7 COMMISSIONING AND OPERATION

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More information
Although the building may appear to be complete, commissioning is the true test of whether it functions as a system. Commissioning is best described as the process of ensuring that a building performs according to its design intent and to suit the needs of its owners and occupants. Proper commissioning of the hotel’s mechanical, electrical and plumbing installations is essential to achieve optimum energy efficiency once the building commences full operation. If the water and air systems are not balanced, the equipment will have to run longer and harder to maintain comfort conditions, which increases operating costs and environmentally harmful emissions. Guests may have to wait longer until hot water flows from the tap or for the air-conditioning to respond.

Commissioning is important for any building project, although its role differs according to the size of the individual building and its location. In some countries there is a ‘commissioning leader’ or dedicated engineer responsible for commissioning, in others it is the responsibility of the designers and contractors. The earlier in the development process it can be started, the more effective it will be, as it is commissioning that generally reveals any weaknesses in the design and construction. Benefits include fewer defects at handover, timely completion and fewer complaints during the building’s operational life.

The performance of each system and item of equipment item must be documented in the commissioning report. As buildings and their systems become more complex, so the requirement for commissioning has developed. The process not only ensures that all systems are in good working order, but also confirms that all specified capacities are being achieved. This data can also be used as part of the company environmental management system such as ISO 14001 and in corporate environmental performance reporting.

7.1 Planning and design

A. Appoint the commissioning engineer at the earliest opportunity. It is preferable to have one person with overall responsibility for commissioning and ensuring that the building objectives and schedules are met.

B. Keep systems as simple as possible but ensure that adequate time provision is built in for accurate and efficient testing and regulation.

C. Ensure there is adequate provision of the following:
   - Flushing facilities to flush and clean water systems thoroughly.
   - Venting and draining facilities.
   - Facilities for water treatment and analysis.
   - Requirements for access and maintenance.

D. Review fabric requirements particularly with regard to air leakage and infiltration.

E. Ensure personnel and plant safety during operation.

F. Review clarity of ‘cause and effect’ in fire detection mode and power failure mode.

G. Determine the need for plant or equipment testing by manufacturers at their own works. For example, a full load test of a chiller may be difficult to perform on site. A requirements document should be produced in relation to this and included in the design brief.

H. Establish start-up and operating procedures.

I. The commissioning manager should produce a logic network\(^6\) for the testing and commissioning (T&C) showing the logical sequence of events and also how it interfaces with the construction work. The network should include all the various systems and items of equipment and how they interface with each other, culminating in the final integrated systems test (IST).

J. Ensure that all parties to be involved in the T&C process have a chance to influence the time scale required for their activities and agree that they can complete on schedule. The Construction Manager can then determine the critical path necessary to achieve the completion date.

7.2 Installation monitoring

A. Ensure that installation teams observe good housekeeping principles to prevent unnecessary entry of dirt into ductwork and pipe systems.

B. Review correct installation of plant and equipment. Ensure that there is adequate provision for all air to be vented.

C. Review ductwork and pipework modifications which result from co-ordination clashes with other services and the building fabric, since such changes may result in high pressure drop sections and reduce plant efficiency.

D. Monitor and witness system pressure tests and when proved satisfactory, ensure any sectional caps or membranes are removed.

\(^6\) The logic network is a flow diagram highlighting prerequisites from the various members of the construction teams and indicating testing that needs to be undertaken as construction progresses.
Ensure that record drawings are updated and that they accurately reflect the installation, particularly of services that will be hidden once the building is complete.

Following installation and pressure testing, ensure that pipework is flushed out and, where necessary, chemically cleaned. This work may need to be carried out by a water treatment specialist but should be witnessed at all stages by the Construction Manager. After flushing and cleaning, the system must be quickly treated with appropriate levels of inhibitor to prevent corrosion and contamination, and regular checks of inhibitor levels made to ensure adequate concentrations are maintained.

**7.3 Pre-commissioning**

A. After installation and prior to commissioning, ensure that the system is complete and in a satisfactory and safe condition prior to start-up.

B. Conduct static and electrical checks of the main plant.

C. Prepare documentation in advance in the form of pro forma check and test sheets.

**7.4 Testing and commissioning**

A. Ensure that test instrumentation is not damaged, carries a current calibration certificate and is reasonably easy to use in the environment in question.

B. Always select an instrument with an operating range greater than expected results.

C. Be aware that for the test undertaken there may be a correction factor that needs to be applied to compensate for reading error.

D. Observe plant start-up and shut-down to ensure correct operation.

E. Monitor conditions within the building to ensure required conditions are achieved and the system is stable.

F. Witness cause and effect tests to ensure the services operate as intended in fire detection and power failure modes.

G. Liaise with local authorities, fire officers, building control officers, building insurers and the design team to ensure compliance with all legal and statutory requirements.

**7.5 Operator training and hand-over**

A. Co-ordinate the training of the building user’s operations team, for example, the chief engineer and department member to ensure that first-hand operational knowledge is transferred.

B. At the point of hand over to the owner or operator, it is important that documentation for all systems and materials is presented to the operations team. These include:

- Specifications and design documents.
- As-built drawings.
- Operation and maintenance (O&M) manuals.

Examples of pro forma test sheets can be found in BSRIA application guides 'AG 2/89.3 Commissioning Water Systems' and 'AG3/89.3 Commissioning Air Systems', www.bsria.co.uk.
Commissioning reports (testing and commissioning records) showing all the set points and data relating to the building management system and control systems.

- Warranties.
- Material specifications.
- Spare parts and materials.

### 7.6 Operation, maintenance and continuous commissioning

Continuous commissioning is the last phase of the commissioning process and takes place after handover to the owner or operator. The process enables the function of the equipment to be checked and optimised for energy efficiency and, when changes are made, enables the ‘as-built’ documents to be updated. In these respects, the continuous commissioning process complements the energy management process of a building.

Since the building will use most energy during its operational lifetime, continuous commissioning ensures that existing systems can:

- Handle changes in activities in the building.
- Adjust equipment to new standards and regulations.
- Monitor equipment deterioration.
- Minimise energy consumption.

Typical problems that are identified at this stage include negative pressurisation of the building, blocked reheat coils, air volume systems (VAV) temperatures set too low, broken thermostats and high exhaust pressures.

All systems must be regularly inspected and serviced. Regular testing should be carried out on large energy consumers such as chillers, boilers and air-conditioning systems, to verify actual performance versus the original conditions. In this way, the building will be able to operate to optimum efficiency and ensure the highest level of comfort for guests and staff.

### 7.7 Post occupancy evaluation

Post occupancy evaluation (POE) involves the systematic evaluation of opinion about buildings in use, from the perspective of the people who use them. It assesses how well buildings match their users’ needs, and identifies ways to improve building design, performance and fitness for purpose. POE can be used for many purposes, including fine-tuning new buildings, developing new facilities and managing ‘problem’ buildings. It is also valuable when establishing maintenance, replacement, purchasing or supply policies; preparing for refurbishment; or selecting accommodation for purchase or rent.