Quick Start Guide: An Overview of ISA/IEC 62443 Standards

**Security of Industrial Automation and Control Systems**

**THE TIME IS NOW**
Executive Summary

This document is intended to provide the reader with a detailed overview of the ISA/IEC 62443 series of standards and technical reports. The ISA/IEC 62443 series addresses the security of industrial automation and control systems (IACS) throughout their lifecycle. These standards and technical reports were initially developed for the industrial process sector, but have since been applied to building automation, medical devices, and transportation sectors.

There are several trends that have made cybersecurity an essential property of IACS, along with safety, integrity, and reliability. First, over the last two decades, IACS technologies have migrated from vendor-proprietary to commercial off-the-shelf technologies such as Microsoft Windows™ and TCP/IP networking. Second, the value of data residing in the IACS for the business has significantly increased the interconnectivity of IACS both internal and external to the organization. Finally, the means, resources, skills, and motivation of cyberattackers have significantly increased. The combination of these trends has made IACS more vulnerable to cyberattack. Figure 1 shows some of the notable cyberattacks that have impacted IACS.

Initially, the ISA99 committee considered IT standards and practices for use in IACS. However, it was soon found that this was not sufficient to ensure the safety, integrity, reliability, and security of an IACS. This is because the consequences of a successful cyberattack on an IACS may additionally include loss of life or health, damage to the environment, or loss of product integrity. There are several other differences between IT and IACS such as performance requirements, availability requirements, change management, the time between maintenance windows, and equipment lifetime. [1]

The International Society of Automation (ISA) and the International Electrotechnical Commission (IEC) have joined forces to address the need to improve the cybersecurity of IACS. The ISA99 Committee and the IEC Technical Committee 65/ Working Group 10 develop and publish the ISA/IEC 62443 series of standards. These documents describe a methodical engineered approach to addressing the cybersecurity of IACS. They can be purchased from either organization; the technical content is identical. The benefits of using a standards-based approach include reducing the likelihood of a successful cyberattack, the use of a common set of requirements among stakeholders, security throughout the lifecycle, and a reduction in overall lifecycle cost.

<table>
<thead>
<tr>
<th>Date</th>
<th>Target</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>Australian Sewage Plant</td>
<td>Insider</td>
</tr>
<tr>
<td>2010</td>
<td>Iran Uranium Enrichment</td>
<td>Stuxnet</td>
</tr>
<tr>
<td>2013</td>
<td>ICS Supply Chain attack</td>
<td>Havex</td>
</tr>
<tr>
<td>2014</td>
<td>German Steel Mill</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>Ukraine Power Grid</td>
<td>BlackEnergy, KillDisk</td>
</tr>
<tr>
<td>2016</td>
<td>Ukraine Substation</td>
<td>CrashOverride</td>
</tr>
<tr>
<td>2017</td>
<td>Global shipping company</td>
<td>NotPetya</td>
</tr>
<tr>
<td>2017</td>
<td>IoT DDoS attack</td>
<td>BrickerBot</td>
</tr>
<tr>
<td>2017</td>
<td>Health care, Automotive</td>
<td>WannaCry</td>
</tr>
<tr>
<td>2017</td>
<td>Saudi Arabia Petrochemical</td>
<td>TRITON/TRISIS</td>
</tr>
<tr>
<td>2019</td>
<td>Norwegian Aluminum Company</td>
<td>LockerGaga</td>
</tr>
</tbody>
</table>

Table 1: Some notable cyberattacks impacting IACS

Source: www.awa.csis.org/programs/technology-policy-program/significant-cyber-incidents
Introduction

This document provides an overview of the ISA/IEC 62443 series of standards and technical reports (referred to as the ISA/IEC 62443 series of standards) which specifies requirements for the security of IACS. The goal of the ISA/IEC 62443 series of standards is to improve the safety, reliability, integrity, and security of IACS using a risk-based, methodical, and complete process throughout the entire lifecycle. The ISA/IEC 62443 Series describes a set of common terms and requirements that can be used by asset owners, product suppliers, and service providers to secure their control systems and the equipment under control.

