INTERNATIONAL STANDARD

ISO 16484-1

First edition
2010-11-01

Building automation and control systems (BACS) —

Part 1: Project specification and implementation

Systèmes d'automatisation et de gestion technique du bâtiment —

Partie 1: Spécification et mise en œuvre d'un projet

Reference number
ISO 16484-1:2010(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword iv
Introduction v
1 Scope 1
2 Normative references 1
3 Terms and definitions 2
4 Abbreviated terms 3
5 Requirements and recommendations 4
5.1 Overview 4
5.2 Design phase 7
5.3 Engineering phase 13
5.4 Installation phase 17
5.5 Completion phase 20
5.6 Documentation 21
5.7 Training 23
6 Review and improvement of building performance 23
Bibliography 24

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16484-1 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 247, *Building automation, controls and building management*, in collaboration with ISO Technical Committee ISO/TC 205, *Building environment design*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 16484 consists of the following parts, under the general title *Building automation and control systems (BACS)*:

— *Part 1: Project specification and implementation*

— *Part 2: Hardware*

— *Part 3: Functions*

— *Part 5: Data communication protocol*

— *Part 6: Data communication conformance testing*

The following part is under preparation:

— *Part 4: Applications*

Introduction

ISO 16484 (all parts) is aimed at the design of new buildings and the retrofitting of existing buildings for an acceptable indoor environment, practical energy conservation, and efficiency.

ISO 16484 (all parts) is applicable to building automation and control systems (BACS), as follows:

— The environmental design for all building types requires complex methods of automation and control. The functional integration of services other than heating, ventilating and air conditioning (HVAC) is a general task for all parties employed to develop an integrated multi-application system. The integration comprises, for example, lighting and electric power distribution control, security control, transportation, maintenance management or facilities management. This system integration allows the user to take advantage of synergies between the different applications. ISO 16484 (all parts) gives guidance to architects, consultants and contractors as well as guidance to users on how to share such resources.

— The innovation cycles between devices, systems and networks vary. In order to make it possible to add and to change existing devices and extend the building automation and control network, several interfaces, both proprietary and standardized, are defined between the BACS network and the other systems. A manufacturer can design a product, both to meet his specific marketing objectives and to give the option to integrate that special device into a multi-application BACS. Interfaces are also defined in appropriate parts of ISO 16484 along with the necessary communications protocol and conformance test required to support the interworking of devices.

— A manufacturer, a systems house, or an electrical or mechanical contractor can assemble the implementation of a building automation and control system.

— The application of ISO 16484 (all parts) is not to standardize the hardware and software design or the architecture of a system, but to define the process for the creation of project specifications, where the functionality and the quality of the solution are clearly defined.

ISO 16484 (all parts) is intended for use by those involved in the design, manufacture, engineering, installation, commissioning, operational maintenance and training of BACS when contracted, i.e.:

— as a guide to the terminology of the building automation and control trade. Unambiguous terminology is required for a complete and accurate conveyance of the intent and details of ISO 16484 (all parts);

— in product development, to avoid unnecessary duplication of function or terminology, but not necessarily placing a restraint on the evolution of new products, systems or applications;

— as a basis for interfacing products and systems. In order to interoperate, the elements of a BACS require a unified data communication protocol and information model;

— as a basis for drawing up a project specification for procurement;

— as a code of practice for expert commissioning;

— by educational establishments wishing to train people in the field of BACS.

Building automation and control systems (BACS) —

Part 1:
Project specification and implementation

1 Scope

This International Standard specifies guiding principles for project design and implementation and for the integration of other systems into the building automation and control systems (BACS).

This International Standard specifies the phases required for the BACS project, including:

— design (determination of project requirements and production of design documents including technical specifications),

— engineering (detailed function and hardware design),

— installation (installing and commissioning of the BACS), and

— completion (handover, acceptance and project finalization).

This International Standard also specifies the requirements for as-built documentation and training.

This International Standard is not applicable to operation and maintenance, nor is it applicable to retro or continuous commissioning, including a commissioning authority.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16484-2:2004, *Building automation and control systems (BACS) — Part 2: Hardware*

ISO 16484-3, *Building automation and control systems (BACS) — Part 3: Functions*

ISO 16484-5, *Building automation and control systems — Part 5: Data communication protocol*

ISO 16484-6, *Building automation and control systems (BACS) — Part 6: Data communication conformance testing*

IEC 62305-4, *Protection against lightning — Part 4: Electrical and electronic systems within structures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16484-2, ISO 16484-5, ISO 16484-6 and the following apply.

