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Recommended Practice

Documentation for Control Centers

ISA-RP60.4 — Documentation for Control Centers

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Preface

This preface is included for informational purposes and is not part of ISA- RP60.4.

This recommended practice has been prepared as part of the service of ISA toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static, but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms, and asks that they be addressed to the Secretary, Standards and Practices Board, ISA, 67 Alexander Drive, P. O. Box 12277, Research Triangle Park, NC 27709, Telephone (919) 549-8411, e-mail: standards@isa.org.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards. The Department is further aware of the benefits to U.S.A. users of ISA standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, this Department will endeavor to introduce SI-acceptable metric units in all new and revised standards to the greatest extent possible. *The Metric Practice Guide*, published by the Institute of Electrical and Electronics Engineers as ANSI/IEEE Std. 268-1982, and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors. Certain metric units that are not a part of the SI system are in common accepted use. This recommended practice uses bar as a pressure measurement that is convertible to kilopascals by multiplying by 100.

It is the policy of ISA to encourage and welcome the participation of all concerned individuals and interests in the development of ISA standards. Participation in the ISA standards-making process by an individual in no way constitutes endorsement by the employers of the individual, of the Instrument Society of America, or of any of the standards that ISA develops.

The information contained in the preface, footnotes, and appendices is included for information only and is not a part of this recommended practice.

This recommended practice is one of a series that constitutes the control center standard, ISA-S60. The individual sections provide continuity of presentation, convenience of reference, and flexibility of revision. The complete standard consists of the following sections:

SECTION	TITLE	SCOPE
RP-60.1	Control Center Facilities	Guide for preparation of engineering designs and specifications for control center facilities.
dRP60.2*	Control Center Design Guide and Terminology	Design methods and terminology used in the specification of control center facilities.
RP60.3	Human Engineering of Control Centers	Design concepts accommodating man's physiological and psychologicalcapabilities.
RP60.4	Documentation for Control Centers	Guide to the documentation associated with control center specifications.

dRP60.5*	Control Center Graphic Displays	Guide to the use of available graphic display techniques.
RP60.6	Nameplates, Tags, and Labels for Control Centers	Guide to the methods of identification of control center equipment and parts.
RP60.7	Control Center Construction	Guide to control center profiles, fabrication and finish methods, and enclosure selection.
RP60.8	Electrical Guides for Control Centers	Design concepts for control center electrical requirements.
RP60.9	Piping Guide for Control Centers	Design concepts for control center piping requirements.
dRP60.10*	Control Center Inspection and Testing	Guide to the methods of inspection andtesting prior to control center acceptance.
dRP60.11*	Crating, Shipping, and Handling for Control Centers	Guide to available methods for control center crating, shipping, and handling.

*Draft Recommended Practice. For additional information on the status of this document, contact ISA Headquarters.

The persons listed below served as active members of the SP60 Control Centers Committee for the major share of its working period.

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Contents

1 Scope

This recommended practice covers the type, content, and extent of documentation required as record data and information particular to a control center and control center facility. It is written to provide guidelines covering various types of documentation and to promote uniformity of document terminology.

This recommended practice covers the technical documentation associated *only* with control centers and control center facility design and fabrication. It does not cover documentation requirements for associated procedures such as process design or plant or unit operations, nor does it cover commercial considerations such as purchasing, contracting, and shipping. The wide variety of industries using control centers has made it necessary that this recommended practice be general in its coverage. The reader is cautioned to consult the specific codes, laws, and practices that apply to the actual industrial applications.

2 Definitions

As built—A document revision that includes all modifications performed as a result of actual fabrication or installation. Various issues of "as built" documents may exist that reflect various milestones such as "as purchased," "as manufactured," "as insured," and "as commissioned."

Control center—An equipment structure, or group of structures, from which a system is measured, controlled, and/or monitored.

Control center facility—A combination of the services, protective enclosures, and environmental treatment necessary for the proper functioning of the control center.

Drawings—Graphic representations of the control center, which also may include bills of material, hard copies of video display tube (VDT) displays, photographs, and tables (e.g., wire and cable lists).

Manuals—A compilation of electrical and mechanical specifications, parts lists, operating or service instructions, calibration procedures, test logs, performance requirements, and pertinent technical data required for the specific project.

Specifications—Written data, drawings and instructions that form the complete requirements the system must meet. This may include equipment lists, approved vendor lists, applicable company standards, and references to published standards (e.g., the National Electric Code and ISA Standards).

Tagged item—An item that has been assigned a unique identification. Items appearing on piping and instrument diagrams (P&IDs) are usually tagged in accordance with ISA-S5.1, Instrumentation Symbols and Identification. Items that do not appear on a P&ID may be assigned unique identifications that do not conflict with previously assigned tag numbers.

Untagged item—Any system, equipment item, or accessory that may be initially specified, listed, or referenced in quantity by model number, catalog number, part number, etc., for general identification and for ordering or handling purposes. These items are completely

interchangeable and could be uniquely identified with an assigned tag number after installation in the control center.

3 Introduction

The creation of a control center and its supporting facilities usually requires a tremendous amount of data flow between the organizations that participate in the design, production, installation, and use of the control center. If this data flow is organized properly from conceptual design through startup, it can become the historical documentation required for the control center.

