

INTRODUCTIONS

- PSM/RMP Covered Process?
 - Types:
 - Ammonia
 - Chlorine
 - Flammables
 - Chemical
 - Oil/Gas
- What do we want to cover?

BORDERS ICE CREAM, HOUSTON, TEXAS– DECEMBER 12, 1983



Brandworthy Food Solutions



At approximately 1:20 p.m. on March 23, 2005, a series of explosions occurred at the BP Texas City refinery during the restarting of a hydrocarbon isomerization unit. Fifteen workers were killed and 180 others were injured. Many of the victims were in or around work trailers located near an atmospheric vent stack. The explosions occurred when a distillation tower flooded with hydrocarbons and was overpressurized, causing a geyser-like release from the vent stack.

Brandworthy Food Solutions



On the night of December 2-3, 1984, a sudden release of about 30 metric tons of methyl isocyanate (MIC) occurred at the Union Carbide pesticide plant at Bhopal, India. The accident was a result of poor safety management practices, poor early warning systems, and the lack of community preparedness. The accident led to the death of over 2,800 people (other estimates put the immediate death toll as high as 8000) living in the vicinity and caused respiratory damage and eye damage to over 20,000 others. At least 200,000 people fled Bhopal during the week after the accident. Estimates of the damage vary widely between \$350 million to as high as \$3 billion.

Brandworthy Food Solutions

WEST, TEXAS



Brandworthy Food Solutions

TREVOR KLETZ, 1922-2013



- *"Safety is something a lot of people learn by accident."*
- *"There's an old saying that if you think safety is expensive, try an accident. Accidents cost a lot of money. And, not only in damage to plant and in claims for injury, but also in the loss of the company's reputation."*
- *"For a long time, people were saying that most accidents were due to human error and this is true in a sense but it's not very helpful. It's a bit like saying that falls are due to gravity."*

OVERVIEW

- Process Safety Management – 29 CFR 1910.119
 - Worker Protection
 - 10,000 pounds of listed chemical or flammables
 - 14 Elements
 - Performance Standard
- Risk Management Plan – 40 CFR part 68
 - Community/Environment Protection
 - File with EPA

TOP 17 PARTS OF PSM CITED

- 1. Written MI Procedures
- 2. Perform an initial PHA
- 3. Written procedures to manage change
- 4. Document RAGAGEP compliance
- 5. Written Employee Participation Plan
- 6. Develop and Implement SOPs
- 7. Correct deficiencies outside limits
- 8. Trained in SOPs
- 9. System to Promptly address PHA findings & recommendations
- 10. Emergency Planning and Response
- 11. Annual SOP Certification
- 12. Inspections/tests on equipment
- 13. Training means used to verify
- 14. 3 year compliance audit certification
- 15. Steps for each operating phase
- 16. P&IDs
- 17. Safe Work Practices

PROCESS SAFETY INFORMATION (PSI)

Information pertaining to the HAZARDS OF THE HIGHLY HAZARDOUS CHEMICALS in the process shall consist of at least the following:

- Toxicity information
- Permissible exposure limits
- Physical data
- Reactivity data
- Corrosivity data
- Thermal and chemical stability data
- Hazardous effects of inadvertent mixing of different materials that could foreseeably occur

Note: Material Safety Data Sheets meeting the requirements of 29 CFR 1910.1200(g) may be used to comply with this requirement to the extent they contain the information required by this subparagraph.

PROCESS SAFETY INFORMATION (PSI)

Information concerning the TECHNOLOGY OF THE PROCESS includes at least the following:

- A block flow diagram or simplified process flow diagram
- Process chemistry (**Does this apply to NH3 refrigeration????**)
- Maximum intended inventory
- Safe **UPPER** and **LOWER** limits for such items as temperatures, pressures, flows or compositions
- An evaluation of the consequences of deviations, including those affecting the safety and health of employees.
- Where the original technical information no longer exists, such information may be developed in conjunction with the process hazard analysis in sufficient detail to support the analysis.

