1 Introduction

This chapter introduces asset integrity management (AIM), including the scope and objectives of AIM programs throughout a facility life cycle and the relationship of AIM to other process safety elements. The last section in this chapter outlines the structure of this document.

Since a successful AIM program involves leadership, managers, engineers, operating and maintenance personnel, contractors, suppliers and support staff, this document was prepared for a wide range of audiences and potential users. AIM is an integrated product of proper equipment, dependable human performance and effective management systems. Guidelines are given for developing, implementing and continually improving an AIM program that includes these areas of focus. Behind these focus areas needs to be an involved, supportive management. Consequently, this document also includes guidance to those supporting the program.

1.1 BACKGROUND AND SCOPE

For decades, AIM activities, in one form or another, have been a part of industry’s efforts to prevent incidents and maintain productivity. Industry initiatives, company initiatives and regulations in various countries have helped both to define AIM program requirements and to accelerate implementation of AIM programs. AIM is already ingrained in the culture of many process plants, as well as facilities in other related industries. AIM activities are essential for process facilities to maintain economic viability.

AIM has been a part of international process safety regulations for many years, including the Seveso Directive and its implementations in Europe (Reference 1-1) as well as Offshore Installation (Safety Case) regulations (Reference 1-2). Since 1992, a major incentive for process industries in the United States to implement AIM programs has been the Occupational Safety and Health Administration (OSHA) process safety management (PSM) standard, 29 CFR 1910.119 (Reference 1-3). This was followed by the Environmental Protection
GUIDELINES FOR ASSET INTEGRITY MANAGEMENT

Agency (EPA) risk management program (RMP) rule, 40 CFR 68 (Reference 1-4). These performance-based regulations each contain a mechanical integrity (MI) element that defines the minimum requirements of a program through six sub-elements that address:

- Equipment to be maintained
- Written MI procedures
- MI training
- Inspection and testing
- Equipment deficiencies
- Quality assurance.

Specific requirements are not prescriptively stated in these regulations, but the sub-elements represent time-proven practices for an effective AIM program. The details of each sub-element are left to the discretion of the facility to develop and implement. All PSM- and RMP-covered U.S. facilities in operation since the regulations were issued have been required to audit compliance with these requirements at least every three years. Many of these audits reveal that companies continue to have significant opportunities to improve their AIM programs.

This document was written primarily for process industry facilities. However, most of the content applies to other industries as well. Although this document was written in the United States, a conscious effort has been made to keep the book applicable to facilities worldwide.

1.2 WHAT IS ASSET INTEGRITY MANAGEMENT?

For the purposes of this book, *asset integrity management* (AIM) is a management system for ensuring the integrity of assets throughout the life cycle of the assets. In this context, an *asset* is a process or facility that is involved in the use, storage, manufacturing, handling or transport of chemicals, or the equipment comprising such a process or facility. Examples of assets include off-shore and on-shore extraction and processing equipment; process and auxiliary tanks, vessels and piping systems including their internal components; control systems; safety systems; buildings and other structures; and transport containers. The selection of which assets are “important” is discussed in Section 1.3 and in Chapter 5.

AIM is a product of many activities, usually performed by many people. When these activities are done well, AIM can provide the foundation for a safe, reliable facility that minimizes threats to the workforce, the public and the environment. Effective AIM is also consistent with good business practices.
AIM programs vary according to industry, regulatory requirements, geography and plant culture. However, some characteristics appear to be common to effective AIM programs. For example, they:

- Include activities to ensure that assets are designed, procured, fabricated, installed, operated, inspected, tested and maintained in a manner appropriate for its intended application.
- Clearly designate assets to be included in the program based on defined criteria.
- Prioritize assets to help optimally allocate financial, staffing, storage space and other resources.
- Help plant staff perform planned maintenance and reduce the need for unplanned maintenance.
- Help plant staff recognize when equipment deficiencies occur and include controls to help ensure that equipment deficiencies do not lead to serious incidents.
- Incorporate applicable codes, standards and other recognized and generally accepted good engineering practice (RAGAGEP).
- Help ensure that personnel assigned to perform AIM activities are appropriately trained and have access to appropriate procedures for these activities.
- Develop standard work roles and consistent activities.
- Maintain service documentation and other records to enable consistent performance of AIM activities and to provide accurate asset information to other users, including other process safety and risk management elements.

