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Guide to facilities maintenance management

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 32, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 December 2012. It was prepared by Technical Committee FMW/1, *Facilities management*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 8210:1986, which is withdrawn.

Information about this document

This British Standard does not prescribe "how to do maintenance", but acts as the basis of an approach for achieving successful maintenance outcomes for a range of facilities. It is intended to assist facility owners and operators, or those acting on their behalf, in regard to facilities maintenance management in aligning the formulation and implementation of maintenance strategies and policies to the core objectives of the organization in the most efficient and effective way.

This is a full revision of the standard, and introduces the following principal changes:

- the scope of this standard has shifted from largely operational matters to those of a more strategic and tactical nature, while retaining a focus on matters of practical importance;
- a broader range of facility assets has been taken into account;
- developments in technology affecting the nature of facility assets and the maintenance management process, in particular the use of information and communications technology (ICT), have been taken into account.

Use of this document

As a guide, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice and claims of compliance cannot be made to it.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The guidance in this standard is presented in roman (i.e. upright) type. Any recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This British Standard gives guidance on the maintenance management of facilities by:

a) outlining a process approach to maintenance management at the strategic and tactical levels, with links to operational activities;

b) assisting organizations and individuals to formulate strategy and policies for maintenance management;

c) assisting those responsible for ensuring that facility assets continue to perform as intended, retaining their asset value at minimum cost;

d) highlighting the importance of regular and planned maintenance as a value adding activity;

e) highlighting relevant areas of importance with regard to occupational health and safety and information management.

NOTE It might be necessary and economically desirable to carry out maintenance at the same time as improvements, additions or alterations.

This British Standard applies to most types of building-related facilities, for example, those for health care, education, housing, manufacturing and distribution, commerce, retailing, utilities, communication and transportation.

This British Standard does not give guidance on:

1) the procurement of services for maintenance (see BS 8572);

2) how to carry out different types of maintenance;

3) any improvements, additions or alterations to a facility that would make it suitable for a purpose other than that for which it was designed;

4) cleaning facilities (see BS 6270-3);

5) maintenance of engineering infrastructure.

2 Normative references

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

BS 7671, *Requirements for electrical installations – IET Wiring Regulations – Seventeenth Edition*

BS 8572, *Procurement of facility-related services – Guide*

3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

3.1 asset register
collection of records holding information about facility assets in terms of their manufacturer, vendor, make, model, specifications, date of acquisition, initial cost, maintenance costs and requirements, accumulated depreciation and written-down value

[BS 8587:2012, **3.1.3**]

3.2 building fabric
elements and components of a building other than furniture and engineering installations

3.3 building management system (BMS)
computer-aided control systems, including hardware and software, to collect and monitor parameters and performance data of plant, equipment, systems and elements either at source or remotely and to enable corrective action to be initiated

3.4 building physicist
person with knowledge and experience of the behaviour and performance of buildings and their components under the influence of physical, chemical and biological phenomena

3.5 computer-aided facilities management system (CAFM)
systems, applications and tools that automate functions needed to support the core business in its efficient and effective use of facilities

3.6 computer-aided maintenance management system (CMMS)
system specifically designed to enable planning, organizing, directing and controlling maintenance programmes and to collect and collate historical data on the performance of assets so the most effective maintenance is selected under actual performance and environmental conditions

3.7 condition monitoring
act of measuring and recording data from operating parameters, using either human senses or instrumentation, to verify plant and equipment condition and trends

3.8 corrective maintenance
maintenance carried out after fault recognition and intended to put an item into a state in which it can perform a required function

[BS EN 13306:2010, **7.5**]

3.9 critical environment
area or location that, in the event of its non-availability, would have a significant negative impact upon business processes and activities

3.10 element
functional part of a building or other facility

3.11 facilities maintenance
work needed to maintain the performance of the building structure, fabric and components, and engineering installations

3.12 facility
tangible asset that supports an organization

[BS EN 15221-1:2006, **2.6**]

3.13 facility asset performance
requirements in terms of measurable outcomes to meeting organizational goals

3.14 maintenance management
process of ensuring that the most effective and efficient maintenance programme is formulated and delivered to ensure that assets continue to perform their intended function

3.15 maintenance manual
technical instructions intended to preserve an item in, or restore it to, a state in which it can perform a required function

[BS EN 13460:2009, **5.3**]

3.16 maintenance plan
structured and documented set of tasks that include the activities, procedures, resources and the time scale required to carry out maintenance

[BS EN 13306:2010, **2.5**]

3.17 maintenance policy
scope and course of action taken to achieve an organization's objectives

NOTE This can include requirements related to regulations and standards to be observed during maintenance.

3.18 maintenance programme
arrangement of maintenance tasks in terms of their sequence, durations and resource requirements

3.19 maintenance strategy
statement of organizational approach to maintenance management

3.20 operational plan
organization's statement of actions intended to achieve a specific business goal(s)

3.21 planned preventive maintenance
maintenance organized and carried out with forethought, control and the use of records to a plan based on the results of condition surveys

3.22 reliability centred maintenance (RCM)
systems-based methodology used to determine maintenance tasks required to ensure that a facility asset or system continues to function in order to fulfil its purpose as designed in its present operating context

4 Facilities maintenance

4.1 General

*COMMENTARY ON **4.1***

A well-defined facilities maintenance strategy supports the organization's goals, whereas, a poorly defined or absent strategy could have significant adverse safety and commercial consequences for an organization. The effectiveness of an organization to fulfil its environmental and social responsibility commitments and targets is also dependent upon an effective maintenance strategy. Since targets are subject to revision and are progressive, a static maintenance arrangement is unlikely to meet the developing needs of the organization. A review process is particularly important as changes, for example, to health and safety can impact the way in which maintenance is undertaken.

An organization should formulate a facilities maintenance strategy and policy that meets its current and likely future needs. The strategy and policy should be reviewed, at least annually, to ensure that it continues to be aligned to the organization's core business and primary processes (see **8.1**). An organization should ensure that the needs of its stakeholders are identified and the impact of those needs is assessed and taken into account when formulating the strategy and policy. A communication plan to disseminate the strategy and policy, as well as tactical and operational actions, to stakeholders should be prepared by the organization. Details of annual, or more frequent, reviews to check on the alignment between actions and the organization's facilities maintenance strategy should be included in the plan.

NOTE 1 BS ISO 55001 [1)] *gives guidance of the high level approach to the maintenance of assets, including those related to constructed facilities. BS 8544* [1)] *provides guidance on the life cycle costing of maintenance.*

Where a new facility is being procured, the organization should ensure that operational requirements, including those concerning maintenance, are taken into account during design briefing.

NOTE 2 BS 8536 gives recommendations on an appropriate approach for organizations and their designers.

4.2 Maintenance strategy

*NOTE Facilities maintenance strategies can embody different methods of maintenance, e.g. corrective, preventive, condition-based or a combination of these and other methods (see Clause **6** and Annex A).*

The facilities maintenance strategy should define the criteria by which an appropriate method or combination of methods of maintenance can be assessed (see Clause **6** and Annex A). This strategy should form an integral part of the organization's facilities management strategy. Where no facilities management strategy exists, such a strategy should be prepared to support the organization's core business and primary processes (see BS EN 15221-5).