3.1
acceptance
decision and act of signing the handover document during the completion phase

NOTE The transfer of the responsibility for the system(s) from the supplier to the customer or their representative can be a legal act.

3.2
building performance
set of measurable building characteristics

NOTE 1 This includes energy efficiency, indoor air quality, moisture management and thermal comfort.

NOTE 2 This is also influenced by building construction and utilization, installed technical services and their operation.

3.3
building services
BS
utilities and installations supplied and distributed within a building

EXAMPLES Electricity, gas, heating, water and communications.

[Adapted from ISO 16484-2:2004, 3.33]

3.4
BACS commissioning
project and system-specific process of calibrating field devices, testing data points, adjusting parameters, verifying sequences of operation and other functionalities for the various elements of a BACS application

NOTE 1 The BACS commissioning is a part of the engineering services, according to ISO 16484-2:2004, 3.71 and includes commissioning activities at the installation phase.

NOTE 2 Commissioning reports are proof of the completeness of tasks and work.

NOTE 3 There are country variations in the naming of the term “commissioning” and variations in the tasks covered by this term.

3.5
commissioning process
systematic application of processes and procedures designed to ensure that the project objectives are achieved and maintained throughout the building lifetime

NOTE 1 The commissioning process begins at project conception and continues through to the pre-design, design, construction, start-up, turnover and occupancy to the operation phase.

NOTE 2 Details of how to conduct the commissioning process are outside the scope of this International Standard.

3.6
commissioning authority
CxA
entity identified by the owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process

NOTE In some countries there are “certified commissioning authorities”.

3.7
completion
project phase where, when handover and finalization are achieved, the implementation of the BACS project can be considered as completed

3.8
engineering
acquiring and applying technical knowledge to design and implement devices, systems and processes that realize the desired objective

NOTE This includes project and system-specific services for planning, configuring and commissioning of the various parts of a BACS.

3.9
finalization
task during the project completion phase where the supplier resolves outstanding items

3.10
functional description
overall description that explains how each part of the system/plant is expected to operate, interact and be interacted with

NOTE The description covers material energy and signal flow of a plant or a system. Functions/operations are described as: storing, transmitting, converting, transforming and interlinking.

3.11
handover
formal process that transfers a system or part of a system usage from the supplier to the customer or their representative

NOTE The transfer of the operational responsibility for the system from the supplier to the customer can be a legal act or be agreed by contract.

3.12
installation instruction
document that explains how to install a technical device

NOTE 1 There can be several installation instructions for a device, e.g. mechanical, electrical.

NOTE 2 Installation instructions can be found from many sources, e.g. directives, standards, guidelines, professional recommendations, manufacturer's instructions for products.

3.13
migrate, verb
modernize the implemented software or the hardware under extensive utilization of the present infrastructure

3.14
system integration
bringing together subsystems into one system to function together as a system

4 Abbreviated terms

For the purposes of this document, the symbols, abbreviations and acronyms given in ISO 16484-2, ISO 16484-5, ISO 16484-6 and the following apply.

BACS Building automation and control system

CxA Commissioning authority

EMC Electromagnetic compatibility

EMP Electromagnetic pulse

HVAC Heating, ventilating and air conditioning

LEMP Lightning electromagnetic pulse

UPS Uninterruptible power supply

VPN Virtual private network

5 Requirements and recommendations

5.1 Overview

5.1.1 General

The BACS project normally commences after the client appoints a BACS consultant or supplier.

The quality of the implementation of a BACS is dependent on the design of building systems and the specification of the commissioning process. The scope of commissioning referred to in this part of ISO 16484 is as defined in ISO 16484-2:2004, 3.42. In order to produce and maintain the required quality of building performance after the implementation has been completed, application of a commissioning process for review and improvement of commissioned values is recommended. Retro or continuous commissioning, including a commissioning authority, is not within the scope of this International Standard.

5.1.2 Phases of the BACS project

This clause specifies the main actions and decisions necessary in order to implement a project in the different phases (see Figure 1). It serves for all the parties involved in the different phases of a project. The phases of a project associated with the implementation of a BACS are as follows.

