

**COURSE NAME: INDUSTRIAL PIPING SYSTEM**

**LECTURE XI-WEEK XI: PIPING SYSTEM PREVENTIVE  
MAINTENANCE**

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# OBJECTIVES

By the end of this session the learner/student will be able to:

- ✓ Identifying the Importance of Piping System Preventive Maintenance
- ✓ Develop a Piping system Preventive Maintenance Program
- ✓ Discuss Key Preventive Maintenance Activities in piping system
- ✓ Identify Piping System Preventive Maintenance Techniques

## **XI.1. Introduction**

Preventive maintenance is a proactive approach to maintaining and preserving the functionality and reliability of equipment, systems, and infrastructure. It involves regularly scheduled inspections, maintenance activities, and repairs to identify and address potential issues before they escalate into costly breakdowns or failures. The importance of preventive maintenance cannot be overstated, as it offers numerous benefits to organizations across various industries.

## **XI.2. Importance of Piping System Preventive Maintenance**

### **a. Increased Equipment Reliability**

Regular maintenance helps identify and resolve potential issues in equipment and systems, reducing the likelihood of unexpected breakdowns. By addressing minor problems early on, preventive maintenance minimizes equipment downtime and increases overall reliability, leading to improved productivity and operational efficiency.

# Importance of Piping System Preventive Maintenance Cont'd

## **b. Cost Savings**

Preventive maintenance can result in significant cost savings for organizations. By detecting and addressing issues in their early stages, maintenance tasks are typically less complex and costly compared to major repairs or replacements required after a breakdown. Additionally, by extending the lifespan of equipment through regular maintenance, organizations can avoid the high costs associated with premature equipment replacement.

# Importance of Piping System Preventive Maintenance Cont'd

## c. Improved Safety

Regular inspections and maintenance activities contribute to creating a safe working environment for employees. Malfunctioning equipment or systems can pose serious safety risks, such as electrical hazards, leaks, or structural failures. Preventive maintenance helps identify and rectify potential safety issues, reducing the chances of accidents, injuries, and costly liability claims.

# Importance of Piping System Preventive Maintenance Cont'd

## **d. Enhanced Efficiency and Performance**

Well-maintained equipment operates at optimal levels, delivering consistent performance and efficiency. Preventive maintenance includes tasks such as cleaning, lubrication, calibration, and adjustments, ensuring equipment operates within desired specifications. This leads to improved energy efficiency, reduced waste, and optimized production processes.

# **Importance of Piping System Preventive Maintenance Cont'd**

## **e. Preventing Leaks and Costly Repairs**

Leaks in piping systems can result in product loss, environmental contamination, and safety risks. By implementing preventive maintenance measures, such as regular inspections and testing, potential leak points can be identified and addressed promptly. This prevents leaks from occurring and minimizes the need for expensive repairs or replacements.

# Importance of Piping System Preventive Maintenance Cont'd

## f. Ensuring Regulatory Compliance

Many industries have specific regulations and codes governing the design, installation, and maintenance of piping systems. Compliance with these regulations is essential to ensure safety, environmental protection, and legal requirements. Implementing a preventive maintenance program helps organizations meet these regulatory obligations, avoiding penalties and legal consequences.

# **Importance of Piping System Preventive Maintenance Cont'd**

## **g. Increased Equipment Lifespan**

Regular maintenance and care can significantly extend the lifespan of equipment and assets. By addressing issues promptly and implementing appropriate maintenance strategies, organizations can prevent premature wear and tear, corrosion, and deterioration. This prolongs the useful life of equipment, allowing organizations to maximize their return on investment.

# **Importance of Piping System Preventive Maintenance Cont'd**

## **h. Better Planning and Resource Management**

With a well-structured preventive maintenance program, organizations can plan maintenance activities in advance, schedule downtime, and allocate necessary resources effectively. This minimizes disruptions to operations and enables efficient utilization of labor, materials, and equipment, resulting in improved workflow and reduced downtime.

