CHARTING THE FUTURE

ClassNK

Guidelines for Cyber resilience of on-board systems and equipment (Edition 1.1)

[English]

Cyber Resilience of

SYSTEMS

EQUIPMENT

Revision History

No.	Date	Revised part	Revision details
1.0	2023.11.29	---	First issue
1.1	2025.8.29	All	Revised following items: - Audit flow - Application - Explanation of each requirement - Rules Issued - Others

Introduction

Traditional marine systems primarily relied on physical connections and controls without giving much consideration to threats such as unauthorized access or attacks from external sources. However, with rapid advancements in technology, marine systems have become digitally interconnected through computers and the Internet. As a result, such systems are now exposed to cyberspace and, thus, find themselves under the ever increasing the risks of cyber-attacks.

In April 2022, IACS (International Association of Classification Societies) issued two new URs (Unified Requirements) for cybersecurity (UR E26 and UR E27). These URs specify requirements related to the capability to reduce the occurrence and mitigate the effects of cyber incidents due to cyber-attacks (hereinafter referred to as "cyber resilience"). UR E26 covers ships and UR E27 covers on-board systems and equipment. The aim of the two URs is to ensure cyber security of ships by providing a minimum set of requirements for cyber resilience of ships, on-board systems, and equipment. Following the publication of UR E26 and UR E27, the Nippon Kaiji Kyokai (hereinafter referred to as "the Society") has decided to incorporate these requirements in Part X of the *Rules for the Survey and Construction of Steel Ships* (hereinafter referred to as "Part X").

In November 2023, we published the first edition of this Guidelines to help the relevant parties deepen their understanding of cyber security measures as a mandatory requirement for new shipbuilding for the first time. After the formal issuance of the regulations, the Guidelines was revised based on the findings obtained through the operation of the regulations. This time, the Guidelines is intended to provide more practical examples of how to respond to the regulations and to enhance explanations to give an image of how to respond.

This *Guidelines for cyber resilience of on-board systems and equipment* (hereinafter referred to as "Guidelines") is a commentary on Chapter 4, Part X (UR E27). Specifically, this Guidelines explains the following.

- Scope and approval process

This Guidelines describes procedures for approval by the Society including whether computer-based systems are applicable. It also explains in detail requirements related to document reviews and surveys.

- Cyber resilience requirements

This Guidelines explains requirements related to the cyber resilience of on-board systems and equipment. These requirements are based on and incorporate parts of the International Electrotechnical Commission standard IEC 62443. This guidelines provides details of these requirements and examples of how to deal with them as our interpretation.

Outline

Chapter 1 Application

This chapter describes the scope of application of Chapter 4, Part X (UR E27), and explains how to determine whether it applies to a particular computer-based system.

Chapter 2 Approval process

This chapter provides an overview of the two types of approval processes (individual product approval and type approval) specified for computer-based system in Chapter 4, Part X (UR E27). This chapter is intended to get an overview of the approval process.

Chapter 3 Explanation of Documentation

This chapter explains requirements related to the documentation to be submitted to the Society's Machinery Department for review and approval. This chapter is intended to understand the details of documentation.

Chapter 4 Explanation of Surveys

This chapter explains the requirements related to the surveys carried out by Society branch offices (In this Guidelines, surveys conducted in the presence of Surveyor of the Association are simply referred to as "surveys".) after documentation review. This chapter is intended to understand the details of surveys.

Chapter 5 Explanation of System requirements

This chapter explains "system requirements", which consist of security requirements for computer-based system related to security features that should be provided. This chapter is intended to understand the details of "System requirements".

Chapter 6 Explanation of Secure Development Lifecycle requirements

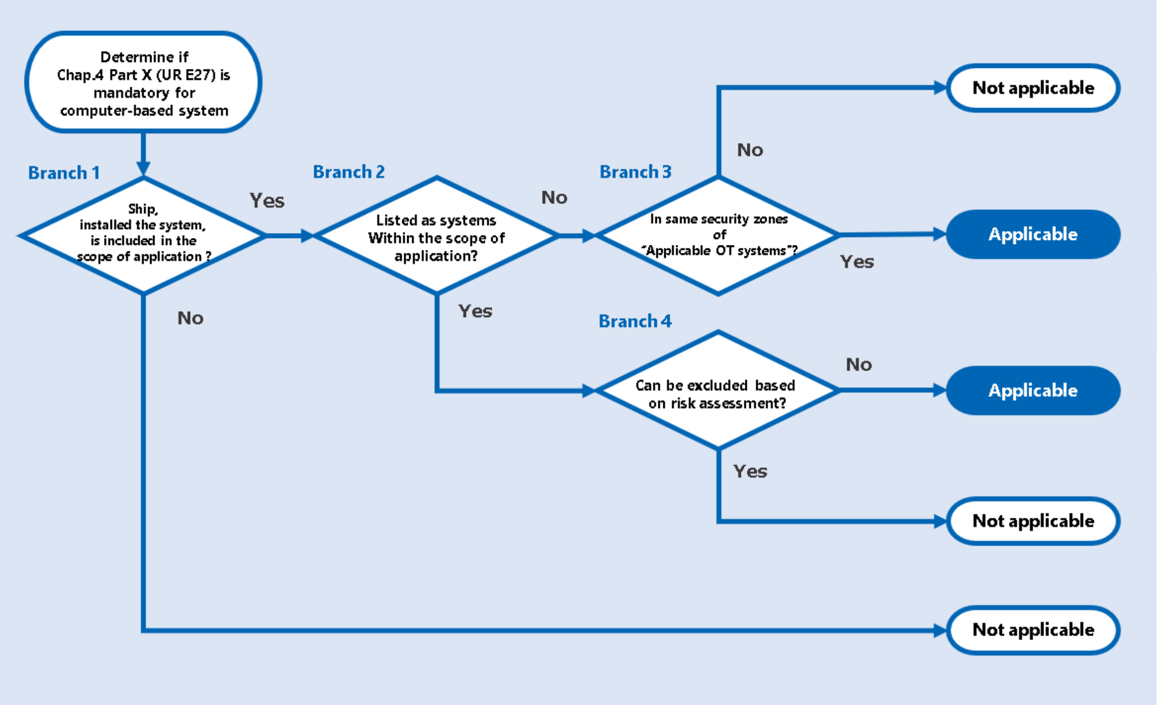
This chapter explains "secure development lifecycle requirements", which consist of security requirements for computer-based system related to lifecycle support for installation and maintenance. This chapter is intended to understand the details of "Secure Development Lifecycle requirements".

Contents

Note: This guideline is subject to change. The latest information will be posted on our website as needed. We would appreciate your understanding on this matter.

Chapter 1　Application

This chapter describes those computer-based systems to which Chapter 4, Part X (UR E27) is applicable, and the following flowchart (Figure 1) can be used to help determine this applicability.



Determine if Chap.4 Part X (UR E27) is mandatory for computer-based system
Branch 1
Ship, installed the system, is included in the scope of application ?
Yes
No
Branch 2
Listed as systems Within the scope of application?
No
Yes
Branch 3
In same security zones of "Applicable OT systems"?
No
Yes
Not applicable
Applicable
Branch 4
Can be excluded based on risk assessment?
No
Yes
Applicable
Not applicable
Not applicable

Figure 1 Flowchart of possibility of Application

Branch 1 Vessels within the scope of Chapter 4, Part X (UR E27)

Chapter 4, Part X (UR E27) applies to computer-based systems installed on board the following vessels registered with ClassNK, whose contracts for construction are made on or after 1 July 2024..

- Passenger ships (including passenger high-speed craft) engaged in international voyages
- Cargo ships of 500 GT and upwards engaged in international voyages
- High speed craft of 500 GT and upwards engaged in international voyages
- Mobile offshore drilling units of 500 GT and upwards
- Self-propelled offshore structures engaged in construction (i.e., wind turbine installation maintenance and repair, crane units, drilling tenders, accommodation, etc.)

Computer-based system installed on vessels other than those listed above are not applicable and do not require approval. Type approval, however, may still be obtained even if the computer-based system is not intended to be installed on a vessel. Please refer to "Type approval process" for more details.

Type approval process　P. 13

Branch 2 Computer-based system within the scope of Chapter 4, Part X (UR E27)

A computer-based system is a programmable electronic device or interoperable set of programmable electronic devices that are organised to achieve one or more specified purposes such as the collection, processing, maintenance, use, sharing, dissemination, or disposition of information. A programmable electronic device is a physical component in which software is installed and includes a programmable logic controller (PLC).

Those systems subject to Chapter 4, Part X (UR E27) are ones that can potentially lead to dangerous situations for human safety and safety of the ship and/or threat to the environment.

The following are examples of computer-based systems that may be considered to fall within the scope of application of Chapter 4, Part X (UR E27). Please note that these are only examples, and systems may otherwise be deemed applicable or non-applicable regardless of the table below.

Propulsion

Engine control systems	Engine remote control systems
Main boiler control systems	CPP control systems
Electric propulsion control systems	FGSS control systems
Machinery alarm and monitoring systems (including data loggers)	Waterjet propulsion systems
Engine telegraph	

Steering

Steering system control systems	Azimuth thruster control systems

Anchoring and mooring

Windlass control systems	Mooring winch control systems

Electrical power generation and distribution

Generator engine control systems (including power management systems)	Electric power converters (for electric propulsion ship)
Battery management systems (consisting of lithium-ion batteries with total	

capacities of 20 kWh or more, and associated equipment)

Fire detection and **extinguishing systems**

- Fire detection and alarm systems
- Fixed CO_2 fire extinguishing systems
- Fixed local application fire-fighting systems
- Dry chemical fire-extinguishing equipment
- Fixed foam fire extinguishing systems
- Fixed deck foam systems
- Water-spraying systems

Bilge and **ballast system**, **loading computer**

- Ballast transfer valve remote control systems
- Loading computers

Watertight integrity and **flooding detection**

- Watertight door power opening/closing devices
- Water level detection and alarm systems

Lighting (e.g. emergency lighting, low locations, navigation lights, etc.)

- Emergency lighting
- Navigation lighting control systems
- Low location lighting

Any required **safety system** whose disruption or functional impairing may pose risks to ship operations (e.g. emergency shutdown system, cargo safety system, pressure vessel safety system, gas detection system, etc.)

- Inert gas systems
- Liquefied gas emergency shutdown systems
- Reliquefication plants
- GCU control systems
- Cargo monitoring control systems
- Flammable gas detection systems
- Auxiliary boiler control systems
- Gas fuel tank monitoring and control systems

Navigational systems required by statutory regulations

- Radar
- Electronic plotting aids (EPA)
- Automatic tracking aids (ATA)
- Automatic radar plotting aids (ARPA)
- Echo sounding devices
- Global navigation satellite systems (GPS)
- Transmitting heading devices (THD)
- Automatic identification systems (AIS)
- Voyage date recorders (VDR)
- Heading control systems (HCS)
- Track control systems (TCS)
- Long range identification and tracking systems

	(LRIT)
Sound reception systems	Bridge navigational watch alarm systems (BNWAS)
Speed and distance measuring devices	Electronic chart display and information systems (ECDIS)
Electronic Inclinometer	Rate-of-turn indicator

Internal and external communication systems required by class rules and statutory regulations

General emergency alarm	Public addressor
NAVTEX receiver	VHF DSC device
EGC receiver	DSC device
VHF DSC continuous watch device	DSC continuous watch device
GMDSS radio installation	

Others

Dynamic positioning systems (DPS)

If the system is nautical equipment or radio communication equipment, products that comply with IEC61162-460 or equivalent standards may be exempted from some or all the system requirements (See Chapter 5), subject to verification, provided that they meet the requirements of Chapter 5, Part X (UR E26).

Branch 3 Devices in the same security zone as the applicable computer-based system

Figure 2 shows an example of the network configuration diagram covered according to Chapter 4 or 5, Part X (UR E26 or 27). As shown in Figure 2, this rule has the concept of a "security zone" formed by the applicable computer-based system described in Branch 2. A security zone is a group of onboard networks, consisting of one or more network segments that satisfying the same security policy. Zone boundary devices must be placed between different security zones.

In this case, zone boundary device and network devices such as LAN switches shown in orange as in Figure 2, located on computer-based system side of those devices, and other systems shown in green as "Applicable systems other than the applicable computer-based system" that communicate directly with the applicable computer-based system without zone boundary device in between, and which are not designated as Branch 2 "computer systems included in the scope of application", are also applicable.

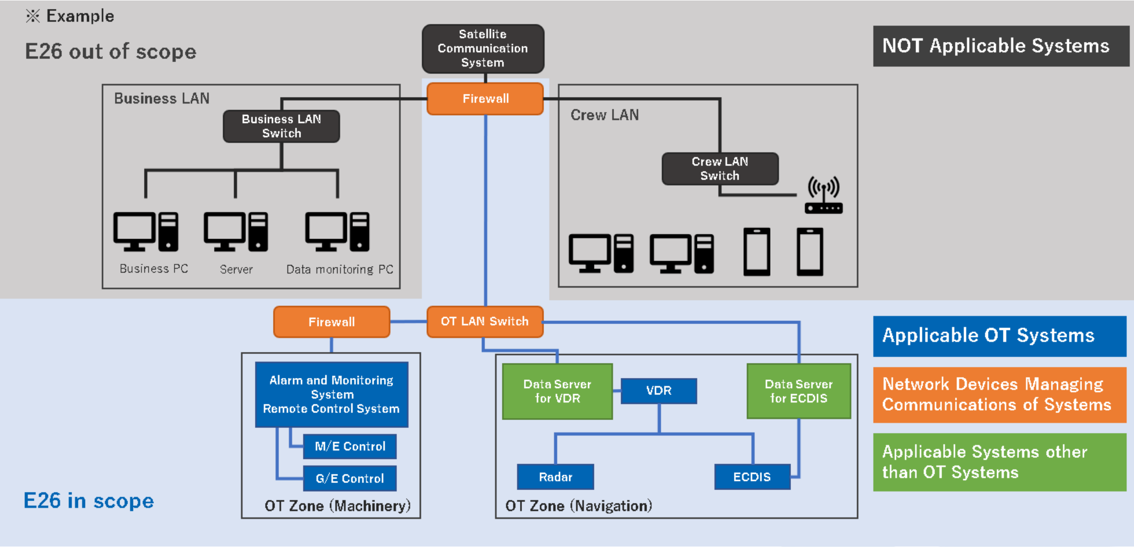


Figure 2 Applicable devices depending on the security zone

Branch 4 Exclusion based on Risk assessment

For computer-based systems described in Branch 2, if they are subject to the risk assessments required by Chapter 5, Part X (UR E26) and approved by the Society are excluded from Chapter 4, Part X (UR E27). Regarding the details of the risk assessment, please refer to the "Guidelines of Cyber Resilience of Ships" issued by the Society.

Computer-based system subject to Chapter 4, Part X (UR E27)

Since computer-based system subject to Chapter 4, Part X (UR E27) must meet the requirements set forth in that chapter, document reviews and surveys should be conducted prior to shipment. Please refer to "Individual product approval process" for more details.

Individual product approval process P. 6

Chapter 2　Approval process

This chapter describes the computer-based system approval process as defined in Chapter 4, Part X (UR E27) and *GUIDANCE FOR THE APPROVAL AND TYPE APPROVAL OF MATERIALS AND EQUIPMENT FOR MARINE USE* Part 7 Chapter 10. The purpose of this chapter is to provide an overview of our approval process in Chapter 4 Part X (UR E27).

Overview of Approval process

The first step is to determine whether the product is subject to Chapter 4, Part X (UR E27). This is explained in more detail in "Chapter 1 Application".

Chapter 1　Application　P. 1

For computer-based system to which this chapter applies, there are two types of approval: individual product approval and type approval. A summary of each type of approval is as follows.

Approval type	Description
Individual product approval	This refers to product approval. Chapter 4, Part X (UR E27) applies to computer systems installed on applicable ships, and approval is required for each product.
Type approval	This refers to type approval. Part of the process required for individual product approval is eliminated by conducting the examinations and inspections of representative types specified in Chapter 4, Part X (UR E27) before it is prepared to be installed on board a ship.

Individual product approval process

The process for approving an individual product is divided into several processes depending on whether the system has type approval and on the approval records for sister vessels. The overview of processes is as follows:

Individual product approval process	Description
System is not type approved	In principle, all documentation and surveys are required.
System is type approved	Some documentation may be omitted. In addition, surveys may also be omitted in lieu of the submission of "test reports".
Previously approved system installed on sister vessel	After comparing and examining any differences with the previously approved system, some or all documentation may be

	reused. The surveys are required.

Figure 3 shows a flowchart for individual product approval.

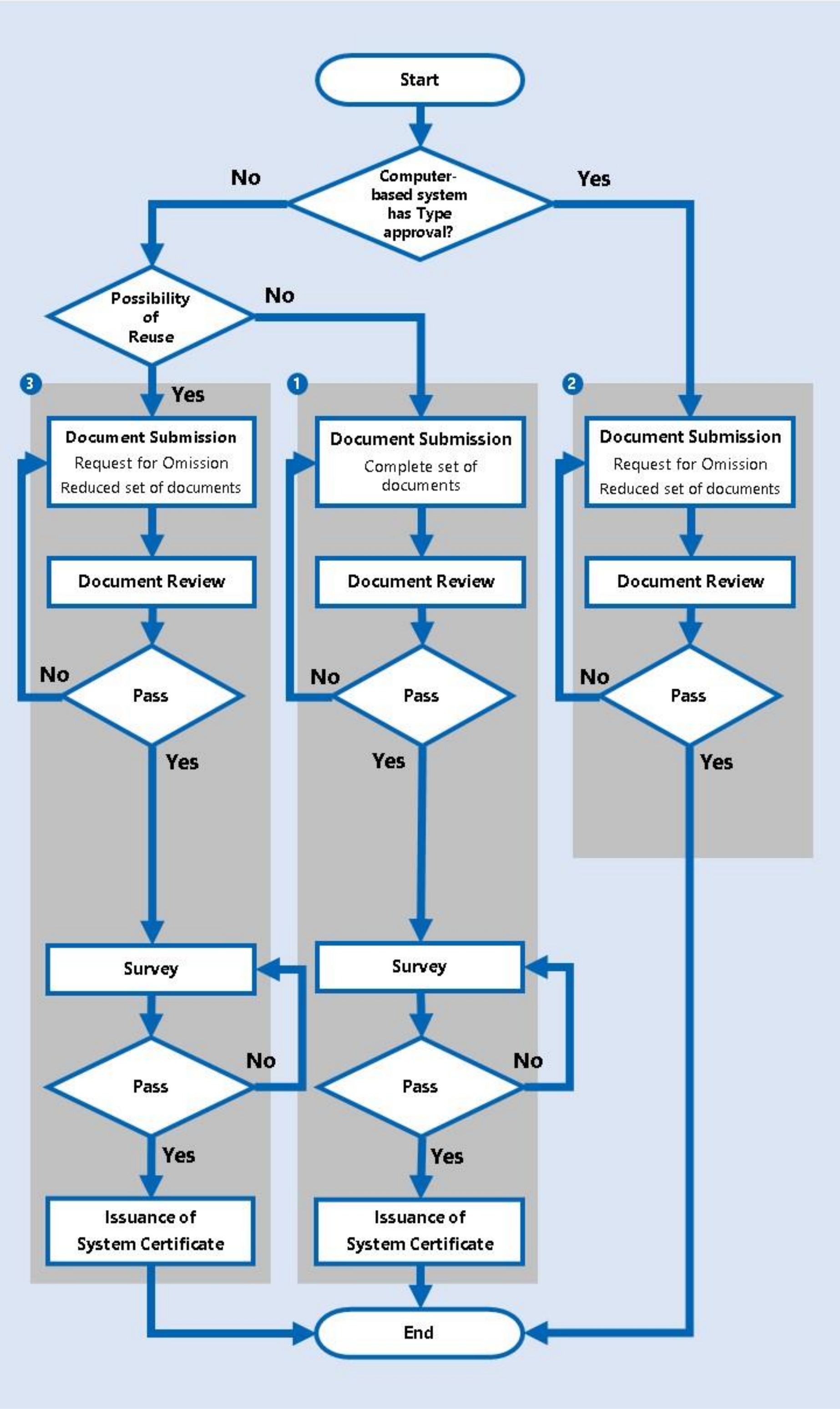


Figure 3 Flowchart of Individual product approval

❶ System is not type approved

Figure 4 shows a flowchart for systems that are not type approved.

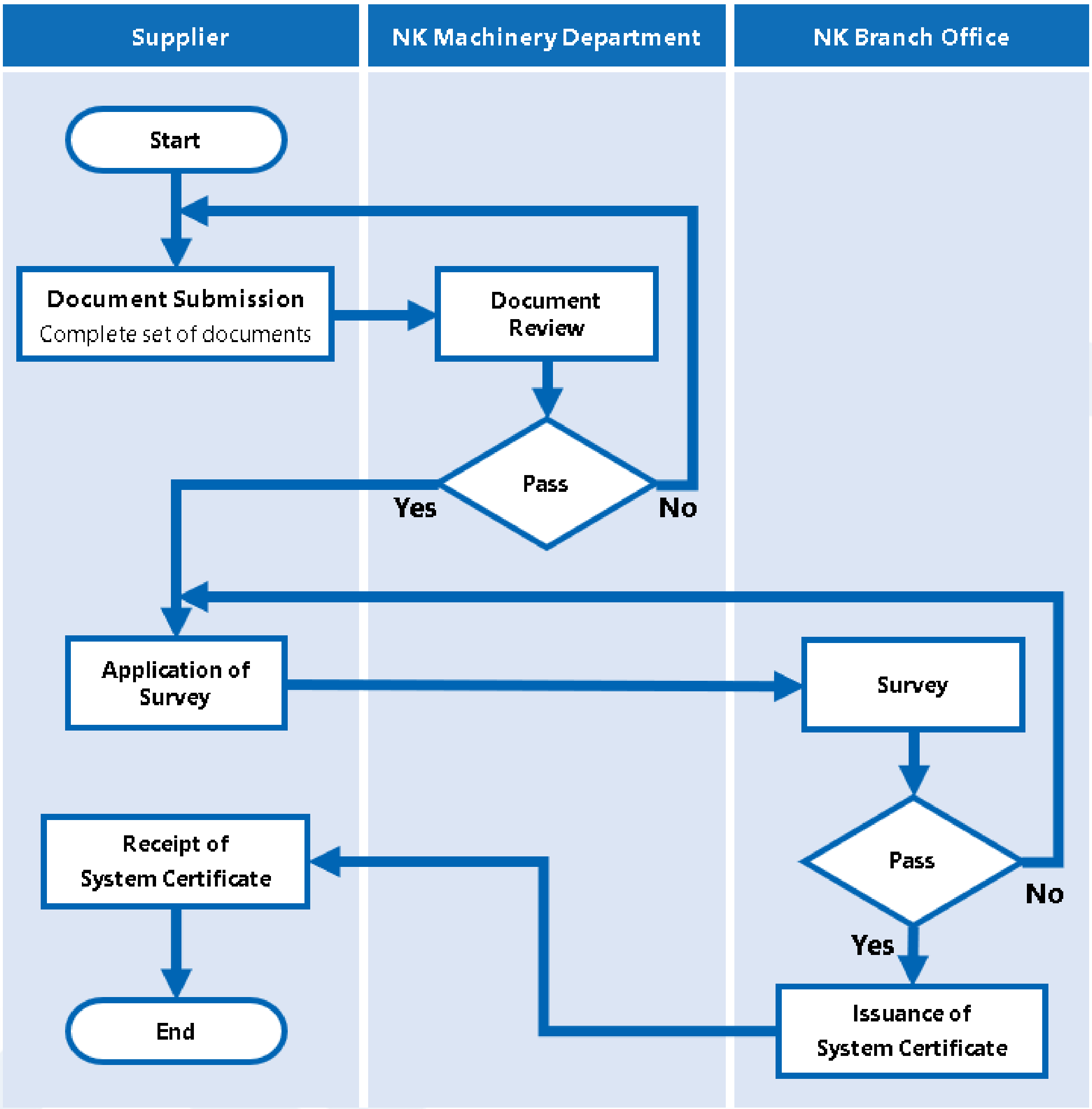


Figure 4 Flowchart for systems that are not type approved

■ Document submission and review

In principle, all documentation must be submitted on a ship-by-ship basis for systems that are not approved for use. Please use NK-PASS to submit relevant documentation. Please refer to the following URL for more information on NK-PASS.

URL: https://www.classnk.com/hp/en/activities/portal/nk-pass.html

The following documentation is to be submitted.

	Documentation
□	Computer-based system asset inventory
□	Topology diagrams
□	Description of Security capabilities
□	Test procedure of security capabilities
□	Security configuration guidelines
□	Secure development lifecycle documents
□	Plans for maintenance and verification of the computer-based system
□	Information supporting the owner's incident response and recovery plan
□	Management of change plan

Please refer to "Chapter 3 Document submission and review" in "Chapter 3 Documentation" for more information on the documentation required.

Chapter 3 Explanation of Documentation P. 18

The Machinery Department reviews submitted documents upon receipt, and contacts applicants when it has any comments, requires any modifications or requires the submission of additional documents. Submitted documents which have been approved are returned to applicants stamped with the Society's official stamp.

Surveys

Surveys are required after the document review process is completed. Please apply to the branch office nearest to your location for such surveys. Please refer to the following URL for a current list of NK branch offices.

URL: https://www.classnk.com/hp/en/directory/dir_top.aspx

The following are some of documents required for surveys.

	Documentation required for surveys
□	Computer-based system asset inventory
□	Topology diagrams
□	Test procedure of security capabilities
□	Security configuration guidelines
□	Secure development lifecycle documents

Please ensure that the document review is completed and that any comments related to non-survey matters are resolved before applying for surveys. Once confirmed, please submit an application form and all required documents to the branch office in charge of the survey.

In principle, the following survey items are required for systems that are not type approved.

	Survey items
□	General survey items
□	Test of security capabilities
□	Correct configuration of security capabilities
□	Secure development lifecycle

Please refer to “Chapter 4 Explanation of Surveys” for more information on surveys.

Chapter 4 Explanation of Surveys P. 40

The branch office in charge of the survey will issue a system certificate when the survey is completed, and the Society’s approval process is considered to be completed upon receipt of the system certificate by the applicant.

❷ System is type approved

Figure 5 shows a flowchart for systems that are type approved.

