Data Center Commissioning Guideline

Document Number: *********

Revision	Revision Date	Written By	Notes
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1. Introduction

The purpose of this document is to provide a structured framework that outlines the key responsibilities, protocols, guidelines, and standards to be followed throughout the commissioning process, so that the project team can effectively manage the commissioning activities, facilitate seamless communication, and ensure compliance with the client's expectations, industry codes, regulations, and best practices.

The document is organized into several sections, each addressing specific aspects and delving into the details of the commissioning process, highlighting the role of the commissioning team, communication protocols, recommended electronic platforms and software, and the importance of commissioning meetings for effective coordination and progress tracking.

It also emphasizes the significance of comprehensive reporting, providing guidance on the types of reports to be generated at different stages of the commissioning process, and address the development of a well-structured commissioning program, documentation requirements, system studies, commissioning strategies, training of facility staff, and the use of tools and instruments.

Note: It is important for all people involved in the process to familiarize themselves with the content of this document and apply the guideline requirements, helping contribute to overall success of the project.

2. Commissioning Delivery Overview

Utilizing a clear and concise Commissioning Process on the project will ensure the quality delivery of the building's systems and equipment.

The process will verify and document that the building and its systems are planned, designed, installed, tested, and can be operated and maintained, meeting the Owner's Project Requirements [OPR], the systems' future operations, costs, and maintenance of the building.

This Commissioning Guideline should be read in conjunction with all information, including the commissioning strategies and commissioning specification/plans/guides, as it describes the process, and responsibilities of advancing the systems through the commissioning stages that are to be undertaken by All Parties involved before moving through to the Occupancy and Operations/Continuous Commissioning Stages.

Evaluation of the operation of the systems will be based upon the Owners Project Requirements Document [OPR] and approved project documentation requirements, after which the Owner's operating staff will then be instructed in the correct system's operation and maintenance.

All elements of the systems and equipment should be thoroughly tested and commissioned to ensure they perform as required, proving its planned purpose, and that all performance criteria are being met before handover to the Owner for daily operation.

Testing and Commissioning records and documents shall be written, managed, issued, and reviewed/approved by various parties throughout the project, as noted in later sections, and shall be maintained systematically for future easy and quick reference by the Owners teams and maintenance staff.

Document formats and structure including and how this data is captured, held, and filed shall be agreed upon by all parties. This is detailed further in the document.

Non-conformances discovered in the testing and commissioning works shall be recorded and monitored for prompt rectification by the CxP/General Contractor. Any items raised should be rectified and closed out within 14 days.

The testing and commissioning works will be programmed and structured to let the **Owner's** operations and maintenance Engineers participate in the tests of the different systems to allow a better understanding of the operation and maintenance of the building, with them being invited to all testing so that they can accept to attend or not.

All activities shall be planned with flexibility so that testing can be completed immediately after completing the installation works and pre-commissioning checks on-site.

A fully sequenced commissioning programme shall be produced, with all interdependencies and integrated tests clearly detailed by the General Contractor, to confirm the date and order that the plant and equipment shall be commissioned. This should also be integrated fully with the construction sequence of the building.

The following sections provide additional information and details of how the commissioning process will be managed and documented.

2.1. Delivery Basis of Commissioning & Responsibility

The overall commissioning delivery process will be based upon this document, focusing upon Data Centre Levels 0 to 6:

Level	Description	Overall Responsible	Tag Colour
Level 0	Design and Planning	General/Main Contractor	
Level 1	Factory Testing	General/Main Contractor	Red
Level 2	Component and System Delivery, Installation and Pre-Start-up	General/Main Contractor	Yellow
Level 3	Pre-Functional Systems and Equipment Start-Up	General/Main Contractor	Green
Level 4	Systems and Equipment Functional Performance Testing	Commissioning Agent	Blue
Level 5	Integrated Systems Testing	Commissioning Agent	White
Level 6	Closeout and Turnover	Commissioning Agent	

2.2. Commissioning Guidelines

The following documents should be referred to and will form a requirement of the overall delivery process for the Commissioning tasks and activities throughout the project.

ASHRAE Guideline 0 - the commissioning process.

- ASHRAE Guideline 1.1 - HVAC&R Technical Requirements.
- ASHRAE Guideline 202 - Commissioning Process for Buildings and Systems.

2.3. Commissioning Codes, Guides and Standards

The below details the requirements for the codes, guides, and standards. If there are any conflicts the most rigorous will take precedence.

Codes

All relevant country and local codes should be adhered to.

[add your specific codes that are to be used for the project]

Code	Description
[add]	[add]
[add]	[add]

Regulations

All relevant country and local regulations should be adhered to.

[add your specific regulations that are to be used for the project]

Regulation	Description
[add]	[add]
[add]	[add]

Standards

All relevant industrial standards should be referred and adhered to.

[add your specific standards that are to be used for the project]

Standard	Description
[add]	[add]
[add]	[add]

Guidelines

All industry guidelines should be adhered to as noted below.