5.1.2.1 Design phase

The design phase consists of:

a) the determination of project requirements;

b) the project planning and organization;

c) the technical specification;

d) the establishment of a contract.

5.1.2.2 Engineering phase

The engineering phase consists of:

a) project planning and coordination;

b) detailed function and hardware specification design;

c) engineering design approval;

d) hardware configuration;

e) control strategy and processing functions configuration;

f) management and operator functions configuration;

g) system testing.

5.1.2.3 Installation phase

The installation phase consists of:

a) installing;

b) BACS commissioning.

5.1.2.4 Completion phase

The completion phase consists of:

a) system demonstration;

b) operator training;

c) handover;

d) acceptance;

e) finalization;

f) completion decision.

5.1.3 Documentation

Work done during the engineering, installation and completion phases will serve as a basis for providing as-built documentation, see 5.6.

5.1.4 Training

Work done during the engineering, installation and completion phases will serve as a basis for providing training, see 5.7.

5.1.5 Reviewing and improving building performance

This phase has been included for completeness. It does not form part of a BACS project but, after completion, improved building performance (according to the actual use) can be achieved by the BACS if the commissioned values are reviewed and amended periodically, providing improved energy performance and reduced operating costs. This can be achieved through the commissioning process, which is not covered in this International Standard.

5.1.6 Graphical overview

A possible sequence of the important decisions and activities in each phase is shown in Figure 1. It is not prescriptive; some activities can be carried out earlier or later, depending on the project requirements, e.g. documentation and training.

