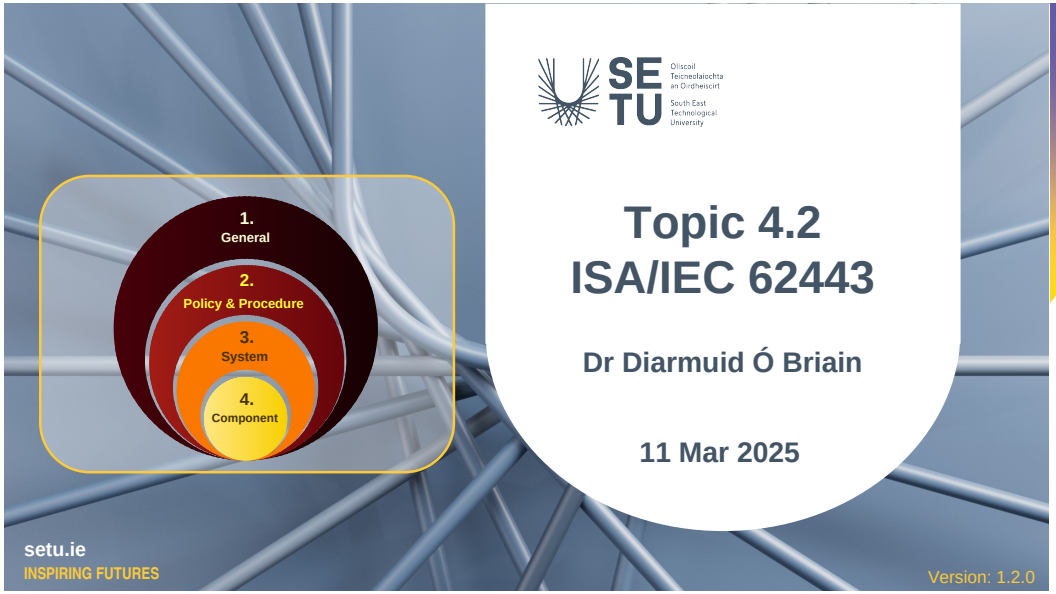


# Topic 4.2
# ISA/IEC 62443

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11 Mar 2025

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INSPIRING FUTURES

Version: 1.2.0

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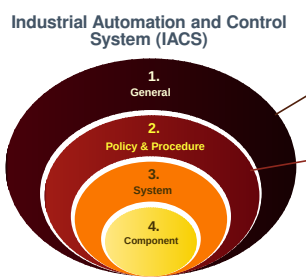
## Learning objectives

At the end of this section of the topic on ISA/IEC 62443 the learning will:

- define the elements of a comprehensive IACS CSMS.
- explain the concept of maturity levels and how to assess and improve the cybersecurity maturity of an IACS organisation.
- understand the requirements for security programme ratings, patch management, and security programme requirements for service providers.
- gain insights into the guidance provided for IACS asset owners to help them implement and maintain a secure IACS environment.
- describe the security technologies and requirements for IACS systems, and the secure product development lifecycle for IACS components.



## ISA/IEC 62443 Part 2: Policy and Procedure




**Asset owner responsibility:**

**Part 1-1: Terminology, concepts and models**
Part 1-2: Master glossary of terms and conditions
Part 1-3: System security conformance metrics
Part 1-4: ICAS security lifecycle and use cases

**Part 2-1: Security programme requirements for IACS asset owners**
Part 2-2: ICAS Security programme ratings
Part 2-3: Patch management in the IACS environment
**Part 2-4: Security programme requirements for IACS service providers**
Part 2-5: Implementation guidance for ICAS asset owners

## Part 2-1: Establishing an IACS Security Programme

- The standard applies to all organisations that own, operate, or maintain IACS.
- The standard also applies to all types of IACS, including:
  - Process Control Systems (PCS)
  - Supervisory Control and Data Acquisition (SCADA) systems
  - Distributed Control Systems (DCS)
  - Manufacturing Execution Systems (MES)
  - Industrial Automation Systems (IAS)

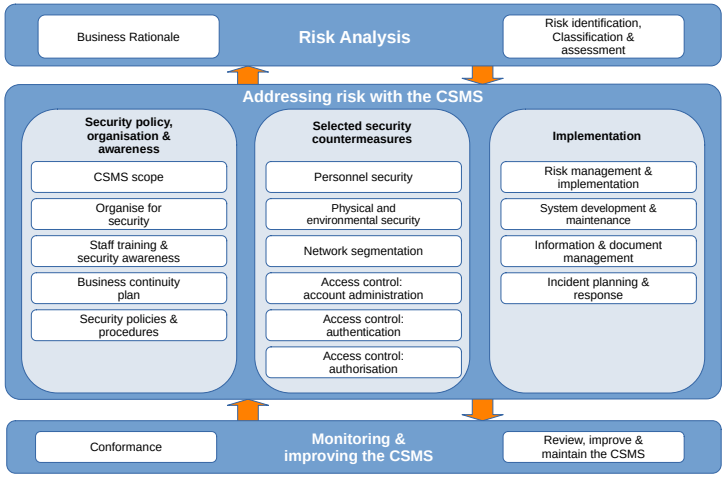


## Part 2-1: Establishing an IACS Security Programme

- **Key Requirements**
  - Policy and organisation
  - Resource management
  - Process management
  - Communication and cooperation