PROCESS SAFETY INFORMATION (PSI)

Information pertaining to the **EQUIPMENT IN THE PROCESS** shall include:

- Materials of Construction
- Piping and Instrument Diagrams (P&ID's)
- Electrical classification
- Relief system design and design basis
- Ventilation system design
- Design codes & standards employed
- Material and energy balances for processes built after May 26, 1992
- Safety systems (e.g. interlocks, detection or suppression systems)
- Document that equipment complies with **RECOGNIZED AND GENERALLY ACCEPTED GOOD ENGINEERING PRACTICES (RAGAGEP)**.
- For existing equipment designed and constructed in accordance with codes, standards, or practices that are no longer in general use, the employer shall determine and document that the equipment is designed, maintained, inspected, tested, and operating in a safe manner.

PROCESS SAFETY INFORMATION (PSI)

Recognized **A**nd **G**enerally **A**ccepted **G**ood **E**ngineering **P**ractices (RAGAGEP) are engineering, operation, or maintenance activities based on **ESTABLISHED** codes, standards, published technical reports or recommended practices (RP) or a similar document.

RAGAGEPs detail generally approved ways to perform specific engineering, inspection or mechanical integrity activities, such as fabricating a vessel, inspecting a storage tank, or servicing a relief valve.

PROCESS HAZARD ANALYSIS (PHA)

- Perform an initial PHA (hazard evaluation)
- PHA MUST be appropriate to the complexity of the process and **identify, evaluate,** and **control the hazards** involved in the process.
- Use one or more of the following methodologies that are appropriate to determine and evaluate the hazards of the process being analyzed
 - What-If
 - Checklist
 - What-If/Checklist
 - Hazard and Operability Study (HAZOP)
 - Failure Mode and Effects Analysis (FMEA)
 - Fault Tree Analysis
 - An appropriate equivalent methodology

PROCESS HAZARD ANALYSIS (PHA)

- PHA MUST address:
 - hazards of the process
 - identification of any previous incident which had a likely 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
 - A qualitative evaluation of a range of the possible safety and health effects of failure of controls on employees in the workplace
- PHA MUST be performed by a team with expertise in engineering and process operations
- Team MUST include at least:
 - One employee who has experience and knowledge specific to the process being evaluated.
 - One member of the team must be knowledgeable in the specific process hazard analysis methodology being used.

PROCESS HAZARD ANALYSIS (PHA)

- Establish a system to:
 - **PROMPTLY ADDRESS** findings and recommendations
 - assure that the **RECOMMENDATIONS ARE RESOLVED IN A TIMELY MANNER** and that the **RESOLUTION IS DOCUMENTED**
 - **DOCUMENT WHAT ACTIONS ARE TO BE TAKEN**
 - complete actions **AS SOON AS POSSIBLE**
 - develop a **WRITTEN SCHEDULE** of when these actions are to be completed
 - **COMMUNICATE** the actions to operating, maintenance and other employees whose work assignments are in the process and who may be affected by the recommendations or actions
- **AT LEAST EVERY FIVE (5) YEARS** after the completion of the initial PHA, update/revalidate using a team meeting the requirements stated early, to assure that the PHA is consistent with the current process
- Retain PHA(s) and **UPDATES/REVALIDATIONS** for each process, as well as the documented resolution of recommendations for the **LIFE OF THE PROCESS**

OPERATING PROCEDURES (SOPS)

- Develop and implement **WRITTEN OPERATING PROCEDURES** that provide clear instructions for safely conducting activities involved in each covered process consistent with the PSI and 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 shutdown responsibility to qualified operators to ensure that emergency shutdown is executed in a safe and timely manner.
 - Emergency Operations
 - Normal shutdown
 - Startup following a turnaround, or after an emergency shutdown
 2. Operating limits
 - Consequences of deviation and Steps required to correct or avoid deviation

OPERATING PROCEDURES (SOPS)

3. Safety and health considerations:

- Properties of, and hazards presented by, the chemicals used in the process
 - 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
4. Quality control for raw materials and control of hazardous chemical inventory levels
 5. Any special or unique hazards
 6. Safety systems and their functions
- SOPs MUST be **READILY ACCESSIBLE** to employees who work in or maintain a process.
 - SOPs shall be **REVIEWED AS OFTEN AS NECESSARY** to assure that they reflect current operating practice, including changes that result from changes in process chemicals, technology, and equipment, and changes to facilities.
 - **CERTIFY ANNUALLY** that SOPs are current and accurate.
 - Develop and implement safe work practices to provide for the control of hazards during operations such as LOTO, CSE, Opening process equipment or piping; and control over entrance into a facility by maintenance, contractor, laboratory, or other support personnel.
 - These safe work practices shall apply to employees and contractor employees.