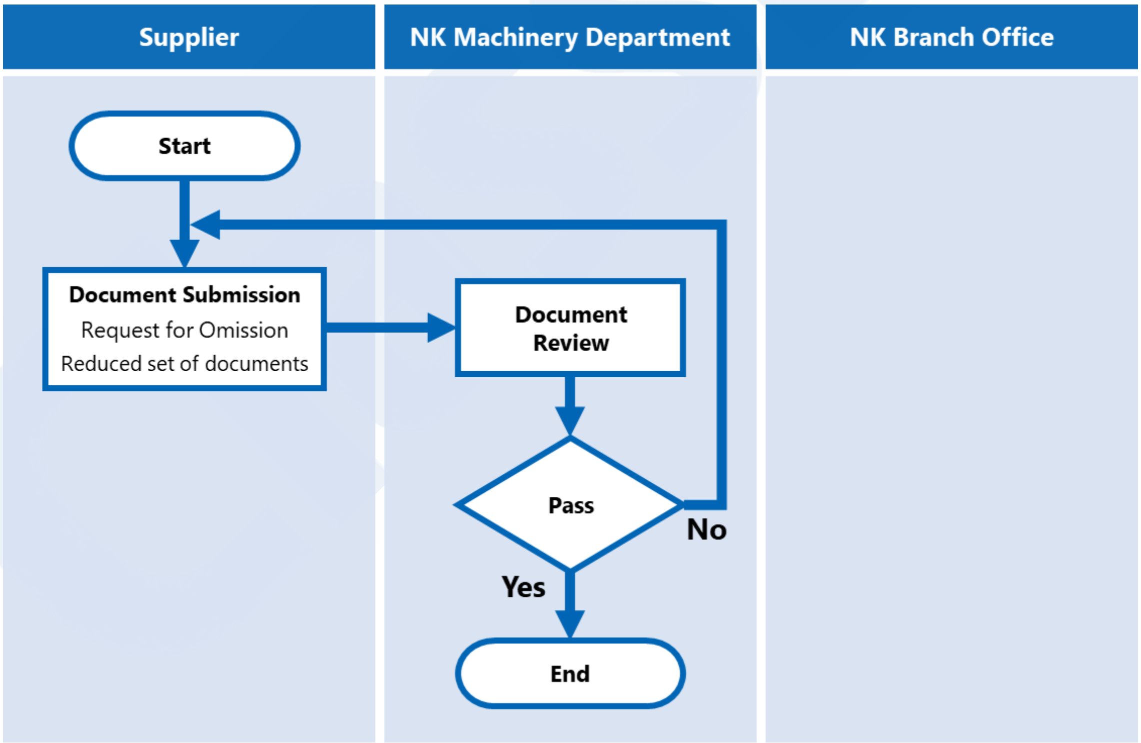


Figure 5 Flowchart for systems that are type approved

Document submission and review

The submission of some of the required documents may be exempted for systems that are type approved. Applications for exemptions from submission of documents are to include the following information.

	Applications for exemption from submission of documents based on type approval
□	Submission of documentation described in Chapter 4.6, Part X and request for omission of surveys.
□	Copy of the type approval certificate

Please use NK-PASS to submit relevant documentation. Please refer to the following URL for more information on NK-PASS.

URL: https://www.classnk.com/hp/en/activities/portal/nk-pass.html

The following documentation is required for exemptions.

	Documentation
□	Computer-based system asset inventory
□	Topology diagrams
□	Test reports by the suppliers
□	Application for exemption from submission of documents based on the type approval

Please refer to “Chapter 3 Explanation of Documentation” for more information of the documentation required.

Chapter 3 Explanation of Documentation P. 18

The Machinery Department reviews submitted documents upon receipt and contacts applicants when it has any comments, requires any modifications or requires the submission of additional documents. Submitted documents that have been approved are returned to applicants stamped with the Society’s official stamp.

Since surveys are optional for systems that are type approved, and the Society’s approval process is considered to be completed upon receipt of the approved documents by the applicant.

❸ Previously approved system installed on sister vessel

Figure 6 shows a flowchart for previously approved systems that are subsequently installed on sister vessels.

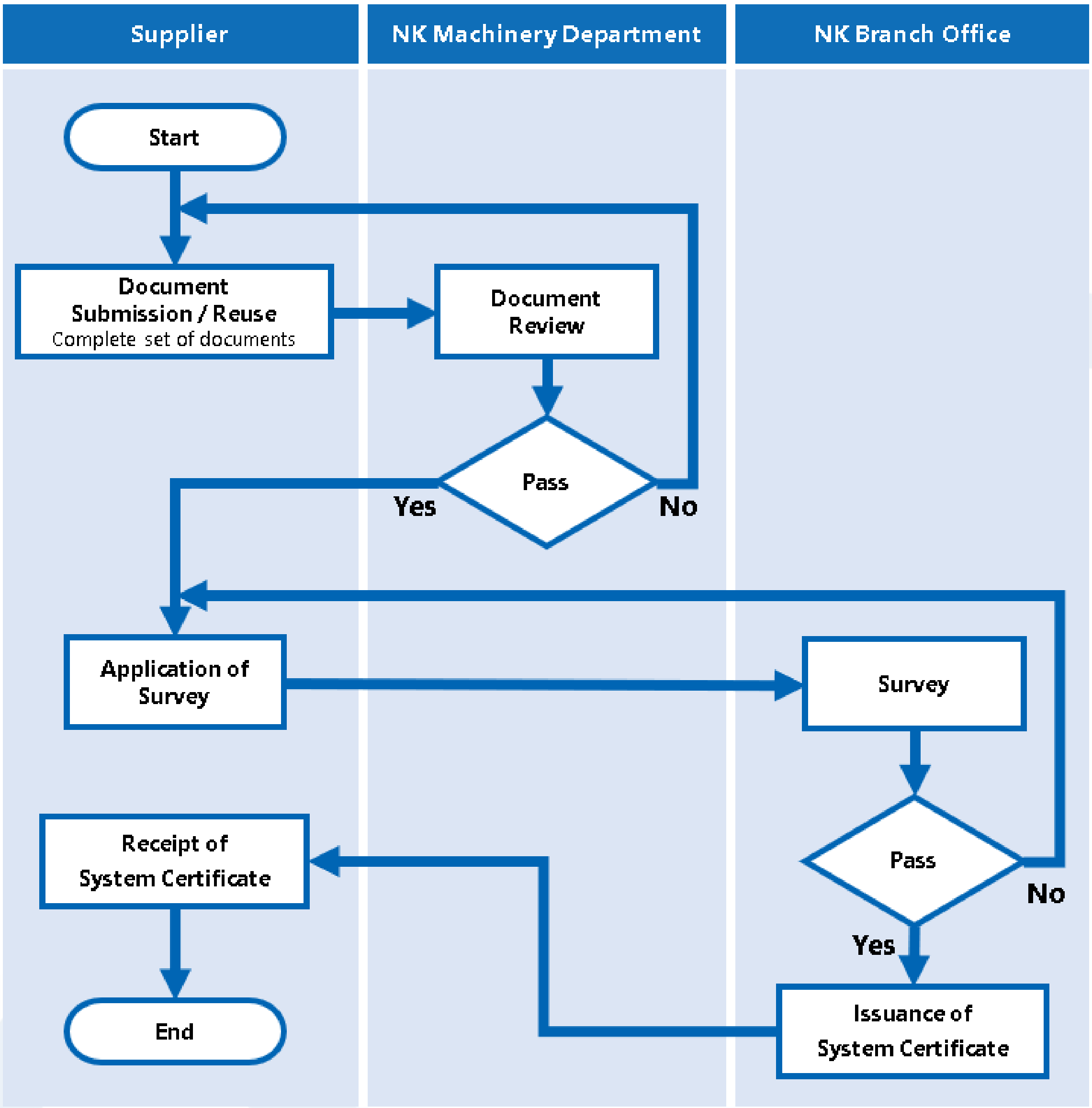


Figure 6 Flowchart for previously approved system installed on sister vessel

■ Document submission and review

The reuse of previously approved documents for second and subsequent ships for previously approved systems installed on sister vessels is possible when there are no modifications made to such systems and there are no changes in the previously approved documents. If you wish to reuse the documents, please apply through NK-PASS, our drawing submission system.

■ Surveys

Surveys may still be requested where desired by contacting the nearest branch office as described in "❶ System is not type approved". Please refer to following URL for a current list of NK branch offices.

URL: https://www.classnk.com/hp/en/directory/dir_top.aspx

The following documents are required for surveys.

	Documents required for survey
□	Computer-based system asset inventory
□	Topology diagrams
□	Test procedure of security capabilities
□	Security configuration guidelines
□	Secure development lifecycle documents

In principle, the following survey items are required for systems that are not type approved. The following survey items should be conducted in the presence of a Society surveyor.

	Survey items
□	General survey items
□	Test of security capabilities
□	Correct configuration of security capabilities
□	Secure development lifecycle

Please refer to "Chapter 4 Explanation of Surveys" for more information on surveys.

Chapter 4 Explanation of Surveys P. 40

Upon completion of surveys, certificates are issued by the branch offices respectively in charge of the surveys. The individual product approval process for previously approved systems installed on sister vessels is considered to be completed upon receipt of the certificate by the applicant.

Type approval process

This section provides an overview of the type approval process. Figure 7 shows a flowchart for this process.

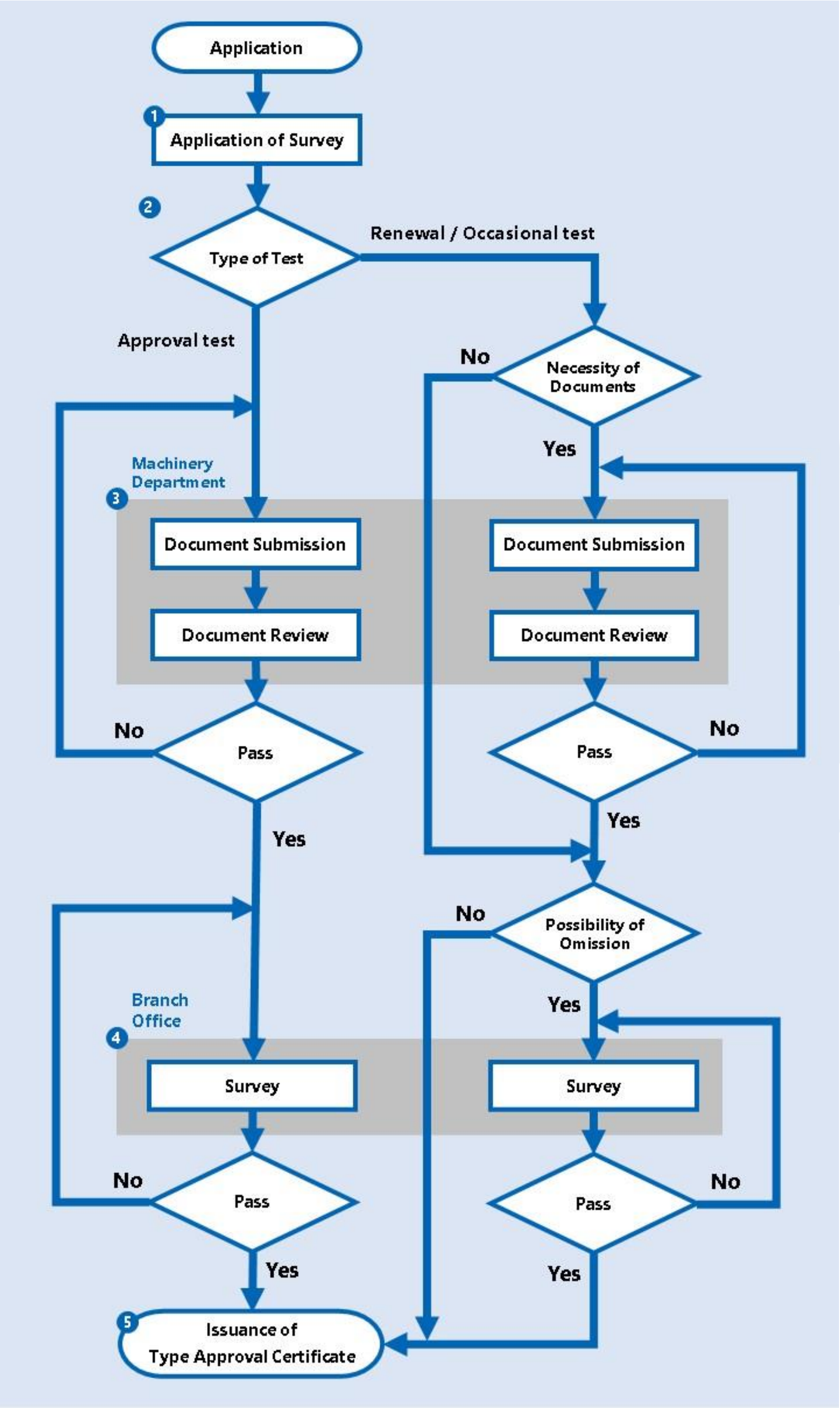


Figure 7 Flowchart for the type approval process

❶ Application

Applicants for type approval should submit application form "Form 7-10(E)" to the Machinery Department (email: mcd@classnk.or.jp) by NK-PASS or email after filling in the required items. The application form can be downloaded from the "Class Survey (Manufacturers)" section of the Society's official website. Please use the following URL to download the form.

URL: https://www.classnk.com/hp/en/download/dl_appli.aspx

❷ Type of test

The following three types of tests are available for type approval.

Survey	Description
Approval Test	Conducted when type approval is to be newly obtained for the computer-based system.
Renewal Test	Conducted when renewing the expiration date of a computer-based system which is type approved. The validity period of the type approval is five years, and this test is to be conducted when renewal of the validity period is desired.
Occasional Test	Conducted when a computer-based system which is type approved is changed or modified in some way.

❸ Document Submission, Document Review

The documents required for type approval are to be submitted in one of the following ways.

a) NK-PASS
b) Email (mcd@classnk.or.jp)
c) Regular mail (three copies of each document are to be submitted.)

It is acceptable to submit the documents at the time of application, and the following documents are to be submitted.

	Documentation required for type approval
□	Computer-based system asset inventory
□	Topology diagrams
□	Description of Security capabilities
□	Test procedure of security capabilities
□	Security configuration guidelines
□	Secure development lifecycle documents
□	Plans for maintenance and verification of the computer-based system
□	Information supporting the owner’s incident response and recovery plan
□	Management of change plan

Please refer to “Chapter 3 Explanation of Documentation” for more information on the documents to be submitted.

Chapter 3 Explanation of Documentation P. 18

The Machinery Department reviews submitted documents upon receipt, and contacts applicants when it has any comments, requires any modification or requires the submission of additional documents.

All documents are to be submitted for approval tests, but a document review will be conducted as necessary for renewal tests and some documents may not need to be submitted. Cases that require document review include those in which changes are made to the specifications of the type approved product since the date of approval (renewal date), or changes or additions needing to be made to previously submitted documents due to revisions of the Society’s rules.

Only those documents that have been changed need be submitted for occasional tests. In such cases, a “history of changes” or another suitable document that clearly identifies the changes made should be sent to the Machinery Department along with the application for occasional test and documents required to be submitted.

④ Surveys

Surveys in the presence of a Society surveyor are required after the document review process is completed. Please apply to the branch office nearest to your location for such surveys. Please refer to the following URL for a current list of NK branch offices.

URL: https://www.classnk.com/hp/en/directory/dir_top.aspx

The following are some of the documents required for surveys.

	Documents required for surveys
□	Computer-based system asset inventory
□	Topology diagrams
□	Test procedure of security capabilities
□	Security configuration guidelines
□	Secure development lifecycle documents

Please ensure that the document review process is completed before applying for surveys. Once confirmed this, please apply form and all the required documents to the branch office in charge of the survey.

Surveys may differ for approval tests, renewal tests, and occasional tests. In principle all survey items are required for approval tests, and all surveys must be conducted in the presence of a Society survey. Please consult with the branch office in charge of the survey regarding the survey schedule and details.

Only necessary survey items are required for renewal surveys; for example, surveys are required for changes in system specifications, or changes or additions to survey requirements due to revisions of the Society's rules.

Only those survey items related to system changes requiring the presence of a Society surveyor are required for occasional tests.

Please refer to "Chapter 4 Explanation of Survey" for more information on surveys.

Chapter 4 Explanation of Surveys P. 40

❺ Issuance of Type Approval Certificate

The branch office in charge of the survey will inform the Machinery Department of the survey results, and a type approval certificate will be issued by the Machinery Department when such results are satisfactory.

In principle, the period of validity for type approval certificates is as follows: five years from the date of issue for those issued for approval tests, five years from the day after the expiration date of the previous certificate for those issued for renewal tests, and the period of validity of the previous certificate for those issued for occasional tests.

The type approval process is considered to be completed upon receipt of a new type approval certificate by the applicant.

Chapter 3 Explanation of Documentation

This chapter provides detailed information about the documentation described in Part X, Chapter 4 (UR E27).

Overview of Documentation

Documentation Requirements

Part X, Chapter 4 (UR E27), specifies the requirements for a total of 10 documentation related to computer system cybers resilience. Each documentation is as follows.

Documentation Requirements

Required documentation varies in approval process

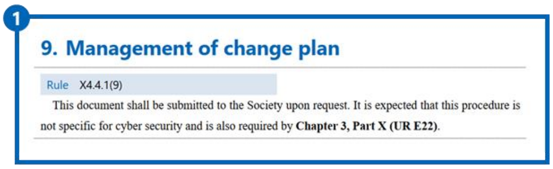
In the case of individual product approval, required documentation varies depending on whether approval for use has been granted or not, and the approval performance of the same type of ship. The required documentation for each approval process is described in detail in Chapter 2: Approval

Process.

Chapter 2　Approval process　P. 6

Detail of Documentation

How to view the following pages

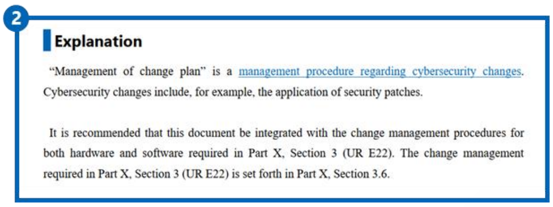


1

9. Management of change plan

Rule　X4.4.1(9)

This document shall be submitted to the Society upon request. It is expected that this procedure is not specific for cyber security and is also required by **Chapter 3, Part X (UR E22)**.

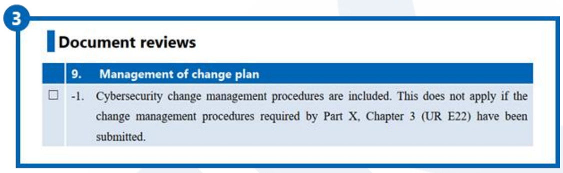


2

Explanation

"Management of change plan" is a management procedure regarding cybersecurity changes. Cybersecurity changes include, for example, the application of security patches.

It is recommended that this document be integrated with the change management procedures for both hardware and software required in Part X, Section 3 (UR E22). The change management required in Part X, Section 3 (UR E22) is set forth in Part X, Section 3.6.



3

Document reviews

	9.	Management of change plan
□	-1.	Cybersecurity change management procedures are included. This does not apply if the change management procedures required by Part X, Chapter 3 (UR E22) have been submitted.

1 Requirement

The names and the details of the documentation requirements described in Part X.

2 Explanation

An explanation of documentation. This section describes the purpose of each document, points to be included, and supplementary information.

3 Document reviews

Document review checklist for the requirements. Suppliers can use this information to self-check when preparing documentation.

1. Computer-based system asset inventory

Reg. 4.4.1(1), Part X of the Rules

The following documents are to be submitted to the Society for review and approval in accordance with the requirements in this Chapter (see also 4.6.2).

(a) List of hardware components (e.g., host devices, embedded devices, network devices)

i) Name

ii) Brand/manufacturer

iii) Model/type

iv) Short description of functionality/purpose

v) Physical interfaces (e.g., network, serial)

vi) Name/type of system software (e.g., operating system and firmware)

vii) Version and patch level of system software

viii) Supported communication protocols

(b) List of software components (e.g., application software and utility software)

i) The hardware component where it is installed

ii) Brand/manufacturer

iii) Model/type

iv) Short description of functionality/purpose

v) Version of software

Explanation

"Computer-based system asset inventory" provides a detailed list of assets owned by the computer-based system. Here, assets refer to the components that make up the computer system. There are two types of components: hardware and software.

The details are as follows:

- **Hardware Components**

These are the physical components of a system, such as host devices, embedded devices, and network devices (switches, routers, etc.).

- **Software Components**

These are the logical components of a system and refer to application software. Unlike hardware components, software components are internal system programs and cannot be physically contacted. In addition, operating systems are organized into hardware components by convention, but they are to be described in software components because they are tied to the operation of hardware components

The purpose is to identify the hardware and software components of the system and identify their versions, patches.

All components that use the computer need to be described exhaustively.

Note: Confirm that your computer system is properly configured according to the computer system asset inventory by on-site inspection. Details are explained in detail in “General survey items”.

General survey items P. 42

Document reviews

	1. Computer-based system asset inventory
□	-1. The following items are to be included.
□	(1) List of hardware components
□	(a) Name
□	(b) Brand/manufacturer
□	(c) Model/type
□	(d) Short description of functionality/purpose
□	(e) Physical interfaces (e.g., network, serial)
□	(f) Name/type of system software (e.g., operating system and firmware)
□	(g) Version and patch level of system software
□	(h) Supported communication protocols
□	(2) List of software components
□	(a) The hardware component where it is installed
□	(b) Brand/manufacturer
□	(c) Model/type
□	(d) Short description of functionality/purpose
□	(e) Version of software

2. Topology diagrams

Reg. 4.4.1(2), Part X of the Rules

(a) The physical topology diagram is to illustrate the physical architecture of the system. It is to be possible to identify the hardware components in the computer-based system asset inventory. The diagram is to illustrate the following:

i) All endpoints and network devices, including identification of redundant units

ii) Communication cables (networks, serial links), including communication with I/O units

iii) Communication cables to other networks or systems

(b) The logical topology diagram is to illustrate the data flow between components in the system. The diagram is to illustrate the following:

i) Communication endpoints (e.g., workstations, controllers and servers)

ii) Network devices (switches, routers, firewalls)

iii) Physical and virtual computers

iv) Physical and virtual communication paths

v) Communication protocols

(c) One combined topology diagram may be acceptable if all requested information can be clearly illustrated.

Explanation

"Topology diagrams" is a diagram showing the physical and logical configuration of the network. There are two types of diagrams: physical and logical.

The details are as follows:

- **Physical topology diagram**

A physical network structure diagram. For example, information such as system configuration and connection cable route.

- **Logical topology diagram**

A logical network structure diagram. In addition to the flow of communication about physical components, this diagram also illustrates the flow in virtual spaces, such as virtual computers and virtual communication paths.

The purpose here is to grasp the physical and logical configuration of the system. This is important in determining and segmenting the security zones of the network during system integration.

Topology diagrams need to include data communications, such as IP and serial communications. These include communications used to exchange data and commands between computer-based system, such as TCP/IP-based communications, fieldbus communications, and serial communications (e.g., RS-232/422/485).

On the other hand, simple analog signals (e.g., 4-20 mA current loop) and digital signals (A simple ON/OFF signal that does not transmit information in terms of time) are not required to be included in the topology diagram. However, they are to be included if these signals are exchanged between untrusted networks. Also, please consider including them if they might affect system security.

Note: Confirm that the computer system is properly configured according to the topology diagram by on-site inspection. Details are explained in detail in “General survey items”.

General survey items P. 42

Document reviews

	2. Topology diagrams
□	-1. The following items are to be included.
□	(1) Physical topology diagram
□	(a) All endpoints and network devices, including identification of redundant units
□	(b) Communication cables (Networks, serial links, etc.), including communication with I/O units
□	(c) Communication cables to other networks or systems
□	(2) Logical topology diagram
□	(a) Communication endpoints (Workstations, controllers, servers, etc.)
□	(b) Network devices (Switches, routers, firewalls, etc.)
□	(c) Physical and virtual computers
□	(d) Physical and virtual communication paths
□	(e) Communication protocols

3. Description of Security capabilities

Reg. 4.4.1(3), Part X of the Rules

(a) This document is to describe how the computer-based system with its hardware and software components meets **the required security capabilities in 4.4.2**.

(b) Any network interfaces to other computer-based systems in the scope of applicability of **Chapter 4, Part X (UR E26)** is to be described. The description is to include destination computer-based systems, data flows, and communication protocols. If the System integrator has allocated the destination computer-based systems to another security zone, **components providing protection of the security zone boundary (see 5.4.3(2)(a))** are to be described in detail if delivered as part of the computer-based systems.

(c) Any network interfaces to other systems or networks outside the scope of applicability of UR E26 (untrusted networks) are to be described. The description is to specify compliance with the **additional security capabilities in 4.4.3**, and include relevant procedures or instructions for the crew. **Components providing protection of the security zone boundary (see 5.4.3(2)(a))** are to be described in detail if delivered as part of the computer-based systems.

(d) A separate chapter is to be designated for each requirement. All hardware and software components in the system are to be addressed in the description, as relevant.

(e) If any requirement is not fully met, this is to be specified in the description, and compensating countermeasures are to be proposed. The compensating countermeasures should the following:

i) protect against the same threats as the original requirement,

ii) provide an equal level of protection as the original requirement,

iii) not be a security control that is required by other requirements in this Chapter, and

iv) not introduce a higher security risk

(f) Any supporting documents (e.g. OEM[1] information) necessary to verify compliance with the requirements are to be referenced in the description and submitted.

Explanation

"Description of Security capabilities" explains how the 30+11 security requirements specified in Part X, 4.4.2 (Required Security Capabilities) and 4.4.3 (Additional Security Capabilities) are applied.

Specifically, the following should be described:

・**Security capabilities and compensating countermeasures**

This document should describe security capabilities to meet system requirements. System requirements are requirements for security capabilities required for computer systems as part of cybersecurity measures.

[1] **OEM**: Original Equipment Manufacturer. A company that manufactures products of other brands.

Compensating countermeasures are measures adopted in place of the original security capabilities. If the required security capabilities cannot be implemented in the system, compensating countermeasures are taken to replace those capabilities.

Depending on the specifications of the component, there may be requirements for security functions that are not applicable. If this is the case, a reason for "Not applicable" needs to be provided.

For details, see Chapter 5, “Explanation of System Requirements”.