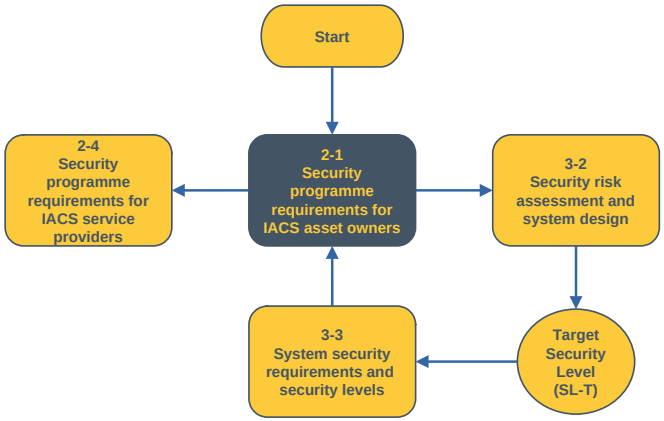


## Part 2-1: Categories of a CSMS

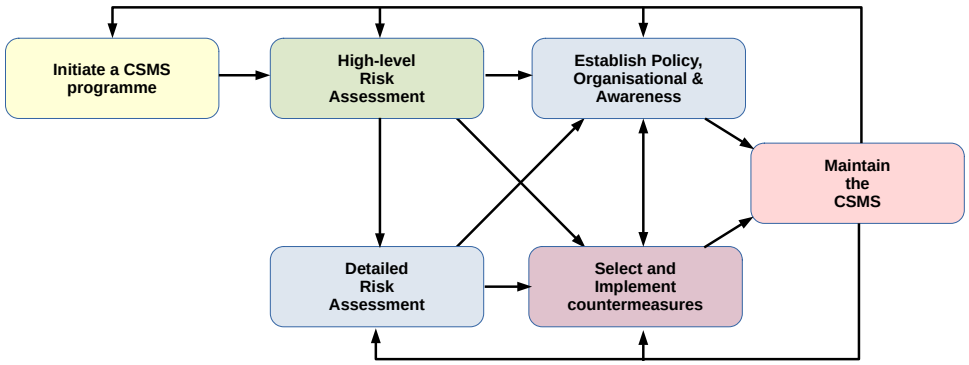





## ISA/IEC 62443 relationship between parts



## Process to develop a CSMS






## Process to develop a CSMS

**Initiate a CSMS programme**
- Business rationale
- Develop CSMS scope
- Involve stakeholders
- Obtain leadership commitment, support & funding

**High-level Risk Assessment**
- Define methodology
- Identify risks
- Define methodology for assessing priority of risks
- Assess the priority of risks
- Document results and rationale

**Detailed Risk Assessment**
- Inventory IACS systems, networks & devices
- Screen and prioritise
- Identify detailed vulnerabilities
- Identify and prioritise associated risks

**Establish Policy, Organisational & Awareness**
- Create policies & procedures
- Implement policies & procedures
- Communicate policies
- Develop training activities
- Assign organisational responsibilities

**Select and Implement countermeasures**
- Establish risk tolerance
- Select countermeasures
- Implement countermeasures
- Develop new or modify existing systems

**Maintain the CSMS**
- Monitor legal and regulatory constraints
- Monitor industry practices
- Monitor available countermeasures
- Monitor effectiveness of the CSMS
- Audit compliance
- Review the CSMS
- Refine the CSMS



## Part 2-2: ICAS Security programme ratings

- Set of levels of security, from Category 0 (lowest) to Category 4 (highest).
- These requirements cover a wide range of areas, including:
  - Asset management
  - Communication security
  - Application security
  - Operational security
  - Maintenance security



## Part 2-3: Patch Management

- Set of requirements for patch management, including:
  - Identifying and classifying vulnerabilities
  - Prioritising vulnerabilities
  - Deploying patches
  - Testing patches
  - Monitoring patch deployment
  - Remediating non-deployed patches

## Part 2-4: Security programme requirements for IACS service providers

- Part 2-4 applies to all organisations that provide IACS services such as:
  - Design and development of IACS
  - Manufacturing of IACS
  - Installation and commissioning of IACS
  - Maintenance and support of IACS
  - Operation and monitoring of IACS
  - Outsourcing of IACS services