# **Importance of Piping System Preventive Maintenance Cont'd**

## **i. Documentation and Record-Keeping**

Preventive maintenance programs typically involve documentation of maintenance activities, including inspection reports, work orders, and equipment history. This documentation serves as a valuable resource for tracking maintenance history, identifying recurring issues, analyzing trends, and making informed decisions regarding repairs, replacements, or upgrades.

Preventive maintenance is vital for organizations to ensure the reliability, safety, and optimal performance of their equipment and systems. By conducting regular inspections, addressing maintenance needs promptly, and adhering to industry regulations, organizations can minimize downtime, prevent leaks and failures, improve energy efficiency, and enhance the overall performance of their piping systems.

## **XI.3. Developing a Piping System Preventive Maintenance Program**

A well-designed preventive maintenance program for piping systems is essential to ensure their reliability, longevity, and optimal performance. Here are key steps to help you develop an effective piping system preventive maintenance program:

### **a. Perform System Assessment:**

Conduct a comprehensive assessment of your piping system to identify critical components, potential failure points, and maintenance requirements. Consider factors such as system design, material degradation, environmental conditions, and operational demands.

# Developing a Piping System Preventive Maintenance Program Cont'd

## **b. Determine Maintenance Goals and Objectives**

- ✓ Define the specific goals and objectives of your preventive maintenance program.
- ✓ This may include minimizing downtime, preventing leaks, optimizing system performance, ensuring regulatory compliance, and maximizing equipment lifespan.

# Developing a Piping System Preventive Maintenance Program Cont'd

## c. Establish Maintenance Schedule

- ✓ Develop a maintenance schedule that outlines the frequency and types of maintenance activities required for each component of the piping system.
- ✓ Consider manufacturer recommendations, industry standards, regulatory requirements, and the operational demands of your facility.

# Developing a Piping System Preventive Maintenance Program Cont'd

## d. Define Maintenance Procedures

- ✓ Identify the specific maintenance tasks and procedures for each component of the piping system.
- ✓ This may include activities such as cleaning, lubrication, inspection, testing, calibration, repair, and replacement.
- ✓ Consult equipment manuals, industry guidelines, and best practices to establish comprehensive procedures.

# Developing a Piping System Preventive Maintenance Program Cont'd

## e. Allocate Resources

- ✓ Determine the necessary resources, including personnel, tools, equipment, and materials, needed to implement the preventive maintenance program effectively.
- ✓ Ensure that you have the right skills and capabilities within your maintenance team or consider outsourcing specific tasks to qualified contractors.

# Developing a Piping System Preventive Maintenance Program Cont'd

## f. Develop Inspection and Testing Protocols

- ✓ Establish detailed protocols for inspecting and testing the piping system.
- ✓ This may involve visual inspections, non-destructive testing (NDT) techniques, pressure testing, thermography, vibration analysis, and other relevant methods.
- ✓ Clearly define inspection criteria, acceptance standards, and reporting formats.

# Developing a Piping System Preventive Maintenance Program Cont'd

## **g. Implement Documentation and Record-Keeping**

- ✓ Establish a system for documenting and maintaining records of all maintenance activities.
- ✓ This includes creating work orders, inspection reports, testing results, maintenance logs, and equipment history.
- ✓ Ensure that documentation is easily accessible, well-organized, and up-to-date.

# Developing a Piping System Preventive Maintenance Program Cont'd

## **h. Train and Educate Maintenance Staff**

- ✓ Provide comprehensive training and education to maintenance personnel on the preventive maintenance procedures, safety protocols, and specific requirements of the piping system.
- ✓ Ensure that they have the necessary skills, knowledge, and understanding to perform maintenance tasks effectively.

# Developing a Piping System Preventive Maintenance Program Cont'd

## i. Monitor and Evaluate

- ✓ Continuously monitor the effectiveness of your preventive maintenance program.
- ✓ Track key performance indicators (KPIs) such as equipment downtime, leak incidents, repair costs, and system performance.
- ✓ Analyze data, identify trends, and make necessary adjustments to optimize the program.

