



Ministry for the
Environment
Manatū Mō Te Taiao

Sustainable Government Buildings

**Beyond Design
A Best Practice Approach to
Building Commissioning, Completion
and Ongoing Operation**

Appendix A: Typical Procurement Documentation

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1 Introduction

In this appendix the best practice approach described in the Main Report has been translated into documentation to assist in the normal range of procurement stages for a leased government office building. The extent of information provided on building commissioning, completion and ongoing operation builds into progressively more detailed documentation from one stage of the procurement process to the next. These stages generally run as follows.

1. Expression of interest or request for first-stage proposal – an open or limited request for proposals from the marketplace is made, based on a relatively limited statement of requirements and information, to be provided by the respondents.
2. Request for second-stage proposal – an outline building brief is issued to a short-listed group of respondents selected in response to the proposals provided by the first-stage respondents. At this stage the client's consultants may work collaboratively with each of the short-listed respondents to refine and optimise their design and commercial proposal.
3. Building performance specification – this is a contractually binding agreement with the preferred respondent following the second stage of the evaluation process. It will be used as the basis for construction of the leased premises for the ministry, department or agency (the client).

The respondents are typically either developers or building owners, with their associated team of professional advisors. The tenant is normally represented by their associated team of professional advisors.

The documentation can easily be adapted if the buildings are government-owned rather than leased. It can also be scaled down for smaller and less complex building types. However, the fundamental principles of the approach need to remain the same.

2 Expression of Interest or Request for First-Stage Proposal

At this stage of the procurement process high-level pro-forma project details and requirements are issued by the client to the marketplace for expressions of interest and requests for a first-stage proposal. Responses are normally assessed using a standardised evaluation template and a ranking and weighting evaluation tool, which might cover the main aspects such as:

- business needs
- building location
- size and configuration
- design specification
- high-level commercial terms
- development team approach
- experience and delivery risk.

The relative weighting of each aspect will be project-specific. It is recommended that the approach to commissioning, completion and ongoing operation should have a significant weighting of the potential scoring of both the ‘development team approach’ and the ‘experience and delivery risk’ sub-categories.

A typical question in the client’s expression of interest (EOI) or request for proposal (RFP) documentation to assess the market respondent’s approach towards commissioning at this stage could be:

The [ministry/department/agency] understands that the performance objectives of a 'sustainable' or 'green' building will only be achieved by a high standard of building commissioning. Describe your approach to the completion of the building, including:

- *design and documentation review*
- *base building and fit-out integration*
- *testing and commissioning*
- *operator/user training*
- *operating and maintenance documentation*
- *acceptance and handover*
- *post-occupancy fine-tuning, review and performance testing the mix of building systems and occupants*
- *facilities management and ongoing operation and maintenance.*

The respondent’s attention is drawn to the Ministry for Environment’s document Best Practice Approach to Building Commissioning, Completion and Ongoing Operation in this respect.

3 Request for Second-Stage Proposal

A request for a second-stage proposal normally follows short-listing of the stage 1 respondents. It generally includes a more detailed set of requirements, including an outline building brief. This will include an outline of the better commissioning, completion and ongoing operation approach.

At this stage the selected respondent’s proposals are generally refined in a collaborative process with the client’s advisors. Responses are normally finalised for assessment by the advisors using the response template provided as part of the outline building brief. Typical outline building brief details are included in Table 1.

Responses are similarly assessed using a standardised evaluation template and a ranking and weighting evaluation tool. Weightings should be similar to the request for first stage proposal.

