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Key Cyber Security Requirements for Wind Farms according to IEC 62443

SPEAKER

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Mr. Elyoenai Egozcue received his M.Sc. in Telecommunications Engineer from the UPNA University of Pamplona, Spain undertaking his Master Thesis at the VUB University of Brussels, Belgium. He started his professional career as a cyber security researcher at S21sec Labs, dealing with open-source cyber intelligence, RFID security, Network security and biometrics. He is currently the head of cyber security services for industrial automation and control systems at S21sec and leads relevant projects in this field in sectors such as renewable power generation, power transmission and distribution, railway transportation, logistics, etc.

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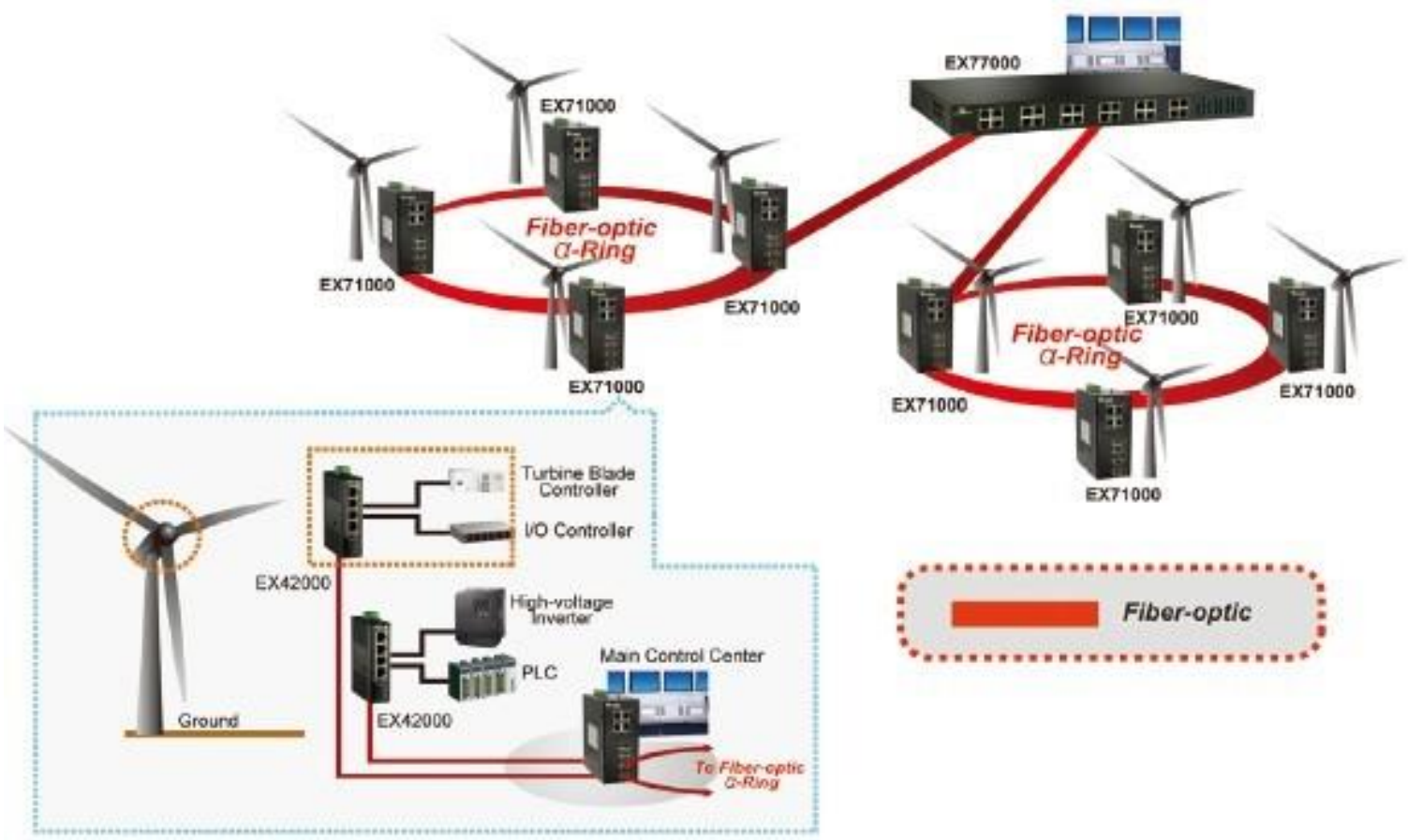
INDEX

1. General concepts: SuC, FR, SL
2. Security requirements at system and component levels
3. Conclusions

IEC 62443 – System Under Consideration (SuC)



SYSTEM COMPONENTS:

Embedded Device (ED): PLC, IEDs (e.g. inverter), CMS, controller.

