - Serves as a Sanity Check re: Common Sense Problems
  - Couples with All Other Elements and Ensures Successful Implementation
- What is Required, Employers Must
  - Have a Written Plan to Ensure Employee Participation: Give Example of BA for PEMID
  - Involve Employees in Conduct and Implementation of PHAs & Other Elements of PSM
  - Provide Access to PHAs and all other Information Required to Be Developed by PSM Rule

Please see employee participation guidelines

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PSI

Employers must complete a compilation of written process safety information before conducting any PHA required by the standard.

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1. Information on the hazards of the highly hazardous chemicals in the process shall consist of at least the following:
- Toxicity,
- Permissible exposure limits,
- Physical data,
- Reactivity data,
- Corrosivity data, and
- Thermal and chemical stability data, and hazardous effects of inadvertent mixing of different materials.

2. Information of the technology of the process must include:
- A block flow diagram or simplified process flow diagram,
- Process chemistry,
- Maximum intended inventory,
- Safe upper and lower limits for such items as temperatures, pressures, flows or compositions, and
- An evaluation of the consequences of deviations, including those affecting the safety and health of employees.

3. Information on the equipment in the process must include the following:
- Materials of construction,
- Piping and instrument diagrams (P&IDs),
- Electrical classification,
- Relief system design and design basis,
- Ventilation system design,
- Design codes and standards employed,
- Material and energy balances for processes built after May 26, 1992, and
- Safety systems (e.g., interlocks, detection, or suppression systems).

Process Safety
Pre

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Employer shall document for equipment to show that those are in good engineering practices.

Document shall prove that equipment is designed, maintained, inspected, tested, and operated in a safe manner.

Document for equipment will help to have process HAZID and could help to develop PHA
Also docs of equipment may needed for MOC and Incident investigation of PMS too.

Talking about PSP, PHSEP, and other HSE Management System related to Information management of HSE Guidelines

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PHA

Information is needed for PHA.

PHA: Is a thorough, orderly, systematic approach for identifying, evaluating, and controlling the hazards of processes involving highly hazardous chemicals.

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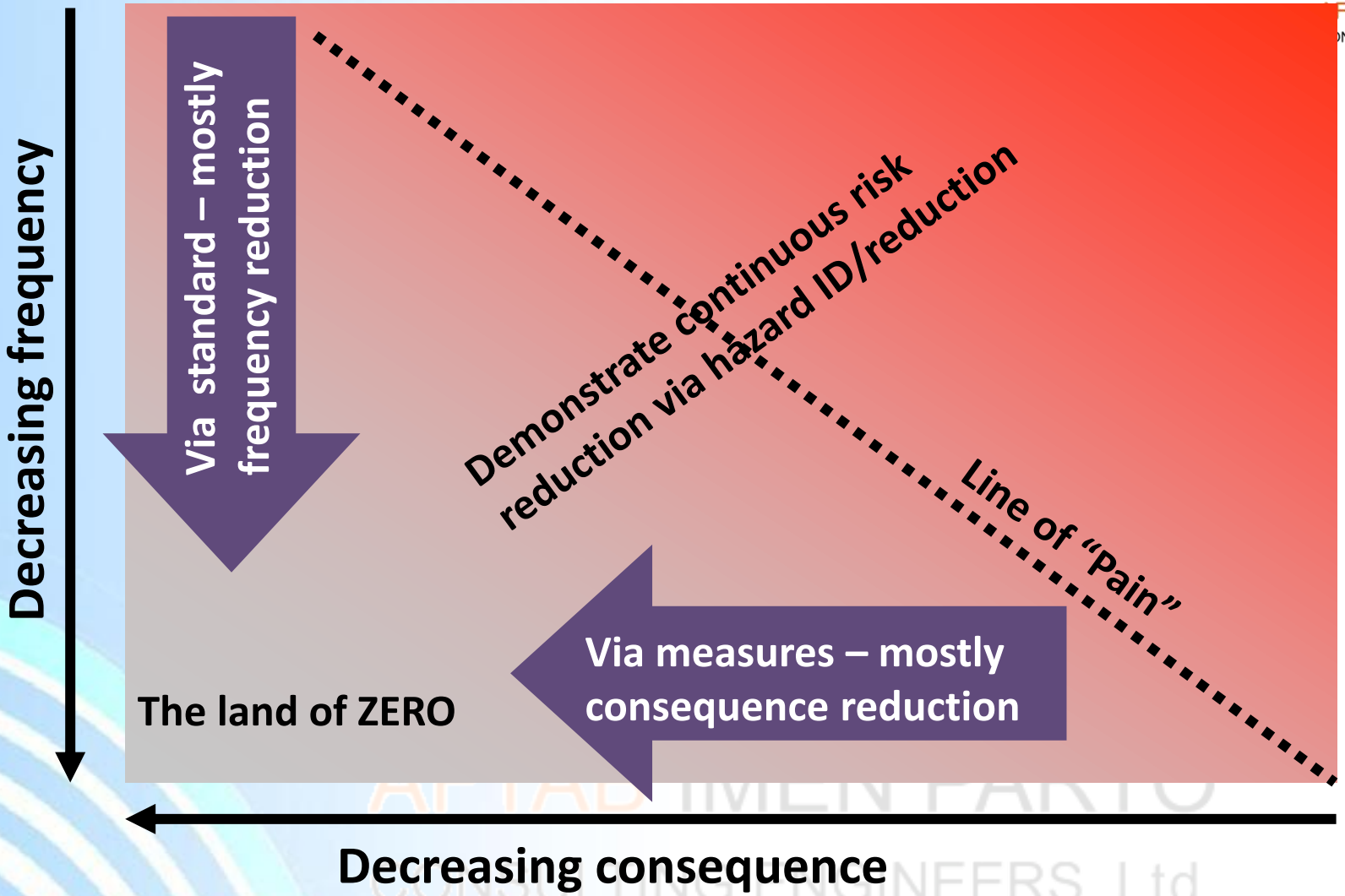
PHA: Every 5 Years

PHA Methods:
- ✓ What-if,
- ✓ Checklist,
- ✓ What-if/checklist,
- ✓ Hazard and operability study (HAZOP),
- ✓ Failure mode and effects analysis (FMEA),
- ✓ Fault tree analysis, or
- ✓ An appropriate equivalent methodology.

PHA must address the following:
- ✓ The hazards of the process;
- ✓ The identification of any previous incident that had a potential for catastrophic consequences in the workplace;
- ✓ Engineering and administrative controls applicable to the hazards and their interrelationships, such as appropriate application of detection methodologies to provide early warning of releases. Acceptable detection methods might include process monitoring and control instrumentation with alarms, and detection hardware such as hydrocarbon sensors;
- ✓ Consequences of failure of engineering and administrative controls;
- ✓ Facility siting;
- ✓ Human factors; and
- ✓ A qualitative evaluation of a range of the possible safety and health effects on employees in the workplace if there is a failure of controls.



Process Hazard Analysis

Simply, PHA allows the employer to:

- Determine locations of potential safety problems
- Identify corrective measures to improve safety
- Preplan emergency actions to be taken if safety controls fail

PHA Requirements

- Use one or more established methodologies appropriate to the complexity of the process
- Performed by a team with expertise in engineering and process operations
- Includes personnel with experience and knowledge specific to the process being evaluated and the hazard analysis methodology being used

What-If

- Experienced personnel brainstorming a series of questions that begin, "What if…?"
- Each question represents a potential failure in the facility or miss-operation of the facility

- The response of the process and/or operators is evaluated to determine if a potential hazard can occur
- If so, the adequacy of existing safeguards is weighed against the probability and severity of the scenario to determine whether modifications to the system should be recommended

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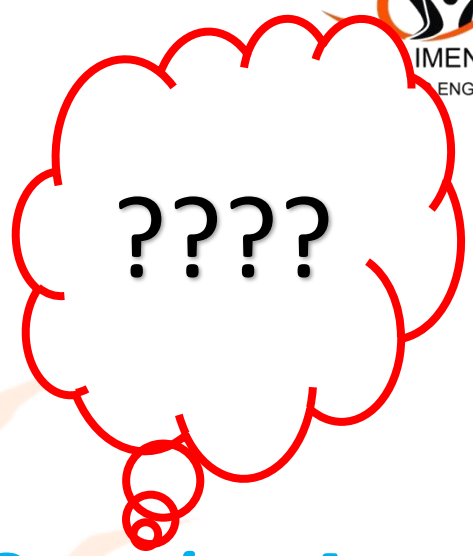
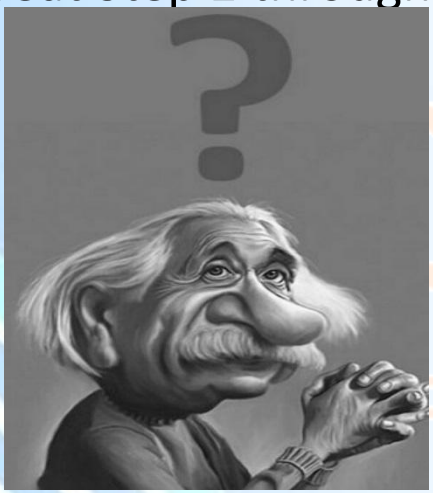
What-If – Steps

1. Divide the system up into smaller, logical subsystems
2. Identify a list of questions for a subsystem
3. Select a question
4. Identify hazards, consequences, severity, likelihood, and recommendations
5. Repeat Step 2 through 4 until complete





What-If Question Areas

- Equipment failures
  - What if … a valve leaks?
- Human error
  - What if … operator fails to restart pump?
- External events
  - What if … a very hard freeze persists?

What-If – Summary

- Perhaps the most commonly used method
- One of the least structured methods
  - Can be used in a wide range of circumstances
  - Success highly dependent on experience of the analysts
- Useful at any stage in the facility life cycle
- Useful when focusing on change review

Checklist

- Consists of using a detailed list of prepared questions about the design and operation of the facility
- Questions are usually answered “Yes” or “No”
- Used to identify common hazards through compliance with established practices and standards

Checklist Question Categories

- Causes of accidents
  - Process equipment
  - Human error
  - External events
- Facility Functions
  - Alarms, construction materials, control systems, documentation and training, instrumentation, piping, pumps, vessels, etc.

