
**Ergonomic design of control centres —
Part 3:
Control room layout**

Conception ergonomique des centres de commande —

Partie 3: Agencement de la salle de commande

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Printed in Switzerland

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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11064-3 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

ISO 11064 consists of the following parts, under the general title *Ergonomic design of control centres*:

- *Part 1: Principle for the design of control centres.*
- *Part 2: Principles of control suite arrangement* [ISO 11064-3:1999](https://standards.iso.int/catalog/standards/sist/f140e53b-3266-47bc-8f24-121e437ffc4e/iso-11064-3-1999)
- *Part 3: Control room layout*
- *Part 4: Workstation layout and dimensions*
- *Part 5: Displays and controls*
- *Part 6: Environmental requirements for control centres*
- *Part 7: Principles for the evaluation of control centres*
- *Part 8: Ergonomic requirements for specific applications*

Annexes A and B of this part of ISO 11064 are for information only.

Introduction

This part of ISO 11064 establishes ergonomic requirements, recommendations and guidelines for control room layout.

User requirements are a central theme of this part of ISO 11064 and the processes described are designed to take account of needs of users at all stages. The overall strategy for dealing with the user requirements as strategy to be adopted for control room design is presented in ISO 11064-1.

ISO 11064-2 provides guidance on the design and planning of the control room in relation to its supporting areas. Requirements for the design of workstations, displays and controls and the physical working environment are presented in ISO 11064-4 to ISO 11064-6. Evaluation principles are dealt with in ISO 11064-7.

ISO 11064-1 to ISO 11064-7 cover general principles of ergonomic design appropriate to a range of industries and service providers. The specific requirements appropriate to particular sectors or applications areas are covered in ISO 11064-8. The requirements presented in ISO 11064-8 are to be read in conjunction with ISO 11064-1 to ISO 11064-7.

The ultimate beneficiaries of this part of ISO 11064 will be the control room operator and other users. It is the needs of these users that provide the ergonomic requirements used by the developers of International Standards. Although it is unlikely that the end user will read this part of ISO 11064, or even know of its existence, its application should provide the user with interfaces that are more usable and a working environment which is more consistent with operational demands. It should result in a solution which will minimize error and enhance productivity.

For determining design dimensions, the practice of providing formulae, into which appropriate user population data is inserted, is adopted. A table of anthropometric data is presented in annex B.

Ergonomic design of control centres —

Part 3: Control room layout

1 Scope

This part of ISO 11064 establishes ergonomic principles for the layout of control rooms. It includes requirements, recommendations and guidelines on control room layouts, workstation arrangements, the use of off-workstation visual displays and control room maintenance.

It covers all types of control centres, including those for the process industry, transport and dispatching systems in the emergency services. Although this part of ISO 11064 is primarily intended for non-mobile control centres, many of the principles could be relevant/applicable to mobile centres, such as those found on ships and aircraft.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 11064. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 11064 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 7250:1996, *Basic human body measurements for technological design*.

ISO 9241-3:1992, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 3: Visual display requirements*.

ISO 9241-5:1998, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 5: Workstation layout and postural requirements*.

ISO 11428:1996, *Ergonomics – Visual danger signals – General requirements, design and testing*.

3 Terms and definitions

For the purposes of this part of ISO 11064, the following terms and definitions apply.

NOTE To assist with the interpretation of these definitions, descriptive Figures 1 and 2 are included in this clause.