The extent to which a control center is documented depends upon its complexity and use. The need for, and cost of, documentation should be considered for each individual project rather than being based upon standard distribution or general requirements. Secure redundant storage is recommended. Documentation may be hard copy of the above referenced data flow — consisting of decisions, records, procedures, instructions, and recommendations agreed upon by the participants. These items may be categorized as specifications, correspondence, drawings, manuals, and software.

Conflicting or omitted requirements should be brought to the attention of the specifying party for resolution. Control center documentation serves many uses not apparent when the specification is written. Some of these uses may be the following:

1) Approval by the participating organizations having jurisdiction;
2) Approval by the authorities having jurisdiction;
3) Code compliance;
4) Quality assurance, quality control;
5) Bases of cost estimate, budget, and schedule;
6) Basis of quotation;
7) Basis of purchase contract;
8) Support documentation for field installation, test, and calibration;
9) Manufacturer's test record;
10) Basis of shipping damage claims;
11) Performance guarantees;
12) Basis of planning for future expansion, modification, or duplication;
13) Documentation for microprocessor system configuration (for example, shared displays, programmable controllers, and program documentation for data loggers and computer controls, etc.);
14) Support documents for maintenance;
15) Historical records;
16) Data source and reference for operation instructions.

Various sources of these documents may be the user, designer, engineering contractor, control center fabricator, and instrument or device manufacturer. Since the extent of control center documentation is variable, it is recommended that a specific individual be assigned the responsibility and authority to determine which documents are required, the quantity required, who will supply them, and the scheduled issue date.

Changes to the documentation should be itemized to show who changed what, when, and why.

4 Specifications

Control center specifications should describe, in writing, every item that cannot be better described or defined graphically on drawings. By the time a control center design effort reaches the specification stage, many engineering decisions that contribute to the conceptual design of the specific control center have already been made.

It is recommended that a conceptual design and functional description be included for the benefit of those reading the specification to gain an insight that cannot be gleaned from the usual terse technical content. This information is for clarification only, and it should be noted that it is not a part of the bidding document.

The specification must clearly define responsibilities with respect to detail design of the control center, the equipment, and all subsystems and their components. Detailed instructions may be required for design approval procedures whereby the responsible party receives authority to proceed with the purchase and fabrication up to the next approval stage.

When manufacturing progress reports are required, their contents should be clearly defined in the specification. Photographs of manufacturing progress may be used to support the usual written reports.

Approved revisions of the specification should be issued immediately while the revisions are still fresh in memory; otherwise, important changes, even conceptual design changes, can be forgotten.

4.1 Codes, standards, and practices. Compliance with national, state, and local regulations may require conformance with various specific codes. Good engineering practice also requires conformance with well established standards and practices. A partial list of possible applicable codes and standard practices is listed in Appendix A.

Specification reference to a published standard in full, although better than no reference at all, usually is too general and may even lead to confusion because of multiple methods recommended by many standards. It is more precise to refer to specific paragraphs of the standard and describe how that paragraph applies (or is to be modified) for the specific control center.

4.2 Instrument and equipment lists. Instruments and equipment that will be installed in control centers are of three basic types:

1) Tagged items (see 4.2.1);

2) Untagged items (see 4.2.2);

3) Fabricated items (see 4.2.3).

The specification should include a list of instruments and equipment. It also should indicate who is to supply the instruments and equipment.

4.2.1 Tagged items

4.2.1.1 The following are examples of tagged items:

1) Indicating controllers;
2) Recorders;
3) Converters;
4) Transducers;
5) Receiver switches;
6) Push buttons, status lights, selector switches, etc.;
7) Prefabricated interconnecting cables.

The list of tagged items should be specific and identify every individual significant item that must be handled separately. Tagging will permit tracking items enroute and ease in recovery from storage. If an item is shipped to a fabricator in multiple pieces, each piece should be uniquely identified – even if differentiated only by a suffix, e.g., FY123-A and FY-123-B. Refer to ANSI/ ISA-S5.1-1984 for instrument tagging.

4.2.1.2 The following are examples of information required to properly list tagged items:

1) Tag number;
2) Item function (e.g., MV/I converter);
3) Item data sheet reference;
4) Item purchase order reference;
5) Manufacturer;
6) Model number;
7) Service description;
8) Drawing number of P&ID (latest revision);
9) Loop drawings;
10) Serial number (if assigned);
11) Location (e.g., Aux. Cab. No. 5).

A typical instrument and equipment list is furnished in Appendix B.

4.2.2 Untagged items

4.2.2.1 Untagged items are interchangeable and can be tagged as a group. The following are examples of untagged items:

1) Instrument shelves;
2) Instrument racks;
3) Computers and associated peripherals;

4) VDT displays, video station (VDT, keyboard, etc.);

5) Power supplies, including uninterruptible power supply (UPS) systems;

6) Terminal blocks;

7) Relays;

8) Clocks;

9) Programmable controller (if only one);

10) Multiplexers;

11) Input/output (I/O) racks.

4.2.2.2 Untagged instruments and equipment are more difficult to control and track due to the lack of a unique identifying tag number. It is recommended that a general identification number be assigned to a group of like items. Equipment, once installed in the control center, may be assigned a unique tag number.