Table 1: Outline building brief: building commissioning, completion and ongoing building operation

Ref	Defining aspect	Performance objective	NZGBC Green Star reference	Performance criterion or measure	Respondent’s response
1.0	Design and documentation review and the appointment of a commissioning agent.		MAN 4	<p>The overall design shall be progressively reviewed by the tenant’s representative at the 60%, 90% and 100% base building and fit-out stages.</p> <p>An independent commissioning agent shall be appointed by the developer/ building owner to proactively manage and verify the commissioning process.</p> <p>The commissioning agent shall also review the services design for commissionability and maintainability at the 60%, 90% and 100% stages and shall submit a commissioning plan and programme for the building. The commissioning agent shall report progressively and concurrently to the developer / building owner and the tenant.</p> <p>At completion of the design and in addition to the normal design documentation, the services consultants shall summarise the design intent and performance requirements into a stand-alone document for the commissioning agent, the installing subcontractors and the building operators.</p>	

Ref	Defining aspect	Performance objective	NZGBC Green Star reference	Performance criterion or measure	Respondent's response
2.0	Testing and commissioning	Minimise energy use and maximise air quality by fully commissioning the building before occupation	MAN 2	<p>Commissioning of the building shall meet the requirements of the Ministry for the Environment's <i>Best Practice Approach to Building Commissioning, Completion and Ongoing Operation</i> and shall be in accordance with appropriate CIBSE/BSRIA codes, New Zealand standards and NZGBC Green Star management clauses.</p> <p>The commissioning agent shall manage and verify the commissioning process and report the results to the developer/building owner and tenant concurrently.</p> <p>The commissioning shall be properly allowed for and programmed from the outset. All the principal commissioning activities shall be completed before the tenant's soft fit-out.</p> <p>Final commissioning before occupation shall include a two-week continuous controlled run period and a concurrent overnight elevated bake-out period following soft fit-out of the office floors.</p>	
3.0	Clearance of defects			All significant building defects shall be cleared before the tenant's soft fit-out and shall not interfere with access to and completion of the soft fit-out works.	
4.0	Operator/user training			Structured training in the sustainable use of the building and its operation shall be provided to facilities management staff and nominated tenant staff representatives before handover.	
5.0	Operating and maintenance documentation		MAN 5	<p>Two bound copies of tailored operating and maintenance documentation shall be provided in hard copy and Word or PDF electronic format.</p> <p>Two copies of A1 and A3 as-built drawings shall be provided in hard copy and AutoCAD or PDF format.</p> <p>In addition to the above, the services consultant(s) shall provide two bound copies of a high-level, user-friendly building user guide in hard copy and Word or PDF electronic format. This shall include the basis of the design, load summaries, design narrative, design drawings and acceptance criteria.</p>	

Ref	Defining aspect	Performance objective	NZGBC Green Star reference	Performance criterion or measure	Respondent's response
6.0	Acceptance and handover for occupation by the tenant			<p>The building shall not be accepted for practical completion until the following deliverables are available:</p> <ul style="list-style-type: none"> • a report from the independent commissioning agent to verify the pre-handover commissioning process is complete, with the exception of post-occupancy fine tuning • proof that the commissioning of the building meets the requirements of Green Star MAN 2, MAN3, MAN 4 and MAN 5 • all necessary producer statements and certificates of compliance • a 'complete for review' set of all as-built drawings • a 'complete for review' set of all O&M manuals and a building user guide • training of building operating staff has been completed • a statement from all consultants that the contract works are in their opinion complete and acceptable for occupation • acceptance from the Insurance Council for fire services • final inspection report from the territorial authority, including their documentation requirements for the Code Compliance Certificate application • confirmation that the builder has lodged the Code Compliance Certificate application, and copies of the application have been passed to the developers/building owners for acceptance • provision of all written guarantees required to be obtained by the builder under the outline building brief. 	
7.0	Post-occupancy fine-tuning, review and performance testing the mix of building systems and occupants	Ongoing optimisation of all building systems	MAN 3	<p>An environmental management plan (EMP) shall be provided to structure the approach to the sustainable operation of the building.</p> <p>The building services are required to be fine-tuned initially on a monthly basis for the first three months and then on a quarterly basis during the first year of operation. Results and remedial actions shall be reported by the commissioning agent to the building owner and tenant concurrently. The tenant will maintain a log of any operational issues/faults to assist with this process.</p> <p>Monthly energy and water audits using the building's metering shall be carried out and reconciled with performance targets. Results and remedial actions shall be reported by the independent services commissioning agent to the building owner and tenant concurrently.</p> <p>The tenant will be carrying out an independent post-occupancy evaluation 6 months after occupation and shall make the results of this available to the building owner to identify any residual issues in terms of occupancy comfort and satisfaction.</p>	

