Setting the Standard for Automation™

# Introduction to ISA112 SCADA Systems Standard

June 30, 2021

Graham Nasby
ISA112 committee co-chair

Standards
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# What is ISA112?

- ISA112 is a standards committee formed by the International Society of Automation in mid-2016
- **Committee Members:** software vendors, hardware vendors, end users, system integrators, consultants, and government from a wide variety of industries. Currently over 250 committee members.
- **Goal:** Develop a series of ISA standards and technical reports that provide guidance for system design, implementation, operation, and maintenance of SCADA systems for pipelines, water and wastewater, power, oil and gas, and other industries to support the overall integrity and reliability of these systems.

# Industry/End-User Needs for ISA112

- Need for common terminology for SCADA systems
- Specification for minimum SCADA software requirements
- Suggested I/O interfaces for interfacing with equipment
- Standardized Control Modes: Remote vs. Local, Auto vs. Manual
- Reference architectures for levels of control
- Guidance for applying other ISA standards to SCADA
  - Cyber Security
  - Alarm Management
  - HMI Design
  - Data Storage
  - Designing robust, resilient and redundant systems

# Design Consultant Needs for ISA112

- Need for common terminology for SCADA systems
- Specification for minimum SCADA software requirements
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  - Cyber Security
  - Alarm Management
  - HMI Design
  - Data Storage
  - Designing robust, resilient and redundant systems

# Equipment Vendor Needs for ISA112

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  - Alarm Management
  - HMI Design
  - Data Storage
  - Designing robust, resilient and redundant systems

# Contractor Needs for ISA112

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  - Cyber Security
  - Alarm Management
  - HMI Design
  - Data Storage
  - Designing robust, resilient and redundant systems

# System Integrator Needs for ISA112

- Need for common terminology for SCADA systems
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  - HMI Design
  - Data Storage
  - Designing robust, resilient and redundant systems

# Current Status of ISA112

| | |
|---|---|
| Jun 2016 | Committee approved by ISA |
| Aug 2016 | Initial call for volunteers (40 members) |
| Sept 2016 | First meeting held in Newport Beach, California, USA |
| Jan 2017 | Committee co-chairs named<br>-Graham Nasby, City of Guelph Water Services (Guelph, Ontario, Canada)<br>-Ian Verhappen, CIMA+ (Calgary, Alberta, Canada) |
| Apr 2017 | Monthly conference calls start |
| May 2017 | Second meeting in Raleigh, North Carolina, USA<br>Semi-annual face-to-face meetings start |
| May 2018 | ISA112 Lifecycle & Architecture Diagram Developed |
| Nov 2018 | Table of Contents Developed |
| 2019-2020 | Writing Phase begins, as of June 2021 we have 500 pages of rough draft content, which will be to be split between standard and technical reports. 75 active authors |
| July 2020 | Release of Draft ISA112 lifecycle diagram at www.isa.org/isa112 |

- 2021-2022 – Document Development / Section Working Groups
- 2022-2023 – Comment rounds
- 2023 – Publication of ISA112

# Work so far on ISA112

- Defining what a “SCADA System” is
- General SCADA System Architecture Drawing
- ISA112 SCADA System Lifecycle Diagram
- Key Definitions
- Working Table of Contents
- In progress text for ISA112 standard and technical reports

# What is a SCADA System?

## ISA112 Definition

SCADA, Supervisory Control and Data Acquisition

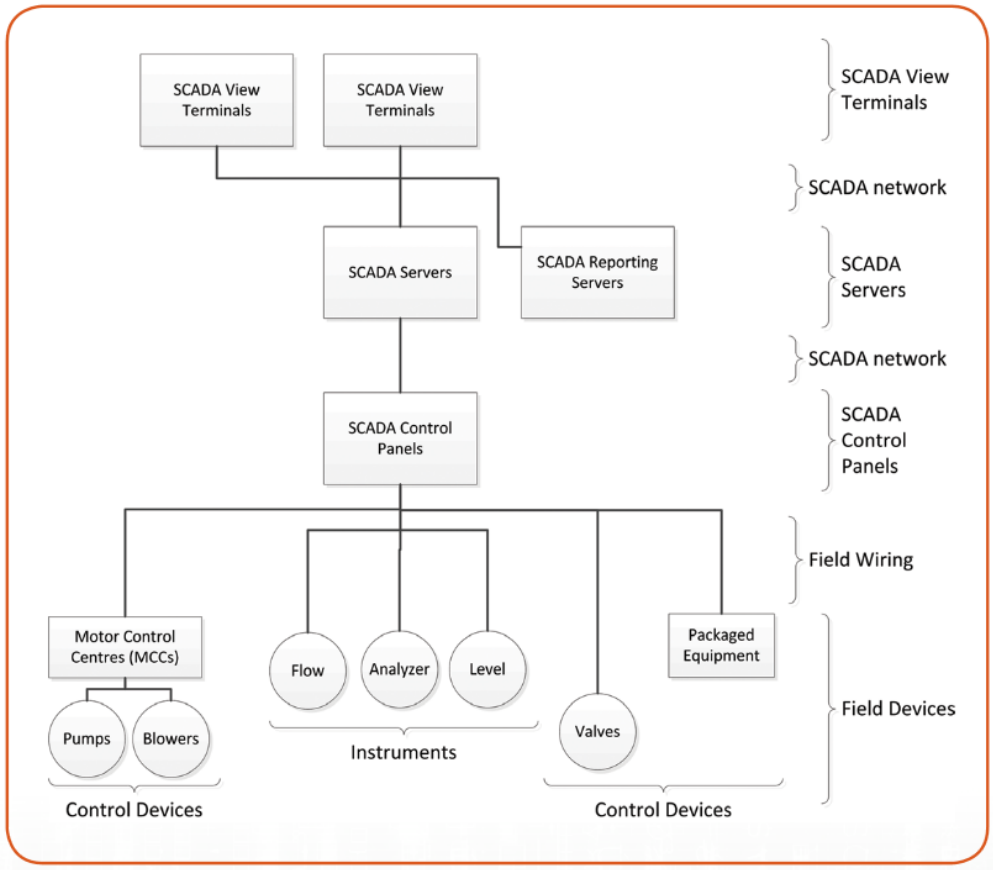
"SCADA = a system which is a combination of hardware and software used to send commands and acquire data for the purpose of monitoring and controlling."