3.1

control centre

combination of control rooms, control suites and local control stations which are functionally related and all on the same site (see Figure 1)

- 3.2**
control console
structural framework which supports equipment, worksurfaces and storage and which together comprise a control workstation
- 3.3**
control panel
discrete surface on which groups of displays and controls are mounted; control panels may be mounted on the control workstation or on walls (see Figure 2)
- 3.4**
control room
core functional entity, and its associated physical structure, where control room operators are stationed to carry out centralized control, monitoring and administrative responsibilities
- 3.5**
control room operator
individual whose primary duties relate to the conduct of monitoring and control functions, usually at a control workstation, either on their own or in conjunction with other personnel both within the control room or outside
- 3.6**
control suite
group of functionally related rooms, co-located with the control room, and including it, which house the supporting functions to the control room, such as related offices, equipment rooms, rest areas and training rooms (see Figure 1)
- 3.7**
control workstation
single or multiple working position, including all equipment such as computers and communication terminals and furniture at which control and monitoring functions are conducted (see Figure 2)
- 3.8**
direct operator supervision
supervision of control room operators and other staff, by direct observation and/or via direct speech links
- 3.9**
display
device for presenting information that can change with the aim of making things visible, audible or discriminable by tactile or proprioceptive perception
- 3.10**
functional groups
grouping of control workstations where the operational duties are such that close, direct liaison is required and therefore benefit from proximity to one another
- 3.11**
functional layout
layout in which the general location of differing control functions in a control room are indicated
- 3.12**
gross area
overall number of square metres designated for a control room
- 3.13**
disability
any reduction in normal capacity due to mental or physical factors which prevents an individual from experiencing or performing a full complement of activities [8]
- 3.14**
intimate zone
distance at which the presence of another person is unmistakable through such factors as sight, olfaction, heat and sound

3.15**local control station**

operator interface that is located near the equipment or system being monitored and/or controlled

3.16**off-workstation display**

displays which are not mounted on the control workstation; such displays, often visual, may be display panels, mimic diagrams and observation windows (see Figure 2)

3.17**primary information**

information which is essential for the satisfactory exercise of control functions

3.18**primary workstation**

control workstation that is usually staffed and is in the main control area

3.19**secondary information**

information which is either of secondary importance to the control function or which does not need to be immediately available to the control room operator

3.20**secondary workstation**

workstation on which supportive tasks are undertaken, or on which an overload of tasks can be carried out during periods of peak workloads

3.21**shared visual display device**

on-workstation visual display which needs to be used by more than one control room operator while they are at their control workstations

3.22**stature (body height)**

vertical distance from the floor to the highest point of the head (vertex)

[ISO 7250:1996]

3.23**supervisor**

individual whose primary responsibilities relate to the satisfactory conduct of control functions by the control room, the supervision of staff and equipment and, when necessary, the conduct of control tasks

3.24**task analysis**

analytical process employed to determine the specific behaviours required of people when operating equipment or doing work

[ISO 9241-5:1998]

3.25**usable area**

gross area less deduction for unusable spaces, such as around pillars, awkward corners and nearby entrances/exits