Ref	Defining aspect	Performance objective	NZGBC Green Star reference	Performance criterion or measure	Respondent's response
8.0	Facilities management and ongoing operation and maintenance			<p>Maintenance contracts shall be let within three months of completion for ongoing preventive maintenance.</p> <p>Ongoing commissioning shall occur throughout the lease period as a result of the yearly energy and water audits and a three-yearly building audit. Any re-commissioning required as a result shall be carried out and the documentation updated. An audit of the building shall be carried out on a three-yearly basis by an independent consultant(s) who shall report to both the building owner and the tenant concurrently. This shall review the condition and performance of the building in relation to the requirements and performance measures of the building performance specification (BPS). The review shall also include all tenancies and any impact of any subsequent fitting out work since completion or the last audit. The need for any corrective actions such as partial re-commissioning to restore operational performance shall be identified.</p>	

4 Building Performance Specification (BPS)

The building performance specification is a binding contractual document between the developer/building (owner) and the tenant and defines the level of specification to be provided for the building.

4.1 Design intent and design review

4.1.1 Design intent

The design engineer should record the design intent for the building systems. This should include the:

- basis of design – design standards/codes and parameters such as internal/external/design temperatures and statistical basis, outdoor air rates or air-change rates, humidity, filtration level, occupancy densities and schedules, small power and lighting loadings, hot-water loadings and cold-water storage quantities, and fire hazard category
- load summary – including the cooling load, heating load, air handling and fan duties, pump duties, electric loads, hot-water loads, cold-water storage quantities and all allocated diversities and safety factors
- design narrative and fire report – a description of the design, including the system scope, system types, plant locations and control strategies, and also a fire report
- design drawings –plant system and control schematics, together with air and water diagrammatics with all flow rates shown for balancing purposes
- acceptance criteria – tolerances for acceptance of commissioning results.

4.1.2 Design review

The base building and hard fit-out design shall be reviewed by the client's advisor at the 50%, 90% and 100% design completion stages for compliance with the performance specification. At the 90% and 100% stages the design shall also be reviewed by the commissioning agent (and the facilities manager, if available), who may provide input on potential problems in terms of achieving commissionability, maintainability and energy efficiency.

The following high-level design checklist is provided to assist in this process.

Design checklist

- a. Has the commissioning agent been appointed?
- b. Has the design intent been recorded/issued?
- c. Can the systems be commissioned in accordance with the specification and Chartered Institution of Building Services Engineers commissioning codes? Are there adequate regulation devices and test points?
- d. Can the installed services be adequately and safely maintained after handover? Is adequate access provided for all equipment?
- e. Has sufficient detailed design information been provided, especially in respect of controls, including strategies, set-points and system flow rates?
- f. Is the specification definitive in its coverage of the commissioning responsibilities, acceptance criteria and tolerances?
- g. Have all interfaces with other systems been identified and co-ordinated (electrical, fire alarms, etc)?
- h. Have interfaces with packaged plant and proprietary systems been identified and co-ordinated?
- i. Have air and water diagrammatics been provided to assist in air and water balancing?
- j. Are air or water velocities within an acceptable range?
- k. Has adequate sound attenuation been provided for all systems?
- l. Can the design be simplified while still achieving the performance criteria?
- m. Are there any value-added components that should be considered?

4.2 Commissioning management

4.2.1 Scope of works

An independent commissioning agent shall be appointed by the developer/building owner. The commissioning agent shall, with the builder's authority, direct the services subcontractors technically with the intention of achieving the objectives of the commissioning process as defined in the Chartered Institution of Building Services Engineers codes and Building Services Research and Information Association application guides. The builder shall retain responsibility for the production of the overall construction programme, management and overall direction of the services subcontractors.

