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INTRODUCTION

The term pre-startup safety review (PSSR), in its simplest definition, means a final check prior to initiating the use of process equipment. When the term is used as a part of the overall process safety management program at a facility, it implies a management system within that program for ensuring that new or modified processes are ready for startup. This is accomplished by verifying that equipment is installed in a manner consistent with the design intent and that process safety management systems are in place. As each change, the associated risk, and the process in question may be unique, applying PSSR in a systematic way to your work processes simply represents a good business practice. Performing an effective pre-startup safety review is analogous to checking your math after performing a calculation or, for a more vivid analogy, checking your parachute before a jump.

In this book we examine the application of the practice of PSSR to the physical plant hardware, software, engineering, and management activities, and documentation associated with operating chemical processes. Although we focus on the chemical process industries (CPI) and specifically the associated process safety aspects, the concept of PSSR and its benefits apply to almost any human endeavor, especially in the manufacturing realm.

Since 1992, a major incentive for the chemical process industries (CPI) in the United States to make pre-startup safety review a part of day-to-day business practices has been the Occupational Safety and Health Administration's (OSHA's) process safety management (PSM) regulation (29 *Code of Federal Regulations* [CFR] 1910.119) (Reference 1-1). This regulation was followed by the Environmental Protection Agency's (EPA's) risk management program (RMP) rule (40 CFR 68) (Reference 1-2). These regulations are performance based and apply to facilities processing certain chemicals when present at or above specific threshold quantities. The term performance based means that each facility that falls under the regulation needs to meet certain minimum requirements, but how

they meet those requirements is not prescriptive. A facility can build the PSSR program that best fits its risk levels, organizational culture, and resources.

However, other countries and industry organizations have recognized the importance of PSSR to process safety and have published similar rules or guidelines for using it. We will keep the general aspect of the concept of this “final check” in mind, address specific U.S. regulatory needs, but at the same time, give some specific examples of how global chemical processing companies apply pre-startup safety review to their operations to both comply with the applicable laws and enhance their manufacturing performance.

Whether implementing process safety management as a requirement or as a good practice, pre-startup safety review is essential to keeping the system alive and functioning properly to protect a facility against risk.

1.1 WHAT ARE THE BENEFITS OF PERFORMING PRE-STARTUP SAFETY REVIEWS?

There are many benefits to be gained from performing pre-startup safety review for your processes. A simple list includes:

- The change is more likely to operate as intended.
- The construction, maintenance, or programming work performed to build, install, or program the process change meets the design specifications originally intended.
- Pre-startup activities have been completed and post-startup activities are scheduled and tracked to help ensure that equipment is designed, fabricated, procured, installed, operated, and maintained in a manner appropriate for its intended application.
- New chemicals or materials used in the process are understood in regard to safety, health, environmental and material performance issues.
- Personnel assigned to inspect, test, maintain, procure, fabricate, install, or commission process equipment are appropriately trained and have access to current and up-to-date procedures and process safety information.
- In the event of an incident, a strong pre-startup safety review program documents corporate operational discipline and social responsibility.
- The safety systems are confirmed to be operating as designed.
- Engineering calculations and assumptions used for design and installation match recognized and generally accepted good engineering practices (RAGAGEP) which describe applicable codes and standards.
- Regulatory requirements for managing changes are met.
- Quality management system requirements for your company have been addressed.

- PSSR provides an opportunity for turnover of ownership from engineering or project managers to operations personnel

This book provides advice for developing a PSSR program that will assist organizations in achieving these benefits. Facilities should consider evaluating how they are doing in regard to reaping the benefits above. Chapter 7 – *Continuous Improvement* addresses this issue.