4.3 Maintenance policy

4.3.1 General

*COMMENTARY ON **4.3.1***

Facility assets need to be maintained to ensure that:

a) they are suitable for their intended purpose;

b) they continue to perform their function throughout their useful life in a safe and efficient way;

c) their value is protected.

Ignoring maintenance risks the failure of systems and components and incurs needless additional cost, as well as threatening business continuity. Lack of maintenance can arise, in part, from a belief that a facility is a long-lived asset that deteriorates gradually. Even so, failure to maintain the structure and fabric can affect its function and presents safety risks in addition to reducing the value of the facility as an asset.

[1)] In preparation.

Requirements for the health and safety of persons in and around a facility, coupled with the need to discharge the responsibilities of ownership, mean that an organization would benefit from adopting a proactive approach to its facilities maintenance management. The maintenance requirements of a facility are, to a large extent, a consequence of its original design and construction. Inefficient design, inappropriate specifications and poor quality work can result in faults that are subsequently difficult and expensive to diagnose and remedy. Inappropriate maintenance and repairs amount to unnecessary cost and inconvenience, which can be compounded by further attempts to remedy faults.

A policy should be developed to support the preparation of operational plans in accordance with the maintenance strategy. The policy should outline the scope (see **4.3.2**) and course(s) of action that should be taken to achieve an organization's goals (see **4.1**). Organizations should ensure that suitable expertise is available for maintenance and its management at all levels within the organization. Where this expertise is not available in an organization, external resources should be employed instead. Persons responsible for managing the maintenance of facilities, including engineering installations, should possess appropriate management ability and technical competence.

4.3.2 Scope of policy

The maintenance policy should embody the principle of best value for money (see BS 8572) to protect both the asset value and the resource value of the facility. The policy should cover:

a) the organization's anticipated future requirements for the facility, taking into account the facility's physical performance and functional suitability, for example:

   1) the use of the facility, i.e. anticipating likely upgrades and the effect on the life cycles of existing materials, components and engineering installations;

   2) a change of use for the facility and the effect of any conversion work on the life cycles of existing materials, components and engineering installations;

   3) the anticipated date of conversion, renovation or refurbishment work;

b) any cycles of maintenance determined in accordance with a);

c) the method of maintenance, taking account of cycles of maintenance [see b)] together with the requirements of the organization with respect to the use of the facility and any special requirements to which this might give rise;

d) holding spare parts and other items to replace those that are beyond repair or which have exceeded their useful life (see **9.7.6**);

e) the means for reporting on performance achieved.

4.4 Permits and approvals

NOTE 1 A permit-to-work is a formal system that states, in precise terms, the work to be done and when, and which parts of it are safe. A permit-to-work is a means of communication between site management, plant supervisors and operators, and those carrying out the work. It helps in coordinating different work activities to avoid conflicts. Guidance is given in HSE "Guidance on permit-to-work systems" [1]; while focusing on the petroleum, chemical and allied industries, it is still applicable.

An organization should determine the extent to which permits and approvals apply to maintenance work. A risk assessment should be carried out to determine the need for a safe system of work or permit-to-work. Safety should be checked at each stage.

NOTE 2 This anticipates the likelihood of changes to normal operations over the lifetime of the facility as an organization responds to different business objectives and drivers.

4.5 Procurement of maintenance-related services

*COMMENTARY ON **4.5***

One of the functions of maintenance management is to determine which procurement option, or combination of options, for the delivery of maintenance-related services best fits the core business and primary processes of an organization. It is important for organizations to understand the full maintenance requirements and the capability and capacity required to deliver these services.

An organization should define its procedures on the procurement of maintenance-related services in accordance with BS 8572, collaborative business arrangements [see BS 11000 (both parts)] and the preparation of facility management agreements (see BS EN 15221-2).

5 Facilities maintenance planning

5.1 General

Maintenance plans should be driven by and support the intended outcomes stated in the facilities maintenance strategy and should be fully aligned with them.

Maintenance plans should be prepared in consultation with stakeholders, taking account of the following as a minimum:

a) the organization's requirements for production and operational demands and constraints;

b) the organization's financial circumstances and/or taxation position;

c) feedback data on maintenance outcomes, including associated costs.

NOTE An organization might find it beneficial to implement an annual programme of maintenance that takes into account climate, seasonal changes and conditions, physical environment, business continuity and occupant requirements.

Multi-year programmes of maintenance should be put in place where appropriate, i.e. for long-term planning, finance or other expediency. Programmes should state a review date for assessing progress and performance (see Clause **8**).

When formulating maintenance plans, a number of maintenance methods should be evaluated (see Clause **6**). The links between the selected maintenance method(s), maintenance performance, facility asset performance and service delivery (see Clause **8**) should be established through metrics, e.g. key performance indicators (KPIs), based on a practical and effective maintenance process.

5.2 Assessment of maintenance planning

An organization should assess the benefits of maintenance planning, basing the assessment on the following:

a) its contribution to the organization's goals;

b) the satisfaction of stakeholder interests;

c) the effectiveness of the facility in supporting the organization's operational plans;

d) the availability and reliability of the facility at minimal cost;

e) capital and tax planning;

f) asset management strategy;

g) the protection of the value of facility assets;

h) the provision of data on facility asset performance;

i) the provision of data for maintenance benchmarking;

j) the provision of data for continual process improvement;

k) the provision of data on environmental performance;

l) the basis for service life planning (see BS ISO 15686-1 and BS ISO 15686-2);

m) the contribution to energy management;

n) the contribution to business continuity management (see BS 25999-1:2006*);*

o) the basis for service level agreements;

p) the transparency and sound governance in financial reporting;

q) the identified security risks;

r) the awareness environmental sustainability;

s) the improvement of outsourcing and collaboration agreements;

t) the contribution to the facilities management strategy;

u) the contribution to total quality management;

v) the contribution to procurement and supply chain management.

5.3 Service life planning

Maintenance plans should be devised to ensure that the service life of facility assets matches or, where desirable, exceeds their design life.

NOTE Further guidance on service life planning is given in BS ISO 15686-1 and BS ISO 15686-10.

5.4 Facility assets and maintenance resources

A facility, and the individual assets that it comprises, should be maintained to deliver the most effective outcomes in terms of minimal cost and risk. Assets should be classified into risk categories, e.g. small, medium, severe and critical, according to their potential impact on the core business of the organization in the event of failure in performance. The condition of assets should be determined and a decision made as to the most effective option for their maintenance (see Clause **6**).

A maintenance resource plan should be prepared for assets operating under normal (operating) conditions. This plan should be modified, where necessary, to reflect operating conditions within the facility that fall outside specified design requirements and/or tolerances. The plan should be capable of aligning with changes in demand for, or modes of, service delivery. For an existing facility, a condition assessment of the assets should be undertaken before preparing the maintenance resource plan, wherever practicable. The cost of implementing the plan should be estimated and adequate provision made within budgets. Once implemented, the plan should be monitored for effectiveness and performance, with adjustments made where appropriate to ensure that the requirements set out are met.

NOTE 1 Where the condition of the facility is unknown or incomplete, one option for the organization might be to implement condition-based maintenance (see Annex A).

An organization should align its service needs, including service dependency, utilization, location, capacity and functionality, and maintenance planning with the required level of facility asset performance. Where a new facility is being procured, an organization should ensure that adequate provision is made during the design and construction phases to incorporate these requirements.