The commissioning agent shall undertake the following activities to enable the commissioning of the works:

- familiarisation and review of the engineering designs and agreeing testing facilities with the services design engineer and services subcontractors
- confirmation that the system has adequate provision to be fully commissioned and maintained
- preparation of a commissioning plan for the works

- preparation and monitoring of programmes for the testing activities, and producing sequential network programmes jointly with the builder and the services subcontractors
- co-ordination and technical supervision of the testing and commissioning process
- confirmation that draft operation and maintenance information is available for all equipment and systems to enable commissioning to begin
- monitoring and reporting of all tests, and collating records of same in accordance with the requirements given in the contract documents (note: confirmation of any certified data by the services subcontractors is required for selection of associated plant, eg, confirmation of evaporator, strainer and coil hydraulic losses to enable confirmation of pump heads)
- checking that all control equipment is in accordance with the specification requirements and is located in correct position
- checking that the building management system (BMS) is in accordance with the specification, including the point-to-point checking
- verifying the pre-commissioning and setting-to-work activities by the services subcontractors
- verifying the correct operation and regulation of all systems
- verifying the correct operation of all systems under automatic control, including environmental services, fire and security services, hydraulic services, electrical services and lifts
- verifying the correct operation of the BMS, and the correct operation of systems when controlled by the BMS and/or fire alarm system
- identifying any variances in systems performance against the design data and agreeing the course of action with the services design engineer for resolving such variances
- verifying commissioning of the systems to conform to design values
- verifying compliance with the requirements of statutory authorities
- final reporting of the setting-to-work by the services subcontractors before practical completion
- collation and presentation of system and equipment testing and commissioning data into a comprehensive commissioning report
- input into the fine-tuning process during the first year of operation.

4.2.2 Commissioning management code

The following publications shall apply in conjunction with the commissioning agent's role:

- CIBSE Commissioning Code M – *Commissioning Management*
- BSRIA AGS/2002 – *Commissioning Management: How to Achieve a Fully Functioning Building*
- CSA TM/1 – *Standard Specification for Commissioning and Commissioning Management.*

4.2.3 Familiarisation and advisory duties

During the detailed design and working drawing period, the commissioning agent shall become familiar with the detailed design, prepare documentation, and advise on any features of the systems considered necessary to aid satisfactory commissioning and testing of the systems in accordance with the design intent and requirements.

The commissioning agent shall liaise with the relevant services subcontractors and draw up a sequential programme for setting-to-work, regulation and testing. These programmes shall be compiled to the satisfaction of, and with assistance from, the builder.

Duties during site installation

The commissioning agent shall, during the installation period, visually inspect the works to ensure that all commissioning devices are installed in accordance with the manufacturer's instructions and as detailed on the contract drawings.

The commissioning agent shall also during this period verify commissioning results and collate data in preparation for editing the testing and commissioning records.

Duties after site installation

After site installation the commissioning agent shall complete the compilation of the testing and commissioning documentation into a commissioning report for inclusion into the building user guide and operation and associated maintenance documentation.

During this time it is intended that the relevant services subcontractors will be making final adjustments to any item of plant and equipment and the operation of systems brought to design performance. This activity shall be allowed for in the commissioning agent's programmes.

4.2.4 Commissioning plan and programming

Commissioning plan

A commissioning plan shall be provided by the commissioning agent before tender. This should include the:

- scope or level of commissioning
- commissioning programme
- roles and responsibilities
- communication, reporting and management protocols
- documentation requirements of each team member
- detailed scope of monitoring and verification
- detailed scope of training
- deliverables by practical completion
- deliverables post-occupancy and during the defects/warranty period.

Programming the commissioning works

Programme set-up

The commissioning agent shall prepare and issue to the builder a comprehensive programme and supporting method statement for the commissioning and testing of the works.

Programme integration

The builder shall provide the construction programme information forming the basis of the commissioning programme. The builder shall be available for liaison and clarification of the construction programme during the programme set-up period.

Commissioning programme

The commissioning programme shall show key dates for activities, as outlined below, and critical milestone dates for integration in the construction programme as agreed with the builder. It shall also take into account any requirements for sectional completion and the need for any final commissioning or re-commissioning of any systems following the fitting-out works. The commissioning programme shall indicate for each of the relevant services contracts the information as listed below and integrate the information for all services, with due allowance being made for the interdependency of services:

- key dates for the availability and safe use of primary services (ie, water, gas, electricity, refrigeration, heating)
- services subcontractors' static check certification
- services subcontractors' setting-to-work date (followed by the commissioning agent's inspection and builder's agreement to set to work)
- services subcontractors to regulate/adjust system
- commissioning agent to witness system and report
- integration of the commissioning of all the building services systems
- witnessing inspections and acceptance tests
- period for operational instruction to facilities management staff
- compilation of documentation.