Network Device (ND): switches, routers, VPN terminator, firewalls.

Host: Linux Redhat, Windows XP, Windows 2000 Server, etc.

Software Application: Historian, SCADA, engineering station, etc.

IEC 62443 – Foundational Requirements (FR)

The IEC 62443 groups technical security controls into 7 categories

FR1 – Identification and Authentication Control (IAC)

FR2 – Use Control (UC)

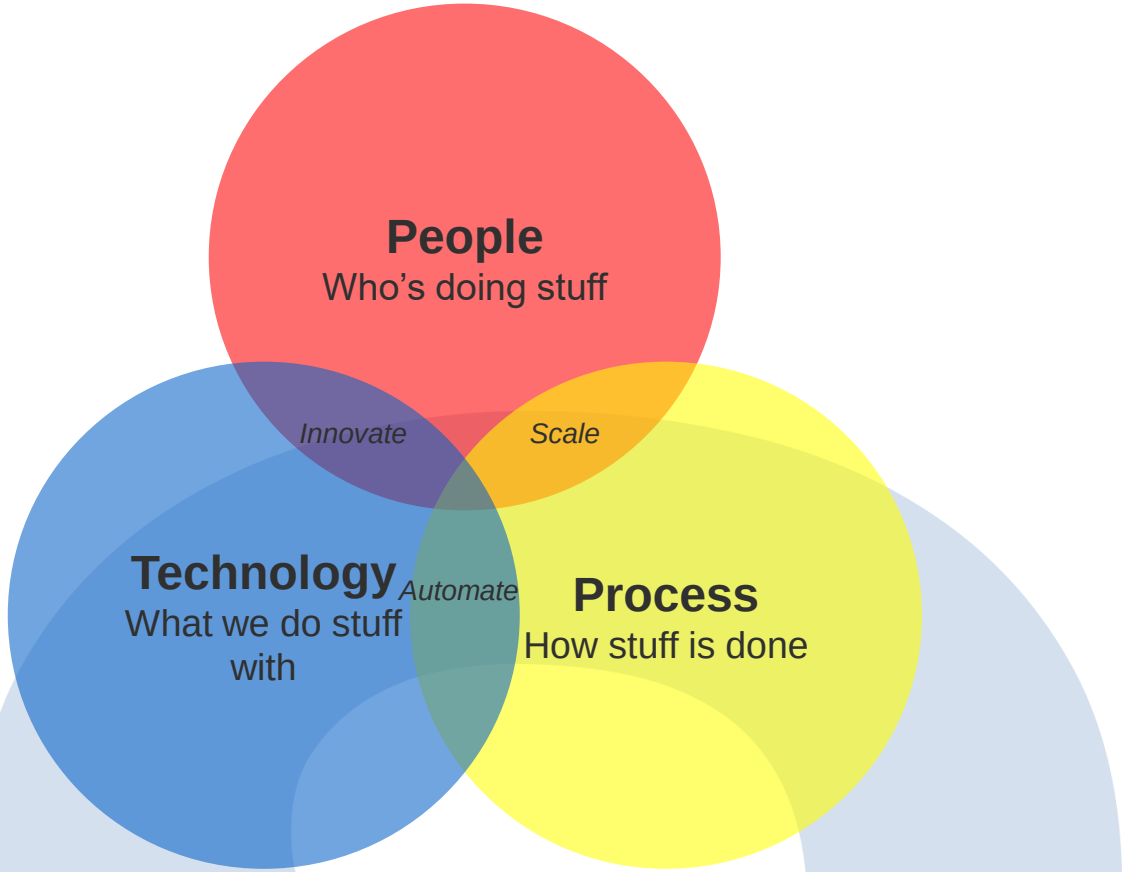
FR3 – System Integrity (SI)

FR4 – Data Confidentiality (DC)

FR5 – Restricted Data Flow (RDF)

FR6 – Timely Response to Events (TRE)

FR7 – Resource Availability (RA)



Technical security requirements are derived from FR and defined at system (SR) and component levels (CR). Component Requirements (CR) will vary sometimes depending on the component type: EDR, NDR, HR, SAR

IEC 62443 – Security Levels

Safety systems have used the concept of **Safety Integrity Levels (SIL)**.