Scope and Purpose

The scope of the ISA/IEC 62443 series of standards is the security of IACS. An IACS is defined as:

A collection of personnel, hardware, software, and policies involved in the operation of the industrial process and that can affect or influence its safe, secure, and reliable operation.

Note that an IACS includes more than the technology that comprises a control system; it also includes the people and work processes needed to ensure the safety, integrity, reliability, and security of the control system. Without people who are sufficiently trained, risk-appropriate technologies and countermeasures, and work processes throughout the security lifecycle, an

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IACS could be more vulnerable to cyberattack. Because IACS are physical-cyber systems, the impact of a cyberattack could be severe. The consequences of a cyberattack on an IACS include, but are not limited to:

- Endangerment of public or employee safety or health
- Damage to the environment
- Damage to the equipment under control
- Loss of product integrity
- Loss of public confidence or company reputation
- Violation of legal or regulatory requirements
- Loss of proprietary or confidential information
- Financial loss
- Impact on entity, local, state, or national security

The first four consequences in the above list are unique to physical-cyber systems and are not typically present in traditional IT systems. Indeed, it is this difference that fundamentally results in the need for different approaches to securing physical-cyber systems and caused standards development organizations to identify the need for standards that are unique to IACS. Some other characteristics of IACS that are not typical in IT systems include:

- More predictable failure modes
- Tighter time-criticality and determinism
- Higher availability
- More rigorous management of change
- Longer time periods between maintenance
- Significantly longer component lifetimes
- Safety, Integrity, Availability, and Confidentiality (SIAC) instead of CIA

Cyber threat actors include but are not limited to insiders (accidental or intentional), hacktivists, cybercriminals, organized crime, and state-sponsored attackers. Types of cyberattacks include but are not limited to ransomware, destructive malware, directed remote access attacks, and coordinated attacks on control systems and associated support infrastructure. Table 1 lists several noteworthy directed and non-directed cyberattacks impacting IACS.

Table 1

<table>
<thead>
<tr>
<th>Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ransomware</td>
<td>Extortion</td>
</tr>
<tr>
<td>Destructive Malware</td>
<td>Data Wiping</td>
</tr>
<tr>
<td>Directed Remote Access</td>
<td>Keylogger</td>
</tr>
<tr>
<td>Coordinated Attacks</td>
<td>Poisoning</td>
</tr>
</tbody>
</table>

ISA/IEC 62443 Series of Standards Development Organizations

There are two standards development organizations involved in the development of the ISA/IEC 62443 series of standards and technical reports:

- International Society of Automation – ISA99 Committee
- International Electrotechnical Commission – IEC TC65/WG10 Committee

There is a formal liaison agreement between these two standards development organizations. The ISA/IEC 62443 series of standards and technical reports are developed primarily by the ISA99 Committee with input, review, and simultaneous adoption by both the ISA and IEC. The one exception is ISA/IEC 62443-2-4, which was developed by the IEC TC65/WG10 Committee and adopted by ISA. As a result, whether an ISA/IEC 62443 document is published by ISA or IEC, the content is identical except for the non-normative preface and foreword.

The United Nations Economic Commission for Europe (UNECE) confirmed at its annual meeting in late 2018 that it will integrate the widely used ISA/IEC 62443 Series into its forthcoming Common Regulatory Framework on Cybersecurity (CRF). The CRF will serve as an official UN policy position statement for Europe, establishing a common legislative basis for cybersecurity practices within the European Union trade markets.

Refer to the Published Standards and Technical Reports section at the end of this document for a complete list of ISA and IEC cybersecurity-related documents currently available.

Summary of ISA/IEC 62443 Series of Standards and Technical Reports

These documents are arranged in four groups, corresponding to the primary focus and intended audience.