The programme shall allow for a 14-day period before the intended practical completion date for the building for continuous running of the completed systems and bake-out period following the proving of each constituent section, during which time the commissioning agent shall, through the builder, organise the services subcontractors to demonstrate that all sections of the systems are capable, satisfactory and demonstrate simultaneous operation. The period shall be used to demonstrate the complete, fully commissioned installation to the developer/building owner and tenants' representatives.

Progress monitoring

The commissioning agent shall supply a copy of a monthly report and programme review, which will reflect the up-to-date situation of the commissioning works. Any delays emanating from any source shall be immediately brought to the attention of the builder. The review and reporting period subsequent to the start of final commissioning shall be on a weekly basis.

4.2.5 Testing

The commissioning agent shall certify that pre-commissioning checks on each of the installations have been carried out by the relevant subcontractor. This shall include, but not be limited to:

- all site testing complete and recorded
- all systems cleaned down internally and externally according to the contract documents
- all lubrication carried out
- all controls, starting sequences and safety devices working correctly
- all electrical switchgear operational and correct overloads fitted.

If the inspection carried out by the commissioning agent reveals that any of the contract requirements have not been met, the matter will be reported to the builder, who shall draw the default to the attention of the responsible subcontractor with instructions to rectify. When the default has been rectified the commissioning agent shall re-inspect and report.

Following confirmation of satisfactory reports from the commissioning agent, the builder shall issue an 'agreement to set to work' for a system (or in appropriate cases, part of a system). Thereafter, the commissioning agent shall verify that the respective subcontractor has set to work all plant and systems before regulation and adjustment being undertaken.

Tests shall be carried out as the installations proceed by the relevant subcontractor. These will include but, not be limited to:

- hydraulic pressure testing of pipe-work systems
- air leakage testing of duct-work systems
- air and water testing of drainage (public health) systems
- inspection and testing of electrical installation
- testing of fire protection systems
- testing of the lifts
- testing of fire detection and alarm systems
- testing of emergency lighting
- further expansion required for other systems, as required.

The responsibility for verification of all site tests as carried out by the services subcontractors is vested with the commissioning agent. The acceptance of all site tests is vested with the builder and services design engineer.

The commissioning agent shall witness and report all site tests and thereafter collate records of these tests into the commissioning report.

4.2.6 Commissioning report

The commissioning agent shall be responsible for the compilation of a commissioning report for incorporation into the operation and maintenance manuals forming a record of the installation testing and commissioning procedures used and the results obtained. This shall be co-ordinated and given to the builder to issue for review to the developer/building owner and services engineer. This should include the:

- master index of all commissioning documents
- final design intent document
- commissioning results, including any agreed non-compliance with the design intent.

The commissioning agent shall be required to review the operation and maintenance documentation in draft form before its issue by the services subcontractors to the services engineers for acceptance.

4.2.7 Commissioning roles and responsibilities

Table 2 identifies the roles and responsibilities of the various parties in a best practice approach towards commissioning.

Table 2: Commissioning roles and responsibilities

Activity number	Activity description	Commissioning agent (CA)	Building services contractor (BSC)	Builder (B)	Design engineer (DE)
1	Review DE's design drawings and specifications for commissioning requirements.	Action and advise DE. Co-ordinate any comments from BSC and B.			Review comments and action as appropriate.
2	Review installation drawings and technical submissions from BSC for commissioning requirements.	Action and advise B and DE.	Prepare and submit for review. Action any comments as instructed by B.	Co-ordinate, supervise and direct/instruct as appropriate.	Review, comment and issue directives to B if applicable.
3	Review installations with respect to compliance with specifications and drawing intent for commissioning.	Supervise inspection of installations and issue reports to B and DE.	Receive CA reports and action as necessary.	Co-ordinate, supervise and direct/instruct as appropriate.	Review, comment and issue directives to B if applicable.
4	Produce detailed co-ordinated commissioning plan, including revisions and updating.	Procure information from BSC. Prepare programme, discuss with B and issue to all parties for comment.	Submit plans/ information and liaise with CA.	Review programme with regard to its impact on the construction process. Issue comments and approve.	Review, comment and accept.
5	Produce detailed commissioning method statements, including pre-commissioning, setting-to-work and interface tests.	Guide and assist in their production. Review and accept content. Liaise with B and DE.	Discuss format and content with CA. Produce method statements.	Receive, review and approve. Liaise with DE and CA.	Review, comment and accept.