## Part 2-4: Security programme requirements for IACS service providers

- The standard also applies to organisations that provide services that are not directly related to IACS, but that could impact the security of IACS such as:
  - Networking and telecommunications
  - Security consulting
  - Vulnerability management
  - Security training and awareness



## Part 2-4: Security programme requirements for IACS service providers

| Feature | ISA/IEC 62443-2-1 | ISA/IEC 62443-2-4 |
|---|---|---|
| Target audience | IACS owners and operators | IACS service providers |
| Focus | Establish and implement a CSMS | Establish and implement a cybersecurity programme for service providers |
| Scope | Policy and organisation, resource management, process management, and communication and cooperation | Policy and organisation, resource management, process management, and communication and cooperation |



## Part 2-4

- The security programmes implementing these requirements are **expected to be independent of different releases** of the products used in the automation solution.
- The requirements are defined in terms of the **capabilities that these security programmes** are required to provide.
- The standard recognises that security programmes evolve and that capabilities go through a life cycle of their own, often starting as completely manual and evolving over time to become more formal, more consistent, and more effective 62443-2-4 addresses this issue of evolving capabilities by **defining a maturity model to be used with** the application of this standard.
- **Service providers and asset owners should negotiate** and agree on which of these required capabilities are to be provided and how.
- **Encourage service providers** to implement the required capabilities so they can be adaptable to a wide variety of asset owners.
- The **maturity model** also allows asset owners to understand the maturity of a specific service provider's capabilities better

## Part 2-4

- Part 2-4 is relevant for asset owners and addresses capabilities of service providers that may support or undermine the security maturity of asset owners.
- Contains security requirements for providers of integration and maintenance services for IACS.
- The standard specifies requirements for **security capabilities for IACS service providers** that they can offer to the asset owner during integration and maintenance activities of an automation solution.
- It is related to Part 2-1, which describes requirements for the security management system of the asset owner.
- Part 2-4 can be used by asset owners to request specific security capabilities from the service provider.
- Part 2-4 can be used by asset owners to determine whether or not a specific service provider's security programme includes the capabilities that the asset owner needs.



## Part 2-5: Guidance for ICAS asset owners

- Provides implementation guidance for ICAS asset owners on how they can improve the security of their assets.
- The standard provides guidance on a wide range of topics, including:
  - Asset identification
  - Asset classification
  - Asset protection
  - Asset management
  - Asset disposal



## Part 2-5: Guidance for ICAS asset owners

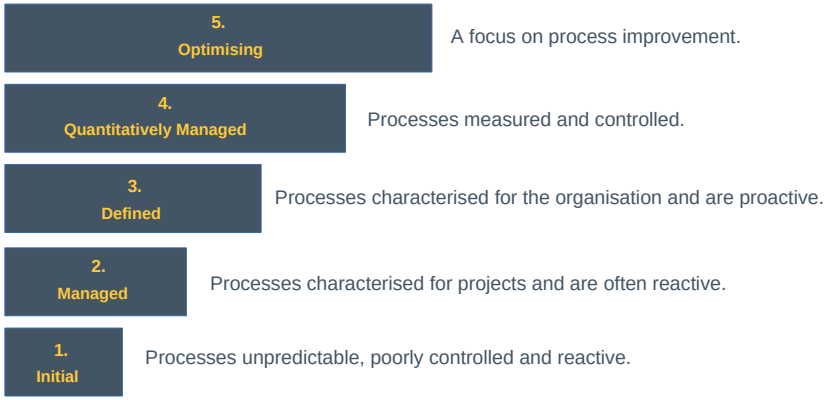
- The standard also provides guidance on how to implement the necessary security controls to protect IACS assets. These controls include:
  - Physical security
  - Environmental security
  - Data security
  - Network security
  - Application security
  - Operational security
  - Maintenance security



## Part 2-5: Guidance for ICAS asset owners

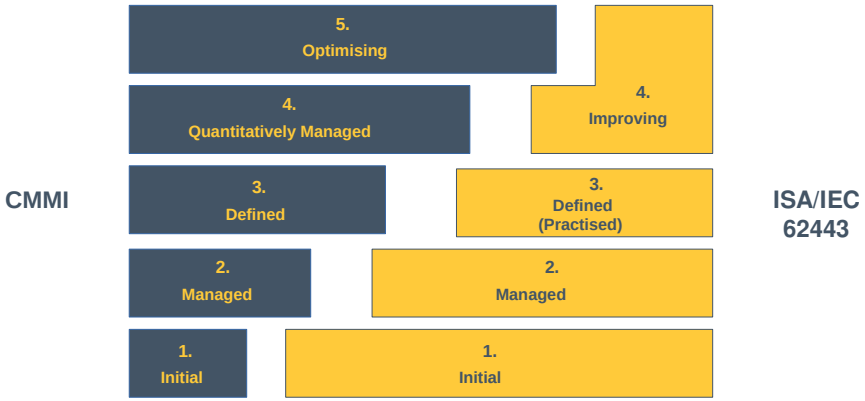
- Additionally, the standard provides guidance on how to assess the effectiveness of the security controls, including:
  - Vulnerability assessments
  - Penetration testing
  - Incident response