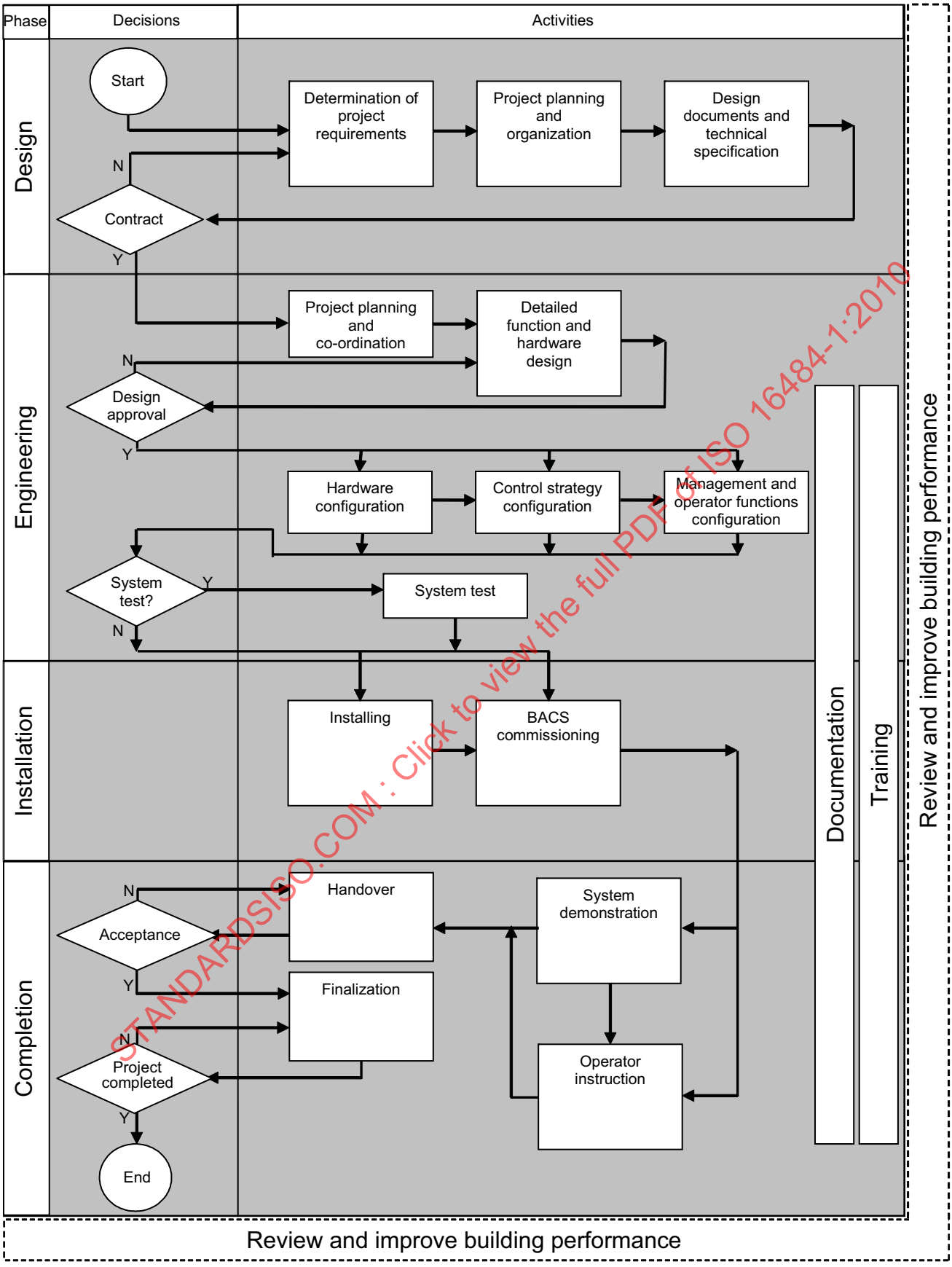

Figure 1 — Process and structure of BACS project implementation

5.2 Design phase

5.2.1 General

This section specifies tasks to be carried out in the design process of the various parts of a BACS. It is assumed that at the start of the design process, the information necessary in order to accommodate a BACS is available. The tasks to perform are project and system-specific.

The design phase covers the following areas:

a) determination of project requirements;

b) project planning and organization;

c) design documents and technical specification;

d) the contract.

Owners and users of buildings can benefit from the integration of various technical building systems. In cases of system integration, it is important that parties agree on the particular meaning of system integration with respect to the specific project requirements. Project management consideration shall be given to the functional operation responsibility for attached subsystems.

5.2.2 Determination of project requirements

5.2.2.1 Overview

In order to meet the client's requirements, the general project requirements for the BACS should take into account the following:

a) general considerations;

b) integration requirements;

c) physical requirements;

d) occupational requirements;

e) system requirements;

f) site and client-specific requirements.

Attention should also be given to energy performance.

The description of project requirements shall be approved by the client.

5.2.2.2 General considerations

When considering the determination of system requirements, the following factors should be taken into account:

a) building structure, e.g. metal frame, concrete, size, thermally active building components, historical construction (listed objects);

b) type of building(s), e.g. high rise, one storey, open campus, tunnel;

c) building usage type and profile, e.g. hospital, single/multi tenant, industrial, commercial, residential;

d) space usage profile, e.g. occupation schemes, diverse usage of space, continuous operation;

e) system integrity including off-site considerations, e.g. communication infrastructure and topology, availability, reliability, response time, safety and security, redundancy;

f) EMC, EMP and LEMP requirements according to IEC 62305-4;

g) intended organization of operation and technical services, e.g. third party, caretaker, trade segregation, user account levels;

h) energy supply requirements, e.g. alternative energy systems, load shedding, energy monitoring;

i) safety and security systems integration with BACS and mutual interaction, e.g. fire system, access control system, interoperability area and integration depth;

j) implementation of the project by phases, e.g. timescales for each phase, constraints on plant shutdowns, impact on continuous operation;

k) budget, e.g. change contingency, overtime work;

l) future usage, e.g. spare capacity, flexibility, future intended extensions;

m) application of the commissioning process.

5.2.2.3 Integration requirements

5.2.2.3.1 Overview

This International Standard specifies general considerations for integration that are to be implemented in the following categories:

a) integration/implementation;

b) integration/operation;

c) integration/function;

d) integration/infrastructure.

5.2.2.3.2 Integration/general considerations

The following requirements for integration should be considered:

a) the deployment of special system integration consultants;

b) the allocation of responsibilities, e.g. for subsystem functionality and interfaces, for delivery of integration of subsystems;

c) vendor and manufacturer independence, e.g. standardized protocols, profiles and interfaces;

d) enhanced energy performance, e.g. interdisciplinary operations of HVAC, blinds and lighting controls;

e) compatibility, e.g. software/hardware versions of subsystems, protocol versions, proprietary protocols;

f) interoperability, e.g. data sharing, event and alarm management, scheduling, trend and event logging, device and network management;

g) functional interaction, e.g. fans disabled by fire conditions;

h) single seat operation, e.g. shared computer, consolidated user information and alarms;

i) infrastructure sharing, e.g. Ethernet structured cabling, shared computer;

j) commissioning, e.g. availability and interaction of subsystems;

k) interoperability diagnostics, e.g. event recording, device and object binding integrity, protocol analysing.

