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ISA-TR77.00.01-2019

Fossil Fuel Power Plant Definitions and Basic Control Concepts

Approved 29 November 2019

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ISBN: 978-1-64331-089-3

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ISA
67 T.W. Alexander Drive
P.O. Box 12277
Research Triangle Park, North Carolina 27709

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NAME	COMPANY
D. Lee, Chair	ABB Inc.
G. Cohee	Power Generation Consultant
M. Cushing	Honeywell Process Solutions
J. Gilman	JFG Technology Transfer LLC
W. Hocking	Schneider Electric
P. Hollingshead	Consultant
R. Hubby	Robert N Hubby Consulting
H. Johansen	Bechtel
W. Shin	Suncor Energy
A. Zadiraka	Consultant

The following members of ISA77 approved this document for publication in 2019:

NAME	COMPANY
D. Lee, Chair	ABB Inc.
J. Weiss, Managing Director	Applied Control Solutions LLC
J. Batug	JPB Consulting
G. Cohee	Power Generation Consultant
M. Cushing	Honeywell Process Solutions
R. Eng	Mitsubishi Hitachi Power Systems America
D. Evely	Southern Company
J. Gilman	JFG Technology Transfer LLC
W. Hocking	Schneider Electric
P. Hollingshead	Consultant
R. Hubby	Robert N Hubby Consulting
H. Johansen	Bechtel
S. Kwong	Emerson Automation Solutions
X. Lou	GE Power
D. Orlando	Babcock Power
A. Robertson	Consultant
D. Roney	Consulting Engineer

W. Shin	Suncor Energy
M. Skoncey	Consultant
T. Stevenson	TAI Engineering
C. Taft	Taft Engineering Inc.
W. Talbot	Talbot Simulation Associates LLC
J. Vavrek	Consultant
A. Zadiraka	AJ Zadiraka LLC

This standard was approved by the ISA Standards Board on 29 November 2019.

NAME	COMPANY
D. Bartusiak	ExxonMobil Research & Engineering
D. Brandl	BR&L Consulting
P. Brett	Honeywell Inc.
E. Cosman	OIT Concepts, LLC
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J. Weiss	Applied Control Solutions LLC
M. Wilkins	Yokogawa UK Ltd.
D. Zetterberg	Chevron Energy Technology Co.

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Contents

1	Scope	9
2	Purpose	9
3	Introduction	9
4	Definitions	10
5	Abbreviations and acronyms	30
6	Design consideration	31
6.1	HMI station hierarchy	31
6.2	Transmitter selection	35
6.3	Lead/Lag equipment selection	38
6.4	Input-Output (IO) partitioning	38
6.5	Tripping redundancy	39

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1 Scope

The *Fossil Fuel Power Plant Definitions and Basic Control Concepts* technical report defines specialized terms and basic control concepts used within the ISA77 documents and in the fossil fuel power industry. The terms of this technical report are suitable for use by people involved in all activities related to the fossil fuel power industry, including sales, marketing, engineering, commissioning, operation, and maintenance.

2 Purpose

The purpose of this technical report is to establish uniform terminology for the ISA77 documents and to explain commonly used control concepts that are not described in detail within the ISA77 documents. The technical report should serve as a guideline for suppliers, owner operators, and engineers when preparing function diagrams or system configurations.

3 Introduction

Individual ISA77 working groups developed the terminologies for their specific standards and/or technical reports. This document consolidates these terms to ensure consistency among the working groups.

Within the various ISA77 documents, there are design considerations that are mentioned but not explained. This document explains several design concepts and how they apply to fossil power plant control systems.

4 Definitions

4.1

actuator

a field device that receives the controller output signal as a reference and changes the position of a final control element accordingly through pneumatic, electro-mechanical, or hydraulic means

4.2

adaptive tuning

see gain scheduling

4.3

air

the mixture of oxygen, nitrogen, and other gases, which, with varying amounts of water vapor, forms the atmosphere of the earth

4.4

air purge

a flow of air through the furnace, boiler gas passages, and associated flues and ducts that will effectively remove any gaseous combustibles and replace them with air. Purging may also be accomplished by an inert medium.

4.5

alarm

an audible and/or visible means of indicating to the operator an equipment malfunction, process deviation, or abnormal condition requiring a response

4.6

ammonia slip

ammonia that passes through the SCR without reacting with the NO_x in the flue gas

4.7

anchor

a reliable support that fastens the sensing line or other component in place and prevents movement in all directions

4.8

anhydrous ammonia

essentially pure ammonia, 99.8% or higher ammonia content, typically referred to as commercial or metallurgical grade. Not diluted with water.