OPERATING PROCEDURES (SOPS)

- Develop and implement safe work practices to provide for the control of hazards during operations such as
 - Lockout/Tagout
 - Confined Space Entry
 - Opening process equipment or piping
 - Control over entrance into a facility by maintenance, contractor, laboratory, or other support personnel
- Safe work practices apply to **EMPLOYEES AND CONTRACTOR EMPLOYEES.**

TRAINING

- Initial training
 - Each employee presently involved in operating a process, and each employee before being involved in operating a newly assigned process, **MUST BE** trained in
 - an overview of the process and
 - in the SOPs and SWPs
 - Training must **EMPHASIS** the:
 - specific safety and health hazards,
 - emergency operations including shutdown, and
 - safe work practices applicable to the employee's job tasks
- Refresher training
 - MUST be provided **AT LEAST every three (3) years**, and more often if necessary, to each employee involved in operating a process to assure that the employee understands and adheres to the current SOPs and SWPs of the process
 - In consultation with the employees involved in operating the process, determine the appropriate frequency of refresher training
- Training documentation
 - Ascertain that **each employee involved in operating a process** has received and **UNDERSTOOD** the training
 - Prepare a record which contains:
 - the identity of the employee,
 - the date of training
 - the means used to **VERIFY THAT THE EMPLOYEE UNDERSTOOD** the training

PRE-STARTUP SAFETY REVIEW (PSSR)

- Perform a pre-startup safety review for
 - new facilities and
 - modified facilities when the modification is significant enough to require a change in PSI
- PSSRs confirm that prior to the introduction of HHC to a process:
 - Construction and equipment is in accordance with design specifications
 - Safety, operating, maintenance, and emergency procedures are in place and are adequate
 - For new facilities, a PHA has been performed and recommendations have been resolved or implemented **before startup**
 - Modified facilities meet the requirements contained in the MOC
 - Training of each employee involved in operating/maintaining a process has been completed

MECHANICAL INTEGRITY (MI)

- Applies to the following process equipment:
 - Pressure vessels and storage tanks
 - Piping systems (including piping components such as valves (including drain/vent valves), gaskets, thread dope)
 - Relief and vent systems and devices (PSV, Hydrostats, Rupture Disc)
 - Emergency shutdown systems
 - Controls (including monitoring devices and sensors, alarms, and interlocks)
 - Pumps
- Establish and implement **WRITTEN PROCEDURES** to maintain the on-going integrity of process equipment
- **TRAIN** each employee involved in maintaining the on-going integrity of process equipment in:
 - an overview of that process
 - its hazards
 - the procedures applicable to the employee's job tasks to assure that the employee can perform the job tasks in a safe manner

MECHANICAL INTEGRITY (MI)

Inspection and Testing...

- Inspections and tests **MUST** be performed on process equipment
- Inspection and testing procedures shall follow RAGAGEPs
- Frequency of inspections and tests of process equipment **MUST** be consistent with applicable **MANUFACTURERS' RECOMMENDATIONS** and RAGAGEPs, and **more frequently if determined to be necessary by prior operating experience**
- Document each inspection and test that has been performed
- Documentation must identify:
 - the date of the inspection or test
 - the name of the person who performed the inspection or test
 - the serial number or other identifier of the equipment on which the inspection or test was performed,
 - a description of the inspection or test performed
 - the results of the inspection or test
- RAGAGEP OSHA Definition -
https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=30785

MECHANICAL INTEGRITY (MI)

Equipment deficiencies

- **Correct deficiencies in equipment that are outside acceptable limits** (defined by the PSI) before further use or in a safe and timely manner when necessary means are taken to assure safe operation