The information required to properly identify untagged items may include the following:

1) General identification;

2) Purchase order reference;

3) Functional description;

4) Quantity;

5) Manufacturer;

6) Model number;

7) Serial number (if assigned).

4.2.3 Fabricated items. The following are examples of fabricated items:

1) Control center sections;

2) Consoles;

3) Auxiliary relay and equipment racks.

It is recommended that fabricated items be assigned a general identification number. An ideal “break point” for numbering fabricated items is at each break. This facilitates panel shop tracking and identification for shipment to the installation site. Also, this facilitates location of the control center components on the control center facility plan drawing.

4.2.4 Shipping and receiving reports. The instrument and equipment list should make provision for logging the shipment and receipt of the equipment and certified drawings. The control center manufacturer should be instructed in the method by which shipment and receipt ofequipment is reported to the user or purchaser. Instructions also should be provided to cover damaged equipment.

4.3 Graphics. ISA-S5.5 establishes symbols used on dynamic displays such as VDTs.

Documentation for graphic displays should be sufficient to allow future modification of the displays using original materials, methods, symbols, and colors. Materials, when not the fabricator's standard, should be documented by listing manufacturer, material type, specification

number, thickness, surface finish, colors, etc., as applicable. Methods should be documented by listing the method of cutting the material, edge preparation, surface preparation, and adhesive or fastener specification. The recommended adhesive solvent should also be listed.

4.3.1 Symbols. Graphic symbols should be documented on dimensioned or scaled drawings. A list of all symbol engravings should be included. Colors should be documented by listing a manufacturer's color or recognized standard color name or number.

4.4 Identification. Identification for control centers is described in ISA-RP60.6, Nameplates, Labels, and Tags for Control Centers.

Control center specifications should identify what items to tag, what materials to use, and the method of attachment for the tags. The identification plate material, color, surface finish, etc., should be specified. Methods of engraving, letters or numbers, and size of nameplates, as well as size and color of engraving, printing, etc., also should be included. A list of all nameplate engraving data should be included.

4.5 Construction. Additional documentation will be required in those cases where special vibration conditions must be considered, i.e., seismic or other vibrations. High humidity, limited accessibility, and other construction considerations will also require special documentation.

4.5.1 Modularity and shipping sections. The modularity of a finished control center usually is dictated by shipping and handling considerations and intended future control center use. The signal interconnections between modular sections should be documented sufficiently for proper reconnection after installation at the site. Documentation should contain connector part numbers, plug and pin numbers, and any special (crimp, insertion, extraction) tools needed.

4.5.2 Interconnections. If the interconnections are made with polarized connectors, the connector pin layout as well as cable lengths should be documented so that replacement cables can be fabricated.

All multiwire cables should be identified by a complete wiring list showing source and destination. An interconnection layout drawing, with cable numbers, is recommended. For additional information, see Section 4.6.

Pneumatic interconnections should be documented by tubing specification (size, wall thickness, material, colors, etc.), connector type, and a source-destination listing. For additional information, see Section 4.7.

4.5.3 Structural fabrication. The materials and methods of construction should be documented in enough detail that sections (or the complete control center) can be duplicated. How sections connect to adjoining sections, to the floor, and to the overhead filler panel are important details.

4.5.4 Finishing. Surface preparation should be documented to allow replacement sections to receive the same pre-treatment and finish as the original to provide replacements of the same durability and appearance as the original. Painting methods, materials, gloss, and texture of both the exterior and the interior surfaces should be documented. A color chip will assist in recording this data.

4.6 Electrical. Electrical practices for control centers are described in ISA-RP60.8, Electrical Guide for Control Centers.

4.6.1 Area classification. The location of the control center and control center facility should be classified in accordance with Article 500 of the National Electrical Code, National Fire Protection Association NFPA: 70-90, or other codes as required by the authority having jurisdiction. As documentation, this area classification (and, preferably, the reference followed) should prominently

appear in the specification and be rigidly adhered to in all future additions, modifications, and replacements. The specification should note that any intrinsically safe portion of wiring within the control center and the control center facility shall be clearly documented so that future additions and modifications do not violate intrinsic safety requirements as defined in ANSI/ISA-RP12.6, UL 913, or NEC Article 504. The type of purge (Type X, Type Y, or Type Z as specified by NFPA 496), if required, for the enclosure should be documented.

4.6.2 Power supply and distribution. A list of all electrical loads and their calculated or estimated demands should be listed in the control center specification. This list should be updated with the final loads as determined during field acceptance tests. This electrical load listing is of critical importance in determining the scope of future additions or modifications. Circuit protection of each branch circuit should be listed—current trip setting and speed of trip (for fuse coordination calculations).

Spare circuits and their ampacities shall be listed. If time versus current coordination curves are produced, they always should be made a part of the control center documentation package. Methods of grounding incoming electric power sources, power supplies, shields, electronic signal circuits and cabinetry should be clearly described on drawings of specifications. If the power system includes an uninterruptible power supply (UPS), all pertinent UPS data should be stated. Redundancy requirements also should be listed, where required.

4.6.3 Open or enclosed wiring. The details of all wiring, open or enclosed, should be described in the specification. The interface points (i.e., the points of interconnection between field and control center wiring) should be described on the drawings or specifications.