## CMMI



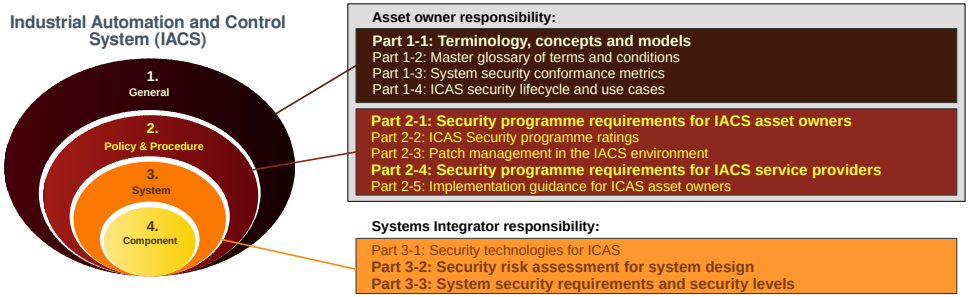



## ICAS Maturity compared to CMMI






## ISA/IEC 62443 Part 3






## Part 3-1 - Security technologies for IACS

- Technical specification that defines the requirements for securing IACS by providing guidance on how to implement security technologies for IACS.
- This is important because IACS are increasingly being targeted by cyberattacks.
- Assists organisations to significantly reduce their risk of cyberattacks and protect their IACS from harm.

## Part 3-1 - Security technologies for IACS

- **Key Requirements**
  - Network Segmentation
  - Access Control
  - Encryption
  - IDS/IPS
  - Honeypots
  - SIEM



## Part 3-1 - Security technologies for IACS

- **Security Requirements**
  - Availability
  - Integrity
  - Confidentiality
  - Accessibility



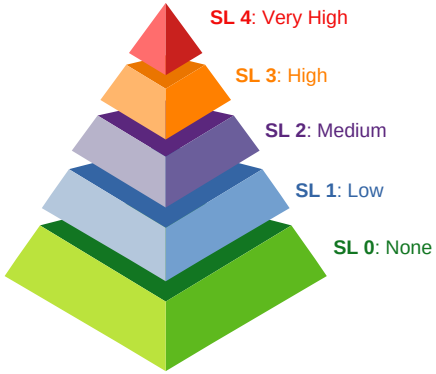
## Part 3-2 - Security risk assessment for system design

- defines the requirements for conducting security risk assessments for IACS:
  - Identify assets
  - Analyse threats
  - Evaluate vulnerabilities
  - Assess risk
- Also defines a set of security requirements for each step of the security risk assessment process.

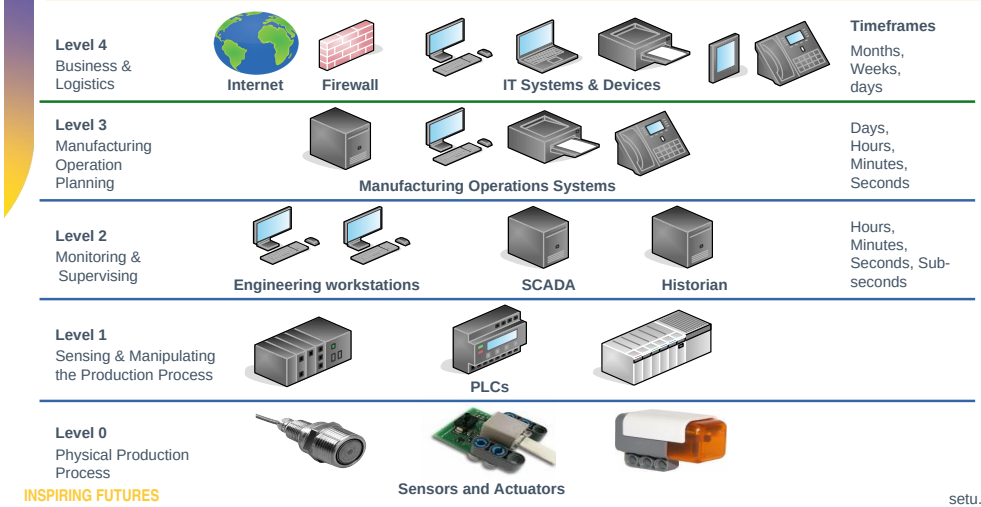


## Part 3-3 - System security requirements and security levels

- defines a 4-level security classification scheme for IACS:

