PROJECT DESCRIPTION

ENERGY SECTOR ASSET MANAGEMENT

For Electric Utilities, Oil & Gas Industry

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NCCoE NATIONAL CYBERSECURITY CENTER OF EXCELLENCE

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This document describes a challenge that is relevant across the energy sector. NCCoE cybersecurity experts will address this challenge through collaboration with members within the energy industry and with cybersecurity technology providers. The resulting example solution will detail an approach that can be used by the energy sector.

ABSTRACT

Industrial control systems (ICS) comprise a core part of our nation's critical infrastructure. Energy sector companies rely on ICS to generate, transmit, and distribute power. There is a wide variety of ICS assets, such as supervisory control and data acquisition (SCADA) systems, distributed control systems (DCS), and other devices (e.g., programmable logic controllers [PLCs]), that provide command and control functions on operational technology (OT) networks. These assets are primary targets of cyber attacks. Vulnerabilities within these systems and devices present opportunities for malicious actors to cause disruptions to the power grid.

Energy sector companies must monitor and manage ICS assets at all times to reduce the risk of such attacks. The NCCoE, in collaboration with members of the energy community and with cybersecurity technology providers, is planning a project to create an example solution to address this complex asset management challenge. This project will result in a freely available NIST Cybersecurity Practice Guide that includes an example solution for electric utilities and for oil and gas companies to effectively track and manage their assets.

KEYWORDS

energy sector asset management (ESAM); industrial control system(s) (ICS); malicious actor; monitoring; operational technology (OT); supervisory control and data acquisition system (SCADA)

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1 Executive Summary

Purpose

The National Cybersecurity Center of Excellence (NCCoE) is responding to the energy sector's request for an operational technology (OT) asset management solution. To remain fully operational, energy sector entities should be able to effectively identify, control, and monitor all of their OT assets. This project will provide guidance on how to enhance OT asset management capabilities by leveraging capabilities that may already exist in an operating environment or by implementing new capabilities.

The publication of this project description initiates the process to identify project collaborators, as well as standards-based, commercially available, and/or open-source technologies. These products will be integrated and implemented in a laboratory environment to build a standards-based, modular, end-to-end example solution that will address the security challenges of OT asset management. The approach will include architectural definition, physical and logical design, a comprehensive security analysis, security control mapping, and future build considerations. The output of the process will be the publication of a multi-volume National Institute of Standards and Technology (NIST) Cybersecurity Practice Guide that organizations can use to enhance their ability to improve energy sector asset management.

Scope

This project will address the following characteristics of asset management:

- **Asset Discovery**: establishment of a full baseline of physical and logical locations of assets
- **Asset Identification**: capture of asset attributes, such as manufacturer, model, operating system (OS), Internet Protocol (IP) addresses, MAC addresses, protocols, patch-level information, and firmware versions
- **Asset Visibility**: continuous identification of newly connected or disconnected devices
- **Asset Disposition**: the level of criticality (high, medium, or low) of a particular asset, its relation to other assets within the OT network, and its communication with other devices
- **Alerting Capabilities**: detection of a deviation from the expected operation of assets

Assumptions

This project identifies security benefits, including the automated identification of OT assets to enable quick security alerts and increased cybersecurity resilience.

This project makes the following assumptions:

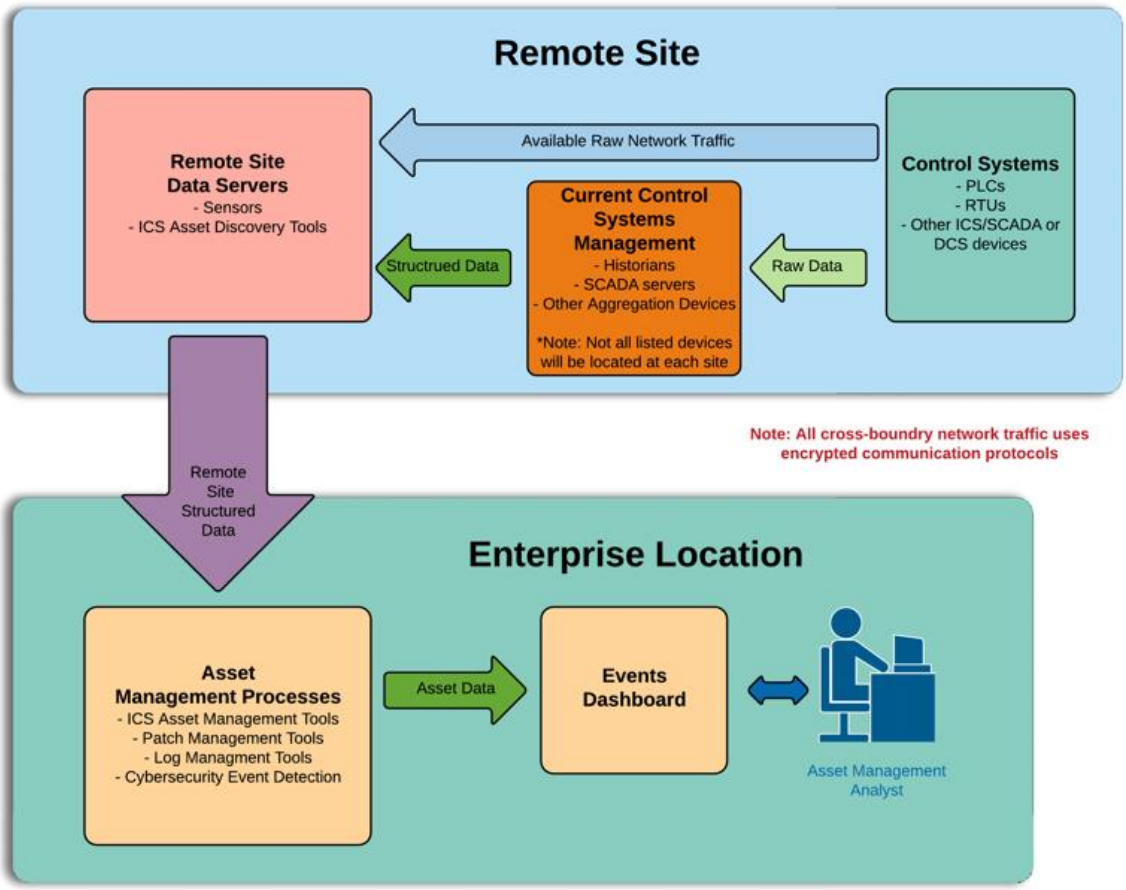
- Some level of an asset management capability already exists within an organization.
- All OT assets within an organization's infrastructure, especially those that are considered critical, need to be identified, tracked, and managed.
- OT networks are comprised of numerous ICS devices, such as programmable logic controllers (PLCs), in addition to other vital components, such as engineering workstations, historians, and human-machine interfaces (HMIs), which are typically installed on Windows and/or Linux OS.
- Some level of patch management already exists within the organization.

Background

The NCCoE, in collaboration with organizations in the energy sector, identified the need to strengthen their asset management capabilities, especially for assets that are geographically dispersed. Vulnerabilities in OT assets present opportunities for malicious actors to cause disruptions and power outages. Such disruptions can result in economic loss and the interruption of critical services to millions of people. To properly assess cybersecurity risk within the OT network, energy companies must be able to identify all of their assets, especially the most-critical assets. This project will describe a reference architecture and an example solution for managing, monitoring, and baselining assets, and will also include information to help identify threats to these OT assets. An OT asset management solution may also serve as a key component of an organization's comprehensive asset inventory, including enterprise assets as well.

2 High-Level Architecture

The figure below depicts the proposed high-level environment and architecture to help improve asset management within an energy organization.



Component List

Collaborating partners (participating vendors) will need to provide components to develop an example solution, including, but not limited to, the following components:

- OT/ICS-specific asset discovery and management tools
- patch management tools
- encrypted communication devices
- log management/security information and event management (analytics, storage, alerting)

Desired Capabilities

The security capabilities of the example solution are identified in the following list:

- OT asset inventory
- patch management
- high-speed communication mechanisms for remote asset management
- encrypted communications
- continuous asset monitoring
- log analysis and correlation
- cybersecurity event/attack detection