On a broader scale, effective PSSR supports any mature, well-designed PSM program by keeping the total program robust and vibrant in the face of change. The CCPS booklet *The Business Case for Process Safety* summarizes the benefits of process safety – and these same benefits are supported by performing effective pre-startup safety reviews:

"...methodically implementing process safety provides four benefits essential to any healthy business. Two of these benefits are qualitative and as a result are somewhat subjective. You can see them in the way the public, your shareholders, government bodies, and your customers relate to your company. The two remaining benefits are quantitative. These have measurable impact in terms of your bottom line and company performance. All four benefits, when realized together by adhering to a sound process safety system, combine to support the profitability, safety performance, quality, and environmental responsibility of your business

- **Corporate Responsibility** – *Process safety is the embodiment of corporate responsibility and accountability. It helps your company display these characteristics through its actions. The heart of process safety lies in consistently planning to do the right things, then doing them right – consistently. Corporate responsibility leads to the second benefit...*
- **Business Flexibility** – *Corporate responsibility as demonstrated in your process safety management program leads to a greater range of business flexibility. When you openly display responsibility through implementing an effective process safety program, your company can achieve greater freedom and self-determination.*
- **Risk Reduction** – *Process safety provides unparalleled loss avoidance capability. A healthy process safety program significantly reduces the risk of catastrophic events and helps prevent the likelihood of human injury, environmental damage, and associated costs that arise from incidents. Although the essence of process safety focuses on preventing catastrophic incidents, the number of less severe incidents is also reduced*
- **Sustained Value** – *Process safety relates directly to enhanced shareholder value. When properly implemented, it helps ensure reliable processes that can produce high quality products, on time, and at lower cost. This increases shareholder value."*

Pre-startup safety review provides a second level of protection to ensure operational readiness, which will drive continuous improvement in your process safety management system, and help your organization realize these four benefits.

1.2 HOW PSSR RELATES TO OTHER PROCESS SAFETY ELEMENTS

This guideline assumes the reader is already familiar with the fourteen basic elements of process safety as defined in the OSHA process safety management regulation and the EPA risk management program rule. These are:

1. Employee Participation
2. Process Safety Information
3. Process Hazard Analysis
4. Management of Change
5. Operating Procedures
6. Mechanical Integrity
7. Emergency Planning & Response
8. Training
9. Contractors
10. Hot Work Permit
11. Compliance Audits
12. Pre-Startup Safety Review
13. Incident Investigation
14. Trade Secrets

A well-designed PSSR program will fit within a facility's existing process safety and risk management program as well as any other performance enhancement effort (for example, six sigma, total quality, environmental management, or profitability initiatives). Personnel charged with developing, implementing and upgrading the PSSR program can better achieve a higher level of overall process safety performance when they know how pre-startup safety review affects or is affected by the other elements of process safety. Table 1-1 illustrates how the other elements of PSM may relate to PSSR.

TABLE 1-1 How PSSR Typically Interfaces with Other PSM Elements	
<i>PSM Element</i>	<i>Potential Interface</i>
Employee Participation	<ul style="list-style-type: none"> • Employees from various departments can have input into the PSSR program as developers, team leaders, team members, or interviewees during the reviews • The PSSR procedure and PSSR checklist documentation provides clear evidence of how your organization encourages employee participation.
Process Safety Information	<ul style="list-style-type: none"> • PSSR assists in verifying that process safety information (PSI) for equipment, material hazards, and technology is updated in a timely fashion.
Process Hazard Analysis (PHA)	<ul style="list-style-type: none"> • PSSR assists in verifying any PHA action items required have been or will be addressed.
Operating Procedures	<ul style="list-style-type: none"> • PSSR provides a second check on whether the operating procedures affected by the change have been written or revised to properly reflect the change
Operator Training	<ul style="list-style-type: none"> • PSSR checks to verify any changes to training related to the trigger event have been made and that training on the affected procedures has occurred as needed.
Mechanical Integrity	<ul style="list-style-type: none"> • PSSR verifies maintenance task procedures are in place and workers have been trained on the tasks and applicable safe work practices. • PSSR verifies equipment has been reviewed for placement in the mechanical integrity program and that it was designed and installed according to codes, standards, and manufacturers' recommendations
Contractors	<ul style="list-style-type: none"> • PSSR can identify when certain contract job tasks require special training in response to a change and when contractors need to be trained or informed on aspects of a change.
Hot Work Permit (and other safe work practices)	<ul style="list-style-type: none"> • PSSR verifies new safe work practices (SWPs) required for the trigger event are in place and designed and implemented for the targeted workers
Management of Change (MOC)	<ul style="list-style-type: none"> • PSSR is a check of every MOC-related activity and its documentation, it is a second level of protection to ensure MOC is working to keep workers and the public safer. • The complexity of the PSSR is determined based upon information in the initial MOC request and associated documentation. • PSSR can confirm that a proper management of change effort was performed.
Incident Investigation	<ul style="list-style-type: none"> • PSSR documentation may provide support to investigation teams. • Investigation recommendations may impact future PSSR activities • Lessons learned are powerful tools for improvement.
Emergency Planning and Response	<ul style="list-style-type: none"> • A well-designed PSSR verifies that applicable emergency response plan changes are included in the review and affected workers are trained.
Compliance Audits	<ul style="list-style-type: none"> • The PSSR program will be audited on a regular basis and those audit results can help improve the PSSR program and a facility's overall PSM performance.
Trade Secrets	<ul style="list-style-type: none"> • A well-designed PSSR can verify that applicable trade secrets are addressed properly.