4.6.4 Conductors. Wire for each type of service should be described in detail: conductor material, construction (solid or stranded), insulation temperature rating, voltage rating, conductor size (normally in AWG), insulation material and thickness, color code, and, if required, shielding. Multiconductor cable descriptions should also include shielding requirements, outer jacket material and thickness, and cable type (e.g., MC or TC). The identification of wires and cables is described in ISA-RP60.6, Nameplates, Labels, and Tags for Control Centers. The method of shielding low-voltage signal wiring should be documented. Shielding should be in accordance with local practices, taking into account the recommendations of the particular instrument manufacturer. The instrument manufacturer may not be known at the time of original specification issue; however, when the requirements become known, they should be included in the next specification revision. Electrical raceway requirements for each type of service should be described in detail.

4.6.5 Terminations. Terminal blocks for each type of service and voltage rating should be described by the manufacturer's name and model number. If the specifications allow an "or equal" or an "approved equal," the manufacturer's name and model number of the terminal blocks selected should be included in the next issue of the drawings or the specification. Wire lugs for each type of service should be described and updated in a manner as described for terminal blocks. Cable connectors should be documented by manufacturer's name, the model number, and pin layouts so that exact replacements can be obtained. The identification of terminations is described in ISA-RP60.6, Nameplates, Labels, and Tags for Control Centers. Termination enclosures should be documented by the manufacturer's name and model number, if commercially manufactured, or by detailed fabrication drawing if custom manufactured. The termination of spare wires is recommended and, if so, should be documented.

4.6.6 Communications. Commercial communication systems usually are best documented by reference to purchase specifications and manufacturers' manuals. Telephone systems (including sound-powered telephones) that utilize the communication conductors in electronic and pneumatic signal cables should be documented by a detailed description of the system, head/hand set manufacturer's name and model number, and wiring drawings. Where radio frequency interference

(rfi) (particularly from two-way radios) or other electromagnetic interference (emi) signals might interfere with control center equipment, appropriate warnings should be included in the documentation.

4.6.7 Lighting. Where lighting is furnished integral to the control center, the locations, power source, types of fixtures, and lamp wattages should be documented for replacement

Documentation for the control center facility should include, in addition to the above, details of emergency lighting, design lighting levels, and lighting controls.

4.6.8 Miscellaneous electrical items. Miscellaneous electrical items (e.g., fuses, diodes, push buttons, indicators, switches, and intrinsic safety barriers) should be considered. When supplied, the voltage, current, and service rating (as applicable) of each item should be documented.

4.7 Tubing and piping. Tubing and piping practices are described in ISA-RP60.9, Piping Guide for Control Centers. All tubing and piping materials used should have the relevant ASME or ASTM specifications listed.

4.7.1 Supply and regulation. Control center instrument air (or other supply medium) demand calculations (including spare capacity) and pressure regulator sizing equations or curves should be included for future additions or modifications. If filtering is included in the control center supply and regulation station, the complete purchase data on the filter media is required (see ISA-S7.3). Manufacturers' part or model numbers should be documented in the specification for regulators, filters, relief valves, etc. Regulating station pressure gages should be documented by a pressure gage specification (see ISA- S20.41a).

4.7.2 Piping. Air supply piping should be documented by stating the size, schedule, material, and end preparation for all straight lengths. Fittings and valves should be documented by stating the size, rating, material, end preparation, and description of fittings or valve manufacturer's part or model number.

4.7.3 Tubing. Signal and air supply tubing should be documented by stating the outside diameter (O.D.), wall thickness, material, whether it is seamless or welded, and color code. Fittings and valves should be compatible with the tubing used and should be documented by stating the size, material, end preparation (of both or all ends, if different), description of the fitting, and manufacturer's part or model number.

4.7.4 Identification. Recommended identification of piping, tubing and connections is described in ISA-RP60.6, Nameplates, Labels, and Tags for Control Center. Each run of piping and tubing in a control center should be identified by its unique number, which is traceable to a tagging list or diagram. Each valve or disconnect in the system may require a unique identifier, especially if an operating or calibrating procedure is required as part of the documentation.

4.7.5 Terminations. Tubing and piping terminations that will be connected in the field should be completely documented and identified. Consideration should be given to the termination of spare tubes and pipes.

4.7.6 Support. It may be necessary to document, by manufacturer's part or model number, supports (e.g., tubing straps, channels, and raceways). Additional documentation will be required in those cases where thermal expansion must be considered.

4.8 Inspection and testing

4.8.1 Inspection. Inspection of a control center may be performed at various milestones during its fabrication. Progress required to reach each milestone shall be clearly defined and indicated on the fabrication schedule. A detailed description of the progress desired at each milestone will enable a progress inspection report to be prepared. Photographs accompanying the inspection report are helpful in verifying the progress. Ownership and restrictions on the use of photographs should be defined.

A quality assurance/quality control (QA/QC) program should ensure good design and workmanship. Nuclear work requires rigid documentation of all QA/QC activities.

