In this topic guide you will learn about project close-out activities and the different considerations that need to be taken into account when handing over completed building services engineering projects.

This topic guide will cover end-of-project processes, including:

- commissioning procedures
- preparing and completing relevant documentation
- removal of plant and equipment from site
- handover procedures.
1 Commissioning procedures

Engagement of commissioning specialists

It is usual on large building services engineering projects for the final commissioning of the installed air, water and heating/cooling systems to be set up for system user operation by a team of expert commissioning specialists. This section contains a summary of the typical processes and procedures for the commissioning of air and water systems.

Whether system commissioning is completed by the contractor’s own personnel or by external experts, the process followed should be identical and fully in accordance with the appropriate industry regulations and codes of practice.

For building services engineering systems, the key guidance documents in relation to system commissioning are either the CIBSE or BSRIA commissioning codes. Details of these guides can be found at:

www.cibse.org
www.bsria.co.uk/information-membership/bookshop/publication/commissioning-air-systems/.

In addition to the CIBSE and BSRIA guides, the commissioning of gas systems (appliances and supply pipework) must be done in accordance with the appropriate Institution of Gas Engineers and Managers (IGEM) codes of practice (e.g. IGE/UP/10, IGE/UP/1A). Electrical installations must be commissioned in accordance with appropriate electrical standards and fully compliant with the latest version of British Standard BS 7671.

The commissioning process

Commissioning of building services engineering systems takes place after installation has been completed. On larger projects and buildings, commissioning may encompass work on a number of different floors and diverse built areas. In these situations, commissioning may take months to complete.

The process of commissioning involves the implementation of a systematic quality assurance process, which is designed to confirm that building systems have been installed, and are functioning, correctly. The process spans the design, construction/installation and operation of the building and its systems, and aligns to industry best practices and environmental efficiency standards. Although the process is usually (on larger projects) completed by specialist commissioning companies, the process itself is relevant to (among others) building owners, building operators, architects and design engineers.

Outcomes of the commissioning process include the production of documents such as the ‘Owner’s Project Requirements’ document and the ‘Systems Manual’. The systems manual is particularly important as it effectively becomes an operating manual for the occupiers’ use and reference. However, the production of the systems manual is not the limit of the commissioning team’s responsibility – they must also produce verification checklists and functional test schedules and
complete seasonal or deferred systems testing. The commissioning team may also be involved in training the building’s users to ensure that they are able to run and operate the building systems effectively and efficiently, in order to achieve the performance levels of the system design. The systems manual is in many ways the culmination of information that is built into the health and safety file (as compliant with the Construction (Design and Management) Regulations 2007).

In your role as someone with overall project control over building services engineering systems, commissioning will be a key consideration in your project plans and programmes.

**Activity**

There are a number of organisations that provide additional information and guidance on commissioning procedures and processes for building services engineering systems. These include:

- the Chartered Institution of Building Services Engineers (CIBSE): [www.cibse.org](http://www.cibse.org)
- the Building Services Research and Information Association (BSRIA): [www.bsria.co.uk](http://www.bsria.co.uk)
- the Commissioning Specialists Association: [www.csa.org.uk](http://www.csa.org.uk)

Visit their websites and familiarise yourself with the kind of advice each one offers.

## 2 Preparing and completing relevant documentation

A number of important documents must be prepared and completed before the final close-out and handover of a newly constructed/refurbished building. This section is designed to provide a brief summary of what these documents are likely to be and the documents that are particularly relevant to the installed building services engineering systems.

### Commissioning records/system manual

The commissioning records for the various building services engineering systems installed in a building are key documents when it comes to calculating its overall ‘effectiveness’ in terms of energy usage and carbon emissions.

The systems manual is a key document that is largely completed during the commissioning process. It comprises essential information on how the installed systems actually operate, what the maintenance requirements are of different system components, the required servicing intervals, and the details of recommended settings for controls in order to achieve maximum levels of system efficiency and occupier comfort. This builds into a record of key information that is then retained by the building users/building maintenance team to inform programmes of maintenance and servicing. On bigger projects that may involve the installation of numerous larger items of plant, such as the rooftop chiller shown in Figure 17.4.1, this can result in a significant amount of information.
As-built records

These are a crucial set of documents, as they constitute a record of project progress from start to finish. Although the exact composition of the full set of ‘as-built’ records will vary slightly from job to job, most contractors will file at least one set of complete design records.