[add your specific guidelines that are to be used for the project]

Guideline	Description
[add]	[add]
[add]	[add]

3. Commissioning Team Information

The Commissioning Team for the project will consist of two groups, 1. The Owner/Client Commissioning Management Team and, 2. The General Contractor Commissioning Management Team.

Each team member will have their specific roles on the project as noted in the overall responsibility matrices.

3.1. Owner Commissioning Team [CxP]

To ensure that the project testing and commissioning requirements are met and delivered in line with the Owners Project Requirements and Basis of Design documents, the Owner will employ a Commissioning Authority [CxP] based upon the following criteria:

- They can be a qualified employee of the owner, or
- An independent consultant
- The CxP company and their Engineers will be fully experienced with the Commissioning Process as noted within this document,
- Their experience will cover at least two projects with similar scopes and sizes,

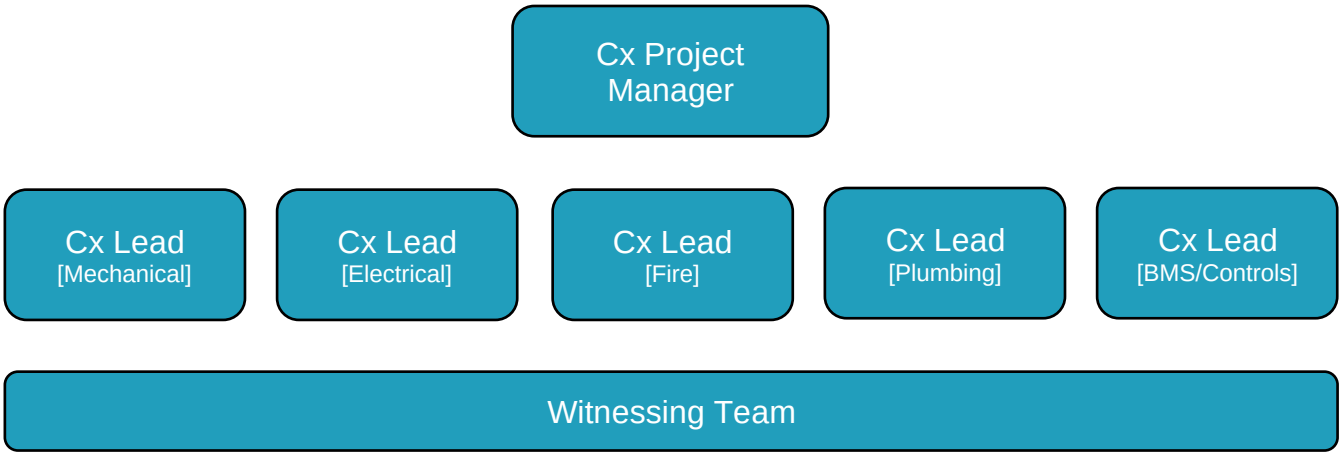
As noted above, their ultimate responsibility is to ensure that this testing and commissioning process including the tasks and activities, are delivered, and will be managed by:

- ensuring that the owners' interests are represented,
- providing advice to the project on any commissioning activities or concerns,
- reporting progress of the commissioning directly to the owner,
- overseeing the project commissioning process that is to be deployed,
- overseeing the general contractors commissioning delivery,
- resolving and oversee any commissioning related issues,
- documenting and verify that, upon completion the systems and equipment operate in line with the project requirements.

[For full responsibilities, refer to the responsibility matrices in later sections]

CxP High Level Organigram

The CxP team is expected to consist of the following roles for the project.



Cx Project Manager

Reporting directly to the Owner, the Cx Project Manager will be fully experienced and skilled at deploying, managing, and overseeing the complete commissioning process for the owner.

Cx Lead

Reporting directly to the Cx Project Manager, the Commissioning Lead will represent and be responsible for a particular discipline throughout the project.

They should be fully experienced in the discipline, how it operates and how to commission and validate it.

Witnessing Team

Reporting directly to the Cx Discipline Lead, the witnessing team will be responsible for the validation, verification and witnessing of all onsite activities that are to be delivered under the CxP scope of works.

They should be fully experienced in the witnessing and inspections they are carrying out.

General Contractor Commissioning Team

The General Contractor will be fully responsible for the delivery of the commissioning tasks and activities, to do this they should employ a 3rd Party Commissioning Management company to oversee the delivery of the process, integrating them with their own team.