Activity number	Activity description	Commissioning agent (CA)	Building services contractor (BSC)	Builder (B)	Design engineer (DE)
6	Testing and pre-commissioning, including off-site works testing (as requested).	Procure procedures from BSC and suppliers for approval. Witness and validate tests and results.	Submit information and liaise with CA. Complete outstanding works schedules.	Review/comment and approve. Carry out spot checks.	Review, comment and accept. Carry out spot check as required.
7	Produce project-specific test sheets.	Prepare and issue pro-forma sheets, including interface and performance tests.	Liaise with CA.	Receive, review and approve.	Review, comment and accept.
8	Monitor and report on commissioning progress.	Prepare spreadsheets to be used to monitor all progress. Issue and update at regular intervals.	Assist CA during monitoring process.	Receive and review reports and circulate. Monitor progress and manage any programme changes.	Review and comment.
9	Progressive installation tests and pre-commission.	Monitor, witness and ensure accurate recording of all results, in accordance with method statements.	Implement testing. Prepare records and demonstrate.	Monitor progress. Carry out spot checks.	Review, comment and accept. Carry out spot checks as required.
10	Pipe-work system flushing, cleaning and dosing.	Monitor, witness and ensure accurate recording of all results, in accordance with method statements.	Implement activities, prepare records and issue analysis reports.	Monitor progress. Carry out spot checks.	Review, comment and accept. Carry out spot checks as required.
11	Setting-to-work of plant and systems, commissioning and performance testing in accordance with programme.	Direct BSC, giving guidance as necessary. Witness activities and ensure accurate recording of results.	Execute all planned activities. Demonstrate selected items to B/DE as directed.	Monitor progress. Witness as required.	Carry out spot checks and witness activities on a selective basis.
12	Prepare testing and commissioning reports, incorporating all plant and system test results.	Action and submit to B.	Liaise with B and supply all relevant documentation. Action adjustments to system performance as advised or instructed by B.	Monitor progress. Issue directives/instructions to BSC as appropriate.	Review, comment and accept. Issue directives to B as appropriate.
13	Prepare models for record documents/drawings and O&M manual format.	Monitor preparation, and comment on submissions via B.	Submit information and liaise with CA.	Monitor progress. Liaise with client. Issue directives to BSC, as appropriate.	Review, comment and accept.
14	Provide demonstrations to the relevant territorial authorities.	Manage and co-ordinate the demonstration of all life safety systems, as required, to the statutory authorities.	Execute all planned activities in conjunction with the B.	Monitor progress. Attend demonstrations.	Review, comment and attend demonstrations.
15	Prepare final record documents.	Receive, collate and comment on submissions by BSC.	Submit record documents for approval and liaise with B. Update to suit comments.	Issue to client and co-ordinate all comments with BSC.	Review, comment and accept.

Activity number	Activity description	Commissioning agent (CA)	Building services contractor (BSC)	Builder (B)	Design engineer (DE)
16	Client/end-user awareness and liaison	Co-ordinate activities and advise the client of all potential operational implications.	Liaise with CA and be responsive to the client/end-user's needs.	Liaise with the client/end-user.	Monitor status.
17	Client/end-user training programme.	Co-ordinate and manage BSC contractual obligations.	Liaise with CA. Co-ordinate the activities of specialist suppliers.	Monitor progress and participate. Liaise with client/end-user.	Review, comment and accept. Participate as required.
18	Post-occupancy fine-tuning/warranty period	Review operation with facilities management staff, initially on a monthly basis for the first three months and then quarterly.	Carry out post-handover fine-tuning, respond to any operational problems and attend to any required remedial works.	Assist in directing any BSC remedial work and attend to any building remedial work.	Respond to any design-related issues raised during the post-occupancy period and carry out warranty inspections.
19	Post-occupancy warranty period energy/water-use monitoring	Review energy- and water-use trends with facilities management staff and refer issues to DE or BSC, as appropriate.	Attend to any remedial works requirements.	Assist in directing any BSC remedial works.	Attend to any remedial design action required.