Perhaps the most important document in the context of ‘as-built’ records is the drawings register. This is, in effect, a record of every drawing that is issued during a project, complete with final issues, which are archived as complete with all changes incorporated. Figure 17.4.2 shows a sample template for a drawings register.

<table>
<thead>
<tr>
<th>Drawings register</th>
<th>Rev. number</th>
<th>Issue date:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sheet of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sheets</td>
</tr>
</tbody>
</table>

Project title:  
Department:  
Drawing number prefixes:

<table>
<thead>
<tr>
<th>Drawing title</th>
<th>Serial number</th>
<th>Issues record</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rev. Date</td>
<td>Rev. Date</td>
</tr>
</tbody>
</table>

Figure 17.4.2: A drawings register.

The building services systems will usually have their own sub-set of drawings within the drawings register for a construction project.

Vendor’s drawings and documentation

This category of documentation includes all operating and maintenance instructions for items of building services equipment and plant that is installed in a new building. It is considered good practice for the main contractor to retain their own copies of this documentation in addition to the copies that are supplied to the building’s users.
Sometimes vendors will also be required to supply other documentation, such as installation drawings, parts lists, consumable component lists and test certificates.

It is usually considered best practice to retain all of the information relating to a particular item of plant or equipment. This can be done by referring to the original purchase order number that was used for the acquisition.

**Portfolio activity (5.1, 5.2)**

Produce a short report including a log of all the different types of handover documentation you would expect to prepare for a client before the completion of a new building project. Use examples from projects you have worked on, or are familiar with, to back up your report.

### 3 Removal of plant and equipment from site

#### Off-hire of plant and equipment

As the construction phase of a project nears completion, it is likely that there will be a significant amount of plant and equipment that will need to be off-hired and removed from site.

In just the same way that it is important to ensure that such items are in place ready for project commencement, it is also essential to ensure that items are off-hired promptly on confirmation that they are no longer required. However, this must only be done once you are certain that the plant/equipment will no longer be required. Although money will be saved by off-hiring the items, any savings will be lost if subsequently the item has to be re-hired because it needs to be used again at a later date (i.e. during the completion of ‘snagging’ works).

### 4 Handover procedures

On smaller jobs (domestic/small commercial), the handover/job close-out procedures may consist of a simple demonstration of how a system works, an explanation of the recommended settings for system controls and the handing over of system documentation (manufacturers’ instructions, commissioning and servicing records).

However, on larger projects it is not unusual for the project closure and handover elements of the work programme to have their own budget and work plans, in order to make sure that all elements of project closure are handled professionally and expediently.

**Aims of a successful project close-out/handover**

Closure activities tend to be unpopular with the contractor and project employees because they are seen as not being creative or contributory to the project (as much of the works cannot be directly charged to the client). Despite this, an orderly project close-out/handover is necessary to ensure that:

- lessons are learned from the project and this knowledge is used in future projects
• archives are put in place in case supporting evidence is required for disputes or legal claims
• the condition of the building is accurately recorded
• the client is given any post-project services required.

**Soft Landings**

The Soft Landings initiative, developed through BSRIA, aims to recognise and overcome problems beyond building handover. Soft Landings means designers and constructors staying involved with buildings beyond practical completion. They will assist the client during the first months of operation and beyond, to help fine tune and de-bug the systems, and ensure that occupiers understand how to control and make the best use of their buildings.

**About the Soft Landings process**

Soft Landings documentation extends the duties of the team during handover and the first three years of occupation, following the process outlined below.

• **Stage 1: Inception and briefing**
  More time for constructive dialogue between the designer, constructor and client.

• **Stage 2: Design development and review**
  Brings the entire project team together to review insights from comparable projects and detail how the building will work from the point of view of the manager and individual user.

• **Stage 3: Pre-handover**
  Enables building users to spend more time understanding interfaces and systems before occupation.