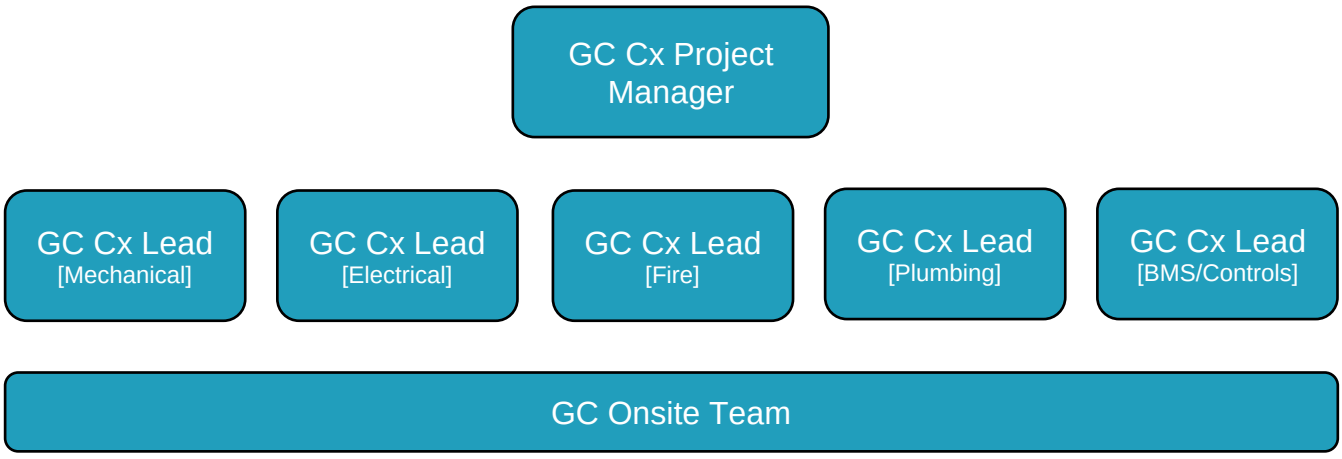
The contractors commissioning management company should have a proven track record and experience to deliver this type of project and process, to the expectations and quality as stipulated within this document.

[Note: For understanding of the full responsibilities, refer to the responsibility matrices in later sections.]

General Contractor High Level Organigram

To ensure that the GC achieves the expectations of this document and project it is advised that they engage an experienced 3rd Party Commissioning Consultant, used to this type of works.

The General Contractors team is expected to consist of the following roles for the project.



GC Cx Project Manager

The GC Cx Project Manager should be fully experienced and skilled at deploying, managing, and overseeing the complete commissioning process for a project of this size and design.

The Cx Project Manager will report directly to the Owners' Commissioning Team and Management.

GC Cx Lead

Generally, the expectation will be for the general contractor's project management/engineering installation team to transition over to the commissioning works when the installations are complete and signed off.

Each lead will be one of the project managers that are experienced in the systems and setting up/operating them.

They should report to the GC Cx Project Manager.

GC Onsite Team

The onsite team will be made up of operatives from the sub-contractors, vendors, novated contractors, novated vendors, and the testing, adjusting and balancing team [TAB].

There general roles will be to set up the systems, complete the testing requirements under the direction of the general contractors Cx Lead and document all testing.

They should report to the GC Cx Lead for each discipline.

4. Commissioning Communication Protocol

The ‘Commissioning Communication Protocol’ should aim to ensure structured, timely information flow, promote collaboration, and minimize communication gaps and misunderstandings for the project.

It should be developed and issued by the general contractor at the start of the project, for review by the Owners’ Commissioning Consultant.

As guidance it should include the following information.

4.1. Stakeholders

Identify the key stakeholders involved in the project, such as any project sponsors, client representatives, architects, designers, engineers, construction teams, and vendors.

List their roles and responsibilities within the project, along with their preferred communication methods and contact information.

4.2. Communication Channels

Specify the communication channels that will be used for project-related communication, examples include project meetings, email, project management software, collaborative platforms, messaging, and phone calls.

Explain the purpose and appropriate usage of each channel to ensure consistent and effective communication.

4.3. Communication Frequency

Define the frequency of communication for various stakeholder groups and project phases, for example, meetings may be conducted weekly, while progress reports can be shared monthly.

Tailor the communication frequency to meet the specific needs of each stakeholder group.

4.4. Escalation Procedures

Outline a clear escalation process for resolving issues or addressing urgent matters, and define the hierarchy of escalation, indicating who should be contacted, when, and how. This ensures timely resolution and prevents delays in decision-making.

Include contact information for escalation points.

4.5. Communication Templates

Provide standardized templates and flow diagrams for common project communication, such as meeting agendas, minutes, progress reports, and change requests.

These templates ensure consistency and clarity in communication.

Include these templates as appendices.

4.6. Language and Tone

Emphasize the use of clear and concise language in project communication.

Encourage stakeholders to avoid technical jargon and use plain language whenever possible to ensure easy comprehension by all.

4.7. Communication Review

Highlight the importance of periodically reviewing and evaluating the effectiveness of the communication protocol and encourage stakeholders to provide feedback on their communication experiences and suggest improvements.

Use this feedback to refine the protocol and enhance communication efficiency throughout the project.

5. Electronic Platforms and Software

The project will utilize two types of electronic platforms relating to the testing and commissioning works, tasks and activities. These will cover:

- Document Management and,
- Commissioning Management.

5.1. Electronic Document Management Platform

The project will utilize '*Add the Platform Name*', which is a cloud-based construction management software that will help manage the project from start to finish by offering a range of management tools and features such as project documentation, communication, financials, quality and safety, and project insights.

