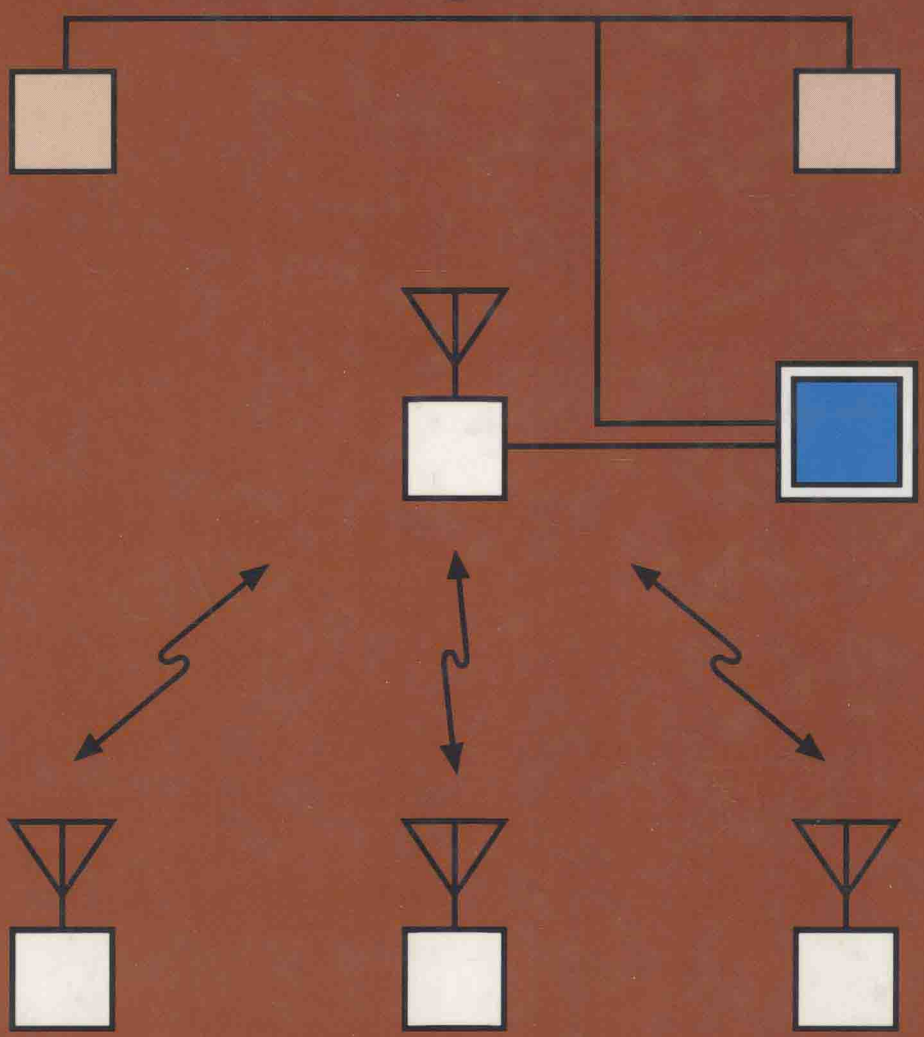
SCADA
SUPERVISORY CONTROL AND DATA ACQUISITION

by Stuart A. Boyer



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An Independent Learning Module
from the
Instrument Society of America

PREFACE

ISA's Independent Learning Modules

This book is an Independent Learning Module (ILM) as developed and published by the Instrument Society of America (ISA). The ILMs are the principal components of a major educational system designed primarily for independent self-study. This comprehensive learning system has been custom designed and created for ISA to more fully educate people in the basic theories and technologies associated with applied instrumentation and control.

The ILM System is divided into several distinct sets of Modules on closely related topics; each such set of individually related Modules is called a Series. The ILM System is composed of:

- the ISA Series of Modules on Control Principles and Techniques;
- the ISA Series of Modules on Fundamental Instrumentation;
- the ISA Series of Modules on Unit Process and Unit Operation Control;
- the ISA Series of Modules for Professional Development;
- the ISA Series of Modules for Specific Industries; and
- the ISA Series of Modules on Software-Associated Topics.

The principal components of the Series are the individual ILMs (or Modules)) such as this one. They are especially designed for independent self-study; no other text or references are required. The unique format, style, and teaching techniques employed in the ILMs make them a powerful addition to any library.

Most of the original ILMs were envisioned to be the more traditional or fundamental subjects in instrumentation and process control. With the publications planned over the next few years, the ILM Series will become much more involved in emerging technologies.

ISA has increased its commitment to the ILM Series and has set for itself a goal of publishing four ILMs each year. Obviously, this growing Series is part of a foundation for any professional library in instrumentation and control. The individual practitioner will find them of value, of course, and they are a necessity in any institutional or corporate library.

There is obvious value in maintaining continuity within your personal set of ILMs; place a standing purchase order with ISA.

Paul W. Murrill
Consulting Editor, ILM Series

Comments about This Volume

Certain processes cover areas that may be measured in the thousands of square miles and have dimensions that may be hundreds—occasionally thousands—of miles long.