Chapter 5 Explanation of System requirements P. 48

- **Network interface**

This refers to the point of contact (point of contact) for connecting to the network. For example, Ethernet NIC[1] and wireless LAN adapter are applicable. Network interfaces should be included in this document, along with information such as the computer system to which they communicate, data flows, and communication protocols. Network interfaces should be listed for each of the following networks:

- **Networks within the scope of Part X, Chapter 4 (UR E27)**

This refers to networks configured by systems approved according to Part X, Chapter 4 (UR E27).

- **Untrusted Networks**

This refers to networks outside the scope of Part X, Chapter 4 (UR E27). For example, the Internet, etc. In this case, details must be provided on whether the components responsible for protecting the security zone boundaries are delivered as part of the system.

- **Any supporting documents necessary to verify compliance with the requirements**

Document reviews

	3. Description of Security capabilities
□	-1. The following items are to be included.
□	(1) Security capabilities and compensating countermeasures
□	See “Chapter 5 Explanation of System requirements” for more information.
□	(2) Network interface
□	(a) Networks within the scope of Part X, Chapter 4 (UR E27)
□	(b) Untrusted Networks
□	For the components responsible for protecting security zone boundaries, the detail whether they are delivered as a part of system should be described.
□	(3) Any supporting documents necessary to verify compliance with the requirements

[1] **NIC**: Network Interface Card. For example, LAN port.

4. Test procedure of security capabilities

Reg. 4.4.1(4), Part X of the Rules

(a) This document is to describe how to demonstrate by testing that the system complies with the requirements in 4.4.2 and 4.4.3, including any compensating countermeasures. Demonstration of compliance by analytic evaluation may be specially considered. The procedure is to include a separate chapter for each applicable requirement and describe the following:

i) necessary test setup (i.e. to ensure the test can be repeated with the same expected result),

ii) test equipment,

iii) initial condition(s),

iv) test methodology, detailed test steps, and

v) expected results and acceptance criteria

(b) The procedure is to also include means to update test results and record findings during the testing.

Explanation

"Test procedure of security capabilities" is the test plan for the surveys of the security capability test as specified in Part X 2.2.3 (2). The survey demonstrates the required security capability in accordance with this document. Details of the required security features are described in detail in "Chapter 5 Explanation of system requirements".

Chapter 5 Explanation of System requirements P. 48

When you take compensating countermeasures in place of security capabilities, Confirm the compensating countermeasures. These confirmation methods should also be included in this document.

This document should also include the necessary test setup, test equipment, initial conditions, test methodology, and expected results for the demonstration test for each requirement. It should also include a space to record test results and findings during the testing.

The details of the survey are explained in detail in "2. Test of security capabilities".

Test of security capabilities P. 44

Document reviews

	4. Test procedure of security capabilities
□	-1. The following items are to be included.
□	(1) Demonstration tests of security capabilities and confirmation of compensating

	countermeasures
□	See “Chapter 5 Explanation of System requirements” for more information.
□	(a) Necessary test setup
□	(b) Test equipment
□	(c) Initial condition(s)
□	(d) Test methodology, detailed test steps
□	(e) Expected results and acceptance criteria
□	(f) Entry column to update test results and record findings during the testing

5. Security configuration guidelines

Reg. X4.4.1(5), Part X of the Rules

(a) This document is to describe recommended configuration settings of the security capabilities and specify default values. The objective is to ensure the security capabilities are implemented in accordance with **Chapter 5** and any specifications by the System integrator (e.g. user accounts, authorisation, password policies, safe state of machinery, firewall rules, etc.)

(b) The document is to serve as basis for verification of item no. 29 **"Network and security configuration settings"** in System Requirements.

Explanation

"Security configuration guidelines" is a document that explains recommended settings and default values for security capabilities provided to a computer system. The purpose of this document is to ensure that the integrator's customers can properly set up and utilize the security capabilities of their products and systems according to their own specifications.

For more information, see the following:

- **Description of the recommended configuration settings for security capabilities**

Security configuration guidelines provide detailed descriptions on how to set up and use security capabilities. This includes, for example, how to configure user authentication, selection and configuration of cryptographic options, and configuration of network filtering.

- **Specified default values**

The guidelines also specify default values for each security setting. Default values typically indicate settings immediately after the system installation. However, because there are some cases that the default settings are not the most secure settings, the integrator should review these settings and adjust them to meet the needs and policies of the owner.

In addition, the security configuration settings must be implemented in the system as a security feature, according to one of the system requirements, "29 Network and security configuration settings". For details, see "29 Network and security configuration settings".

Network and security configuration settings P. 131

Document reviews

	5. Security configuration guidelines
□	-1. The following items are to be included.

□	(1) Description of the recommended configuration settings for security capabilities
□	(2) Specified default values

6. Secure development lifecycle documents

Reg. 4.4.1(6), Part X of the Rules

This documentation is to be submitted to the Society upon request and is to be described the supplier's processes and controls in accordance with requirements for **Secure development lifecycle in 4.5**. Software updates and patching are to be described. The document is to prepare **the Society for survey** for survey as per 2.2.2-5.

Explanation

This document outlines the processes and management systems that suppliers implement to ensure security throughout the lifecycle of computer-based system development and maintenance. Secure development lifecycle is a comprehensive approach that incorporates security considerations at every stage of a product's development. This process spans planning, design, development, testing, release, operation, maintenance, and ultimately disposal. The goal is to minimize the creation of vulnerabilities and to ensure an effective response when vulnerabilities are discovered.

For more information, see the following:

- **Records how the security aspects have been addressed**

According to Part X 4.5.1, system development is required to provide writing a record of how security aspects were handled at the following stages:

(1) Requirement analysis phase

(2) Design phase

(3) Implementation phase

(4) Verification phase

(5) Release phase

(6) Maintenance phase

(7) End of life phase (Including security considerations for the product's end-of-life and retirement.)

- **Processes and Controls for Secure development lifecycle**

Secure development lifecycle documents provide for the integration of the processes specified in Part X 4.5.2 through 4.5.8. Therefore, these processes need to be included in this document. Also, it needs to demonstrate that the system has been designed and manufactured according to these processes. Therefore, it also needs to be mentioned that documentation, such as records, will be prepared. Details of the requirements related to the secure development lifecycle are described in "Chapter 6 Explanation of Requirements for Secure Development Lifecycle".

Chapter 6 Explanation of Secure Development Lifecycle requirements P. 164

- **Software updates and patching**

It is necessary to clarify whether software updates and adapting patches are supported. For adapting patches, it is necessary to clarify the risks of not patching. Software updates are described in detail in “3. Dependent component or Operating system security update documentation”. Adapting patches is described in detail in “2. Security update documentation”.

Dependent component or Operating system security update documentation P. 171

Security update documentation P. 169

Document reviews

	6. Secure development lifecycle documents
□	-1. The following items are to be included.
□	(1) Records how the security aspects have been addressed
□	Recorded Documents should be prepared at the following stages:
□	(a) Requirement analysis phase
□	(b) Design phase
□	(c) Implementation phase
□	(d) Verification phase
□	(e) Release phase
□	(f) Maintenance phase
□	(g) End of life phase
□	(2) Processes and Controls for Secure development lifecycle
□	See “Chapter 6 Explanation of requirements for Secure development lifecycle” for more information.
□	(3) Software updates and patching

7. Plans for maintenance and verification of the computer-based system

Reg. 4.4.1(7), Part X of the Rules

This document is to be submitted to the Society upon request and is to include procedures for security-related maintenance and testing of the system. The document is to include instructions for how the user can verify correct operation of the system's security functions as required by **item No.19 “Security functionality verification” in System requirements**.

Explanation

“Plans for maintenance and verification of the computer-based system” is a document that describes the maintenance and testing procedures for periodic verification (verification testing) of security features implemented in computer-based system in order to continue to function normally.. It provides information and instructions for system owners to maintain and test security capabilities after system operation. The clear provision of such information by the supplier enables the owner to do the appropriate work. Maintenance and testing after system operation are required to be carried out periodically in Part X, Chapter 5 (UR E26).

In addition, one of the system requirements, “19 Security functionality verification” stipulates that a function to verify the operation of security capabilities should be implemented. This function supports maintenance and testing of security capabilities. Therefore, details and usage of this function should be included in this document. More details are provided in "19 Security functionality verification ".

📖 Security functionality verification P. 104

Document reviews

	7. Plans for maintenance and verification of the computer-based system
□	-1. The following items are to be included.
□	(1) Instructions for how the user can verify correct operation of the system's security functions
	The capabilities implemented by the system requirements “19 Security functionality verification” should be included.

8. Information supporting the owner's incident response and recovery plan

Reg. 4.4.1(8), Part X of the Rules

This document is to be submitted to the Society upon request and is to include procedures or instructions allowing the user to accomplish the following:

(1) local independent control

(2) network isolation

(3) forensics by use of audit records

(4) deterministic output

(5) backup

(6) restore

(7) controlled shutdown, reset, roll-back and restart

Explanation

"Information supporting the owner's incident response and recovery plan" is a document that describes specific procedures for shipowner/ship management companies to respond to and recover from a cyber incident in operational stage of a ship.

Details are as follows:

- **Local independent control**

Local independent control is control of the system directly at or near the installation site. This applies to the propulsion machinery and the auxiliary machinery, essential for the propulsion and safety of the ship. For applicable computer systems, procedures for moving from the network to the independent control state and operating procedures in the independent control state should be described.

If computer-based system is used for such independent control, it is necessary to segment from the remote-control system on the network. Specifically, the system that provides this function is to be designed to communicate with the remote-control system via serial communication or other means, or if it is connected by IP, it is to be separated by a zone boundary device such as a firewall. For more information on segmentation, see "Guidelines for Cyber Resilience of Ships."

In addition, if it is assumed that the remote control is maintained as much as possible without relying on independent control, please also describe the procedure in such a case.

- **Network isolation**

Network isolation is the separation of a computer system from a network. It helps prevent further damage and maintains essential functions by isolating the system if security is breached. This document should provide instructions for isolating the system from the network. For example, operating a physical ON/OFF switch on an embedded network device or unplugging the specified network cable for remote monitoring. It is necessary to plan such measures so that the safe operation of the ship can be maintained even after these measures are conducted.

- **Forensics by use of audit Records**

Forensics refers to activities that use audit records[1] and audit logs[2] to investigate and analyse the causes and circumstances of important events. This document should include specific steps for forensics to support forensics. For example, procedures for collecting information and analysing the cause of audit records and audit logs.

It is necessary to provide an explanation of the contents of warnings and displays that are required for the forensic procedures including audit logs.

This response is supported by the ability to achieve “13. Auditable events” which is one of the requirements for security capabilities. Details are explained in detail in “13. Auditable events”.

📖 Auditable events **P. 88**

- **Deterministic output**

This function shifts the output to a specified safe state when normal operation cannot be maintained. In this document, please describe the expected behaviour of computer-based system in the event of a cyber incident and the state in which it becomes impossible to maintain normal operation. This is supported by the ability to achieve “20. Deterministic output” which is one of the requirements for security features. The details are explained in detail in "20. Deterministic output".

📖 Deterministic output **P. 107**

- **Backup**

This action is used to back up important files, such as programs and data of computer-based system. This document should include specific backup procedures. This action is implemented as a function that achieves one of the security function requirements, “26. System backup” The details are explained in detail in “26. System backup”.

📖 System backup **P. 124**

- **Restore**

This action is a known recovery and reconfiguration response in the event of a system disruption or failure. A known protected state is one of the following:

[1] **Audit records**: A single record of important security events.

[2] **Audit log:** A collection of audit records over time.

- System parameters are set to default[1] or secure value.
- Security-critical patches[2] are reinstalled.
- Security-related configuration is rechecked and re-established.
- System documentation and operating procedures are available.
- Application and system software is reinstalled with secure setting.
- Reconstitution from the backup data.

This document should include procedures and instructions for restoring and reconfiguring to a known protected state.

Note that some of the requirements in this document may be implemented as the capability that achieves one of the security capability requirements, “27. System recovery and reconstitution”.

For details, see “27. System recovery and reconstitution”.

System recovery and reconstitution P. 126

- **Controlled shutdown, reset, roll-back and restart**

This section should describe the procedure for controlled shutdown, reset, rollback, and restart.

Controlled shutdown is a safe shutdown of a system. When the power to computer-based system or the network is turned off, the software performs, stops, or terminates the processing that other connected systems are executing, and then disconnects the system to a safe and known state. This procedure is required because a forced shutdown can result in the loss of essential functions due to corruption of data, programs, and operating system files.

A reset is to erase the system's memory and restore it to its initial state.

A rollback is to restore the system to its previous safe state.

A reboot means stopping the running system and then restarting itself immediately.

Document reviews

	8. Information supporting the owner’s incident response and recovery plan
□	-1. The following procedures or instructions are included.
□	(1) Local independent control
□	(2) Network isolation
□	(3) Forensics by use of audit records
□	(4) Deterministic output
□	(5) Backup
□	(6) Restore
□	(7) Controlled shutdown, reset, roll-back and restart

[1] **Default**: The standard values, conditions, and operating conditions that the system ships with.
[2] **Patch**: A program that fixes system vulnerabilities and security defects.

9. Management of change plan

Reg. 4.4.1(9), Part X of the Rules

This document is to be submitted to the Society upon request. It is expected that this procedure is not specific for cyber security and is also required by **Chapter 3, Part X (UR E22)**.

Explanation

"Management of change plan" is a management procedure regarding cybersecurity changes. Cybersecurity changes include, for example, the application of security patches.

It is recommended that this document be integrated with the change management procedures for both hardware and software required in Part X, Chapter 3 (UR E22). The change management required in Part X, Chapter 3 (UR E22) is set forth in Part X, Chapter 3.6. If a management of change plan in Part X, Chapter 3 has already been prepared, the management of change perspective on cybersecurity should be added and clarified.

Document reviews

	9. Management of change plan
□	-1. Cybersecurity change management procedures are included. This does not apply if the change management procedures required by Part X, Chapter 3 (UR E22) have been submitted.

10. Test reports

Reg. 4.4.1(10), Part X of the Rules

Computer-based systems with approval certificate covering the security capabilities of **Chapter 4, Part X (UR E27)** may be exempted from survey by the Society. However, test reports signed by the supplier are to be submitted to the Society, demonstrating that the supplier has completed design, construction, testing, configuration, and hardening as would otherwise be verified by **the Society in survey (4.6.3 and 2.2.3)**.

Explanation

This document certifies that the design, manufacture, testing, configuration, and enhancement of the product have been completed by the supplier at its responsibility in the individual product approval process in Section 2 of this Guidelines, where the system has type approval. If a computer system has a certificate of approval for use, this document can be submitted to the Society, thereby omitting part of the materials submitted to the Society and the surveys. Refer to "Chapter 2 Approval Process" for the process of individual product approval when a certificate of approval for use is provided.

Chapter 2 Approval process P. 6

Details are as follows:

❶

Test	Date	Result	Attachment
(1)General survey items			
(2)Correct configuration of security capabilities			
(3)Hardening at installation			

❷

Date	
Company	
Department	
Name	
Signature	

❶ Test report columns

(1), (2) are the test items for the survey required by Part X 2.2.3 (Guideline 4). (3) is the hardening at the time of installation. Here, the hardening must be done according to the guidelines specified in the Security configuration guidelines and Security hardening guidelines. The details of the Security configuration guidelines and Security hardening guidelines are explained in detail below.

Security configuration guidelines P. 29

Security hardening guidelines P. 179

Tests from (1) through (3) are recorded for test dates and results. In addition, please submit supporting documents that substantiate the test results. (Examples: test methods for security capabilities, hardening practice records, etc.)

❷ Signature from the supplier

Test reports must be signed by the supplier. When all tests have been completed, please sign with the date, company name, department name and full name.

Document reviews

	10. Test reports
□	-1. The following survey items are to be included.
□	(1) General survey items
□	(2) Correct configuration of security capabilities
□	(3) Hardening at installation
□	-2. A signature from the supplier is to be included.

Chapter 4　Explanation of Surveys

This chapter describes the requirements related to surveys specified in Chapter 4, Part X (UR E27). In this Guidelines, surveys conducted in the presence of Surveyor of the Association are simply referred to as "surveys".

Overview of Surveys

Requirements

Chapter 4, Part X (UR E27) specifies requirements for four survey items as on-site surveys for computer system cybersecurity. Each item is as follows.

Required survey items

1. General survey items P. 42
2. Test of security capabilities P. 44
3. Correct configuration of security capabilities P. 45
4. Secure development lifecycle P. 47

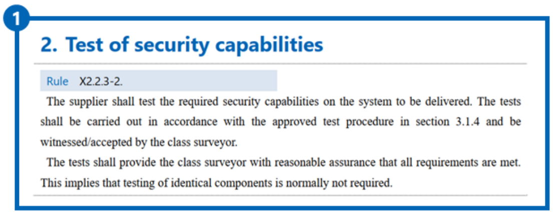
Prepared documentation

The following are some of the documents that are required to be approved for survey. Applicants should submit the following materials along with their survey applications.

	Documents required for surveys
□	Computer-based system asset inventory
□	Topology diagrams
□	Description of security capabilities
□	Test procedure of security capabilities
□	Secure product development lifecycle documents

Detail of Surveys

How to read the following pages

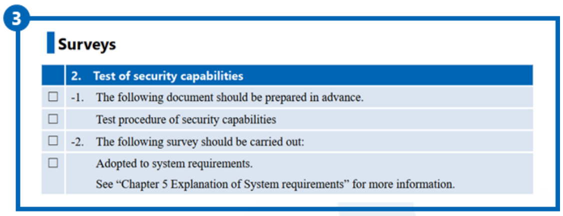


2. Test of security capabilities

Rule X2.2.3-2.

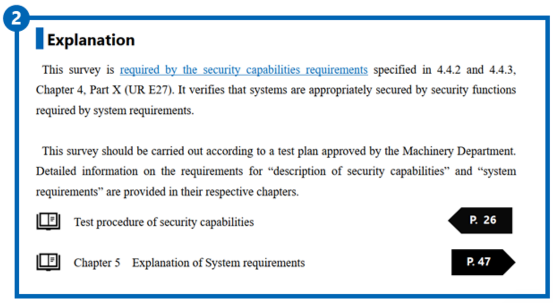
The supplier shall test the required security capabilities on the system to be delivered. The tests shall be carried out in accordance with the approved test procedure in section 3.1.4 and be witnessed/accepted by the class surveyor.

The tests shall provide the class surveyor with reasonable assurance that all requirements are met. This implies that testing of identical components is normally not required.



Surveys

	2.	Test of security capabilities
□	-1.	The following document should be prepared in advance.
□		Test procedure of security capabilities
□	-2.	The following survey should be carried out:
□		Adopted to system requirements. See “Chapter 5 Explanation of System requirements” for more information.



Explanation

This survey is required by the security capabilities requirements specified in 4.4.2 and 4.4.3, Chapter 4, Part X (UR E27). It verifies that systems are appropriately secured by security functions required by system requirements.

This survey should be carried out according to a test plan approved by the Machinery Department. Detailed information on the requirements for “description of security capabilities” and “system requirements” are provided in their respective chapters.

Test procedure of security capabilities P. 26

Chapter 5 Explanation of System requirements P. 47

1 Requirement

The names and the details of the survey requirements.

2 Explanation

An explanation of surveys.

3 Surveys

A survey checklist for the requirements

1. General survey items

Reg. 2.2.2-2, Part X of the Rules

The supplier is to demonstrate that design, construction, and internal testing has been completed.

It is to also be demonstrated that the system to be delivered is correctly represented by the approved documentation. This is to be done by inspecting the system and comparing the components and arrangement/architecture with **the asset inventory (4.4.1(1))** and **the topology diagrams (4.4.1(2))**.

Explanation

This survey item verifies that the system was correctly manufactured. It involves document verification and visual inspections to confirm that systems are completed according to approved processes.

The details of this survey are as follows.

- **Document Verification**

Review records indicating that design, manufacture, and internal tests have been completed.

- **Visual Inspection**

Review system components and deployment/configuration using computer-based system asset inventory and topology diagrams.

See “Chapter 3 Explanation of Documentation” for more information about computer-based system asset inventory and topology diagrams.

Computer-based system asset inventory P. 20

Topology diagrams P. 22

Surveys

	1. General survey items
□	-1. The following documents should be prepared in advance.
□	(1) Computer-based system Asset Inventory
□	(2) Topology Diagrams
□	-2. The following inspections should be performed:
□	(1) Document Verification
□	(a) Record indicating completion of the design

□		(b)	Record indicating completion of manufacturing
□		(c)	Record indicating completion of internal testing
□	(2)	Visual Inspection	
□		(a)	System configuration
□			Comparison with computer system asset inventory and topology diagram

2. Test of security capabilities

Reg. 2.2.2-3., Part X of the Rules

The supplier is to test the required security capabilities on the system to be delivered. The tests are to be carried out in accordance with the approved test procedure in 4.4.1(4) and be witnessed/accepted by a surveyor.

The tests are to provide the surveyor with reasonable assurance that all requirements are met. This implies that testing of identical components is normally not required.

Explanation

This survey is required by the security capabilities requirements specified in Chapter 4.4.2 (Required Security Capabilities) and Chapter 4.4.3 (Additional Security Capabilities), Part X (UR E27). It verifies that systems are appropriately secured by security functions required by system requirements.

This survey should be carried out according to the Test procedure of security capabilities. Detailed information on the requirements for "Test procedure of security capabilities" and "Explanation of system requirements" is provided in their respective chapters.

Test procedure of security capabilities P. 27

Chapter 5 Explanation of System requirements P. 48

The items tested in this functional test can be omitted in commissioning stage tests at the shipyard. The following items, which are not specified in Part X 4.4.2 (Required Security Functions) and 4.4.3 (Additional Required Security Functions), can also be omitted if tests are conducted to meet the following requirements in this functional test.

- 5.4.5 (2) Local, independent and/or manual operation
- 5.4.5 (3) Network isolation
- 5.4.6 (1) Recovery plan

Surveys

	2. Test of security capabilities
□	-1. The following document should be prepared in advance.
□	Test procedure of security capabilities
□	-2. The following survey should be carried out:
□	Adopted to system requirements. See "Chapter 5 Explanation of System requirements" for more information.

3. Correct configuration of security capabilities

Reg. 2.2.2-4., Part X of the Rules

The supplier is to test/demonstrate for a surveyor that security settings in the system's components have been configured in accordance with the configuration guidelines in 4.4.1(5). This demonstration may be carried out in conjunction with testing of the security capabilities.

The security settings are to be documented in a report, e.g. a ship-specific instance of the configuration guidelines.

Explanation

This survey verifies that system components are configured according to Security configuration guidelines. Security configuration guideline is a document that describes recommended settings for the security features of a computer-based system. See "Security configuration guidelines" for more information.

Security configuration guidelines

P. 29

The details of this survey are as follows:

- **Testing/Demonstration by Suppliers**

Suppliers must demonstrate that system components are configured in accordance with established Security configuration guidelines to ensure that recommended settings for security features are configured.

- **Concurrent with Test of Security Capabilities**

This Security configuration validation is to be conducted as a Demonstration test for the functions of "Network and security configuration settings", which are shown in "Test of security capabilities". The test method is detailed in "Network and security configuration settings".

Network and security configuration settings

P. 131

- **Documentation**

Security settings and their validation results should be documented in a reports for each vessel and should be available for presentation if requested by the Society. This is to explicitly indicate that the settings comply with guidelines so that they can be validated later.

Surveys

	3. Correct configuration of security capabilities
□	-1. The following document should be prepared in advance:
□	Security configuration guidelines

□	-2. The following survey should be carried out:
□	Adopted to the requirements of network and security configuration settings. See “Network and security configuration settings” in the “Chapter 5 Explanation of System requirements” for more information.

4. Secure development lifecycle

Reg. 2.2.2-5., Part X of the Rules

The supplier is to, in accordance with documentation in section 4.4.1(6), demonstrate compliance with requirements for secure software development lifecycle in 4.5.

Explanation

This survey is a survey of the secure development lifecycle requirements specified in Chapter 4.5, Part X (UR E 27). It verifies that products are managed in accordance with secure development lifecycles.

This survey verifies that products are manufactured in accordance with the controlled processes specified in secure development lifecycle requirements and demonstrates that the handling of each requirement documented in management system documentation is implemented accordingly. Since management system documentation should make a record of how the requirement was met for each requirement, this survey verifies such records.

To grasp the details of each requirement, this survey refers to secure development lifecycle documents approved by the Machinery Department. See the following for more information about “secure development lifecycle documents”.

Secure development lifecycle documents P. 47

Chapter 6 Explanation of Secure Development Lifecycle requirements P. 164

Surveys

	4. Secure development lifecycle
□	-1. The following document should be prepared in advance.
□	Secure product development lifecycle documents
□	-2. The following survey should be carried out:
□	Adopted Secure development lifecycle requirements. See “Chapter 6 Secure development lifecycle requirements” for more information.

Chapter 5 Explanation of System requirements

This chapter provides details on the system requirements required by Part X 4.4.2 and 4.4.3. System requirements are requirements for the security capabilities required of a computer-based system. Security capabilities provide a specific way to protect against threats and attacks on computer-based systems. By implementing security capabilities on computer-based systems that meet the minimum-security level requirements, cyber-attack risks for ships are reduced.

Overview of System requirements

What are required security capabilities

The system requirements set 6(six) foundational requirements as technical security requirements.

Protect against casual or coincidental access by unauthenticated entities

Prevent the unauthorized disclosure of information via eavesdropping or casual exposure

Protect against casual or coincidental misuse

Monitor the operation of the CBS and respond to incidents

Protect the integrity of the CBS against casual or coincidental manipulation

Ensure that the control system operates reliably under normal production conditions

The foundational requirements define the system requirements to meet each objective. Each system requirement implements the security functions required by that requirement. In general, the required security capabilities apply to all computer-based systems. The required security capabilities are as follows:

Protect against casual or coincidental access by unauthenticated entities

Protect against casual or coincidental misuse

Protect the integrity of the computer-based system against casual or coincidental manipulation

Prevent the unauthorized disclosure of information via eavesdropping or casual exposure

Monitor the operation of the computer-based system and respond to incidents

Ensure that the control system operates reliably under normal production conditions

■ Untrusted network Requires Additional Security capabilities

Networks that contain computer systems and that are not covered by Part X, Chapter 4 (UR E27) are called untrusted networks. This refers to networks that are not guaranteed to have measures in place for Cyber Resilience under X Chapters 4 and 5. When network communication with untrusted networks is involved, security is to be more enhanced. Therefore, additional security capabilities requirements are applied.