SIL allowed integrity capability of components and systems to be represented by a number (e.g. SIL 2).

Security Levels provide a qualitative approach to addressing security for a zone, system, component

- **Target security level (SL-T):** desired level of security.
- **Achieved security level (SL-A):** the actual level of security for a particular system.
- **Capability security level (SL-C):** the security level that components or systems can provide.

SIL Safety Integrity Level (per IEC 61508)	Safety Availability	PFD Probability of Failure on Demand 1 – Availability	RRF Risk Reduction Factor 1 / PFD
4	> 99.99%	< 0.0001 ($1E^{-4}$)	> 10,000
3	99.9 – 99.99%	0.001 – 0.0001 ($1E^{-3}$ to $1E^{-4}$)	1,000 – 10,000
2	99 – 99.9%	0.01 – 0.001 ($1E^{-2}$ to $1E^{-3}$)	100 – 1,000
1	90 – 99%	0.1 – 0.01 ($1E^{-1}$ to $1E^{-2}$)	10 - 100
0	Basic Process Control		

SL	Definition of protection level
4	intentional violation using sophisticated means with extended resources, system specific skills and high motivation
3	intentional violation using sophisticated means with moderate resources, system specific skills and moderate motivation
2	intentional violation using simple means with low resources, generic skills and low motivation
1	casual or coincidental violation
0	no especial security requirements for any FR

IEC 62443 – Security requirements: Human user identification and authentication

IEC 62443-3-3	IEC 62443-4-2	Real world examples
SR 1.1 The control system shall provide the capability to identify and authenticate all human users on all interfaces that provide human user access to the control system. **SR 1.1 RE 1** Uniquely identify and authenticate all human users **SR 1.1 RE 2** Employ multifactor authentication for access via untrusted networks **SR 1.1 RE 3** Multifactor authentication for all networks	**CR 1.1** All human users need to be identified and authenticated for all access to components (e.g. applications and devices) on all interfaces. This includes access through network protocols HTTP, HTTPS, FTP, SFTP, and protocols used by device configuration tools. **CR 1.1 RE 1** Unique identification and authentication **CR 1.1 RE 2** Multifactor authentication for all interfaces of the component	**Authentication methods:** passwords, tokens, biometrics and a combination of them. **Other factors:** geographic location Role-based authentication can be used but it is not a unique identification. A system-level identification and authentication capability is preferred from a management perspective (i.e. AD, LDAP, Radius)

Note: Access controls (IAC and UC) shall not prevent the operation of essential functions

IEC 62443 – Security requirements: Zone boundary protection

IEC 62443-3-3	IEC 62443-4-2	Real world examples
SR 5.2 The control system shall monitor and control communications at zone boundaries to enforce the compartmentalization defined in the risk-based zones and conduits model. **SR 5.2 RE 1** Deny by default, allow by exception policy. **SR 5.2 RE 2** Prevent communication through the control system boundary (Island mode) **SR 5.2 RE 3** Fail close functionality	**NDR 5.2** the network device shall monitor and control communications at zone boundaries to enforce the compartmentalization defined in the risk-based zones and conduits model. **NDR 5.2 RE 1** Dany all, permit by exception **NDR 5.2 RE 2** Island mode **NDR 5.2 RE 3** Fail close	**Boundary protection mechanisms:** firewalls, routers, proxies, etc. **Island mode** is key to content security breaches when been detected within the control system, or when an attack is occurring at the enterprise level. When a hardware/power failure occurs at the boundary protection mechanism, the goal is to prevent any communications through the control system boundary (**fail close**)