Over the last thirty years, a method has evolved to monitor and control large processes like these. As with most evolving technologies, it has borrowed something from one applied science and something else from another. It is now a mature technology. That is not to say that it will stop evolving, but rather that most of its present techniques have cleared the hurdles that the real world places in the path of new ideas.

This Independent Learning Module was developed to provide the reader with an understanding of this technology called SCADA.

Dedication

I would like to dedicate this book to Linda, who has provided both practical and moral support in its development, even though—or perhaps because—neither of us understood at the beginning how much work would be involved.

Stuart A. Boyer

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Introduction and Overview

UNIT 1

Introduction and Overview

Welcome to the ISA's ILM (Independent Learning Module) *SCADA—Supervisory Control and Data Acquisition*. This unit provides an overview of the course and information needed for independent study.

Learning Objectives — When you have completed this unit, you should:

A. Know the nature of the material in the course.

B. Understand the general organization of the material.

C. Know the course objectives.

1-1. Course Coverage

This course covers introductory technical material about SCADA systems. The basic layout of SCADA systems and process selection parameters are addressed. Communication and the main building blocks are dealt with in more detail. Economic tools and projections into the future round out the course.

No recommendations about specific equipment or methods are provided, although techniques to allow the reader to make such selections are included.

1-2. Purpose

The purpose of this ILM is to introduce the student to the basics of SCADA by considering overviews where possible and details where necessary. Major differences between SCADA systems for different industries are identified. However, because the basics are much the same from one industry to another, examples from many industries have been included in the course.

1-3. Audience and Prerequisites

This ILM is designed for those who wish to learn the basics of SCADA by themselves at their own pace. It is designed to be

useful to managers, supervisors, engineers, operators, and technicians who contemplate coming in contact with SCADA systems. It will be useful to students of technical schools and colleges as an introduction to the subject. It should also serve, to any technical people with personal interest, as a source of overview information about SCADA.

1-4. Study Materials

This text is the only study material required. It is one of ISA's Independent Learning Modules system. As such, it is designed as an independent, stand-alone textbook that is uniquely and specifically structured for self-study.

The student may find it helpful to study Independent Learning Modules on related subjects. Several of them are identified in the list of suggested reading and study materials found in Appendix A.

1-5. Organization and Sequence

This ILM is divided into 14 separate units. The next unit is an overview of SCADA, with some definitions and limitations. It should focus the student's attention to those factors that make SCADA what it is. The third unit provides a sketch of the history of the technology and defines it in the context of related technologies.

Units 4 and 5 discuss the importance of data currency (''How up to date is the information?'') and describe how this data currency is used to select what process functions can be addressed by SCADA.

Units 6 and 7 concern the transfer of information between the remote field location and the master or central location. While several communications media are available, radio is probably the most common. For this reason, and because radio has some problems that other media do not have, an entire unit is devoted to it.

Units 8 and 9 describe the hardware. The ''black box''—the RTU (Remote Terminal Unit)—is discussed in Unit 8; the MTU (Master Terminal Unit) is explained in some detail in Unit 9.

The end devices and the auxiliary equipment at the process end of the communication link are presented in Unit 10. Individual sensors, actuators, and signal conditioners are relatively inexpensive, but because there are so many of them in a SCADA system, their cumulative purchase, installation, and maintenance cost may exceed the cost of all the more complex elements.

Unit 11 identifies some of the applications for which SCADA is used. It points out that present systems are used much more for remote control than they are for automatic control. Some cautions are voiced in this unit to avoid applications that would be weakened by natural limitations of SCADA. Different industries have developed SCADA in subtly different directions. Comments in Unit 11 will identify some of these differences.

Unit 12 discusses how the operator receives information from and sends information to the system. The SCADA operator interface is a field that has ridden on the shoulders of several other operator interface technologies.

Our industrial success depends on making sound economic and implementation decisions. The factors to consider in evaluating SCADA projects is the subject of Unit 13.

Unit 14 projects SCADA into the future, based on trends in both operations and the technology. It is useful—even necessary—to try to imagine what SCADA will be doing in the future so that systems currently being planned will have longer useful lives.

The Appendices provide references for further reading and definitions of acronyms and specialty words. As with most electronics-based technologies, SCADA is a virtual cornucopia of these. Finally, the solutions to the exercises found at the end of each chapter are given in Appendix C.

1-6. Course Objectives

When you have completed this entire ILM, you should be able to:

A. Be conversant with SCADA nomenclature.

B. Describe the typical SCADA architecture.

C. Understand when a SCADA system would be beneficial to your operation.

D. Understand the basic technology of each of the major building blocks for SCADA.

E. Understand the limitations of SCADA.

F. Select the appropriate SCADA technologies for your operational requirements.

In addition to these general objectives, each unit contains a specific set of learning objectives to help direct your study in that unit.

1-7. Course Length

The basic idea of the ISA system of ILMs is that students learn best if they proceed at their own personal pace. As a result, there will be significant variations in the amount of time taken by individual students to complete this ILM. Most students will complete this course in 18 hours.

Unit 2:
What Is SCADA?