NOTE 2 BS 8536 gives recommendations on an appropriate approach for organizations and their designers.

Maintenance should be planned to take account of the maintenance cycle of each element/sub-element and inspections should be made at regular intervals (as determined by the properties of each element/sub-element and its anticipated service life). An organization's production and operational requirements should be integrated into the maintenance plan. Annual programmes of maintenance should take into account subsequent years' programmes so that additional costs or abortive works are minimized. Decisions to replace or repair components should be taken after due consideration of whole-life costs.

NOTE 3 BS 8544 [2)] *provides guidance on the life cycle costing of maintenance.*

5.5 Maintenance planning process

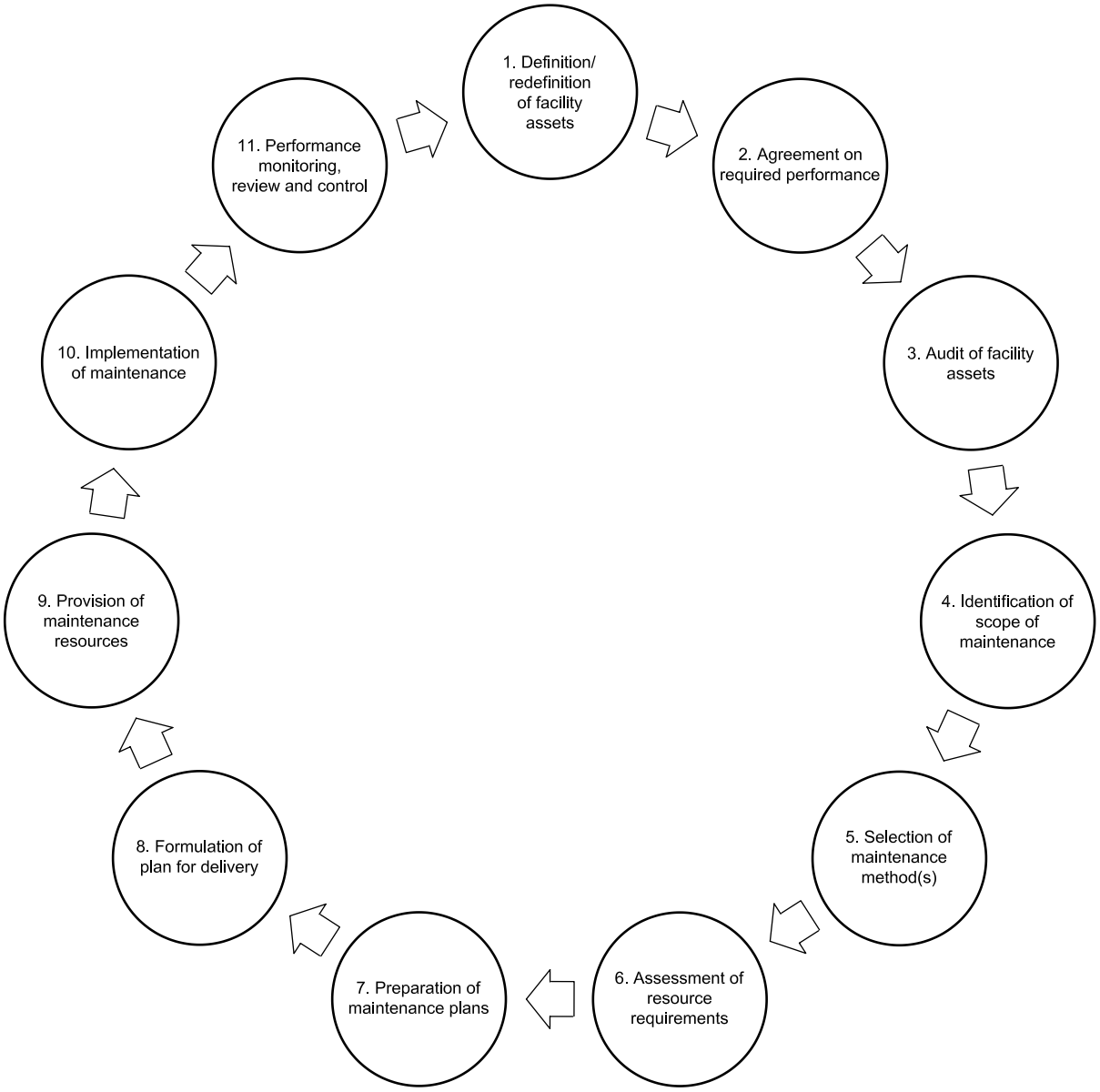
Maintenance planning should be carried out as follows (see Figure 1):

1) the facility assets required to support the core business and the delivery of services should be defined;
2) the required level of facility asset performance, including performance indicators, should be agreed;
3) the condition and sufficiency of facility assets for their intended purpose should be audited;
4) the scope of the maintenance required should be identified through gap analysis;
5) an appropriate maintenance method from those available should be selected;
6) the resources required for the chosen maintenance method should be assessed;
7) maintenance plans and budgets should be prepared to cover the required scope of services over the short, medium and long term;
8) a tactical plan for delivery of maintenance should be formulated;
9) the resources to deliver the scope of maintenance should be provided;
10) maintenance plans and programmes of work should be implemented;
11) performance monitoring, review and control of maintenance plans and programmes of work should be carried out.

Information and data gathered from this process should be used to re-inform the organization's need for, and use of, facility assets during this, and any future iterations, of this process.

[2)] In preparation.

Figure 1 **Maintenance planning process**



NOTE The cycle that this figure represents could begin again at a time or at a frequency to be determined by the organization having regard to the extent, complexity and condition of facility assets.

5.6 Maintenance costs and finance

*COMMENTARY ON **5.6***

Financial control is an important aspect of maintenance management; this ensures that maintenance proposals justify the funds requested and that organizations obtain best value for money.

A maintenance strategy, and its associated maintenance programme(s), should include estimates of the cost of known work and provision for work that might be required but where the extent is unknown. These estimates should be used as the basis for preparing budgets for maintenance in line with an organization's overall financial planning and management accounting requirements. Budgets should include, but are not limited to, repair/replace decisions, the optimization of planned preventive maintenance, surveying/inspection costs and whole-life costs. Budget proposals should be presented in a way that identifies:

a) the impact on capital value;

b) the costs and benefits that accrue from the funds required;

c) the risks and associated costs of not carrying out maintenance programmes in accordance with the maintenance strategy;

d) the costs and benefits of repair against refurbishment and against replacement and the basis of calculation, e.g. net present value (NPV).

NOTE 1 BS 8544 [3)] *provides guidance on the life cycle costing of maintenance.*

Proposed budgets should align with any planned future facility and/or property portfolio decisions such as mergers, disposals and relocations.

NOTE 2 Financial considerations include decisions regarding optimal repair reaction times and the choice of the most appropriate method of execution: in-house, outsourced or co-sourced. This leads to the need for budgetary control during the course of each financial year over which maintenance programmes extend.

In the case of outsourced contracts, the contract sums and the costs associated with the management of the contracts, should be prepared (see BS 8572).

An audit should be carried out in each financial year to ascertain the extent to which best value for money has been obtained from the funds expended in the previous year on maintenance and to determine if any changes are needed to improve value for money. The extent to which maintenance has provided any operational benefits for an organization should also be determined. This information should be used to inform decisions on budgets for subsequent maintenance plans and programmes.