4.3 Testing and commissioning

4.3.1 Scope

All works tests, pre-commissioning checks, setting-to-work, commissioning and performance testing of the works shall be carried out by the builder in accordance with the developer/building owner's design intent. The scope of work shall be generally as follows.

Air systems	CIBSE Commissioning Code A: Air Distribution Systems BSRIA AG3/89.2: The Commissioning of Air Systems in Buildings BSRIA TM1/88: Commissioning of HVAC Systems – Division of Responsibilities BSRIA AG1/91: Commissioning of VAV Systems in Buildings TR19: Guide to Good Practice 'Internal Cleanliness of Ventilation Systems'
Boilers	CIBSE Commissioning Code B: Boilers
Controls	CIBSE Commissioning Code C: Automatic Controls
Refrigeration	CIBSE Commissioning Code R: Refrigeration Systems

Water systems	CIBSE Commissioning Code W: Water Distribution Systems BSRIA AG8/91: Pre-commission Cleaning of Water Systems BSRIA AG20/95: Commissioning of Pipework Systems – Design Considerations BSRIA AG2/89.2: The Commissioning of Water Systems in Buildings CSA GN/1: White Water Balancing CSA GN/2: Automatic Balancing Devices CSA GN/3: Variable Volume Water Systems CSA GN/4: Bacteria Within Closed Circuit/Pipework Systems CSA TM/9: Water Treatment and the Commissioning Engineer
Plumbing and drainage	NZS/AS 3500
Fire detection and alarm systems	NZS4512
Automatic fire sprinkler systems	NZS 4541
Electrical installations	NZS/AS 3000
Lighting	CIBSE Commissioning Code L: Lighting
Lifts	NZS/AS 1735
Smoke ventilation	AS 1668

4.3.2 Commissioning specialists

The services subcontractors shall engage experienced 'hands-on' commissioning specialists to carry out all commissioning activities.

4.3.3 Continuous system operation run test

Upon satisfactory completion of the commissioning and performance testing, all systems shall be subjected to a period of continuous operation and bake-out. The minimum duration of the continuous operation period shall be two calendar weeks.

4.3.4 Building Management System testing

Building Management System (BMS) testing shall include full point-to-point/end-to-end testing of all BMS points, and shall include documentary evidence for each point in the form of a checklist that each point has been tested in terms of wiring, address, span, calibration and software functionality.

4.4 Building user guide and as-built documentation

Provide a building user guide and associated operating and maintenance documentation in a consistent format for each system.

4.4.1 Building user guide

The building user guide should form an easily understood summary of the building and should be provided by the design team. The user guide should cover the following main points.

Energy and environmental strategy

Information on energy-efficient features and strategies, including an overview of the potential savings (stated for economic and environmental impact) shall be provided to building users and occupants.

Monitoring and targeting

Energy targets and benchmarks shall be provided for the building and tenancy as well as a metering and sub-metering strategy, with details on how to record and present meter readings.

Building services

A description of the basic functioning and operation of the following shall be provided, with simplified system diagrams and explanation of energy-saving features:

- ventilation
- heating system
- cooling system
- electrical systems
- lighting
- domestic hot water
- fire detection and protection systems
- lifts.

Transport facilities

Car-parking requirements, including details of the provision of cycling facilities, conditions of access and appropriate use, shall be provided. Also, if applicable, local public transport information, maps and timetables, and information on or links to alternative methods of transport to the workplace (eg, carpooling) shall be provided.