1. General—This group includes documents that address topics that are common to the entire series.
   - Part 1-1: Terminology, concepts, and models introduces the concepts and models used throughout the series. The intended audience includes anyone wishing to become familiar with the fundamental concepts that form the basis for the series.
   - Part 1-2: Master glossary of terms and definitions is a list of terms and abbreviations used throughout the series.
Part 1-3: System security conformance metrics describes a methodology to develop quantitative metrics derived from the process and technical requirements in the standards.

Part 1-4: IACS security lifecycle and use cases provides a more detailed description of the underlying lifecycle for IACS security, as well as several use cases that illustrate various applications.

Part 1-4: IACS security lifecycle and use cases provides a more detailed description of the underlying lifecycle for IACS security, as well as several use cases that illustrate various applications.

2. Policies and Procedures—Documents in this group focus on the policies and procedures associated with IACS security.

Part 2-1: Establishing an IACS security program describes what is required to define and implement an effective IACS cybersecurity management system. The intended audience includes asset owners who have responsibility for the design and implementation of such a program.

Part 2-2: IACS security program ratings provides a methodology for evaluating the level of protection provided by an operational IACS against the requirements in the ISA/IEC 62443 series of standards.

Part 2-3: Patch management in the IACS environment provides guidance on patch management for IACS. The intended audience includes anyone who has responsibility for the design and implementation of a patch management program.

Part 2-4: Security program requirements for IACS service providers specifies requirements for IACS service providers such as system integrators or maintenance providers. This standard was developed by IEC TC65/WG10.

Part 2-5: Implementation guidance for IACS asset owners provides guidance on what is required to operate an effective IACS cybersecurity program. The intended audience includes asset owners who have responsibility for the operation of such a program.

3. System Requirements—The documents in the third group address requirements at the system level.

Part 3-1: Security technologies for IACS describes the application of various security technologies to an IACS
environment. The intended audience includes anyone who wishes to learn more about the applicability of specific technologies in a control systems environment.

- **Part 3-2: Security risk assessment for system design** addresses cybersecurity risk assessment and system design for IACS. The output of this standard is a zone and conduit model and associated risk assessments and target security levels. These are documented in the cybersecurity requirements specification. This standard is primarily directed at asset owners and system integrators.

- **Part 3-3: System security requirements and security levels** describes the requirements for an IACS system based on security level. The principal audience include suppliers of control systems, system integrators, and asset owners.

### 4. Component Requirements

The fourth and final group includes documents that provide information about the more specific and detailed requirements associated with the development of IACS products.

- **Part 4-1: Product security development life cycle requirements** describes the requirements for a product developer’s security development lifecycle. The principal audience include suppliers of control system and component products.

- **Part 4-2: Technical security requirement for IACS components** describes the requirements for IACS Components based on security level. Components include embedded devices, host devices, network devices, and software applications. The principal audience include suppliers of component products that are used in control systems.

Table 2 shows the complete list of ISA/IEC 62443 standards and technical reports. The part can be derived from the document number, for example ISA/IEC 62443-2-1 is referred to as Part 2-1 in this document.

The document types are:

- IS – International Standard
- TR – Technical Report
- TS – Technical Specification

Finally, the publication date is shown for each document as of the publication date of this document. ISA/IEC standards are on a five-year update cycle, so many of the published documents are currently in revision.

### Fundamental Concepts

#### Security Program

Part 2-1 specifies asset owner security program requirements for the IACS. A security program consists of the implementation and maintenance of personnel, policy & procedural, and technology-based capabilities that reduce the cybersecurity risk of an IACS.

In the context of Part 2-1, the asset owner is also the operator of the IACS and the equipment under control. The security program covers the entire lifecycle of the IACS. Because the lifetime of an IACS can be longer than the product supplier support timeframe, the standard recognizes that not all requirements can be met by legacy systems, so compensating countermeasures may be needed to secure the IACS.

Although the asset owner is ultimately accountable for the secure operation of the IACS, implementation of security capabilities requires the support of product suppliers and...