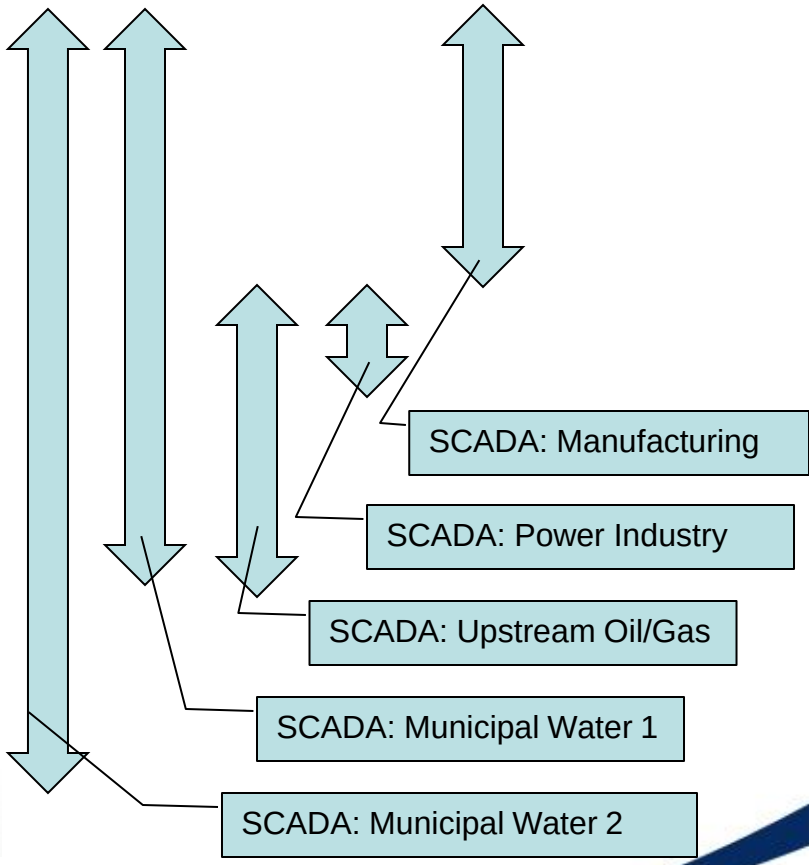
(DEFINITION AS ADOPTED AT THE MAY 5, 2017 MEETING OF ISA112 IN RALEIGH, NORTH CAROLINA, USA)

*Different Industries use the term "SCADA" to mean many different things that are specific to that individual industry. Each of these industries is correct in how it uses the term SCADA within its own context. We must be aware of this, and our definition and standard must be written so that it can be used by all industries.*

