Fundamentals of Asset Lifecycle Management

COURSE DESCRIPTION

It is no secret that many of the subject matter experts (SMEs) in the process industries are retiring. For many large, multi-national oil and gas companies, this isn't necessarily an issue since many of these companies have well-developed internal training programs for their new engineers. In fact, E^2G teaches portions of these training programs. But many mid- to smaller-sized companies do not have a technical training program for recently hired engineers because they often have limited SME resources. The Fundamentals of Asset Lifecycle Management (FALCM) course is designed to help companies that lack technical training programs train their new engineers. Let E^2G's SMEs train your future SMEs!

Since its founding, E^2G has been committed to sharing knowledge within the oil and gas and petrochemical industries. And since 2006, E^2G has been hosting technical training courses all over the world to share the technical expertise demonstrated by our experienced engineers. To that end, E^2G offers this FALCM course so that our customers may begin to develop their own technical competency among the next generation of engineers.

This course begins with describing the process of lifecycle management (LCM) of fixed equipment, illustrated in Figure 1, and the importance of technical knowledge of owner/users to maximize safety and mechanical integrity (MI). Building on these ideas, the course turns to the basics of process safety management (PSM) and why this program is critical to the effective management of operational hazards. Next, the course covers fixed equipment conception and design, which begins with an understanding of common damage mechanisms and ways to eliminate or mitigate those threats via material selection. This sets the foundation for fixed equipment design using ASME and other construction codes. The course then introduces the new engineer to many of the basic equipment types found throughout oil and gas processing facilities: pressure vessels, piping, rotating equipment, and storage tanks. Once equipment design and function are known, the course turns to the basics of reliability, an often overlooked element of an engineer's education, which emphasizes the goal of maximizing an asset's performance throughout its lifecycle. Closely related to reliability, inspection of in-service equipment and why it is an essential component of LCM are then presented. Techniques from API 579-1/ASME FFS-1 for assessing the equipment to determine if it is fit for continued service are presented for situations in which inspection finds damage to the equipment. The course also gives an overview of one of the most important safety items found in these processing facilities: pressure relief devices. Finally, combining many facets of what they learned, engineers learn best practices to design, purchase, procure, install, and commission equipment that meets MI and PSM requirements.