6 Maintenance methods

An organization should determine which method or combination of methods best satisfies its operational needs in maintenance in accordance with its facilities maintenance strategy (see **4.2**) and policy (see **4.3**). Each method should be assessed in terms of the extent to which it satisfies (or does not satisfy) the criteria defined as part of the facilities maintenance strategy (see **4.2**). When taking into account asset criticality and monitoring capacity within the facility, the benefit of combining methods should be evaluated.

NOTE Annex A gives details on different types of maintenance methods.

7 Factors affecting maintenance

7.1 Health and safety

7.1.1 General

*COMMENTARY ON **7.1.1***

The health and safety information given in this clause is intended as guidance for those who have to incorporate occupational health and safety (OH&S) management within their facilities maintenance management. For a more comprehensive overview, see BS OHSAS 18001, BS OHSAS 18002 and BS 18004. The latter standard has been used as the primary basis for the occupational health and safety guidance provided in this British Standard.

The management of occupational health and safety should be viewed as an integral component of facilities maintenance management and not as a separate function or as an add-on.

[3)] In preparation.

An organization should assess risks and other hazards at all stages in a facility's life cycle. Identified risks should be monitored and, wherever possible, their potential impacts should be mitigated. An organization should implement a formal system of risk management, including establishing and maintaining a risk register. Periodic reassessment of risks should be undertaken to update the risk register and associated risk mitigation.

NOTE Attention is drawn to legislation affecting health and safety in the workplace, in particular the need for risk assessment, which includes but is not limited to the following:

- *The Control of Asbestos Regulations 2012 [2];*
- *The Control of Noise at Work Regulations 2005 [3];*
- *The Control of Substances Hazardous to Health Regulations 2002 [4];*
- *The Health and Safety at Work etc. Act 1974 (Application to Environmentally Hazardous Substances) Regulations 1996 [5];*
- *The Health and Safety (Display Screen Equipment) Regulations 1992 [6];*
- *The Management of Health and Safety at Work Regulations 1999 [7];*
- *The Manual Handling Operations Regulations 1992 [8];*
- *The Regulatory Reform (Fire Safety) Order 2005 [9].*

7.1.2 Initial review

An initial review should be undertaken to provide information on the appropriateness, efficiency and effectiveness of existing health and safety management systems. Where no formal, or a minimal, health and safety management system exists (such as when an organization is newly established or when carrying out new activities) the initial review should be used as a base from which to develop a new system.

7.1.3 Risk control and corrective actions

An organization should implement risk control, as an integral part of its risk management, to ensure that control measures remain in place and that they remain efficient and effective. The risk management system should allow, as a minimum, for the following:

a) identification of health and safety hazards arising from maintenance and other work determined by workplace inspections, behavioural observations, safety tours, and formal and informal discussions with the workforce;

b) identification of people who might be at risk from maintenance, e.g. maintenance personnel, occupants, visitors, passers-by and trespassers;

c) evaluation of the risks to which individuals and/or an organization might be exposed;

d) devising ways to eliminate, reduce and/or control risks, e.g. guarding and fencing, method statements, safe systems of work, permit-to-work, training and supervision;

e) monitoring and recording the effectiveness of risk control measures and systems, e.g. inspections, observations, safety tours and checklists;

f) taking coordinated corrective action;

g) providing feedback to the workforce and other stakeholders;

h) training, together with health and safety checks, of operatives;

i) auditing and reviewing the system and, therefore, health and safety performance.

The use of access equipment should be assessed to maximize the benefits of its use and to optimize the overall cost of maintenance; this should take into account future requirements for access that might arise on multi-year programmes of maintenance. The longer term implications of providing access, particularly the equipment required for this purpose, should be evaluated and permanent means of access should be used where possible.

NOTE Some maintenance can require access to be provided over and above that needed for the day-to-day operation of the facility. Repeated cycles of equipment erection and dismantling can add to the risks faced by operatives engaged in this work as well as adding needlessly to maintenance costs.

7.2 Environmental factors

7.2.1 External

*COMMENTARY ON **7.2.1***

Air is liable to various forms of contamination. Near the coast, it can contain significant salt-bearing water vapour with consequential corrosion for iron and steel and deleterious effects on other materials. The effects of industrial pollution can cause carbonation of mortar, which can have an adverse impact on embedded metals, even in rural areas.

The main structures of facilities are normally unaffected by wind, however, damage to external cladding can sometimes occur. This can vary from displaced roofing tiles to more extensive damage caused by freak weather conditions. Tall structures and those in exposed positions are more at risk, but there are places where unexpected wind conditions exist in otherwise sheltered locations. In cases where damage to fabric is not caused, excessive air infiltration can affect the interior environment and impair control of engineering installations. Wind conditions, for example near tall structures or groups of buildings, could result in precautions becoming necessary to prevent rain penetration and resultant damage.

Different forms of precipitation influence the maintenance needs of a facility. Rain by itself normally has no deleterious effect but when combined with wind can cause problems (see "An index of exposure to driving rain" [10] for further guidance, including a driving rain index. Additionally, rain can saturate part of the fabric causing, for example, sulphate attack or frost damage following a sharp drop in temperature.

Snow usually causes problems by blocking drainage channels, leading to water penetration in unexpected places. In the UK, hailstones rarely achieve a size that can cause actual damage, but it is not unknown. Extreme temperatures can also cause problems; the effect of thermal expansion on roofs and parapets is possible. Some external cladding can be subject to frost attack.

All of the above factors can act both singly and in combination, e.g. rain penetration can be more severe when wind driven.

An organization should assess the extent to which external environmental factors could influence the condition of the structure, fabric, engineering installations, fixtures and external finishes, and take such factors into account when drawing up maintenance plans. This should also include control of moisture.

7.2.2 Internal

*COMMENTARY ON **7.2.2***

Humidity, temperature and pollution are factors that can adversely affect the condition of the structure, fabric, engineering installations, fixtures and internal finishes. The effects of intermittent heating and condensation can be particular problems.

Industrial facilities can be subject to many different factors depending on the processes carried out within them. Other facilities can be affected by particular conditions; swimming pool structures, for example, are vulnerable to the effects of the chlorine used in the water. The maintenance requirements of facilities and their various parts are directly related to the type and intensity of use they attract; for example, a school would necessitate robust doors and door fittings in excess of the requirements for housing. Facilities that accommodate animals or vehicles need provision for potential failure in controls. Some facilities might suffer from deliberate misuse and vandalism. An important factor when considering such behaviour is that lack of repair tends to encourage further damage.

An organization should assess the extent to which internal environmental factors, as well as the performance of maintenance (see Clause **8**), influences the condition of the structure, fabric, engineering installations, fixtures and internal finishes. These factors should be taken into account when maintenance plans are drawn up. Factors that have a damaging effect on physical conditions, e.g. control of moisture, static electricity, as well as any unintended consequences for maintenance personnel, occupants and other users of the facility, should also be taken into account.