Using this platform will allow us to collaborate across the whole project creating, storing, and sharing all types of documents in a centralized location, streamlining distribution, versioning, and ensuring accurate delivery of the project information.

High Level Roles Responsibilities

Ref	Tasks and Activities	Owner	CxP	Designer	General Contractor
1	Source and **pay** for platform	●			
2	**Set up platform** and provide guidance on usage expectations	●			
3	Arranging **Training** specific to Commissioning for CxP Team	●	●		
4	Arranging **Training** specific to Commissioning for Design Team	●		●	
5	Arranging **Training** specific to Commissioning for GC Team	●			●

Ref	Tasks and Activities	Owner	CxP	Designer	General Contractor
6	Attending **Training** Sessions	●	●	●	●
7	**Uploading** required documents and information to progress and close out the Commissioning Process	●	●	●	●
8	Pulling Data and Creating Commissioning Progress **Reports**		●		●

5.2. Electronic Commissioning Platform

For managing the specific commissioning process, the project will utilize '*Add the Platform Name*'.

The platform will provide the project with the tools for commissioning management, helping streamlining issue tracking, document management, and reporting of activities.

It will allow the Commissioning Team, including the Owner, Designer, General Contractor, and Commissioning Authority, to collaborate in real-time and manage the commissioning process from start to finish.

High Level Roles Responsibilities

Ref	Tasks and Activities	Owner	CxP	Designer	General Contractor
1	Source and **pay** for platform		●		
2	**Set up platform** and provide guidance on usage expectations		●		
3	Provide Checklist Templates		●		
4	Create Checklist for Level 0		●		
5	Create Testing / Equipment **Template Format** for **Level 1** and		●		

Ref	Tasks and Activities	Owner	CxP	Designer	General Contractor
	issue to GC				
6	Create Testing / Equipment **Template Format** for **Level 2** and issue to GC		●		
7	Create Testing / Equipment **Template Format** for **Level 3** and issue to GC		●		
8	Create Testing / Equipment **Template Format** for **Level 4**		●		
9	Create Testing / Equipment **Template Format** for **Level 5**		●		
10	Create Template Format for Level 6		●		
11	**Manage** Closeout Items for **Level 0**		●		
12	**Populate Templates** and Issue to CxP for Uploading **Level 1**				●
13	**Populate Templates** and Issue to CxP for Uploading **Level 2**				●
14	**Populate Templates** and Issue to CxP for Uploading **Level 3**				●
15	**Populate Templates** and Issue to Client for Uploading **Level 4**		●		
16	**Populate Templates** and Issue to Client for Uploading **Level 5**		●		
17	**Populate Templates** and Issue to Client for Uploading **Level 6**		●		

Ref	Tasks and Activities	Owner	CxP	Designer	General Contractor
18	Input and responsible for managing closeout **Observations and Issues** for **Level 1**				●
19	Input and responsible for managing closeout **Observations and Issues** for **Level 2**				●
20	Input and responsible for managing closeout **Observations and Issues** for **Level 3**				●
21	Input and responsible for managing closeout **Observations and Issues** for **Level 4**		●		
22	Input and responsible for managing closeout **Observations and Issues** for **Level 5**		●		
23	Input and responsible for managing closeout **Observations and Issues** for **Level 6**		●		
24	Pulling Data and Creating Commissioning Progress **Reports for all Levels**		●		

5.3. Document Control Resources

Due to the quantity of information that is expected to be produced and managed on the project, the general contractor should ensure that it is managed in a central location, this is to be done by employing experienced ‘Document Controller/s’.

The Document Controller should be fully experienced in the platforms being used; and be responsible for managing the General Contractors information, ensuring it is efficiently being processed, collaborating with the Owners’ team.

Below are listed some expectations for the resources:

General Responsibilities

- Support in setting up and configuring the electronic document platforms for construction projects, ensuring proper access control and user permissions,
- Establish document control procedures and standards, ensuring compliance with project requirements and industry best practices,
- Manage the uploading, organization, and categorization of project documents on the electronic platforms,
- Oversee the document approval process, tracking document versions, and ensuring timely reviews and approvals,
- Collaborate with the Owner Project Teams to ensure accurate and up-to-date documentation, including drawings, specifications, and contracts,
- Monitor the integrity of the electronic document platforms, resolving technical issues and providing user support as needed,
- Conduct regular audits to ensure adherence to document control procedures and identify areas for improvement,
- Generate reports and metrics related to document control activities, highlighting key performance indicators and trends.

Document Controller Qualifications:

- Certification in the platform being adopted for the project,
- Previous experience as a Document Controller or similar role,
- Strong knowledge of electronic document management systems and platforms,
- Proficiency in using document control software and tools,
- Excellent organizational and time management skills,
- Exceptional attention to detail and accuracy,
- Strong communication and interpersonal skills to collaborate effectively with project teams and stakeholders,
- Familiarity with construction project documentation and processes,

- Ability to adapt to changing project requirements and priorities,
- Relevant certifications or training in document.