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**Table 2: ISA/IEC 62443 Series Status**
service providers. The asset owner must include requirements for security throughout the supply chain to meet the overall security program requirements.

The security program for the IACS must be coordinated with the overall information security management system (ISMS) of the organization. The ISMS sets the overall security governance and policies for the organization. However, as mentioned above, the IACS is significantly different from IT systems, so there are additional requirements and considerations for its security program.

**Risk Management**

**Risk Assessment**

Part 3-2 describes the requirements for addressing the cybersecurity risks in an IACS, including the use of zones and conduits, and security Levels. While Part 3-2 includes the requirements for the risk assessment process, it does not specify the exact methodology to be used. The methodology used must be established by the asset owner and should be consistent with the overall risk assessment methodology of the organization. Examples using the risk matrix methodology are included as informative content. Figure 3 shows the risk assessment process.

**Zones and Conduits**

A zone is defined as a grouping of logical or physical assets based upon risk or other criteria such as criticality of assets, operational function, physical or logical location, required access, or responsible organization.

A conduit is defined as a logical grouping of communication channels that share common security requirements connecting two or more zones.

A key step in the risk assessment process is to partition the system under consideration into separate zones and conduits. The intent is to identify those assets which share common security characteristics in order to establish a set of common security requirements that reduce cybersecurity risk.

Partitioning the system under consideration into zones and conduits can also reduce overall risk by limiting the scope of a successful cyber-attack. Part 3-2 requires or recommends that some assets are partitioned as follows should:

- Separate business and control system assets
- Separate safety related assets
- Separate temporarily connected devices
- Separate wireless devices
- Separate devices connected via external networks

**Cybersecurity Requirements Specification**

Part 3-2 also requires that required security countermeasures from the risk assessment as

![Figure 3: Risk Assessment Process](https://www.isa.org/ISAGCA)
The CRS includes information such a description of the system under consideration, zone and conduit drawings, threat environment, and countermeasures from risk assessments.

**Threat Modeling**

Part 4-1 describes the requirements for the security development lifecycle (SDL) of control system and component products. One of the key processes in the product SDL is threat modeling which is a systematic process to identify data flows, trust boundaries, attack vectors, and potential threats to the control system. The security issues identified in the threat model must be addressed in the final release of the product and the threat model itself must be periodically updated during the product's lifecycle.

**Foundational Requirements**

Foundational requirements (FR) form the basis for technical requirements throughout the ISA/IEC 62443 Series. All aspects associated with meeting a desired IACS security level (people, processes, and technology) are derived through meeting the requirements associated with the seven following Foundational Requirements:

- **FR 1 – Identification and Authentication Control (IAC)**
- **FR 2 – Use Control (UC)**
- **FR 3 – System Integrity (SI)**
- **FR 4 – Data Confidentiality (DC)**
- **FR 5 – Restricted Data Flow (RDF)**
- **FR 6 – Timely Response to Events (TRE)**
- **FR 7 – Resource Availability (RA)**

Foundational requirements are used to organize the requirements for IACS systems (part 3-3) and components (part 4-2).

The combination of FR 1 and FR 2 is sometimes called access control; they were split into two FRs to keep the total number of requirements at a manageable level.

**Security Levels**

Security level is defined as the *measure of confidence that the system under consideration, zone, or conduit is free from vulnerabilities and functions in the intended manner.*

Part 3-3 further defines the security level in terms of the means, resources, skills, and motivation of the threat actor, as shown in Table 3. It is used as a means to discriminate between requirement enhancements for systems (Part 3-3) and components (Part 4-2).

There are three types of security levels that are used throughout the ISA/IEC 62443 Series:

- **Capability Security Levels (SL-C)** are the security levels that systems (Part 3-3) or components (Part 4-2) can provide when properly integrated and configured. These levels state that a particular system or component is capable of meeting the SL-T natively without additional compensating countermeasures.