IEC 62443 – Security requirements: Zone boundary protection

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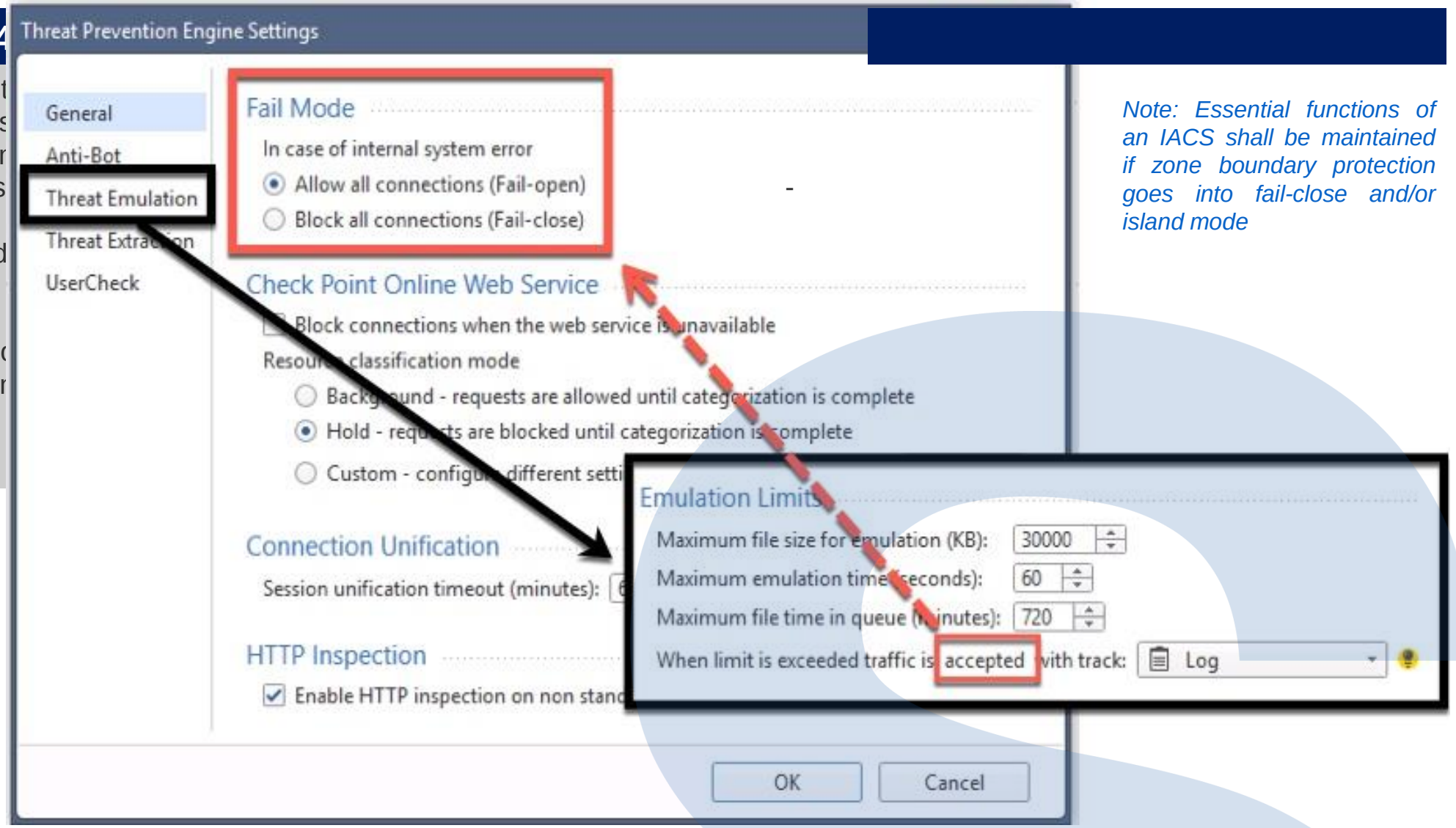

Note: Essential functions of an IACS shall be maintained if zone boundary protection goes into fail-close and/or island mode

IEC 62443 – Security requirements: Control system backup

IEC 62443-3-3	IEC 62443-4-2	Real world examples
SR 7.3 The control system shall support backups of user-level and system-level information (including system state information) without affecting normal plant operations. Information required for post-incident forensic activity (e.g. audit logs) should be included **SR 7.3 RE 1** Capability to verify the reliability of backup mechanisms. **SR 7.3 RE 2** Capability to automate the backup function based on a configurable frequency	**CR 7.3** Components shall provide the capability to participate in system level backup operations in order to safeguard the component state (user- and system-level info). The backup process shall not affect the normal component operations. Cryptographic keys should be included and recommended to backup separately as security requirements for protecting the backup are higher. **CR 7.3 RE 1** Capability to validate the integrity of backed up information prior to the initiation of a restore	**Techniques and tools:** - NAS server with a file structure and a batch process - Proprietary solutions (e.g. Siemens TIA Portal) - Multivendor solutions: VersionDOG or MDT Autosave