Regardless of the industry, the expected quality must be properly defined and documented before it can be achieved in fabrication. Inspection certification may be required by one or more of the parties participating in the production of a control center. Properly executed inspection certificates may become admissible evidence in the case of loss or damage during shipping or during installation. An audit report of items and their condition, comprising each control center package, as shipped, should be issued as a written report.

4.8.2 Testing. Although the control center may be retested in the field, it is recommended that the control center be tested in the fabricator's shop. The specification or related documents should state the types of tests to be performed, acceptance criteria, the source and types of test instruments, consumables, the place of the tests, the requirement for test reports, and the qualified personnel to perform the tests. Test results, both acceptable and unacceptable, should be recorded, and unacceptable items should be placed on a re-test list. A detailed, well-documented test will record the condition of the control center as it leaves the fabrication facility and indicate the quality of the product to the field that will receive it.

4.9 Crating and shipping

4.9.1 Crating. The type of crating required will be dictated by the means of shipping and the anticipated stage of completion of the control center facility at the scheduled control center arrival time. The specification should clearly indicate the minimum type of crating for the control center assembly to meet the requirements for shipping and storage. It should also state the means of shipping instruments and equipment (e.g., whether the instruments should be left in control center shelves or repacked in original shipping cartons). All required crate and carton markings should be specified. The method of handling at the site should also be indicated.

4.9.2 Shipping. Shipping instructions should be limited to the means of transportation (e.g., air ride van, truck, ship, or air) from the fabricator to the site. Trained shipping personnel, traffic manager, and brokers usually are ideal sources of additional information, and their contributions should be documented in an expanded specification update.

4.9.3 Shipping documents. The various shipping and receiving documents required for a shipment are beyond the scope of this recommended practice. Experienced shipping personnel, traffic managers, and export brokers are the best guides. Photographs of the control center before, during, and after crating are not only long-term documentation (see Paragraph 4.8.1 above), but may also become evidence in shipping damage claims.

Shipping documents should list the number of each shipping section, crate, pallet, carton, etc., that the field can expect to receive (e.g., "5 of 20").

See ISA-RP60.11, Crating, Shipping, and Handling for Control Centers.

5 Drawings

Control center drawings should depict the three main areas of control center design:

1) Control center facility;

2) Control center;

3) Control center fabrication details.

It is beyond the scope of this document to recommend that drawings be scaled or dimensioned. However, where accurate sizing information is required, it is best shown on scaled drawings. The existing state of the art should be considered when establishing the type (e.g., reproducibles or magnetic media such as tapes or discs, etc.) and quantity of drawings required. This section is not intended to recommend the number, types, or title of drawings, but rather to recommend views, layouts, arrangements, and details that will facilitate design, approval construction, and historical documentation of control centers. The documentation should include specification of the spare equipment and space for future expansion.

5.1 Control center facilities. Control center facility drawings are usually architectural in nature, showing the plot plan, building plan, control center facility (control room) plan and necessary overlay plans, sections, and elevations. Plot and building plans are recommended to show access to and clearances around the control center facility. Control center facility drawings are tools in determining the maximum size of the control center shipping sections, routing from shipping vehicle to facility, and allocation of heavy equipment for the installation. Door and passageway clearances for the control center also should be shown.

5.1.1 The control center facility plans should include, as a minimum, the following:

1) The control center shipping sections superimposed on the facility plan;

2) Locations of auxiliary racks, distribution panels, terminal cabinets, computer mainframes, consoles, etc.;

3) Overhead or underfloor routings of signal, power, and communication cables;

4) Layout of the grounding grids — both the safety and the signal integrity;

5) Conduit stub-up areas and cable spreading rooms;

6) Definitions of heating, ventilating, and air conditioning (HVAC) requirements, including heat liberation of electrical and electric gear and miscellaneous utilities.

5.1.2 Other facility requirements (e.g., lighting, fire protection, heating, ventilation and air conditioning, and computer flooring details) should be furnished and designated. Often, disciplines other than electrical and instrument engineering are required.

5.2 Control center. Control center drawings are usually layout-type drawings showing the control center in plan and profile, with shipping breaks indicated. General arrangement drawings showing specific instrument locations and graphic representations also should be furnished.

Plan and profile drawings should be detailed and dimensioned to the extent necessary for the control center manufacturer to produce detailed fabrication drawings. Some details, such as the means of connecting the shipping sections together, may be designated by the manufacturer. In this case, the manufacturer's drawing would become one of the historical documentation drawings.

General arrangement drawings of panel face, panel rear, and auxiliary racks are usually necessary to show the location of specific instruments, controls, and equipment. Also, the drawings are used to block out areas that will receive pre-engineered equipment such as future instruments, annunciators, graphics, or VDT displays.

Detailed design drawings fit into one of two categories: 1) certified instrument or equipment dimensional drawings, and 2) interconnection details and diagrams. Certified instrument dimensional drawings are furnished by the instrument manufacturer and indicate the physical size, connection locations, and clearances (for doors, as an example) required by that particular piece of equipment. These drawings are used by the control center fabricator to dimension steel cutting or forming drawings (see Paragraph 4.2.4).

Interconnection details and diagrams are usually required to show signal and power connections for both electronic and pneumatic equipment. A detailed layout of electrical terminals listing active and spare terminals is recommended, as is a layout of pneumatic tubing bulkhead connections. These detailed drawings may be produced by the control center manufacturer, the designer, or the user, but they should be produced and kept up to date.