This document provides guidance for developing an AIM program that includes all of these characteristics.

To present sound guidance for developing and/or improving AIM programs, this document evaluated lessons learned by the process industries. It does not give just one way of managing the integrity of assets, since there are many ways to approach the implementation of an AIM program, and other resources will be needed to develop a full program. Where appropriate, this book gives strengths and weaknesses of different approaches. Company management will need to recognize which approaches best suit their facility and company needs.

Having a successful AIM program is consistent with the business case for process safety. Benefits of AIM programs that can provide greater value for the business include:
• Improved equipment reliability and availability
• Reduced frequency of asset failures that lead to safety and environmental incidents
• Improved product consistency
• Improved maintenance consistency and efficiency
• Reduced unplanned maintenance time and costs
• Reduced operating costs
• Improved spare parts management
• Improved contractor performance
• Compliance with regulatory requirements.

Each of these objectives may have associated costs, such as more detailed procedures, a larger warehouse or improved computer systems, so that companies may need to prioritize their objectives.

One AIM program development approach that is not advocated in this book is to focus only on compliance with regulations. Compliance is one outcome of an AIM program; however, the primary focus of such a program needs to be on the management of risk, in order to deliver the benefits that an AIM program can provide. The requirements for compliance are often vague and subject to misinterpretation. Furthermore, requirements are subject to change via legislated modifications or new interpretations of existing legislation. In addition, a compliance-only program may miss out on many of the benefits of a more holistic approach, such as improved profitability and reduced risks for employees, the facility and the neighboring community. A more holistic approach can help to:

• Present the AIM program as a company priority, rather than just something the company is forced to do; this approach also helps to ensure compliance, since personnel are less likely to take shortcuts.
• Create synergies with equipment and process reliability initiatives that could improve results and/or lower costs.
• Address risks to employees, community and the business.

Therefore, the more holistic approach helps ensure compliance with governing regulations and is often the greater business value than the minimum compliance effort. Although compliance with federal, state and local regulations is often a motivating factor for a facility, following the guidelines in this document can help a facility develop, implement and/or improve an AIM program that:

• is effective in containing and controlling hazardous materials and energies,
• enables the facility to operate reliably and
• is in compliance with regulatory requirements.
1.3 WHAT ASSETS ARE INCLUDED?

One of the key questions when embarking on an AIM program is to identify the facility assets to include in the AIM program. This question is introduced here and further examined in Chapter 5.

As can be seen in the next section on AIM life cycle, an AIM program consists of two major parts:

1. Properly designing and installing the facility’s assets before startup
2. Maintaining the ongoing integrity of the assets over a lifetime of facility operation.

The question of what assets to include in an AIM program is likely to be different for these two major tasks. For the first part, it would be generally considered as necessary to correctly design and properly install all facility assets before startup. However, it is recognized that greater care or rigor is likely to be taken in the design and installation of some assets that are considered as critical to safe or reliable operation of the facility. For example:

- A building that is within an identified potential vapor cloud explosion blast zone (Reference 1-5) and is intended to be blast resistant will require more rigor in its specification, design and construction than a general-purpose maintenance warehouse outside of the blast zone.

- A piping system for transferring a liquefied flammable gas that has the potential for cold embrittlement of common piping materials will require more rigor in its specification, design and installation than standard cooling water piping.

Nevertheless, even the maintenance warehouse and cooling water piping will perform important functions, so their proper design and construction is still warranted.