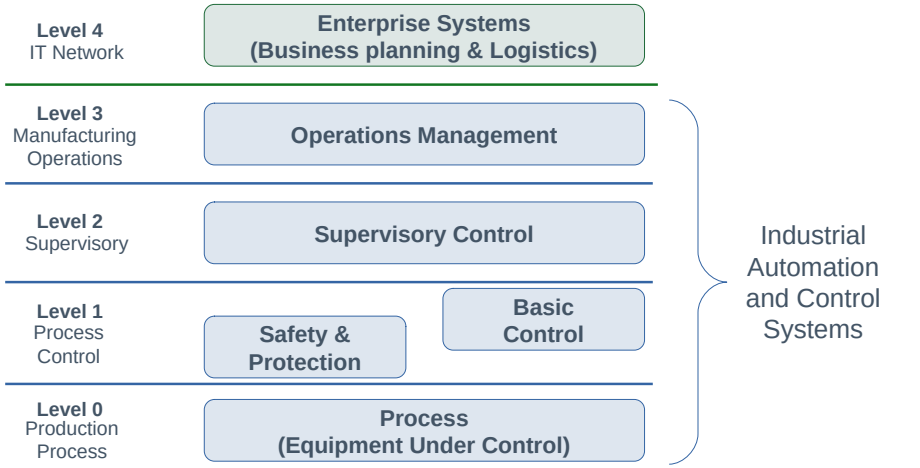


# ISA-95 Reference Model



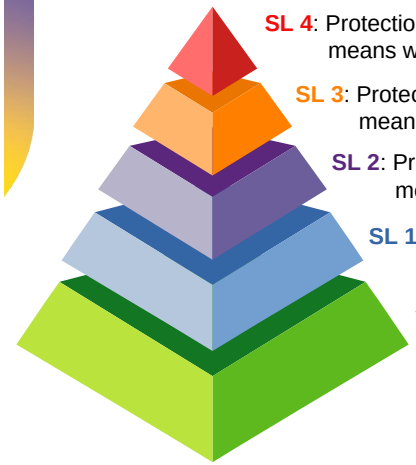



# ISA-99 Reference Model






# Security Levels



**SL 4**: Protection against intentional violation using sophisticated means with extended resources, skills and motivation

**SL 3**: Protection against intentional violation using sophisticated means with moderate resources, skills and motivation

**SL 2**: Protection against intentional violation using simple means with low resources, skills and motivation

**SL 1**: Protection against casual or coincidental violation

**SL 0**: No specific requirements



# Security Levels

| SL | Means | Resources | Skills | Motivation |
|---|---|---|---|---|
| 0 | Accidental unintentional | None | None | None |
| 1 | Un-intentional | Individual | No attack skills | Mistakes |
| 2 | Simple | Low (Isolated individual) | Generic | Low |
| 3 | Sophisticated | Moderate (Hacker Group) | IACS Specific | Mode rate |
| 4 | Sophisticated | Extended (Multidisciplinary teams) | IACS Specific | High |

## Security Level Controls

The following controls are mandated for SL4:

- Access Control Mechanisms
- Auditing and Logging
- Date Integrity Protection
- Configuration Management
- Identity and Access Management
- Vulnerability Management
- Security Awareness Training
- Segmentation
- Security Testing
- Incident Response



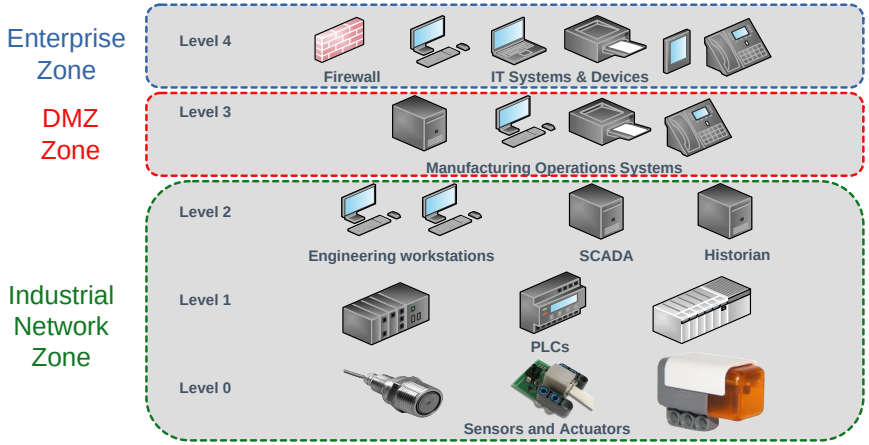
## Security Level Types

SLs are grouped into three types:

- **Target SLs (SL-T)**:
  - These are the desired level of security for an automation solution.
  - A System or Component can achieve SL-T natively without additional countermeasures.
- **Achieved SLs (SL-A)**:
  - These are the actual level of security for an IACS.
  - The SL-A are determined as a result of Risk Assessment.
  - They are used to select products and design additional countermeasures during the integration phase of the IACS lifecycle.
- **Capability SLs (SL-C)**:
  - These are the security levels that components or systems can provide when properly configured.