5.3 Fabrication details. Control center fabrication drawings usually fall into one of four categories: (1) structural, (2) electrical, (3) pneumatic, or (4) graphic layout.

5.3.1 Structural. Structural drawings are necessary for the fabrication of control centers. Details normally shown on these drawings are the structural base (usually channel) and reinforcing bar (rebar) locations, mounting and bolting details, door and cutout details, and internal equipment locations. These detailed structural drawings are probably best produced by the control center manufacturer to take advantage of the manufacturer's expertise and proven fabrication techniques. Structural drawings are invaluable if a section of the control center is to be modified or replaced.

5.3.2 Electrical. Electrical fabrication drawings may include but are not limited to, the following:

1) Power distribution (single line diagram);
2) Circuit breaker and fuse block layouts;
3) Control schematics and logic diagrams;
4) Point-to-point wiring diagrams;
5) Electronic loop diagrams;
6) Wire lists;
7) Terminal block and connector pin layouts;
8) Interconnecting cabling diagrams;
9) Ground systems;
10) Conduit and cable schedules;
11) Bills of material.

5.3.3 Pneumatic. Pneumatic (or hydraulic) fabrication drawings may include, but are not limited to, the following:

1) Power supply;
2) Distribution system;
3) Control schematics and logic diagrams;
4) Point-to-point tubing/piping diagrams;
5) Pneumatic (hydraulic) loop diagrams;
6) Bulkhead layouts;
7) Interconnecting tubing diagrams;
8) Tubing and bundle schedules;
9) Bills of material.

5.3.4 Graphics layout. A scaled graphic layout drawing (full size is preferred if drawing size is not excessive) may be provided by any of the control center participating organizations. This drawing may be used not only for graphic layout approval and fabrication,but also for planning future modifications. To facilitate future modifications, the graphic drawing should be updated as major changes are made.

6 Manuals

Control center manuals should include, under a detailed index or table of contents, a list of all applicable specifications and drawings, software documents, and all data provided by manufacturers of instruments and equipment. If the above items are not physically a part of the manual, their file location should be indicated. If multiple manuals are furnished, one manual should be defined as the "Master Manual," and all original documents, signed certificates, etc., should be kept in this Master Manual.

6.1 As built specifications. The latest revision of the control center specification (the "as built" specification) should be listed in the index, and a copy should be made a part of the manual. Specifications for all control center-mounted equipment should be indexed and included.

6.2 As built drawings. The latest revision of control center drawings ("as built" drawings) should be listed in the index and copies made a part of the manual. Reduced copies of drawings may be used, where convenient. Also, certified instrument and equipment drawings should be indexed and included.

6.3 Installation instructions. Installation instructions should be issued to the field prior to equipment shipment. Installation instructions (especially those covering special procedures required for safe receipt and handling of the control center at the site) and instructions for unpacking and setting the control center in place in the control center facility should be included in the control center manual.

6.4 Maintenance. Maintenance instructions for each type of instrument and other equipment should be carefully indexed and included in the control center manual.

6.5 Spare parts list. Spare and replacement parts recommended for each type of instrument and equipment should be listed in the control center manual. The spare parts list may be an integral part of the maintenance instructions (see Section 6.4).

6.6 Photographs. It is recommended that photographs of the control center be filed with the control center manual. It may be necessary to include only a set of prints and the negatives in the Master Manual, as opposed to a set of prints for each manual.

6.7 Statement of conformance. If a statement of conformance is required, it should be properly executed and filed in the Master Manual.

6.8 Certificate of compliance. If a certificate of compliance is required, it should be properly executed and filed in the Master Manual.

6.9 Calibration logs. A record of all tests performed at various stages of control center fabrication, installation, calibration, and start-up should be kept in the control center Master Manual. All deficiencies and corrective actions should be logged. Each entry should include the date and the name of the person who performed the work.

6.10 Unpriced purchase orders. A copy of all unpriced purchase orders associated with the control center should be included in the Master Manual.

7 Software documentation

Documentation of software for programmable controllers, computers, and other software-driven devices should be included in the Master Manual. The documentation may be in the form of specifications, drawings, and manuals, or a combination thereof. Although it is recognized that documentation of software is necessary, it is difficult to provide uniform guidelines due to the diversity of available methods of documentation. It is recommended, however, that software be completely documented in a form that can be easily understood and revised.

Appendix A — References

American National Standards Institute (ANSI)

ANSI C19.3, General

ANSI C19.4, Enclosures

ANSI C19.5, Switching or Controlling Devices

ANSI C19.6, Control Circuit Devices and Assemblies

ANSI C19.7, Controllers and Controller Assemblies

ANSI/NFPA: 493, Standards for Intrinsically Safe Apparatus and Associated Apparatus in Groups I, II and III, Div. 2, Hazardous Locations

ANSI/NFPA: 496, Purged and Pressurized Enclosures for Electrical Equipment

ANSI/NFPA: 497 A, Recommended Practice for Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Plants

ANSI N413, Guidelines for Documentation of Digital Computer Programs

ANSI Y14.15, Y14.15a, Y14.15b, Electrical and Electronic Diagrams, Graphic Symbols