5.4. Electronic Platform Training

Full training of both platforms will be provided by the Owners Team, which the project team should allow attendance of.

Training Methodology

The training will be conducted through a combination of interactive sessions, demonstrations, and hands-on exercises, covering the platform's functionalities, structure, configuration, and project standards to ensure efficient document control and management of the commissioning process throughout the project lifecycle.

Participants will have the opportunity to practice using the platforms under the guidance of the trainers, with training materials, including user manuals and reference guides, will be provided for future reference.

Duration

The training duration will depend on the complexity of the management platforms and the specific needs of the project.

A recommended timeframe of *2 days* is suggested to cover all the necessary topics comprehensively.

Target Audience

The training is specifically designed for document controllers, engineers and project members of the Owner and General Contractor involved in the project.

It is essential for all individuals responsible for interacting with the platforms to attend the training to ensure there consistent and effective use, where upon completion of the training, participants should have a clear understanding of functionalities, configuration, and standards, being equipped with the necessary skills to efficiently manage the platforms, contributing to streamlined processes and enhanced collaboration within the project.

Training Topics

The below provides an overview of what will be covered at the training.

Introduction to the Document Management Platform

- Overview of the platform's purpose, benefits, and key features,
- Explanation of the platform's role in document control and management within the project.

Platform Structure and Navigation

- Familiarization with the platform's user interface and layout,
- Understanding the folder structure and organization of documents within the platform,
- Navigation techniques to locate and access relevant documents efficiently.

Document Upload and Version Control

- Instructions on uploading documents to the platform, including file naming conventions and metadata requirements,
- Understanding the version control mechanisms and procedures for document revisions and updates.

Document Approval Process

- Explanation of the document approval workflow within the platform,
- Step-by-step guide on submitting, reviewing, and approving documents,
- Understanding the roles and responsibilities of stakeholders involved in the approval process.

Document Retrieval and Distribution

- Techniques for searching, retrieving, and retrieving specific documents or document sets,
- Methods for generating and exporting document packages for distribution to relevant project members.

Platform Configuration and Customization

- Overview of platform configuration options and settings,
- Explanation of customization possibilities to align with project-specific requirements and standards.

Best Practices and Standards

- Guidelines for adhering to document management best practices,
- Explanation of project-specific standards, naming conventions, and metadata requirements.

Troubleshooting and Support

- Troubleshooting common issues and error messages,
- Contact information for technical support and assistance with platform-related queries.

6. Commissioning Meetings

Meetings will be held to foster effective communication, collaboration, and decision-making among the project team involved in the commissioning process, and should focus on items such as, coordination and collaboration, progress updates, issue resolution, decision making, documentation reviews, training and handover, stakeholder engagement etc.

Whilst some of these meetings will be conducted only once, there will be a requirement to conduct others in a recurring manner throughout the project programme, the frequency will vary depending upon the project's specific requirements.

6.1. Commissioning Kick-Off Meeting

The Owners Commissioning Consultant will hold a kick-off meeting to discuss the project's commissioning process before it is deployed at the Level 0 stage.

This meeting will mark the beginning of the commissioning process where the commissioning team gathers to discuss project goals, scope, roles, responsibilities, and establish a shared understanding of the overall commissioning objectives.

Usually attended by the Owner, Design Team, Commissioning Authority and General Contractor.

[To be completed by: Owners Commissioning Consultant]

6.2. Design Review Meetings

These meetings will involve reviewing the design documents and specifications of the building systems to discuss the design intent, system performance requirements, and any necessary design modifications or clarifications / commission ability issues.

Usually attended by the Owner, Design Team, Commissioning Authority and General Contractor.

[To be completed by: Owners Commissioning Consultant]

6.3. Controls Integration Meetings

Meetings relating to the operation sequence and control logics will be organized by the general contractor.

The objective is to make it easier to address review comments and confirm that the control system and system sequences are comprehensive, verifiable, synchronized, and fulfil OPR requirements.

Usually attended by the Commissioning Authority, General Contractor, and Controls Vendors.

[To be completed by: General Contractor]

6.4. Pre-Construciton Meetings

To be held prior to the start of construction activities to discuss the commissioning plan, sequencing of installation, coordination requirements, and quality control procedures.

Usually attended by the Commissioning Authority and General Contractor.

[To be completed by: Owners Commissioning Consultant / General Contractor]

6.5. Progress Review Meetings

Will occur throughout the construction and commissioning phases of the project and focus upon tracking the completion of commissioning activities, installation, testing / witnessing and addressing any issues or delays encountered.

Usually attended by the Commissioning Authority and General Contractor.

[To be completed by: Owners Commissioning Consultant / General Contractor]

6.6. Functional Performance Testing (FPT) Meetings

FPT meetings are conducted to review and discuss the testing procedures, protocols, and results for individual building systems, where required, to evaluate system performance, identify deficiencies, and determine necessary corrective actions.

Usually attended by the Commissioning Authority and General Contractor, Contractors, and Vendors.