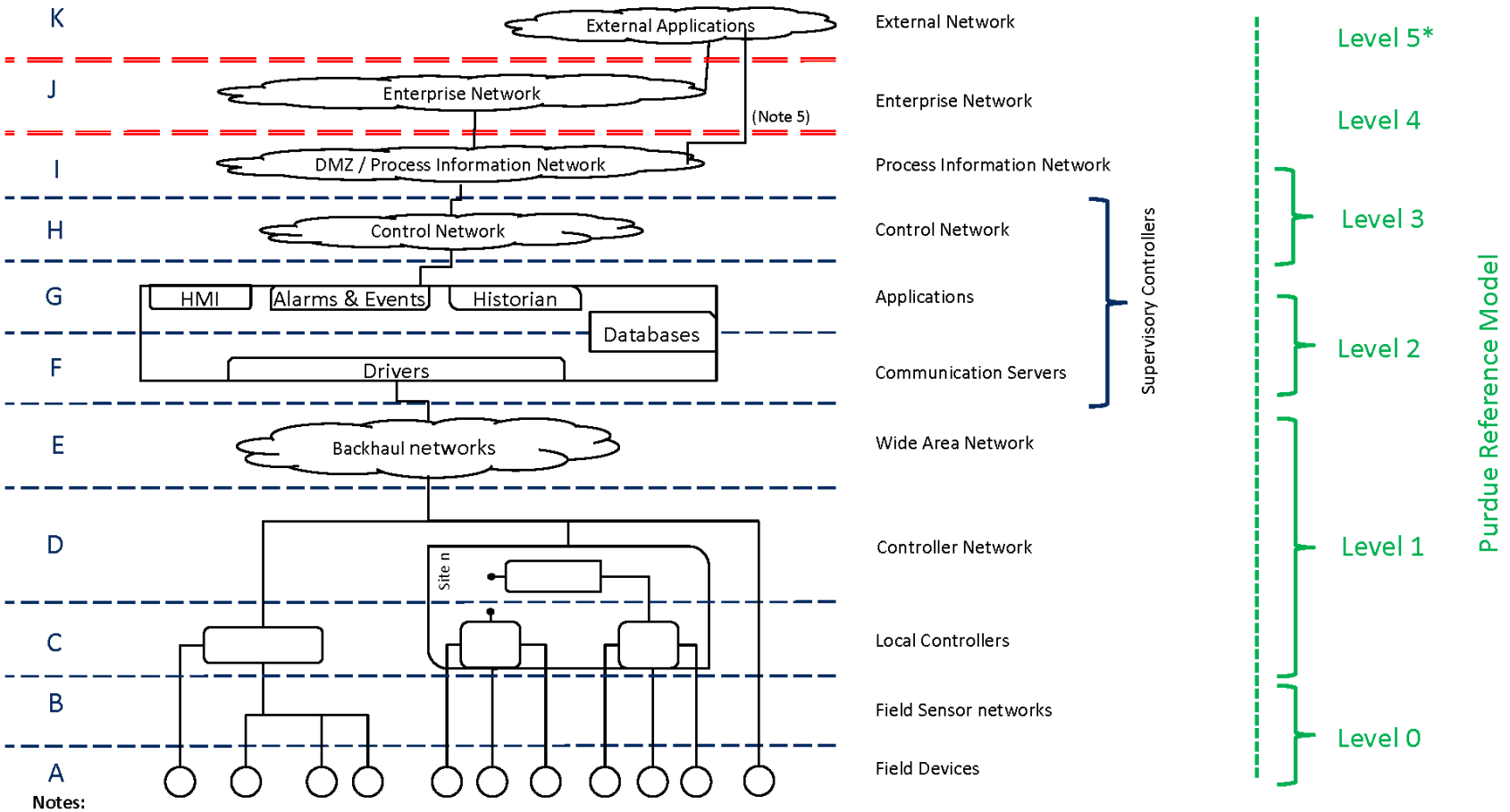
# Term “SCADA vs. Several Industries

- Examples of differing definitions of SCADA by industry
- Definitions can also vary by geographic area/country