Checklist Questions

- Causes of accidents
  - Is process equipment properly supported?
  - Is equipment identified properly?
  - Are the procedures complete?
  - Is the system designed to withstand hurricane winds?
- Facility Functions
  - Is is possible to distinguish between different alarms?
  - Is pressure relief provided?
  - Is the vessel free from external corrosion?
  - Are sources of ignition controlled?

Checklist – Summary

- The simplest of hazard analyses
- Easy-to-use; level of detail is adjustable
- Provides quick results; communicates information well
- Effective way to account for 'lessons learned'
- **NOT** helpful in identifying new or unrecognized hazards
- Limited to the expertise of its author(s)

Checklist – Summary (cont'd)

- Should be prepared by experienced engineers
- Its application requires knowledge of the system/facility and its standard operating procedures
- Should be audited and updated regularly

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What-If/Checklist

- A hybrid of the What-If and Checklist methodologies
- Combines the *brainstorming* of What-If method with the *structured features* of Checklist method

What-If/Checklist – Steps

- Begin by answering a series of previously-prepared 'What-if' questions
- During the exercise, brainstorming produces additional questions to complete the analysis of the process under study

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What-If/Checklist – Summary

- Encourages creative thinking (What-If) while providing structure (Checklist)
- In theory, weaknesses of stand-alone methods are eliminated and strengths preserved – not easy to do in practice
- E.g.: when presented with a checklist, it is typical human behavior to suspend creative thinking

HAZOP

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Hazard and Operability Analysis

- Identify hazards (safety, health, environmental), and
- Problems which prevent efficient operation

1. Choose a vessel and describe intention
2. Choose and describe a flow path
3. Apply ***guideword*** to ***deviation***
   - Guidewords include **NONE, MORE OF, LESS OF, PART OF, MORE THAN, OTHER THAN, REVERSE**
   - Deviations are expansions, such as **NO FLOW, MORE PRESSURE, LESS TEMPERATURE, MORE PHASES THAN** (there should be),
4. Can deviation initiate a hazard of consequence?
5. Can failures causing deviation be identified?
6. Investigate detection and mitigation systems
7. Identify recommendations
8. Document
9. Repeat 3-to-8, 2-to-8, and 1-to-8 until complete

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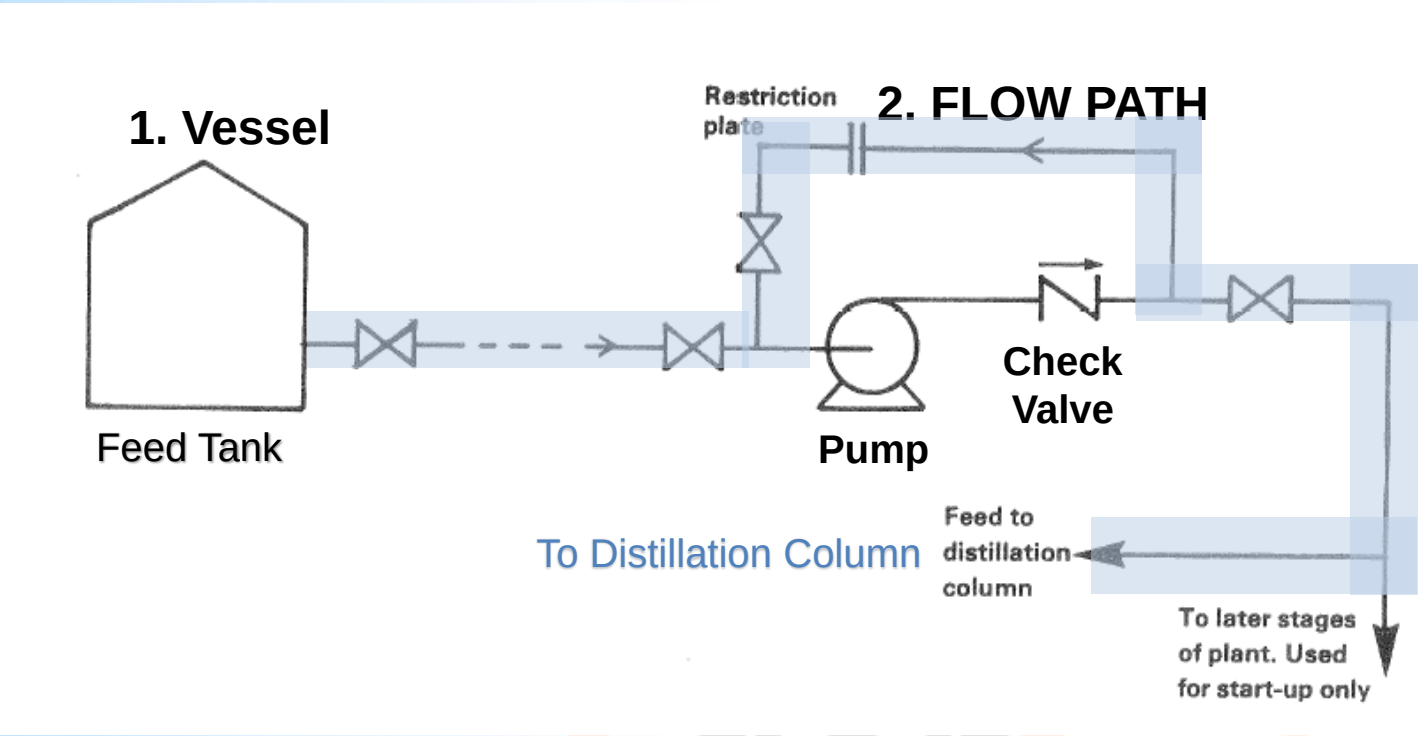
HAZOP



3. REVERSAL OF FLOW

4. Distillation materials returning via pump-around

5. Pump failure could lead to REVERSAL OF FLOW

6. Check valve located properly prevents deviation

7. Move check valve downstream of pump-around

Loss of Containment Deviations

- Pressure too high
- Pressure too low (vacuum)
- Temperature too high
- Temperature too low
- Deterioration of equipment

HAZOP's Inherent Assumptions

- Hazards are detectable by careful review
- Plants designed, built and run to appropriate standards will not suffer catastrophic *loss of containment* if ops stay within design parameters
- Hazards are controllable by a combination of equipment, procedures which are *Safety Critical*
- HAZOP conducted with openness and good faith by competent parties

HAZOP – Pros and Cons

- Creative, open-ended
- Completeness – identifies all process hazards
- Rigorous, structured, yet versatile
- Identifies safety *and* operability issues

- Can be time-consuming (e.g., includes operability)
- Relies on having right people in the room
- Does not distinguish between low probability, high consequence events (and vice versa)