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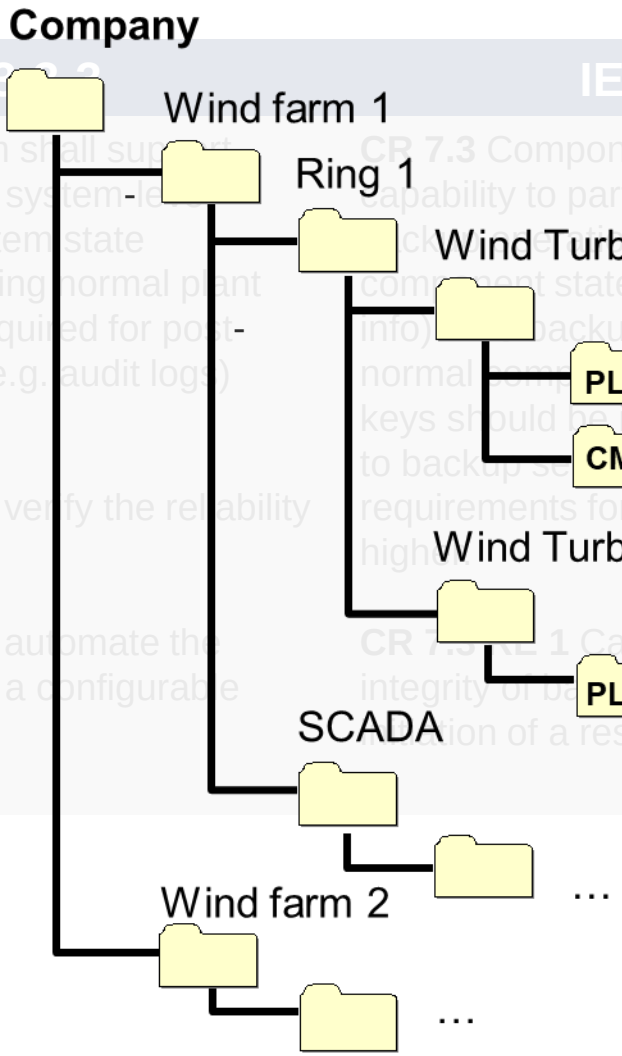

IEC 62443 – Security requirements: Control system backup

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IEC 62443-4-2

Real world examples

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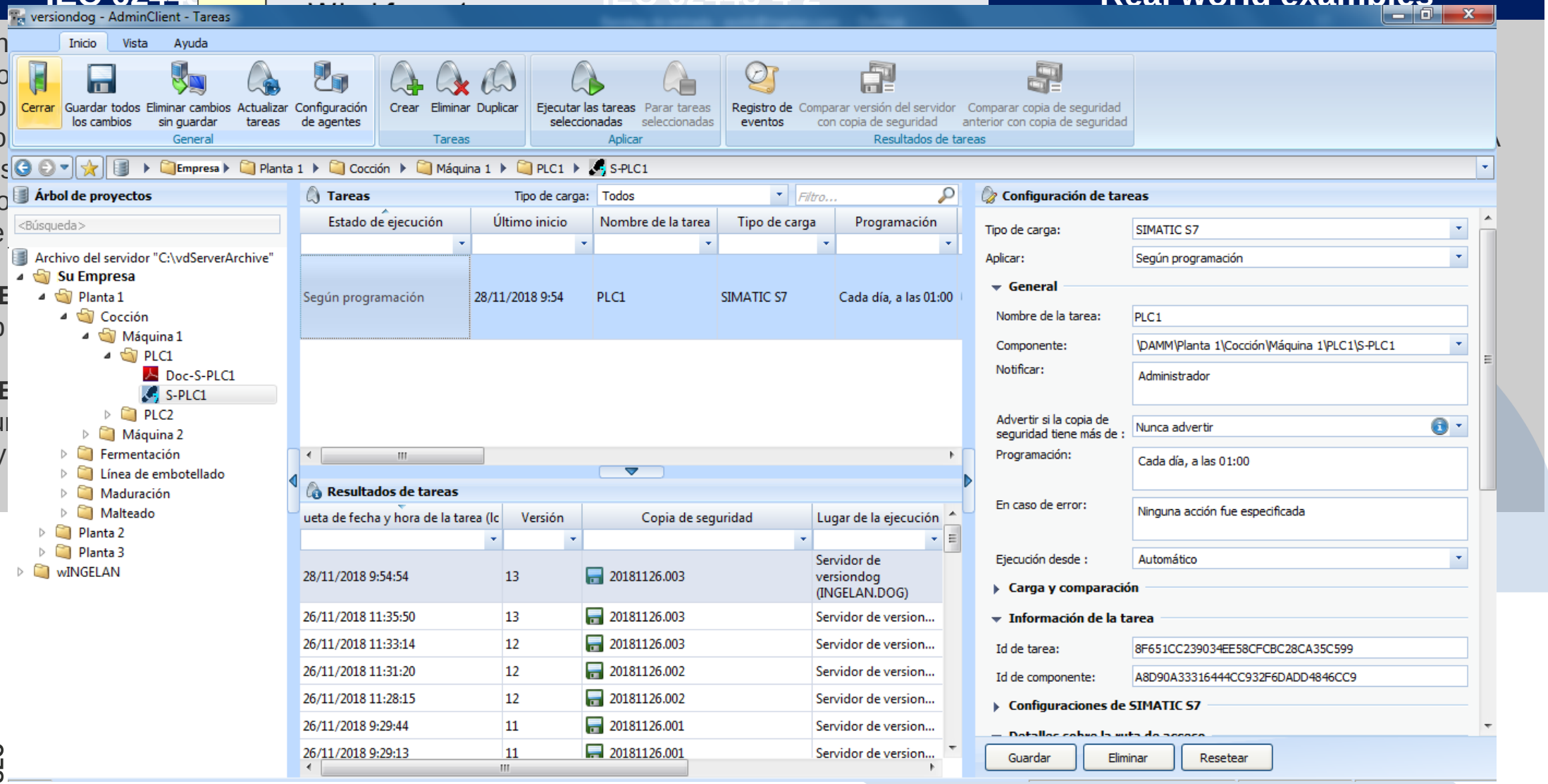