From a programmatic point of view, the more difficult question pertains to the second major AIM task; namely, maintaining the ongoing integrity and reliability of site processes, including production, utility and support system assets, over a lifetime of facility operation. The question for this task can be rephrased as “What facility assets do we need to maintain, and to what degree of rigor?” A closely related question is “With limited resources, and sometimes needing to deal with unforeseen circumstances, we may not be able to always keep up with every scheduled maintenance task. How do we manage this situation?” These questions have been answered, implicitly or explicitly, in many ways:

**Breakdown Maintenance.** By this approach, no or minimal inspections, testing and maintenance are performed on facility assets. Repairs are made to equipment
only when failure of the equipment is evidenced by a release of material or energy or a failure of the equipment to allow process operations to continue. Although breakdown maintenance requires the least effort in planning, performing, and documenting ITPM activities, it has numerous drawbacks from the perspectives of safety, reliability, maintenance planning and compliance.

**Compliance Maintenance.** This approach performs only those Inspection, Testing, and Preventive Maintenance (ITPM) tasks required by applicable codes and regulations (and perhaps specific company requirements), at minimal frequencies, with all other maintenance being performed on a breakdown basis.

**Risk-Based Maintenance.** Analysis tools such as risk-based inspection (RBI) and reliability-centered maintenance (RCM) are used to prioritize maintenance activities and establish ITPM frequencies in such a way as to meet risk-based safety and/or reliability goals. While more planning effort is required than breakdown or compliance maintenance, both on initial and ongoing bases, risk-based approaches can incorporate operating history into the planning process and, in some cases, adjust ITPM plans where data are available to support these adjustments and thereby optimize use of resources. However, risk-based tools are more often used to supplement other approaches rather than to be the primary means of determining what assets are to be maintained.

**Prioritized Maintenance.** Taking into account the realities of resource limitations and unplanned repairs, this approach identifies some assets as safety-critical equipment (SCE) or critical equipment and performs no-expect, no-exception planned maintenance on all such equipment, while conducting necessary ITPMs on all other assets as appropriate but with allowances for task or schedule slippage. The concept of SCE and the selection of assets to receive prioritized maintenance are fully discussed in Chapter 5.

**Comprehensive Maintenance of All Assets.** This approach seeks to maintain every facility asset according to its pertinent manufacturer’s or supplier’s recommended tasks and frequencies, as well as by all applicable RAGAGEP and regulatory requirements. While comprehensive maintenance is ideal, it is not often successfully implemented in practice. Some supplier-recommended tasks and frequencies tend to be conservative or even excessive, and company resources rarely are sufficient to plan and perform all specified tasks at the required frequencies, especially when unforeseen circumstances arise.
Some combination of these approaches is often employed. For example, a facility using a risk-based approach is not likely to totally ignore compliance requirements, even when meeting those requirements is not indicated as being necessary to meet risk-based goals. Another facility might perform comprehensive maintenance on some assets and relegate all others to breakdown maintenance.

1.4 AIM LIFE CYCLE

Integrity needs to be built into a facility’s assets and planned operation before the facility is started up. This asset integrity is then maintained over time by proper facility operation; by ITPM activities; by managing tasks; and by learning from experience. When failures do occur or deficiencies are detected, integrity is re-established by proper repairs or replacements.

Thus, managing asset integrity begins well before a new process/facility is started up and extends throughout the facility lifetime until final decommissioning. It recognizes that the functional integrity of equipment can degrade over time by corrosion, erosion, fatigue and various other mechanisms (i.e., “aging plants”; see Reference 1-6), so these mechanisms need to be understood, detected, and corrected before containment, control, or the ability to respond to an abnormal or emergency situation is lost. The primary AIM life cycle activities can be summarized as shown in Figure 1-1. These life cycle activities are detailed in Chapter 3.

1.5 RELATIONSHIP TO OTHER PROGRAMS

A practical AIM program will fit within a facility’s existing process safety and risk management program, as well as other initiatives such as for reliability and quality improvement. Personnel charged with developing and administering the AIM program can optimize the process by taking advantage of existing programs and by knowing which people and groups of people are responsible for related activities. Table 1-1 illustrates potential interfaces with other facility programs.