# SCADA System Architecture

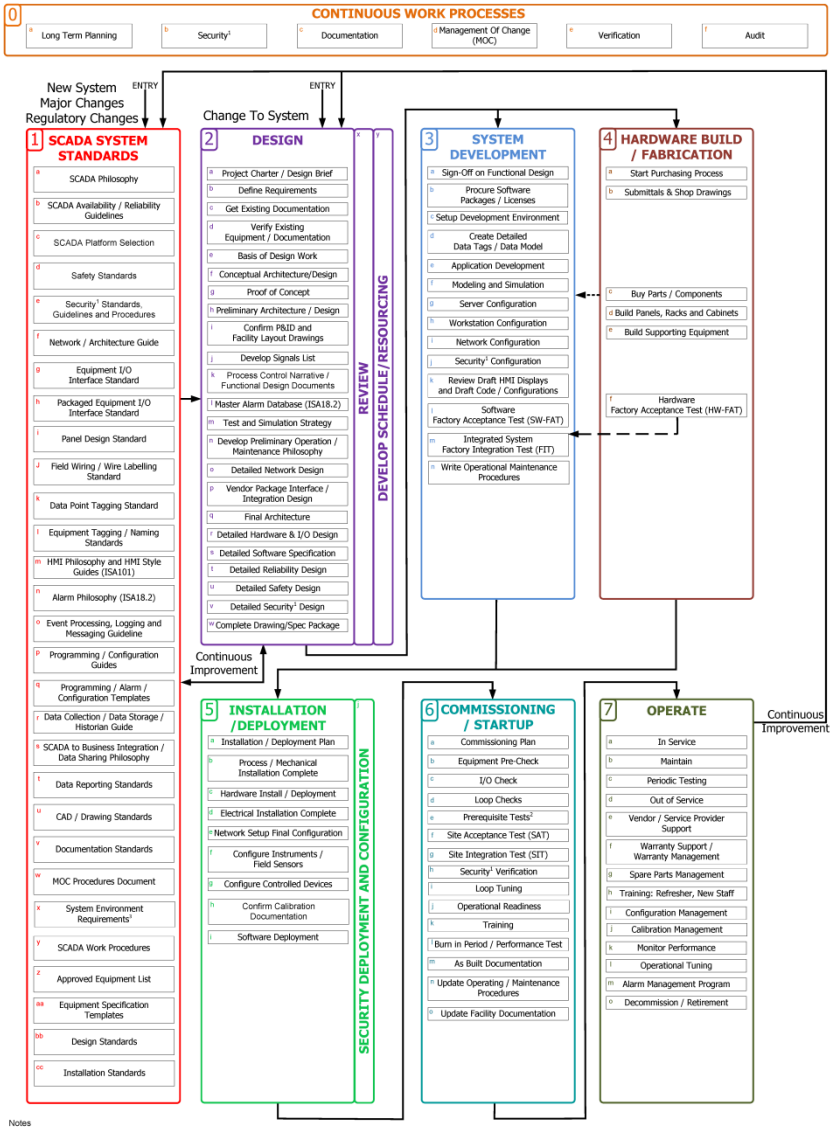


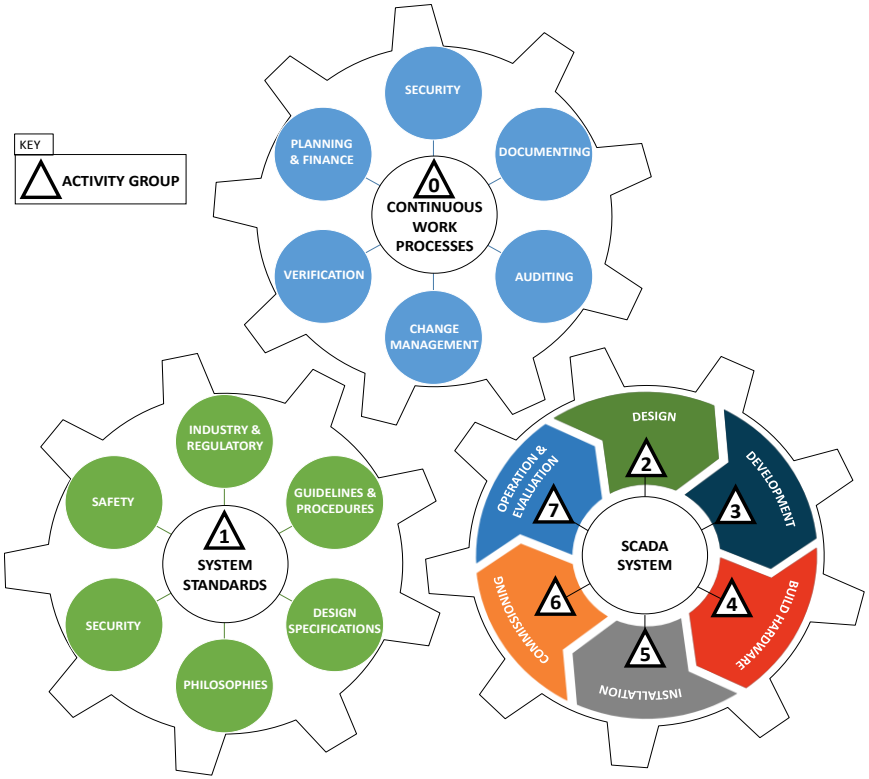

**Notes:**

1 Letters are used to avoid potential conflict with ISA-95 and other "Layer" models.
2 Routers and Firewalls between layers are not shown.
3 Other system-specific servers, applications ,and workstations are not shown.
4 Communications for any remote-hosted external applications (Cloud) with lower levels must be done using extreme care.
5 The use of direct-connections for remote applications is strongly discouraged. Refer to ISA/IEC-62443 for guidance on an appropriate zone/conduit implementation.
* We show a Purdue Level 5. The true Purdue Model only has levels 0-4 because it did not anticipate external applications.