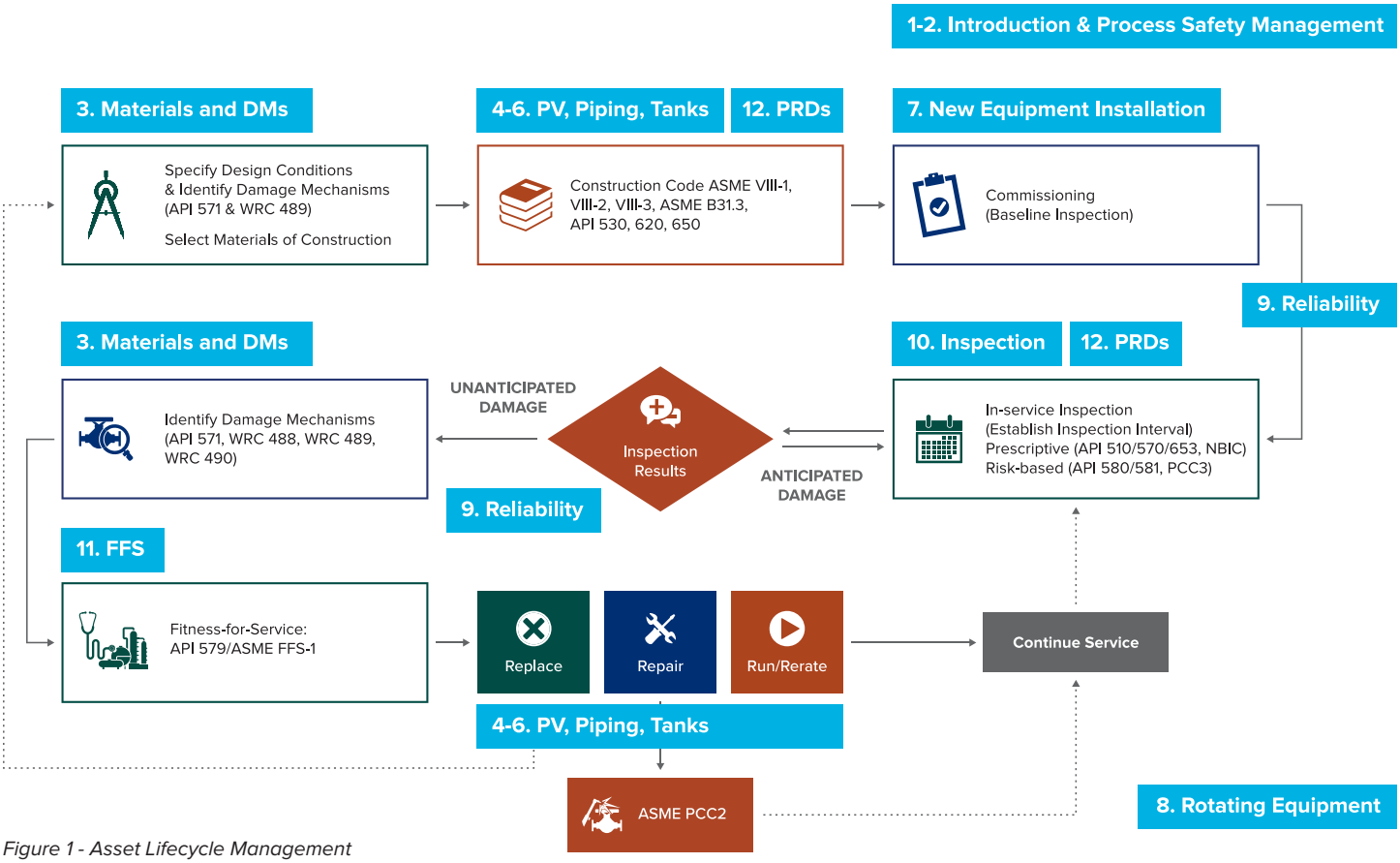

Figure 1 - Asset Lifecycle Management

GENERAL COURSE OUTLINE

The following topics represent the general course outline. *(See below for a more detailed course outline with a short bio of each instructor.)*

1. Introduction and LCM
2. Process Safety Management (PSM)
3. Materials & Damage Mechanisms (DMs)
4. Pressure Vessels
5. Piping
6. Storage Tanks
7. New Equipment Installation
8. Rotating Equipment
9. Reliability
10. Inspection
11. Fitness-for-Service
12. Pressure Relief Devices (PRDs)

COURSE FORMAT

This course will be delivered over 5 days within one work week, 8 hours per day, for a total of 40 hours of instruction. Course delivery is a hybrid format, allowing the attendees to choose one of the following options:

- In-person attendance at E^2G's headquarters in Shaker Heights, Ohio
- Virtual attendance using MS Teams or a similar conferencing application

WHO SHOULD ATTEND

This course is intended for recently hired engineers in the oil and gas, petrochemical, chemical, fertilizer, pulp and paper, power generation, and related process industries. It is suitable for engineers who work in plant engineering, reliability, maintenance, project management, or MI roles for midstream or downstream business operations.

Though it is designed with the new engineer in mind, personnel working in inspection, operations, and turnaround planning would likely benefit from learning the fundamentals of asset LCM.

COURSE OUTCOMES

There are many course outcomes expected to result from this instruction on fundamental and broad-ranging technical topics. In general, after completing this course, the attendees will be able to...