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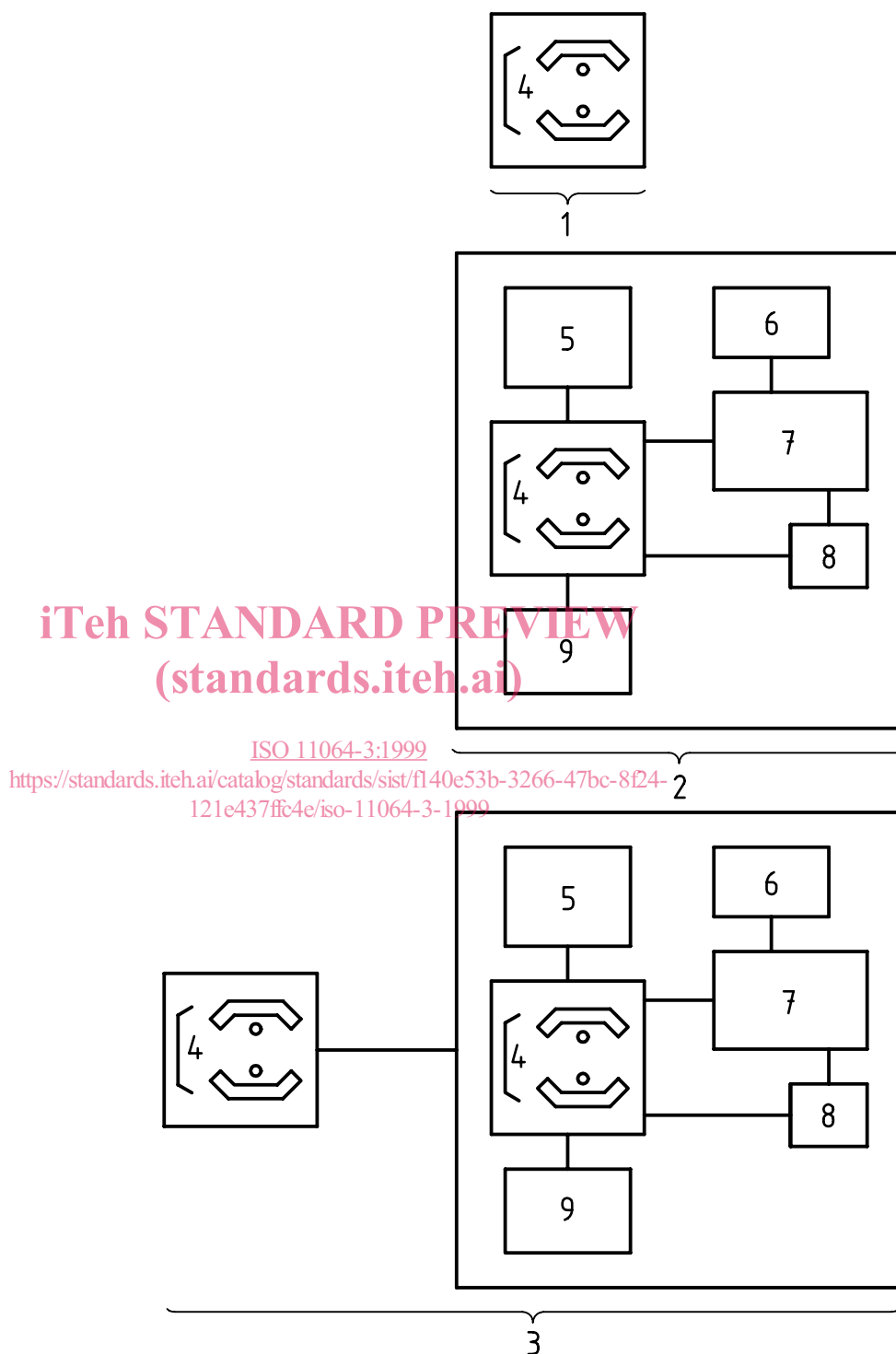


Figure 1 — Schematic illustrations of control room, control suite and control centre

