2
The basic process unit

2.1 INTRODUCTION

A process control system comprises a process involved in a controlled system and a process controller. Functions of the entire process control system are described in this chapter. The basic process unit which integrates all essential process and process control functions is identified as the basic building block of the process control system, both for its vertical and horizontal integration. The most critical parameter of the functioning of the basic process unit is its data processing ability. Therefore the different functions of the basic process unit controller are considered separately. The necessary data processing functions of the controller are established and analysed as based on available data processing time. The timing relations and informational features of process input/output devices are also given because they limit the functional and informational characteristics of the basic process unit and therefore the entire process control system.

2.2 THE BASIC PROCESS UNIT

A verbal descriptive form of a control system includes all procedures, relations and logics shown in a process. In order to systematize the description, Z. Kehler (private communication, 1975) proposed the following postulates:

Postulate 1  The basic hardware elements of the production process and plant are called the basic process units of the entire process plant. A basic process unit generally consists of:

- large mechanical process hardware that includes all process devices, sensors, transducers and signal converters;
- the controller for the basic process unit that includes all the hardware and software, where all the procedures, relations and logics, as well as a connection with the superimposed control system(s), are executed.

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Postulate 2  A basic process unit is responsible for at least one specific process function. Any part of the unit is based, designed, manufactured, mounted and put into action only if it completely fulfils its part in the functioning of the whole unit.

Postulate 3  Common process functions of the whole process or plant are executed in and by means of a **process controller** that unifies the hardware and software into the following functions:

- mutual functional interconnections and coordination functions between basic process units;
- acquisition of common process signals, execution of common shutdown commands and issuing of permissions for the start-up of the whole process;
- presentation of common functions to process operators.

The interaction of the basic process unit, process controller and superimposed control system is shown in Figure 2.1.

**Example 1**
The functions of a crude-oil/natural-gas separator can be split up into the functions of the controller for the basic process unit, the process controller for the whole measurement station, the synoptics of the basic process unit and the special device function as shown in Figure 2.2. The basic process unit is responsible for three main functions.

1. Processing process signals A, C, D and E and command B, where

   - flow transmitter data (A) are transmitted directly to process controller level;
   - level transmitter data (C and D) are processed for the synoptics of the basic process unit with the logic functions
     \[
     C_1 = C \cdot (Q21 + 1 \text{ Hz}) \\
     D_1 = D \cdot (Q22 + 1 \text{ Hz})
     \]  
     (2.1)

   where Q21 and Q22 are set/reset sequential functions generated at the process controller and 1 Hz is a 1 hertz signal generated at the basic process unit controller for the alarm warning purposes of the local synoptics;

   - data from flow pulse transmitter (E) are preprocessed at the level of special device functions where they are converted into pulse-cumulative and flow-rate data;

   - the command (B) is issued according to the logic relation
     \[
     B = A \cdot L \cdot J1 + F
     \]  
     (2.2)

   where L and J1 are set/reset sequential functions generated at the basic process unit controller and F is a logic variable generated at the