The requirements for additional security capabilities are as follows:

Additional security capabilities

■ If some security capabilities are not provided

If the required security capabilities cannot be provided for any reason, alternatives measures must be provided. This is called compensating countermeasure and may be accepted as an alternative if the following conditions are met:

i) Protect against the same threats as the original requirement
ii) Provide an equal level of protection as the original requirement
iii) Not be a security control that is required by other requirements
vi) Not introduce a higher security risk

Compensating countermeasures may be exemplified in the details of each requirement. For example:

e.g., The account function cannot be implemented

In this case, the user cannot be identified and there is a risk of being easily accessed by an attacker. Compensating countermeasures include placing them in a locked box. Locking the key allows access only to the person who owns the key and is therefore an acceptable alternative.

If the security capability is to be used as a compensating countermeasure, the countermeasure and the test procedure are to be described in the following documentation.

- **Description of security capabilities**

This document explains what capabilities are implemented for the requirements of each security capabilities. If the security capability is used as a compensating countermeasure, the details of this countermeasure are included. For details, see “Description of the security capabilities”.

Description of Security capabilities

P. 25

- **Test of security capabilities**

This is a test procedure for demonstration tests required for each security capability. If the security capability is to be used as a compensating countermeasure, it is necessary to confirm by witness survey that this countermeasure satisfies the requirements of the security capability. Four details, see “Test of security capabilities”.

Test of security capabilities

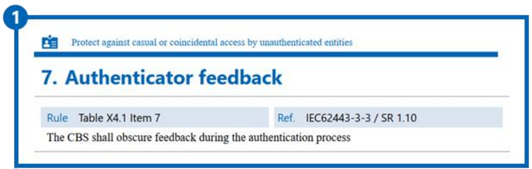
P. 44

■ Some security capabilities may not apply

Some system requirements may not apply to some computer-based systems. For example, the requirement “5. Wireless access management” is a required security capability for computer-based system that communicate wirelessly, so computer-based systems that do not communicate wirelessly are exempt. An example of the need for application is shown in the details of each requirement. If the specific system requirement is not applicable, the details are to be described in “Description of security capabilities”.

Detail of System requirements

How to read the following pages

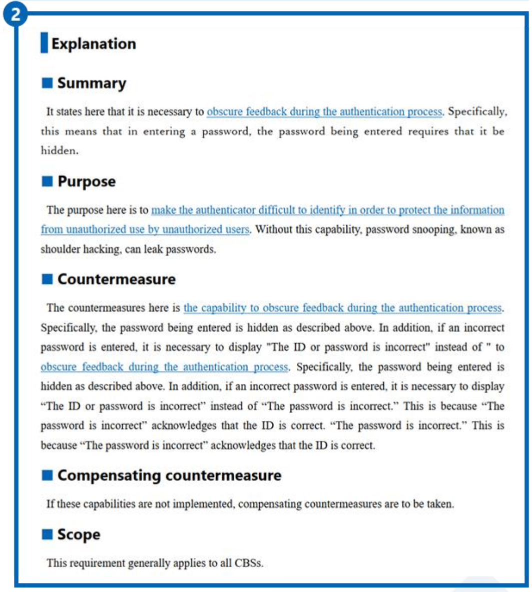

1

Protect against casual or coincidental access by unauthenticated entities

7. Authenticator feedback

Rule Table X4.1 Item 7	Ref. IEC62443-3-3 / SR 1.10

The CBS shall obscure feedback during the authentication process


2

Explanation

■ Summary

It states here that it is necessary to obscure feedback during the authentication process. Specifically, this means that in entering a password, the password being entered requires that it be hidden.

■ Purpose

The purpose here is to make the authenticator difficult to identify in order to protect the information from unauthorized use by unauthorized users. Without this capability, password snooping, known as shoulder hacking, can leak passwords.

■ Countermeasure

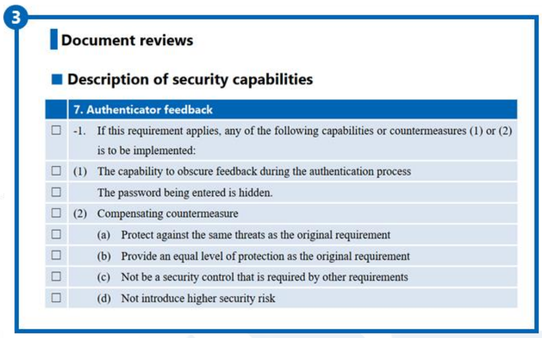
The countermeasures here is the capability to obscure feedback during the authentication process. Specifically, the password being entered is hidden as described above. In addition, if an incorrect password is entered, it is necessary to display "The ID or password is incorrect" instead of " to obscure feedback during the authentication process. Specifically, the password being entered is hidden as described above. In addition, if an incorrect password is entered, it is necessary to display "The ID or password is incorrect" instead of "The password is incorrect." This is because "The password is incorrect" acknowledges that the ID is correct. "The password is incorrect." This is because "The password is incorrect" acknowledges that the ID is correct.

■ Compensating countermeasure

If these capabilities are not implemented, compensating countermeasures are to be taken.

■ Scope

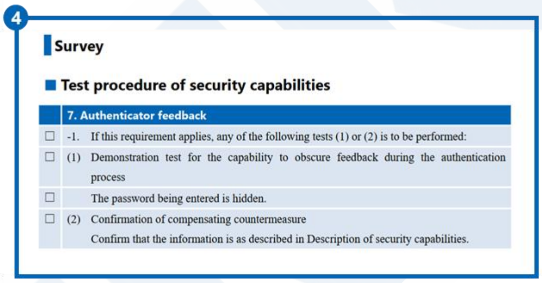
This requirement generally applies to all CBSs.


3

Document reviews

■ Description of security capabilities

	7. Authenticator feedback
□	-1. If this requirement applies, any of the following capabilities or countermeasures (1) or (2) is to be implemented:
□	(1) The capability to obscure feedback during the authentication process
□	The password being entered is hidden.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce higher security risk


4

Survey

■ Test procedure of security capabilities

	7. Authenticator feedback
□	-1. If this requirement applies, any of the following tests (1) or (2) is to be performed:
□	(1) Demonstration test for the capability to obscure feedback during the authentication process
□	The password being entered is hidden.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

① Requirement

The names and the details of the system requirements. The upper part of the titles indicates the basic requirements.

② Explanation

The explanation of system requirements. It consists of the following:

- Summary: Overview of Requirements
- Purpose: Main purpose of Requirements
- Countermeasures: Specific countermeasures of requirements
- Compensating countermeasures: Countermeasures taken in place of the original security capability to meet the requirement.
- Scope: Whether the requirement applies or not

③ Document reviews

A document review checklist for system requirements

- Description of security capabilities: Documentation required by 4.4.1 (3), Part X.

④ Surveys

A survey checklist for system requirements.

- Test procedure of security capabilities: Surveys required by 2.2.3-2., Part X.

1. Human user identification and authentication

Reg. Table X4.1 Item 1, Part X of the Rules	Ref. IEC62443-3-3 / SR 1.1

The computer-based system is to identify and authenticate all human users who can access the system directly or through interfaces.

Explanation

Summary

Item 1, Table X4.1, Part X states that it is necessary to identify and authenticate all human users who can access the system. The description for identification and authentication is as follows:

Term	Description
Identification	This is to distinguish each user. This is done using an identifier that identifies who you are. In the case of identifying person, the identifier is typically the username.
Authentication	This is to prove the identity of the user. This is done using an identifier as well as information to prove the identity of the user called an authorization code. An authorization code is typically a password.

This means that you should use an identifier and an authorization code to log in to the system.

Purpose

The purpose is to reduce the risk of being used by people who are not authorized to use the system. If the system does not identify and authenticate, an attacker can access without authorization. This could affect the operation of the vessel.

This requirement does not require individual identification and authentication (that is, individual identification) and it allows role-based identification and authentication.

Countermeasures

These countermeasures here are the capability that identify and authenticate all users (human user). Specifically, they are as follows:

- **Account functions**

A combination of an identifier and an authenticator is called an account and is used to identify and authenticate users. Users of the system must be able to log in to the system through this function.

Identifiers, authenticators, and accounts are described in detail in the respective requirements.

Account management P. 57

Identifier management P. 60

Authenticator management P. 63

■ Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

・**Physical access control**

Instead of implementing identification and authentication as a function, you can complement this function by restricting physical access. For example, you might have a structure in which the system cannot be operated without a key controlled by predetermined personnel, and the system should be placed in a controlled space, such as a bridge or a room that can be locked. In particular, in the case of a system that performs control that requires immediate access, it is stipulated in Part X, 5.4.3 (4) (d) i), etc., that the authentication function is not required for the operation. Please consider these factors when implementing this function or complementary measures.

In this case of adopting physical access control, it is important that the permissions of each user, such as physical access control for operation and physical access control for maintenance, are considered. The authority is explained in detail in “8. Authorization enforcement”.

Authorization enforcement P. 75

■ Scope

This requirement, in principle, applies to all computer-based systems.

Document reviews

■ Description of security capabilities

	1. Human user identification and authentication
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) Capability to identify and authenticate users(person)
□	(a) identifying by an identifier.
□	(b) authenticating by an identifier and an authenticator.
□	(2) Compensating countermeasure

□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	1. Human user identification and authentication
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability of Human user identification and authentication
□	(a) Can log in with a valid identifier and authenticator
□	(b) Cannot log in with an invalid identifier and authenticator
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

2. Account management

Reg. Table X4.1 Item 2, Part X of the Rules | Ref. IEC62443-3-3 / SR 1.3

The computer-based system is to provide the capability to support the management of all accounts by authorized users, including adding, activating, modifying, disabling and removing account

Explanation

Summary

Item 2, Table X4.1, Part X states that it is necessary to manage all accounts. An account is used to identify and authenticate a user and consists of an identifier[1] and an authenticator[2]. Identification and authentication are explained in detail in "1. Human user identification and authentication".

Human user identification and authentication P. 54

In addition, the user subject to this requirement is basically only a person. However, in addition to People, Software Processes and Devices are also covered if the following conditions are met:

- Wireless communication
- Network communication with an untrusted network

Wireless communication is described in detail in "5. Wireless access management" and network communication with an untrusted network is described in "32. Software process and device identification and authentication".

Wireless access management P. 67

Software process and device identification and authentication P. 139

Purpose

The purpose is to properly manage users of the system. Improper management can result in unauthorized access by someone who does not have permission to use it.

Countermeasures

The countermeasure described here is to support the management of all accounts by authorized

.

[1] **Identifier** An indication what it is such as user ID, etc.

[2] **Authenticator** information used to prove the identity of the user itself such as password, etc.

users (Including adding, enabling, modifying, disabling and deleting accounts). This capability should be restricted to use only by people with administrative privileges (administrators).

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. If account activation and deactivation is not implemented, it should be noted that it will be supplemented by additions and deletions.

Scope

This requirement does not apply to the following cases:

- **In the case that the capability of “1. Human user identification and authentication” is as a compensating countermeasure or the requirement is not applicable.**

If the capability to identify and authenticate the user is not implemented, there is no capability of the account. In this case, this requirement is not applicable.

Document reviews

Description of security capabilities

	2. Account management
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to support the management of all accounts by authorized users
□	(a) The following capabilities should be implemented.
□	i) Adding, modifying and removing account
□	ii) Activating and disabling account (In case compensating countermeasures are taken, the reasons shall be provided)
□	(b) Only authorized users can manage account.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	2. Account management

□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to support the management of all accounts by authorized users
□	(a) The following capabilities should be implemented:
□	i) Adding, modifying and removing account
□	ii) Activating and disabling account
□	(b) Account management permissions should be as follows:
□	i) Only authorized users can manage account.
□	ii) Unauthorized users cannot manage account.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

3. Identifier management

Reg. Table X4.1 Item 3, Part X of the Rules | Ref. IEC62443-3-3 / SR 1.4

The computer-based system is to provide the capability to support the management of identifiers by user, group and role.

Explanation

Summary

Item 3, Table X4.1, Part X states that it is necessary to manage identifiers by user, group, and role. An identifier is a representation of who you are. In the identification of a person, a username is generally used.

In addition, the user subject to this requirement is basically only a human user. However, if the following conditions are met, a software process and a device are also targeted besides to a human user.

- Wireless communication
- Network communication with an untrusted network

Wireless communication is described in detail in “5. Wireless access management,” and network communication with an untrusted network is described in “32. Software process and device identification and authentication”

Wireless access management P. 67

Software process and device identification and authentication P. 139

Purpose

The purpose is to manage identifiers by user, group, and role in accordance with the requirement.

Countermeasures

The countermeasure described here is to support the management of identifiers by user, group and role. Specifically, it is as follows.

- **Capability to manage identifiers by user**

A user is anyone who operates or maintains a control device. This requires the ability to assign an identifier (ID) to each user's account and manage it.

- **Capability to manage identifiers by group and role**

A group or role is a collection of user's accounts. If a system has these capabilities, it wants the ability to assign and manage identifiers (IDs) for each.

An example of an account might be following:

- Officer and Engineer
- System User and Maintenance Engineer
- System Administrator and User

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **In the case that the capability of "1. Human user identification and authentication" is as a compensating countermeasure or the requirement is not applicable.**

If the capability to identify and authenticate the user is not implemented, there is no capability of the account. In this case, this requirement is not applicable.

Human user identification and authentication P. 54

Document reviews

Description of security capabilities

	3. Identifier management
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to support the management of identifiers by user, group and role
□	Add, modifying and remove identifiers
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	3. Identifier management
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to support the management of identifiers by user, group and role
□	Add, modifying and remove identifiers
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

4. Authenticator management

Reg. Table X4.1 Item 4, Part X of the Rules	Ref. IEC62443-3-3 / SR 1.5

The computer-based system is to provide the capability to:

- initialize authenticator content,
- change all default authenticators upon control system installation,
- change/refresh all authenticators, and
- protect all authenticators from unauthorized disclosure and modification when stored and transmitted.

Explanation

Summary

Item 4, Table X4.1, Part X states that it is necessary to manage the authenticator. The **authenticator** is information that allows you to prove your identity. Authenticator mainly include passwords, PINs[1], tokens[2], public key authentication methods[3], physical keys[4], fingerprint authentication, and facial authentication. There are three types of authentication factors below, and you can use one (or a combination) of them to authenticate.

In addition, the user subject to this requirement is basically only a human user . However, if the following conditions are met, a software process and a device are also targeted besides to a human user.

- Wireless communication
- Network communication with an untrusted network

Wireless communication is described in detail in “5. Wireless access management,” and network communication with an untrusted network is described in “32. Software process and device identification and authentication”

Wireless access management P. 67

Software process and device identification and authentication P. 139

[1] **PIN** It stands for Personal Identification Number. One of the authentication codes. Usually consists of 4 to 6 digits.

[2] **Security token** One of the authorization codes. Generally, serves as a temporary certificate for users to access the system. For example, one-time password (OTP) generation device.

[3] **Public key authentication method**: A method of authentication using a pair of public and private keys.

[4] **Physical key** One of authentication codes. A key to unlock the physical lock such as safe and system.

Purpose

The purpose is to ensure the confidentiality of the authenticator. Leaking the authenticator could allow it to be misused by an attacker. This could affect the operation of the vessel.

Countermeasures

The countermeasure described here is the capability to manage authenticator. Using passwords as an example, specifically as follows:

- **Initialize authenticator content**

For example, initializing a password. If the authenticator is lost, a new authenticator can be set. Systems where the initial password associated with the account is fixed when the account is created require that the initial password used during initialization be changeable. Other features include the ability for an administrator to set an initial password when creating an account and the ability for an administrator to reset a password if, for example, a user forgets it. As a further precaution, it is better to have a password set by the owner when creating the account.

- **Change all default authenticators upon control system installation**

For example, changing the initial password for all accounts on the first use of the system. Potential security risks can be mitigated if the default authentication code is easily predictable due to the factory settings (e.g., it is set to "password") or if it is widely disclosed in the manual.

- **Change/refresh all authenticators**

For example, change of the password. It can change the code at any time by user.

- **Protect all authenticators from unauthorized disclosure and modification when stored and transmitted.**

For example, password cryptographic (hashing, etc.) and the use of hardware security modules. The ability to protect the confidentiality of authentication codes is required.

Note: If a password is used as the authenticator, requirements regarding its strength are stipulated in “6 Strength of password-based authentication”.

6. **Strength of password-based authentication** P. 70

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **In the case that the capability of “1. Human user identification and authentication” is as a compensating countermeasure or the requirement is not applicable.**

If the capability to identify and authenticate the user is not implemented, there is no capability of the account. In this case, this requirement is not applicable.

Human user identification and authentication

P. 54

Document reviews

Description of security capabilities

	4. Authenticator management
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to manage authenticators
□	The following capabilities should be implemented.
□	(a) Initialize authenticator content (e.g., initial password setting function)
□	(b) Change all default authenticators upon control system installation (e.g., changing from the initial password)
□	(c) Change/refresh all authenticators (e.g., changing of the password)
□	(d) Protect all authenticators from unauthorized disclosure and modification when stored and transmitted. (e.g., password cryptographic)
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	4. Authenticator management
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to manage authenticators
□	The following capabilities should be implemented.
□	(a) Initialize authenticator content (e.g., verifying the set initial password feature)
□	(b) Change all default authenticators upon control system installation (e.g., changing from the initial password)
□	(c) Change/refresh all authenticators (e.g., attempting to change of the password)

□	(d) Protect all authenticators from unauthorized disclosure and modification when stored and transmitted. (e.g., verifying password cryptographic)
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

5. Wireless access management

Reg. Table X4.1 Item 5, Part X of the Rules	Ref. IEC62443-3-3 / SR 1.6

The computer-based system is to provide the capability to identify and authenticate all users (humans, software processes or devices) engaged in wireless communication

Explanation

Summary

Item 5, Table X4.1, Part X states that the user who communicates wirelessly is necessary to be identified and authenticated. In the case of wireless communications, the identification and authentication of the user is not only about the person, but also about the software process and device. Software processes and devices are described below.

Term	Description
Software Process	An execution unit of a program or application used by the system. For example, include data collection processes, control logic execution processes, and communication management processes. Each process has execution permissions.
Device	A physical hardware or an equipment in the system. For example, include PLC, RTU, and IO units.

Purpose

The purpose is to enhance security under wireless communications where there is a risk of cyber-attacks. The major difference between wireless and wired communications is that an attacker can easily access a network remotely within range of radio waves. In the case of wired communications, installing a blocker on a physical port and managing entry and exit are also effective. However, these measures are not effective for wireless communications. Therefore, it is necessary to provide identification and authentication functions that can be used under wireless connections so that only authorized users can access them.

Countermeasures

The countermeasure described here is the capability to identify and authenticate a human user, software process, or device that engaged in wireless communication. Specifically, it is as follows.

- **IEEE802.1X**

This is a standard for authenticating network terminals. Ensure the security of wireless connections by identifying and authenticating users with an authentication server such as RADIUS. Various authentication methods can be supported using Extensible Authentication Protocol (EAP).

- **Certificate-based authentication**

An authentication method that uses digital certificates. A unique certificate is issued for each device or user and is verified when connecting. When it comes to certificate operation, it is necessary to plan for expiration and renewal.

- WPA3-Enterprise

It is the latest wireless LAN cryptographic and authentication standard and provides strong cryptographic and authentication functions. It provides functions such as authentication with individual credentials, secure generation of session keys, and protection of encrypted communication.

- **WPA2-PSK/WPA3-personal (pre-shared key) and MAC address filtering**

It is the latest wireless LAN cryptographic and authentication standard and provides strong cryptographic and authentication functions. It provides functions such as authentication with individual credentials, secure generation of session keys, and protection of encrypted communication.

■ Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

■ Scope

This requirement does not apply to the following cases:

- **Computer-based system does not communicate wirelessly**

If the computer-based system does not communicate wirelessly, this requirement does not apply.

Document reviews

■ Description of security capabilities

	5. Wireless access management
☐	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
☐	(1) The capability to identify and authenticate all users (humans, software processes or

	devices) engaged in wireless communication
□	(a) Human user identification and authentication
□	i) identifying by an identifier.
□	ii) authenticating by an identifier and an authenticator.
□	(b) Software process identification and authentication
□	i) identifying by an identifier.
□	ii) authenticating by an identifier and an authenticator.
□	(c) Device identification and authentication
□	i) identifying by an identifier.
□	ii) authenticating by an identifier and an authenticator.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	5. Wireless access management
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to identify and authenticate all users (humans, software processes or devices) engaged in wireless communication
□	(a) Human user identification and authentication
□	i) Can log in with a valid identifier and authenticator
□	ii) Cannot log in with an invalid identifier and authenticator
□	(b) Software process identification and authentication
□	i) Can log in with a valid identifier and authenticator
□	ii) Cannot log in with an invalid identifier and authenticator
□	(c) Device identification and authentication
□	i) Can log in with a valid identifier and authenticator
□	ii) Cannot log in with an invalid identifier and authenticator
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

6. Strength of password-based authentication

Reg. Table X4.1 Item 6, Part X of the Rules	Ref. IEC62443-3-3 / SR 1.7

The computer-based system is to provide the capability to enforce configurable password strength based on minimum length and variety of character types.

Explanation

Summary

Item 6, Table X4.1, Part X states that the ability to enhance password configuration based on minimum length and variety of character types is required. This means that passwords should not be too short and should be configurable to include a variety of characters depending on the user's password policy.

Purpose

The purpose is to prevent unauthorized access due to poor password strength by making it harder for an attacker to guess the password. For example, if a password consists of only 4(four) digits, it is less strong and more likely to be easily guessed. In particular, it is more likely to become vulnerable to dictionary attacks, rainbow tables, and brute force attacks. To cope with such attack methods, it is required to be able to change the length and character types of passwords that can be accepted.

Countermeasures

The countermeasure described here is the capability to enforce configurable password strength. Specifically, the system needs the ability to set the minimum number of characters and character type of a password suitable for the system to the required level depending on the usage.

With this feature, the password strength of the system is set according to user policy. For example, the password strength is "Must be at least eight characters and contain numbers, letters (both uppercase and lowercase), and symbols.". Some helpful guidelines are following:

- **NIST[1] SP800-63**
  Length: At least 8 characters (for user-created passwords)
  Type: ASCII (REF 20) characters. Spaces. Unicode (ISO/OSC10646) characters, etc.
- **(NISC[2]) internet security**
  Type: Large and small letters in English + numbers + 26 symbols, total of 88

[1] **NIST** It stands for National Institute of Standards and Technology.

[2] **NISC** It stands for National Center of Incident Readiness and Strategy for Cybersecurity.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

- **Restricting the password input environment**

When a password is entered through an external device or an environment where communication is available, it is easy to become vulnerable to the attack described in the purpose because a computer is connected. Therefore, it is possible to prevent attacks using computers by limiting the devices that can enter passwords instead of requiring a fixed minimum length and character type.

Scope

This requirement does not apply to the following cases:

- **Password is not used for an authenticator.**

When the password is not used for an authenticator, this requirement is not applicable.

- **In the case that the capability of “1. Human user identification and authentication” is as a compensating countermeasure or the requirement is not applicable.**

If the capability to identify and authenticate the user is not implemented, there is no capability of the authentication. In this case, this requirement is not applicable.

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Description of security capabilities

	6. Strength of password-based authentication
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to enforce password policy
□	(a) Minimum length
□	Being modifiable.
□	(b) Variety of character types
□	Being modifiable.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement

□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	6. Strength of password-based authentication
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to enforce password policy
□	(a) Minimum length
□	Adopted to the following items:
□	i) Minimum length of a password can be set :
□	ii) A password can be set at least the shortest length configured :
□	iii) A password cannot be less than the minimum length configured.
□	(b) Variety of character types
□	i) A password can be set the character types required for it.
□	ii) A password can be set in the configured character type.
□	iii) A password cannot be set without configured character type.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

7. Authenticator feedback

Reg. Table X4.1 Item 7, Part X of the Rules

Ref. IEC62443-3-3 / SR 1.10

The computer-based system is to obscure feedback during the authentication process.

Explanation

Summary

Item 7, Table X4.1, Part X states that it is necessary to obscure feedback during the authentication process. Specifically, this means that in entering a password, the password being entered requires that it be hidden.

Purpose

The purpose is to make the authenticator difficult to identify in order to protect the information from unauthorized use by unauthorized users. Without this capability, password snooping, known as shoulder hacking, can leak passwords.

Countermeasures

The countermeasure described here is the capability to obscure feedback during the authentication process. Specifically, the password being entered is hidden as described above. For example, the characters displayed on the screen should be asterisks (*).

In addition, if an incorrect password is entered, it is desirable to display "The ID or password is incorrect" instead of "The password is incorrect." This is because "The password is incorrect" acknowledges that the ID is correct.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **Password is not used for an authenticator.**

When the password is not used for an authenticator, this requirement is not applicable.

- **In the case that the capability of "1. Human user identification and authentication" is as a compensating countermeasure or the requirement is not applicable.**

If the capability to identify and authenticate the user is not implemented, there is no capability of the authentication. In this case, this requirement is not applicable.

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Document reviews

Description of security capabilities

	7. Authenticator feedback
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to obscure feedback during the authentication process
□	The password being entered is hidden.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	7. Authenticator feedback
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to obscure feedback during the authentication process
□	The password being entered is hidden.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

8. Authorization enforcement

Reg. Table X4.1 Item 8, Part X of the Rules

Ref. IEC62443-3-3 / SR 2.1

On all interfaces, human users are to be assigned authorizations in accordance with the principles of segregation of duties and least privilege.

Explanation

Summary

Item 8, Table X4.1, Part X states that it is to be assigned authorizations in accordance with two important principles of "segregation of duties" and "least privilege". Separation of duties and least privilege are described below.

Term	Description
Separation of duties	The principle of separating one important task into two or more people and preventing one person from having all the power to prevent the completion of fraud by a single user. This can be separated by roles and groups as well as individuals. For example, separating the person responsible for the work from the approver.
Least Privilege	The principle that an employer (person) has only the minimum authority necessary to perform his/her duties. Specifically, an administrator can configure the system, add users, and so on, while a general user is only allowed to operate the system.

Therefore, it is necessary to clearly define the role of the human user or the human user, assign appropriate permissions, and restrict the human user to allow only authorized operations.