*NOTE It might be necessary to seek the assistance of a building physicist (see **3.4**) or other appropriate specialists to determine the root cause of a defect or failure where this cannot be readily or reliably diagnosed. The decision depends on the particular circumstances of each case and rests with the individual or firm responsible for inspection. Some matters, such as accurate assessment of slip resistance of floors and paving, require appropriate apparatus and experienced operators.*

7.3 Materials and components

When drawing up maintenance programmes and plans, including inspection schedules, the likely maintenance cycle of each element/sub-element (in accordance with the known quality of the materials and components employed and their manufacturers' recommendations where available) should be incorporated. The following should be included:

a) potentially hazardous materials and components such as:

   1) those containing asbestos;

   2) lead, which might be present in some paint or be used for pipes carrying potable water;

   3) materials that are either highly combustible or give off large quantities of smoke and fumes when involved in an established fire or in confined spaces (e.g. electrical risers);

   4) areas that should operate under a permit-to-work system;

b) types or methods of construction that, under certain circumstances, might become dangerous;

c) finishes and decorations, including their protection and treatment, where required.

NOTE 1 Cleaning facilities can fall within the scope of maintenance. Cleaning and good housekeeping before, during and after maintenance is a big part of achieving satisfactory performance. Poor cleaning or the use of inappropriate cleaning methods or materials can have a significant, adverse effect on the life of materials and components.

The person responsible for maintenance should coordinate closely with those responsible for cleaning.

NOTE 2 For further guidance on cleaning see BS 6270-3. Attention is drawn to The Provision and Use of Work Equipment Regulations 1998 [11].

8 Performance management

8.1 General

*COMMENTARY ON **8.1***

Performance management involves monitoring, controlling and improving the efficiency and effectiveness of facilities maintenance management and applies to both internal and outsourced arrangements. Various models, methods and tools are available to assist in the measurement of performance and in indicating where improvement is required; examples include, but are not limited to, value management, the EFQM Excellence Model [4], balanced scorecards and benchmarking (see BS EN 15521-7).

Performance management can be used as a means to foster efficient and effective working relationships between the parties of a contract or agreement relating to maintenance and/or its management, with the aim of achieving continual improvement in performance. It is not intended to be used as the basis for penalizing contractors or service providers, but instead to encourage better performance.

Requirements for performance management should be formulated as part of the facilities maintenance strategy (see **4.2**) and policy (see **4.3**) and communicated to all affected stakeholders (see **4.1**).

An organization should establish a performance management system based upon service level agreements. Where a quality management system exists, the relationship between that and the performance management system should be made clear. In such cases, information and data should be capable of being entered once into either system and should be accessible from both.

A means for measuring performance over time to indicate progress towards meeting defined objectives should be incorporated in the performance management system. This should report current and past performances to highlight where improvement has been achieved and where it has not. Performance indicators should be defined for the purpose of measuring and reporting achievement and those performance indicators that are regarded as significant among them should be defined as KPIs. A process for reviewing and, where appropriate, updating performance indicators should be established as part of a process of continual improvement.

NOTE KPIs are those that measure progress towards achieving objectives or other factors that are critical to success (see BS EN ISO 9004).

8.2 Quality control

Maintenance should ideally be inspected while it is being undertaken and immediately after completion to ensure that it complies with requirements. Records and accounts rendered for maintenance work carried out should be checked for completeness and accuracy.

NOTE Quality control is part of a much larger consideration of quality (see BS EN 15221-3 for further details).

8.3 Inspections

*COMMENTARY ON **8.3***

Maintenance is intended to ensure that the facility remains fit for purpose in terms of satisfying organizational goals. This requirement is met, in part, through an effective inspection regime and forward-looking maintenance reporting.

[4] See http://www.efqm.org.

8.3.1 General

The facility should be inspected to determine the quality of the internal environment and the condition and performance of the structure, fabric, engineering installations, fixtures and finishes. Inspection intervals should take into account the properties and anticipated service life of elements/sub-elements (see **7.2** and **7.3**).

Inspections should be carried out carefully as unrecorded dangers might exist. If any area or task is suspected of being hazardous, suitable precautions should be taken (see **7.1.3**).

NOTE Inspections might involve many types of operations and maintenance tasks, which are covered by legislation. The organization has a duty to identify a responsible person(s) for the work.

8.3.2 Frequency of inspection

Inspections should be carried out as follows:

a) routine: consultation with occupants and other users of the facility to determine the existence of any maintenance matters that might require action and, where such work has been undertaken, measurement of users' satisfaction with the outcomes;

b) general: visual inspections of the main elements carried out on an annual basis that informs an organization's budgets for maintenance programmes and other maintenance;

c) detailed: a full inspection at intervals of not more than five years.

An inspection should be carried out by using a checklist made up of facility elements/sub-elements and arranged in way that supports safe working.

8.3.3 Reporting

A maintenance report should be prepared. Information gained from inspections should be collated into two groups:

a) the degree of urgency needed to carry out repairs;

b) a comparison of maintenance plans, including work of a planned preventive nature.

Attention should be paid to the requirements defined in the maintenance policy (see **4.3.2**). Each item should be carefully assessed when postponing apparently non-urgent work so that it does not result in a major defect or failure over the longer term. The anticipated life of the facility, or any element of it, should be taken into account.

Anticipated failures and defects expected to lead to failure should be highlighted in reports. The resulting information should be arranged in three categories: those matters requiring immediate attention, those that could be placed into a maintenance programme and those which could be postponed but which should continue to be monitored and reviewed.

The maintenance report should address all maintenance requirements not covered by planned preventive maintenance for a period of five to ten years. Where contracts run over longer periods, maintenance plans may extend beyond this limit. The following points should be included, as a minimum, in the maintenance report:

1) location;

2) name of element (e.g. roof);

3) name of sub-element (e.g. roof covering – tiling);

4) existing condition (e.g. excellent, satisfactory, adequate, poor or unsafe);

5) prioritization of the element, (e.g. the redecoration of a customer-facing reception area would have a higher ranking than a storage room);

6) anticipated phasing of maintenance;

7) cost of maintenance.

9 Information management

9.1 General

Records and documents relating to the maintenance of the facility should be organized, kept up-to-date and stored in a secure environment.

NOTE 1 BS 8587 provides comprehensive guidance on the management of facility-related information and data.

The following general information should be recorded:

a) classification: the facility and its sub-divisions (i.e. rooms and other spaces) should be assigned codes according to type or use to support the management of information and data;

NOTE 2 Uniclass Table D (Facilities) [12] provides a classification that covers most types of facility. Close alignment with the Uniclass system in general offers benefits in areas such as maintenance, repair work, cost accounting and benchmarking. While intended for new facilities, adoption of the system can prepare the organization for those occasions where alteration or extension of the facility is necessary.

b) obligations under conditions of lease or occupancy (e.g. frequency of repainting);

c) statutory and insurance inspections;

d) estate terrier (records of property holdings with legal status);

e) ownership of and/or maintenance obligations of parties, separating and boundary walls;

f) rights of way, easements and wayleaves (particularly with respect to buried utilities);

g) requirements and restrictions laid down by planning, building regulation control and fire authorities including, in the case of the latter, fire risk assessments.

Elements/sub-elements of the facility should be labelled or marked, as far as is practicable, so that the materials, components, systems, plant, equipment and parts can be easily identified.

Where information is limited or lacking, records should be compiled during maintenance. Alternative (or additional) surveys or investigations should be initiated to accelerate the gathering of information for record purposes; photographic records can be of assistance in this respect.

All personnel involved in the maintenance of the facility should be made aware of the existence of records containing information about it. Hazardous areas should be marked on the records as well as marked in their physical location and should be made known to personnel, together with any system of work adopted for use in these areas.