5.2.2.3.3 Integration/implementation

The following requirements for the implementation of integration should be considered:

a) responsibilities, e.g. supplier of subsystems for its functionality and interfaces, party for the delivery of integration of subsystems;

b) compatibility, e.g. change control, software/hardware versions, protocol versions, proprietary protocol details;

c) commissioning, e.g. sequence of commissioning from subsystems to primary system.

5.2.2.3.4 Integration/operation

The following requirements for the effective operation of an integrated system should be considered:

a) the number and types of data points, e.g. values, alarms, point/object names and mnemonics;

b) the depth of information required, e.g. limits, scheduling, trends;

c) the human system interface (HSI) requirements, e.g. single computer multi applications, single application, web browser, access rights;

d) the user actions required, e.g. monitoring, commanding, acknowledgement, local overrides.

Integration can be achieved by multiple applications on a single computer (e.g. a web browser) or a single application that handles all information (e.g. full graphical representation of information). The information can be used for the purpose of monitoring or commanding, or both.

5.2.2.3.5 Integration/function

The following points for the interoperability of integration should be considered:

a) function types to perform in which systems, e.g. time scheduling, maximum demand and other BACS functions from ISO 16484-3;

b) interactions, dependencies and priorities, e.g. fire stopping fans, plant activation from access system;

c) system behaviour in case of abnormality, e.g. default values, partial system/device restart, maintenance shutdown;

d) number and types of shared data points, e.g. outdoor air temperature, scheduling, trending.

5.2.2.3.6 Integration/infrastructure

Infrastructure includes common physical items that facilitate communication and media sharing. Consideration should be given to the following regarding the infrastructure of integration:

a) installation requirements, e.g. cabling systems, power over Ethernet, grounding, communication protocols, topology;

b) network management, e.g. addresses, VPN, firewalls, remote access, access rights, segmentation;

c) network capacity, e.g. bandwidth, normal and abnormal usage;

d) availability and reliability, e.g. redundancy, setup and commissioning of integrated, decentralized and autonomous systems.

5.2.2.4 Physical requirements

Building infrastructure and plant equipment influence physical attributes of BACS and should be considered along with the following:

a) new equipment and its ability to be monitored and controlled, e.g. adding monitoring and control;

b) existing equipment and its ability to be monitored and controlled, e.g. reuse, adding functionality;

c) existing controls or BACS, e.g. integrate, migrate, replace;

d) space, e.g. for cabinets, wall mountings, human system interface (HSI);

e) human system interface, e.g. local display, operator workstation;

f) local conditions, e.g. environmental, temperature, humidity, seismic risk, extreme weather;

g) cabling, e.g. topology, media type, size, rating, environment;

h) power supply, e.g. frequency, voltage, emergency power supply, UPS.

5.2.2.5 Occupational requirements

The client's requirements will influence the scope and attributes of BACS and should be considered along with the following:

a) priorities for operation of the building, e.g. emergency situations, normal conditions, overrides;

b) occupancy profile, e.g. schedules/calendar, setpoints, operating modes, daylight saving, energy use;

c) energy performance, e.g. energy usage, energy savings;

d) comfort conditions, e.g. thermal, visual, acoustic, air quality;

e) human system interfaces, e.g. local override/indication devices, operator and monitoring units or panels, operator work stations including visual display units, internet browser on different types of platforms.

5.2.2.6 System requirements

The client's requirements will influence the design of BACS and should be considered along with the following:

a) priorities for operation, e.g. safety of personnel, protection of equipment, occupancy profile, comfort, energy savings, cost savings, reliability, indoor air quality;

b) control strategies (see ISO 16484-3);

c) management functions (see ISO 16484-3), e.g. data storage, data retrieval;

d) maintenance management requirements, e.g. condition-based monitoring, local/remote reporting;

e) energy management requirements;

f) alarm strategy, e.g. categories, priorities, delivery, routing;

g) human system interface, e.g. localization, multi language, graphics quality, types, functionality;

h) system support, e.g. remote access, technical support;

i) system performance, e.g. accuracy, response time, display response;

j) system reliability, e.g. availability, redundancy;

k) documentation, e.g. format and media, content, quantity, compliance certificates.