ANSI/IEEE:STD 100, Electrical and Electronic Terms, Dictionary of

ANSI/IEEE:STD 91, Graphic Symbols for Logic Diagrams

ANSI/NFPA: 70-90, National Electrical Code

ANSI C2, National Electrical Safety Code

ANSI MH 10.1, MH 10.2, Transport Package Sizes

ANSI/NFPA: 75, Electronic Computer/Data Processing Equipment

ANSI/IEEE: Std. 567, IEEE Trial Use Standard Criteria for the Design of the Control Room Complex for a Nuclear Power Generating Station

ANSI/IEEE: P566, D1.1, Proposed Standard for the Design of Display and Control Facilities for Main Control Room of Nuclear Power Generating Stations

American Petroleum Institute (API)

API: RP 500A, B, and C, Classifications

API: RP 550, Part I, Process Instrumentation and Control

API: RP 550, Part II, Process Stream Analyzers

API: RP 550, Part III, Fired Heaters and Inert Gas Generators

API: RP 550, Part IV, Steam Generators

API: RP 14F, Recommended Practice for Design and Installation of Electrical Systems for Offshore Production Platforms

ISA

ANSI/ISA-S5.1, Instrumentation Symbols and Identification

ANSI/ISA-S5.2, Binary Logic Diagrams for Process Operations

ANSI/ISA-S5.4, Instrument Loop Diagrams

ANSI/ISA-RP7.1, Pneumatic Control Circuit Pressure Test

ANSI/ISA-RP12.6, Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations

ISA-SI2.13, Part I, Performance Requirements, Combustible Gas Detectors

ISA-S12.13, Part II, Installation, Operation, and Maintenance of Combustible Gas Detection Instruments

ISA-Sl2.15, Part I, Performance Requirements for Hydrogen Sulfide Detection Instruments (10-100 ppm)

ISA-S12.15, Part II, Installation, Operation, and Maintenance of Hydrogen Sulfide Detection Instruments

ANSI/ISA-S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves

ANSI/ISA-RP42.1, Nomenclature for Instrument Tube Fittings

ANSI/ISA-S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments

ANSI/ISA-S51.1, Process Instrumentation Terminology

ISA-S71.04, Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants

National Electrical Manufacturers Association (NEMA)

ANSI/NEMA: ICS 6, Enclosures for Industrial Controls and Systems

Appendix B — Typical instrument and equipment list

ABC Incorporated

Instrument Summary — Routine B

INST. TAG NUMBER	SPEC NUMBER	PON	MODEL NO	PLAN DRAWING	LOOP DRAWING	PDET	SDET	PROCESS LINE NO	LINE CLASS
FC - 404	001.13 -20.0	001	2462 SS		001.13 -271C				
FE - 404	001.13 -02.0	015							
FI - 404	001.13 -25.0	004	210M	001.13 -703O	001.13 -271C		907M		
FIC - 404	001.13 -20.0	001	230 SM		001.13 -271C				
FR - 404	001.13 -20.0	001	220S-2R6		001.13 -271C				
FT - 404	001.13 -25.0	004	1151DP	001.13 -703O	001.13 -271C	904A	907M	4102	-3J1
FV - 404	001.13 -01.0	005	667 ES	001.13 -803O	001.13 -271C	905A		4102	-3J1
FY - 404 - 1	001.13 -20.0	001	2AI+I3V		001.13 -271C				
FY - 404 - 2	001.13 -20.0	001	2AO-V3I		001.13 -271C				
FY - 404 - 3	001.13 -24.3	001	69TA-II	001.13 -803O	001.13 -271C				
FE - 405	001.13 -02.0	015						4101	-3J1
FR - 405	001.13 -20.0	001	220S-1R6	001.13 -215C					
FT - 405	001.13 -25.0	004	1151DP	001.13 -703O	001.13 -215C	904A	907M	4101	-3J1
FY - 405 - 1	001.13 -20.0	001	2AI+I3V		001.13 -215C				
FY - 405 - 2	001.13 -20.0	001	2AX+D10		001.13 -215C				
FAL - 407	001.13 -32.0	025	70-5FSS		001.13 -245C				
FC - 407	001.13 -20.0	001	2462 SS		001.13 -245C				