[To be completed by: Owners Commissioning Consultant]

6.7. Daily Catchup Meetings

Throughout the Level 2 to Level 5 works, daily catchups will be held with the team to keep all relevant parties up to date.

The catchups will allow for reporting of daily progress, issues and discuss planning for future works and testing.

Usually attended by the Commissioning Authority and General Contractor, Contractors, and Vendors.

[To be completed by: Owners Commissioning Consultant / General Contractor]

6.8. System Integration Meetings

These meetings involve coordinating the integration of various building systems, and to discuss the interdependencies between systems, conduct compatibility checks, and ensure proper coordination and communication for successful system integration.

Usually attended by the Commissioning Authority and General Contractor, Contractors, and Vendors.

[To be completed by: General Contractor]

6.9. Training and Handover Meetings

Will be used to focus on training building operators and maintenance staff to help coordinate the transfer of knowledge related to the operation and maintenance of the commissioned systems and facility.

Usually attended by the Commissioning Authority and General Contractor and Facility Team.

[To be completed by: General Contractor]

6.10. Final Commissioning Meeting

This will mark the completion of the commissioning process for the project, it will be used to review the overall activities, discuss the final commissioning report, and obtain final sign-off and acceptance of the commissioned systems.

Usually attended by the Owner, Designer, Facility Team, Commissioning Authority and General Contractor.

[To be completed by: Owners Commissioning Consultant]

6.11. Lessons Learned Meeting

This will be a collaborative session where the project team come together to reflect on the project's successes, challenges, and areas for improvement, providing an opportunity to share valuable insights and experiences gained during the project, identify best practices, and discuss strategies to enhance future project execution.

The focus is on capturing lessons learned to optimize project outcomes, mitigate risks, and promote continuous improvement in project management and delivery.

Usually attended by the Owner, Designer, Facility Team, Commissioning Authority and General Contractor.

[To be completed by: Owners Commissioning Consultant]

7. Reporting

Reporting will be a crucial aspect of the project, providing a regular update on the overall progress of the commissioning activities, documentation, testing, and issues/resolutions that have been encountered.

For this project the frequency will be as per the below table for each level of building commissioning reports being issued is an important consideration.

Level	Daily	Weekly	Monthly	End of Project
0			●	
1			●	
2		●	●	
3	●	●	●	
4	●	●	●	
5	●	●	●	
6				●

7.1. Daily Report

The daily report should be a concise document prepared and distributed to the project team daily to provide an overview of the previous day's activities, progress, and significant events related to the commissioning works.

It serves as a snapshot of the project's daily operations and will help keep the team informed and updated.

[To be completed by: Owners Commissioning Consultant / General Contractor]

7.2. Weekly Commissioning Updates

Write and distribute a high-level weekly report to the project team, outlining the progress of commissioning documentation and the status of systems commissioning. This report should be based on the plant schedule/tracker downloaded from the electronic commissioning platform and should also highlight any issues that require the team's attention.

[To be completed by: Owners Commissioning Consultant / General Contractor]

7.3. Monthly Commissioning Report

A monthly report will be issued at the end of each month, adding depth and detail to the weekly reports, and providing a comprehensive overview of the project's status. It will cover all trackers, method statement statuses, open/closed issues, and updates on the progress of the works through program updates, and other relevant information.

[To be completed by: Owners Commissioning Consultant / General Contractor]

7.4. Level Completion Report and Closeout

After the installation of all coloured tags upon the completion of each Level [1, 2, 3, 4 & 5], the General Contractor will generate and distribute a high-level closeout report to the Owner's Commissioning Consultant.

This report will serve as documentation that tasks and activities for the respective level have been completed.

For Levels 4, 5 & 6, if needed, the owners CxP will handle the completion process.

[To be completed by: Owners Commissioning Consultant]

7.5. Final Commissioning Report

Once all testing and commissioning tasks and activities have been successfully completed at Level 5, the Owner's Commissioning Consultant will prepare and release a final commissioning/closeout report for approval by the owner.

This detailed report will highlight the successful completion of all tasks and activities, serving as a comprehensive documentation of the project's commissioning status and as a reference for the ongoing operations of the facility.

Once issued the report will be reviewed by the owner to ensure accuracy and compliance with project requirements before being finalized and officially issued.

[To be completed by: Owners Commissioning Consultant]

7.6. Project Turnover Report

The Level 6 Project Turnover Report, written by the Owner's Commissioning Consultant, will be used as a formal document that provides an overview of the project's final status and key deliverables. It will serve as a comprehensive summary of the project's outcomes, achievements, and any outstanding items, helping with the smooth transition from the project construction team to the owner and facilities, who will be responsible for its ongoing operation.

Could be combined with the 'Final Commissioning Report'.

[To be completed by: Owners Commissioning Consultant]

8. Commissioning Programme

8.1. Fully Integrated and Coordinated

A commissioning program will be produced that is clear, comprehensive, systematic, fully coordinated, sequenced, and timed, detailing the process, tasks and activities that are to be completed to meet the overall construction programme, this document, and the Owners Project Requirements.