- Recall the LCM flow chart and how the various phases of a fixed asset's lifecycle are managed
- State the importance of PSM, the general requirements of regulation 1910.119, and the 8 elements of PSM learned during this course
- List some common damage mechanisms, where they are found in common process units, and what material choices are appropriate to mitigate those mechanisms
- Describe the general philosophy and organization of the ASME VIII-1 code, typical loading considerations, basic design for internal and external pressure, component design, and common testing requirements
- Recall the governing piping codes, B31.3 pressure design considerations, and fundamentals of piping flexibility, loading, supports, and flange design
- List the common types of tanks and typical services, applicable design codes and standards, common tank materials, design requirements, and considerations for settlement evaluation
- Recognize best practices for selecting, purchasing, fabricating, installing, and commissioning new equipment
- Describe typical services and applications for pumps, compressors, and turbines; recall common issues for rotating equipment; perform pump sizing using pump curves
- State some fundamental reliability concepts, technologies, and best practices for maximizing asset performance and performing root cause analysis to eliminate defects
- Recall the general requirements of the codes and standards governing inspection; explain risk-based inspection and how to plan inspections using its methodology; list common non-destructive examination techniques to find common DMs
- List some requirements for an FFS assessment; recall the general assessment procedures for common DMs; explain some example problems demonstrating FFS applications
- Name common types of PRDs, applicable codes and standards, general requirements for design and testing, and common overpressure scenarios

COURSE OUTLINE

SECTION 2: Process Safety Management

James Olson

- Overview of PSM regulation, specifically 1910.119
- Process Safety Information (PSI)
- Process Hazards Analysis (PHA)
- Operating Procedures
- Mechanical Integrity (MI)
- Management of Change (MOC)
- Pre-Start-Up Safety Review (PSSR)
- Training
- Key Documents: PFDs, P&IDs, MAL, Equip Files, Electrical One-line, Instrument Loops & Safety Interlocks, Piping Isometrics

SECTION 3: Materials & Damage Mechanisms (DMs)

Kenneth Kirkham & Nate Sutton

- Metallurgy 101
- Common Process Units (PFDs)
  - Gas Plant (e.g., LNG, Light Ends)
  - Hydrotreating
  - Utilities (steam, BFW, condensate, CW)
  - Amine, Ethylene, SMR/Ammonia
- Basic Materials and Selection
- Common Damage Mechanisms
- Positive Material Identification (PMI)

SECTION 4: Pressure Vessels

James Sowinski

- Introduction/Background to ASME VIII-1: History, Design
- Philosophy, Structure
- Design of Components: Loading Consideration, Internal/
- External Pressure, Equations
- Design of Common Components: Nozzles and Flanges
- Assemblage of Component, Equipment Design: Horizontal
- Vessels, Vertical Vessels, Heat Exchangers
- Non-Destructive Examination and Testing: Radiographic/ Ultrasonic Examination, Joint Efficiencies, Hydrostatic Testing, Nameplates/Stamping

SECTION 5: Piping

Kraig Shipley

- Design Codes (ASME B31.1, B31.3, B31.4, B31.8)
- B31.3 Pressure Design
- Piping Classes
- B31.3 Allowed P-T Variations
- B31.3 Piping Flexibility Compliance (Sustained, Occasional, and Expansion)
- Equipment Loading
- Flanged Joints (ASME B16.5, B16.47, PCC-1, ASME UG-44)
- Piping Supports

SECTION 6: Storage Tanks

Joel Andreani

- Common Types
- Design Codes (API 650, 620)
- Material Selection
- Design Calculations
- Settlement Evaluation

SECTION 7: New Equipment Installation

James Olson

- Preliminary Design of Equipment
- Developing Purchasing Documents
- Incorporating Engineering Practices
- Fabrication, Installation, and Commissioning
- Key Documents: Design Data Sheets, Request for Proposal, Inspection and Testing Plans, Field Installation and Acceptance, Preparing for Chemicals

SECTION 8: Rotating Equipment

Michael Bifano

- Pumps, Compressors, & Turbines
- Common Issues
- Reliability
- Key Document: Pump Data Sheets
- Sizing Example Using Pump Curve

SECTION 9: Reliability

James Olson

- The Discipline of Reliability – fundamentals, work process, and interface to ops, maintenance, engineering
- Developing Asset Reliability Strategies – all assets
- Bad Actors List
- Root Cause Failure Analysis for Defect Elimination
- Data-Driven Decision-Making
- Reliability-Centered Maintenance
- P-F Curve