Typical instrument and equipment list - Routine B (continued from previous page)									
FE - 407	001.13 -02.0	015			001.13 -245C			4059	-3J1
FI - 407	001.13 -25.0	004	210M	001.13 -703O	001.13 -245C		907M		
FIC - 407	001.13 -20.0	001	230 SM		001.13 -245C				
FR - 407	001.13 -20.0	001	220S-2R6		001.13 -245C				
FSL - 407	001.13 -20.0	001	2AP+ALM		001.13 -245C				
FT - 407	001.13 -25.0	004	1151DP	001.13 -703O	001.13 -245C	904B	907M	4059	-3J1
FV - 407	001.13 -01.0	005	1051V100	001.13 -803O	001.13 -245C	905A		4059	-3J1
FY - 407 - 1	001.13 -20.0	001	2AI+I3V		001.13 -245C				
FY - 407 - 2	001.13 -20.0	001	2AO-V3I		001.13 -245C				
FT - 407 - 3	001.13 -24.3	001	69TZ-II	001.13 -803O	001.13 -245C				
FY - 407 - 4	001.13 -20.0	001	2AX+D10		001.13 -245C				
FC - 408	001.13 -20.0	001	2462 SS		001.13 -271C				
FE - 408	001.13 -02.0	015						4101	-3J1
FI - 408	001.13 -25.0	004	210M	001.13 -703O	001.13 -271C		907M		
FIC - 408	001.13 -20.0	001	230 SM		001.13 -271C				
FR - 408	001.13 -20.0	001	220S-1R6		001.13 -271C				
FT - 408	001.13 -25.0	004	1151DP	001.13 -703O	001.13 -271C	904A	907M	4101	-3J1
FV - 408				001.13 -803O	001.13 -271C	905A			
FY - 408 -1	001.13 -20.0	001	2AI+I3A		001.13 -271C				
FY - 408 - 2	001.13 -20.0	001	2AO-V3I		001.13 -271C				
FY - 408 - 3	001.13 -24.3	001	69TA-II	001.13 -803O	001.13 -271C				
FY - 408 - 4	001.13 -20.0	001	2AX+D10		001.13 -271C				

Appendix B — Typical instrument and equipment list

ABC Incorporated

Instrument Summary - Routine A

INST. TAG NUMBER	SERVICE DESCRIPTION	FUNC.DESCR.	LOCATION	EQUIPMENT	SG	P&ID NO.	REV.DATE
FC - 404	STEAM TO KR - 402 EFFL. DESUP KM-407	PI CARD	404401		EN	001.000-217E	05/19/77
FE - 404		OR PL	FLD		NN	001.000-217E	05/19/77
FI - 404		XMIT OUTPUT GAGE	FLD		EN	001.000-217E	05/19/77
FIC - 404		1ND CONT	P08202		EN	001.000-217E	04/19/77
FR - 404		2ND PEN TR-403	P08301		EN	001.000-217E	05/19/77
FT - 404		DP XMIT	FLD		EN	001.000-217E	05/19/77
FV - 404		Cv	FLD		PN	001.000-217E	05/19/77
FY - 401 - 1		I-E	RO4402		EN	001.000-217E	05/19/77
FT - 404 - 2		E-I	R04403		EN	001.000-217E	05/19/77
FY - 404 - 3		I-P	FLD		BN	001.000-217E	05/19/77
FE - 405	STEAM FROM KD-415 STEAM DRUM	OR PL	FLD		NN	001.000-215E	05/19/77
FR - 405		REC 1 PEN	P07101		EN	001.000-215E	05/19/77
FT - 405		DP SMIT +OP GAGE	FLD		EN	001.000-215E	05/19/77
FY - 405 - 1		I-E	R03609		EN	001.000-215E	05/19/77
FY - 405 - 2		DIST MOD	R03608		EN	001.000-215E	10/03/77
FAL - 407	LEAN MEA TO KE-404	ANN PT	PNL		EN	001.000-218E	05/19/77
FC - 407		PI CARD	R04705		EN	001.000-218E	05/19/77
FE-407		OR PL	FLD		EN	001.000-218E	05/19/77
FI-407		XMIT OUTPUT GAGE	FLD		EN	001.000-218E	05/19/77

Typical instrument and equipment list - Routine A (continued from previous page)						
FIC-407		IND CONT	P08309	EN	001.000-218E	05/19/77
FR-407		REC 2 PEN	P08409	EN	001.000-218E	05/19/77
FSL-407		RCVR SW ALARM	R04707	EN	001.000-218E	05/19/77
FT-407		UP XMIT	FLD	EN	001.000-218E	05/19/77
FV-407		Cv	FLD	RN	001.000-218E	10/03/77
FY-407-1		I-E	R04703	EN	001.000-218E	05/19/77
FY-407-2		E-I	R04704	EN	001.000-218E	05/19/77
FY-407-3		I-P	FLD	BN	001.000-218E	05/19/77
FY-407-4		DIST MOD	R04706	EN	001.000-218E	05/19/77
FC-408	PROCESS STEAM TO KB-401	PI CARD	R02709	EN	001.000-215E	05/19/77
FE-408		OR PL	FLD	NN	001.000-215E	05/19/77
FI-408		XMIT OUTPUT GAGE	FLD	EN	001.000-215E	05/19/77
FIC-408		IND CONT	P06204	EN	001.000-215E	05/19/77
FR-408		REC 1 PEN	P06304	EN	001.000-215E	05/19/77
FT-408		DP XMIT	FLD	EN	001.000-215E	05/19/77
FV-408		ACC EJECT ACTU-ATR	FLD	PN	001.000-215E	10/03/77
FY-408-1		I-E	R02707	EN	001.000-215E	05/19/77
FY-408-2		E-I	R02708	EN	001.000-215E	05/19/77
FY-408-3		I-P	FLD	BN	001.000-215E	05/19/77
FY-408-4		DIST MOD	R02710	EN	001.000-215E	05/19/77

Developing and promulgating technically sound consensus standards, recommended practices, and technical reports is one of ISA's primary goals. To achieve this goal the Standards and Practices Department relies on the technical expertise and efforts of volunteer committee members, chairmen, and reviewers.

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