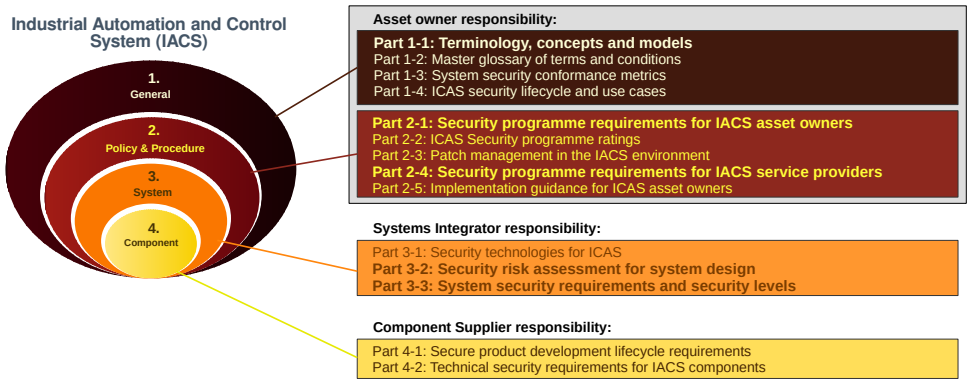


## Zones and Conduits






## ISA/IEC 62443 Part 4



## Part 4-1 - Secure product development lifecycle

- Technical specification that defines the requirements the requirements for implementing a secure product development lifecycle for IACS.
- The specification describes the requirements for the Security Development Lifecycle (SDL) of OT System and Component products.



## Part 4-1 - Secure product development lifecycle

- **Key Requirement Categories**
  - Planning
  - Design
  - Development
  - Testing
  - Deployment
  - Operation
  - Decommissioning



## Part 4-2 – Security Requirements for Components

- Provide guidance on how to select, install, and maintain secure IACS components through the definition of Common Cyber Security Constraints (CCSC).
- This is important because IACS components are often the weakest link in an IACS security posture.



## Part 4-2 – Security Requirements for Components

- **Key Requirement Categories**
  - Identification and classification
  - Security policy
  - Vulnerability management
  - Protection against unauthorised access
  - Security updates
- The standard also defines a set of security constraints.

## Part 4-2 – Security Requirements for Components

- **Threat Modelling**
  - Systematic process to identify data flows, trust boundaries, attack vectors, and potential threats to the ICAS.
  - The vendor must address any security issues that are identified in the threat modelling process before product release.
  - The threat modelling process must be updated between releases and changes addressed before each release.

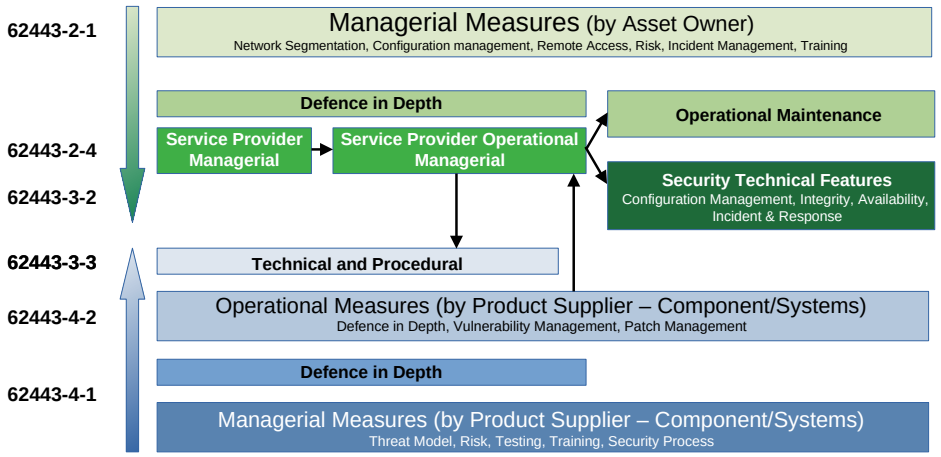


## Part 4-2 – Security Requirements for Components

- **Common Cyber Security Constraints**
  - **CCSC 1**: describes that components must take into account the general security characteristics of the system in which they are used.
  - **CCSC 2**: specifies that the technical requirements that the component cannot meet itself can be met by compensating countermeasures at system level.
  - **CCSC 3**: requires that the Principal of Least Privilege (PoLP) is applied in the component.
  - **CCSC 4**: requires that the component is developed and supported by a Part 4-1 compliant development processes.