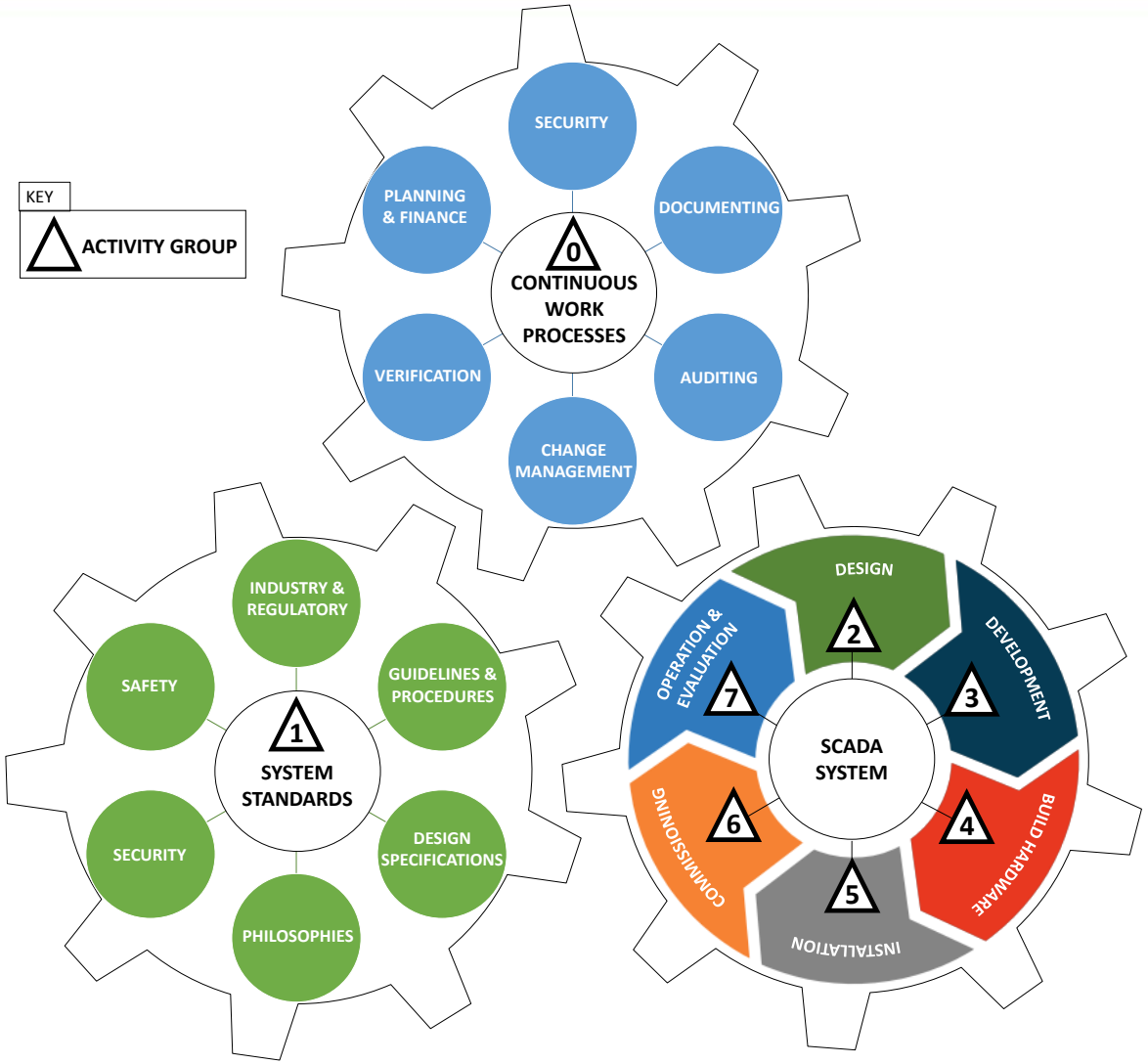
**Revision May 28, 2020**

# SCADA Systems Lifecycle Diagram

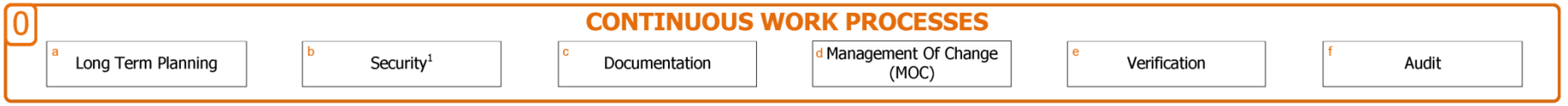


# SCADA Systems Lifecycle Diagram



# SCADA Continuous Processes




**Long Term Planning** – Planning for 5, 10, 15, 20, 25+ year outlook
Some organizations may use a SCADA Master Plan as part of this