HAZOP Study Methodology and PHA-Pro Software

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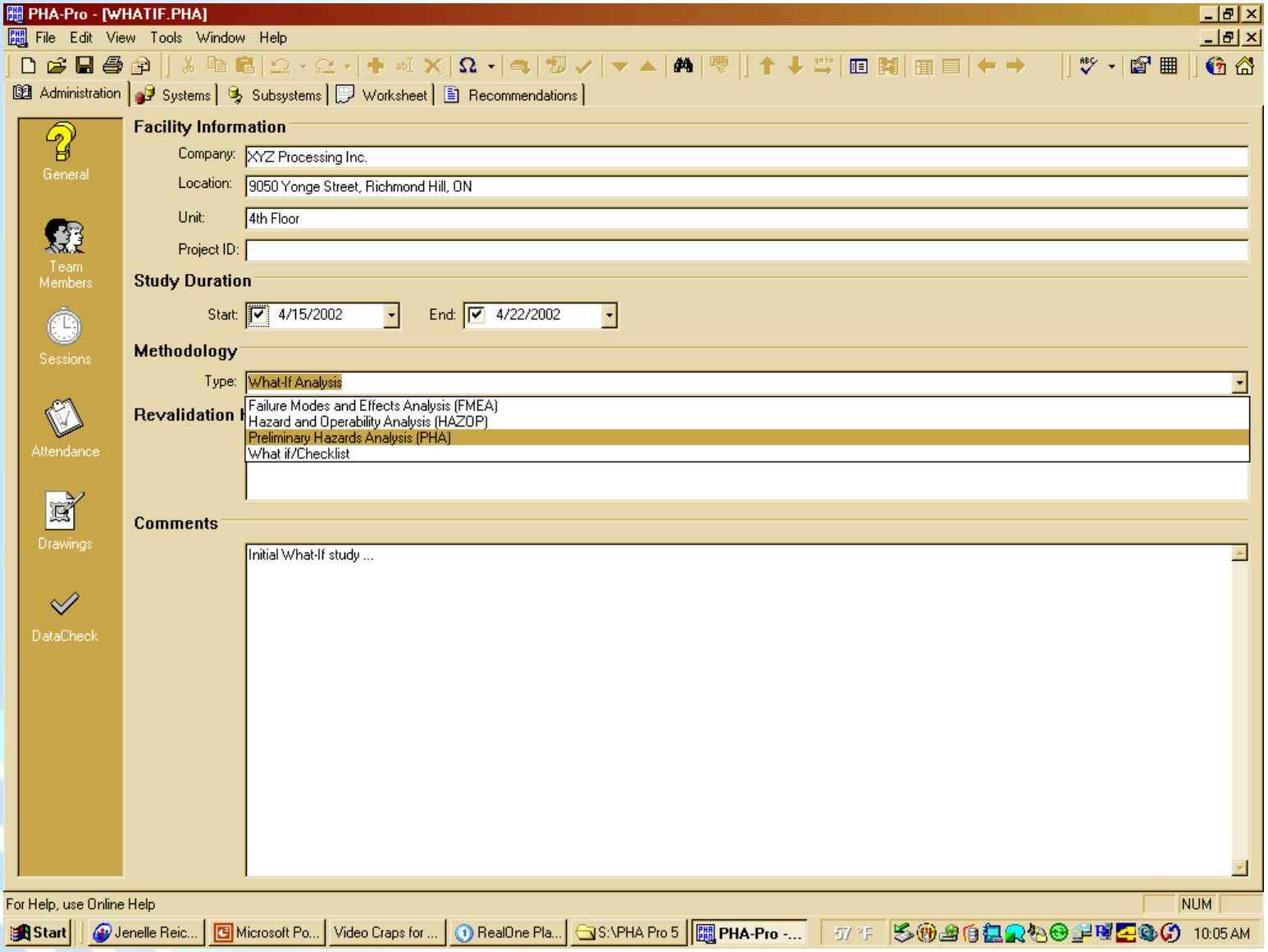
PHA-Pro - [WHATIF.PHA]
File Edit View Tools Window Help
Administration
Systems
Subsystems
Worksheet
Recommendations
General
Team Members
Sessions
Attendance
Drawings
DataCheck
Facility Information
Company: XYZ Processing Inc.
Location: 9050 Yonge Street, Richmond Hill, ON
Unit: 4th Floor
Project ID:
Study Duration
Start: 4/15/2002
End: 4/22/2002
Methodology
Type: What-If Analysis
Failure Modes and Effects Analysis (FMEA)
Hazard and Operability Analysis (HAZOP)
Preliminary Hazards Analysis (PHA)
What if/Checklist
Revalidation
Comments
Initial What-If study ...
For Help, use Online Help
NUM
Start
Jenelle Reic...
Microsoft Po...
Video Craps for ...
RealOne Pla...
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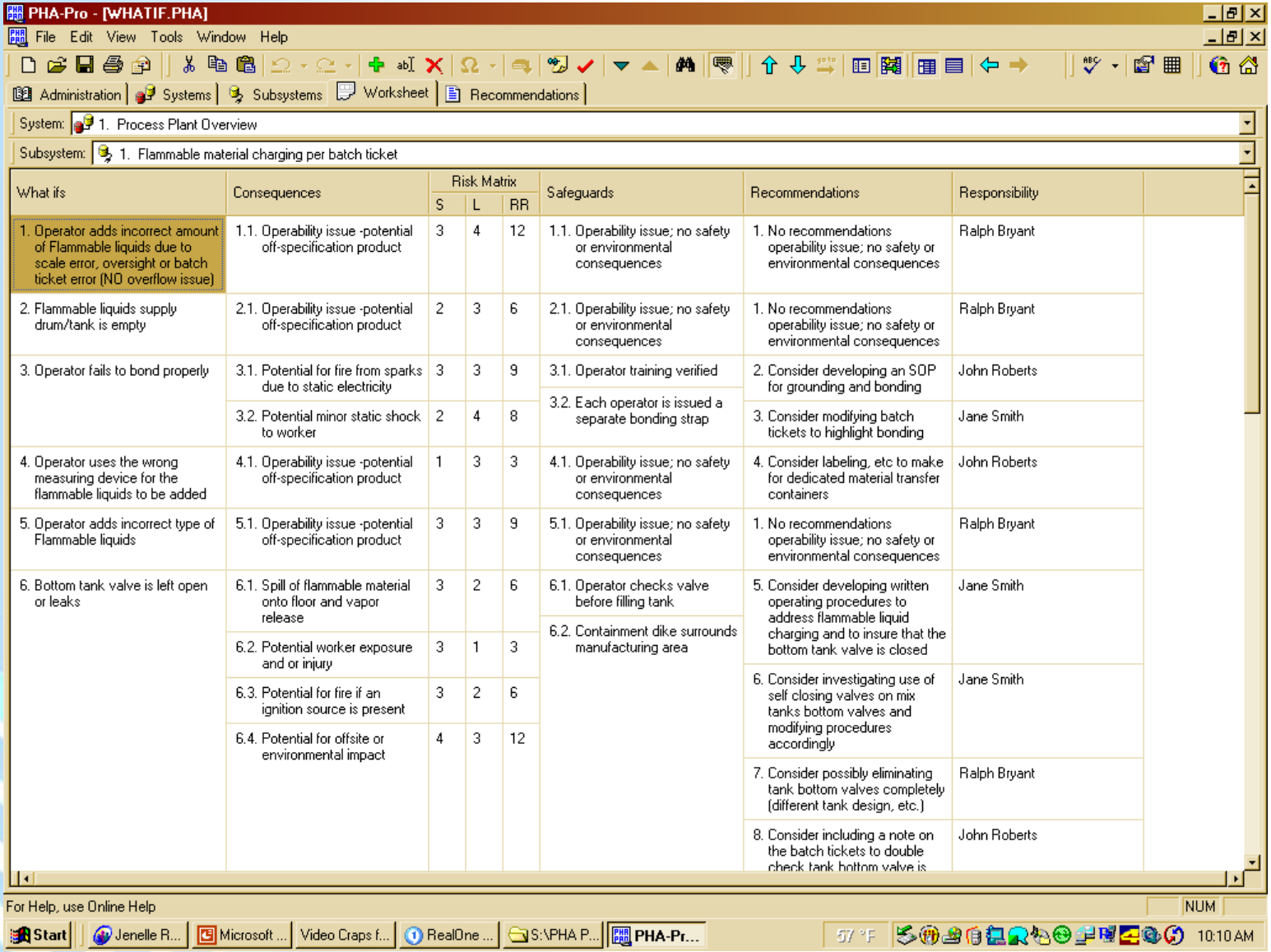
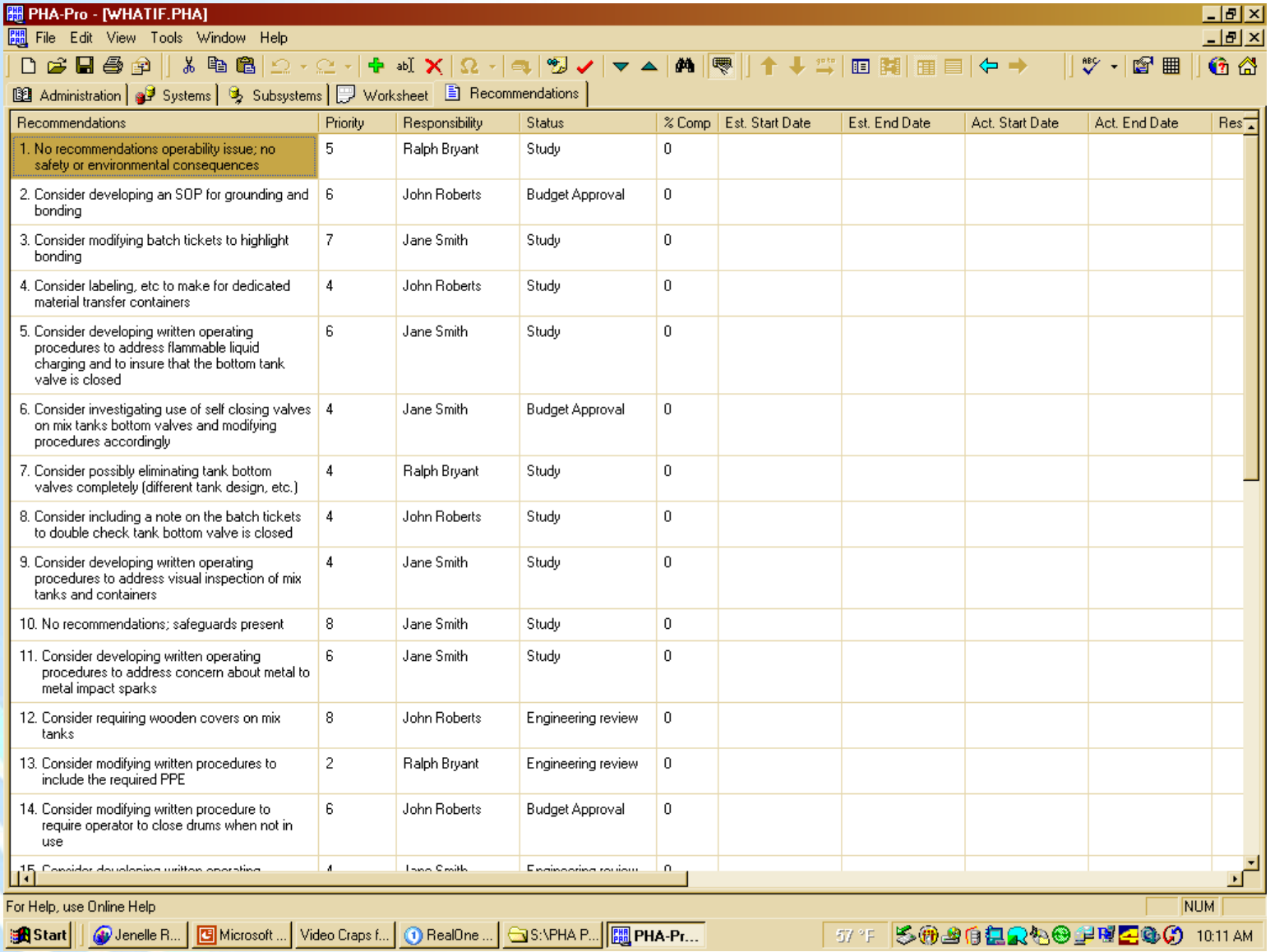