## Dependencies





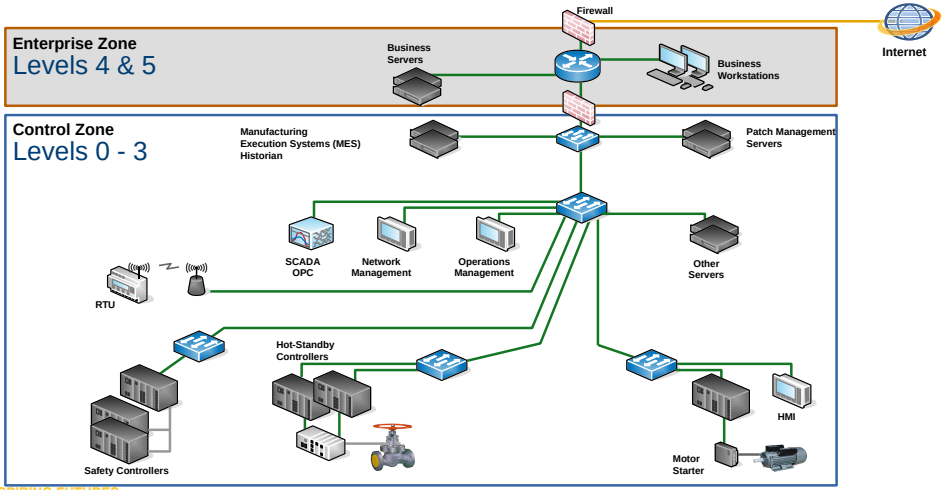

## Summary

- **ISA/IEC 62443 series of standards**
  - **Security for product development lifecycle**: provides guidance on how to secure IACS products throughout the product development lifecycle, from requirements gathering to deployment and decommissioning.
  - **Security risk assessment**: provides guidance on how to identify, assess, and prioritise security risks in IACS environments.
  - **Security levels**: defines a four-level security classification system for IACS assets.
  - **Security for components**: provides guidance on how to secure IACS components, such as PLCs and HMIs.
  - **Security of communication networks**: provides guidance on how to secure IACS communication networks, such as SCADA networks.