AIM starts with a well-designed facility, with clear expectations with respect to expected facility performance. CCPS provides input to design practices and considerations from a process safety perspective in Guidelines for Engineering Design for Process Safety, Second Edition (Reference 1-7). Other activities essential to managing asset integrity include the proper procurement, fabrication, construction, and installation of assets, as discussed in Chapter 3.
AIM is also an integral part of an ongoing, risk-based process safety management program. It is part of the “Managing Risks” pillar of CCPS’ risk-based process safety model (Reference 1-8). Significant relationships with other process safety elements are shown in Table 1-2. As can be seen from this table, nearly all parts of a risk-based process safety program have some bearing on managing asset integrity.

1.6 RELATIONSHIP TO RAGAGEP

Codes, standards, and practices, which are sometimes termed “recognized and generally accepted good engineering practice” (RAGAGEP), are an important resource for an AIM program. RAGAGEP stems from the selection and application of appropriate engineering, operating, and maintenance knowledge when designing, operating, and maintaining process facilities with the purpose of ensuring safety and preventing process safety incidents.

RAGAGEP involves the application of engineering, operating or maintenance activities derived from engineering knowledge and industry experience based upon the evaluation and analyses of appropriate internal and external standards,
### TABLE 1-1. Example AIM Interfaces with Other Facility Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Example AIM Interface</th>
</tr>
</thead>
</table>
| Equipment Reliability           | • An AIM program is the foundation of a plant’s reliability program  
• Reliability program activities (e.g., vibration monitoring, equipment quality control) contribute to AIM                                                                                                                                                                                                                           |
| Occupational Safety;            | • Occupational safety programs help ensure the safe performance of AIM activities  
• Occupational safety personnel may help maintain the integrity of emergency response equipment                                                                                                                                                                                                                                               |
| Safe Work Practices             |                                                                                                                                                                                                                                                                                                                                                     |
| (including Hot Work)            |                                                                                                                                                                                                                                                                                                                                                     |
| Environmental Control           | • Environmental initiatives (e.g., monitoring for fugitive emissions, investigating chemical releases) contribute to AIM                                                                                                                                                                                                                                 |
| Workforce Involvement           | • Employees from various departments have input into the AIM program                                                                                                                                                                                                                                                                                   |
| Project Management              | • Design codes and standards influence AIM activities such as equipment design, inspection and repair  
• AIM quality management (QM) activities help document that equipment is appropriate for its intended use, including inspection and testing activities during fabrication, construction and commissioning as well as baseline inspections  
• Process safety information and asset data need to be handed off to facility operator                                                                                                                                                                                                                                          |
| Purchasing                      | • Purchasing is involved in the acquisition of new or used equipment and spare parts                                                                                                                                                                                                           |
| Hazard Identification and Risk  | • HIRAs, also known as process hazard analyses (PHAs), can help define the equipment scope for the AIM program and prioritize AIM activities  
• AIM history can help HIRA teams determine the adequacy of safeguards                                                                                                                                                                                                                                                                                                     |
| Analysis                        |                                                                                                                                                                                                                                                                                                                                                     |
| Operating Procedures            | • Operating procedures may cover AIM-related activities, such as equipment surveillance as part of operator rounds, reporting operating anomalies, recording historical equipment operating data and preparing equipment for maintenance                                                                                                                                                                |
| Training and Performance Assurance| • AIM training in an overview of the process and its hazards can be consistent with the content of the operator training program                                                                                                                                                                                                                                  |
| Contractor Management           | • Inspection and maintenance tasks under the AIM program may dictate skills required of contractors  
• Because contractors often perform AIM activities, the contractor selection process considers both contractor safety performance and the contractor’s work quality                                                                                                                                                                        |
| Operational Readiness           | • The AIM QA practice to ensure that equipment is fabricated and installed according to design may be fully or partially addressed during a pre-startup safety review                                                                                                                                                                                                   |
| Management of Change (MOC)      | • MOC applies to AIM activities and documents (e.g., new or modified equipment, changes to task frequencies and procedures)  
• The MOC program ensures that AIM issues (e.g., corrosion rates and mechanisms) are considered when evaluating process changes  
• AIM activities may help establish or dictate a change to safe upper and lower limits  
• MOC review teams can include process and AIM personnel  
• The MOC program may be upgraded to help manage equipment deficiencies  
• Practices for replacing equipment “in kind” are reviewed to ensure that AIM records are not compromised (e.g., inspection records, schedules are updated)                                                                                                                                                   |
| Incident Investigation          | • AIM records may be needed by investigation teams  
• Investigation recommendations may impact AIM activities                                                                                                                                                                                                                                                                                                   |
| Emergency Management            | • Emergency response equipment needs to be inspected and maintained                                                                                                                                                                                                                                                                                     |
| Auditing                        | • The AIM program will be audited; audit results can help improve the AIM program                                                                                                                                                                                                                                                                     |
| Trade Secrets                   | • Trade secrets needed for AIM activities cannot be withheld                                                                                                                                                                                                                                                                                          |
### TABLE 1-2. Relationships between AIM Activities and Risk-Based Process Safety Elements