9.2 Records and documents

9.2.1 General

A facility handbook should be prepared, which can be stored and retrieved electronically, as well as being reproduced on paper wherever necessary. The form of the handbook should be such that content can be easily updated and for versions of it to be controlled. The handbook should include the records relating to the maintenance of the facility and the documents to support the wider needs of the organization in regard to its facilities management (see BS 8587).

Records should be broadly classified according to:

a) "as built" information, which should have been prepared before the handover of the facility, such as construction details, floor plans and other perspectives showing the location of engineering installations;

b) "as subsequently altered", which need to be kept during the operational life of the facility, such as details of defects, maintenance, alterations and redecoration work.

NOTE 1 The use of digital design and drawings allows plans to be regularly updated to reflect changes to layouts and enables them to be stored in an efficient and easy-to-access manner.

A record should be kept of all reported defects and the measures taken to rectify them. Details of maintenance should also be recorded and cross-referenced to the reported defect.

NOTE 2 Photographs captioned and dated can be particularly useful when monitoring defects developing over time.

Periodic reviews of records should be made and where there are recurrences of the same defect, the causes should be investigated.

9.2.2 Building log-book and building manual

NOTE 1 Attention is drawn to the The Building Regulations 2000, Regulation 40, [13] for details on building log-books.

Where a building log-book is available, it should be incorporated into the facility handbook. Where no building log-book is available, information and data on the operation and maintenance of the facility, including measures to conserve fuel and power, should be incorporated into the facility handbook. The organization should ensure that the scope of a building log-book is satisfied by provisions made in the facility handbook.

NOTE 2 The building log-book was conceived as a single reference source for information needed to operate a building and for those with the responsibility for the building to be able to understand their obligations and duties. It summarizes design assumptions, describes engineering installations, including operational and maintenance requirements for the safe and correct use of the facility, in terms that non-specialists can follow. The intention is that the building log-book can be a dynamic document, recording the performance of the facility over time and that it covers energy performance as well as maintenance (see the "Building log book toolkit" [14]).

Where a building manual and/or building user guide has been prepared it/they should be incorporated in the facility handbook.

NOTE 3 The "Building Manuals and Building User Guides" [15] gives guidance to those responsible for creating documentation to satisfy requirements for the building log-book and building user information for the Building Research Establishment Environmental Assessment Method. Building manuals and building user guides are intended to exceed the scope of building log-books. Similarly, the facility handbook is intended to extend the scope of building manuals by considering a broader base of information and data required to manage a facility.

NOTE 4 Attention is drawn to The Building Regulations 2000, Approved document L2A [16] regarding the conservation of fuel and power in new buildings other than dwellings and building log-books.

9.2.3 Drawings

The records of the facility should include as-built and as subsequently altered drawings and contain, as a minimum, the following (see *BIP 2207* [17]):

a) a neighbourhood plan, showing the position of the facility and the site upon which it is located in relation to its surroundings;

b) the site plan, showing the facility and other structures forming the facility and external engineering installations, e.g. drainage runs and incoming public utilities;

c) general arrangement plans of each floor and the roof to a scale not normally greater than 1:50;

d) elevations and sections;

e) foundation plans and details, together with available soil investigation reports;

f) structural plans and sections, including information relating to design parameters, such as permissible superimposed loadings on floors;

g) structural details, such as structural steel connections and concrete reinforcement drawings and bending schedules; these are particularly important when prestressed or post-stressed forms of structure have been used;

h) details of the construction of external wall elements and roofs, including insulation materials and vapour barriers;

i) materials that might be injurious to health and safety;

j) location of public health (i.e. waste) systems;

k) location of essential intake and shut-off of public utilities (water, electricity, gas and telecommunications).

All drawings, including those used in design and construction, should be verified against the as-built facility. Where a discrepancy is found, full details should be recorded and, wherever practicable, the affected drawing(s) should be labelled as subsequently altered.

9.2.4 Specifications and schedules

The records of the facility should include detailed specifications of:

a) all materials incorporated, e.g. name of facing brick, mix of concrete, species and grade of timber;

b) materials with properties that could prove injurious to health and safety;

c) all plant and machinery, including manufacturers' trade literature, manuals and instructions for installation, operation and maintenance;

d) methods of work used during construction, which are unusual or atypical such as assembly of purpose-made manufactured units.

All specifications and schedules, including those used during construction work, should be verified against the as-built facility. Where a discrepancy is found, full details should be recorded and, wherever practicable, the affected specification(s) and/or schedule(s) should be labelled as subsequently altered.

9.3 Mechanical installations

Records should be kept of the following as installed:

a) the location, including level if buried, of all external connections (e.g. gas and cold water supplies) together with the points of origin and termination, size and materials of pipes, line pressure and other relevant information;

b) the layout, location and extent of all piped services showing pipe sizes, together with all valves for regulation, isolation and other purposes as well as the results of all balancing, testing and commissioning;

c) the location, identity, size and details of all apparatus and control equipment served by, or associated with, each of the various piped services together with copies of any test certificates for such apparatus where appropriate;

NOTE 1 The information for size and details may be presented in schedule form.

d) the layout, location and extent of all air ducts showing dampers and other equipment, acoustic silencers, grilles, diffusers or other terminal components. Each duct and each terminal component should be marked with its size, the air quantity flowing and other relevant balancing data;

e) the location and identity of each room or space housing plant, machinery or apparatus.

Drawings should record the following as installed:

1) detailed general arrangements of boiler houses, machinery spaces, air handling plants, tank rooms and other plant or apparatus, including the location, identity, size and rating of each apparatus;

NOTE 2 The information for the size and rating may be presented in schedule form.

2) isometric or diagrammatic views of boiler houses, plant rooms, tank rooms and similar rooms or spaces housing plant, machinery or apparatus, including valve identification charts. A copy of such drawings should be framed and mounted on the wall of the appropriate room or space;

3) comprehensive diagrams that show power wiring and control wiring and/or pneumatic or other control piping, including size, type or conductor or piping used, identifying the terminal points of each.

All records and drawings, including those used during construction work, should be verified against the as-built facility. Where a discrepancy is found, full details should be recorded and, wherever practicable, the affected records(s) and/or drawing(s) should be labelled as subsequently altered.

9.4 Electrical installations

Records should be kept of the following as installed:

a) main and sub-main cables, showing origin, route, termination, size and type of each cable. Cables providing supplies to specialist equipment, for example data centre equipment, should be identified separately;

b) lighting conduits and final sub-circuit cables, showing origin, route, termination and size of each, together with the number and size of cables within each conduit. The drawings should indicate, for each conduit or

cable, whether it is run on the surface or concealed, for example in a wall chase, in a floor screed, cast in situ or above a false ceiling. These drawings should also indicate the locations of lighting fittings, distribution boards, switches, draw-in-boxes and point boxes, and should indicate circuitry;

c) details of secondary power sources for inclusion in a safe systems of work regime;

d) location and purpose of each emergency lighting fitting, including an indication of the circuit to which it is connected;

e) single and three-phase power conduits and final sub-circuit cables showing locations of power distribution boards, motors, isolators, starters, remote control units, socket outlets and other associated equipment;

f) other miscellaneous equipment, conduits and cables;

g) lightning conductor air terminals, conductors, earth electrodes and test clamps;

h) location of earth tapes, earth electrodes and test points other than those in g), cables providing earth circuits for specialist equipment should be identified separately.