SECTION 10: Inspection

Jim McVay

- In-Service Codes (API 510, 570, 653, NBIC)
- Risk-Based Inspection (RBI)
- Common Non-Destructive Examination Techniques for
- Various Damage Mechanisms
- Key Documents: API In-Service Codes, API 580 & 581, Inspection Reports, Thickness Management Program, ITPs

SECTION 11: Fitness-for-Service (FFS)

Brian Macejko

- Introduction to API 579-1/ASME FFS-1 (API 579)
- General Requirements for a Fitness-for-Service (FFS)
- Assessment and the Engineering Assessment Procedures (API 579 Parts 1 and 2)
- Introduction to each part related to damage mechanisms covered in API 579, including:
  - Volumetric Damage (API 579 Parts 4, 5, and 6)
  - Brittle Fracture Screening and Evaluation of Crack-like Flaws (API 579 Parts 3 and 9)
  - Geometric Imperfections (API 579 Parts 8 and 12)
  - Low-Temperature Hydrogen Damage (API 579 Part 7)
  - High-Temperature Creep (API 579 Part 10)
  - Fatigue (API 579 Part 14)
  - Fire Damage (API 579 Part 11)
  - Laminations (API 579 Part 13)
- Examples demonstrating FFS application

SECTION 12: Pressure Relief Devices (PRDs)

Phil Henry

- Common Types of PRDs
- Codes and Standards (API 520/521)
- Reference Codes (API 510, ASME)
- Common Overpressure Scenarios
- Introduction to Sizing
- Inspection/Testing
- Key Documents: Relief Valve Data Sheets, Pop Test Reports, Relief Valve Study

Joel Andreani, P.E.

Principal Engineer II

- 36 years of owner-user and consulting experience in refining and chemical industries
- Leader of the entire consulting engineering group at E^2G
- Specializes in tank design, settlement analysis, and RBI
- Serves on design subgroup of the API Subcommittee on Aboveground Storage Tanks

Michael Bifano, Ph.D., P.E.

Consulting Engineer I

- 9 years of consulting experience
- Leader of rotating equipment, vibration, & dynamics team
- Piping vibration, measurement, fatigue, and R-life assessments
- Diagnostic, performance, and RCFA of rotating equipment
- Computational fluid dynamics

Phil Henry, P.E.

Principal Engineer II

- 35 years of owner-user and consulting experience in the refining and chemical industries
- Chairman of the API PRS Subcommittee Task Force
- Master editor of API 520
- Technical advisor for in RBI

Kenneth Kirkham, P.E

Principal Engineer II

- 42 years of owner-user and consulting experience in petrochemical & refining industries
- Process and utilities DM identification and mitigation
- RBI DM reviews

Brian Macejko, P.E.

Consulting Engineer II

- 18 years of owner-user and consulting experience in the refining and chemical industries
- FFS evaluations using API 579
- Advanced stress analysis
- Fracture mechanics and brittle fracture screening
- ASME code compliance calculations for PV and piping

Jim McVay

Principal Engineer II

- 34 years of owner-user experience in the refining industry
- Specialties include inspection, NDE testing, DM identification, materials selection, welding engineering

James Olson

Principal Engineer I

- 29 years of owner-user experience in chemical and polymers industries
- Operations and asset management leader – planning, design, procurement, installation, inspection, maintenance, reliability, and MI programs

Kraig Shipley, P.E.

Principal Engineer I

- 31 years of owner-user and consulting experience in refining industry
- ASME piping code flexibility & vibration analysis
- Fitness-for-service assessments
- ASME code compliance calculations expert
- Bolted flange joint design & troubleshooting

James Sowinski, P.E.

Principal Engineer I

- 29 years of owner-user and consulting experience in refining and power utility industries
- Mechanical & structural engineering business leader
- Fitness-for-service assessments
- ASME code compliance calculations expert

Nate Sutton, P.E.

Senior Engineer I

- 6 years experience
- Highly-rated API 571 DM instructor
- Specialties include creep testing/crack growth analysis, HTHA modeling, RBI DM reviews