Purpose

The purpose is to properly assign privileges to users.

Countermeasures

The countermeasure described here is the capability to support the assignment of privileges according to the separation of duties and the principle of least privilege. Specifically, it is as follows.

- **Managing Permissions with Access Control Lists**

Access control lists control access to system resources (such as files and databases). An access control list consists of the following elements:

Elements	Description
Subject	The human user who has been granted access. This applies to all human users, including group-based users.
Object	The resource that has been granted access. Examples include files, databases, and network resources.
Permission	The operation for which access was granted. For example, read, write, and execute.
Condition	If necessary, conditions such as the time, date, and location that the user is allowed access to may be set.

■ Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

- **Physical access control**

If compensating countermeasure is taken for the capability of "1. Identification and authentication of user (person)", this capability cannot be implemented in the system. In such cases, it is necessary to supplement this capability through physical security or other means. For example, in the case of authorization of system users and maintenance users, maintenance can be performed by the key held only by the maintenance users.

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■ Scope

This requirement, in principle, applies to all computer-based systems.

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■ Description of security capabilities

	8. Authorization enforcement
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to support the assignment of privileges according to the separation of duties and the principle of least privilege

□	The following elements are to be controlled by access control lists or other means.
□	(a) Subject (e.g., all users, including groups)
□	(b) Object (e.g., files, databases, network resources)
□	(c) Permissions (e.g., read, write, execute)
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	8. Authorization enforcement
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) The Demonstration test for the capability to support the assignment of privileges according to the separation of duties and the principle of least privilege
□	The following elements are to be managed in accordance with the principles of segregation of duties and least privilege by means of access control lists, etc.
□	(a) Subject (e.g., all users, including groups)
□	(b) Object (e.g., files, databases, network resources)
□	(c) Permissions (e.g., read, write, execute)
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

9. Wireless use control

Reg. Table X4.1 Item 9, Part X of the Rules | Ref. IEC62443-3-3 / SR 2.2

The computer-based system is to provide the capability to authorize, monitor and enforce usage restrictions for wireless connectivity to the system according to commonly accepted security industry practices

Explanation

Summary

Item 9, Table X4.1, Part X states that it is to authorize, monitor, and enforce usage restrictions for wireless connectivity to the system according to commonly accepted security industry practices. "Commonly accepted security industry practices" generally use wireless communication technologies. For example, the restriction technologies used in commonly used wireless communication technology such as Wi-Fi and Bluetooth is applicable. Authorization, monitoring, and restrictions on the use of wireless connections are as follows.

Capability	Description
Authorization	The process of granting or denying access to a specific resource or feature. This typically occurs after authentication and controls what users can access or perform.
Monitoring	Monitoring devices that are connected wirelessly.
Implementation	Ensuring compliance with predetermined rules for restricting the use of wirelessly connected devices.

Purpose

The purpose is to provide greater security for use under wireless communications, where the risk of cyberattacks is high. Without adequate security measures in place, an attacker could connect to the affected access point and be attacked.

Countermeasures

The countermeasure described here is that the capability to authorize, monitor and enforce usage restrictions for wireless connectivity to the system. The example below describes the case of

WPA2-PSK/WPA3-Personal authentication[1] for IP-based wireless devices and users authenticated by the authentication feature.

- **Authorization**

This allows or denies access to a specific resource for each user. Control access to the network by authenticating with SSID (Service Set Identifier) and cryptographic key using mechanisms such as WPA2-PSK authentication.

- **Monitoring**

This monitors wirelessly connected devices. The system can check the list of connected devices and detect access by non-specified devices. Note that the connected devices are identified by their MAC addresses.

- **Implementation**

A function that restricts the functions and privileges available to devices that can be connected wirelessly. For example, a function such as an access control list that allows only data acquisition without allowing system control or rewriting of values from wireless devices is applicable.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **Without wireless communication**

This requirement does not apply if the computer-based system does not have wireless communication technology and is not an access point and client.

Document reviews

Description of security capabilities

	9. Wireless use control
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to authorize, monitor and enforce usage restrictions for wireless connectivity to the system
□	(a) The following functions are implemented in accordance with generally accepted industry security practices regarding restriction of wireless connection

[1] **WPA2-PSK / WPA3-Personal Authentication**: An authentication method that secures access under wireless communication using a pre-shared key.

□	i) Authorization
□	ii) Monitoring
□	iii) Implementation
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	9. Wireless use control
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capabilities to authorize, monitor, and usage restrict of wireless connections to the system
□	The following items are to be satisfied.
□	(a) Demonstration of authorization capability of accessible resources for wireless devices
□	(b) Demonstration of the ability to monitor wireless devices.
□	(c) Verifying that access restrictions to wireless devices are enforced.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

10. Use control for portable and mobile devices

Reg. Table X4.1 Item 10, Part X of the Rules	Ref. IEC62443-3-3 / SR 2.3

When the computer-based system supports use of portable and mobile devices, the system is to include the capability to do the following:

- limit the use of portable and mobile devices only to those permitted by design, and
- restrict code and mobile devices.

Note: Port limits / blockers (and silicone) could be accepted for a specific system

Explanation

Summary

Item 10, Table X4.1, Part X states that it is necessary to control for portable and mobile devices when the computer-based system connects to devices. Portable and mobile devices are devices that can be carried around. Examples include USB flash drives, smartphones, tablets, and laptops.

Purpose

The purpose is to reduce the risk of malware infection through portable or mobile devices. Malware infection from devices should be protected as a security feature of the system, not just the device itself.

Countermeasures

The countermeasure described here is that the capability to restrict the usage and transfer of portable and mobile devices. The details are as follows.

- **Usage Restrictions**

  Limits the connection to only authorized devices. For example, include device serial numbers and USB device class protocol restrictions.

- **Transfer Restrictions**

  Restricts the transfer of code and data between a system and a device.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

- **Block a port with a port blocker**

A port blocker is a physical security tool that physically blocks a computer's USB port or LAN port by plugging it into the computer. Blocking a port with a port blocker complements this feature to prevent the use of portable and mobile devices.

- **Clean up of portable and mobile devices**

Before using portable and mobile devices, you can complement this function by using specialized hardware to scan and clean up malware. In this case, in addition to the supplier performing the cleanup during maintenance, the user's cleanup procedure must be clearly indicated by the supplier, and the effect must be equivalent to the usage and forwarding restrictions.

Scope

This requirement does not apply to the following cases:

- **Not Supporting the Use of portable and mobile devices**

If the device does not have a physical interface port and does not support the use of portable and mobile devices, this requirement does not apply.

Document reviews

Description of security capabilities

	10. Use control for portable and mobile devices
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) Capabilities for restricting the use of portable and mobile devices and restricting data transmission
□	(a) Restrictions on the use of portable and handheld devices
□	Only authorized devices are permitted to be used
□	(b) Restrictions on data transfer for portable and mobile devices
□	The transfer of device codes and data are to be restricted
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	10. Use control for portable and mobile devices

□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capabilities of use limitation and data transfer limitation for portable and handheld devices
□	(a) Restriction of use of portable and mobile devices. (e.g. device connection attempt verification)
□	The following shall be complied with
□	i) Authorized devices can be used.
□	ii) Unauthorized devices cannot be used.
□	(b) Unauthorized devices cannot be used.
□	The transfer of device codes and data are to be restricted
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

11. Mobile code

Reg. Table X4.1 Item 11, Part X of the Rules   Ref. IEC62443-3-3 / SR 2.4

The computer-based system is to control the use of mobile code such as java scripts, ActiveX and PDF.

Explanation

Summary

Item 11, Table X4.1, Part X states that the use of mobile code is to be controlled. Mobile code is a program that is downloaded from another computer system via a network and automatically executed without the user having to explicitly download, install or otherwise operate it.

Purpose

The purpose is to prevent security risks from the automatic execution of mobile code. This section aims to prevent security risks from the automatic execution of mobile code. Some malwares can exploit the mechanism of mobile code and apply it to infect viruses, unauthorized operations or tampering. To prevent them, mobile codes are to be restricted.

Countermeasures

The countermeasure described here is the ability to control the use of mobile code. Specific examples are as follows.

- Execution restrictions based on policy settings and security settings for computers and Web browsers
- Authentication of mobile code creator, such as with a digital certificate
- Whitelist method, such as running only mobile code that matches a registered hash value
- For critical computer-based system, disable it completely, for example, by removing your web browser or by setting a policy that prevents Mobile code from working.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **No web access (client) functionality**

If a generic operating system (generic OS) such as Windows is not used, in most cases, applications that can run mobile code through web access (client) function (browser, document viewer, mail client, etc.) are not implemented. If there is no web access, the mobile code is not automatically downloaded. In such cases, this requirement does not apply.

Document reviews

Description of security capabilities

	11. Mobile code
☐	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
☐	(1) The capability to control the use of mobile codes
☐	(a) Capability to control the use of mobile codes (e.g., remove browsers, prohibit mobile code behaviour in policy settings).
☐	(2) Compensating countermeasure
☐	(a) Protect against the same threats as the original requirement
☐	(b) Provide an equal level of protection as the original requirement
☐	(c) Not be a security control that is required by other requirements
☐	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	11. Mobile code
☐	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
☐	(1) The Demonstration test for the capability to control the use of mobile codes
☐	(a) Control the use of mobile codes (e.g., remove browsers, prohibit mobile code behaviour in policy settings).
☐	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

12. Session lock

Reg. Table X4.1 Item 12, Part X of the Rules	Ref. IEC62443-3-3 / SR 2.5

The computer-based system is to be able to prevent further access after a configurable time of inactivity or following activation of manual session lock.

Explanation

Summary

Item 12, Table X4.1, Part X states that a capability of session lock, either automatic or manual, is to be provided. **Session** is the series of operations from the time users log into the system until they log out. Locking a session when the system has not been operated for a certain period is called session lock. **Session lock** is the locking of a session when the system is inactive for a certain period.

Purpose

The purpose is to reduce the risk of session abuse during periods of inactivity. If a session cannot be locked, an attacker can hijack the session. As a result, system availability may be lost due to unauthorized manipulation of the system.

Countermeasures

The countermeasure described here is the capability of session lock, either automatically or manually.

- **Automatic session lock.**
  The inactivity period is configurable. On the other hand, the application of this function to systems that directly affect ship navigation is not recommended, as it may compromise availability.
- **Manual session lock.**

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **In the case that the capability of "1. Human user identification and authentication" is as a compensating countermeasure or the requirement is not applicable.**

If the capability to identify and authenticate the user is not implemented, there is no capability for the account. In this case, this requirement is not applicable.

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Description of security capabilities

	12. Session lock
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) Session lock functionality, either automatic or manual
□	(a) For automatic session locks, the following is to be checked:
□	i) The session locks after a period of inactivity
□	ii) The inactivity period is configurable.
□	(b) For manual session locks, the following is to be checked:
□	i) Session lock is manually enabled.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	12. Session lock
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) For automatic session locks, the following is to be checked:
□	(a) The session locks after a period of inactivity
□	i) The inactivity period is configurable.
□	ii) For manual session locks, the following is to be checked:
□	(b) Session lock is manually enabled.
□	i) For automatic session locks, the following is to be checked:
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

13. Auditable events

Reg. Table X4.1 Item 13, Part X of the Rules

Ref. IEC62443-3-3 / SR 2.8

The computer-based system is to generate audit records relevant to security for at least the following events: access control, operating system[1] events, backup and restore events, configuration changes, loss of communication.

Explanation

Summary

Item 13, Table X4.1, Part X states that the requirement to generate audit records of important events relevant to security. “Audit records” are records of important events relevant to security.

Purpose

The purpose is to record important events that need audits. If an essential record is lacking, the audit will not be proper, making it difficult to analyse the cause of the incident.

Countermeasures

The countermeasure described here is to generate audit records of important events. Specifically, audit records of the following events are necessary:

- **Access control**

This is the means to restrict who can access a computer or network. Successful and failed login attempts, changes in access privileges, etc. are examples. By recording these events, unauthorized access and abuse of privileges can be traced.

- **Operating system events**

This refers to all OS-related[1] activities such as system startup and shutdown, system errors, software updates and installations, etc.

- **Backup and restore events**

Records activities related to data backup and restoration, including backups and restores, successful and failed backups, etc.

- **Configuration changes**

It means timestamp, procedure, and account of the system setting changes. The settings include security settings, network settings, and user permission settings.

[1] **Operating System:** The software that serves as the foundation for running a computer system, or OS for short. A commonly used OS, such as Windows, is called a general-purpose OS.

- **Loss of communication**

Records interruptions and loss of network connectivity, interruptions in communication between components of the control systems, and events that prevent the system from connecting to the network. This record enables the identification of network attacks and connectivity problems.

Compensating countermeasures

If these capabilities are not implemented, compensating countermeasures are to be taken an example of a compensating countermeasure:

- **Audit records are produced by an external monitoring system.**

External monitoring systems can complement this requirement by recording the events. An external monitoring system could be, for example, a network monitoring system (NMS).

Scope

This requirement, in principle, applies to all computer-based systems.

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Description of security capabilities

	13. Auditable events
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The function to generate audit records of important events
□	(a) The audit records of the following events are necessary
□	i) Access control
□	ii) Operating system events
□	iii) Backup and restore events
□	iv) Configuration changes
□	v) Loss of communication
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	13. Auditable events
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) The tests of the function to generate audit records of important events
□	(a) It is to be confirmed the audit records of the following events can be generated.
□	i) Access control
□	ii) Operating system events
□	iii) Backup and restore events
□	iv) Configuration changes
□	v) Loss of communication
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

14. Audit storage capacity

Reg. Table X4.1 Item 14, Part X of the Rules	Ref. IEC62443-3-3 / SR 2.9

The computer-based system is to provide the capability to allocate audit record[1] storage capacity according to commonly recognized recommendations for log management. Auditing mechanisms are to be implemented to reduce the likelihood of such capacity being exceeded.

Explanation

Summary

Item 14, Table X4.1, Part X states that the requirement to allocate sufficient audit record[1] storage capacity according to commonly recognized recommendations for log management and system configuration. The NIST[2] Special Publication (SP) 800-92 is an example of them.

It also states that the audit function should be implemented in such a way as to reduce the likelihood of exceeding the capacity. The function ensures the capacity to supplement audit records over the required period.

Purpose

The purpose is to store audit records needed for audits. If storage for records is insufficient, the audit record will be lacking, making it difficult to analyse the threat of the incident.

Countermeasures

The countermeasure described here is the capability allocating sufficient audit record storage capacity according to commonly recognized recommendations for log management and system configuration and an audit mechanism reducing the likelihood of exceeding the capacity. Specifically, they will be the following:

- **Ensuring sufficient audit record storage capacity based on general recommendations**

Needs to allocate sufficient audit record storage capacity considering guidelines and policies stating general recommendations like NIST SP 800-92.

- **Ensuring the capacity to supplement audit records over the required period**

In designing the capacity of audit records, the amount of audit logs in a certain period and the period sufficient capacity is available are to be considered.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities

[1] **Audit record** Single record of significant security events

or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

- **Output function of the records to external storage devices.**

In designing the capacity of audit records, the amount of audit logs in a certain period and the period sufficient capacity is available are to be considered.

If storing the records needed for audits is impossible, complement this function by putting out the records to external storage. In this case, the specification of export functions needs is to be clearly stated, such as the need for export in a certain period.

Scope

This requirement does not apply to the following cases.

- **In "13. Auditable events", compensating countermeasures are either to be adopted or the requirements do not apply.**

If the capability to generate audit records is not implemented, there is no identifier. In such cases, this requirement is not applicable.

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Document reviews

Description of security capabilities

	14. Audit storage capacity
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capabilities allocating sufficient audit record storage capacity according to commonly recognized recommendations for log management
□	(a) Based on commonly recognized recommendations for log management（e.g. NIST SP800-92）。
□	(b) Ensuring the capacity to supplement audit records over the required period.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

■ Test procedure of security capabilities

	14. Audit storage capacity
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) The Demonstration test for the capability allocating sufficient audit record storage capacity according to commonly recognized recommendations for log management
□	(a) Based on commonly recognized recommendations for log management（e.g. NIST SP800-92）。
□	(b) Ensuring the capacity to supplement audit records over the required period.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

15. Response to audit processing failures

Reg. Table X4.1 Item 15, Part X of the Rules	Ref. IEC62443-3-3 / SR 2.10

The computer-based system is to provide the capability to prevent loss of essential services and functions in the event of an audit processing failure.

Explanation

Summary

Item 15, Table X4.1, Part X states that the need to prevent the loss of essential services and functions when the audit process fails. The audit process is the process that involves the audit record[1]. The audit process is related to the audit record, including to generate the audit record. Typical possible failures are software or hardware errors in the system, a failure of the audit process, or an excess of storage capacity. In addition, essential services and functions mean those whose failure will be fatal to vessel operation. Therefore, the essential functions must not fail in the event of an error in the processing involved in the audit record.

Purpose

The purpose is to prevent the risk of loss of essential services and functions due to the audit process. If the audit process and essential services and functions are part of the same process, the failure of the record function can cause an outage of essential functions.

Countermeasures

The countermeasure described here is the capability to prevent the loss of essential services and functions in the event of a failure of the audit process. Separating audit functions from essential functions is one of the examples.

Here, essential services refer to services necessary for maintaining propulsion and steering and for maintaining ship safety. For example, they refer to control devices for propulsion and steering systems and control devices for related equipment (such as power generation systems) for maintaining propulsion and steering.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

[1] **Audit record** Single record of significant security events

This requirement does not apply to the following cases.

- **In "13. Auditable events", compensating countermeasures are either to be adopted or the requirements do not apply.**

If the capability to generate audit records is not implemented, there is no identifier. In such cases, this requirement is not applicable.

Auditable events P. 88

Document reviews

Description of security capabilities

	15. Response to audit processing failures
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) Capabilities to prevent the loss of essential services and functions when the audit process fails
□	(a) Prevent the loss of essential services and functions in the event of a failure of the audit process. (e.g., Separating audit functions from essential functions)
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	15. Response to audit processing failures
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for Capabilities to prevent the loss of essential services and functions when the audit process fails
□	(a) Prevent the loss of essential services and functions in the event of a failure of the audit process. (e.g., Separating audit functions from essential functions)
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

16. Timestamps

Reg. Table X4.1 Item 16, Part X of the Rules	Ref. IEC62443-3-3 / SR 2.11

The computer-based system is to timestamp audit records.

Explanation

Summary

Item 16, Table X4.1, Part X states that the audit record must include the date and time of the events.

Purpose

The purpose is to create a timeline of when the events requiring audit occurred. Without the timeline, analysis of the cause will be difficult.

Countermeasures

The timestamp does not need to synchronize with other systems.

The countermeasure described here is the capability to record the date and time. Specifically, it is a time stamp. A timestamp is the date and time when a specific event is generated as a log.

For reliability, it is recommended to use dedicated clock hardware (e.g., real-time clock IC[1]) or a system internal clock (system clock[2]) to generate timestamps. When using a system clock, it is possible to record the date and time by reading the counted value of the operation time after startup as the date and time.

It is desirable to synchronize timestamps with other systems to enable a consistent analysis of time series. However, this synchronization is not required by the rule.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases.

- **In "13. Auditable events", compensating countermeasures are either to be adopted or the**

[1] **Real-time clock IC:** An integrated circuit maintains the current date and time. It has a backup battery and maintains the time even if the system is off.

[2] **System clock**: A clock on the system. It is based on the number of operations of hardware at a fixed period (e.g., arithmetic unit).

requirements do not apply.

If the capability to generate audit records is not implemented, there is no identifier. In such cases, this requirement is not applicable.

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Document reviews

Description of security capabilities

	16. Timestamps
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to include the date and time in the audit record
□	(a) To include the timestamp in the audit record (e.g., Real-time clock IC, System clock)
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	16. Timestamps
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to include the date and time in the audit record
□	(a) To include the timestamp in the audit record (e.g., Real-time clock IC, System clock)
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

17. Communication integrity

Reg. Table X4.1 Item 17, Part X of the Rules	Ref. IEC62443-3-3 / SR 3.1

The computer-based system is to protect the integrity of transmitted information.

Note: Cryptographic mechanisms are to be employed for wireless networks.

Explanation

Summary

Item 17, Table X4.1, Part X states that the integrity of the information transmitted is to be protected. **Integrity** means that the information is accurate and complete. This means that there needs to be a mechanism to ensure that information is not tampered with and that the information is transmitted as it is.

Purpose

The purpose is to prevent the risk of information that is transmitted being improperly altered, deleted and destroyed. If the information transmitted is tampered with, this could lead to a loss of confidence in the information and threaten the safety of the navigation.

Countermeasures

The countermeasure described here is the capability of the receiver of the information to verify that the information has been tampered with. The specific functions are as follows.

- **Implementation of the ability to detect differences between incoming and outgoing data (e.g. checksum, hash, message authentication code (MAC), etc.)**
- **When there is a discrepancy between the received data and the transmitted data, the function requests the sender to retransmit or discards the data.**
- **When the received data continues to differ from the transmitted data, an alarm is triggered.**

If wireless communication is used, a high-strength cryptographic algorithm is to be used together to protect the integrity. Therefore, simple checksums and hashes are not sufficient, and integrity protection using cryptographic mechanisms such as TLS is required. Because, under wireless communication, signals in transmission can easily be tampered with from outside the computer-based system. Cryptography is explained in more detail in Item No.22. Use of cryptography. Also, the use of cryptography to protect integrity is explained in more detail in Item "No.38. Cryptographic integrity protection".

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To prevent signals from being affected by environmental conditions, such as onboard electromagnetic interference from being treated as false positive security incidents, appropriate measures for electromagnetic shielding, waterproofing, and dustproofing are also effective.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

- **Physical access control**

Instead of providing Communication integrity as a function, you can complement this function by restricting physical access. For example, physical access control can be limited by placing the entire communication path, such as ports and cables, in a locked disk or console and using a direct serial link (such as Modbus-RTU) as the communication protocol. This prevents the communication from being tampered with. In addition, special consideration must be given to the effects of the onboard environment, including electromagnetic interference.

Scope

This requirement, in principle, applies to all computer-based systems.

Document reviews

Description of security capabilities

	17. Communication integrity
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to protect the integrity of transmitted information
□	(a) The following functions are to be provided
□	i) When there is a discrepancy between the received and transmitted data, a function to request the sender to retransmit the data.
□	ii) A function to issue an alarm when discrepancies between the received and transmitted data continue to be detected.
□	(b) Where wireless communications are used, the information transmitted is to be encrypted.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement

□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	17. Communication integrity
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for capability to protect the integrity of transmitted information
□	(a) The following functions are to be provided
□	i) When there is a discrepancy between the received and transmitted data, a function to request the sender to retransmit the data.
□	ii) A function to issue an alarm when discrepancies between the received and transmitted data continue to be detected.
□	(b) Where wireless communications are used, the information transmitted is to be encrypted.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

18. Malicious code protection

Reg. Table X4.1 Item 18, Part X of the Rules

Ref. IEC62443-3-3 / SR 5

The computer-based system is to provide capability to implement suitable protection measures to prevent, detect and mitigate the effects due to malicious code or unauthorized software. It is to have the feature for updating the protection mechanism.

Explanation

Summary

Item 18, Table X4.1, Part X states that it is necessary to implement suitable protection measures to prevent, detect and mitigate the effects due to malicious code or unauthorized software. Malicious code or unauthorized software is any program or software that is designed to intentionally cause a system to behave in an unauthorized and harmful manner, commonly referred to as **malware**.

Purpose

The purpose is to minimize the risk from malware.

Countermeasures

The countermeasure described here is the capability to implement suitable protection measures to prevent, detect and mitigate the effects due to malware. Specifically, it is a combination of the following features.

- **Capability to prevent the effects of malware**

This is a means to prevent malware from entering the system. These include application whitelist restrictions to limit malware launch, removable media execution restrictions, and sandbox[1] functionality.

- **Capability to detect the effects of malware**

A means of checking whether malware has entered the system. These include intrusion detection systems (IDS), malware scanning, anti-malware software[2], and detection by endpoint security software, etc..

- **Capability to mitigate the effects of malware**

[1] Sandbox: The ability to run software in an isolated virtual environment that is used to contain the impact of software operations on systems. A security mechanism that can safely inspect and run unknown programs and files and prevent malware from affecting key systems.

[2] Anti-malware software: A generic term for software that prevents malware from entering a system. There are two types of anti-malware software: blacklist-type anti-malware software that detects and isolates programs that match a pre-listed pattern of malware, and whitelist software that blocks programs other than pre-registered software.

A means of minimizing the impact of malware when it occurs. This includes deleting files and isolating infected terminals.

In addition, these countermeasures are required to be regularly updated so that the mechanisms in place can function effectively.

When updating, in addition to the procedure for updating anti-malware software, it is necessary to consider updating the malware definition file (A database of programs considered to have adverse effects in advance for blacklist anti-malware software).

■ Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

- **External security devices**

External security devices, such as firewalls, can complement this capability by preventing, detecting, and reducing malware. In this case, it is necessary to use one-way communication to prevent program transmission over the network to the protected system, or to use a firewall with mechanisms such as deep packet inspection (DPI) to detect abnormalities in the transmitted data itself. Special consideration should also be given to access control to interfaces such as USB.

■ Scope

This requirement does not apply to the following cases:

- **Not to use a general-purpose OS**[1]

Malware is usually targeted at general-purpose operating systems such as Windows, Linux, and UNIX. Therefore, computer-based systems with proprietary operating systems that do not use general-purpose operating systems are likely to be free of malware, and this requirement does not apply.

Document reviews

■ Description of security capabilities

	18. Malicious code protection
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to implement suitable protection measures to prevent, detect and mitigate the effects due to malware

[1] **General-purpose OS**: A general operating system. For example, Windows.

□	(a) The following capabilities are to be implemented:
□	i) Capability to prevent the effects of malware (e.g., Application whitelist restrictions, removable media execution restrictions, Sandbox capabilities)
□	ii) Capability to detect the effects of malware (e.g., intrusion detection system (IDS), anti-malware scan)
□	iii) Capability to mitigate the effects of malware (e.g., delete files, quarantine infected terminals)
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	18. Malicious code protection
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to implement suitable protection measures to prevent, detect and mitigate the effects due to malware;
□	(a) The following capabilities are implemented:
□	i) Capability to prevent the effects of malware (e.g., Application whitelist restrictions, removable media execution restrictions, Sandbox capabilities)
□	ii) Capability to detect the effects of malware (e.g., intrusion detection system (IDS), anti-malware scan)
□	iii) Capability to mitigate the effects of malware (e.g., delete files, quarantine infected terminals)
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

19. Security functionality verification

Reg. Table X4.1 Item 19, Part X of the Rules | Ref. IEC62443-3-3 / SR 3.3

The computer-based system is to provide the capability to support verification of the intended operation of security functions and report when anomalies occur during maintenance.