Records should also include, where applicable:

1) distribution diagrams or schedules to show size, type and length (to within 1 m) of each main and sub-main cable, together with the measured earth continuity resistance of each;

2) schedule of lighting fittings installed stating location, manufacturer and type or catalogue number together with the type or manufacturer's reference, voltage and wattage of the lamp installed;

3) schedule of escape and emergency lighting fittings installed stating location, manufacturer, type or catalogue number together with the type or manufacturer's reference, voltage and wattage of the lamp installed. For battery systems, the position of the battery, its ampere-hour rating and battery system rated endurance in hours should be stated;

4) records of smoke detectors, sprinklers and fire precautions generally (see **9.5**), as well as security precautions;

5) incoming supply details including the type of system, voltage, phases, frequency, rated current and short circuit level, with the details of the supply protection and time of operation as appropriate;

6) main switchgear details which, for purpose-made equipment, should include a set of manufacturers' drawings and the site layout;

7) transformer, capacitor and power plant details. e.g. in the case of transformers, the volt-ampere rating, voltages and type of cooling;

8) completion certificate in accordance with BS 7671.

All records and drawings, including those used during construction work, should be verified against the as-built facility. Where a discrepancy is found, full details should be recorded and, wherever practicable, the affected record(s) and/or drawing(s) should be labelled as subsequently altered.

9.5 Fire protection

Records should be kept of the following:

a) description of fire detection and fire alarm system;

b) details of any fire suppression systems, e.g. sprinkler, inert gas or chemical agent installations;

c) location and servicing arrangements of all fire alarm and call points;

d) location and servicing arrangements of all risers, hose reels, extinguishers and any other fire-fighting equipment;

e) location of all fire compartment walls, doors, floors and screens;

f) location of all areas of exceptional fire hazard;

g) fire escape routes;

h) details of the application of any fire protection treatment, for example the use of intumescent materials;

i) location, details and description of any installation for smoke control or protection of escape routes, e.g. pressurization of lobbies and staircases;

j) details of any master key system;

k) names, home addresses and telephone numbers of key holders, which should be kept up-to-date and should be lodged with the fire and police authorities.

All records, including those used during construction work, should be verified against the as-built facility. Where a discrepancy is found, full details should be recorded and, wherever practicable, the affected record(s) should be labelled as subsequently altered.

NOTE Attention is drawn to The Regulatory Reform (Fire Safety) Order 2005 [9] relating to fire risk reduction and fire prevention and to BS 5839-1. Under The Regulatory Reform (Fire Safety) Order 2005 [9] and The Fire (Scotland) Act 2005 [18], those who have a degree of control over the premises (or certain areas on the premises) might be designated as the "responsible person", for example, the owner, an agent, an employee or the occupier.

9.6 Building management system

Where a BMS or equivalent arrangement exists for monitoring and controlling mechanical, electrical or other engineering installations, an organization should ensure that the requirements for the maintenance of the BMS are fully incorporated into maintenance programmes. In the event of actuator failures or other faults, corrective actions should be initiated with minimal delay.

*NOTE The "Effective BMS – A guide to improving system performance" [19] provides guidance on improving the effectiveness of a BMS. A BMS can help to reduce energy consumption and CO_2 emissions, improve occupant comfort, operate engineering installations more efficiently and transfer data to other systems such as those for maintenance management (see **9.9**).*

9.7 Manuals, registers and inventories

9.7.1 General

*COMMENTARY ON **9.7.1***

Whether an organization is responsible for the maintenance of a number of facilities or a single facility, the preparation of a manual tailored to suit each facility can offer significant advantages in terms of providing a clear statement of intentions and required actions.

An organization's procedures for undertaking maintenance should be formalized in a maintenance manual or manuals. The manual may form part of wider documentation covering operational plans and arrangements; where this is the case, all such documentation should be incorporated in the facility handbook (see **9.2.1**).

In the event of a change of organization or maintenance advisor, an up-to-date manual and/or facility handbook should ensure continuity of maintenance. Copies of maintenance manuals should be held by the organization and any maintenance advisor if appointed.

9.7.2 Structure of maintenance manual

The maintenance manual should be prepared in two parts: the first part should be addressed to the organization; and the second part should be addressed to those responsible for inspecting the facility and reporting to and advising the organization.

9.7.2.1 General particulars

The first part of the manual should:

a) recommend intervals between:

   1) routine, general and detailed inspections (see **8.3.2**);

   2) inspection and maintenance of each engineering installation and items of special equipment;

   3) maintenance of items which, as recommended by their manufacturers, require regular attention to preserve satisfactory performance, e.g. the lubrication and adjustment of moving parts in component assemblies and systems;

   4) other periodic work as experience in use shows to be necessary, e.g. the clearing of gutters, downpipes or surface water gullies;

b) draw attention to the need to ensure that a facility's provisions for means of escape in the event of fire, i.e. fire resisting self-closing doors and exit hatches, are in satisfactory working order at all times, including those periods during which any maintenance is being undertaken;

c) draw attention to critical environments, including special arrangements for gaining access for the purpose of inspections or when undertaking maintenance;

d) specify proprietary maintenance materials, e.g. floor sealers and polishes likely to offer acceptable service and slip resistance;

e) set out the names, addresses and other contact details of firms responsible for the following:

   1) inspecting, reporting and advising on the condition of the building fabric;

   2) emergency repairs to the building fabric;

   3) servicing and emergency repairs for each engineering installation and items of special equipment.

9.7.2.2 Guidance

The second part of the manual should:

a) consist mainly of selected, concise information, abstracted from the facility handbook, and likely to be needed during inspections; this information should be ordered in the sequence in which examination is likely to be carried out;

b) schedule those materials and components that experience shows to be prone to failure and/or to require special attention.

NOTE Advice on the preparation of manuals can be found in BS 4884-2, BS 8587 (especially in regard to the facility handbook) and BS EN 15331.

9.7.3 Updating of manual

The maintenance manual should be reviewed annually and updated where necessary to reflect changes in legislation as well as current circumstances and arrangements. When changes occur to facilities, or where new information becomes available, all copies of the maintenance manual should be revised accordingly, irrespective of whether it is self-standing or forms an integral part of the facility handbook.

9.7.4 Asset register

An organization should include other information and data as might be necessary in the form of a register of its facility assets, for example:

a) identification number or unique reference for the asset;

b) make and/or model;

c) manufacturer;

d) vendor, if different to manufacturer;

e) date of manufacture;

f) date of acquisition, installation or completion of construction;

g) location of asset;

h) whether or not access equipment is required;

i) whether or not the asset is subject to a permit-to-work requirement

j) initial cost;

k) predicted lifetime;

l) specification;

m) replacement cycle;

n) cost breakdown;

o) servicing requirements, including type and frequency of service;

p) other maintenance required;

q) maintenance costs;

r) accumulated depreciation;

s) written-down value;

t) source of components and spare parts, where applicable (see **9.7.6**);

u) energy consumption and, where applicable, energy-efficiency rating;

v) identification of hazardous or other risks to people or property.

9.7.5 Engineering installations

Information describing the facility's engineering installations should be recorded (see **9.3**, **9.4** and **9.5**). Details should include points of entry, or termination, of public utilities.