**Security** –Physical Security, Operational Security and Cyber Security

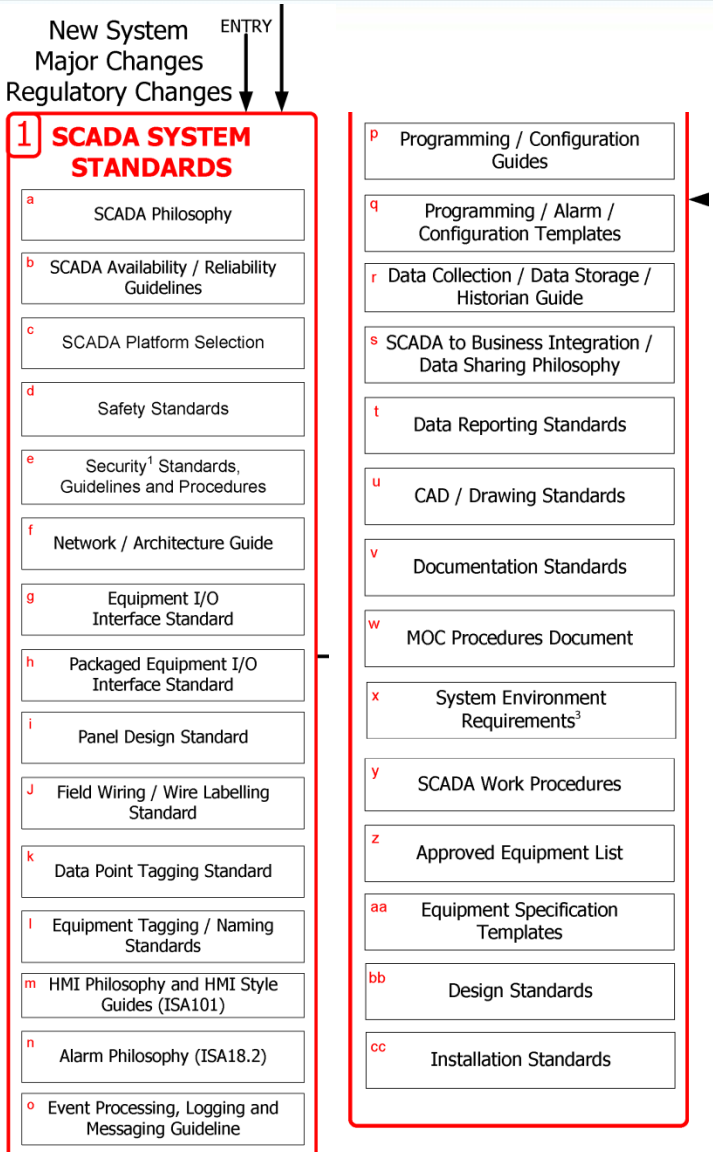
**Documentation** – ongoing documentation of the system for operations

**Management of Change (MOC)** – managing/controlling system changes

**Verification** – SCADA system is working the way it is documented

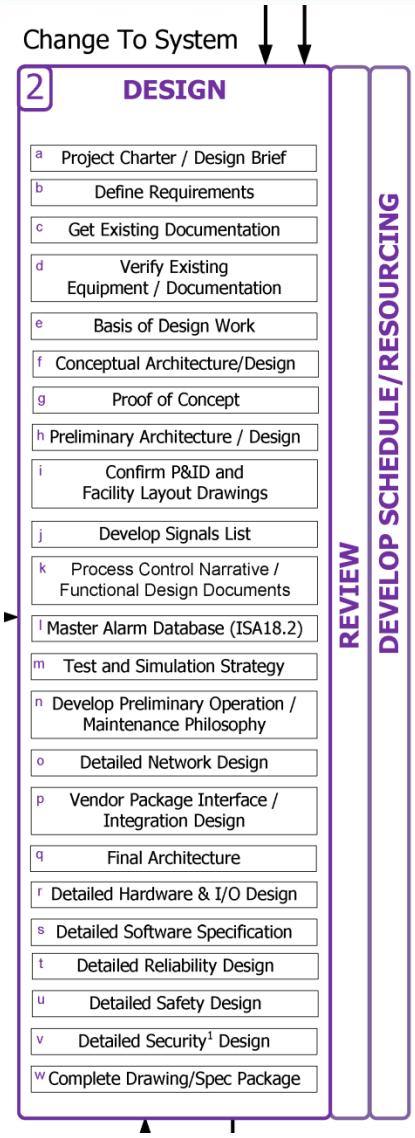
**Audit** – that work processes are being followed and documented

# SCADA Facility System Standards




SCADA Philosophy Document
SCADA Availability/Reliability Guideline
SCADA Platform Selection
Safety Standards (for automatic shutdown systems)
Security Standards, Guidelines and Procedures
Network / Architecture Guide
Equipment I/O Interface Standard
Packaged Equipment I/O Interface Standard
Panel Design Standard
Field Wiring / Wire Labelling Standard
Data Point Tagging Standard
Equipment Tagging / Naming Standards
HMI Philosophy and HMI Style Guides (ISA1010)
Alarm Philosophy (ISA18.2)
Event Processing, Logging and Messaging Guideline
Programming / Configuration Guides
Programming / Alarm / Configuration Templates
SCADA to Business Integration / Data Sharing Philosophy
Data Reporting Standards
CAD / Drawing Standards
Documentation Standards
MOC Procedures Document (Change Management)
System Environment Requirements
SCADA Work Procedures
Approved Equipment List
Equipment Specification Templates
Installation Standards