PHA-Pro - [WHATIF.PHA]
File Edit View Tools Window Help
Administration Systems Subsystems Worksheet Recommendations
System: 1. Process Plant Overview
Subsystem: 1. Flammable material charging per batch ticket
What ifs | Consequences | Risk Matrix S L RR | Safeguards | Recommendations | Responsibility
1. Operator adds incorrect amount of Flammable liquids due to scale error, oversight or batch ticket error (NO overflow issue) | 1.1. Operability issue -potential off-specification product | 3 4 12 | 1.1. Operability issue; no safety or environmental consequences | 1. No recommendations operability issue; no safety or environmental consequences | Ralph Bryant
2. Flammable liquids supply drum/tank is empty | 2.1. Operability issue -potential off-specification product | 2 3 6 | 2.1. Operability issue; no safety or environmental consequences | 1. No recommendations operability issue; no safety or environmental consequences | Ralph Bryant
3. Operator fails to bond properly | 3.1. Potential for fire from sparks due to static electricity | 3 3 9 | 3.1. Operator training verified | 2. Consider developing an SOP for grounding and bonding | John Roberts
3. Operator fails to bond properly | 3.2. Potential minor static shock to worker | 2 4 8 | 3.2. Each operator is issued a separate bonding strap | 3. Consider modifying batch tickets to highlight bonding | Jane Smith
4. Operator uses the wrong measuring device for the flammable liquids to be added | 4.1. Operability issue -potential off-specification product | 1 3 3 | 4.1. Operability issue; no safety or environmental consequences | 4. Consider labeling, etc to make for dedicated material transfer containers | John Roberts
5. Operator adds incorrect type of Flammable liquids | 5.1. Operability issue -potential off-specification product | 3 3 9 | 5.1. Operability issue; no safety or environmental consequences | 1. No recommendations operability issue; no safety or environmental consequences | Ralph Bryant
6. Bottom tank valve is left open or leaks | 6.1. Spill of flammable material onto floor and vapor release | 3 2 6 | 6.1. Operator checks valve before filling tank | 5. Consider developing written operating procedures to address flammable liquid charging and to insure that the bottom tank valve is closed | Jane Smith
6. Bottom tank valve is left open or leaks | 6.2. Potential worker exposure and or injury | 3 1 3 | 6.2. Containment dike surrounds manufacturing area | 6. Consider investigating use of self closing valves on mix tanks bottom valves and modifying procedures accordingly | Jane Smith
6. Bottom tank valve is left open or leaks | 6.3. Potential for fire if an ignition source is present | 3 2 6 | | 7. Consider possibly eliminating tank bottom valves completely (different tank design, etc.) | Ralph Bryant
6. Bottom tank valve is left open or leaks | 6.4. Potential for offsite or environmental impact | 4 3 12 | | 8. Consider including a note on the batch tickets to double check tank bottom valve is | John Roberts
For Help, use Online Help
NUM
Start Jenelle R... Microsoft ... Video Craps f... RealOne ... S:\PHA P... PHA-Pr... 57 °F 10:10 AM



Recommendations	Priority	Responsibility	Status	% Comp	Est. Start Date	Est. End Date	Act. Start Date	Act. End Date	Res
1. No recommendations operability issue; no safety or environmental consequences	5	Ralph Bryant	Study	0					
2. Consider developing an SOP for grounding and bonding	6	John Roberts	Budget Approval	0					
3. Consider modifying batch tickets to highlight bonding	7	Jane Smith	Study	0					
4. Consider labeling, etc to make for dedicated material transfer containers	4	John Roberts	Study	0					
5. Consider developing written operating procedures to address flammable liquid charging and to insure that the bottom tank valve is closed	6	Jane Smith	Study	0					
6. Consider investigating use of self closing valves on mix tanks bottom valves and modifying procedures accordingly	4	Jane Smith	Budget Approval	0					
7. Consider possibly eliminating tank bottom valves completely (different tank design, etc.)	4	Ralph Bryant	Study	0					
8. Consider including a note on the batch tickets to double check tank bottom valve is closed	4	John Roberts	Study	0					
9. Consider developing written operating procedures to address visual inspection of mix tanks and containers	4	Jane Smith	Study	0					
10. No recommendations; safeguards present	8	Jane Smith	Study	0					
11. Consider developing written operating procedures to address concern about metal to metal impact sparks	6	Jane Smith	Study	0					
12. Consider requiring wooden covers on mix tanks	8	John Roberts	Engineering review	0					
13. Consider modifying written procedures to include the required PPE	2	Ralph Bryant	Engineering review	0					
14. Consider modifying written procedure to require operator to close drums when not in use	6	John Roberts	Budget Approval	0					
15. Consider developing written operating	4	Jane Smith	Engineering review	0					

FMEA – Failure Modes, Effects Analysis

- **Manual analysis** to determine the consequences of component, module or subsystem failures
- Bottom-up analysis
- Consists of a spreadsheet where each failure mode, possible causes, probability of occurrence, consequences, and proposed safeguards are noted.

FMEA – Failure Mode Keywords

- Rupture
- Crack
- Leak
- Plugged
- Failure to open
- Failure to close
- Failure to stop
- Failure to start
- Failure to continue
- Spurious stop
- Spurious start
- Loss of function
- High pressure
- Low pressure
- High temperature
- Low temperature
- Overfilling
- Hose bypass
- Instrument bypassed

FMEA on a Heat Exchanger

Failure Mode	Causes of Failure	Symptoms	Predicted Frequency	Impact
Tube rupture	Corrosion from fluids (shell side)	H/C at higher pressure than cooling water	Frequent – has happened 2x in 10 yrs	Critical – could cause a major fire

- Rank items by risk (frequency x impact)
- Identify safeguards for high risk items

Please see sample of FMEA

FMEA – Failure Modes, Effects Analysis

- FMEA is a very structured and reliable method for evaluating hardware and systems.
- Easy to learn and apply and approach makes evaluating even complex systems easy to do.
- Can be very time-consuming (and expensive) and does not readily identify areas of multiple fault that could occur.
- Not easily lent to procedural review as it may not identify areas of human error in the process.

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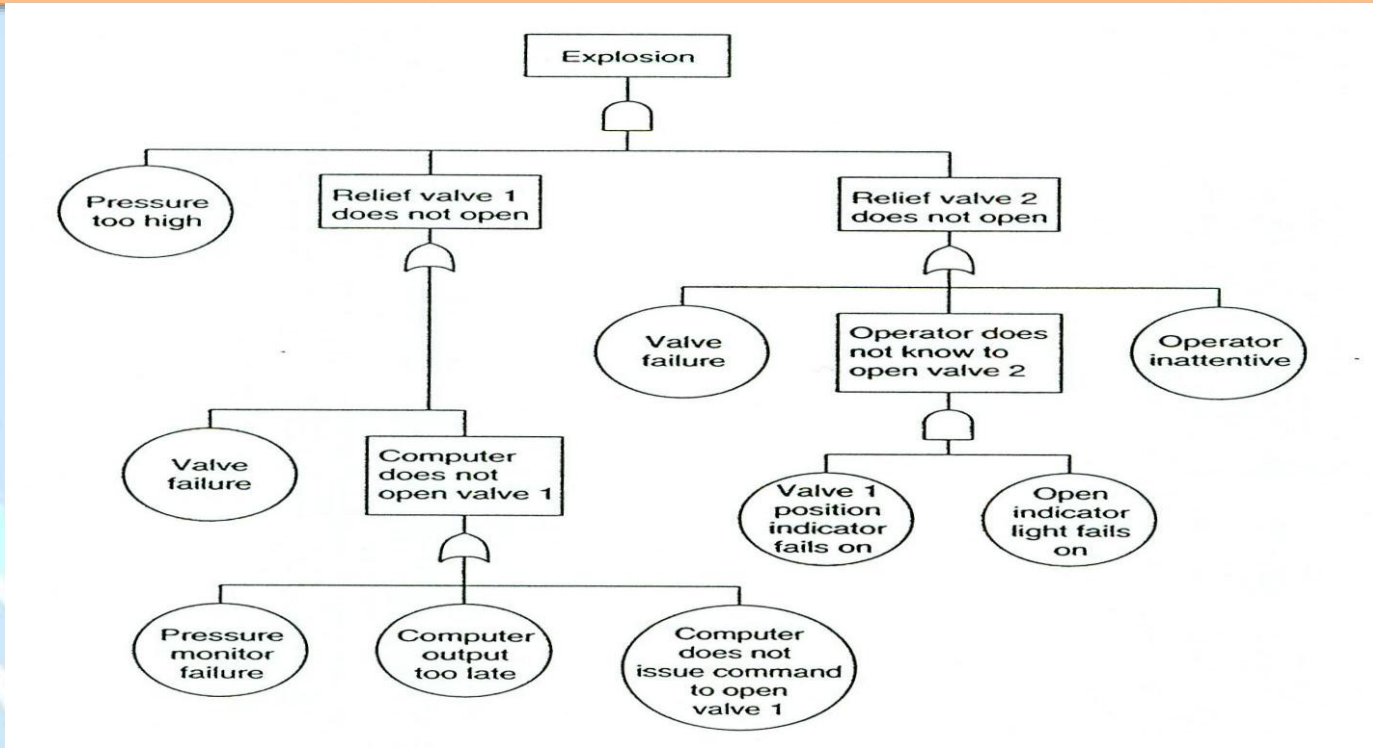
Fault Tree Analysis

- **Graphical method** that starts with a hazardous event and works backwards to identify the causes of the ***top event***
- Top-down analysis
- Intermediate events related to the top event are combined by using logical operations such as AND and OR.



Fault Tree Analysis

- Provides a traceable, logical, quantitative representation of causes, consequences and event combinations
- Amenable to – but for comprehensive systems, requiring – use of software
- Not intuitive, requires training
- Not particularly useful when temporal aspects are important

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Accident Scenarios May Be Missed by PHA

- No PHA method can identify all accidents that could occur in a process
- A scenario may be excluded from the scope of the analysis
- The team may be unaware of a scenario
- The team consider the scenario but judge it not credible or significant
- The team may overlook the scenario

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Where to Get More Information

- Chemical Safety and Hazard Investigation Board's web site: *www.csb.gov*
- MPRI web site: *www. Mpri.lsu.edu/main/*
- Crowl and Louvar – *Chemical Process Safety: Fundamentals with Applications*
- Kletz – *HAZOP & HAZAN: Notes on the Identification and Assessment of Hazards*

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Operating procedures

Procedures must address at least the following elements:

1. Steps for each operating phase:
- ✓ Initial startup;
- ✓ Normal operations;
- ✓ Temporary operations;
- ✓ Emergency shutdown, including the conditions under which emergency shutdown is required, and the assignment of shut down responsibility to qualified operators to ensure that emergency shutdown is executed in a safe and timely manner;
- ✓ Emergency operations;
- ✓ Normal shutdown; and
- ✓ Startup following a turnaround, or after an emergency shutdown.

2. Operating limits:
- ✓ Consequences of deviation, and
- ✓ Steps required to correct or avoid deviation.

3. Safety and health considerations:
- ✓ Properties of, and hazards presented by, the chemicals used
- ✓ Precautions necessary to prevent exposure, including engineering controls, administrative controls, and personal protective equipment;
- ✓ Control measures to be taken if physical contact or airborne exposure occurs;
- ✓ Quality control for raw materials and control of hazardous chemical inventory levels; and
- ✓ Any special or unique hazards.
- ✓ Safety systems (e.g., interlocks, detection or suppression systems) and their functions.

Operating procedures

Operating procedures must be accessible for all who are working in work places.

