Introduction to ISA112
SCADA Systems Standard

June 2019

Graham Nasby
ISA112 committee co-chair
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. Currently over 100 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. Man.
• 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
- 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
Equipment Vendor 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
Contractor 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
System Integrator 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
## Current Status of ISA112

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun 2016</td>
<td>Committee approved by ISA</td>
</tr>
<tr>
<td>Aug 2016</td>
<td>Initial call for volunteers (40 members)</td>
</tr>
<tr>
<td>Sept 2016</td>
<td>First meeting held in Newport Beach, California, USA</td>
</tr>
<tr>
<td>Jan 2017</td>
<td>Committee co-chairs named</td>
</tr>
<tr>
<td></td>
<td>- Graham Nasby, City of Guelph Water Services (Guelph, Ontario, Canada)</td>
</tr>
<tr>
<td></td>
<td>- Ian Verhappen, CIMA+ (Calgary, Alberta, Canada)</td>
</tr>
<tr>
<td>Apr 2017</td>
<td>Monthly conference calls start</td>
</tr>
<tr>
<td>May 2017</td>
<td>Second meeting in Raleigh, North Carolina, USA</td>
</tr>
<tr>
<td></td>
<td>Semi-annual face-to-face meetings start</td>
</tr>
<tr>
<td>May 2018</td>
<td>ISA112 Lifecycle &amp; Architecture Diagram Developed</td>
</tr>
<tr>
<td>Nov 2018</td>
<td>Table of Contents Developed</td>
</tr>
</tbody>
</table>

- 2019 – Document Development / Section Working Groups
- 2020 – Comment rounds
- 2022 – 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
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. Remote-hosted external applications (Cloud) could be configured to attach to devices at any level, with appropriate firewalls, tunneling and routing.
* We show a Purdue Level 5. The true Purdue Model only has levels 0-4 because it did not anticipate external applications.
SCADA Continuous Processes

- **Long Term Planning** – Planning for 5, 10, 15, 20, 25+ year outlook
- **Security** – both Physical Security and Cyber Security
- **Documentation** – ongoing documentation of the system for operations
- **Management of Change (MOC)**
- **Verification** – SCADA system is working the way it is documented
- **Audit** – that work processes are being followed and documented
SCADA Facility System Standards

1. SCADA Philosophy Document
2. SCADA Availability/Reliability Guideline
3. SCADA Platform Selection
5. Safety Standards (for automatic shutdown systems)

- Network/Architecture Guide
- Equipment I/O Interface Standard
- Packaged Equipment Interface Standard
- Panel Design Standard
- Field Wiring/Labelling Standard
- Data Point Tagging Standard
- Equipment Tagging/Naming Standards
- Programming/Configuration Guides
- Programming/Configuration Templates
- HMI Design Documents
- Alarm Philosophy
- Data Storage/Historian Guide
- SCADA to Business Integration/Data Sharing Philosophy
- Data Reporting Standards
- Drawing Standards
- Documentation Standards
- MOC Procedures Document
- SCADA Work Procedures
- Approved Equipment List
- Equipment Specification Templates
SCADA Design Work Process

1. **Project Charter / Design Brief**
   - Define Requirements

2. **Get Existing Documentation**
   - Verify Existing Equipment/Documentation

3. **Preliminary Design Work**
   - Conceptual Architecture/Design
   - Proof of Concept
   - Preliminary Architecture/Design

4. **P&ID’s and Facility Layouts**
   - Process Control Narrative

5. **Master Alarm Database (ISA18)**
   - Develop Signals List
   - Test and Simulation Strategy

6. **Detailed Network Design**
   - Develop Preliminary Operation/Maint. Philosophy
   - Detailed Network Design
   - Vendor Package Interface/Integration Design
   - Final Architecture

7. **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)

8. **Complete Drawing/Spec Package** (for group that will do building/programming)
### SCADA Development & Hardware

#### System Development
- Sign-Off Functional Design Doc (Process Control Narrative)
- Setup Development Environment
- Create Detailed Data Tags
- 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
- Software Factory Acceptance Test (FAT)
- Integrated System Factory Integration Test (FIT)
- Write Operational Procedures (how to use the control system)