5.2.2.7 Site and client specific requirements

The site and client requirements influence the documentation and delivery of the BACS and should be considered along with the following:

a) installation, e.g. electrical, mechanical, controls;

b) commissioning and handover requirements, e.g. witness testing, process for uncompleted actions, summer/winter operation, phased delivery, documentation of the results;

c) training, e.g. instructions for use, operation and maintenance, system/product training;

d) documentation, e.g. language, content, media, certificates, software licences and backup;

e) post completion, e.g. warranty/guarantee requirements, spare parts requirement, maintenance requirements and software updates;

f) application of the commissioning process, e.g. required qualification and role of commissioning authority.

5.2.3 Project planning and organization

5.2.3.1 Overview

A clear management and reporting structure shall be described for all parties involved. The process shall allow for resolution of issues raised during the project and include:

a) project planning;

b) project organization;

c) definition of responsibilities;

d) details of specific constraints;

e) change management.

5.2.3.2 Project planning

The project plan defines the milestones, tasks and deliverables that will drive the project. It details dependencies on other trades that affect the BACS timetable and identifies who is responsible for doing what, as well as the deadlines. A timetable detailing the BACS design, engineering, installation/commissioning and completion phases shall be provided.

5.2.3.3 Organization

Details of the roles and relationships within the organization required to deliver the project plan shall be provided. Consideration should at least be given to the following and where required it shall be documented:

a) system integration, e.g. coordination, decision making;

b) change management, e.g. authorization;

c) commissioning, e.g. coordination, decision making, authority/agent;

d) approvals, e.g. design, witness testing, acceptance;

e) conflict management, e.g. escalation path.

5.2.3.4 Definition of responsibilities

A clear definition of all the roles mentioned in the organization document and their responsibilities shall be provided.

5.2.3.5 Details of specific constraints

All site-specific working requirements shall be detailed. Consideration should be given to the following:

a) third party equipment, e.g. plant shutdown, clearance, access;

b) security processes, e.g. personnel, computers, phones, security clearance;

c) working hours, e.g. night/weekend shifts;

d) special qualifications, e.g. training records, languages;

e) environmental restrictions, e.g. clean areas, health and safety, wireless communications.

5.2.3.6 Change management

There shall be a change management process that handles changes based on customer feedback or from deficiencies found in the design specifications. Procedures should be defined to track and deal with:

a) information exchange, documentation and circulation;

b) the modifications of the design specifications;

c) the approval by the involved parties of these design changes as interpreted by the supplier;

d) the process by which the supplier requests additional data from the customer, e.g. the name of the data points, the setpoint values, the occupancy schedule, specific requirements on graphics;

e) the agreement of contractual and financial consequences of any change.

5.2.4 Design documents and technical specification

The technical specification shall contain all relevant documents to fully detail the requirements as identified in 5.2.2 and 5.2.3. The detailed engineering works that are required should make use of the BACS function list as defined in ISO 16484-3. The BACS function list provides the correct allocation of engineering works in system integration projects and prevents unnecessary duplication of engineering.

The documents issued for tender should contain:

a) required standards and regulations;

b) address and location;

c) site layout drawing;

d) contractual requirements;

e) systems and equipment within the scope of the project;

f) overall functional description;

g) project organization and responsibilities;

h) project milestones and dependencies;

i) project constraints;

j) training and documentation requirements;

k) specification documents for each system comprising:

   1) required standards and regulations,

   2) physical location of the system items,

   3) functional description including the sequence of operation as text or diagram,

   4) data points list and BACS function list if required,

   5) the principle and structure of point addressing and/or naming,

   6) commissioning requirements,

   7) system demonstration requirements,

   8) mechanical plant schematics and equipment details including sizing information, and

   9) spare parts requirement.

5.2.5 Contract

A contract that embodies the technical specification shall be established with participating parties before proceeding to the engineering phase.

5.3 Engineering phase

5.3.1 General

This section specifies tasks carried out in the process of configuring the various parts of a BACS. These tasks are project/system-specific.

The engineering phase covers the following areas:

a) project planning and coordination details;

b) detailed hardware and function design;

c) approval of design submittals;

d) hardware configuration;

e) control strategy configuration;

f) management and operator functions configuration;

g) system test.