The format should be as a Gant Chart or a Logic Diagram.

[To be completed by: General Contractor]

8.2. 2 Week Look Ahead

Developed from the main commissioning programme, and expected site works, a rolling 2 week look ahead programme shall be produced, from Level 2, that details the schedule of works to be inspected and witnessed by the commissioning team, to allow the planning of the validation resources in advance.

The look-ahead will typically be expected to include the following information:

- Individual test number
- Description of test
- Date of test
- The start time of the test
- Finish date of the test
- Reference of method statement/testing procedure the testing is to be conducted under
- General/Main Contractor engineer responsible
- Status of the test

It will be updated each day to ensure the information is fully up to date.

[To be completed by: Owners Commissioning Consultant / General Contractor]

8.3. Daily Schedule

During the commissioning works relating to Levels 3, 4 & 5 a daily schedule will be produced that outlines the activities and tasks to be accomplished on a specific day including resource allocation / expectations.

It will provide a detailed plan for the commissioning team, indicating the sequence of activities, durations, and resource allocations.

[To be completed by: Owners Commissioning Consultant / General Contractor]

8.4. Early Handover of Areas

If due to the sequence of the programme, it is possible for areas to be handed over early, an early handover programme will be created and issued.

[To be completed by: General Contractor]

8.5. Recovery Programme

Where elements of a project are in delay, a ‘task-related’ recovery programme will be produced listing each activity needed to bring the commissioning activities back within the project’s overall programme requirements.

[To be completed by: General Contractor]

9. Commissioning Documentation

All commissioning documentation will be uploaded and managed via the Electronic Document Management Platform.

The General Contractor should ensure that their team are fully trained on the system, processes, and expectations.

Below provides a brief overview of some documentation that will be created, maintained, and reviewed throughout the complete Commissioning Process, there is also a list showing others that will be expected to be produced and provided as an example / expectation.

[All documents should be written in line with the requirements of ASHRAE Guideline 0 – The Commissioning Process | Guideline 202 – Commissioning Process for Buildings and Systems and 1.1 - HVAC&R Technical Requirements for The Commissioning Process.]

[For the roles and responsibilities refer to the roles and responsibilities matrices later in this document].

9.1. Submittal and Sampling Rates

The Commissioning Authority will conduct the following sampling rates for any commissioning related documentation that is issued.

Type	% Reviewed
Design Documents	100%
Construction Documents	100%
Handover Documents	100%

9.2. Numbering System of Documents

To ensure effective document management and clarity throughout the project, the General Contractor is required to implement the Owners specific document numbering requirements.

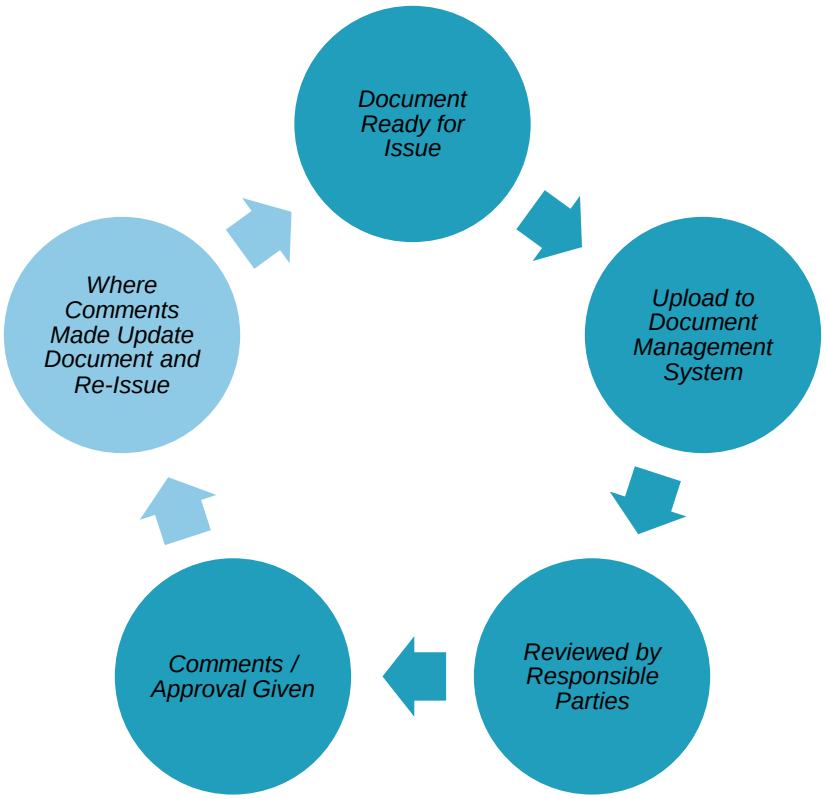
[See contract specific numbering requirement document]

These requirements aim to streamline communication, enhance traceability, and facilitate efficient retrieval of project-related information.