#### Hardware Building / Fabrication
- Start Purchasing Process
- Shop Drawings / Submittals
- Buy Parts / Components
- Build Panels, Racks and Cabinets
- Build Supporting Equipment
- Hardware Factory Acceptance Test (FAT)
5 INSTALLATION/DEPLOYMENT
a. Installation/Deployment Plan
b. Develop Training Material
c. Hardware Install
d. Equipment/Wiring Installation
e. Configure Instruments
f. Software Deployment
g. Network Setup

6 COMMISSIONING
a. Commissioning Plan
b. Equipment Pre-Check
c. I/O Check
d. Loop Checks
e. Pre-Requisite Tests
f. Site Acceptance Test (SAT)
g. Site Integration Test (SIT)
h. Operational Readiness
i. Training
j. Burn in Period
k. As Built Documentation
l. Update Operating/Maintenance Procedures

7 OPERATE
a. In Service
b. Maintain
c. Periodic Testing
d. Out of Service
e. Vendor Support
f. Training: Refresher, New Staff
g. Configuration Management
h. Monitor Performance
i. Operational Tuning
j. Decommission/Retirement

Continuous Improvement

Revised June 7th 2019
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 2019
More Information on ISA112

• [www.isa.org/isa112/](http://www.isa.org/isa112/)

• Contact the committee co-chairs
  - Graham Nasby
    [graham.nasby@guelph.ca](mailto:graham.nasby@guelph.ca)
  - Ian Verhappen
    [ian.verhappen@cima.ca](mailto:ian.verhappen@cima.ca)

*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.*
Introduction to ISA Standards Committees
Standards Committees

• The consensus bodies for standards developed under the SCC/ANSI Essential Requirements.

• Committees have:
  – Title,
  – Scope, approved by the ISA S&P Board,
  – Purpose, approved by the ISA S&P Board.

• Committees consist of:
  – a Chair or two Co-Chairs,
  – members who have a direct and material interest in the subject,
  – members may be voting, alternate, or informational members.

• Membership is not conditional upon ISA membership, or unreasonably restricted for any other reason.

• Membership not dominated by a single interest category. Safety committee membership interest categories are limited to 1/3.

• Minimum of 5 voting members.
Standards Committees

• Member affiliation and interest category shall be disclosed.
• Members shall also disclose the "ultimate parent entity" of his or her affiliation.
• Failure to disclose affiliation or misleading disclosure shall result in loss of any membership privileges and may also result in loss of privileges for such affiliated members.
• Interest categories:
  – General,
  – Architect-Engineer, Engineer-Constructors, Integrators,
  – Testing/Certification/Approval,
  – Regulatory/Government,
  – Producer,
  – User.
ISA & the IEC

• ISA is a recognized Standards Developing Organization (SDO) by ANSI (American National Standards Institute)
  – In Canada CSA is an SDO for the SCC (Standards Council of Canada) which is the equivalent to ANSI
  – Other countries, there will be an equivalent national standards body

• National Standards Bodies are members of the IEC and ISO
  – Only countries can be made members of IEC/ISO
  – IEC membership can be as P (Participating) or O (Observer)

• Can also have direct link between organization and IEC through Liaison
International Standards Development

Global

ISO
www.iso.org

IEC
www.iec.ch

ITU
www.itu.int

IECEE
www.ieCEE.org/

Compliance Group

National

Standards Council of Canada (SCC)
www.scc.ca/

American National Standards Institute
www.ansi.org/

British Standards Institute
www.bsigroup.com/

DKE (Germany)
www.vde.com

SDO

CSA

ISA

IEEE

VDE
IEC Organization

System Aspects: To prepare standards regarding the generic aspects of systems used in industrial-process measurement and control:

Measurement and control devices: Standardization in the field of specific aspects of devices (hardware and software) used in industrial process measurement and control

Industrial networks: To prepare standards on Digital Data Communications sub-systems for industrial-process measurement and control

Devices and integration in enterprise systems: To prepare international standards to specify digital representation of device properties and functions, methodologies and applications
More Information on ISA112

• [www.isa.org/isa112/](http://www.isa.org/isa112/)

• Contact the committee co-chairs
  
  – Graham Nasby
    [graham.nasby@grahamnasby.com](mailto:graham.nasby@grahamnasby.com)
  
  – Ian Verhappen
    [ian.verhappen@cima.ca](mailto:ian.verhappen@cima.ca)

*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.*