<table>
<thead>
<tr>
<th>RBPS Pillar</th>
<th>RBPS Element</th>
<th>AIM Activities Related to RBPS Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commit to Process Safety</td>
<td>Process Safety Culture</td>
<td>All AIM activities</td>
</tr>
<tr>
<td></td>
<td>Compliance with Standards</td>
<td>Use standards and RAGAGEP</td>
</tr>
<tr>
<td></td>
<td>Process Safety Competency</td>
<td>Involve competent personnel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ensure required inspector and technician certifications</td>
</tr>
<tr>
<td></td>
<td>Workforce Involvement</td>
<td>Develop procedures for critical maintenance activities</td>
</tr>
<tr>
<td>Stakeholder Outreach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understand Hazards and Risk</td>
<td>Process Knowledge Management</td>
<td>Identify assets to be included in AIM program</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Develop ITPM plan</td>
</tr>
<tr>
<td></td>
<td>Hazard Identification and Risk Analysis</td>
<td>Identify assets to be included in AIM program</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Develop ITPM plan</td>
</tr>
<tr>
<td>Manage Risk</td>
<td>Operating Procedures</td>
<td>Develop procedures for critical maintenance activities</td>
</tr>
<tr>
<td></td>
<td>Safe Work Practices</td>
<td>Develop procedures for critical maintenance activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plan and perform ITPMs and repairs</td>
</tr>
<tr>
<td>ASSET INTEGRITY AND RELIABILITY</td>
<td>Contractor Management</td>
<td>Train employees and contractors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ensure required inspector and technician certifications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Audit contractor work on assets</td>
</tr>
<tr>
<td></td>
<td>Training and Performance Assurance</td>
<td>Train employees and contractors</td>
</tr>
<tr>
<td></td>
<td>Management of Change</td>
<td>Update ITPM plan when equipment conditions change</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adjust ITPM frequencies, test methods, training and procedures if warranted</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Keep asset information up to date</td>
</tr>
<tr>
<td></td>
<td>Operational Readiness</td>
<td>Confirm assets as installed meet design specifications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conduct baseline tests and inspections</td>
</tr>
<tr>
<td></td>
<td>Conduct of Operations</td>
<td>Plan and perform ITPMs and repairs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promptly address conditions that can lead to failure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Review inspection/test records</td>
</tr>
<tr>
<td></td>
<td>Emergency Management</td>
<td>Plan and perform ITPMs and repairs</td>
</tr>
<tr>
<td>Learn from Experience</td>
<td>Incident Investigation</td>
<td>Investigate chronic failures</td>
</tr>
<tr>
<td></td>
<td>Measurement &amp; Metrics</td>
<td>Collect, analyze and archive data</td>
</tr>
<tr>
<td></td>
<td>Auditing</td>
<td>Develop written AIM program</td>
</tr>
<tr>
<td></td>
<td>Management Review and Continuous</td>
<td>Investigate chronic failures</td>
</tr>
</tbody>
</table>
applicable codes, technical reports, guidance, or recommended practices or documents of a similar nature. RAGAGEP can be derived from singular or multiple sources and will vary based upon individual facility processes, materials, service, and other engineering considerations.