Also shall be reviewed to make sure any changes on equipment, facilities, process chemicals and technology are covered.

Develop safe work practices for example for LOTO, CS, laboratory, opening process or piping equipment.

Employee Participation

Employers must develop a written plan of action to implement the employee participation required by PSM

Training

Implementation of an effective training program

Training Is not only simple courses: use other ways such as safety alerts, TBT, Face to face or make some program to cover it such making behavioral audit program, also encouragement system, evaluation personnel to taking more working grade, even working on home safety culture is very important.

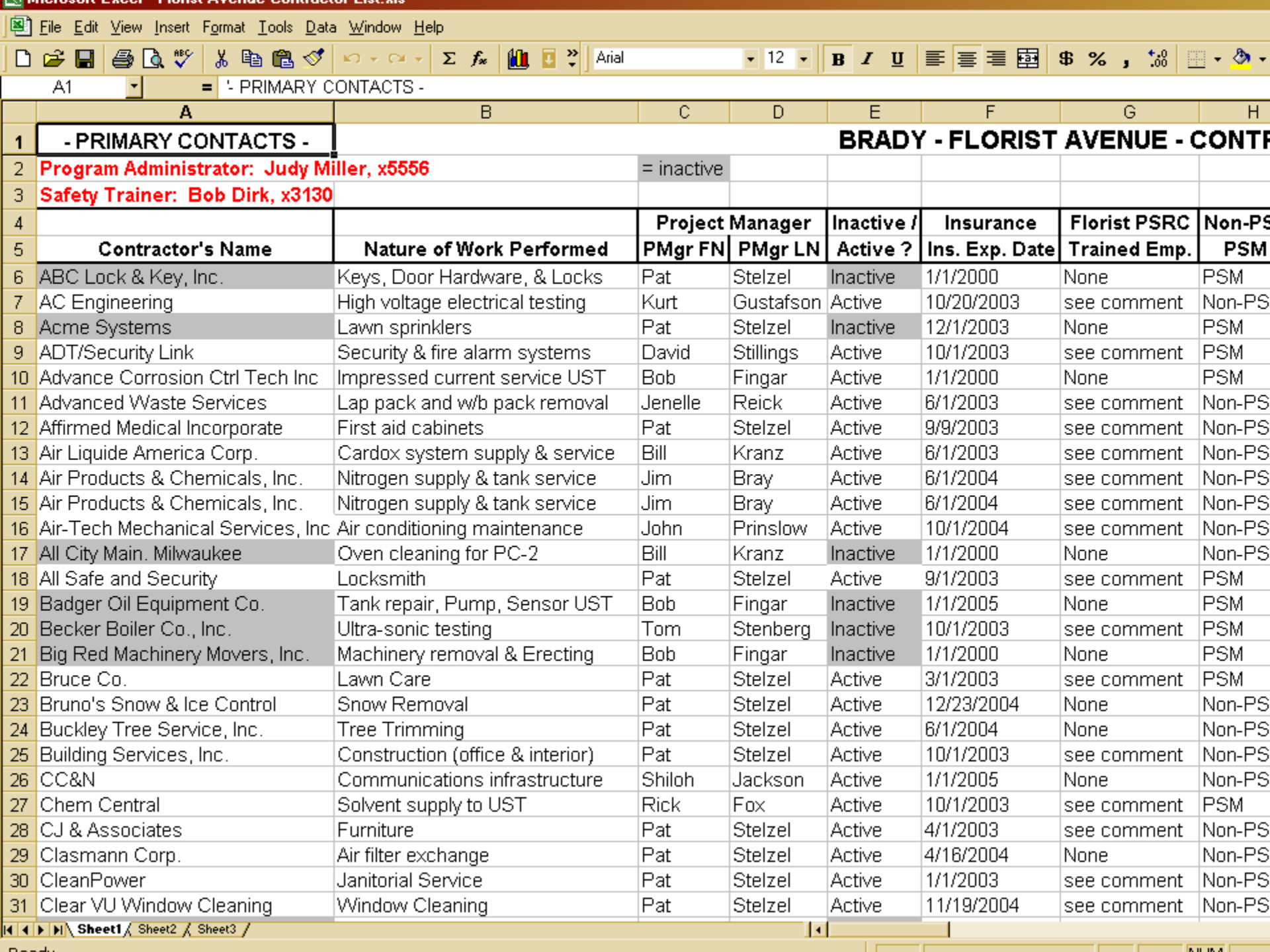
PSM requires that each employee presently involved in operating a process or a newly assigned process must be trained in an overview of the process and in its operating procedures.

The training must include hazards, emergency operations including shutdown, and other safe work practices that apply to
the employee's job tasks.

Refresher training must be provided at least every three years, may need employee consultation too.

A record must be kept containing the identity of the employee, the date of training, and how the employer verified that the employee understood the training.

See samples of Training Matrix, Training Time Table, Efficiency and related elements.



Microsoft Excel - Florist Avenue Contractor List.xls

File Edit View Insert Format Tools Data Window Help

Arial 12

A1 = '- PRIMARY CONTACTS -

	A	B	C	D	E	F	G	H
1	- PRIMARY CONTACTS -						BRADY - FLORIST AVENUE - CONTR	
2	Program Administrator: Judy Miller, x5556		= inactive					
3	Safety Trainer: Bob Dirk, x3130							
4			Project Manager		Inactive /	Insurance	Florist PSRC	Non-PS
5	Contractor's Name	Nature of Work Performed	PMgr FN	PMgr LN	Active ?	Ins. Exp. Date	Trained Emp.	PSM
6	ABC Lock & Key, Inc.	Keys, Door Hardware, & Locks	Pat	Stelzel	Inactive	1/1/2000	None	PSM
7	AC Engineering	High voltage electrical testing	Kurt	Gustafson	Active	10/20/2003	see comment	Non-PS
8	Acme Systems	Lawn sprinklers	Pat	Stelzel	Inactive	12/1/2003	None	PSM
9	ADT/Security Link	Security & fire alarm systems	David	Stillings	Active	10/1/2003	see comment	PSM
10	Advance Corrosion Ctrl Tech Inc	Impressed current service UST	Bob	Fingar	Active	1/1/2000	None	PSM
11	Advanced Waste Services	Lap pack and w/b pack removal	Jenelle	Reick	Active	6/1/2003	see comment	Non-PS
12	Affirmed Medical Incorporate	First aid cabinets	Pat	Stelzel	Active	9/9/2003	see comment	Non-PS
13	Air Liquide America Corp.	Cardox system supply & service	Bill	Kranz	Active	6/1/2003	see comment	Non-PS
14	Air Products & Chemicals, Inc.	Nitrogen supply & tank service	Jim	Bray	Active	6/1/2004	see comment	Non-PS
15	Air Products & Chemicals, Inc.	Nitrogen supply & tank service	Jim	Bray	Active	6/1/2004	see comment	Non-PS
16	Air-Tech Mechanical Services, Inc	Air conditioning maintenance	John	Prinslow	Active	10/1/2004	see comment	Non-PS
17	All City Main. Milwaukee	Oven cleaning for PC-2	Bill	Kranz	Inactive	1/1/2000	None	Non-PS
18	All Safe and Security	Locksmith	Pat	Stelzel	Active	9/1/2003	see comment	PSM
19	Badger Oil Equipment Co.	Tank repair, Pump, Sensor UST	Bob	Fingar	Inactive	1/1/2005	None	PSM
20	Becker Boiler Co., Inc.	Ultra-sonic testing	Tom	Stenberg	Inactive	10/1/2003	see comment	PSM
21	Big Red Machinery Movers, Inc.	Machinery removal & Erecting	Bob	Fingar	Inactive	1/1/2000	None	PSM
22	Bruce Co.	Lawn Care	Pat	Stelzel	Active	3/1/2003	see comment	PSM
23	Bruno's Snow & Ice Control	Snow Removal	Pat	Stelzel	Active	12/23/2004	None	Non-PS
24	Buckley Tree Service, Inc.	Tree Trimming	Pat	Stelzel	Active	6/1/2004	None	Non-PS
25	Building Services, Inc.	Construction (office & interior)	Pat	Stelzel	Active	10/1/2003	see comment	Non-PS
26	CC&N	Communications infrastructure	Shiloh	Jackson	Active	1/1/2005	None	Non-PS
27	Chem Central	Solvent supply to UST	Rick	Fox	Active	10/1/2003	see comment	PSM
28	CJ & Associates	Furniture	Pat	Stelzel	Active	4/1/2003	see comment	Non-PS
29	Clasmann Corp.	Air filter exchange	Pat	Stelzel	Active	4/16/2004	None	Non-PS
30	CleanPower	Janitorial Service	Pat	Stelzel	Active	1/1/2003	see comment	Non-PS
31	Clear VU Window Cleaning	Window Cleaning	Pat	Stelzel	Active	11/19/2004	see comment	Non-PS

Sheet1 Sheet2 Sheet3

Contractors

Many categories of contract labor: General or Specific Tasks, Long or Short term, Local or international, Educate or non educate..

PSM includes special provisions for contractors and their employees to emphasize the importance of everyone taking care that they do nothing to endanger those working nearby who may work for another employer.

PSM, therefore, applies to contractors performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to a covered process.

Employer Responsibilities

The employer: 1. must obtain and evaluate information regarding the contract employer's safety performance and programs,
2. shall inform contractor regarding all job hazards, ERP, Process
3. Inspect periodically…
4. Maintain Contractor HSE statistics such as: injury

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Contract Employer Responsibilities

Ensure employees are trained to perform job safely;

Ensure that contract employees are instructed in the known potential fire, explosion, or toxic release hazards related to their job and the process, and in the applicable provisions of the emergency action plan;

• Document that each contract employee has received and understood the training required by the standard by preparing a record that contains the identity of the contract employee, the date of training, and the means used to verify that the employee understood the training;

• Ensure that each contract employee follows the safety rules of the facility including the required safe work practices required in the operating procedures section of the standard; and

• Advise the employer of any unique hazards presented by the contract employer's work.

