Process Control Systems—
Process Control System Design

API RECOMMENDED PRACTICE 554, PART 2
FIRST EDITION, OCTOBER 2008

REAFFIRMED, NOVEMBER 2016

Process Industry Practices

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Downstream Segment

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Introduction

Advances in computing and digital communications technologies since the preparation of the first edition of API 554 have had major impacts on the way instrumentation and control systems function as compared to historical designs. The advances have also radically changed the way that the design and specification of such systems must be approached and have created major issues relative to system design and system security. These issues are as follows.

— The virtual disappearance of conventional central control room control panels.

— Advances in computing power, software standards and communications standards have resulted in many of the functions historically implemented in stand alone process control and historization computers being integrated within the process control systems. This has greatly expanded the scope of process control system design and blurred the division between real time control and historization functions and higher-level information systems that provide input to business and maintenance systems.

— Advances in field instrumentation design leading to the general use of "smart" digital field instrumentation. Further advances in field bus and related technologies allow these "smart" instruments to communicate directly with the process control systems or with each other. These instruments not only transfer information about the basic process measurement, but also communicate diagnostic information about the health of the device or other secondary information derived from the primary measurements.

— Further developments in standardization of operating systems and software practices have enabled use of standard computer components and peripherals operating on standard operating systems. This has resulted in a developing trend away from control systems applications being implemented on proprietary hardware and software systems, but rather being implemented on standard personal computer, workstation and network communication products running widely available operating systems.

— This standardization has reduced the cost and increased the flexibility of the systems. It has also resulted in greater exposure of the process control systems to external interference and requires additional support to keep the operating systems current and secure. Security and virus-protection are major concerns of newer process control systems and must be addressed at both the design and operational phases.

The result of all these technical advances is that process control systems are no longer entirely based upon proprietary closed hardware and software systems offered by a single vendor. While these implementations are still available and form the preponderance of the existing installed base, there is a very strong trend away from closed systems provided by one vendor to more open systems based upon industry standard hardware and software which have both proprietary and open system components.

These trends result in a far greater flexibility in selection of the control functions and the control hardware.

These trends place greater responsibility upon the design engineer and user to understand the interaction between process control systems and the business functions of an organization; select and specify the functions that are necessary for a given application; and implement those functions in a safe, reliable, cost effective and maintainable manner.

Therefore, this edition of API 554 has been reorganized and split into three documents in order to better define the processes required to properly scope, specify, select, install, commission, operate, and maintain process control systems. This recommended practice is not intended to be used as a purchase specification, but recommendations are made for minimum requirements that can be used as a specification basis.

Process Control Systems—Process Control System Design

1 Scope

This recommended practice (RP) addresses the processes required to successfully implement process control systems for refinery and petrochemical services. The major topics addressed are listed below.

— *Part 1*. The basic functions that a process control system may need to perform, and recommended methodologies for determining the functional and integration requirements for a particular application.

— *Part 2*. Practices to select and design the installation for hardware and software required to meet the functional and integration requirements.

— *Part 3*. Project organization, skills and management required to execute a process control project and then to own and operate a process control system.

Figure 1 shows the general overall scope of refinery control and automation functions and the portions of which this recommended practice addresses.

The first edtions of API 554, Part 2 and API 554, Part 3 have been prepared by a collaborative effort of the API Subcommittee on Instrumentation and Control Systems and the PIP (Process Industries Practices) Process Control Function Team. As such, the general scope of the material contained has been expanded to cover general industrial process control topics that are applicable to both refineries and petrochemical facilities (PIP is a consortium of owner and engineering/construction contractor companies whose purpose is to produce a set of harmonized engineering standards in a variety of discipline areas, including process control).

Although the scope has been extended beyond traditional refining services, the user is cautioned to fully consider the requirements of the particular applications and circumstances that may exist and carefully apply the concepts described in this RP as appropriate. This document is not intended to present a tutorial on the subjects discussed, but rather to aid the reader in identifying and understanding the basic concepts of process control systems. The references provided within the document direct the reader to publications that describe one or more subjects in greater detail than is necessary or desirable for the purposes of this document.

1.1 Document Organization

This document is organized to follow the sequence of activities associated with the typical life cycle of a process control system as summarized in Table 1.

The life cycle phases as they apply to process control systems are listed below.

— *Appraise*. Develop business goals and requirements and identify basic functions required. This step is often also referred to as the conceptual stage.

— *Select*. Further develop business goals and functions into a process control systems scope definition. This step often is part of the early portion of front end engineering design (FEED).

— *Define*. Finalize process control systems scope definition, select hardware and software and prepare all applicable design drawings, specifications and procure other hardware and equipment. This step often forms the bulk of FEED.

— *Execute*. Detailed design and procurement, construction/installation, checkout, commissioning.

— *Operate*. Commission operate and maintain.