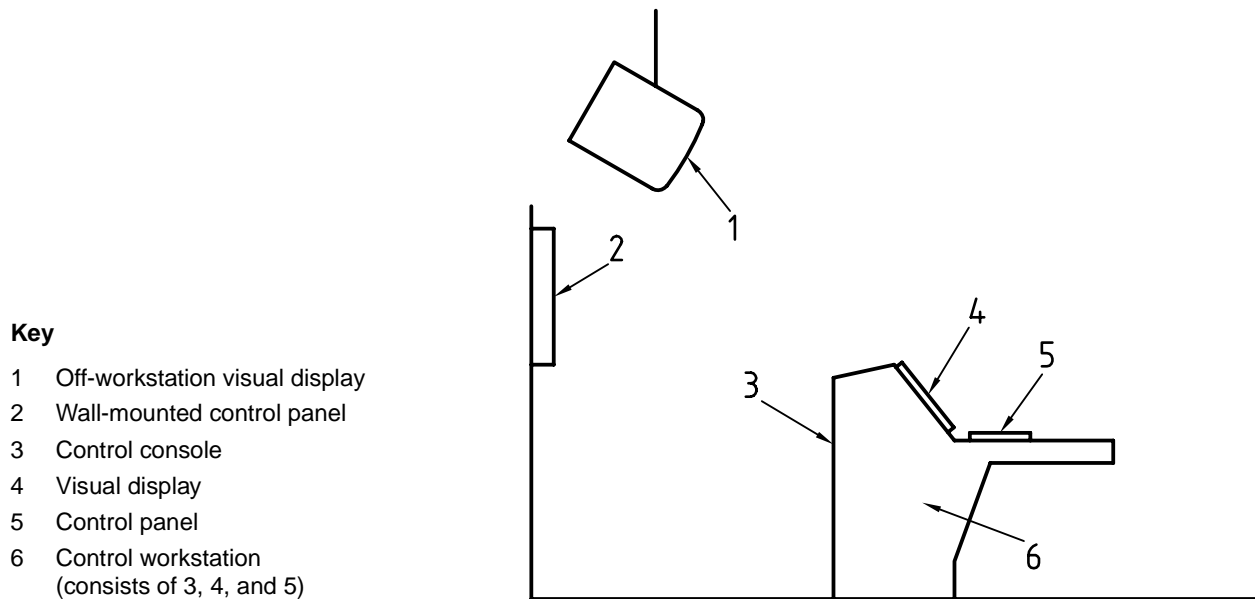


Figure 2 — Illustration of definitions associated with control workstation and off-workstation visual displays

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4 Ergonomic design of control centres

4.1 Process for control room layout

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The following flowchart summarizes a general procedure for the control room layout, where only the main activities have been noted (see Figure 3).

For the purposes of this part of ISO 11064, it is assumed that a number of control room characteristics have been largely finalized and act as an input to the process summarized in the flowchart. These ergonomic features include job descriptions, staffing profiles, equipment specifications and overall operating procedures. For many control room projects, at the stage where layouts need to be undertaken, not all of the ergonomic features have been finalized. In order to proceed with the ergonomic design process in accordance with this part of ISO 11064, it is necessary to agree upon working assumptions for those aspects where final information is not available. This information and the finalized ergonomic features are recorded in an Operational Specification or Functional Specification.

The flowchart refers to information input during the preparation of “functional layouts”. This information will include the number of control workstations as well as any required arrangements of workstations. Grouping should be based on functional linkages, for example, equipment sharing, direct lines of sight and requirements for direct speech.

The development of a preferred control room layout will, typically, include the following activities. Based on the operational requirements summarized in a functional link analysis, workstation arrangement and layouts should be prepared within the available space. These layouts should take account of such functional links, as face to face communications and sightlines to shared off-workstation overview displays, as noted in the functional link analysis. Functional layout need only be approximately to scale. A number of different functional layout options are prepared which meet, to varying degrees, the requirements in the Operational Specification. Translating these functional layouts to possible room layouts is achieved by replacing functional groups with approximate workstation footprint sizes and adjusting the layouts to maintain required circulation and maintenance access. A similar process can be used for room layouts where no space has been decided for the control room, under which circumstances the functional layouts/room layouts can be used to specify the space to be provided for these functions.

Once having determined alternative control room layouts, these shall be tested by control room operators/users against the requirements contained within the Operational Specification. Through a process of iteration, the best control room layout should be sought.

The final control room layout selected should be validated against documented performance criteria, and a record made of the performance of the room against these criteria and any compromises made (see 4.2.6).

4.2 General considerations for control room layout

This subclause summarizes some general considerations for the planning and layout of control rooms. A fuller account of these is presented later in this part of ISO 11064 together with other requirements concerned with control room layout.

4.2.1 Architectural considerations

4.2.1.1 Entrances/exits

Main entrances and exits should not form part of the working visual fields of the control room operator, unless the operators have some specific responsibility for checking on the entry/exit of staff (see 4.4.1).

Entrances and exits should not be positioned behind the control room operator (see 4.3.3).

4.2.1.2 Personnel safety

Features, such as guard-rails and handrails, should be provided to minimize safety hazards in control rooms (see 4.3.2) where various floor levels are found.