Explanation

Summary

Item 19, Table X4.1, Part X states that it is necessary to support verification of the intended operation of security functions. In this section, security functions are all of the security capabilities required by Chapter 4 of Part X (UR E27) that are implemented. This means it is necessary to ensure the implemented security functions work correctly.

In addition, it is necessary to report when anomalies occur during maintenance. In other words, in addition to being able to perform the implemented security functionality verification tests, it is also necessary to be able to check the reporting function when a security abnormality occurs. Given that it is practically difficult to verify such functionality while the operation is running, this requirement requires that it be able to verify the reporting function during maintenance (during planned maintenance hours).

Purpose

The purpose is to implement the security capabilities required by Part X, Chapter 4 (UR E27) in the computer-based system and to verify that the capabilities are performing the operation successfully to satisfy the requirements. If proper testing is not implemented, the security capabilities may not function when needed. Furthermore, if an anomaly occurs during maintenance, it is necessary to report it to increase confidence in maintenance.

Countermeasures

The countermeasures are the capability to support verification of the intended operation of security functions and the capability to report when anomalies occur during maintenance. This requirement requires the ability to verify the operation of implemented security features. This will verify the integrity of all features required by UR E27 but does not necessarily mean that all test procedures are performed. Specifically, they are as follows:

・**Verifying login capability**

For example, in the capability for authenticating people, if a login is attempted by an invalid identifier (IDs) and authentication codes (e.g., passwords), the login is denied.

・**Verifying anti-malware capability**

For example, when anti-malware software is installed, you can use dummy malware (such as EICAR) that is harmless even if it is infected, to see how it reacts to malware.

Note: These capabilities are used by the owner to maintain the system. To support their use, the supplier should include instructions on how to verify these capabilities in “Plans for maintenance and verification of the computer-based system”.

Plans for maintenance and verification of the computer-based system **P. 33**

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement, in principle, applies to all computer-based systems.

Document reviews

Description of security capabilities

	19. Security functionality verification
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to support verification of the intended operation of security functions and report when anomalies occur during maintenance
□	(a) Capability to support verification of the intended operation of security functions
□	Verify the intended operation of security functions
□	(b) Capability to report when anomalies occur during maintenance
□	Report when anomalies occur during maintenance (e.g., if antivirus software is installed, a message is output when virus or malware identification codes or patterns fail to update, etc.)
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce higher security risk

Surveys

Test procedure of security capabilities

	19. Security functionality verification
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) The demonstration test for the capability to support verification of the intended operation of security functions and report when anomalies occur during maintenance
□	(a) Capability to support verification of the intended operation of security functions
□	i) Verify the intended operation of security functions
□	(b) Capability to report when anomalies occur during maintenance
□	i) Report when anomalies occur during maintenance (e.g., if antivirus software is installed, a message is output when virus or malware identification codes or patterns fail to update.)
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

20. Deterministic output

Reg. Table X4.1 Item 20, Part X of the Rules	Ref. IEC62443-3-3 / SR 3.6

The computer-based system is to provide the capability to set outputs to a predetermined state if normal operation cannot be maintained as a result of an attack. The predetermined state could be the following:

- unpowered state,
- last-known value, or
- fixed value.

Explanation

Summary

Item 20, Table X4.1, Part X states that it is necessary to set outputs to a predetermined state if normal operation cannot be maintained as a result of an attack. "Predetermined state" is as follows.

Term	Description
Unpowered state	The system is turned off.
Last-known value	The value that the system was outputting just before the system was attacked.
Fixed value	The specific value that has been pre-set by the system. This value is determined by the owner or other parties.

Purpose

The purpose is to make the entire system more secure and easier to resolve by maintaining a specific state, even if the system is incompetent by an attack. As an example, suppose a system controlling a marine plant is attacked. If the system experiences an unexpected output due to an attack, it may cause equipment to malfunction and prevent normal operation. In such a case, safety can be ensured by moving to a predetermined state, such as shutting down the system or returning it to a safe operating range.

Countermeasures

The countermeasure described here is to ensure the system can maintain normal operation in the event of possible attacks, including DoS attacks, by having the capability to set outputs to a predetermined state. This capability is necessary to change to the specified state described above.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

・**Adoption of system isolation and passing control to users**

Disconnection of a system, migration to another system (For example, transition from a remote-control system to machine-side control system), and transfer of operation rights to a user fall under compensating countermeasures.

Scope

This requirement, in principle, applies to all computer-based systems.

Document reviews

Description of security capabilities

	20. Deterministic output
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to set outputs to a predetermined state
□	The output can be changed to at least one of the following states
□	(a) Unpowered state
□	(b) Last-known value, or Fixed value
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	20. Deterministic output
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) The Demonstration test for the capability to set outputs to a predetermined state
□	The output can be changed to at least one of the following states
□	(a) Unpowered state
□	(b) Last-known value, or Fixed value
□	(2) Confirmation of compensating countermeasure

	Confirm that the information is as described in Description of security capabilities.

21. Information confidentiality

Reg. Table X4.1 Item 21, Part X of the Rules	Ref. IEC62443-3-3 / SR 4.1

The computer-based system is to provide the capability to protect the confidentiality of information for which explicit read authorization is supported, whether at rest or in transit.

Note: For wireless network, cryptographic mechanisms are to be employed to protect confidentiality of all information in transit.

Explanation

Summary

Item 21, Table X4.1, Part X states that confidentiality protection of information for which explicit authorization is required with respect to reading, whether in storage or in transmission.

Reading means retrieving information from a database or file. For example, when viewing a web page on the Internet, the browser reads data from the web server to display the page. At this time, the data for display is stored on the server and transmitted via communication.

In addition, information that requires explicit authorization is only to be accessed by authorized persons. This explicitly authorized information that requires authorization to obtain must be kept confidential both at rest and in transit.

Purpose

The purpose is to ensure the confidentiality of information that can only be accessed by authorized persons. If the confidentiality of information is compromised, it may lead to information leaks or unauthorized information use.

Countermeasures

The countermeasures here are capabilities to protect the confidentiality of information that requires explicit authorization for reading. Specifically, the measures are as follows:

- **Capability to protect the confidentiality of information in storage.**

For example, the ability to encrypt confidential information, which is a way to secure Information confidentiality that you store.

- **Capability to protect the confidentiality of information during transmission**

This is a way to ensure confidentiality, such as by encrypting communications. If a CBS has a physical security environment, it can communicate via a one-to-one wired connection to ensure confidentiality during transmission.

In addition, when wireless communication is used, cryptographic mechanisms must be employed because of the possibility that data in transmission may be accessed. For cryptographic mechanisms, please refer to “22. Use of cryptography”.

📖 Use of cryptography P. 113

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement, in principle, applies to all computer-based systems. If the information is not transmitted, the confidentiality of the information during transmission is not applicable.

In addition, signals that do not need to be protected (not confidential information) in the transmission of information, such as control command values and measured values, can be excluded from the application of Information confidentiality during transmission. However, it is necessary to consider whether the signal constitutes confidential information for stakeholders such as suppliers or users.

Document reviews

Description of security capabilities

	21. Information confidentiality
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) Confidentiality protection capabilities of information for which explicit authorization is required with respect to reading, whether in storage or in transmission
□	(a) The following capabilities are to be confirmed.
□	i) Capabilities to protect the confidentiality of information in storage.
□	ii) Capabilities to protect the confidentiality of information during transmission.
□	(b) When wireless communication is used, cryptographic mechanisms are to be employed.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	21. Information confidentiality
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration of the ability to protect the confidentiality of information requiring explicit permission to be read, whether in storage or transit
□	(a) The following capabilities are implemented:
□	i) Verify the ability to protect information confidentiality at rest
□	ii) Verify the ability to protect information confidentiality during transmission
□	(b) If using wireless communications, ensure that cryptographic mechanisms are used to protect all Information confidentiality in transit.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

22. Use of cryptography

Reg. Table X4.1 Item 22, Part X of the Rules	Ref. IEC62443-3-3 / SR 4.3

If cryptography is used, the computer-based system is to use cryptographic algorithms, key sizes and mechanisms according to commonly accepted security industry practices and recommendations.

Explanation

Summary

Item 22, Table X4.1, Part X states that the recommended cryptographic algorithms, key sizes, and mechanisms are needed. Descriptions of the cryptographic algorithms, key lengths, and mechanisms are following.

Terms	Descriptions
Cryptographic algorithm	The procedures and rules for encrypting and decrypting (restoring) data.
Key size	The number of bits that make up a key. The greater the number of bits, the more combinations of keys, and the stronger the cryptographic.
Key mechanism	How keys are generated and managed. Management includes, for example, periodic changes, destruction, key distribution, and cryptographic key backup.

Purpose

The purpose is to ensure the integrity and confidentiality of the encrypted information.

Countermeasures

The countermeasure described here is to employ cryptographic schemes in accordance with generally accepted security industry practices and recommendations. “Generally accepted security industry practices and recommendations” include followings:

- **ISO/IEC 19790**
- **NIST[1] SP800-57**
- **NIST FIPS14**

Compensating countermeasures

[1] **NIST**: National Institute of Standards and Technology

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **In case of no use of cryptographic.**

If cryptography is not used, this requirement does not apply.

Document reviews

Description of security capabilities

	22. Use of cryptography
□	-1. If this requirement applies, any of the following mechanisms or countermeasures (1) or (2) is to be implemented:
□	(1) Cryptographic algorithm, key length, and mechanism according to generally accepted security industry practices and recommendations
□	Generally accepted security industry practices and recommendations are employed for the following items
□	(a) Cryptographic algorithm
□	(b) Key size
□	(c) Key mechanism
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

	22. Use of cryptography
	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration of cryptographic algorithms, key sizes and mechanisms implemented in accordance with generally accepted security industry practices and recommendations
	(a) If cryptographic is used, verify that the cryptographic protocol is used as described in the security function specification.
□	(1) Confirmation of compensating countermeasure

	Confirm that the information is as described in Description of security capabilities.

23. Audit log accessibility

Reg. Table X4.1 Item 23, Part X of the Rules	Ref. IEC62443-3-3 / SR 6.1

The computer-based system is to provide the capability for accessing audit logs on read only basis by authorized humans and/or tools.

Explanation

Summary

Item 23, Table X4.1, Part X states that authorized persons and/or tools must have read-only access to the audit log. An authorized human user is a person authorized to use this function, primarily an administrator. Authorized tools, on the other hand, are programs authorized to use this functionality. An example would be software for monitoring and analysing security-related events and alerts, called SIEM[1]. An audit log is a chronological collection of audit records[2]. It can be viewed as a compilation of multiple audit logs.

Purpose

The purpose is to reduce the risk of audit logs being altered.

Countermeasures

The countermeasure here will be the function of read-only access to the audit log by authorized human users and/or tools.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **In "13. Auditable events", compensating countermeasures are either to be adopted or the requirements do not apply.**

If the capability to generate audit records is not implemented, there is no identifier. In such cases, this requirement is not applicable.

[1] **SIEM**: Security Information and Event Management
[2] **Audit record**: Single record of significant security events

Auditable events

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Document reviews

Description of security capabilities

	23. Audit log accessibility
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The function of read-only access to the audit log by authorized human users and/or tools.
□	(a) The function of access to the audit log by authorized human users and/or tools.
□	(b) The access to the audit log is read-only.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	23. Audit log accessibility
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Capability to set output to a predefined state
□	(a) Conform to the following items.
□	i) Access to the audit log by authorized human users and/or tools is available.
□	ii) Access to the audit log by unauthorized human users and/or tools is not available.
□	(b) The access to the audit log is read-only.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

24. Denial of service protection

Reg. Table X4.1 Item 24, Part X of the Rules	Ref. IEC62443-3-3 / SR 7.1

The computer-based system is to provide the minimum capability to maintain essential functions during DoS events.

Note: It is acceptable that the computer-based system may operate in a degraded mode upon DoS events, but it shall not fail in a manner which may cause hazardous situations. Overload-based DoS events, i.e., the networks capacity flood attacks are attempted and computer resources are about to be consumed, should be considered.

Explanation

Summary

Item 24, Table X4.1, Part X states that essential functions are to be maintained during DoS events. DoS, which stands for "Denial of Service", is an attack technique that causes systems to fail by sending large amounts of information to servers or other devices in an attempt to cause them to overload. This rule assumes an attack that sends a large amount of information to an OT system to consume too much network capacity or system resources.

Purpose

The purpose is to prevent the risk of DoS attacks shutting down essential functions, since such attacks can compromise availability and even cause total system outages. Therefore, measures are required to maintain essential functionality. Essential functions are services required to maintain propulsion and steering, and to maintain the safety of the ship. For example, they are the controllers of propulsion and steering systems and the controllers of related equipment (such as power generation systems) to maintain propulsion and steering.

In response to this requirement, network flooding and application layer attacks must be considered in light of the requirements in Part X, Chapter 5, 5.4.3 (2), "Network protection safeguards".

・**Network flooding：**

The network is in a storm condition (bandwidth saturation). Storm by looping the network (broadcast storm) or sending many packets to a particular system (unicast flood) to ensure critical functionality is maintained.

・**Application layer attack：**

An attack that consumes the processing capacity of a terminal in a network by sending communications that require processing by an application. This includes excessive requests for communication protocols (such as SSL/TLS), concentrated access to control protocols (such as Modbus TCP), and excessive data transmission (NMEA sentences). Data flows that exceed the processing capacity of the application are sent using tools, etc., and the evaluation is made of whether essential functions are maintained in this state.

■ Countermeasures

The following countermeasures provide minimal functionality to maintain essential functions during DoS events.

- **Prioritizing Processes**

To maintain critical processes under the influence of a DoS attack, it is effective to give high priority to critical processes and lower priority to less critical processes such as ship-land communications processing. This enables a transition to effective degraded operation (operation that maintains essential functions).

- **Limit the IP addresses that can be accessed**

To minimize the impact of a denial-of-service attack, you can also drop communications other than from predetermined IP addresses on trusted networks.

■ Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

- **External security devices restrict the IP addresses that can be accessed.**

External perimeter protection devices (firewalls, intrusion detection systems (IDS), etc.) can complement this capability by restricting the IP addresses that can be accessed.

■ Scope

This requirement does not apply to the following cases:

- **In case of no use of IP communication.**

This requirement does not apply if computer-based system does not have a communication function that can cause a DoS attack, such as an IP communication function, and cannot be the target of an attack.

Document reviews

■ Description of security capabilities

	24. Denial of service protection
☐	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.

□	(1)	Minimum capability to maintain essential functions during DoS events
□		Maintenance of essential functions during DoS events (e.g., deprioritising communication processes)
□	(2)	Compensating countermeasures
□		(a) Protect against the same threats as the original requirement
□		(b) Provide an equal level of protection as the original requirement
□		(c) Not be a security control that is required by other requirements
□		(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	24. Denial of service protection	
□	-1.	If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1)	Demonstration test for Minimum capability to maintain essential functions during DoS events
□		Maintenance of essential functions during DoS event (e.g., confirming the results of DoS event simulation tests)
□	(2)	Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

25. Resource management

Reg. Table X4.1 Item 25, Part X of the Rules	Ref. IEC62443-3-3 / SR 7.2

The computer-based system is to provide the capability to limit the use of resources by security functions to prevent resource exhaustion.

Explanation

Summary

Item 25, Table X4.1, Part X states that the use of resources by security features should be restricted, in which "resources" refer to the physical or logical resources available to a system such as CPU processing time, process memory, storage capacity, and network bandwidth.

Purpose

The purpose is to prevent security functions from running out of resources. The following are some examples of security functions affected by a resource shortage and the corresponding expected events.

Cause security functions	Expected events
Virus scanning by antivirus software	Slow down the CPU
	Run out of free memory
Long-term security log storage	Run out of hard disk memory

Countermeasures

The countermeasures described here restrict the use of resources by security functions. It is necessary to implement functions that prevent a shortage of resources in response to security functions or expected events that cause a shortage of resources. For example, the following countermeasures can be adopted.

Cause security functions or Expected events	Countermeasure
Virus scanning by antivirus software	Scan outside system operating hours.
	Stops scanning when the free space of a resource falls below a certain value.
Long-term security log storage	When the log is written, the remaining capacity is

	checked, and an alarm is raised if it is running out.
	Change to the ring buffer method[1].
Network bandwidth compression	The communication amount is controlled by a rate limiting.

■ Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

- **Ensure sufficient resources**

This function ensures that sufficient resources are available to prevent security functions from running out of resources. In such cases, a rationale for sufficient resources is to be provided.

■ Scope

This requirement, in principle, applies to all computer-based systems.

Document reviews

■ Description of security capabilities

	25. Resource management
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) Capability to restrict the use of resources by security functions to avoid exhausting resources
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

■ Test procedure of security capabilities

	25. Resource management

[1] **Ring buffer method**: A data storage system used cyclically in buffer areas for temporarily storing data in which old data is overwritten in the order added to free up additional space for new data.

□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to restrict the use of resources by security functions so that resources are not exhausted
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in the security capability descriptions.

26. System backup

Reg. Table X4.1 Item 26, Part X of the Rules	Ref. IEC62443-3-3 / SR 7.3

The identity and location of critical files and the ability to conduct backups of user-level and system-level information (including system state information) are to be supported by the computer-based system without affecting normal operations

Explanation

Summary

Item 26, Table X4.1, Part X states that two things about backup the system are required.

- Backup critical files
- Backup does not affect normal operations

Purpose

The purpose is to ensure that important files are backed up.

Countermeasures

The countermeasures described here backup critical files that may need to be recovered at some point. The files to be backed up are determined by the system and are backed up in a manner they do not affect normal system operations.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

- **Replacing with a spare system**

Replacing original systems with spares can compensate for said systems' functions. In such cases, however, it is important that the spares have the same settings as the original system. In addition to the system itself, spares may include portable media such as CDs and DVDs. At this time, regarding the handling of system data, it is necessary to consider whether it is necessary to periodically synchronize the data to the spare parts, and if not, whether the operation will be hindered if the spare parts are reset to the state at the time of shipment. In addition, it is required to adopt a system to update the spare parts to the latest state when the program is changed.

Scope

This requirement does not apply to the following cases:

・**When there is no need to back up**

The purpose of a backup is to allow recovery of critical files and other information in cases where systems go down due to reprogramming by attackers. Therefore, backups are not required for programs, data that are written directly to the hardware, such as embedded systems using firmware, that cannot be overwritten. This refers to cases where the system's programs are written on read-only storage media and cannot be physically rewritten. In this case, changes to the program are made by physically replacing the memory in which the program was written.

Document reviews

Description of security capabilities

	26. System backup
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) Capability to back up critical files to be recovered
□	(a) Backup of data needed to recover the system
□	(b) Does not affect normal operation
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	26. System Backup
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstrated capability to back up critical files to be recovered Backup of data needed to recover the system
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in the security capability descriptions.

27. System recovery and reconstitution

Reg. Table X4.1 Item 27, Part X of the Rules	Ref. IEC62443-3-3 / SR 7.4

The computer-based system is to provide the capability to be recovered and reconstituted to a known secure state after a disruption or failure.

Explanation

Summary

Item 27, Table X4.1, Part X states that systems should be capable of being recovered and reconstituted to a known secure state after any disruption or failure.

Purpose

The purpose is to quickly recover and reconfigure a system back to a previous state after an incident has occurred.

Countermeasures

The countermeasures described here help recover and reconfigure a system to a known secure state after any disruption or failure. The known secure state is the state of the system when backups are performed at the frequency determined by the user (shipowner) policy. More specifically, the following are examples of such countermeasures.

- **Recovery capability**

Recovery capability refers to the overall process by which a system or application recovers from a failure or failure. A known secure state means following:

- System parameters are set to default[1] or secure value
- Security-critical patches[2] are reinstalled
- Security-related configuration is rechecked and re-established
- System documentation and operating procedures are available
- Application and system software is reinstalled with secure setting
- Reconstitution from the backup data

Note: Recovery and reconfiguration to known secure state may be difficult to achieve with security capability alone, such as reinstalling patches or applications, or reconfiguring security

[1] **Default**: The standard values, conditions, and operating conditions that the system ships with.
[2] **Patch**: A program that fixes system vulnerabilities and security defects.

settings. Therefore, it is needed to specify how to do this in the instructions for restoring to known secure states. These instructions will serve as reference documents required to be submitted to the Society as “Information supporting the owner’s incident response and recovery plan”. Surveys carried out in the presence of a Society surveyor verify that the system can be restored and reconfigured to a known secure state in accordance with the methods specified in this document. The following links provide more information about this document.

Information supporting the owner’s incident response and recovery plan P. 34

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

- **Restoring and reconfiguring to a known secure state immediately after an incident by replacing the original system with a spare**

System access is complemented by controlling ports with external network devices, such as firewalls. In such cases, the aforementioned “Information supporting the owner’s incident response and recovery plan” is to include instructions for replacing original systems with spares. Points to keep in mind when using spare parts are explained in detail in "26. System backup."

System backup P. 124

Scope

This requirement generally applies to all computer-based systems

Document reviews

Description of security capabilities

	27. System recovery and reconstitution
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) Capability to be recovery and reconstitution to a known secure state after a disruption or failure Capability to achieve the following events: It is not necessary to achieve all events by this capability.
□	(a) System parameters are set to default or secure value

□	(b) Security-critical patches are reinstalled
□	(c) Security-related configuration is rechecked and re-established
□	(d) System documentation and operating procedures are available
□	(e) Application and system software is reinstalled with secure setting
□	(f) Reconstitution from the backup data
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	27. System recovery and reconstitution
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstrated ability to recover and reconfigure to a known protected state. The system can be recovered and reconstituted to a known secure state in accordance with the methods specified in “Information supporting the owner’s incident response and recovery plan”.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in the security capability descriptions.

28. Alternative power source

Reg. Table X4.1 Item 28, Part X of the Rules	Ref. IEC62443-3-3 / SR 7.5

The computer-based system is to provide the capability to switch to and from an alternative power source without affecting the existing security state or a documented degraded mode.

Explanation

Summary

Item 28, Table X4.1, Part X states that the following two points are required for the alternative power source.

- Switch to and from an alternate power source
- Security capability does not affect existing security states or documented degraded modes

A "degraded mode" is a mode that allows the system to continue its original functions, albeit imperfectly, either by limiting the system's performance or functions, or by isolating abnormal areas when a system malfunction occurs.

Purpose

The purpose is to ensure system security during and after the switch to alternative power source. Power loss occurs for a period of time when switching to or from an alternate power source. In this case, the impact of the power loss is not to be reached the security status or functionality of the system.

Countermeasures

The countermeasure described here is the capability to switch to and from an alternate power source without affecting the existing security state or the documented degraded mode. Specifically, to prevent loss of security in the event of a power loss, the power supply is to be uninterrupted by an internal battery or storage battery.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

- **Redundant computer-based system, one of which is supplied by an alternate power source**

Duplicating computer-based system and providing independent power to each system can complement this capability if they are maintained at the time of switchover.

Scope

This requirement generally applies to all computer-based systems

Document reviews

Description of security capabilities

	28. Alternative power source
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) Capability to switch to and from alternate power sources without affecting existing security state or documented degraded mode
□	Switching to and from an alternative power source without affecting the following conditions:
□	(a) Existing security state
□	(b) Documented degraded mode
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	28. Alternative power source
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to switch to and from alternative power sources without affecting existing security conditions or documented degraded modes
□	Switching to and from an alternative power source without affecting the following conditions:
□	(a) Existing security state
□	(b) Documented degraded mode
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in the security capability descriptions.

29. Network and security configuration settings

Reg. Table X4.1 Item 29, Part X of the Rules	Ref. IEC62443-3-3 / SR 7.6

The computer-based system traffic is to provide the capability to be configured according to recommended network and security configurations as described in guidelines provided by the supplier. The computer-based system is to provide an interface to the currently deployed network and security configuration settings.

Explanation

Summary

Item 29, Table X4.1, Part X states that computer-based systems are to implement features that are set according to the network and security configuration recommended in the guidelines provided by the supplier and an interface should be implemented to check the current configuration status. The guidelines provided by the supplier refer to "Security configuration guidelines" as part of the submission.

Purpose

The purpose is to set the network and security configuration as recommended by the supplier. System availability can be hindered by misconfiguration or DoS attacks. In this case, the network and security configuration intended by the supplier are to be corrected.

Countermeasures

The countermeasures taken here are capabilities (such as setting parameters) that can be set according to the network and security configuration recommended in the guidelines provided by the supplier. Specifically, they are as follows.

- **Capability to set network configuration**

  Set IP address[1] and subnet mask[2].

- **Capability to set security configuration**

  Security configuration includes the capability to configure firewalls.

Note: This capability is also used to enhance security during system maintenance. In doing so,

[1] **IP address:** An address on the network. In IPv4, this value that is expressed as four decimal numbers up to 0-255 (for example, "198.51.100.10") and is used to identify the object of communication on the network.

[2] **Subnet mask:** A value indicating which of the IP addresses refers to the network and host sections. Change this value when the network is to be subdivided (subnetting).

“Security hardening guidelines” created by the Secure Product Development Lifecycle support enhanced security. “Security hardening guidelines” are described in detail below.

Security hardening guidelines P. 179

In addition, “Survey carried out with attendance by a surveyor” confirms that the security capability is the recommended setting and the default value for the function that sets the security configuration. The recommended setting and the default value is to be included in “Security configuration guidelines”. The guidelines are explained in detail below.

Security configuration guidelines P. 29

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement generally applies to all computer-based systems

Document reviews

Description of security capabilities

	29. Network and security configuration settings
☐	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
☐	(1) Capability set according to the network and security configuration recommended in the guidelines provided by the supplier
☐	The following items can be established:
☐	(a) Network configuration
☐	(b) Security configuration
☐	(2) Compensating countermeasure
☐	(a) Protect against the same threats as the original requirement
☐	(b) Provide an equal level of protection as the original requirement
☐	(c) Not be a security control that is required by other requirements
☐	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	29. Network and security configuration settings
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability set according to the network and security configuration recommended in the guidelines provided by the supplier
□	The following items can be established:
□	(a) Network configuration
□	(b) Security configuration
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in the security capability descriptions.