PSSER

Please see presentation:

PSSER (Pre-Start Up, Safety and Environment Review)

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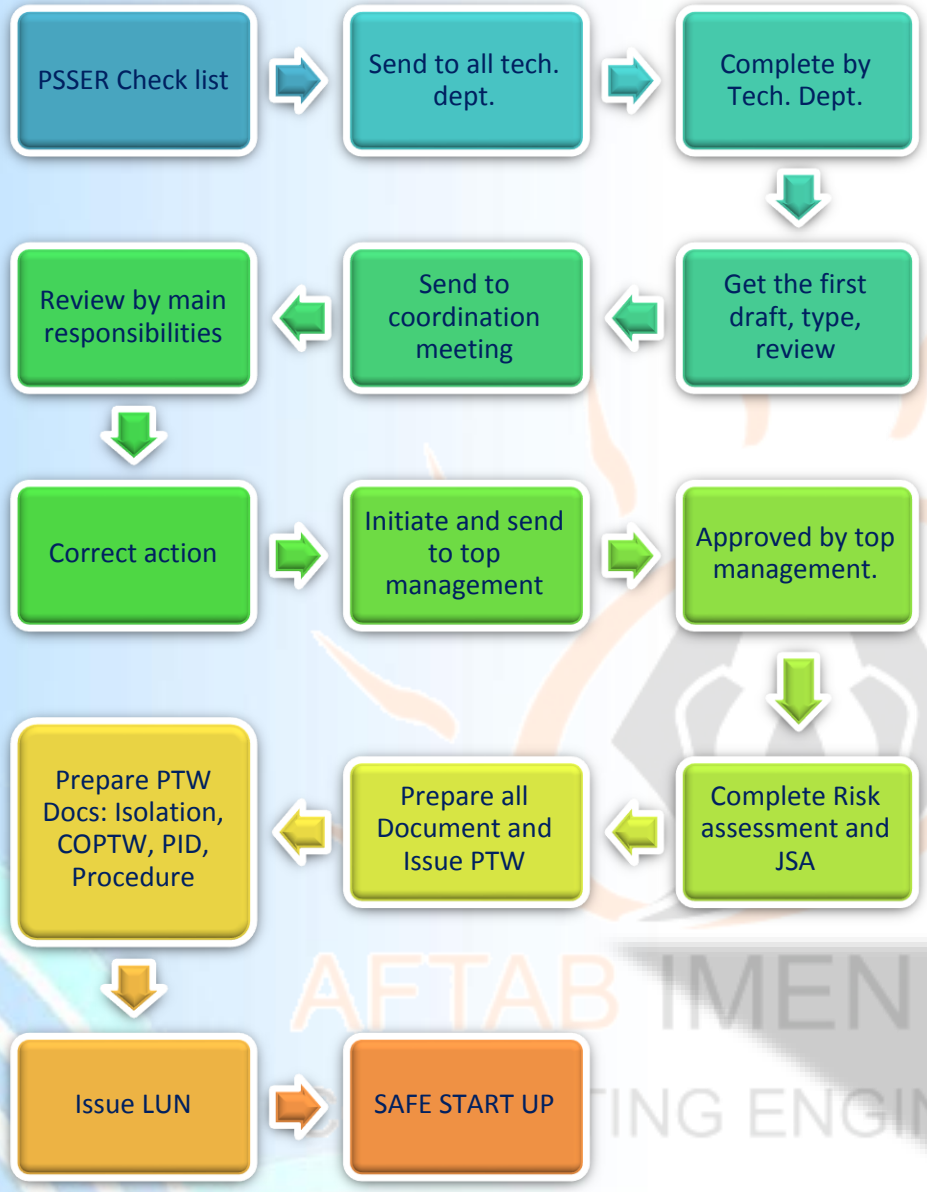

PSSER is an effective system:

1. It is simple, adequate and objective.
2. Line Management are responsible.
3. All technical departments shall cooperate.
4. It is part of information management.
5. By proper team work is following.
6. Shall approved by top management (Covering Leader Ship).
7. Others benefits.

Mechanical Integrity

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It is important to maintain the mechanical integrity of critical process equipment to ensure it is designed and installed correctly and operates properly.

PSM mechanical integrity requirements apply to the following equipment:

- Pressure vessels and storage tanks;
- Piping systems (including piping components such as valves);
- Relief and vent systems and devices;
- Emergency shutdown systems;
- Controls (including monitoring devices and sensors, alarms, and interlocks); and
- Pumps.

Procedures is needed to maintain the ongoing integrity of process equipment, procedures shall show the best engineering practices and shall guide the inspection and testing methods of process equipment. Also all of the testing and inspections shall be documented.

Employees must be trained in an overview of that process and its hazards and procedures applicable to the employees' job tasks.

Mechanical Integrity

- The employer shall develop and maintain a master list of all equipment specifically covered by the standard, and equipment that is important to safety of the process.
  - **Pressure vessels and storage tanks.**
  - **Piping systems including valves and other piping components.**
  - **Relief and vent systems and devices.**
  - **Emergency shutdown systems.**
  - **Controls (including monitoring devices and sensors, alarms, and interlocks).**
  - **Pumps.**
  - **Rotating equipment.**
  - **Heat exchange equipment.**
  - **Electrical generation and distribution equipment.**
  - **Un-interruptable power supplies.**
  - **Emergency power supply equipment.**
  - **Fire protection equipment.**

Hot Work Permit

- Welding, cutting, braising – make sure only trained personnel perform these functions
- Have trained fire watchers (align with fire extinguisher / fire response training)

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Please see presentation:
PTW Advance Training presentation

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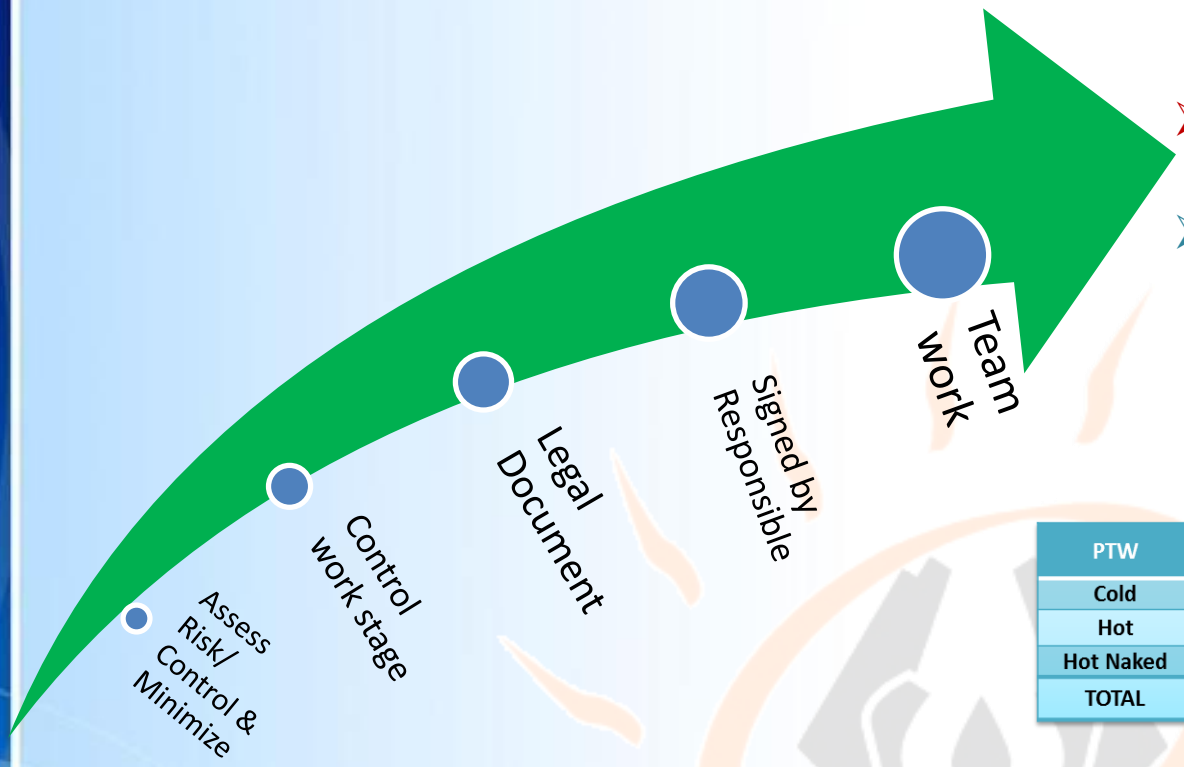
PERMIT TO WORK



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- **PREVENT INCIDENT**
- **More work Efficiency**

Statistics

PTW	ISSUED	Closed	Open	Cumulative PTW Issued
Cold	1816	1752	319	**2842**
Hot	7499	7346	71	**11562**
Hot Naked	1234	1195	50	**2450**
TOTAL	10549	10293	439	**16854 + 4034 = 20888***

Why PTW?