- **Target Security Levels (SL-T)** are the desired level of security for a particular automation solution. They are determined as the result of the risk assessment process (Part 3-2) and are documented in the cybersecurity requirements specification. SL-T are used to select products and design additional countermeasures during the Integration phase of the IACS lifecycle.

- **Achieved Security Levels (SL-A)** are the actual levels of security for a particular automation solution. These are measured after the

<table>
<thead>
<tr>
<th>Security Level</th>
<th>Definition</th>
<th>Means</th>
<th>Resources</th>
<th>Skills</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Protection against casual or coincidental violation</td>
<td>simple</td>
<td>low</td>
<td>generic</td>
<td>low</td>
</tr>
<tr>
<td>2</td>
<td>Protection against intentional violation using simple means with low</td>
<td>simple</td>
<td>low</td>
<td>generic</td>
<td>low</td>
</tr>
<tr>
<td></td>
<td>resources, generic skills, and low motivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Protection against intentional violation using sophisticated means with</td>
<td>sophisticated</td>
<td>moderate</td>
<td>IACS-specific</td>
<td>moderate</td>
</tr>
<tr>
<td></td>
<td>moderate resources, IACS-specific skills, and moderate motivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Protection against intentional violation using sophisticated means with</td>
<td>sophisticated</td>
<td>extended</td>
<td>IACS-specific</td>
<td>high</td>
</tr>
<tr>
<td></td>
<td>extended resources, IACS-specific skills, and high motivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Security Level Definition
automation solution is commissioned and in operation. Part 2-2 combines SL-A with operational and maintenance policies and procedures to form the security program rating for a particular automation solution.

Maturity Model
While security levels are a measure of the strength of technical requirements, maturity levels are a measure of processes (people, policies, and procedures). Parts 2-1, 2-2, 2-4, and 4-1 use maturity levels to measure how thoroughly requirements are met.

As shown in Table 4, the maturity model is based on the capability maturity model integration (CMMI), with levels 4 & 5 combined into level 4.

Design Principles
Secure by Design
Secure by design is a design principle where security measures are implemented early in the lifecycle of the IACS. The intent is that robust security policies, security architectures, and secure practices are established early in development and implemented throughout the lifecycle. This design principle applies to both product development and automation solution development. When using a secure by design philosophy, security measures operate natively within the control System or component without requiring the addition of compensating countermeasures.

Reduce Attack Surface
Reducing the attack surface is a design principle where the physical and functional interfaces of an IACS that can be accessed and exposed to potential attack are minimized, making it more difficult for an attack to succeed. Reducing attack surface includes design principles such as:

- Access control—restricting physical and logical access to IACS systems and networks
- Network segmentation—segmenting IACS networks and controlling the traffic between them
- Least function—hardening IACS systems and networks by removing unneeded functions
- Least privilege—limiting privileges to the minimum necessary for the role or function

Defense in Depth
Defense in depth is defined as the provision of multiple security protections, especially in layers, with the intent to delay or prevent an attack. Defense in depth implies layers of security and detection, even on single systems, and requires attackers to break through or bypass multiple layers without being detected. The IACS is still protected even if a vulnerability in one layer is compromised. Special attention must be paid to a single vulnerability that allows the potential compromise of multiple layers.

Essential Functions
Essential functions are defined as functions or capabilities that are required to maintain health, safety, the environment, and availability of the equipment under control. Essential functions include:

- the safety instrumented function (SIF)
- the control function
- the ability of the operator to view and manipulate the equipment under control

The loss of essential functions is commonly termed: loss of protection, loss of control, and loss of view respectively. In some use cases additional functions such as history may be considered essential. Part 3-3 requires that security measures shall not adversely affect essential functions of a high-availability IACS unless it is supported by a risk.