4.2.1.3 Future expansion

Control rooms should allow for expansion: provision for expansion will be influenced by such factors as the built-in life-span of the control room and predicted changes in workload or logistics: typically allowance for approximately 25 % increase in working positions and equipment has been found from practical experience to be prudent (see 4.3.2).

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4.2.2 Operational considerations

4.2.2.1 Task analysis

Room layouts should be based on an agreed set of principles derived from operational feedback (if available), task analysis and an understanding of the worker population including workers with disabilities: these underlying principles should be fully documented (see 4.1).

4.2.2.2 Team working

The layout of control rooms, where many of the control room operators work, should facilitate team working opportunities and social interaction for operators where this factor is deemed important for the primary tasks to be performed (see 4.4.1).

4.2.2.3 Organizational factors

The control room layout should reflect the allocation of responsibilities and the requirements for supervision.

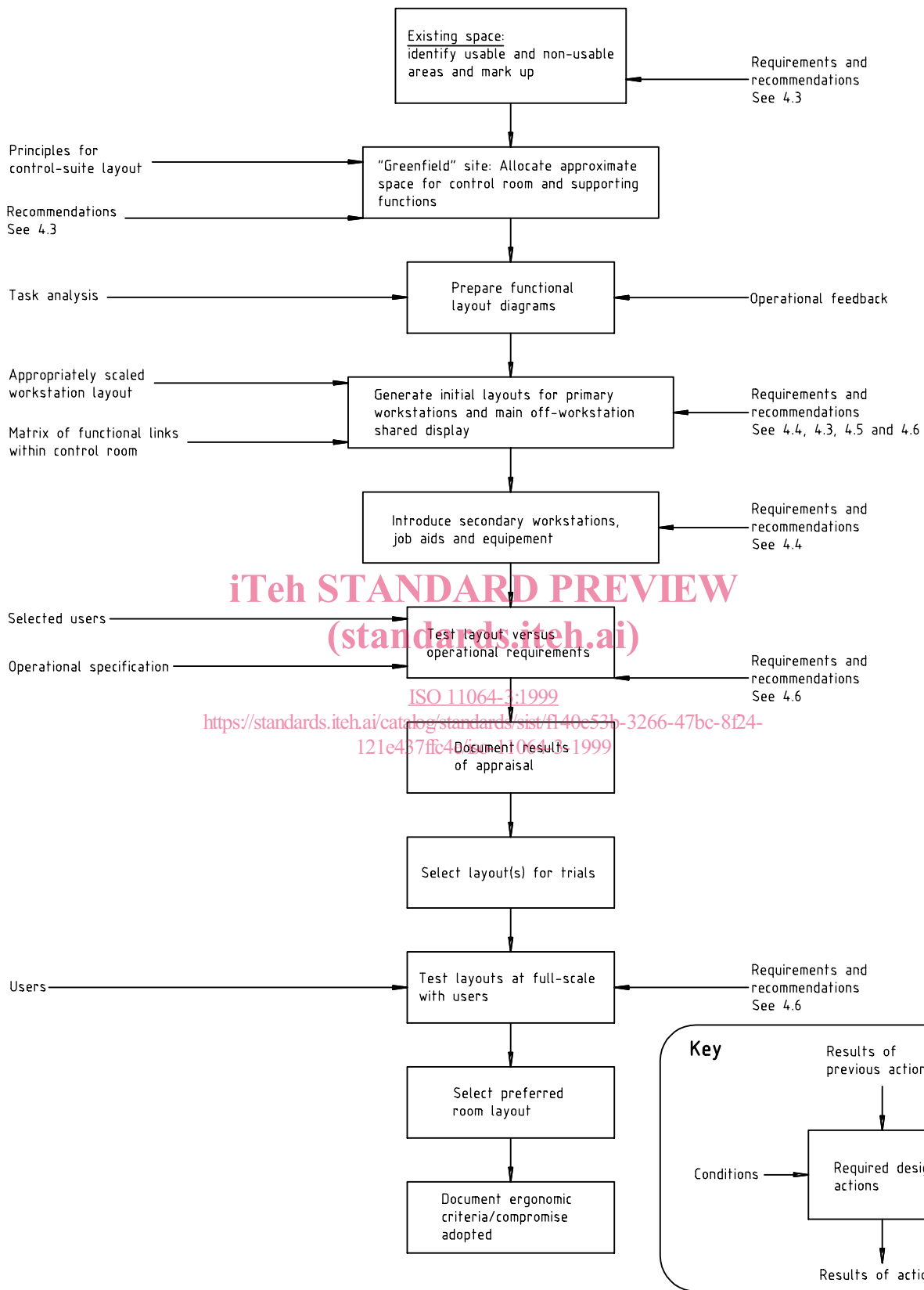
4.2.2.4 Operational links

Optimizing key operational links, including sightlines, or direct speech communication should be a goal in control room layouts (see 4.4.1).

4.2.3 Workstation arrangements

4.2.3.1 Room layout

Control rooms which exhibit either overcrowding of workpositions, or widely dispersed workpositions, are not recommended. Layouts should allow, wherever practical, direct verbal communication between the control room operators and avoid excessively short separations between adjacent operators (see 4.4.1).



NOTE Feedback loops can occur at any stage of the process.

Figure 3 — General procedure for control room layout

4.2.3.2 Consistency

Control rooms with similar functions and in the same plant or facility, such as occur in a control complex, should adopt the same ergonomic principles of room layout to facilitate decision-making and teamwork.

4.2.3.3 Physically disadvantaged

Where physically disadvantaged control room operators or visitors (those exhibiting a disability) are expected to use the control room, adequate facilities should be provided (see 4.4.5).

NOTE National regulations may take precedence over the requirements in this part of ISO 11064.

4.2.3.4 Posture variation

There are ergonomic benefits in varying postures during periods of work. Wherever practicable, it is recommended that control workstation layouts and work regimes allow control room operators to change their posture at the control workstation and to move from their workstations from time to time (see ISO 9241-5:1998). Under no circumstances should this interfere with primary control duties or be undertaken as part of a time-critical activity.