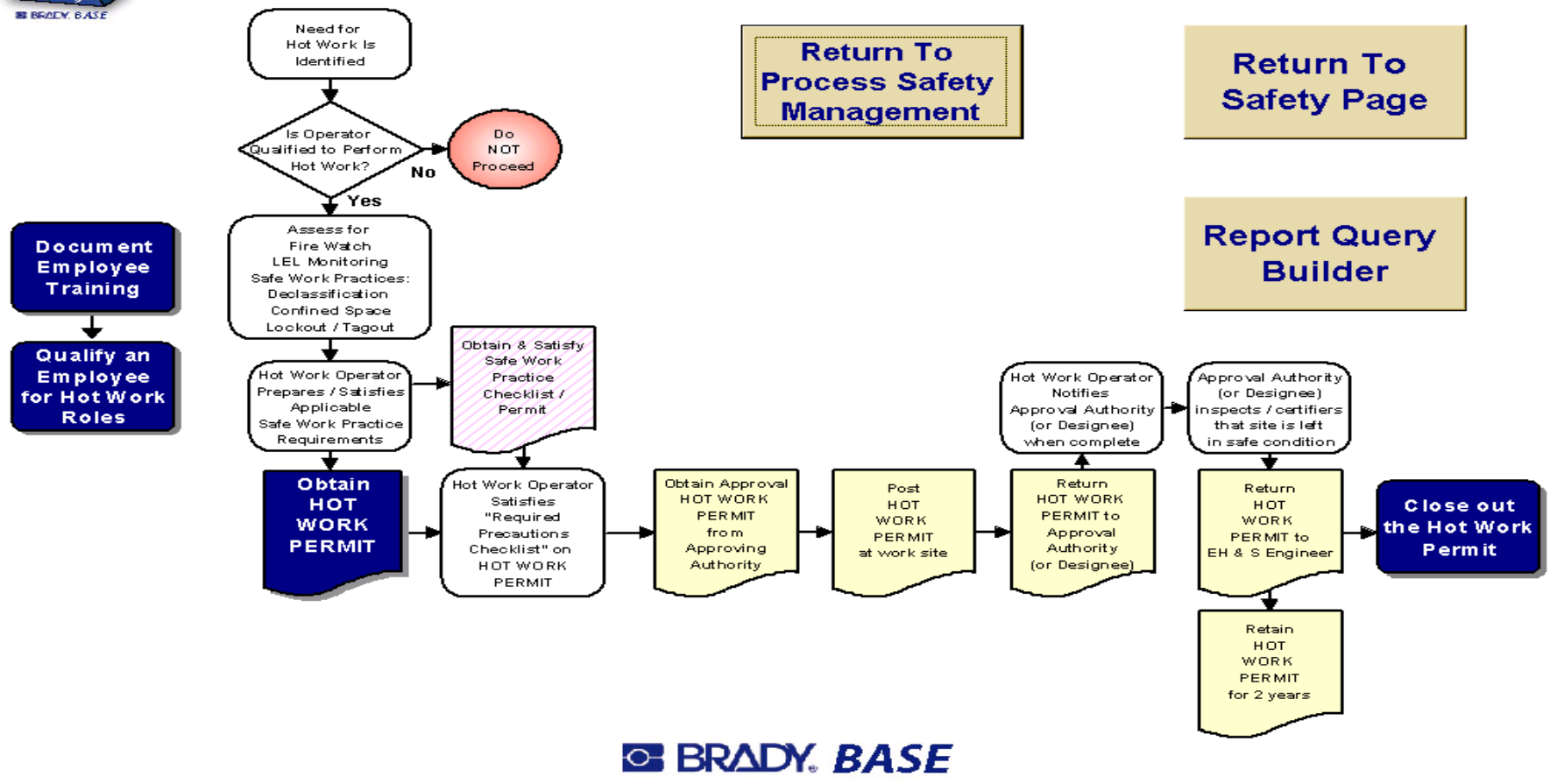
How PTW?
6 Step

1. Request
2. Preparation
3. Approval (Daily PTW Coordination meeting)
4. Execution
5. Interruption
6. Completion

20888
PTW issued from start of project.

Process Safety Management Course
Prepared by ??

Brady Florist Avenue - Hot Work Process



Management of Change

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- Purpose
  - All Accidents are a Result of Uncontrolled Changes
  - Make Sure Changes are Properly Identified and Controlled Before Implemented
- What is Required – Employers Must
  - Write Procedures to Manage Changes (Except for Replacement in Kind) that Address
    - Technical Basis for the Change
    - Impact of Change on Safety and Health
    - Modifications to Operating Procedures
    - Necessary Time Period for the Change
    - Authorization Requirements for the Change
  - Inform and Train Operations, Maintenance, and Contract Employees Affected by the Change Prior to Start-up
  - Update Applicable Process Safety Information
  - Update Operating Procedures or Practices

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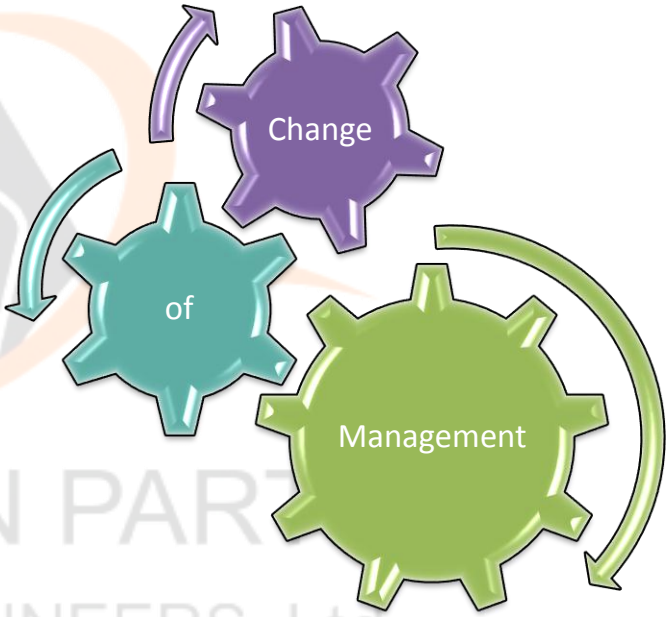
Management of Change

- Create formalized system to review all changes to process areas including:
  - Raw material changes / substitutions
  - Personnel changes
  - Process parameters
  - Facility changes (HVAC / roof / fire protection / ……..)



Management of Change

- PSI
- Mechanical Integrity
- PINDs
- Hot Work
- Contractor Safety
- Employee Training
- PSSR
- Operating Procedures

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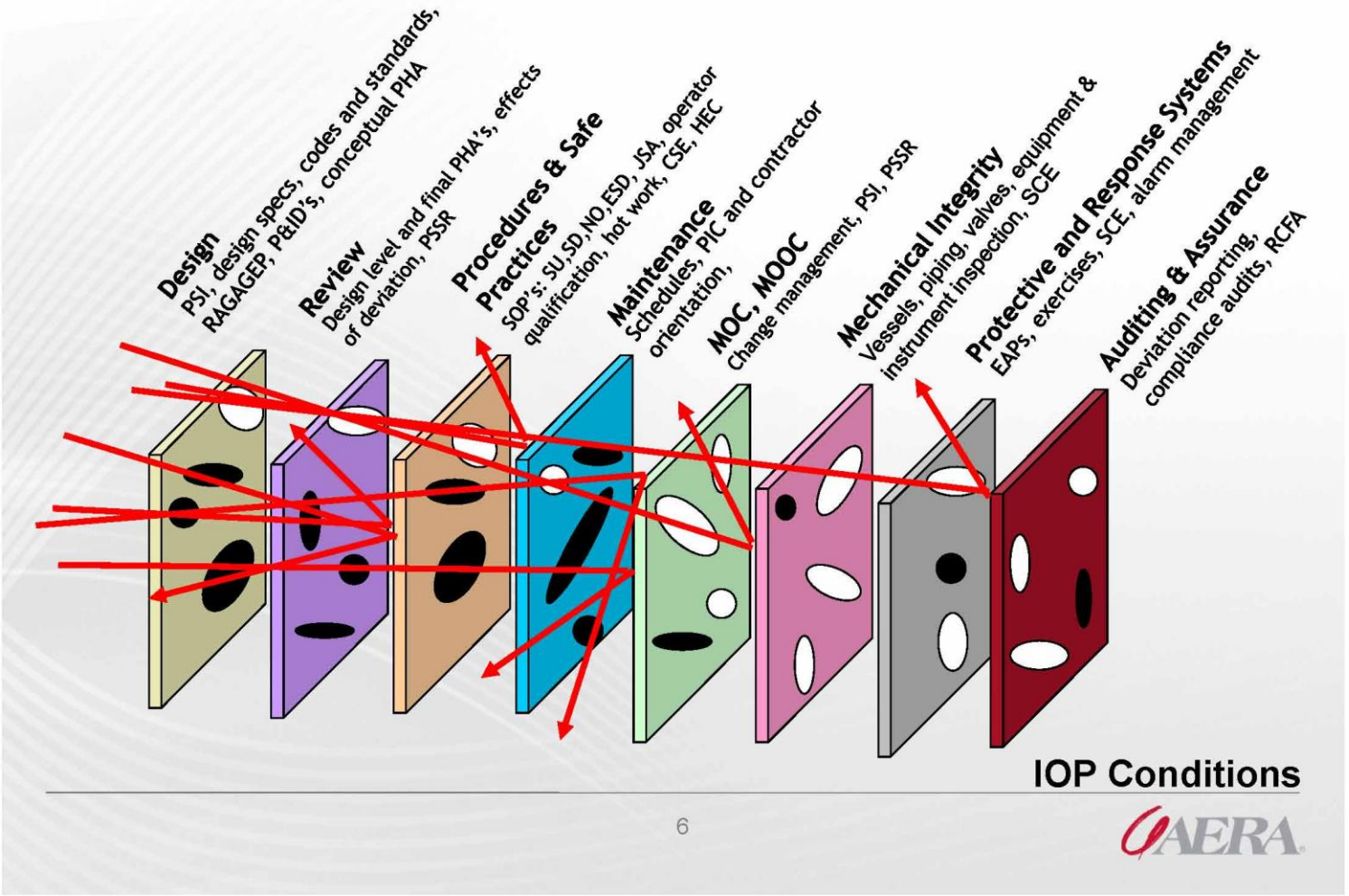
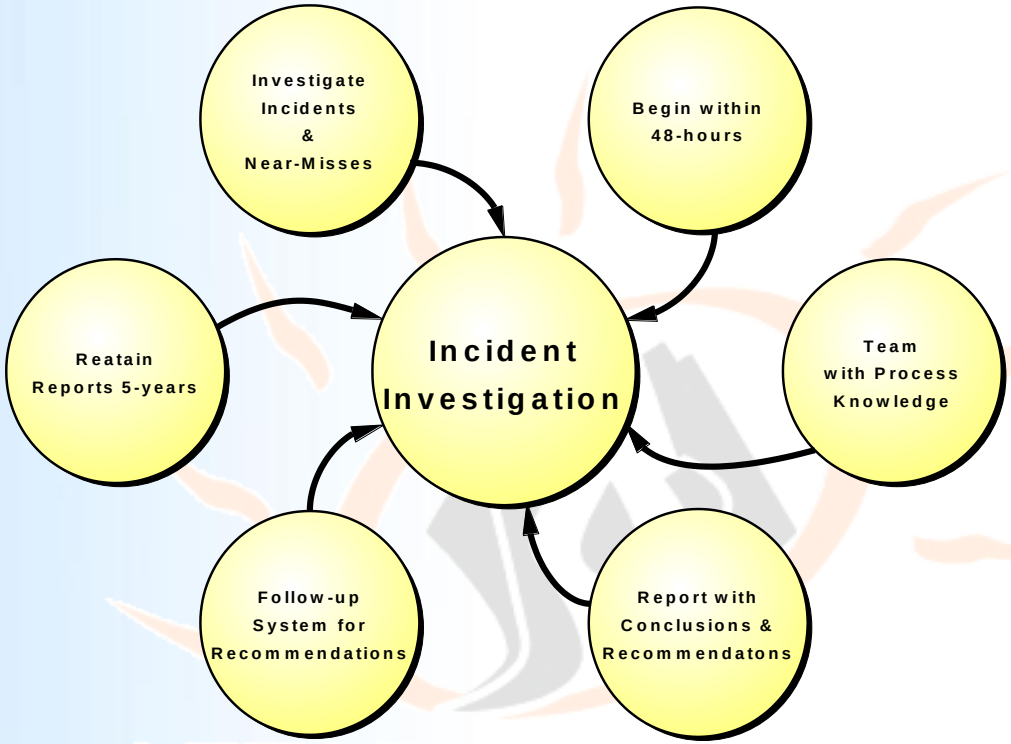
Incident Investigation