<table>
<thead>
<tr>
<th>Level</th>
<th>CMMI</th>
<th>62443</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Initial</td>
<td>Initial</td>
<td>• Product development is typically ad-hoc and often undocumented</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Consistency and repeatability may not be possible</td>
</tr>
<tr>
<td>2</td>
<td>Managed</td>
<td>Managed</td>
<td>• Product development managed using written policies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Personnel have expertise and are trained to follow procedures</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Processes are defined but some may not be in practice</td>
</tr>
<tr>
<td>3</td>
<td>Defined</td>
<td>Defined (Practiced)</td>
<td>• All processes are repeatable across the organization</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• All processes are in practice with documented evidence</td>
</tr>
<tr>
<td>4</td>
<td>Quantitively Managed</td>
<td>Improving</td>
<td>• CMMI Levels 4 and 5 are combined</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Process metrics are used control effectiveness and performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Continuous improvement</td>
</tr>
<tr>
<td>5</td>
<td>Optimizing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Maturity Level Definition
assessments. The concept of essential functions places some design constraints on the design of IACS security measures:
• Access control shall not prevent the operation of essential functions
• Essential functions shall be maintained if the zone boundary protection (firewall) goes into a fail close/island mode
• A denial of service event on the control system or safety instrumented system network shall not prevent safety instrumented functions from acting

Roadmap for the ISA/IEC 62443 Series

Principal Roles
To understand how to use the ISA/IEC 62443 Series it is first necessary to understand the relationship between roles, control system, automation solution, and IACS. Figure 4 visualizes this relationship.

The left-hand side of the figure shows the roles that are identified in the ISA/IEC 62443 series:
• Asset Owner is the organization that is accountable and responsible for the IACS. The asset owner is also the operator of the IACS and the equipment under control.
• Maintenance Service Provider is the individual or organization that provides support activities for an automation solution.
• Integration Service Provider is the organization that provides integration activities for an automation solution including design, installation, configuration, testing, commissioning, and handover to the asset owner. The integration service provider may also facilitate and assist in the activity to partition the system under consideration into zones and conduits and perform the risk assessment.
• Product Supplier is the organization that manufactures and supports a hardware and/or software product. Products may include control systems, embedded devices, host devices, network devices, and/or software applications.

Component, System, Automation Solution, and IACS
The right-hand side of the figure shows the types of systems that are identified in the ISA/IEC 62443 series:
• IACS Components are provided by a product supplier and include the following types:
  • Embedded device – special purpose device designed to directly monitor or control an industrial process
  • Host device – general purpose device running an operating system capable of hosting one or more software applications, data stores or functions from one or more suppliers
  • Network device – device that facilitates data flow between devices, or restricts the data flow, but may not directly interact with a control process
  • Software application – one or more software programs and their dependencies that are used to interface with the process or the control system itself

• IACS System (or control system) consists of an integrated set of embedded devices (e.g. PLC), host devices, network devices, and software applications provided by one or more product suppliers
• Automation Solution is the realization of a control system at a particular facility. It includes essential functions such as safety functions and control functions and other supporting functions such as historization and engineering

![Figure 4: Roles, Products, Automation Solution, and IACS](image-url)
The Industrial Automation and Control System (IACS) includes the automation solution and the operational and maintenance policies and procedures necessary to support it.

Hierarchical View

Figure 5 shows the hierarchical relationships among the ISA/IEC 62443 Series of standards. A hierarchical relationship means that one standard derives its requirements from the requirements in another standard. The arrowhead shows the direction of derivation.

- **Part 1-1** introduces the concepts and models that are used throughout the ISA/IEC 62443 series of standards. In particular, it describes the foundational requirements, which are used to organize technical requirements throughout the series.
- **Part 2-1** sets the requirements for the security program of an asset owner. All of the other standards in the ISA/IEC 62443 series derive their requirements from Part 2-1 and expand upon them in more detail.
- **Part 3-2** sets the requirements for the partitioning of the system under consideration into zones and conduits and their risk assessment. The risk assessment defines the target security level (SL-T), which is used to procure systems and components that have the capabilities defined in part 3-3, and part 4-2 respectively. Part 3-2 also requires a cybersecurity requirements specification, which is used to create the automation solution.
- **Part 4-1** is used by the product supplier to establish and sustain a security development lifecycle, which is used to create control system and component products.
- **Part 2-4** sets the requirements for service providers that are involved in support of the IACS. Integration service providers provide integration services for the automation solution, and maintenance service providers provide maintenance services for the IACS.
- **Part 2-3** sets the requirements for the patch management process, which is used to reduce cybersecurity vulnerabilities in the automation solution.