3 Relevant Standards and Guidance

- ANSI/ISA-TR62443-2-3-2015. Security for industrial automation and control systems Part 2-3: Patch management in the IACS environment. https://www.isa.org/store/isa-tr62443-2-3-2015,-security-for-industrial-automation-and-control-systems-part-2-3-patch-management-in-the-iacs-environment/40228386
- ANSI/ISA-62443-3-3 (99.03.03)-2013. Security for industrial automation and control systems Part 3-3: System security requirements and security levels. https://www.isa.org/store/ansi/isa-62443-3-3-990303-2013-security-for-industrial-automation-and-control-systems-part-3-3-system-security-requirements-and-security-levels/116785
- COBIT V5. ISACA. http://www.isaca.org/cobit/pages/default.aspx
- Electricity Subsector C2M2 (ES-C2M2). https://energy.gov/sites/prod/files/2014/02/f7/ES-C2M2-v1-1-Feb2014.pdf
- IETF RFC 5246. Transport Layer Security Protocol Version 1.2. https://tools.ietf.org/html/rfc5246
- IETF RFC 4254. The Secure Shell (SSH) Connection Protocol. https://www.ietf.org/rfc/rfc4254.txt
- ISO/IEC 19770-1:2017. Information technology — IT asset management—Part 1: IT asset management systems—Requirements. https://www.iso.org/standard/56000.html
- ISO/IEC 19770-5:2015. Information technology – IT asset management – Part 5: Overview and Vocabulary. https://www.iso.org/standard/68291.html

- ISO/IEC 27001:2013. Information technology — Security techniques — Information security management systems — Requirements. https://www.iso.org/isoiec-27001-information-security.html
- NERC Reliability Standards for the Bulk Electric Systems of North America: CIP 002-5 – 014-2.http://www.nerc.com/pa/Stand/Reliability%20Standards%20Complete%20Set/RSCompleteSet.pdf
- NIST Special Publication 1800-5 (DRAFT): It Asset Management: Financial Services. https://nccoe.nist.gov/library/it-asset-management-nist-sp-1800-5-practice-guide
- NIST Special Publication 1800-7 (DRAFT): Situational Awareness for Electric Utilities. https://nccoe.nist.gov/sites/default/files/library/sp1800/es-sa-nist-sp1800-7-draft.pdf
- NIST Cybersecurity Framework - Standards, guidelines, and best practices to promote the protection of critical infrastructure. https://www.nist.gov/cyberframework
- NIST Special Publication 800-40: Guide to Enterprise Patch Management Technologies. https://csrc.nist.gov/publications/detail/sp/800-40/rev-3/final
- NIST Special Publication 800-53, Rev. 4: Security and Privacy Controls for Federal Information Systems and Organizations. http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-53r4.pdf
- NIST Special Publication 800-82, Rev. 2: Guide to Industrial Control Systems (ICS) Security, May 2015. http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-82r2.pdf
- NIST Special Publication 800-160: Systems Security Engineering: Considerations for Multidisciplinary Approach in the Engineering of Trustworthy Systems, November 2016. http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-152.pdf
- NIST Special Publication 800-52: Guidelines for the Selection, Configuration, and Use of Transport Layer Security (TLS) Implementations, April 2014. http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-52r1.pdf
- NIST Cryptographic Standards and Guidelines. https://csrc.nist.gov/Projects/Cryptographic-Standards-and-Guidelines

4 SECURITY CONTROL MAP

			Informative References						
Function	**Category**	**Subcategory**	**CCS CSC 2016**	**COBITS**	**ISA 6244-3-2-1:2009**	**ISA 6243-3-3:2013**	**ISO/IEC 27001:2013**	**NIST SP 800-53 Rev. 4**	**NERC CIP Standards**
IDENTIFY (ID)	**Asset Management (ID.AM):** The data, personnel, devices, systems, and facilities that enable the organization to achieve business purposes are identified and managed consistent with their relative importance to business objectives and the organization's risk strategy.	**ID.AM-1:** Physical devices and systems within the organization are inventoried.	1	BA109.01, BA109.02	4.2.3.4	SR 7.8	A.8.1.1, A.8.1.2	CM-8	CIP-002-5 R1, CIP-002-5 R2
		ID.AM-2: Software platforms and applications within the organization are inventoried.	2	BA109.01, BA109.02, BA109.05	4.2.3.4	SR 7.8	A.8.1.1, A.8.1.2	CM-8	CIP-010-2 R1
		ID.AM-4: External information systems are catalogued.		APO02.02			A.11.2.6	AC-20, SA-9	