# SCADA Design Work Process




Project Charter / Design Brief
Define Requirements

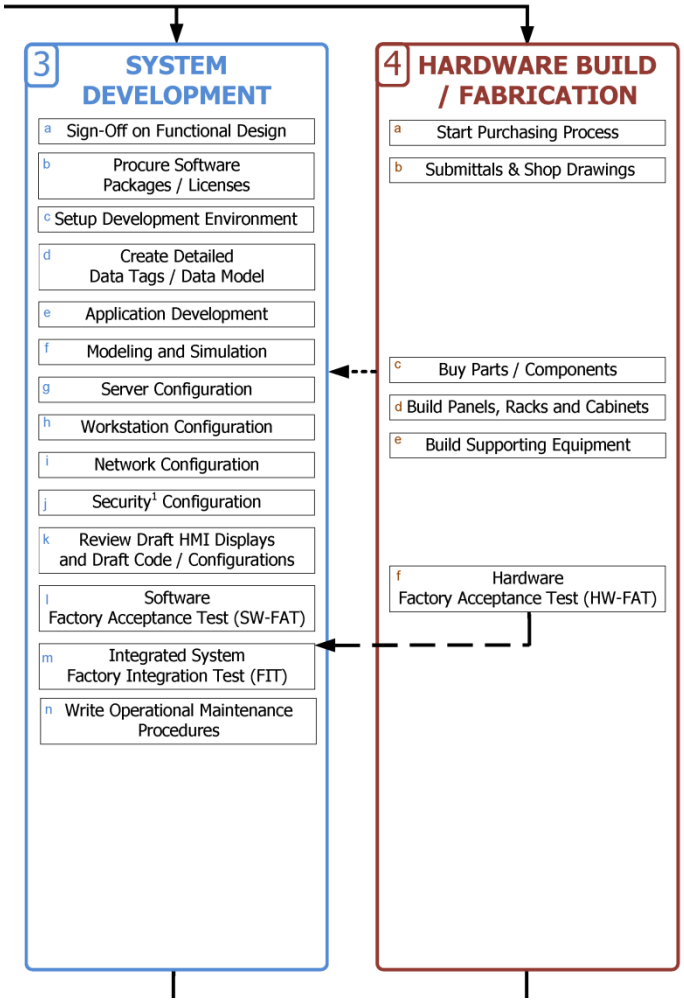
Get Existing Documentation
Verify Existing Equipment/Documentation
Basis of Design work
Conceptual Architecture/Design
Proof of Concept
Preliminary Architecture/Design

Confirm P&ID's and Facility Layout Drawings
Develop Signals List
Process Control Narrative / Functional Design Documents
Master Alarm Database (ISA18.2)
Test and Simulation Strategy
Develop Preliminary Operation / Maintenance Philosophy
Detailed Network Design
Vendor Package Interface/Integration Design
Final Architecture

Detailed Hardware & I/O Design
Detailed Software Specification
Detailed Reliability Design (UPS's, redundant equipment)
Detailed Safety Design (automatic shutdown systems)
Detailed Security Design (check of security & cybersercurity details)

Complete Drawing/Spec Package (for group that will do building/programming)

# SCADA Development & Hardware




**System Development**

- Sign-Off Functional Design Doc (Process Control Narrative)

- Procure Software Packages / Licences
- Train Software Development Team
- Setup Development Environment
- Create Detailed Data Tags / Data Model
- Application Development (PLC & HMI Programming)
- Modelling and Simulation (so one can test as they program)

- Server Configuration
- Workstation Configuration
- Network Configuration
- Security Configuration (check all security settings are right)