Quality assurance

- In the construction of new plants and equipment, **assure that equipment as it is fabricated** is suitable for the process application for which they will be used
- Appropriate checks and inspections must be performed to assure that equipment is **installed properly** and **consistent with design specifications** and the **manufacturer's instructions**
- The employer shall assure that **maintenance materials, spare parts and equipment are suitable for the process application** for which they will be used

INCIDENT INVESTIGATION (II)

- Investigate each incident which resulted in, **or could reasonably have resulted in**, a catastrophic release of HHC in the workplace
 - "Catastrophic release" means a major uncontrolled emission, fire, or explosion, involving one or more highly hazardous chemicals, that presents serious danger to employees in the workplace.
- Initiate the investigation as **promptly as possible, but not later than 48 hours following the incident**
- Establish a team to do the investigation and this team must consist of at least one (1) person **knowledgeable in the process involved** and other persons with appropriate knowledge and experience to thoroughly investigate and analyze the incident
 - Team **MUST** include a contractor if the incident involved work of the contractor **WARNING!** Do not forget about involving the contractor if the equipment that failed was fabricated and/or installed by a contractor!
- A report **MUST** be prepared at the conclusion of the investigation which includes, at a minimum:
 - Date of incident
 - Date investigation began
 - A description of the incident
 - The factors that contributed to the incident
 - Any recommendations resulting from the investigation

INCIDENT INVESTIGATION (II)

- **Establish a system** to promptly address and resolve the incident report findings and recommendations
- **Resolutions and corrective actions shall be documented**
- The report shall be reviewed with **all affected personnel whose job tasks are relevant to the incident findings** including contract employees where applicable
- Incident investigation reports shall be retained for five (5) years
 - Can anyone tell us why 5 years??????

EMERGENCY PLANNING AND RESPONSE

- Establish and implement an emergency action plan (EAP) for the entire plant in accordance with the provisions of 29 CFR 1910.38
- In addition, the emergency action plan shall include procedures for handling small releases
- Employers may also be subject to the hazardous waste and emergency response provisions contained in 29 CFR 1910.120 (a), (p) and (q)

Elements of an EAP

- Procedures for reporting a fire or other emergency
- Procedures for emergency evacuation, including type of evacuation and exit route assignments
- Procedures to be followed by employees who remain to operate critical plant operations before they evacuate
- Procedures to account for all employees after evacuation
- Procedures to be followed by employees performing rescue or medical duties; and
- The name or job title of every employee who may be contacted by employees who need more information about the plan or an explanation of their duties under the plan.

Elements of an ERP

- Pre-emergency planning and coordination with outside parties..
- Personnel roles, lines of authority, training, and communication.
- Emergency recognition and prevention.
- Safe distances and places of refuge.
- Site security and control.
- Evacuation routes and procedures.
- Decontamination.
- Emergency medical treatment and first aid.
- Emergency alerting and response procedures.
- Critique of response and follow-up.
- PPE and emergency equipment.

COMPLIANCE AUDITS

- Employers shall certify that they have evaluated compliance **at least every three (3) years** to verify that the **procedures and practices developed are adequate and are being followed**
- The compliance audit shall be conducted by at least one (1) person knowledgeable in the covered process
- A report of the findings of the audit shall be developed
- **Promptly determine and document an appropriate response to EACH OF THE FINDINGS** of the compliance audit, and **document that deficiencies have been corrected**
- Retain the two (2) most recent compliance audit reports