1.3 AN OVERVIEW OF THE RISK-BASED APPROACH TO PSSR

What do we mean by a *risk-based* approach to pre-startup safety review? This term indicates that we will use the performance-based aspect of the PSSR regulations and industry guidelines to more efficiently and effectively design each change or trigger event's PSSR activities based upon the likelihood and consequences. The goal is to make the best use of organizational resources based upon the risk attributed to the trigger event for the process.

This guideline offers several examples of qualitative tools to help a PSSR leader and his or her team determine whether a PSSR can be done simply (for example, a visual inspection and documentation of completion using a minimal checklist) or whether it needs to be performed in a more complex fashion due to the hazards and potential risks involved. For example, a major addition to a unit might involve several PSSR team meetings and reviews with some action items to be completed after startup.

Detailed examples for your PSM manager and PSSR team leaders to consider are provided in Chapter 4 – *A Risk-based Approach to Pre-startup Safety Review* and throughout the book.

1.4 WHAT IS THE SCOPE OF A PSSR? PROCESS SAFETY, ENVIRONMENTAL, QUALITY AND PERSONNEL SAFETY CONSIDERATIONS

Our objective is not to set new standards for the chemical processing industry, but to encourage companies and individuals to apply existing standards and the operational discipline necessary to establish their own internal requirements for pre-startup safety review that support business excellence. This guideline provides tools to help companies take a systematic approach to managing their PSSR program and implement applicable portions of Responsible Care[®]. CCPS' process safety practices, and other industry guidance, while meeting external and internal health, safety, environmental, and quality requirements.

For this guideline's purposes, a pre-startup safety review is considered to be applying a systematic method to confirm that the startup team and process equipment are prepared for startup. Startup may be considered to be the point at which chemicals or energy is introduced into the system. This practice is key to any loss prevention effort in the manufacturing realm.

It is a final check to confirm that a process or facility has been built as designed, all procedures are in place, training is complete, and all action items from the process hazard analysis for the activity have been resolved.

A PSSR for U.S. OSHA PSM and EPA RMP compliance is required when any change modifies the process safety information. What is a change to the process safety information? It is any change to any of the following items:

- Information pertaining to the hazards of the regulated substances used or produced by the process
 - A new catalyst or treatment additive
 - A new feedstock, even if inherently safer
- Information pertaining to the technology of the process
 - A new control or safety system
- Information pertaining to the equipment in the process
 - A new type of reactor or process vessel
 - New valves or valve operations

The PSSR for OSHA and EPA compliance should consider whether:

- Construction and equipment meet the design specifications.
- Safety, operating, maintenance and emergency procedures are in place and adequate.
- A PHA has been performed for new facilities or that the site management of change process has been followed.
- Training of each employee involved in the operating process is complete.

Chapter 3 - *Regulatory Issues* provides more detail on the U.S. regulatory requirements. For facilities not covered by PSM or RMP regulations, a broader application of the term pre-startup safety review is also addressed in this book.

1.5 THIS GUIDELINE'S AUDIENCE

This book is intended for anyone interested in developing a new PSSR program or upgrading an existing one. It can also help as a simple comparison tool to see where a mature program already uses some of the good practices or to help reinforce or improve upon the current methodology.