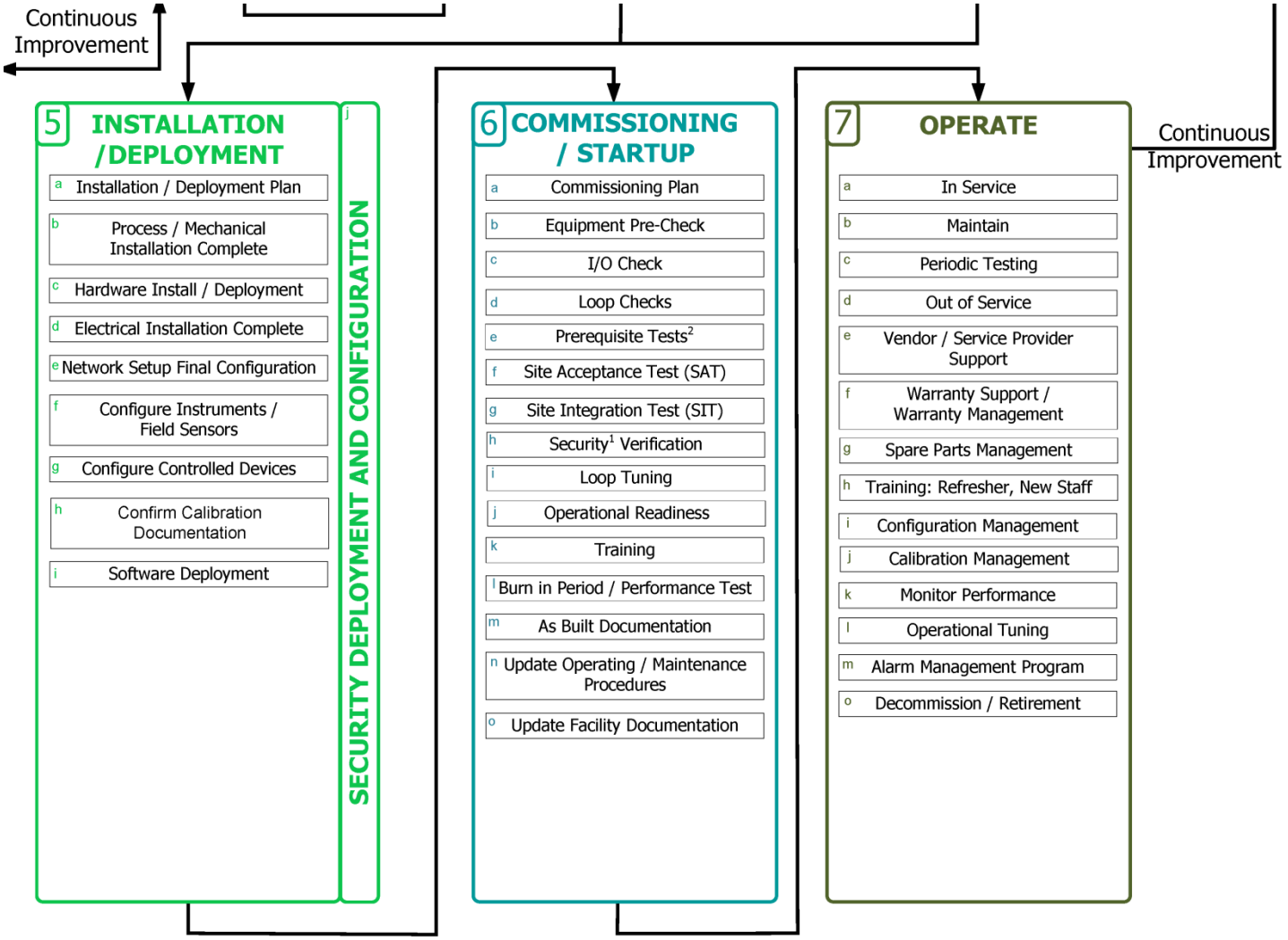
- Review Draft HMI Screens and Draft Code / Configurations
- Software Factory Acceptance Test (SW-FAT)
- Integrated System Factory Integration Test (FIT)
- Write Operational Procedures (how to use the control system)
- Develop Software Training Materials

**Hardware Building / Fabrication**

- Start Purchasing Process
- Shop Drawings / Submittals
- Buy Parts / Components
- Build Panels, Racks and Cabinets
- Build Supporting Equipment

- Hardware Factory Acceptance Test (HW-FAT)

# SCADA Install, Commission, Operate



# ISA112 Current Work Plan

- Write ISA112 definition for “SCADA System” – done
- Refining the SCADA Life Cycle Diagram – done
- Developing SCADA Reference Architecture Diagram – done

- Draft Table of Contents (list of items to cover in ISA112) – done
- Developing “use cases” and “examples” for applying standard - done
- Aligning TOC with Life Cycle Diagram and Architecture Diagram -done
- Create plan for writing content, assign section authors & writing –done
- Defining Key SCADA Terms – in progress
- Writing Content – in progress
- Review Cycles

- Work in Progress
- As of June 2021

# ISA112 Publications

- www.isa.org/isa112
  - Freely available copy of ISA112 SCADA management lifecycle
  - Freely available cop of ISA112 SCADA model architecture
  - List of committee members, copies of presentations/articles and other materials

- ISA112 upcoming publications
  - ISA112 Part 1– Terminology, Diagrams and Definitions
  - ISA112 Part 2 – SCADA Systems Management Lifecycle
  - ISA112 Part 3 – SCADA Systems Model Architecture

- ISA112 Technical Reports
  - Titles and Topics TBD
  - To be focused on examples and best practices for “how” to implement SCADA systems
  - May be industry and/or application specific

# More Information on ISA112

- www.isa.org/isa112/
- Download the current ISA112 lifecycle & diagrams
- Contact the committee co-chairs
  - Graham Nasby
    graham.nasby@guelph.ca
  - Ian Verhappen
    iverhappen@industrialautomationnetworks.com

*The committee is still looking for volunteers from end-users, vendors, system integrators, consultants, utilities, and government to help with writing, editing and reviewing content.*