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Introduction to SCADA for Renewables
(A Six Module Course)

Course Learning Objectives

1. **Describe** SCADA system basics and important differences with other control systems
2. **Demonstrate** competency of the key components of a SCADA system and their functions
3. **Describe** the different communication systems used in SCADA
4. **Demonstrate** competency of the role and capabilities of operator interfaces
5. **Demonstrate** competency of implementing SCADA in real world applications, specifically renewable energy applications (install, operation, maintenance)
6. **Identify** emerging technical trends, shifts, and innovations impacting SCADA and its application in the renewable energy sector

Introduction to SCADA for Renewables

Course Outline / Curriculum Learning Modules:

Module 1 SCADA Overview

Module 2 Components and Functionality

Module 3 Basics of SCADA Communications

Module 4 Human/Machine Interface

Module 5 Applications within Renewable Energy Industry

Module 6 Emerging Trends in SCADA for Renewables

Module 3 – Basics of SCADA Communications

Learning Objectives

- **Distinguish** between proprietary and standards based general purpose communication networks.
- **Establish** communications for a SCADA network.
- **Integrate** sensors and data sources within the SCADA network.
- **Understand** and configure various communication applications.
- **Understand** cybersecurity risks.
- **Understand** measures taken to minimize cybersecurity risks.
- **Understand** basic types of network security.
- **Understand** basic types of data encryption.

References and Additional Learning Material

- https://www.energy.gov/sites/prod/files/oeprod/DocumentsandMedia/21_Steps_-_SCADA.pdf

21 things that can be done to secure SCADA systems with explanations

- https://www.cisco.com/c/en/us/products/security/what-is-network-security.html#~types

Additional ways to secure networks including short videos.

- https://download.schneider-electric.com/files?p_Doc_Ref=998-2095-04-09-12AR0_EN

Explains how vulnerabilities in SCADA systems have led to NERC-CIP standards

- https://electricenergyonline.com/energy/magazine/181/article/SCADA-System-Vulnerabilities-to-Cyber-Attack.htm

Article on the importance of cybersecurity on SCADA systems including our nation's electric grid.

SCADA Communication

- Communication between field devices and RTUs/PLCs can be analog or digital
- Communication between the MTU and the RTUs/PLCs is a critical part of a SCADA system
  - can be wired or wireless (radio, cellular, satellite), usually a combination of both are used
- Communication protocols
  - Range of proprietary, vendor specific communication protocols and open communication standards exist

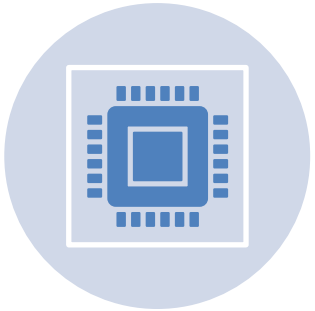
Network Communications

- Network: two or more devices that exchange information (communicate).
- Networks can be wired or wireless.
- For communication to occur between field equipment and MTUs, there must be a protocol in place.

Protocols

- A protocol is a set of rules in which data is transferred on a network.
- In order to communicate, there must be a language chosen; that language is a protocol.
- There are many types of network protocols.
- Multiple protocols can be combined into a suite, such as TCP/IP.
- Some protocols are proprietary, meaning that they are owned and/or exclusive to a company.

Proprietary vs Open SCADA (1)



An **Open** SCADA System is a system where the major components all comply to certain industry standards to enable interoperability

A **Proprietary** SCADA System is a system where all major components come from one vendor/ manufacturer and the standards are usually specific to that system and vendor

Proprietary vs Open SCADA (2)

- Examples of proprietary vendor protocols
  - SAP-bus (ABB)
  - Conitel (Leeds&Northrup)

- Examples of open protocol standards
  - Modbus
  - Profibus
  - IEC 60870-5-101 or 104
  - IEC 61850
  - DNP3 (used commonly for utilities)

Out of Many, Comes One

- In the 1980's, there were many competing and proprietary communication protocols used in SCADA.
- Standardization of these protocols became important for SCADA systems integration.
- For example, the MODBUS protocol was a proprietary protocol introduced by Modicon in 1979.
- Today, MODBUS is an industry standard communication protocol used in many SCADA systems.

MODBUS Video

https://realpars.com/modbus/

SCADA and Security

- Allowing SCADA systems to be controlled on a network leads to unintended consequences of security risks.

- Security risks can come from external intruders or hackers as well as internally within the corporate LAN.

Network Security

- Network security refers to measures that are taken to protect the network and the data contained within.
- There are many ways to secure a network. Here are a few:
  - Firewalls
  - access control
  - IPS (Intrusion Prevention Systems) and
  - VPN (Virtual Private Networks)

Firewalls and Access Control

- Firewalls are the barrier between what gets in and out of a network.
- Firewalls are implemented in SCADA systems to keep unwanted traffic out of the network.
- In addition to firewalls, who can access the SCADA network is vital to its security; this is known as access control.
- Devices or users that are not known are given limited or no access to the network.

IPS and VPN

- IPS or Intrusion Prevention Systems are in place within SCADA systems to block malware or suspicious activity.
- Virtual Private Networks or VPNs allow data to be encrypted and to be sent over the internet.
- VPNs are a crucial network security tool that allows a user or operator the ability to have remote access to devices or information on the SCADA system.

Data Encryption

- Encryption is the process of encoding data so that it remains hidden or inaccessible to unauthorized users.

- Encryption is vital to the security of SCADA systems and networks.

Cybersecurity

- Cybersecurity is the protection of company assets from malicious network attacks or intrusion.

- The North American Electric Reliability Corp (NERC) created standards known as Critical Infrastructure Protection (CIP) to secure networks and energy assets for utility

QUESTIONS?