Whether a person is experienced or inexperienced in process safety, some of the typical positions in a company who may benefit from this guideline are:

- Managers of process safety management and PSM coordinators at a manufacturing facility
- Corporate process safety management staff
- Project managers and project team members whose projects initiate the need for a pre-startup safety review
- Engineers or other staff members performing management of change activities
- Operations, maintenance and other manufacturing personnel who may be part of a PSSR team
- Any employee participating in the PSSR program

1.6 HOW TO USE THIS GUIDELINE

Here are some suggestions on how the following chapters may be helpful to its audience.

CHAPTER 2 – What is A Pre-startup Safety Review?

- For workers with new PSSR team duties and for all facility managers, this chapter provides a description of the basic steps of pre-startup safety review.
- For site trainers and management, it gives guidance for training personnel involved in PSSR activities.
- For PSSR leaders and MOC owners, it discusses how scheduling aspects for different PSSR situations are addressed.

CHAPTER 3 – Regulatory Issues

- For safety professionals and management, this chapter provides an overview of the regulatory aspects of PSSR both in the U.S. and globally.
- For these readers, it also describes the specific U.S. OSHA and EPA regulations regarding PSSR.

CHAPTER 4 – A Risk-based Approach to Pre-startup Safety Review

- For all readers, this chapter introduces a key aspect for performing effective pre-startup safety reviews – using risk to determine the type or complexity level of PSSR to perform.
- For PSSR teams and PSM managers, it provides examples of tools some companies use to make these decisions.

CHAPTER 5 – The Pre-startup Safety Review Work Flow Process

- For all readers but especially PSM managers and PSSR leaders and team members, this chapter describes the components of a PSSR management system for a facility.
- For all readers, it describes considerations for implementing and following up on the steps in your customized PSSR program.

CHAPTER 6 – Methodologies for Developing Customized PSSR Checklist Items

- For PSM managers, PSSR leaders, team members, and employees participating in program development or upgrade, this chapter addresses the checklist, a common and very important tool for guiding effective pre-startup safety reviews.

- For personnel with PSM-related information technology duties or database management duties, it discusses aspects of computer-based electronic management of changes and pre-startup safety review programs.
- For users of the computer-based electronic MOC/PSSR systems, it discusses some typical features, benefits, and possible pitfalls associated with these MOC/PSSR system tools.

CHAPTER 7 – Continuous Improvement

- For PSM managers, PSM compliance audit team members and PSSR program developers, this chapter presents some approaches to maintaining a high quality PSSR program over time through self-assessment.
- For PSM managers, PSM audit team members and PSSR program developers, it offers some examples of typical compliance audit questions for internal and external audit teams to consider.

APPENDICES

- The appendices offer PSSR examples, a compilation of checklist questions, industry references, and regulatory references

1.7 REFERENCES

- 1-1 Occupational Safety and Health Administration, *Process Safety Management of Highly Hazardous Chemicals*, 29 CFR Part 1910, Section 119, Washington, DC, 1992.
- 1-2 Environmental Protection Agency, *Accidental Release Prevention Requirements: Risk Management Programs*, Clean Air Act, 40 CFR 68 Section 112 (r)(7), Washington, DC, 1996.
- 1-3 American Institute of Chemical Engineers, *Guidelines for Engineering Design for Process Safety*, Center for Chemical Process Safety, New York, NY, 1993.
- 1-4 American Institute of Chemical Engineers, *Guidelines for Implementing Process Safety Management Systems*, Center for Chemical Process Safety, New York, NY, 1994.
- 1-5 American Institute of Chemical Engineers, *Guidelines for Process Safety in Outsourced Manufacturing Operations*, Center for Chemical Process Safety, New York, NY, 2000.
- 1-6 American Institute of Chemical Engineers, *The Business Case for Process Safety Management*, edited by AntiEntropies, Inc. for the Center for Chemical Process Safety, New York, NY, 2003.
- 1-7 American Chemistry Council, *Resource Guide for the Process Safety Code of Management Practices*, Washington, DC, 1990.