- Purpose
  - Provide Feedback for Prevention of Future Problems
  - Incidents are Analogous to Hazards (Potential Problem), Become Accidents When Someone is Harmed
  - After the Fact vs. Other Elements Aimed at Anticipation and Prevention
- What is Required
  - Investigation of any Incident that Resulted or Could Have Resulted in Catastrophic Release of a HHC
  - Prompt Initiation, Within 48 Hours
  - Investigation Team Formed Consisting of Knowledge of Process Affected, Contractor if Involved, Others with Appropriate Knowledge
  - Report Prepared
  - Employer has a System to Promptly and Effectively Address Findings and Recommendations; and Document this Resolution
  - Report is Reviewed with Affected Personnel
  - Reports are Retained for Five Years

Operational threats and defenses



Incident Investigation



Emergency Planning and Response

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- Purpose is to Minimize Injuries and Damage in Event of an Incident or Accident
- What is Required
  - Establishment and Implementation of an Emergency Action Plan
  - Procedures for Handling Small Releases
  - Training

- Call in all resources and make plan comprehensive:
  - Information Technology (IT) Disaster Recovery Plan
  - Business Continuity Plan
  - Security
  - Communications / Public Relations
  - Employee Assistance

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Compliance Audits

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- Purpose is to Compare Performance Against the Written Standards and Procedures
- What is Required
  - Employer Certify Every Three Years He Has Verified Procedures and Practices Required by The Rule are Adequate and Being Followed
  - Audit Team Include One Person Knowledgeable in Process and Other Knowledgeable Personnel
  - Audit Report Developed
  - Employer Respond to Findings and Document Deficiencies Have Been Resolved
  - Two Most Recent Audit Reports Be Retained

- Ask for the audit protocol ahead of time
- Have a system in place to identify the location of all PSM documentation
- Identify what's in or out of audit scope
- Ask for money to correct audit items before the audit is conducted
- Prepare management for report

Trade Secrets

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- Purpose
  - To Insure Employees Have Access to Information Needed to Perform Job Safely, Regardless of Trade Secrets
  - A Trade Secret is Knowledge not Patented but Gives a Co. a Competitive Advantage
- What is Required
  - Information (Regardless of Status) be Made Available to Persons Responsible for
    - Compiling Process Safety Information
    - Development of Process Hazard Analysis
    - Development of Operating Procedures
    - Involved in Incident Investigations, Emergency Planning and Response, and Compliance Audits
  - Allows Employer's to Require Confidentiality Agreements of Employees

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Quiz

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1. The Process Safety Management Standard was drafted as a requirement of the Clean Air Act. True or False
2. The PSM program must include a list of highly hazardous chemicals. True or False
3. The initial start-up of a process is not included as an operating phase under the PSM Standard. True or False
4. List three items that the process hazard analysis must address. _____, _____ and _____.
5. PSM does not apply to contractors, regardless of the work they are doing. True or False

Quiz (cont.)

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6. The PSM Standard applies to companies that either process highly _____ materials or use _____ liquids and gases in excess of 10,000 pounds.
7. Process safety information includes: _____, _____ and _____.
8. Fault tree analysis is one form of an approved method of performing a process hazard analysis. True or False
9. A technical basis is not required to change a process covered by the PSM Standard. True or False
10. Two types of training required by the PSM standard are _____

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Quiz Answers

1. True. The Process Safety Management Standard was drafted as a result of the Clean Air Act Amendments of 1990.
2. True.
3. False. The initial start-up of a process is an operating phase that must be included.
4. The items that a process hazard analysis must address include hazards of the process, identification of previous accidents, engineering. and administrative controls, consequences of failure, facility citing, human factors, and qualitative evaluation of S and H effects.
5. False. PSM does apply to contractors who work on or adjacent to a process.

Quiz Answers (cont.)

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6. The PSM Standard applies to companies that either process highly hazardous materials or use flammable liquids and gases in excess of 10,000 pounds.
7. Process safety information includes toxicity, permissible exposure limits, physical data, reactivity data, corrosivity data, and thermal and chemical stability data.
8. True. Fault Tree Analysis is one form of an approved method of performing a process hazard analysis.
9. False. All change must have a technical basis in order to be authorized.
10. Two types of training required by the PSM standard are initial and refresher.

How to Implement PSM in a Refinery?

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- Implementation of PSP in PEMID. Give examples.
- Please see PSP Implementation program presentation.
- Start to talk about PSM implementation. Step by Step.

- What are different between PSM, PSP, PHSEP, HSEMS, OHSAS18001 and Iso14001
- Types of PSM: CCPS, OSHA, Canadian.

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Document needed

Compare to what system you have, other docs needed to be prepared.
Example: if you have HSEMS, you can combine both HSEMS-PSM

- Important document needed:
- Main copy of standard and distribute it to line management.
- Document to prove that equipment is designed, maintained, inspected, tested, and operated in safe manner.
- Training Document: Matrix, Personnel files, refresh, efficiency, etc.
- SIMOS Procedure.
- PSSER Procedure.
- PTW Procedure.
- Operating Procedure.
- ERP Procedure.
- MI procedure.
- MOC Procedure
- PHA Docs, Methods, Procedure.
- Information management: Information on the technology, Information on the hazards of the highly hazardous, Information on the equipment, if no info. take it by methods such as PHA,
- Plan for Employee participation.
- Define and document Organization JD
- For all document PDCA shall be followed.

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Forward Actions

- Don’t forget the Human! – a key component of all systems
- Get senior management involved in technology decisions, their very jobs may depend on it
- Seek out those who think differently

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Conclusion

Where to Get More Information

- Chemical Safety and Hazard Investigation Board's web site: *www.csb.gov*
- MPRI web site: *www. Mpri.lsu.edu/main/*
- Crowl and Louvar – *Chemical Process Safety: Fundamentals with Applications*
- Kletz – *HAZOP & HAZAN: Notes on the Identification and Assessment of Hazards*

References

1. **Canadian Society for Chemical Engineering.** *Process Safety Management Guide.* Ottawa : Canadian Society for Chemical Engineering, 2012.
2. **Energy Institute.** *High Level Framework for Process Safety Management.* London : Energy Institute, 2010.
3. **U.S. Department of Labor.** *Process Safety: (*OSHA 3132). s.l. : U.S. Department of Labor, 2000.
4. **Center for Chemical Process Safety.** *Guideline for Management of Change for Process Safety.* New York : John Wiley & Sons, Inc, 2008.
5. **Government of Canada.** Canada Environmental Protection Act, 1999. *Environment Canada* [Online] 07 10, 2013. http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=E00B5BD8-1
6. **Chemistry Industry Association of Canada.** Responsible Care. *Chemistry Industry Association of Canada.* [Online] 07 10, 2013. http://www.canadianchemistry.ca/ResponsibleCareHome.aspx.
7. **Government of Canada.** Canada Occupational Health and Safety Regulations (SOR/86-304). *Justice Laws Website.* [Online] 07 10, 2013. http://laws-lois.justice.gc.ca/eng/regulations/SOR-86-304/.
8. **Atherton, John and Gil, Fredric.** *Incidents that define process safety.* Hoboken, NJ : John Wiley & Sons, Inc, 2008.

Prepared on June.2017, reviewed by Manouchehr AHANJ

- 9. **Kletz, Trevor.** *What went wrong? Case histories of process plant disasters and how they could have been avoided.* 5th. Oxford : Elsevier, 2009.
- 10. **Oxford Economics.** *Potential Impact of the Gulf Oil Spill on Tourism.* Washington : US Travel Association, 2010.
- 11. **Health and Safety Executive.** *The Flixborough Disaster : Report of the Court of Inquiry.* London : Her Majesty's Stationery Office National Archives, 1975.
- 12. **Turk, M.A. and Mishra, A.** Process Safety Management: Going Beyond Functional Safety. *Hydrocarbon Processing.* [Online] 07 23, 2013. http://www.hydrocarbonprocessing.com/Article/3161534/Process-safety-management-Going-beyond-functional-safety.html.
- 13. **Sutton Technical Books.** Process Safety Management. *Sutton Technical Books.* [Online] 07 23, 2013. http://www.stb07.com/process-safety-management/process-safety-management-index.html.
- 14. **Department of Justice, Government of Canada**. Plain Language guide to Bill C-45. http://www.justice.gc.ca/eng/rp-pr/other-autre/c45/. Accessed: May 30, 2013.

Prepared on June.2017, reviewed by Manouchehr AHANJ

- 15. Government of Nova Scotia. *The Westray Story: A predictable path to Disaster*. http://novascotia.ca/lae/pubs/westray/. Accessed: June 2, 2013.
- 16. **U.S. Department of Labor.** *Process Safety: Regulation 1910* : U.S. Department of Labor, 2000. *[Online]* https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9760
- *17.* ***European Commision****. EU Seveso II Directive*. European Commision , 2013 [Online] http://ec.europa.eu/environment/seveso/index.htm
- 18. **Busick, Jennifer.** Process Safety Management. *SAFETY COMPLIANCE LETTER.* pp. 5-6.
- 19. **Kelly, Brian D.** *Process Safety Management and its impact on the professional engineering community.* Calgary, Ontario, Canada : s.n., 2010

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PSM

JUNE.2017

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