30. Least Functionality

Reg. Table X4.1 Item 30, Part X of the Rules

Ref. IEC62443-3-3 / SR 7.7

The installation, the availability and the access rights of the following are to be limited to the strict needs of the functions provided by the computer-based system:

- operating systems[1] software components[2], processes and services
- network services, ports[3], protocols[4], routes[5] and hosts[6] accesses and any software

Explanation

Summary

Item 30, Table X4.1, Part X states that anything that is not essential to the functionality of the system is not to be installed, available or accessible.

Purpose

The purpose here is to prevent vulnerability[7] by disabling unnecessary functions and minimising system functionality. The more features that are implemented into a system, the more likely the system is to have vulnerability and be subject to cyber-attacks.

Countermeasures

The countermeasure described here is to minimise system functionality and configuration information. More specifically, the following services and functions should be minimised.

- Operating systems software components, processes and services.
- Network services, ports, protocols, route and host accesses, and all software.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

[1] **Operating system:** The underlying software that powers a computer system and is often referred to simply as "OS". For example, Microsoft Windows is a type of operating system.

[2] **Component:** A piece of equipment, a system, software, etc.

[3] **Port:** The terminal part where equipment, systems, software, etc. connect or communicate with other external entities. This also includes physical communication ports such as USB ports and LAN ports.

[4] **Protocol:** The rules and procedures that allow multiple systems to communicate without any problems. It is not possible to communicate using protocols that are not supported.

[5] **Route:** The paths through which data travels, along with the associated network addresses.

[6] **Host:** A computer body containing a processing device, storage device, or the like that provides some function to other equipment.

[7] **Vulnerability:** A security weakness in a system. Here, we assume a weakness where some of the system's features can be exploited as it increases.

Scope

This requirement generally applies to all computer-based systems

Document reviews

Description of security capabilities

	30. Least Functionality
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) Least Functionality
□	To minimise the “Installation, availability, and access rights” of the following items to the minimum levels necessary.
□	(a) Operating systems software components, processes and services.
□	(b) Network services, ports, protocols, route and host accesses, and all software.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	30. Least Functionality
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for least functionality
□	Unnecessary features and services, if implemented, have been disabled.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in the security capability descriptions.

31. Multifactor authentication for human users

Reg. Table X4.1 Item 31, Part X of the Rules	Ref. IEC62443-3-3 / SR 1.1, RE 2

Multifactor authentication is required for human users when accessing the computer-based system from or via an untrusted network.

Explanation

Summary

Item 31, Table X4.2, Part X states that Multifactor authentication is required for human users when accessing the computer-based system from or via an untrusted network. Multifactor authentication means combining two or more different factors and authenticating a human user. According to NIST-SP 800-63[1], authentication factors are classified into following 3(three) types:

Authentication factors	Example
Something you know	It's something only the person knows. For example, password, PIN[2], etc.
Something you have	It's something only the person has. For example, security tokens[3], public key authentication method[4], and physical keys[5].
Something you are	It's part of individual body. For example, fingerprints and faces.

Purpose

The purpose is to strengthen the capability to authenticate human users. An untrusted network is a network that is unreliable in terms of security. Therefore, cybersecurity needs to be enhanced by strengthening the authentication process. With multifactor authentication, if one element is leaked or gets into the hands of others, the other element protects it. For detail of the capability to authenticate human users, see "1. Human user identification and authentication".

Human user identification and authentication P. 54

[1] **NIST:** It stands for National Institute of Standards and Technology
[2] **PIN:** It stands for Personal Identification Number. One of the authentication codes. Usually consists of 4 to 6 digits.
[3] **Security token**: One of the authorization codes. Generally, serves as a temporary certificate for users to access the system. For example, one-time password (OTP) generation device.
[4] **Public key authentication method**: A method of authentication using a pair of public and private keys.
[5] **Physical key**: One of authentication codes. A key to unlock the physical lock such as safe and system.

Countermeasures

The countermeasure described here is the capability of multifactor authentication when authenticating human users. This capability requires that human users be authenticated by two or more authentication factors.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **Computer-based system without network communication to untrusted networks**

This requirement is not applied with the computer-based system, because additional security capabilities are not required to the computer-based system.

Document reviews

Description of security capabilities

	31. Multifactor authentication for human users
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability of multi-factor authentication when authenticating human users
□	(a) Being authenticated by two or more different authentication factors
□	(b) Being able to log in when a valid authenticator is used
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	31. Multifactor authentication for human users
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability of multi-factor authentication when authenticating

		human users
□		(a) Can log in with a valid identifier and authenticator
□		(b) Cannot log in with an invalid authenticator
□	(2)	Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

32. Software process and device identification and authentication

Reg. Table X4.2 Item 32, Part X of the Rules	Ref. IEC62443-3-3 / SR 1.2

The computer-based system is to identify and authenticate software processes and devices

Explanation

Summary

Item 32, Table X4.2, Part X states that it is necessary to identify and authenticate software processes and devices. The software processes and devices are as follows:

Term	Description
Software Process	A program or application used for the computer-based system.
Device	A physical hardware or machinery used for the computer-based system.

Purpose

The purpose is to reduce the risk of unauthorized access by allowing the system to authenticate software processes and devices when communicating with untrusted networks. Untrusted networks increase the likelihood of unauthorized access. Therefore, identification and authentication are not only for humans, but also for software processes and devices to provide greater security for communications.

Countermeasures

The countermeasure described here is the capability to identify and authenticate software processes and devices used for the computer-based system. These are necessary to be identified and authenticated by an identifier and an authenticator, as is the case with human users. As concrete measures, it is considered effective to adopt such measures as authentication using a digital certificate using a public key infrastructure (PKI) for devices, a whitelist method that limits communication to specific applications, and token-based authentication (such as JWT: JSON Web Token), for software processes.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **No network communication with untrusted networks**
  Additional security capabilities are not applied, this requirement is out of scope.

Document reviews

Description of security capabilities

	32. Software process and device identification and authentication
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to identify and authenticate software processes and devices
□	(a) Software process identification and authentication
□	i) identifying by an identifier.
□	ii) authenticating by an identifier and an authenticator.
□	(b) Device identification and authentication
□	i) identifying by an identifier.
□	ii) authenticating by an identifier and an authenticator.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	32. Software process and device identification and authentication
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to identify and authenticate software processes and devices
□	(a) Software process identification and authentication
□	i) Can log in with a valid identifier and authenticator
□	ii) Cannot log in with an invalid identifier and authenticator
□	(b) Device identification and authentication
□	i) Can log in with a valid identifier and authenticator

□	ii) Cannot log in with an invalid identifier and authenticator
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

33. Unsuccessful login attempts

Reg. Table X4.2 Item 33, Part X of the Rules

Ref. IEC62443-3-3 / SR 1.11

The computer-based system is to enforce a limit of consecutive invalid login attempts from untrusted networks during a specified time period.

Explanation

Summary

Item 33, Table X4.2, Part X states that logins over untrusted networks are to be prevented for a specified period of time from repeatedly attempting to log in with the wrong password.

Purpose

The purpose is to defend against continuous cyber-attacks such as brute force attacks[1]. Failing to defend against attacks can result in compromised passwords, network outages or system outages.

Countermeasures

The countermeasures described here limit consecutive invalid login attempts within a certain period of time. This capability requires that access be denied if the configured number of attempts is exceeded. For example, after 5 failed login attempts, you are locked out for 30 minutes. (“5 times” and “30 minutes” parts are assumed to be configurable.) In addition, denied access is to continue either for a specified period of time or until unlocked by an administrator.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **In「1. Human user identification and authentication」, compensating countermeasure are to be taken or the requirements do not apply**

If user identification and authentication functionality is not implemented, there is no identifier. In this case, this requirement is not applicable.

[1] **Brute force attack:** A cyberattack technique that tries every possible combination to crack a password. In some cases, thousands of login attempts may be made using automated tools over a short period of time.

- **No network communication with untrusted networks**

Since additional security capabilities do not apply, this requirement also does not apply.

Document reviews

Description of security capabilities

	33. Unsuccessful login attempts
□	-1. If this requirement applies, any of the following capability or countermeasures (1) or (2) is to be implemented:
□	(1) Capability to limit consecutive invalid login attempts
□	The following items are met:
□	(a) Access is denied when the number of consecutive invalid login attempts exceeds the configured number of attempts.
□	(b) Denied access lasts either for a specified period of time or until unlocked by an administrator.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	33. Unsuccessful login attempts
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to limit consecutive invalid login attempts
□	The following items are met:
□	(a) Deny access if the number of consecutive invalid login attempts exceeds the configured number of attempts
□	(b) Denied access is to be last for a specified period of time or until unlocked by an administrator
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in the security capability descriptions.

34. System use notification

Reg. Table X4.2 Item 34, Part X of the Rules	Ref. IEC62443-3-3 / SR 1.12

The computer-based system is to provide the capability to display a system use notification message before authenticating. The system use notification message is to be configurable by authorized personnel.

Explanation

Summary

Item 34, Table X4.2, Part X states that a system use notification message is required to be displayed. A system use notification message is a message that is displayed before a person is logged into the system.

Purpose

The purpose is to require the user to agree to the terms and conditions of use of the system, including the system's terms of use and security policy, before using the system. Such an agreement clarifies to the user his/her responsibilities in relation to the use of the system.

Countermeasures

The countermeasure described here is the capability to display a system use notification message. This requires that the message is displayed before human users can be authorised. It also requires the capability to configure the message. The reason for this is so that if the system's terms of use or security policy changes, they can be properly reflected. The edit function must only be able to be edited by authorised persons, e.g., administrators, to ensure that the appropriate messages are displayed.

Note The following is an example of what is typically included in a system usage notification message. These are for reference and are not necessarily limited to them.

- The individual is accessing a specific computer-based system.
- That system usage may be monitored, recorded and subject to audit.
- That unauthorized use of the system is prohibited.
- That use of the system indicates consent to monitoring and recording.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **No network communication with untrusted networks**
  Additional security capabilities are not applied, this requirement is out of scope.
- **No HMI is implemented.**

If the system does not have an HMI, such as a monitor for displaying system usage notification messages, this requirement does not apply.

Document reviews

Description of security capabilities

	34. System use notification
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to display and configurate a system use notification message
□	The following capabilities should be implemented.
□	(a) The capability to display a system use notification message
□	Displaying a system use notification message before authenticating.
□	(b) The capability to configurate a system use notification message
□	Can be configurable by authorized personnel.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	34. System use notification
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) The capability to display and configurate a system use notification message
□	The following capabilities should be implemented.
□	(a) The capability to display a system use notification message
□	Displaying a system use notification message before authenticating.
□	(b) The capability to configurate a system use notification message

□	The following items are to be satisfied.
□	i) Can be configurable by authorized personnel.
□	ii) Cannot be configurable by unauthorized personnel.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

35. Access via Untrusted Networks

Reg. Table X4.2 Item 35, Part X of the Rules	Ref. IEC62443-3-3 / SR 1.13

Any access to the computer-based system from or via untrusted networks are to be monitored and controlled.

Explanation

Summary

Item 35, Table X4.2, Part X states that access via untrusted networks is to be monitored and controlled.

Purpose

The purpose is to monitor access from untrusted networks and restrict or block specific access as necessary. This prevents unauthorized access by attackers.

Countermeasures

The countermeasure described here is the capability to monitor and control access. Each function must be implemented according to the intended use of the system. For example, introducing access control Lists (ACL), incorporating firewalls or intrusion detection systems (IDS) to control access and keep records.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented. The following is an example of a compensating countermeasure.

- **Monitoring and controlling access by external security instruments**

If this capability is not provided to the system, this function is complemented by external security instruments.

Scope

This requirement does not apply to the following cases:

- **No network communication with untrusted networks**

Additional security capabilities are not applied, this requirement is out of scope.

Document reviews

Description of security capabilities

	35. Access via Untrusted Networks
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to monitor and control access via untrusted networks
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	35. Access via Untrusted Networks
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to monitor and control access via untrusted networks
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

36. Explicit access request approval

Reg. Table X4.2 Item 36, Part X of the Rules	Ref. IEC62443-3-3 / SR 1.13, RE 1

The computer-based system is to deny access from or via untrusted networks unless explicitly approved by authorized personnel on board.

Explanation

Summary

Item 36, Table X4.2, Part X states that it is necessary to deny access from or via untrusted networks unless explicitly approved by authorized personnel on board.

Purpose

The purpose is to deny unauthorized access requests from untrusted networks. This prevents unauthorized access by attackers.

Countermeasures

The countermeasure described here is the capability to deny access from or via untrusted networks unless explicitly approved by authorized personnel on board. Specifically, the following three capabilities apply.

- **The capability to assign access approval permissions to human users**
- **The capability to deny unapproved access**
- **The capability to interrupt connections from on-board endpoints (terminals)**

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **No network communication with untrusted networks**

Additional security capabilities are not applied, this requirement is out of scope.

Document reviews

Description of security capabilities

	36. Explicit access request approval
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to deny access from or via untrusted networks unless explicitly approved by authorized personnel on board
□	(a) The capability to assign access approval permissions to human users
□	(b) The capability to deny unapproved access
□	(c) The capability to interrupt connections from on-board endpoints (terminals)
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	36. Explicit access request approval
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) The Demonstration test for the capability to deny access from or via untrusted networks unless explicitly approved by authorized personnel on board
□	(a) The capability to assign access approval permissions to human users
□	(b) The capability to deny unapproved access
□	(c) The capability to interrupt connections from on-board endpoints (terminals)
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

37. Remote session termination

Reg. Table X4.2 Item 37, Part X of the Rules

Ref. IEC62443-3-3 / SR 2.6

The computer-based system is to provide the capability to terminate a remote session either automatically after a configurable time period of inactivity or manually by the user who initiated the session.

Explanation

Summary

Item 37, Table X4.2, Part X states that the remote session is to be terminated manually or automatically. **Remote session** is a remotely accessed session to a computer-based system from a remote location, e.g., via the internet.

Purpose

The purpose is to terminate a session as soon as the required remote session has ended. This prevents unnecessary sessions remaining connected and prevents unauthorized access.

Countermeasures

The countermeasure described here is the function to terminate the remote access session. Specifically, the function to log out of the remote session, either automatically or manually.

The automatic termination feature requires that you be able to set the time.

Countermeasure	Description
Automatic termination	This function automatically logs you out if inactivity continues for a time set by the user.
Manual termination	Capabilities should be provided on the side receiving remote access (local side) and on the side accessing remotely (remote side), so that the session can be terminated by an operation of the user who initiated the session. Functionality on the local side includes the function to block session ID connections, e.g., on the administrator's screen. The local side functions are such as the function to block session ID connections on the administrator's screen. On the remote side, functions such as a logout function.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **No network communication with untrusted networks**

  Additional security capabilities are not applied, this requirement is out of scope.

- **No remote access functionality**

  This requirement does not apply if there is only local network communication.

Document reviews

Description of security capabilities

	37. Remote session termination
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) Capability to terminate a remote session
□	Either of the following functions is to be implemented.
□	(a) Capability to terminate a remote session automatically
□	The following items are to be complied with.
□	i) The inactivity time until the end of the session is to be configurable.
□	ii) The session is to be terminated after a configurable period of inactivity.
□	(b) Capability to manually terminate a remote session.
□	The session is to be terminated by operation of the user.
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	37. Remote session termination
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) The demonstration test for the capability to terminate a remote session
□	Either of the following functions is to be implemented.
□	(a) Capability to terminate a remote session automatically

□	The following items are to be complied with.
□	i) The inactivity time until the end of the session is to be configurable.
□	ii) The session is to be terminated after a configurable period of inactivity.
□	(b) Capability to manually terminate a remote session.
□	The session is to be terminated by operation of the user.
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

38. Cryptographic integrity protection

Reg. Table X4.2 Item 38, Part X of the Rules	Ref. IEC62443-3-3 / SR 3.1, RE 1

The computer-based system is to employ cryptographic mechanisms to recognize changes to information during communication with or via untrusted networks.

Explanation

Summary

Item 38, Table X4.2, Part X states that it is necessary to recognize changes to information during communication by cryptographic technology. “cryptographic technology” refers to technology used to ensure that information has not been altered, tampered with or corrupted between source and destination.

Purpose

The purpose is to recognise changes to information during communication. Failure to detect unauthorised changes to information could result in incorrect information being communicated to the system, which could affect system operation. In particular, in access via untrusted networks, the reliability of the devices that pass through the communication path is not ensured, so the risk of tampering is higher than that of communication between the applicable systems. Therefore, simple checksums and hashes are not sufficient, and integrity protection using cryptographic techniques such as TLS is required.

Countermeasures

The countermeasure described here is to adopt the cryptographic mechanisms to recognise changes to information during communication. For example, it is applicable to Digital signatures[1]. Cryptography is explained in detail in “22. Use of cryptography”.

Specifically, protocols such as TLS (also included in HTTPS), SSH, and IP Sec can be used to detect not only cryptographic but also tampering.

Use of cryptography P. 113

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

[1] **Digital signature:** Technology to prove that the sender of a message is the author of that message and to ensure that the message has not been tampered with after transmission

Scope

This requirement does not apply to the following cases:

- **No network communication with untrusted networks**

Additional security capabilities are not applied, this requirement is out of scope.

Document reviews

Description of security capabilities

	38. Cryptographic integrity protection
□	-1. If this requirement applies, any of the following mechanisms or countermeasures (1) or (2) is to be implemented:
□	(1) The cryptographic mechanisms to recognise changes to information during communication
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	38. Cryptographic integrity protection
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Verification testing of a cryptographic mechanism to recognize changes in information during communication with or via an untrusted network
	(a) Confirmation that the protocol specified in the security function specification is adopted by using a network monitoring tool for the content of the communication.
□	(1) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

39. Input validation

Reg. Table X4.2 Item 39, Part X of the Rules	Ref. IEC62443-3-3 / SR 3.5

The computer-based system is to validate the syntax, length and content of any input data via untrusted networks that is used as process control input or input that directly impacts the action of the computer-based system.

Explanation

Summary

Item 39, Table X4.2, Part X states that it is necessary to validate any input data via untrusted networks.

Purpose

On untrusted networks, attackers are more likely to enter unauthorised data. It is necessary to improve security by verifying input data and preventing the reception of invalid data in order to prevent SQL injection attacks that take advantage of the property of erroneously recognizing invalid data as programs or commands.

Countermeasures

The countermeasure described here is the capability to validate the syntax, length and content of any input data.

Countermeasure	Description
Syntax validation	Checks whether the input data **conforms to the specified format and rules**. For example, checks whether the data type, format, character encoding, and encoding of numbers and dates are correct.
Length validation	Checks whether the input data is **within the specified length or range**. For example, checks whether the number of characters, number of digits, and maximum and minimum values are appropriate.
Content validation	Checks whether the input data **meets the specified conditions or criteria**. For example, checks whether the input data contains missing, prohibited, or inconsistent values.

“Validation” refers to a series of processes, including the processing of validation results. In other words, it is necessary to clarify how to respond to invalid data, such as refusing to accept the data if it is determined to be invalid.

For example, verification using regular expressions, as well as syntactic verification of communications as used in Modbus and CAN communications.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **No network communication with untrusted networks**

Additional security capabilities are not applied, this requirement is out of scope.

Document reviews

Description of security capabilities

	39. Input validation
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to validate the syntax, length and content of any input data
□	(a) Verify the following input data elements
□	i) Syntax
□	ii) Length
□	iii) Content
□	(b) If the data is determined to be invalid, take appropriate action. (e.g., refuse to accept the input data.)
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	39. Input validation
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to validate the syntax, length and content of any input data

□		If the data is determined to be invalid, take appropriate action. (e.g., refuse to accept the input data.)
□	(2)	Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

40. Session integrity

Reg. Table X4.2 Item 40, Part X of the Rules	Ref. IEC62443-3-3 / SR 3.8

The computer-based system is to protect the integrity of sessions[1]. Invalid session IDs are to be rejected.

Explanation

Summary

Item 40, Table X4.2, Part X states that it is necessary to protect the integrity of sessions and reject invalid session IDs. To protect the integrity of sessions means that the session is associated with authorised users and maintains this association, using the session ID. The session ID refers to the identifier (ID) that identifies the session.

Purpose

The purpose is to prevent unauthorised use of the session ID. If the integrity of the session ID is not protected, the session ID can be abused by a session hijacking[2] or a session fixation[3].

Countermeasures

The countermeasure described here is two capabilities as follows.

- The capability to protect the integrity of sessions

Using an encrypted session token as the session ID (such as JWT: JSON Web Token) and setting an expiration date for the session token in addition to cryptographic are effective countermeasures.

- The capability to reject invalid session IDs

This is a function that rejects session IDs that have expired or that have not been issued as valid session IDs.

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

[1] **Session** A sequence of operations from the time a session user logs into the system to the time he logs out. **Session ID** is a unique identifier (ID) that identifies the session used by the user.

[2] **Session hijacking** An attack technique that illegally hijacks an existing session

[3] **Session fixation** An attack technique in which the attacker forces the victim to use a pre-determined session ID and impersonates the victim.

- **No network communication with untrusted networks**

  Additional security capabilities are not applied, this requirement is out of scope.

- **If the session is not used**

If the session is not used, e.g., no browser functionality, this requirement does not apply.

Document reviews

Description of security capabilities

	40. Session integrity
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to protect the integrity of sessions and reject invalid session IDs
□	The following items are to be satisfied.
□	(a) Protecting the integrity of sessions and reject invalid session IDs
□	(b) Rejecting invalid session IDs
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	40. Session integrity
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to protect the integrity of sessions and reject invalid session IDs
□	The following items are to be satisfied.
□	(a) Protecting the integrity of sessions and reject invalid session IDs
□	(b) Rejecting invalid session IDs
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

Note: There are other required capabilities with respect to sessions. Please refer to the following pages

Session lock P. 86

Invalidation of session IDs after session termination P. 162

41. Invalidation of session IDs after session termination

Reg. Table X4.2 Item 41, Part X of the Rules

Ref. IEC62443-3-3 / SR 3.8, RE 1

The system is to invalidate session IDs[1] upon user logout or other session termination (including browser sessions).

Explanation

Summary

Item 41, Table X4.2, Part X states that it is necessary to invalidate session IDs upon user logout or other session termination (including browser sessions).

Purpose

The purpose is to prevent the risk of session abuse by quickly disabling the session ID. If the session ID remains valid after the session is terminated, the session ID can be abused by a session hijacking[2] or a session fixation[3].

Countermeasures

The countermeasure described here is the capability to invalidate session IDs upon user logout or other session termination (including browser sessions).

Compensating countermeasures

Compensating countermeasures should be adopted in cases where the aforementioned capabilities or countermeasures have not been implemented.

Scope

This requirement does not apply to the following cases:

- **No network communication with untrusted networks**

Additional security capabilities are not applied, this requirement is out of scope.

- **If the session is not used**

If the session is not used, e.g., no browser functionality, this requirement does not apply.

[1] **Session** A sequence of operations from the time a session user logs into the system to the time he logs out. **Session ID** is a unique identifier (ID) that identifies the session used by the user.

[2] **Session hijacking** An attack technique that illegally hijacks an existing session

[3] **Session fixation** An attack technique in which the attacker forces the victim to use a pre-determined session ID and impersonates the victim.

Document reviews

Description of security capabilities

	41. Invalidation of session IDs after session termination
□	-1. If this requirement applies, either of the following (1) or (2) is to be implemented.
□	(1) The capability to invalidate session IDs upon user logout or other session termination (including browser sessions)
□	(2) Compensating countermeasure
□	(a) Protect against the same threats as the original requirement
□	(b) Provide an equal level of protection as the original requirement
□	(c) Not be a security control that is required by other requirements
□	(d) Not introduce a higher security risk

Surveys

Test procedure of security capabilities

	41. Invalidation of session IDs after session termination
□	-1. If this requirement applies, either of the following (1) or (2) is to be performed.
□	(1) Demonstration test for the capability to invalidate session IDs upon user logout or other session termination (including browser sessions)
□	(2) Confirmation of compensating countermeasure Confirm that the information is as described in Description of security capabilities.

Note: There are other required capabilities with respect to sessions. Please refer to the following pages

Session lock	P. 86
Session integrity	P. 159

Chapter 6 Explanation of Secure Development Lifecycle requirements

This chapter provides details on the secure development lifecycle required by Part X (UR E27). In this context, “secure product development lifecycle” means the lifecycle for the development and maintenance of secure products. This includes, for example, the delivery of security updates after delivery and security defence-in-depth strategies. This lifecycle incorporates some of the requirements of the standard IEC 62443-4-1 into Chapter 4, Part X (UR E27).

Overview of Secure Development Lifecycle requirements

■ What are Secure Development Lifecycle requirements?

Chapter 4, Part X (UR E27) includes seven secure product development lifecycle requirements that reference IEC 62443-4-1. These requirements are as follows.

Secure Development Lifecycle Requirements

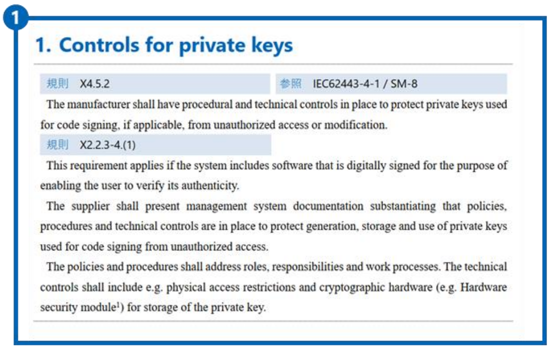
■ Requires processes or controls according to the secure product development lifecycle

Manufacturers are required to implement processes or controls according to the secure product development lifecycle to ensure that their products remain secure at each stage, including the design, manufacturing and maintenance stages.

These processes and management means are procedures or instructions that manufacturers are to follow to maintain secure products. They can, for example, be the processes for creating procedures to provide security updates or the processes for creating security defences and are addressed as part of management systems defined by manufacturers. Therefore, they are to be documented in management system documents, such as quality control manuals or associated procedures.