Conclusions

1. IEC 62443 defines technical requirements at system or component levels to achieve certain SL-C

2. Depending on the security level to be achieved, enhancements to requirements should be considered

3. Security measures shall not adversely affect essential functions of a high availability IACS

4. Both component vendors and system integrators have a major responsibility in achieving the SL-T

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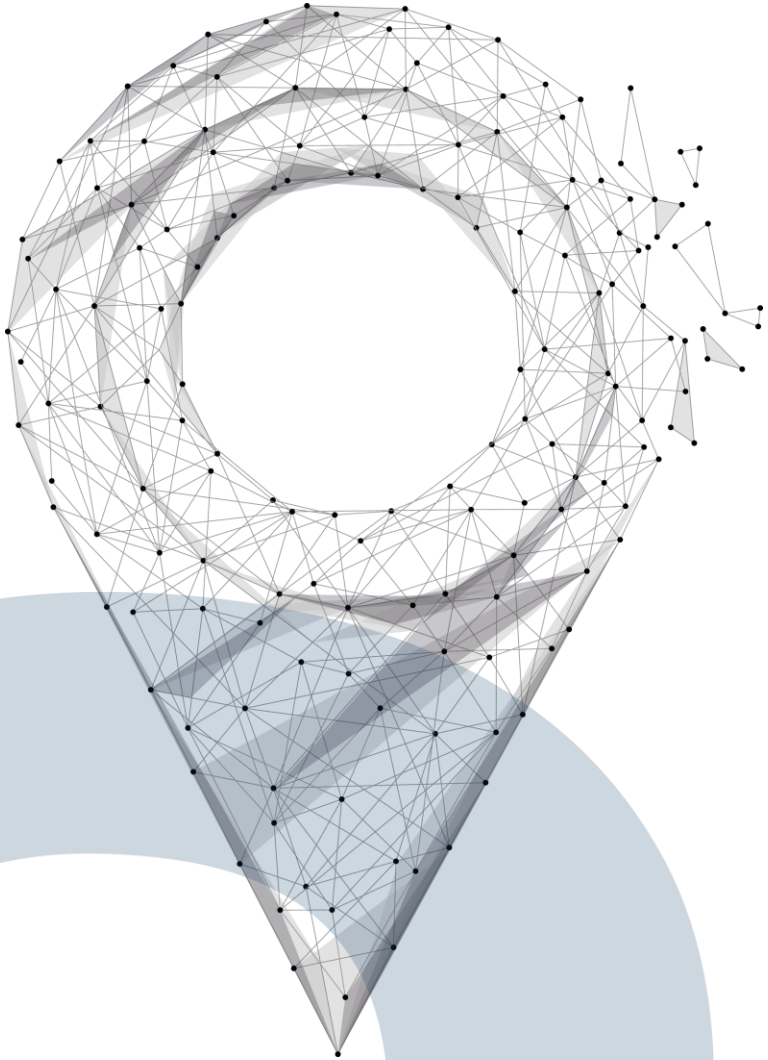

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