<table>
<thead>
<tr>
<th>Product Development Lifecycle</th>
<th>Automation Solution Lifecycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration</td>
<td>Operation and Maintenance</td>
</tr>
<tr>
<td>Part 1-1: Terminology, Concepts, and Models</td>
<td></td>
</tr>
<tr>
<td>Part 2-1: Establishing an IACS Security Program</td>
<td></td>
</tr>
<tr>
<td>Part 2-2: IACS Security Program Rating</td>
<td></td>
</tr>
<tr>
<td>Part 2-3: Patch Management in the IACS Environment</td>
<td></td>
</tr>
<tr>
<td>Part 2-4: Security program requirements for IACS service providers</td>
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<tr>
<td>Part 3-2: Security Risk Assessment for System Design</td>
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<td>Part 3-3: System security requirements and Security levels</td>
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<tr>
<td>Part 4-1: Product Security Development Lifecycle Requirements</td>
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<tr>
<td>Part 4-2: Technical security requirements for IACS components</td>
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Figure 6: ISA/IEC 62443 Standards - Lifecycle View
Lifecycle View
Another view of the ISA/IEC 62443 series is the lifecycle view. There are two independent lifecycles described in the series: the product development lifecycle and the automation solution lifecycle. The automation solution lifecycle is further divided into an integration phase and an operation and maintenance phase. Table 6 shows the relationship between the parts of the ISA/IEC 62443 series and the various lifecycles and phases.

Note that part 3-3 spans the product development lifecycle and the integration phase of the automation solution lifecycle. This is because while the product supplier is the main audience for part 3-3, the integration service provider may also combine components to create control systems. An example would be a SCADA system, where the integration service provider integrates the SCADA system with embedded devices (e.g., PLC) to create an automation solution.

ISA/IEC 62443 Series for Asset Owners
Asset owner activities:
• Establish and sustain a security program that includes IACS-specific requirements
• Partition zones and conduits and perform associated risk assessments
• Document IACS requirements in the cybersecurity requirements specification
• Procure products and services that meet IACS requirements
• Operate and maintain the IACS
• Assess the effectiveness of the IACS security program

Applicable ISA/IEC 62443 standards:
• ISA/IEC 62443-2-1, Establishing an IACS security program
• ISA/IEC 62443-2-2, Security program ratings
• ISA/IEC 62443-2-3, Patch management in the IACS environment
• ISA/IEC 62443-2-4, Requirements for IACS service providers
• ISA/IEC 62443-3-2, Security risk assessment for system design
• ISA/IEC 62443-3-3, System security requirements and security levels

ISA/IEC 62443 Series for Product Suppliers
Product supplier activities:
Establish and sustain a security development lifecycle
• Provide control system products that meet security level capabilities
• Provide component products that meet security level capabilities
• Provide ongoing lifecycle support for their control system and component products

Applicable ISA/IEC 62443 standards:
• ISA/IEC 62443-4-1, Product security development lifecycle requirements
• ISA/IEC 62443-3-3, System security requirements and security levels
• ISA/IEC 62443-4-2, Technical security requirements for IACS components
• ISA/IEC 62443-3-2, Security risk assessment for system design

ISA/IEC 62443 Series for Service Providers
Integration Service Providers
Integration service provider activities:
• Establish and sustain a security program for automation solution integration
• Design and implement automation solutions that meet the requirements in the cybersecurity requirements specification
• Apply security patches during the integration phase of the automation solution lifecycle