The term RAGAGEP comes from U.S. process safety regulations that require its documentation and usage:

- “The employer (owner or operator) shall document that equipment complies with recognized and generally accepted good engineering practices” [OSHA 29 CFR 1910.119(d)(3)(ii) and EPA 40 CFR 68.48(b) and 68.65(d)(2)].

- “Inspection and testing procedures shall follow recognized and generally accepted good engineering practices” [OSHA 29 CFR 1910.119(j)(4)(ii) and EPA 40 CFR 68.56(d) and 68.73(d)(2)].

RAGAGEP gives generally approved ways to perform a specific engineering, inspection or maintenance activity. It may address:

- Equipment design and construction, such as specifying a piping system or fabricating a pressure vessel.
- In-service activities, such as inspecting a storage tank or servicing a relief valve.
- An established work process, such as risk-based inspection (RBI), reliability-centered maintenance (RCM) or specifying and implementing safety instrumented systems (SIS).

RAGAGEP incorporates broad industry experience and technical input and represents the consensus of a relevant organization or technical community. Therefore, it provides a valuable starting point for an AIM program.

In some cases, a country, state, or locality may mandate the use of RAGAGEP. For example, an authority may adopt an NFPA code for its jurisdiction. In addition, many companies internalize standards, often based on RAGAGEP, which are provided by the manufacturer or licensor of a process. Some companies have developed their own internal standards based on company and industry operating experience.

Broad industry experience is not always available for new technologies or for unique or highly specialized processes. In situations where RAGAGEP does not exist, the design of physical facilities or work processes needs to use the best available technology that is relevant to the situation, then take extra care in the design process since the depth of experience may be lacking. This extra care may include additional hazard identification and risk analysis efforts to ensure adequate preventive and mitigative layers of protection are in place to deal with abnormal situations that may develop. Extra inspections, testing and detection methods may
also be warranted, during both commissioning and facility operation, until actual operating experience is gained.

To effectively use RAGAGEP, facility management needs to determine which practices are available and then assess the applicability of each practice to its facility. Regardless of the consensus reached to publish RAGAGEP, most standards were not written for a facility’s specific equipment, specific chemical application, specific locale or specific operations culture. Some facilities with successful AIM programs are establishing their own data records to help determine (or to validate) the ongoing applicability and use of each standard.

Several chapters of this book address the applicability and use of RAGAGEP in more detail. Descriptions of these practices and approaches are included, such as for determining an inspection interval or technique, but the actual RAGAGEP is not repeated in this book. New and revised codes, standards and recommended practices continue to evolve; therefore, it is advisable for companies to have management systems in place to keep up with the new standards and with changes to existing standards. This is further discussed in Section 2.2.5.

1.7 STRUCTURE OF THIS DOCUMENT

These guidelines begin with four chapters that help set the groundwork for an AIM program. Chapter 2 discusses roles and responsibilities for management and other company personnel and examines the ongoing activities that management undertakes to help ensure AIM program success. Chapter 3 gives an overview of AIM activities from a life cycle perspective. Chapter 4 summarizes asset damage and degradation mechanisms to be understood, evaluated, detected and managed in an AIM program. Chapter 5 reviews considerations a facility may have when defining the equipment to include in its program and prioritizing safety-critical equipment.

Once a basic understanding is gained and the goals, objectives and scope of the AIM program is determined, facility management needs to develop and implement systematic activities related to AIM. These include:

- Inspection, testing, and preventive maintenance
- Training of all affected personnel
- AIM procedures development
- Quality management
- Equipment deficiency resolution
- Auditing of the AIM program.
Each of these activities is addressed in turn in Chapters 6 through 11 and Section 14.2. As illustrated in Table 1-3, Chapters 6 through 11 describe management systems for addressing assets as they are originally designed and installed, as they are maintained over time, and as they are repaired or replaced.