INTER-RELATIONSHIP OF ELEMENTS

- During a routine inspection of equipment (Mechanical Integrity) or an incident investigation, the maintenance worker discovers a valve that no longer meets the applicable code and must be changed. Because the type of valve is no longer made, a different type of valve must be selected and installed (**Management of Change**). The type of valve selected may mandate different steps for the operators (**Operating Procedures**) who will require training and verification in the new procedures (**Training**). The rationale for selecting the type of valve must be made available for review by employees and their representatives (**Employee Participation**).
- When the new valve is installed by the supplier (**Contractors**), it will involve shutting down part of the process (**Pre-startup Safety Review**) as well as brazing some of the lines (**Hot Work Permit**). The employer must review the response plan (**Emergency Planning**) to ensure that procedures are adequate for the installation hazards.
- Although **Management of Change** provisions cover interim changes, after the new valve is in place the **Process Safety Information** will have to be updated before the **Process Hazard Analysis** is updated or revalidated, to account for potential hazards associated with the new equipment. Also, inspection and maintenance procedures and training will need to be updated (**Mechanical Integrity**).
- These elements shall be cross checked to see if they show that the changes have been followed through to completion.
- In summary, 11 PSM elements can be affected by changing one valve.
- A CSHO would check a representative number of these 11 elements to confirm that the required follow-up activities have been implemented for the new valve.
- Three key elements shall be routinely reviewed to verify that changes have been implemented.
- They are:
 - * Operating Procedures;
 - * Process Hazard Analysis; and
 - * Training.

EPA'S CLEAN AIR ACT GDC

- Covers a WIDE array of EHS/HHC
- Does **NOT** have to be a listed RMP chemical
- Facilities with 9,000#'s of NH₃ and 4,675 gallons of FLAGS have been cited:
 - *Failed to provide protections consistent with applicable industry codes and standards*
 - *No hazard analysis performed using industry recognized hazard assessment techniques*
 - *Failure to meet Recognized and Generally Accepted Good Engineering Practice (RAGAGEP)*
 - *Inadequate signs and labels*
 - *Lack of Documentation*

NEW RMP RULES

- Emergency Planning Coordination with emergency responders
 - 1 notification exercise per year
 - 1 tabletop exercise every 3 years
 - 1 field exercise every 10 years
- Information sharing upon request with 45 days
- Root Cause analysis – incident investigations
- Safety Technology and Alternatives Analysis - Inherently Safer Design
- Third Party Audits if reportable incident or if required



BEST PRACTICES AND WATCH OUTS



DON'T FORGET THESE ITEMS

- SCOPE of Audit Matters!
 - Fall Protection
 - Fixed Industrial Stairs
 - PPE Hazards Assessments
 - Respiratory Protection (Op's, Maint, ERT)
 - Egress labeling, lighting
 - Fire Protection Systems
 - Fixed and Portable/Personal meters
 - PRCS Rescue Team
 - PIT in HAZLOCs

TAKE A LOOK HERE ALSO

Emergency Planning & Response

- ERP meets 1910.120(q) (Review OSHA CPL on 1910.120)
- Verify Training records of responders
- Verify Medical Evals, Fit testing (OSHA Respirator Physical is NOT enough)
- ERT equipment inspection program
 - Level A's being pressure tested per manufacturer's frequency/protocol
 - SCBA's being inspected/tested per manufacturer's frequency/protocol
 - Bottle Hydro's meet DOT
- EAP meets 1910.38
 - Contractors know how to report emergency, what the alarms sound like, what each tone means, where they go with each alarm
 - Actual head count procedure
 - Procedures for those operators who delay their evac to operate critical equipment

Even those site who do not have a response team **NEED TO COORDINATE** emergency activities with their community responders.

A LOT has changed since the 2009 economic crash... Local FDs have paired back the specialized services they provide.

PAY ATTENTION TO DETAIL

PSI

- RAGAGEPs Listed?
- Walkdown P&ID(s) to validate their accuracy
- Inspect HAZLOC's for proper equipment
- Ventilation design matches engineering documentation?
- Relief System design matches engineering documentation?

A "Design Basis" is more than
formulas and calculations!

PAY ATTENTION TO DETAIL

SOP(s)

- **ALL PHASES** of operation covered?
- Safe Upper and Lower Limits defined (same as PHA?)
- Consequences of Deviation stated (same as PHA?)
- **ACTUAL** steps to correct/avoid deviations?
- Walk-Down some critical SOPs to see if they are accurate (you may be surprised)
 - Triggers for activation of ESD
- PPE in SOP obtained from “certified PPE Hazard Assessment(s)” (1910.132(d))

Take the time to PHYSICALLY WALK-DOWN a Safety Critical Procedure such as RCar/Tanker Unloading or Emergency Shutdown Procedure!