NOTE This may be achieved by locating some off-workstation equipment at a distance from the main operating positions.

4.2.3.5 Body size

Room dimensions and control workstation layout dimensions and features for which peoples' sizes are relevant, e.g. seated view over workstations, shall take account of the range of control room operators for which these items are being provided (see 4.5.1).

4.2.3.6 Windows

Control room operators using visual displays should not be facing windows unless these windows are a primary information source. The location of control workstations where windows are behind the operator should be avoided since this may give rise to reflections on the display screen. If control room operators do have to face windows, whilst using visual display terminals, the differences in luminances should not lead to glare. See clause A.4.

4.2.4 Off-workstation shared visual displays ISO 11064-3:1999

The layout of the control room shall ensure that all off-workstation visual displays, necessary for the control room operators' task, are visible from all relevant control workstations (see 4.5.1).

4.2.5 Circulation of personnel and maintenance access

Circulation of control room staff, maintenance staff and all visitors should be achieved with minimum disruption to the work of control room operators (see 4.6.1).

Where it is anticipated that the supervisory positions will give rise to additional circulation from outside the control room, it is recommended that these positions be located close to main entrances (see 4.6.1).

Operational areas should have a means of restricting thoroughfare access (see 4.6.1).

All aspects of control room layout shall take account of the requirements for maintenance access (see 4.6.2).

4.2.6 Verification and validation of control room layout

Verification is the process of determining that something has been designed and constructed according to a defined specification. Validation is the process of determining that the object, which has been built/developed, is able to carry out the task for which it is intended.

Verification and validation should be integrated with the design process and should be performed in parallel with top level design, detailed design and during the development of prototypes. Verification and validation should be an iterative process during the development of the design. It should give feedback to the designer in moving towards the best possible solution. It may include a number of different methods and techniques.

Examples of these are

- guideline evaluations (or use of checklists), i.e., using human factor guidelines and standards to check the design;