Materials and waste policy

Information shall be provided on recycling, including what can be recycled, where the recycling storage areas are and schedules for waste/recycling removal. Include instructions on the proper use for less common practices such as composting.

Expansion/re-fit considerations

A list of environmental recommendations shall be provided for consideration, highlighting in particular the areas covered in the building users' guide, Green Star and the Green Building Council Australia's *Clean Up Your Office* guide (ie, use of environmentally friendly materials, re-use of other materials, exhausts for printing/photocopying rooms, etc).

References and further information

Links to relevant information shall be provided, including websites, publications and organisations relating to energy and water conservation, efficient building operation, indoor air quality/sick building syndrome, environmentally friendly design features, etc.

4.4.2 Operation and maintenance manuals

Operation and maintenance manuals shall be of high quality and in a consistent format, and shall provide a detailed installation record, describe system operation, and detail maintenance requirements.

4.4.3 As-built drawings

As-built drawings shall be provided, including: schematics, diagrammatics, general arrangement drawings, plant room drawings, schedules, controls schematics, and wiring diagrams of control panels.

4.4.4 Electronic format of as-built documentation

The contractor shall provide all building user guides, maintenance documentation and as-built drawings in electronic CD format and hard copy format.

4.5 Instructing the employer's staff to operate systems and equipment

The contractor shall provide a structured programme of training and instruction to the building operating staff before completion to explain the purpose and function, operation and maintenance of the works.

4.6 Practical completion and handover

The building shall only be accepted for handover when the following have been delivered:

- proof that the commissioning of the building meets the requirements of Green Star MAN 2, MAN 3, MAN 4 and MAN 5
- a report for the independent commissioning agent to verify the commissioning process is complete, with the exception of post-occupancy fine-tuning
- all necessary producer statements and certificates of compliance
- a 'complete for review' set of all as-built drawings
- a 'complete for review' set of all operations and maintenance manuals and a building user guide
- training of building operating staff has been completed
- a statement from all consultants that the contract works are in their opinion complete and acceptable for occupation
- acceptance from the Insurance Council for fire services
- a final inspection report from the territorial authority, including their documentation requirements for the Code Compliance Certificate application
- confirmation that the builder has lodged the Code Compliance Certificate application, and copies of the application have been passed to the developer's/building owner's project manager for acceptance
- all written guarantees required to be obtained by the builder under the outline building brief.

4.7 Post-occupancy

4.7.1 First year of operation and defects/warranty period

Any faults or defects that become apparent during the warranty period shall be promptly remedied by the builder/subcontractors.

The commissioning agent shall return initially on a monthly basis for the first three months and then quarterly through the defects/warranty period to review system operation and to liaise with facility staff to address any performance problems and faults.

A monthly log of energy and water consumption shall also be kept and reconciled with agreed performance targets. Any non-performance problems shall be addressed as part of the system's fine-tuning and operational practices.

4.7.2 Subsequent years of the lease term

A building management committee (BMC) shall be formed by representatives of the landlord and tenant. As part of their general remit for operating the building they shall be responsible for guiding its environmental performance. An environmental management plan (EMP) shall be drawn up to structure and assist with this activity.

Within three months from completion, a comprehensive maintenance programme shall be entered into for maintenance, service, repair and replacement to ensure the building services, equipment and associated fixtures and fittings are maintained and kept in good operational order on a continuous basis and to an appropriate high standard.

An annual warrant of fitness shall be provided for specified systems, requiring a compliance schedule. The building owner shall ensure continued effective operation of those features and systems and shall sign and display an annual building warrant of fitness.

Energy and water usage shall be audited and reconciled with the agreed performance targets on an annual basis.

A full technical audit of the building shall be carried out on a three-yearly basis by an independent consultant(s) who shall report to both the building owner and the tenant concurrently. The audit shall review the condition and performance of the building in relation to the requirements and performance measures of the building performance specification (BPS). The review shall also include all tenancies and any impact of any subsequent fitting out work since completion or the last audit. The need for any corrective actions such as partial re-commissioning to restore operational performance shall be identified. Any failure to maintain energy and water usage performance or building performance standards shall be dealt with in accordance with the lease mechanisms.