Specific details for these activities depend on facility culture, regulatory obligations and company priorities. Therefore, relatively little prescriptive information is included in this book. Rather, this document presents approaches that have worked in different industries and in facilities of various sizes.

Chapter 6 discusses inspection, testing and preventive maintenance (ITPM). In this document, “preventive maintenance” refers to those activities that are not inspections or tests and that are performed to prevent the failure of equipment within the AIM program. Lubrication of rotating equipment is one example of a PM task meeting this definition. Established approaches for developing test and inspection plans, such as risk-based inspection, are further detailed in Chapter 7.

Chapter 8 covers activities to ensure personnel competency, with the focus on AIM-related training. Chapter 9 addresses the procedures needed for AIM. Quality management activities involving initial design and fabrication as well as ongoing repairs and alterations are discussed in Chapter 10. Chapter 11 covers equipment deficiency recognition and resolution.

### TABLE 1-3. Chapters Addressing Management Systems for AIM Activities

<table>
<thead>
<tr>
<th>Attributes</th>
<th>New Equipment</th>
<th>Inspection and Testing</th>
<th>Preventive Maintenance</th>
<th>Deficiency Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task Definition, Purpose and Documentation Requirements</td>
<td>Chapter 10 (Quality Management)</td>
<td>Chapter 6 (ITPM)</td>
<td>Chapter 6 (ITPM)</td>
<td>Chapter 11 (Deficiency Management)</td>
</tr>
<tr>
<td>Acceptance Criteria</td>
<td>Chapter 10 (Quality Management)</td>
<td>Chapter 6 (ITPM) and Chapter 11 (Deficiency Management)</td>
<td>Not applicable</td>
<td>Chapter 10 (Quality Management)</td>
</tr>
<tr>
<td>Technical Basis</td>
<td>Chapter 10 (Quality Management)</td>
<td>Chapter 6 (ITPM)</td>
<td>Chapter 6 (ITPM)</td>
<td>Chapter 10 (Quality Management)</td>
</tr>
<tr>
<td>Competency</td>
<td>Chapter 8 (Asset Integrity Training)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedures</td>
<td>Chapter 9 (Asset Integrity Procedures)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous Improvement</td>
<td>Section 14.2 (Program Audits)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
To a large extent, the implementation of AIM activities depends on the specific types of assets involved. Because many codes, standards and other guidelines are written for specific types of equipment, this document contains a section dedicated to the specific approaches applicable to different equipment categories. Chapter 12 is dedicated to the equipment-specific aspects for the management systems covered in Chapters 6 through 11. Activity tables in Chapter 12 and in the electronic resources accompanying this document are presented in a format similar to Table 1-3. Many available codes, standards and practices are listed in this section. Key aspects derived from them, such as time intervals between inspections, are also listed, but the reader is encouraged to consult the referenced documents for more detailed information.

Chapter 13 reviews issues commonly encountered while implementing an AIM program, including budgeting and resources. Frequently, these resources include a computerized maintenance management system (CMMS). Many commercial CMMS packages are available, although some in-house programs are also effective. Chapter 13 includes basic information typically included in any CMMS that is installed as part of an effective AIM program.

The remaining two chapters contain supplemental information related to AIM programs. Chapter 14 discusses performance metrics that apply to AIM program activities, then offers suggestions for continual assessment and improvement of an AIM program. Continuous improvement is needed to ensure that effective AIM programs continue to operate at a high level. Some improvement can be attained simply by asking the right questions (i.e., auditing) and following up to address any identified weaknesses. Performing improvement activities on a regular basis can be expected to result in continuous improvement.

This document closes by providing an overview of other asset management tools that can be used to help make decisions related to AIM activities. Because of the extensive resource requirements for most AIM programs, risk-based decision making can be effectively employed to prioritize resource allocation. Various texts have been written on applicable tools for making these decisions. Chapter 15 includes an overview of many of the tools and references available in these resources.
CHAPTER 1 REFERENCES