Detail of Secure Development Lifecycle requirements

How to read the following pages



1

1. Controls for private keys

規則 X4.5.2 参照 IEC62443-4-1 / SM-8

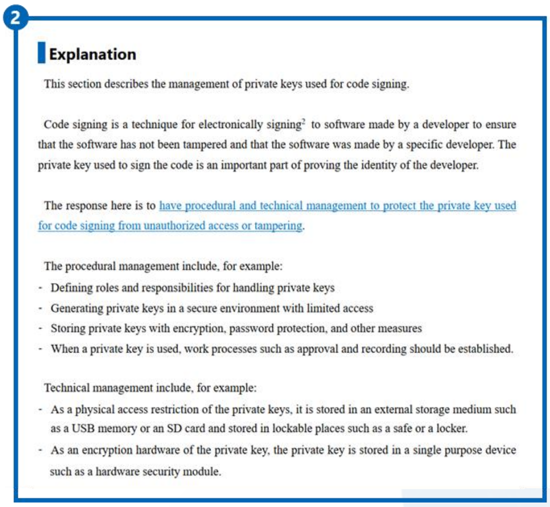
The manufacturer shall have procedural and technical controls in place to protect private keys used for code signing, if applicable, from unauthorized access or modification.

規則 X2.2.3-4.(1)

This requirement applies if the system includes software that is digitally signed for the purpose of enabling the user to verify its authenticity.

The supplier shall present management system documentation substantiating that policies, procedures and technical controls are in place to protect generation, storage and use of private keys used for code signing from unauthorized access.

The policies and procedures shall address roles, responsibilities and work processes. The technical controls shall include e.g. physical access restrictions and cryptographic hardware (e.g. Hardware security module[1]) for storage of the private key.



2

Explanation

This section describes the management of private keys used for code signing.

Code signing is a technique for electronically signing[2] to software made by a developer to ensure that the software has not been tampered and that the software was made by a specific developer. The private key used to sign the code is an important part of proving the identity of the developer.

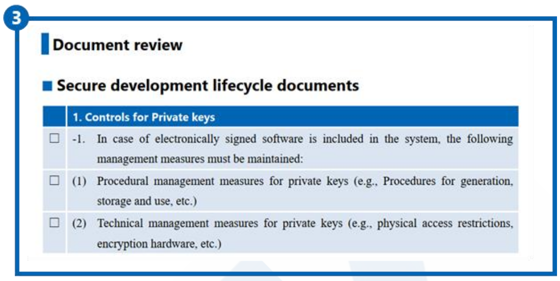
The response here is to have procedural and technical management to protect the private key used for code signing from unauthorized access or tampering.

The procedural management include, for example:

- Defining roles and responsibilities for handling private keys
- Generating private keys in a secure environment with limited access
- Storing private keys with encryption, password protection, and other measures
- When a private key is used, work processes such as approval and recording should be established.

Technical management include, for example:

- As a physical access restriction of the private keys, it is stored in an external storage medium such as a USB memory or an SD card and stored in lockable places such as a safe or a locker.
- As an encryption hardware of the private key, the private key is stored in a single purpose device such as a hardware security module.

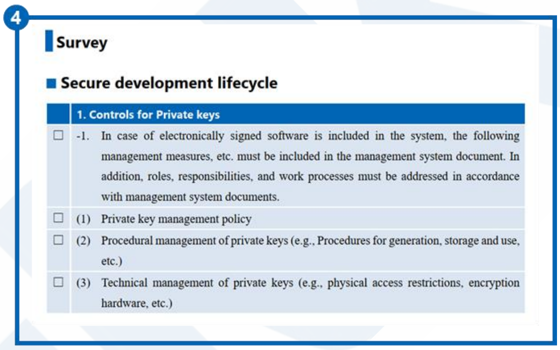


3

Document review

Secure development lifecycle documents

	1. Controls for Private keys
□	-1. In case of electronically signed software is included in the system, the following management measures must be maintained:
□	(1) Procedural management measures for private keys (e.g., Procedures for generation, storage and use, etc.)
□	(2) Technical management measures for private keys (e.g., physical access restrictions, encryption hardware, etc.)



4

Survey

Secure development lifecycle

	1. Controls for Private keys
□	-1. In case of electronically signed software is included in the system, the following management measures, etc. must be included in the management system document. In addition, roles, responsibilities, and work processes must be addressed in accordance with management system documents.
□	(1) Private key management policy
□	(2) Procedural management of private keys (e.g., Procedures for generation, storage and use, etc.)
□	(3) Technical management of private keys (e.g., physical access restrictions, encryption hardware, etc.)

1 Requirements

The names and details for the secure product development lifecycle requirements. Chapter 4, Part X (UR E27) provides two rules for each requirement.

2 Explanation

The explanation of the secure product development lifecycle requirements.

3 Documentation review

A document review checklist for the secure product development lifecycle requirements

- Secure Development Lifecycle Document: Documentation required by 4.4.1(6), Part X.

4 Survey

A survey checklist for the secure product development lifecycle requirements.

- Secure Development Lifecycle: Surveys required by 2.2.2-5, Part X

1. Controls for private keys

Reg. 4.5.2, Part X of the Rules

Ref. IEC62443-4-1 / SM-8

The manufacturer is to have procedural and technical controls in place to protect private keys used for code signing, if applicable, from unauthorized access or modification.

Reg. 2.2.2-5 (1), Part X of the Rules

This requirement applies if the system includes software that is digitally signed for the purpose of enabling the user to verify its authenticity.

The supplier is to present management system documentation substantiating that policies, procedures and technical controls are in place to protect generation, storage and use of private keys used for code signing from unauthorized access.

The policies and procedures are to address roles, responsibilities and work processes. The technical controls are to include e.g. physical access restrictions and cryptographic hardware (e.g. Hardware security module[1]) for storage of the private key.

Explanation

This section describes the management of private keys used for code signing.

Code signing is a technique for the electronic signing[2] of software by developers to ensure that it has not been tampered with and that its software was made by the specified developer. The private keys used to sign codes are an important part of proving software developer identity.

The controls described here is to have procedural and technical controls in place to protect private keys used for code signing from unauthorised access or tampering.

The following are some examples of procedural controls.

- Defining roles and responsibilities for the handling of private keys.
- Generating private keys in secure environments with limited access.
- Storing private keys with cryptographic, password protection and other measures.
- Work processes, such as approval and recording, are established for the use of private keys.

The following are some examples of technical control.

- Private keys are stored in external storage media such as USB memory sticks or SD cards and said media are then further stored in lockable places such as safes or lockers as a physical access control.

[1] **Hardware Security Module (HSM)**: Dedicated hardware devices that securely generate and store private keys. HSM securely stores confidential information and protects it from unauthorized access and tampering.

[2] **Electronically signing**: Mechanisms that use electronic means to certify that the senders and contents of documents or messages are correct. Electronic signatures include public key cryptography, digital certificates, and other technologies.

- Private keys are stored in single-purpose devices such as hardware security modules as a cryptographic hardware control.

In addition, the controls described above, including the private key management policy, are to be established by manufacturers. Furthermore, surveys of management system documentation and records are required to verify the establishment of such controls, and the management policy should include relevant roles and responsibilities.

Document reviews

Secure development lifecycle documents

	1. Controls for private keys
□	-1. If the system includes software that is digitally signed, either of the following controls are to be maintained.
□	(1) Procedural controls for private keys (e.g., procedures for generation, storage and use)
□	(2) Technical controls for private keys (e.g., physical access restrictions and cryptographic hardware)

Surveys

Secure development lifecycle

	1. Controls for private keys
□	-1. If the system includes software that is digitally signed, the following controls are to be included in the management system documentation. In addition, roles, responsibilities and work processes are to be addressed in accordance with the management system documentation.
□	(1) Private key control policy
□	(2) Procedural controls for private keys (e.g., procedures for generation, storage and use)
□	(3) Technical controls for private keys (e.g., physical access restrictions and cryptographic hardware)

2. Security update documentation

Reg. 4.5.3, Part X of the Rules

Ref. IEC62443-4-1 / SUM-2

A process is to be employed to ensure that documentation about product security updates is made available to users (which could be through establishing a cyber security point of contact or periodic publication which can be accessed by the user) that includes but is not limited to the following:

(1) the product version number(s) to which the security patch[1] applies;

(2) instructions on how to apply approved patches manually and via an automated process;

(3) description of any impacts that applying the patch to the product can have, including reboot;

(4) instructions on how to verify that an approved patch has been applied; and

(5) risks of not applying the patch and mediations[2] that can be used for patches that are not approved or deployed by the asset owner.

Reg. 2.2.2-5 (2), Part X of the Rules

The supplier[3] is to present management system documentation substantiating that a process is established in the organization to ensure security updates are informed to the users. The information to the users are to include the items listed in 4 5.3.

Explanation

This section describes the security update documentation.

The response is to adopt a process for system owners to obtain the security update documentation. The security update documentation is to include the following:

- **The product version number(s) to which the security patch applies**

Security patches are additional programs that are distributed to solve problems contained in the current software. The security update documentation is to make clear which version of the software the security patch is intended for.

- **Instructions on how to apply approved patches manually and via an automated process**
- **Description of any impacts that applying the patch to the product can have, including reboot**
- **Instructions on how to verify that an approved patch has been applied**
- **Risks of not applying the patch and mediations that can be used for patches that are not approved or deployed by the asset owner**

"Mediation" refers to the risk mitigation measures that can be applied as an alternative to patches that are not applicable for any reason. Such measures are necessary to clarify the risks of not

[1] **(Security) Patch**: Software designed to update installed software or data to address security vulnerabilities and bugs, or to improve operating systems or applications.

[2] **Mediation**: Risk reduction measures that can be applied as an alternative to patches that are not applicable for some reason.

[3] **Supplier**: The manufacturers or providers of systems. Suppliers are responsible for providing systems to system integrators or system owners.

patching and inform users of possible mediations to reduce those risks.

Processes are to be established by organisations to inform system owners of security updates. Furthermore, surveys of management system documentation and records are required to verify the establishment of such processes.

Document reviews

Secure development lifecycle documents

	2. Security update documentation
□	-1. Verify that a process has been adopted to ensure that security update documentation, including the following items, is available to users.
□	(1) The product version number(s) to which the security patch applies
□	(2) Instructions on how to apply approved patches manually and via an automated process
□	(3) Description of any impacts that applying the patch to the product can have, including reboot
□	(4) Instructions on how to verify that an approved patch has been applied
□	(5) Risks of not applying the patch and mediations that can be used for patches that are not approved or deployed by the asset owner

Surveys

Secure development lifecycle

	2. Security update documentation
□	-1. The management system documentation includes a process for informing system owners of security updates.
□	The information to be provided to the system owner shall include the following items:
□	(1) The product version number(s) to which the security patch applies
□	(2) Instructions on how to apply approved patches manually and via an automated process
□	(3) Description of any impacts that applying the patch to the product can have, including reboot
□	(4) Instructions on how to verify that an approved patch has been applied
□	(5) Risks of not applying the patch and mediations that can be used for patches that are not approved or deployed by the asset owner

3. Dependent component or Operating system security update documentation

Reg. 4.5.4, Part X of the Rules	Ref. IEC62443-4-1 / SUM-3

A process is to be employed to ensure that documentation about dependent component or operating system security updates is available to users that includes but is not limited to stating whether the product is compatible with the dependent component or operating system security update;

Reg. 2.2.2-5 (3), Part X of the Rules

The supplier is to present management system documentation, as required by 4.5.4, substantiating that a process is established in the organization to ensure users are informed whether the system is compatible with updated versions of acquired software in the system (new versions/patches of operating system or firmware). The information is to address how to manage risks related to not applying the updated acquired software.

Explanation

This section describes the documentation for security updates for dependent components or operating systems.

Dependent components are products that are included in systems to ensure proper operation. Since such components are often manufactured by someone other than suppliers, security updates are delivered by someone other than system suppliers. Moreover, security updates for base operating systems are delivered by the vendors that provide the platforms; for example, Microsoft provides updates for its Windows operating system. It is desirable to specify the means for collecting such information and consider the system's response.

The controls described here is to adopt processes for system owners to obtain documentation on security updates for dependent components or operating systems. Documentation of security updates is to include statements about whether the dependent components or operating systems support security updates.

If systems do not support acquired software, information such as the risks of not applying updates and measures to reduce such risks shall be included. Risk management in such cases is also required. For example, additional firewall rules, enhanced monitoring, and changes to the settings of the installed OS or firmware are considered. Furthermore, surveys of management system documentation and records are required to verify the establishment of such processes.

Document reviews

Secure development lifecycle documents

	3. Dependent component or Operating system security update documentation
□	-1. System owners have adopted processes to obtain security update documents for dependent components or operating systems that include the following.
□	Stating whether the product is compatible with the dependent component or operating system security update

Surveys

Secure development lifecycle

	3. Dependent component or Operating system security update documentation
□	-1. Management system documentation is to include processes for informing system owners as to whether systems support updated versions of acquired software.
□	In addition, such information is to address how to manage risks related to not applying the updated acquired software.

4. Security update delivery

Reg. 4.5.5, Part X of the Rules	Ref. IEC62443-4-1 / SUM-4

A process is to be employed to ensure that security updates for all supported products and product versions are made available to product users in a manner that facilitates verification that the security patch[1] is authentic.

The manufacturer is to have QA process[2] to test the updates before releasing.

Reg. 2.2.2-5 (4), Part X of the Rules

The supplier is to present management system documentation, as required by 4.5.5, substantiating that a process is established in the organization ensuring that system security updates are made available to users, and describing how the user may verify the authenticity of the updated software.

Explanation

This section describes security update delivery.

The control here is to require system owners to adopt processes for obtaining security updates in ways that ensure security patches are authentic. Testing before releasing security updates is to be specified in the QA process.

Processes are also to be established by organisations to ensure that security updates are made available to system owners. The security patches provided here are to be verified as authentic, as described above. Verification can be done by digitally signing the software and verifying it. Furthermore, onsite surveys of management system documentation and records are required to verify the establishment of such processes.

Document reviews

Secure development lifecycle documents

	4. Security Update Delivery
□	-1. Processes to acquire security updates for system owners is to be adopted in ways that ensure that security patches are authentic.
	-2. QA process is to be adopted for the test of updates before the release of a security update.

[1] **Security Patch** Software designed to update installed software or data to address security vulnerabilities and bugs or to improve an operating system or application

[2] **QA process** Quality Assurance process. A sequence of activities to ensure that a product or service meets specific requirements, standards, or metrics.

Surveys

Secure development lifecycle

	4. Security Update Delivery
□	-1. Management system documentation is to include processes for ensuring that security updates are provided to system owners.
□	In addition, such information is to include ways for verifying the authenticity of the updated software.

5. Product defence in depth

Reg. 4.5.6, Part X of the Rules

Ref. IEC62443-4-1 / SG-1

A process is to exist to create product documentation that describes the security defence in depth strategy for the product to support installation, operation and maintenance that includes the following:

(1) security capabilities implemented by the product and their role in the defence in depth strategy;

(2) threats addressed by the defence in depth strategy; and

(3) product user mitigation strategies for known security risks associated with the product, including risks associated with legacy code[1].

Reg. 2.2.2-5 (5), Part X of the Rules

The supplier is to present management system documentation, as required by 4.5.6, substantiating that a process is established in the organization to document a strategy for defence-in-depth measures to mitigate security threats to software in the computer- based system during installation, maintenance and operation. Examples of threats could be installation of unauthorised software, weaknesses in the patching process, tampering with software in the operational phase of the ship.

Explanation

This section describes the product defence-in-depth.

"Defence-in-depth" is a strategy that reduces security risks by combining multiple security measures, rather than relying on a single security measure.

The response here is to adopt a process that describes a defence-in-depth strategy for security. Product documentation is to include the following:

- **Security capabilities implemented by the product and their role in the defence in depth strategy**

Identify the specific security capabilities the product provides and describe how each works in the defence-in-depth strategy.

- **Threats addressed by the defence in depth strategy**

Identify levels and types of specific threat addressed by the defence-in-depth strategy and describe how each affects the security layer of the product. Examples of threats include attacks by installing unauthenticated software, attacks on weaknesses in the patching process (software tampering, elevation of privileges, etc.), and software tampering during the ship's operation phase, as stated in the requirements.

[1] **Legacy code**: Programs created by using outdated technologies or techniques. This could include security risks such as not being able to comply with the latest security standards or not being able to apply the latest security patches.

- **Product user mitigation strategies for known security risks associated with the product, including risks associated with legacy code**

Describes measures to mitigate or eliminate known security risks. Especially, older source code, called legacy code, may contain security risks such as not complying with new security standards or being unable to apply security patches.

The processes described above are to be established by organizations. Furthermore, surveys of management system documentation and records are required to verify the establishment of such processes.

Document reviews

Secure development lifecycle documents

	5. Product defence in depth
□	-1. Processes have been adopted for developing security defence-in-depth strategies, including the following product documentation.
□	(1) Security capabilities implemented by the product and their role in the defence in depth strategy
□	(2) Threats addressed by the defence in depth strategy
□	(3) Product user mitigation strategies for known security risks associated with the product, including risks associated with legacy code

Surveys

Secure development lifecycle

	5. Product defence in depth
□	-1. Management system documentation is to include processes for creating security defence-in-depth strategies.

6. Defence in depth measures expected in the environment

Reg. 4.5.7, Part X of the Rules

Ref. IEC62443-4-1 / SG-2

A process is to be employed to create product user documentation that describes the security defence in depth measures expected to be provided by the external environment in which the product is to be used.

Reg. 2.2.2-5 (6), Part X of the Rules

The supplier is to present management system documentation, as required by 4.5.7, substantiating that a process is established in the organization to document defence-in-depth measures expected to be provided by the external environment, such as physical arrangement, policies and procedures.

Explanation

This section describes the defence-in-depth measures expected to be provided for external environments. The following are some examples of such measures.

Defence-in-depth measures	Examples
Physical arrangement	Locked doors, security boxes, etc.
Policy	Use cryptographic, how data is stored and destroyed, etc.
Procedure	Backup critical data, steps to recover from data loss, etc.

The controls described here are to adopt processes that describe the security defence-in-depth measures expected to be provided by the external environments in which products are used. This is important for building defence-in-depth in combination with external security measures and product security measures.

In addition, the processes described above are to be established by organizations. Furthermore, surveys of management system documentation and records are required to verify the establishment of such processes.

Document reviews

Secure development lifecycle documents

6. Defence in depth measures expected in the environment

□	-1. Processes have been adopted to develop documentation for product users that describes the security defence-in-depth measures expected to be provided by the external environments in which the products are used.

Surveys

Secure development lifecycle

	6. Defence in depth measures expected in the environment
□	-1. Management system documentation is to include processes for creating product user documentation that describes the security defence-in-depth measures expected to be provided by the external environments in which the products are used.

7. Security hardening guidelines

Reg. 4.5.8, Part X of the Rules

Ref. IEC62443-4-1 / SG-3

A process is to be employed to create product user documentation that includes guidelines for hardening[1] the product when installing and maintaining the product. The guidelines are to include, but are not limited to, instructions, rationale and recommendations for the following:

(1) Integration of the product, including third-party components, with its product security context

(2) Integration of the product's application programming interfaces[2]/protocols[3] with user applications[4];

(3) Applying and maintaining the product's defence in depth strategy[5]

(4) Configuration and use of security options/capabilities in support of local security policies, and for each security option/capability for the following:

- (a) its contribution to the product's defence in depth strategy
- (b) descriptions of configurable and default values that include how each affects security along with any potential impact each has on work practices; and
- (c) setting/changing/deleting its value;

(5) Instructions and recommendations for the use of all security-related tools and utilities that support administration, monitoring, incident handling and evaluation of the security of the product;

(6) Instructions and recommendations for periodic security maintenance activities;

(7) Instructions for reporting security incidents for the product to the supplier;

(8) Description of the security best practices[6] for maintenance and administration of the product.

Reg. 2.2.2-5 (7), Part X of the Rules

The supplier is to present management system documentation, as required by 4.5.8, substantiating that a process is established in the organization to ensure that hardening guidelines are produced for the system.

The guidelines are to specify how to reduce vulnerabilities in the system by removal/prohibiting /disabling of unnecessary software, accounts, services, etc.

Explanation

[1] **Hardening**: The process of minimizing a system's susceptibility to attacks by decreasing the system's attack surface area.

[2] **Application Programming Interface (API)**: Reducing a system's vulnerability by minimizing its attack surface. A set of protocols and rules that enable information exchange among software and applications.

[3] **Protocol:** A combination of standardized rules and signals employed by computers on a network to facilitate communication - examples of these being HTTP, FTP, and SMTP.

[4] **User application**: A program installed on a computer that is created for the user's business or purpose.

[5] **Defence in depth strategy**: A strategy to mitigate security risks by combining multiple security measures rather than relying on a single security measure. Such strategies are defined in Part X as an "information security strategy integrating people, technology, and operations capabilities to establish variable barriers across multiple layers and missions of the organization".

[6] **Best practice**: Guidelines for the secure design, development, testing, and maintenance of products as determined by suppliers are to be generally recommended security and industry practices.

This section describes security hardening guidelines for product hardening. “Hardening” is the act of reducing system vulnerability by reducing the system’s exposure to attacks; for example, systems are less vulnerable to attacks by removing unnecessary software, accounts and services.

The controls described here require the adoption of processes that includes product hardening guidelines to be applied during product installation and maintenance. These guidelines are to include the following.

- **Integration of the product, including third-party components, with its product security context**

A “security context” refers to the security environments in which systems or applications are implemented, including whether products require physical security or external firewall protection. By designing environments to include external security features, a defence-in-depth strategy can be developed that is appropriate for a particular environment. The goal here is for products to fit into security contexts and for security contexts to provide adequate protection for products. The processes required here include, for example, limiting system access through physical security and limiting communication through external firewalls. When third-party components are included in systems, such components are to conform to the security contexts of products and are to not reduce the overall security level of products.

- **Integration of the product’s application programming interfaces /protocols with user applications**

Since product API and protocols share product functions and data with user applications, insufficient authentication and cryptographic can result in access keys being stolen or communications being intercepted by third-party when such API and protocols are not fully integrated with user applications. Therefore, products using API and protocols are to be provided with instructions, rationales and recommendations for securely integrating user applications with API.

- **Applying and maintaining the product’s defence in depth strategy**

Defence-in-depth is to be maintained to respond to new threats and vulnerabilities by reviewing and updating it as appropriate. Therefore, relevant documentation is to includes information on safe operation and maintenance instructions and is to also explain the owner responsibilities regarding defence-in-depth operation and maintenance.

- **Configuration and use of security options/capabilities in support of local security policies, and for each security option/capability**

“Local security policies” are security requirements and standards in the local environments in which products operate. Such policies should be adapted to local environments and provided with security options and features for support. Descriptions of security configuration options should include the following.

- Contribution to the product defence-in-depth strategy

  Security options and feature should be identified according to which layer and which role they play in product defence-in-depth strategies.

- Describe configurable values and their default values

  Consideration should be given to the balance between security and availability when selecting this option and the effects and reasons for default values should be explained.

- Setting, changing, and deleting values

  Appropriate permissions and procedures much be observed when setting, changing or deleting values. Note that security configuration settings are to be implemented in systems as security functions in accordance with the system requirement “29 Network and Security Configuration Settings”. See “29 Network and Security Configuration Settings” for more details.

Network and security configuration settings P. 131

- **Instructions and recommendations for the use of all security-related tools and utilities that support administration, monitoring, incident handling, and evaluation of the security of the product**

A “security-related tool or utility” is any software or device used to enhance product security or to solve problems. Cryptographic tools, log analysis tools, backup tools and antivirus software are examples of tools and utilities that are necessary to effectively manage, monitor, respond and evaluate incidents related to product security. Relevant documentation should, therefore, include descriptions on how to use such tools and utilities when they are provided.

- **Instructions and recommendations for periodic security maintenance activities**

A “routine security maintenance activity” is a task performed to maintain product security such as applying patches and updates; checking and deleting logs and backup files; and updating passwords and certificates. Regular security maintenance activities are necessary to address new threats and vulnerabilities to products and to improve product security. Relevant documentation should, therefore, include descriptions and recommendations for periodic security maintenance activity methods.

- **Instructions for reporting security incidents for the product to the supplier**

Since security incidents related to products can affect product availability, reporting such incidents to suppliers allows the causes and scopes of incidents to be investigated and appropriate countermeasures and remediation measures to be implemented. Relevant documentation, therefore, should include procedures for reporting security incidents to suppliers.

- **Description of the security best practices for maintenance and administration of the product.**

“Security best practices for product administration and maintenance” are recommended procedures and policies to help ensure the safe operation and maintenance of products, for example, updates and patching. The purposes of such practices are to maintain product security status and protect it against vulnerabilities and attacks. Relevant documentation should, therefore, include descriptions of the best practices for secure product management.

In addition, the processes described above are to be established by organisations. Furthermore, surveys of management system documentation and records in presence of Society surveyors are required to verify the establishment of such processes.

Document reviews

Secure development lifecycle documents

	7. Security hardening guidelines
□	-1. Processes have been adopted that include product hardening guidelines during product installation.
□	And maintenance and includes instructions, rationales and recommendations for the following.
□	(1) Integration of the product, including third-party components, with its product security context
□	(2) Integration of the product's application programming interfaces/protocols with user applications
□	(3) Applying and maintaining the product's defence in depth strategy
□	(4) Configuration and use of security options/capabilities in support of local security policies, and for each security option/capability
□	(a) its contribution to the product's defence in depth strategy
□	(b) descriptions of configurable and default values that include how each affects security along with any potential impact each has on work practices
□	(c) setting/changing/deleting its value
□	(5) Instructions and recommendations for the use of all security-related tools and utilities that support administration, monitoring, incident handling, and evaluation of the security of the product
□	(6) Instructions and recommendations for periodic security maintenance activities
□	(7) Instructions for reporting security incidents for the product to the supplier
□	(8) Description of the security best practices for maintenance and administration of the product.

Surveys

Secure development lifecycle

	7. Security hardening guidelines
□	-1. Management system documentation is to include processes for developing products that include product hardening guidelines for installation and maintenance.

Reference

(1) IACS Unified Requirements, E26 (Rev.1) (November 2023) Cyber resilience of ships

(2) IACS Unified Requirements, E27 (Rev.1) (September 2023) Cyber resilience of on-board systems and equipment

(3) IEC TS 62443-1-1: 2009 Terminology, concepts and models

(4) IEC 62443-3-3: 2013 System security requirements and security levels

(5) IEC 62443-4-1: 2018 Secure product development lifecycle requirements

Guidelines for Cyber resilience of on-board systems
and equipment (Edition 1.1)
[English]

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