PAY ATTENTION TO DETAIL

Training

- Done **AT LEAST** every 3-years
 - Have operators walk-down an SOP to demonstrate they can find the equipment and operate the equipment
- Means to **VERIFY KNOWLEDGE?**
- Training is on **EACH SOP** and **SWP** applicable to the job
 - 3rd party course help but are often times **NOT** process specific
- Look at the training Doc's
 - *Training on 150 SOPs done in 6 hours once every 3 years leads one to a lot of QUESTIONS*

Training is a **NEVER ENDING** process in process safety. We have **three (3) years** to get it all done – **NOT** a 2 year, 11 month, 3 Week, 6 day, 16 hr training break!!

PAY ATTENTION TO DETAIL

Mechanical Integrity

- Refer to PHA(s) to identify those items listed as “safeguards”
 - NOTE: EVERY Mechanical SAFEGUARD listed in PHA should be in the MI inspection/Testing program!
- MI procedures for PM’s
 - Does the data in the MI procedures MATCH the PSI data (i.e. SIS set points?)
- PM’s meet or exceed the manufacturer’s frequency (or RAGAGEP)
- Refer to W.O.’s for those who perform the work - verify TRAINING
- Inspections on Vessels/Piping meet a RAGAGEP (listed in PSI?)
- Inspection/Testing documentation meets (j)(4)
- Equipment found to be outside established limits – removed (e.g. vibration analysis)

LOPC is often times the FIRST domino to fall in a fatal release of the HHC/EHS!

PAY ATTENTION TO DETAIL

Management of Change

- Scope of changes included in the process?
 - Changes to SWPs (PPE, LOTO, PRCs), SOP/MI procedures, EAP/ERP?
 - Changes to personnel or staffing levels, roles and responsibilities?
 - Look for CHANGES that are NOT on the process BUT do impact the process
- Use CMMS and Capital Project to ID changes
- Pay attention during field work to identify “new equipment”
- Pay attention during interviews with operators/mechanics for hints of changes
- Look at dates on ISO controlled documents & P&IDs that indicate document was “changed”
- MOC “paper work” is **NOT** managing changes!
- Are updates being made to PSI, SOPs, MI, EAP/ERP?
- Is facility addressing identified needs from the HAZ Assessment from the MOC

MOCs are MUCH MORE than a paper trail required by OSHA/EPA... they are meant to be a TOOL to MANAGE CHANGES that can impact our covered process(s).

PAY ATTENTION TO DETAIL

PSSR

- Ask for “Capital Projects” over the past 3-5 years
- Match new equipment with MOCs and PSSRs
- Don't be fooled by a piece of Paper with dates and signatures!
- Verify (DETAILS!!!)
 - SOPs were in place BEFORE the process started
 - Equipment was in MI CMMS and MI procedures in place
 - PSI was updated (P&IDs, RV Calcs, etc.)
 - Training for Ops and MI

An MOC is asking for permission and working through the details of a “change” - the PSSR is VERIFICATION that the “change” was done as designed/permitted!!

POTENTIAL CHANGES - OSHA PSM

- Clarifying Atmospheric Storage Tank Exemption – known as Meer decision
- CCPS – Risk Based Process Safety
- Adding definition to RAGAGEP
- Requiring evaluation of RAGAGEP
- Management of Organizational Change
- Adding chemicals
- Updating Ammonium Nitrate rules
- Expand Mech Integrity to Safety critical equipment
- Third Party Compliance Audits



REFERENCES

- Safety Case http://www.csb.gov/assets/1/7/WorkingPaper_87.pdf
- Overview of Risk Based Process Safety
<http://www.aiche.org/ccps/resources/publications/books/guidelines-risk-based-process-safetyccps/documents/overview>
- Center for Chemical Process Safety (CCPS) <http://www.aiche.org/ccps>
- Mary K O'Connor Process Safety Center – Texas A&M <http://process-safety.tamu.edu/>
- Chemical Safety Board <http://www.csb.gov/videos/>
- OSHA - <https://www.osha.gov/SLTC/processsafetymanagement/>
- EPA - <https://www.epa.gov/rmp>
- Chemical Safety Executive Order - <https://www.osha.gov/chemicalexecutiveorder/>



QUESTIONS