• **Stage 4: Initial aftercare**
  Continuing involvement by the client, design and building team, benefiting from lessons learned and occupant satisfaction surveys.

• **Stage 5: Years 1–3 extended aftercare and Post Occupancy Evaluation (POE)**
  Completing the development cycle for future projects, to close the loop between design expectation and reality.

Source: BSRIA

Note: Soft Landings is also briefly covered in Topic guide 17.1.

**Portfolio activity (5.1, 5.2)**

Download the BSRIA Soft Landings framework document from the following link:

[www.bsria.co.uk/services/design/soft-landings/free-guidance](http://www.bsria.co.uk/services/design/soft-landings/free-guidance).

Note: Before you can download the framework document, you need to register with BSRIA.

Consider the document and produce a brief report on how the techniques that are covered in the Soft Landings initiative could be incorporated into the activities of your employing organisation.
Case Study: Edge Hill University

The following example, publicised by BSRIA, shows how effective collaboration between a project management team and effective commissioning can result in a building that operates efficiently. Edge Hill University appointed a specialist consultant to oversee the commissioning and handover of their Faculty of Health building, and also to monitor the production of the operational and maintenance manuals. The specialist had a data link to the building’s control systems so that the building systems could be monitored and operated.

The building is performing very well. The monitored data is reporting average monthly energy consumption lower than both the good practice benchmarks in Energy Consumption Guide 19 (Energy Use in Offices) and CIBSE TM46 Energy Benchmarks. There was good cooperation between the commissioning consultant, the services consultant, the main contractor and the principal sub-contractors. This resulted in a smooth handover and swift resolution of defects.

This project has also benefited from a well-informed client who had a good relationship with the design team. The design team for this building has worked on other campus projects.

The arrangement has allowed for lessons learned to be passed on to newer buildings. Issues have been dealt with quickly as the team are still in regular contact with each other.

The metering of Edge Hill has also been effective, which is a great help when judging the performance of a system during and after commissioning. This is a marked difference from many of the other Carbon Trust Low Carbon Buildings Programme (LCBP) case studies, where metering was installed to gain BREEAM® credits but with little thought put into commissioning them correctly. In many cases the sub-meter readings do not add up to what is recorded by the main incoming energy meters. Relying on BMS (building management system) readings can lead to even greater disparities, with factors of three between the BMS readings and the sub-meters. Commissioning needs to include a proper reconciliation exercise before any monitoring begins.

Source: BSRIA

Checklist

At the end of this topic guide you should be familiar with:

- the processes and stages that need to be considered when commissioning the building services engineering systems within a building
- how to obtain specific information on the commissioning process
- what is expected in terms of project close-out and handover
- what is expected in terms of aftercare following the handover of a building.

Further reading and resources

The Building Services Research and Information Association: www.bsria.co.uk
Chartered Institution of Building Services Engineers: www.cibse.org
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About the author

Originally from an education and civil engineering background (railways infrastructure), Kevan Holmes has spent the past 12 years working within the Building Services Engineering (BSE) sector. During this time he has worked on numerous projects and initiatives relating to the development of National Occupational Standards (NOS), qualifications, training and learning materials across all of the BSE disciplines (including BSE-related environmental technology systems). Through the completion of this work, Kevan has developed close links to key industry bodies, including SummitSkills (the Sector Skills Council for Building Services Engineering), the Association of Plumbing and Heating Contractors (APHC), the Building and Engineering Services Association (B&ES) and the British Plumbing Employers Council (BPEC).

In addition to the completion of project development work, Kevan has also provided bespoke consultancy support to the Joint Industry Board for Plumbing and Mechanical Engineering Services (JIB-PMES) and employers including Morrison Facilities Services and the Mears Group. Kevan’s key educational experience includes major involvement at Director level in the establishment of a construction/building services training centre, which has involved the development and implementation of a number of courses and programmes of learning.

Previous publications with which Kevan has an association include *Plumbing* by Steve Muscroft (Elsevier Ltd). As a friend and long-term colleague of the author, Kevan was heavily involved in the editing and proofreading of the book, which supports Level 2 plumbing qualifications.