Work done during the engineering phase serves as a basis for providing as-built documentation and training.

5.3.2 Project planning and coordination details

Within the scope of their contract the responsibility for detailed planning, management and coordination lies with the organization that places contracts with others.

Named individuals responsible for interfacing between the customer and their supplier(s) shall be identified. Any changes shall be communicated to all parties involved.

The process for reporting performance against milestones is required to be defined and agreed between the involved parties.

The supplier shall create and maintain a delivery plan for equipment and a schedule, with milestones, to meet the overall project program.

5.3.3 Detailed hardware and function design

5.3.3.1 General

In this section the term “hardware” relates to all the physical devices to be provided by the supplier to the customer, including devices supplied by others but controlled by or that provide data to the BACS.

5.3.3.2 Prerequisites and dependencies

This section identifies tasks that should be carried out after receipt of the contract and in preparation of the submittals. The tasks are as follows:

a) review technical specification and request clarifications, as appropriate;

b) identify and communicate necessary dependencies such as, but not limited to:

   1) power requirements,

   2) network requirements, e.g. topology, IP network access points, remote communication services, and

   3) environmental requirements, e.g. temperature, humidity, dust, seismic rating.

5.3.3.3 Preparation of submittals

The submittal shall include the following:

a) system architecture and system description;

b) data points list and BACS function list if required;

c) updated functional description including the sequence of operation as text or diagram;

d) additional documents as required.

5.3.4 Approval of design submittals

The output from the hardware and function design is submitted to the customer's representative responsible for approval.

Approval is necessary to ensure that the hardware and function design meets the design specification and the results of any clarifications received from the prerequisites. It offers the opportunity for both the customer and the supplier to manage each other's expectations.

A response to the submittals, with any appropriate explanation if required, should be given in a timely manner.

The approved submittals form the basis for proceeding to the configuration tasks.

5.3.5 Hardware configuration

This section documents the minimum expected engineering tasks related to the physical items of plant to facilitate installation and BACS commissioning, and comprises the detailing of:

a) field wiring, generation of schematics, terminal identification, device/system and plant connectivity, cable types;

b) input/output allocation;

c) network, addressing, network setup, existing networks, networking devices;

d) equipment lists.

If there is to be system testing, a test plan has to be formulated taking the requirements into consideration. BACS commissioning requirements shall be identified and added to the commissioning plan.

During this phase there shall be input into the documentation and training plan.

5.3.6 Control strategy configuration

This section documents the tasks related to the configuration of the control to facilitate operation, as detailed in the specification.

The technical specification and approved functional description are used to create the control software. The software uses the input and output allocation as detailed in the hardware configuration. The items identified in the BACS function list are also implemented in the software.

When creating the software, consideration should be given to the following:

a) sequence of operation;

b) user accessible adjustments;

c) events, alarms and routing requirements;

d) user levels;

e) interactions with third parties including data sharing;

f) logged data;

g) priorities.

The minimum output from the control strategy configuration comprises the control software and the description of operation.

If there is to be system testing, a test plan shall be formulated. BACS commissioning requirements shall be identified and added to the commissioning plan.

During this phase there shall be input into the documentation and training plan.

5.3.7 Management and operator function configuration

This section documents the tasks related to the configuration of the management and operator functions as detailed in the specification. These functions can be implemented centrally and/or distributed throughout the system.

The technical specification, the approved functional description and the control software are used to create the management and operator functions.

When configuring the management and operator functions consideration should be given to Clause 3 and the following:

a) data collection: what, where, when (frequency) and how much;

b) backing up, restoring and archiving data;

c) interactions with third parties including data sharing.

If there is to be system testing, a test plan shall be formulated. BACS commissioning requirements shall be identified and added to the commissioning plan.

During this phase there shall be input into the documentation and training plan.

5.3.8 System test

This section relates to the system test prior to installation, if required by the contract. The purpose of the testing is to confirm that the system or representative parts of the system meet the functional and operational specifications and work as expected. If the system fails to work as expected, the change management process should be used.

The tests as identified in the configuration sections are executed. These tests can cover, for example, the following:

a) control strategy and BACS functions;

b) electrical panels containing controllers;

c) example installation;

d) human system interface usability;

e) interoperability.

Usually the results of these tests are validated by an authorized person.