4.9

annunciator

an electro-mechanical or electronic packaged alarm system, usually consisting of one or more light boxes, associated logic, and power supply

4.10

anthropometrics

the application of data concerning the measurement of physical features and functions of the body in the design process

4.11

application software

software specific to a user application that is configurable and in general contains logic sequences, permissive and limit expressions, control algorithms, and other codes required to control the appropriate input, output, calculations, and decisions

4.12

aqueous ammonia

a liquid solution of ammonia and water. Normally the concentration of aqueous ammonia for use in SCRs is below 30% ammonia in water. Typical commercial concentrations are 29% and 19%.

4.13

attenuator

a device used for maintaining and controlling the temperature of superheated steam

4.14

attenuator (direct contact type)

a device in which the steam and the cooling medium (water) are mixed

4.15

auto-manual station

see control station

4.16

automatic tracking

the action of a control system to automatically track a setpoint to the process variable without any other corrective mechanisms

4.17

balanced draft

a system of furnace pressure control in which the inlet airflow or the outlet flue gas flow is controlled to maintain the furnace pressure at a fixed value (typically slightly below atmospheric)

4.18

binary

a term applied to a signal or device that has only two discrete positions or states. When used in its simplest form, as in a binary signal (as opposed to an analog signal), the term denotes an on-off or high-low state, i.e., one which does not represent continuously varying quantities.

4.19

blowdown line

the pipe or tubing located below the instrument connection for draining the condensate or steam or undesirable fluids to a safe location

4.20

blowdown valve

the valve in instrument sensing lines used to discharge undesirable fluids

4.21

boiler

the entire vessel in which steam or other vapor is generated for use external to the vessel. This includes the furnace, consisting of waterwall tubes; the firebox area, including burners and dampers; the convection area, consisting of any superheater, reheater, economizer sections, or any combination thereof, as well as drums and headers.

4.22

boiler follow mode

a mode of boiler control where the boiler responds to an energy demand requirement and controls boiler pressure by regulating boiler inputs

4.23

breakable fitting

a fitting that is easily removed without damaging the tubing or pipe

4.24**bumpless transfer**

automatic tracking such that any control mode transfer is accomplished without a sudden process upset

4.25**burner**

a device or group of devices for the introduction of fuel and air into a combustion chamber at the velocity, turbulence, and concentration required to maintain ignition and combustion of fuel

4.26**calculated value**

a virtual process variable that is derived from one or more measurements or other variables. Examples include process variables that have density compensation, median selection, averaging, etc.

4.27**capillary**

a small diameter tubing that runs from the process connection to the instrument

4.28**cascade control**

a control action in which the output of one controller is the setpoint for another controller

4.29**cascade control system**

a control system in which the output of one controller (the outer loop) is the setpoint for another controller (the inner loop). The outer loop is normally a slow-responding process as compared to the inner loop.

4.30**catalyst**

a substance that initiates a chemical reaction and enables it to proceed under milder conditions than otherwise possible

4.31**combustible**

the heat-producing constituent of a fuel, flue gas, or fly ash

4.32**combustion**

the rapid chemical combination of oxygen with the combustible elements of a fuel, resulting in the production of heat

4.33**composed point**

see calculated value

4.34**condensate pots**

reservoirs that are used in the measurement of steam or other vapors for condensing to the liquid state at ambient temperature

4.35

condenser backpressure elements

a multiple breakdown diffuser, normally installed in the steam condenser neck, used to generate a positive back pressure upstream of the condenser vacuum and to reduce the kinematic energy of steam from an external source other than the turbine exhaust

4.36

controllable parameters

the set of all the process variables in a control system

4.37

controlled variable

see process variable

4.38

controller

any manual or automatic device or system of devices used to regulate a process within defined parameters. If automatic, the device or system responds to variations in a process variable.

4.39

controller output

also called the manipulated variable, this is the signal from a controller that positions a final control element in the field or sets the setpoint of another controller.

4.40

control loop

a combination of field devices and control functions arranged so that a controlled variable is measured and compared to the setpoint to create a deviation signal, which is then processed through a controller to produce an output in the form of a manipulated variable to a control actuator

4.41

control piping

the piping that is used to interconnect pneumatically or hydraulically operated control apparatus, as well as signal transmission systems used to interconnect instruments. This applies to all instrument valves, fittings, tubing, and piping.

4.42

control station

a device or function that has a manually adjustable output and setpoint and may also include mode selection, mode status, and indication used in a control loop

4.43

control valve (turbine)

a valve or set of valves used to regulate inlet steam flow to the turbine during normal operation and controlled by the turbine control system

4.44

convection

the transmission of heat by the circulation of a liquid or a gas, such as air. Convection may be natural or forced.

4.45

converter

a device that receives instrument signal information in one form and transmits an output signal in another form. An instrument that changes a sensor's output to a standard signal is properly designated as a transmitter, not a converter. Typically, a temperature element (TE) may connect to a transmitter (TT), not to a converter (TY).