# Developing a Piping System Preventive Maintenance Program Cont'd

## **j. Continuous Improvement**

- ✓ Regularly review and improve your preventive maintenance program based on feedback, lessons learned, industry advancements, and changes in operational requirements.
- ✓ Stay updated on industry standards, regulations, and best practices to ensure the program remains current and effective.
- ✓ PSPMP is a dynamic process as it requires ongoing evaluation, adaptation, and continuous improvement to address emerging challenges and maximize the benefits of maintenance activities.

## **XI.4. Key Piping System Preventive Maintenance Activities**

Implementing a preventive maintenance program for piping systems involves a range of activities aimed at ensuring the reliability, safety, and optimal performance of the system. While specific maintenance activities may vary depending on the type of piping system and its application. There are some key activities commonly included in a piping system preventive maintenance program:

# Key Piping System Preventive Maintenance Activities

## Cont'd

### a. Visual Inspections

- ✓ Regular visual inspections are essential for identifying visible signs of wear, corrosion, leaks, loose connections, and other issues.
- ✓ Inspect pipe supports, hangers, valves, fittings, expansion joints, and other components for any abnormalities or damage.

# Key Piping System Preventive Maintenance Activities Cont'd

## **b. Leak Detection and Repair**

- ✓ Conduct leak detection surveys using appropriate methods such as visual inspection, ultrasonic testing, or pressure testing.
- ✓ Promptly repair any identified leaks to prevent further damage, product loss, or safety hazards.

# Key Piping System Preventive Maintenance Activities

## Cont'd

### c. Cleaning and Flushing

- ✓ Periodically clean pipes, fittings, and valves to remove debris, scale, or sediment that can accumulate and impede flow or cause corrosion.
- ✓ Flushing the system with appropriate cleaning solutions can help remove deposits and ensure optimal performance.

# **Key Piping System Preventive Maintenance Activities**

## **Cont'd**

### **d. Lubrication**

Apply lubricants to valves, actuators, and other moving parts to reduce friction, prevent seizing, and ensure smooth operation. Follow manufacturer guidelines and use compatible lubricants for each component.

### **e. Pressure Testing**

Conduct regular pressure tests to assess the integrity of the piping system and verify its ability to withstand normal operating pressures. This helps identify potential weak points, leaks, or failures that may require repair or replacement.

# **Key Piping System Preventive Maintenance Activities**

## **Cont'd**

### **f. Valve and Actuator Maintenance**

Inspect and maintain valves and actuators to ensure proper functioning and prevent issues such as valve leakage or failure. This includes lubrication, cleaning, calibration, and repair or replacement as needed.

### **g. Corrosion Protection**

Apply appropriate corrosion protection methods to prevent pipe corrosion, such as coating systems, cathodic protection, or corrosion inhibitors. Regularly inspect and maintain corrosion protection measures to ensure their effectiveness.

# Key Piping System Preventive Maintenance Activities

## Cont'd

### **h. Insulation Maintenance**

Inspect and maintain insulation on pipes to prevent heat loss, control temperature, and protect against condensation. Repair or replace damaged or deteriorated insulation to maintain its effectiveness.

### **i. Testing and Calibration**

Regularly test and calibrate pressure gauges, flow meters, temperature sensors, and other instruments to ensure accurate readings and reliable performance. Follow manufacturer recommendations and industry standards for calibration intervals

# Key Piping System Preventive Maintenance Activities Cont'd

## **j. Documentation and Record-Keeping**

- ✓ Keep up comprehensive documentation of all maintenance activities, including inspection reports, work orders, testing results, and repairs performed.
- ✓ This documentation helps track maintenance history, identify trends, and support decision-making processes.

- ✓ It is important to note that the specific maintenance activities for a piping system will depend on factors such as the type of fluid being transported, system design, industry regulations, and the specific requirements of your facility.
- ✓ Consult industry standards, manufacturer guidelines, and expert advice to tailor the maintenance activities to your specific piping system needs.

## **XI.5. Piping System Preventive Maintenance Techniques**

Implementing preventive maintenance techniques for piping systems can help improve their reliability, extend their lifespan, and minimize the risk of unexpected failures.