# Example

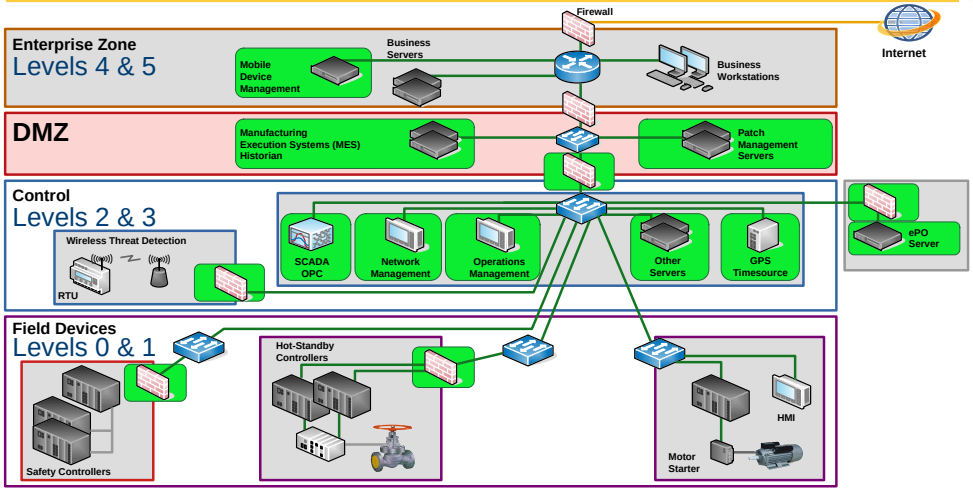


## Sample Network



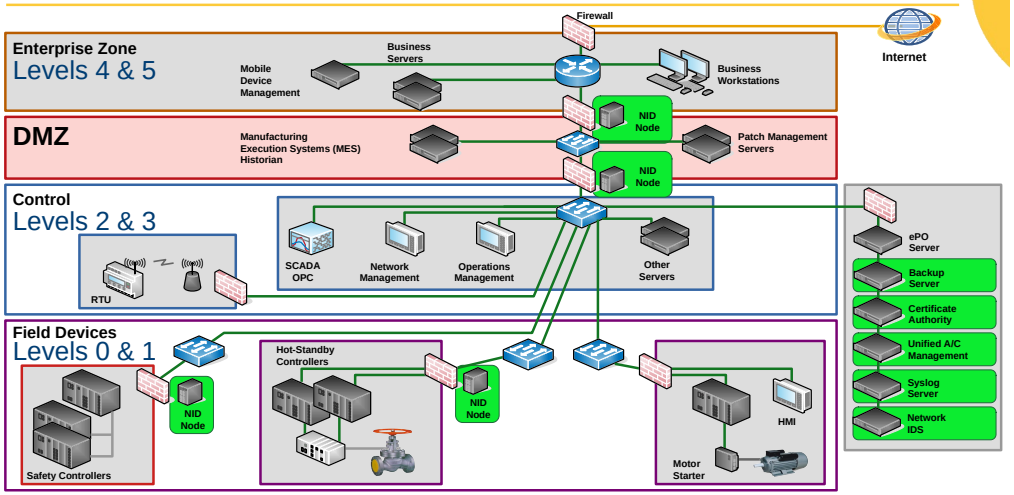



## Security Level 1

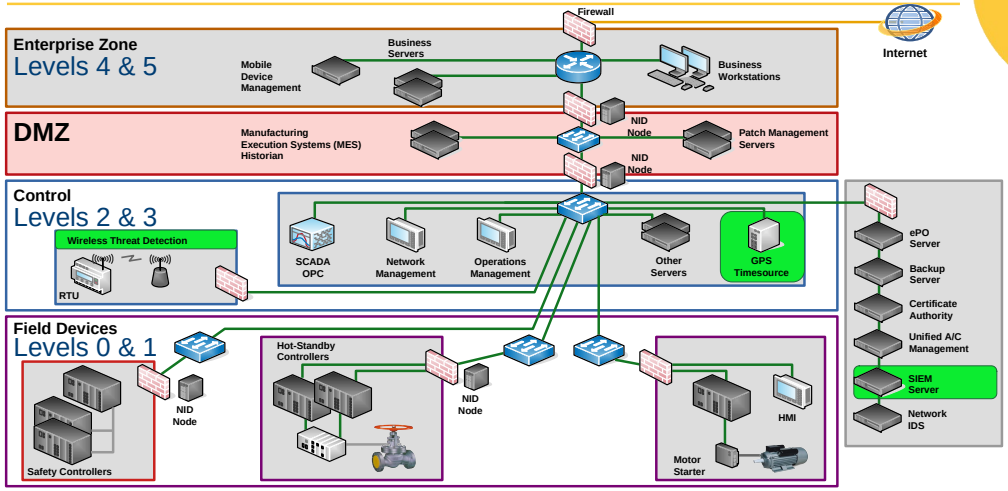





## Security Level 2



## Application of Security Level 3 controls






# Revision

QUIZ



## Question 1

- **Select the incorrect statement from the following:**

☐ SL-0: No specific requirements or security protection are necessary

☐ SL-1: Protection against casual or coincidental violation

☐ SL-3: Protection against intentional violation using simple means with low resources, generic skills, and low motivation

☐ SL-4: Protection against intentional violation using sophisticated means with extended resources, IACS-specific skills and high motivation

1



## Question 1

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## Question 2

- **Which type of security level defines what a component or system is capable of meeting?:**

☐ Capability security level

☐ Achieved security level

☐ Design security level

☐ Target security level




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- **Which type of security level defines what a component or system is capable of meeting?:**

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## Question 3

- **Which of the ISA/IEC 62443 standards focuses on the processes of developing securing products?:**

☐ ISA/IEC 62443-1-1

☐ ISA/IEC 62443-3-2

☐ ISA/IEC 62443-3-3

☐ ISA/IEC 62443-4-1




## Question 3

- **Which of the ISA/IEC 62443 standards focuses on the processes of developing securing products?:**

☒ ISA/IEC 62443-1-1

☒ ISA/IEC 62443-3-2

☒ ISA/IEC 62443-3-3

☑ ISA/IEC 62443-4-1

## Question 4

- **Which of the following ISA-99 Reference model is named correctly?:**

☐ Level 1 – Supervisory Control

☐ Level 2 – Quality Control

☐ Level 3 – Manufacturing Operations

☐ Level 4 – Process




## Question 4

- **Which of the following ISA-99 Reference model is named correctly?:**

☒ Level 1 – Supervisory Control

☒ Level 2 – Quality Control

☑ Level 3 – Manufacturing Operations

☒ Level 4 – Process



## Question 5

- **Which of the ISA 62443 standards focuses on patch management?:**

☐ ISA/IEC 62443-1-3

☐ ISA/IEC 62443-2-3

☐ ISA/IEC 62443-3-1

☐ ISA/IEC 62443-4-1




## Question 5

- **Which of the ISA 62443 standards focuses on patch management?:**

☒ ISA/IEC 62443-1-3

☑ ISA/IEC 62443-2-3

☒ ISA/IEC 62443-3-1

☒ ISA/IEC 62443-4-1

## Learning objectives

- Define the elements of a comprehensive IACS CSMS. ✓
- Explain the concept of maturity levels and how to assess and improve the cybersecurity maturity of an IACS organisation. ✓
- Understand the requirements for security programme ratings, patch management, and security programme requirements for service providers. ✓
- Gain insights into the guidance provided for IACS asset owners to help them implement and maintain a secure IACS environment. ✓
- Describe the security technologies and requirements for IACS systems, and the secure product development lifecycle for IACS components. ✓



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SETU Ollscoil Teicneolaíochta an Oirdheiscirt South East Technological University

# Thank you

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