5.4 Installation phase

5.4.1 General

This section specifies tasks carried out when installing the various parts of a BACS. These tasks are project/system-specific.

Installation phase covers the following areas:

a) installing;

b) BACS commissioning.

Work done during the engineering, installation and completion phases serves as a basis for providing documentation and training. On completion of the installation phase, documents should be updated to reflect changes.

5.4.2 Installing

5.4.2.1 General principles

All equipment shall be installed in accordance with the relevant installation instructions. The location for the equipment is to be as defined in the design submittals. Tagging of equipment and cables shall be completed as required by the specification.

The agreed location access requirements need to be coordinated to ensure that a safe working environment and progress to plan can be achieved.

Where common equipment or integration is required, special attention shall be given to coordination with the involved parties.

The installation can be considered completed when the parts and equipment are correctly installed to enable BACS commissioning to commence. Installation may be phased to enable commissioning on parts of the BACS as subsystems become available.

Installing covers the following areas:

a) field devices;

b) BACS equipment;

c) other equipment;

d) cabling.

5.4.2.2 Field devices

Field devices shall be installed in accordance with the relevant installation instructions. Incorrect installation and location of field devices can lead to poor control performance and increased maintenance efforts. Access to these devices shall be considered for maintenance operations.

Special attention shall be given to items that provide safety or protection, where the placement and mounting of these devices are critical, e.g. high/low limit pressure, high/low limit temperature, smoke detection and control.

5.4.2.3 BACS equipment

BACS equipment shall be installed in accordance with relevant installation instructions. Their access should be possible for maintenance operations.

5.4.2.4 Other equipment

Where required, as part of the contract, other supplied equipment shall be installed according to relevant installation instructions.

5.4.2.5 Cabling

Where required, as part of the contract, cables shall be installed according to regulations. Termination of cables shall be in accordance with installation instructions, e.g. with or without ground protection from electromagnetic interference, maximum length, etc. In general, ISO/IEC TR 14763-2 applies to communication networks.

5.4.3 BACS commissioning

5.4.3.1 General principles

The scope of this section covers the commissioning of the BACS and its interaction with related systems. It is not intended to be a comprehensive description of all aspects of commissioning a building.

In this part of ISO 16484, commissioning of the BACS comprises a series of tasks performed on the installed controls equipment that proves the installation meets the contracted technical specification and enables the BACS to be put into service. The BACS commissioning activities cover the following:

a) commissioning plan;

b) commissioning prerequisites;

c) hardware verification;

d) control strategy verification;

e) management and operator functions verification.

5.4.3.2 Commissioning plan

The commissioning plan is defined during the engineering phase taking into account requirements in the technical specification document. It includes the tests and checks to be performed, coordination requirements and the role of each party in their execution, in addition to the procedure for reporting these tests and checks and the phasing of the commissioning.

The commissioning plan should identify requirements such as:

a) availability of the plant connected to the element to be commissioned;

b) water and air balancing;

c) specific climatic conditions;

d) specific occupation conditions;

e) availability of required services.

5.4.3.3 Commissioning prerequisites

Before beginning commissioning (or one of its stages) the following are required:

a) confirmation of safe working conditions for the system;

b) all variable parameters and switches set to appropriate values and settings;

c) items associated with the system are available and operational;

d) access is possible to all associated areas of the building.

5.4.3.4 Hardware verification

The primary task of hardware verification is the confirmation of the following:

a) installation of items conform to manufacturer's instructions;

b) items are safe to operate;

c) items are correctly cabled, tagged and connected;

d) network communications are installed and operating as specified;

e) commissioning results are recorded.

5.4.3.5 Control strategy verification

The primary task of control strategy verification is the confirmation of the following:

a) system being commissioned is safe to operate;

b) operation of inputs, outputs and processing functions;

c) static and dynamic behaviour of control loops;

d) interaction between various control strategies and systems;

e) time-dependent activities;

f) event handling, including alarm routing and grouping;

g) software and configuration files are backed up;

h) commissioning results are recorded.

5.4.3.6 Management and operator function verification

The primary task of management and operator function verification is the confirmation of the following:

a) display graphics and print outputs are a representation of the actual installation;

b) user interface navigation links (buttons, text, icons, etc.) operate as indicated;

c) data points relate to the intended display items;

d) recorded data relate to the intended data points;