Applicable ISA/IEC 62443 standards:
• ISA/IEC 62443-2-1, Establishing an IACS security program
• ISA/IEC 62443-2-3, Patch management in the IACS environment
• ISA/IEC 62443-2-4, Requirements for IACS service providers
• ISA/IEC 62443-3-2, Security risk assessment for system design
• ISA/IEC 62443-3-3, System security requirements and security levels

Maintenance Service Providers
Maintenance service provider activities:
• Establish and sustain a Security Program for maintenance services
• Provide services and capabilities that meet the IACS security policies and procedures specified by the asset owner
Applicable ISA/IEC 62443 standards:
- ISA/IEC 62443-2-3, *Patch management in the IACS environment*
- ISA/IEC 62443-2-2, *IACS Security program ratings*
- ISA/IEC 62443-2-4, *Requirements for IACS service providers*

**Certification and Training**

**ISASecure® Certification**
The ISA Security Compliance Institute is a non-profit organization that has developed several product certification programs for controls systems and components. Currently available ISASecure certification programs are:

- **Security Development Lifecycle Assurance (SDLA)** which certifies that the security development lifecycle of a product supplier meets the requirements in part 4-1.
- **System Security Assurance (SSA)** which certifies that control system products have the capability to meet the requirements in Part 3-3 and have been developed in accordance with an SDLA program.

**Component Security Assurance (CSA)** which certifies that component products have the capability to meet the requirements in part 4-2 and have been developed in accordance with an SDLA program. Certified component products can be: embedded devices, host devices, network devices, and software applications.

ISASecure certification programs can be found at ISASecure.org.

**ISA Cybersecurity Training**
The following cybersecurity-related training courses are offered by ISA:
- Cybersecurity awareness training for Water/Wastewater Industry Professionals (IC31)
- Using the ISA/IEC 62443 Standards to Secure Your Control System (IC32, IC32M, IC32E)
- Assessing the Cybersecurity of New or Existing IACS Systems (IC33, IC33E, IC33M)
- IACS Cybersecurity Design and Implementation (IC34, IC34M)
- IACS Cybersecurity Operation and Maintenance (IC37, IC37M)
- Overview of ISA/IEC 62443 for Product Suppliers (IC46C, IC46M)

The last letter of the course code designates the type of course as follows:
- <none> - Multi-day classroom course
- C – One-day overview course
- E – Online, instructor-assisted course
- M – On-demand, computer-based training

**ISA Cybersecurity Certificates**

ISA offers the following cybersecurity certificates for students who have completed the training courses listed above. Certificates are not to be confused with product certifications offered by ISASecure.
- ISA/IEC 62443 Cybersecurity Fundamentals Specialist
- ISA/IEC 62443 Cybersecurity Risk Assessment Specialist
- ISA/IEC 62443 Cybersecurity Design Specialist
- ISA/IEC 62443 Cybersecurity Maintenance Specialist
- ISA/IEC 62443 Cybersecurity Expert

**ISASecure-Developed Course for Product Suppliers and Certifying Bodies**
ISASecure for Product Suppliers and Assessors (IC47V) is an virtual, instructor-led course intended for product suppliers who want to build products conforming to 62443 standards that also meet ISASecure certification requirements. It is also intended for conformance/certification assessors of software development processes, and system/component products who need to understand the ISASecure certification programs and the ISA/IEC 62443 standards on which they are based.

Visit [ISASecure for Product Suppliers and Assessors (IC47V) - Virtual](#).
Published Standards and Technical Reports


References

1. NIST SP 800-82 Revision 2, Guide To Industrial Control Systems (Ics) Security
3. The 62443 Series of Standards: Industrial Automation and Control Security, ISA99 Committee
4. Frequently Asked Questions: The ISA99 Committee And 62443 Standards, ISA99 Committee
5. Instrumentation And Control Systems Security Explained: the What and the Why, ISA99 Committee

This document contains some information that is based on ISA99 Committee draft documents. Please refer to the published documents for the definitive set of requirements currently available.