Process Control Systems—Functions and Functional Specification Development

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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 with 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 repurposing and relocation of central control room.

— 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 (PCSs). This has greatly expanded the scope of PCS 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. The control systems engineer is challenged to maintain a design that allows communications between the control and the business networks but that also maintains safe and reliable operations.

— 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 PCSs 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. The smart devices enable very real, albeit basic, “distributed control” across the various real-time devices within the control domain. The degree of such distributed control shall be considered, if it’s within the corporate policy.

— 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, and instead 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 PCS to external interference and requires additional support to keep the operating systems current and secure. Security and virus protection are major concerns of newer PCSs and must be addressed at both the design and operational phases.

— The integration of the human machine interface and communication networks for the PCS and the safety instrumented system (SIS).

— The addition of “wireless process networks” is bringing new challenges and it is transforming the way the information generated in the field sensors is transmitted and the way the facilities are designed.

The result of all these technical advances is that PCSs 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 PCSs and the business functions of an organization: to select and specify the functions that are necessary for a given application; and to implement those functions in a safe, reliable, cost effective, and maintainable manner.

API 554 consists of three documents to better define the processes required to properly scope, specify, select, install, commission, operate, and maintain PCSs. 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—
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1 Scope

1.1 General

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

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

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

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

Figure 1 shows the general overall scope of oil and gas production, refinery process control, and the associated automation functions, as well as the portions of which this recommended practice addresses.

The general scope of the material covers general industrial process control topics that are applicable to oil and gas production, refineries, and petrochemical facilities.

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 PCSs. 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.

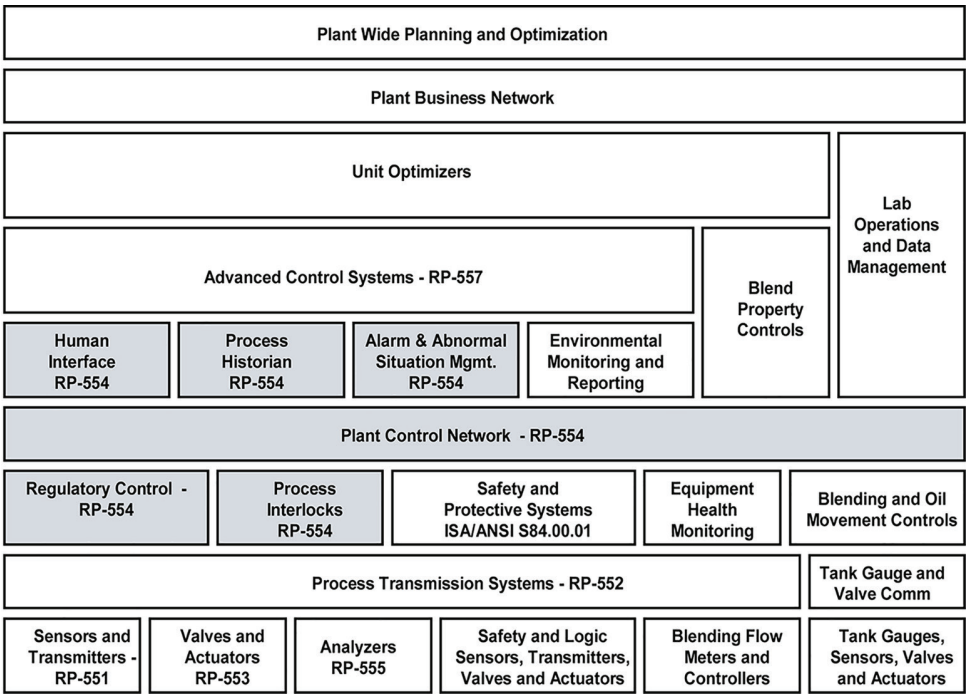

Figure 1—Refinery Control and Automation Functions