Function	Category	Subcategory	Informative References: CCS CSC 2016	COBITS	ISA 6244-3-2-1:2009	ISA 6243-3-3:2013	ISO/IEC 27001:2013	NIST SP 800-53 Rev. 4	NERC CIP Standards
		ID.RA-2: Threat and vulnerability information is received from information-sharing forums and sources.	4		4.2.3, 4.2.3.9, 4.2.3.12		A.6.1.4	PM-15, PM-16, SI-5	
	Data Security (PR.DS): Information and records (data) are managed consistent with the organization's risk strategy to protect the confidentiality, integrity, and availability of information.	**PR.DS-2:** Data-in-transit is protected.	13, 14, 17	APO01.06, DSS06.06		SR 3.1, SR 3.8, SR 4.1, SR 4.2	A.8.2.3, A.13.1.1, A.13.2.1, A.13.2.3, A.14.1.2, A.14.1.3	SC-8	CIP-011-2 R1
		PR.DS-6: Integrity-checking mechanisms are used to verify software, firmware, and information integrity.	2			SR 3.1, SR 3.3, SR 3.4, SR 3.8	A.12.2.1, A.12.5.1, A.14.1.2, A.14.1.3	SI-7	

			Informative References						
Function	**Category**	**Subcategory**	**CCS CSC 2016**	**COBITS**	**ISA 6244-3-2-1:2009**	**ISA 6243-3-3:2013**	**ISO/IEC 27001:2013**	**NIST SP 800-53 Rev. 4**	**NERC CIP Standards**
	Maintenance (PR.MA): Maintenance and repair of industrial control and information system components are performed consistent with policies and procedures.	**PR.MA-1:** Maintenance and repair of organizational assets are performed and logged in a timely manner, with approved and controlled tools.		BAI09.03	4.3.3.3.7		A.11.1.2, A.11.2.4, A.11.2.5	MA-2, MA-3, MA-5	
		PR.MA-2: Remote maintenance of organizational assets is approved, logged, and performed in a manner that prevents unauthorized access.	5, 12	DSS05.04	4.3.3.6.5, 4.3.3.6.6, 4.3.3.6.7, 4.4.4.6.8		A.11.2.4, A.15.1.1, A.15.2.1	MA-4	CIP-005-5 R2

			Informative References						
Function	**Category**	**Subcategory**	**CCS CSC 2016**	**COBITS**	**ISA 6244-3-2-1:2009**	**ISA 6243-3-3:2013**	**ISO/IEC 27001:2013**	**NIST SP 800-53 Rev. 4**	**NERC CIP Standards**
		PR.PT-4: Communications and control networks are protected.	7, 11	DSS05.02, APO13.01		SR 3.1, SR 3.5, SR 3.8, SR 4.1, SR 4.3, SR 5.1, SR 5.2, SR 5.3, SR 7.1, SR 7.6	A.13.1.1, A.13.2.1	AC-4, AC-17, AC-18, CP-8, SC-7	CIP-005-5 R1
DETECT (DE)	**Anomalies and Events (DE.AE):** Anomalous activity is detected in a timely manner, and the potential impact of events is understood.	**DE.AE-1:** A baseline of network operations and expected data flows for users and systems is established and managed.	9, 12	DSS03.01	4.4.3.3			AC-4, CA-3, CM-2, SI-4	

			Informative References						
Function	**Category**	**Subcategory**	**CCS CSC 2016**	**COBITS**	**ISA 6244-3-2-1:2009**	**ISA 6243-3-3:2013**	**ISO/IEC 27001:2013**	**NIST SP 800-53 Rev. 4**	**NERC CIP Standards**
		DE.AE-3: Event data is aggregated and correlated from multiple sources and sensors.	6			SR 6.1		AU-6, CA-7, IR-4, IR-5, IR-8, SI-4	

APPENDIX A – REFERENCES

K. Stouffer, V. Pilliteri, S. Lightman, M. Abrams, and A. Hahn, *Guide to Industrial Control Systems (ICS) Security*, *Revision 2*, NIST SP 800-82 rev2, May 2015. http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-82r2.pdf

APPENDIX B – ACRONYMS AND ABBREVIATIONS

DCS	Distributed Control Systems
ESAM	Energy Sector Asset Management
HMI	Human-Machine Interface
ICS	Industrial Control Systems
IP	Internet Protocol
NCCoE	National Cybersecurity Center of Excellence
NIST	National Institute of Standards and Technology
OS	Operating Systems
OT	Operational Technology
PLC	Programmable Logic Controllers
SCADA	Supervisory Control and Data Acquisition