An organization should stipulate the maintenance requirements for its mechanical and electrical installations and fire protection systems; the tasks to be carried out and their frequency should be included. The following attributes of major components should be taken into account:

a) current condition;

b) current utilization or output;

c) maintenance tasks to be performed;

d) frequency of maintenance;

e) estimated cost of maintenance.

NOTE Attention is drawn to the "Standard Maintenance Specification for Building Services" – SFG 20 [20], which covers the management, specification and delivery of engineering maintenance. This standard is useful when framing tendering requirements and, later, during operation and use when benchmarking the costs of service provision. The standard specifies tasks that need to be performed and the frequency of those tasks to keep engineering installations in the best operational condition.

9.7.6 Warranties, repairs and spare parts

Details of warranties relating to plant, equipment, components and systems should be recorded and cross-referenced to those operational and maintenance requirements that affect them. Details of repairs should be recorded against the respective item. A list of spare parts should be kept up-to-date. Details should include the following as a minimum:

a) description of part;

b) identification number or unique reference for the part;

c) original manufacturer of part;

d) contact details of current manufacturer and/or distributor;

e) predicted lifetime of part;

f) operational parameters affecting lifetime of part;

g) minimum number of parts to be held in stock (within or near to the facility);

h) where permissible, details of any alternative part and its source;

i) availability and minimum delivery period;

j) warranty period;

k) estimated cost of part;

l) transportation and logistical considerations;

m) details of other parts potentially affected by failure and/or replacement;

n) specialist equipment or tools required;

o) specific competence required;

p) details of special conditions or arrangements when installing.

The details given in a) to p) are, in effect, an inventory that should be kept up-to-date if the organization is to minimize disruption and/or loss of business continuity in the event of a breakdown or failure.

An organization should determine its policy on the holding of spare parts (see **4.3.2**).

9.8 Storage and security of records

9.8.1 General

An organization should keep records in a safe and secure location and arrange them in such a way as to enable their rapid retrieval. Records of personnel permitted to access the records and any requirements or conditions attaching thereto should be defined. Duplicate records should be kept in a physically separate and secure environment.

NOTE Attention should be paid to The Data Protection Act 1998 [21].

9.8.2 Storage

The place for storage of records should take into account the form of the records, the media used and the conditions necessary to keep them from damage of any kind; they should also be readily accessible. Backup or duplicate records (electronic and paper-based) should be kept in a secure place in a location other than the facility to which they relate. Both sets should be kept up-to-date.

9.8.3 Security

Measures taken to ensure security should be recorded and a copy should be held in a secure location away from the facility to which they relate. The following records should be kept up-to-date and be readily accessible to authorized personnel when required, which might be at short notice and outside normal working hours:

a) names, home addresses and telephone numbers of key holders;

b) details of master key system;

c) details of intruder alarms and other security systems.

NOTE Attention is drawn to BS ISO/IEC 17799 and BS 5839-1.

9.9 Maintenance management system

An organization should review its requirements for data systems, basic ICT facilities and extended services necessary to support its maintenance management. The use of a CAFM or a CMMS as a means for managing facility-related maintenance information should be evaluated. The following features are likely to provide a suitable basis.

a) budgetary and other financial controls;

b) cost accounting;

c) asset register;

d) condition-based monitoring of assets;

e) early detection of problems and rapid fault reporting;

f) operational plans, including frequency of functions or activities performed;

g) risk and hazard assessment;

h) permits-to-work;

i) personal protective equipment issued and returned;

j) planned preventive maintenance;

k) reactive maintenance;

l) change management;

m) job orders and other requisitions for goods and services;

n) job logging, prioritization and tracking, including details of backlogs;

o) energy use and carbon dioxide equivalent (CO_2-eq) emitted per annum;

p) resource consumption and productivity measures;

q) analysis of work undertaken to identify trends;

r) space planning and space utilization;

s) workstation location and furniture management;

t) performance indicators for the delivery of services;

u) end-user experiences of services delivered;

v) audit trail of system transactions;

w) exception reporting for management purposes.

NOTE Attention is drawn to PAS 700.

Annex A (informative) Maintenance methods

A.1 General

There are a number of methods of maintenance; these can be grouped into three broad categories: planned maintenance (see **A.2**), which includes planned preventive maintenance and shutdown maintenance; preventive maintenance (see **A.3**), which includes condition-based maintenance, reliability centred maintenance (RCM) and total productive maintenance (TPM); and unplanned maintenance (see **A.4**), which includes corrective maintenance, breakdown maintenance and emergency maintenance. Not all of them are suitable, although they can serve as the basis for exploring options.

*NOTE "CIBSE Guide M" [22] gives further details and definitions of the methods given in **A.2**, **A.3** and **A.4**.*

A.2 Planned maintenance

A.2.1 Planned preventive maintenance

This method allows maintenance activities to be organized and carried out with forethought, control and records to a predetermined plan, based on the results of condition surveys. This method aims to avoid or to mitigate the "consequences of failure" and to minimize maintenance-induced failures and their associated costs. It is based on the criticality of failure to the organization and is also known as scheduled maintenance.

A.2.2 Planned shutdown maintenance

This method is normally used for continuous process production and manufacturing facilities, where a detailed plan is produced for all assets for work to be carried out during a total shutdown.

A.3 Preventive maintenance

A.3.1 Condition-based maintenance

This method to maintenance is based on the results of condition monitoring of plant, equipment, systems and elements to avoid loss of function or failure. Condition-based maintenance is performed by selecting and monitoring a parameter which, for example, indicates plant condition. Data are collected and analysed and required maintenance is determined from the findings. This work can be carried out periodically or in real time and is often used for remotely monitoring plant condition.

NOTE An evaluation of engineering installations, including an introduction into its use as a facility maintenance strategy and details of the main parameters that are used in monitoring the condition of installations, is covered by BSRIA's "Condition Based Maintenance" [23].

A.3.2 Reliability centred maintenance

Reliability centred maintenance is a systems-based method used to determine maintenance tasks needed to ensure that a facility asset or system continues to function in order to fulfil its purpose as designed in its present operating context. The method can involve the implementation of asset condition monitoring, based on the advance provision of an asset register (see **9.7.4**).

NOTE Further details on RCM can be found in BS EN 60300-3-11.

A.3.3 Total productive maintenance

Total productive maintenance is a systematic approach to improving maintenance effectiveness, which operates at the tactical level and normally builds on the successful implementation of strategic methods such as RCM (see **A.3.2**). The method also involves the implementation of asset condition monitoring, based on the advance provision of an asset register (see **9.7.4**).

A.4 Unplanned maintenance

A.4.1 Corrective maintenance

Maintenance initiated as a result of the observed or measured condition of plant, equipment, systems, elements, before or after a functional failure, can be used to resolve the problem and ensure correct functional performance. This work could be planned or unplanned.

A.4.2 Breakdown maintenance

Breakdown maintenance relates to the task of restoring an asset so that it can fulfil its original function after failure. This method might result in high replacement costs over the lifetime of the asset, but has a low initial maintenance resource requirement. It is sometimes used for simple facilities that have few operatives and no critical environments to support.

A.4.3 Emergency maintenance

This maintenance method results from a sudden, unforeseen occurrence requiring immediate corrective work to be carried out to restore to function and to avoid potentially serious consequences.

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