There are some commonly used preventive maintenance techniques for piping systems:

# Piping System Preventive Maintenance Techniques Cont'd

## a. Regular Inspections

- ✓ Conduct routine visual inspections of the piping system to identify any signs of leaks, corrosion, loose fittings, or other issues.
- ✓ Use inspection tools such as thermal imaging cameras, ultrasonic detectors, or vibration analysis equipment to identify potential problems.

# **Piping System Preventive Maintenance Techniques Cont'd**

## **b. Ensure regular Cleaning and Flushing**

- ✓ Regularly clean and flush the piping system to remove debris, sediment, or contaminants that can contribute to corrosion or clogging.
- ✓ Consider using appropriate cleaning solutions, pigging techniques, or high-pressure water flushing to maintain the cleanliness of the pipes.

# Piping System Preventive Maintenance Techniques Cont'd

## c. Ensure the protection against Corrosion

Apply corrosion protection measures to prevent or minimize the effects of corrosion on the piping system.

- ✓ Use protective coatings, cathodic protection systems, or corrosion inhibitors to safeguard against corrosion in different environments.

# Piping System Preventive Maintenance Techniques Cont'd

## **d. Lubricate moving parts**

- ✓ Regularly lubricate moving parts such as valves, pumps, and actuators to reduce friction, prevent wear, and maintain their operational efficiency.
- ✓ Follow manufacturer recommendations for lubrication intervals and use suitable lubricants.

# **Piping System Preventive Maintenance Techniques Cont'd**

## **e. Maintain Valves and Equipment**

Perform routine maintenance on valves, pumps, and other equipment within the piping system.

- ✓ Inspect, clean, and lubricate valves, check for leaks, and ensure proper functioning.
- ✓ Follow manufacturer guidelines and industry best practices for equipment maintenance.

# Piping System Preventive Maintenance Techniques Cont'd

## **f. Always test the System Pressure**

Conduct periodic pressure testing to assess the integrity of the piping system and identify potential leaks or weaknesses.

- ✓ Use hydrostatic or pneumatic pressure testing methods in accordance with applicable standards and regulations.

# Piping System Preventive Maintenance Techniques Cont'd

## **g. Documentation and Record-Keeping**

- ✓ Maintain comprehensive records of maintenance activities, including inspection reports, maintenance schedules, repairs, replacements, and any modifications made to the piping system.
- ✓ Keep track of maintenance history, including dates, costs, and outcomes, to facilitate future analysis and decision-making.

It's important to tailor the preventive maintenance techniques based on the specific characteristics and requirements of the piping system, considering factors such as the type of fluids being transported, operating conditions, environmental factors, and applicable industry standards and regulations. Regular review and assessment of the effectiveness of preventive maintenance measures can help identify areas for improvement and ensure the continued reliability and performance of the piping system.

**THANK YOU!!!!!!!!!!!!**

**QUESTIONS AND ANSWERS**

# References

- ✓ American Society of Mechanical Engineers (ASME). (2018). ASME B31.1 Power Piping. Retrieved from <https://cstools.asme.org/csconnect/CommitteePages.cfm?Committee=B3100>
- ✓ American Society of Mechanical Engineers (ASME). (2018). ASME B31.3 Process Piping. Retrieved from <https://cstools.asme.org/csconnect/CommitteePages.cfm?Committee=B31300>
- ✓ Construction Industry Institute (CII). (2013). Effective Preventive Maintenance. Publication Number 286. Retrieved from <https://www.construction-institute.org/resources/knowledgebase/knowledge-areas/construction-industry-institute-cii/topics/avf/avf-2013-286>

## References Cont'd

- ✓ Gupta, V., & Dutta, S. (2015). Preventive Maintenance: An Overview. *International Journal of Engineering Research and General Science*, 3(2), 607-611.
- ✓ National Fire Protection Association (NFPA). (2021). NFPA 25: Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems. Retrieved from <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=25>
- ✓ Prosciak, R., & Basta, J. (2016). Preventive Maintenance of Piping Systems in Nuclear Power Plants. *Acta Mechanica et Automatica*, 10(1), 55-59.
- ✓ Qian, X. (2018). Review on Importance of Piping System Maintenance. *Procedia Engineering*, 211, 679-686. doi: 10.1016/j.proeng.2017.12.136