[To be completed by: Owners Commissioning Consultant / General Contractor]

9.3. Documentation Workflow

A workflow for all commissioning-related documents that are required to be reviewed and approved will be set up and utilized for the project in line with the following example:



Having a proper workflow in place will ensure that each document is thoroughly reviewed and approved, reducing the risk of errors or omissions that could impact the overall commissioning process, providing transparency and accountability, allowing all parties involved to track the progress of the document review and approval process.

[To be completed and issued by: General Contractor]

9.4. Types of Documents

The below provides a list of ‘common’ documents’ [information only], that will be expected for the commissioning process. The General Contractor should review and include any items that will be required and not included here.

Commissioning Documentation List

A commissioning documentation list will be issued to outline all the documentation required during the commissioning process for the project.

[To be completed and issued by: General Contractor]

Commissioning Documentation Register

Using the Commissioning Documentation List above, a Commissioning Document Register will be created and used as a centralized record-keeping system that tracks and manages all commissioning-related documents, serving as an index, providing easy access to the commissioning documents.

[To be completed and issued by: General Contractor]

Commissioning Team Organigram

A commissioning team organigram will be created to provide a graphical representation of the organizational structure of the project commissioning team.

It should illustrate the roles and responsibilities of team members, their reporting lines, and the overall hierarchy of the team.

[To be completed and issued by: General Contractor]

Owners Project Requirements [OPR]

The Owners Project Requirement Document [OPR] will be used as a reference to understand the baseline of the owners needs and expectations for the project building services systems from the outset.

The document will detail and define the concept of the project and provide the basis from which all design, construction, acceptance, and operational decisions are made, and provide a reference for the Basis of Design [BOD] to be created.

[To be completed and issued by: Owner Commissioning Consultant]

Basis of Design Document [BOD]

The Basis of Design Document [BOD] is written to provide all participants involved with the project a baseline, narrative, and overview of how the final design of the HVAC/Electrical/Plumbing and Fire equipment, systems, and integrations related to the project have been selected and designed against the Owners Project Requirements [OPR].

[To be completed and issued by: MEP&F Designer]

Project Specifications

The project specifications should be developed after the Basis of Design has been written and approved by the team and project owner.

Once approved, they will then be monitored for any changes and revisions.

[To be completed and issued by: MEP&F Designer]

Project Drawings

There will be 4 types of drawings provided for the project throughout the different stages:

- Layout Drawings
- Schematic Drawings
- Construction / Shop Drawings
- Record / As Built Drawings

Each stage of drawings will be reviewed by the CxP to ensure that they do not note any issues and the systems, equipment and instruments can be functionally tested and commissioned.

Layout Drawings

Layout drawings will be provided to convey detailed information on the arrangement and placement of building services systems within the facility and project.

These drawings typically will include detailed plans, sections, and elevations that illustrate the specific layout and configuration of the mechanical, electrical, plumbing, and fire protection systems.

[To be completed and issued by: MEP&F Designer / General Contractor]

Schematic Drawings

The schematic drawings will provide a simplified representation of the building services systems, focusing on the overall functional relationships and interactions of the systems.

They typically use block diagrams, flowcharts, and symbols to convey the general concepts and design intent of the systems, without the level of detail found in layout or construction drawings.

[To be completed and issued by: MEP&F Designer / General Contractor]

Construction / Shop Drawings

Construction or shop drawings are detailed drawings that will be created by the General Contractor during the construction phase of the project.

These drawings will be fully coordinated to provide a comprehensive and detailed representation of the design and installation details of the building services systems, and they are typically used for construction and installation purposes.

[To be completed and issued by: General Contractor]

Record / As Built Drawings

Once the installations have been installed and inspected, 'Record' or 'As-Built' drawings will be created and issued to the project team by the General Contractor documenting the actual physical condition and configuration of the building services systems within the facility.

These drawings will detail any changes, modifications, or deviations from the original design or shop drawings that were made during the construction process and will serve as a comprehensive and accurate record for future operation of the building.

[To be completed and issued by: General Contractor]

Project Control Logics

The control and sequence of operation logics will follow a similar development as the project drawings.

As with the drawings, all control logics and sequence of operations will be thoroughly reviewed and commented upon by the CxP, before programming and functional testing.

[To be completed and issued by: MEP&F Designer]

BMS Points List

The Building Management Systems [BMS] Points List will provide and outline of all points or data sources that will be integrated into the building system for monitoring, controlling, and managing various building systems.

The points will be connected to various items of equipment, sensors, controllers, actuators, meters, and other devices that 'collect data' or 'control equipment'.

This document should be thoroughly reviewed and commented upon by the Owner's Commissioning Consultant and MEP Designer prior to implementation on site and be used as a reference when conducting the functional testing of the systems.

[To be completed and issued by: General Contractor]

BMS Graphic Document

The BMS Graphic document details the planned visual/graphical representations of the building systems and their associated data points displayed at the "head end" of the BMS.

The document should consist of graphical representations of the building layout, floor plans, or system diagrams, overlaid with icons, and symbols.

This document should be thoroughly reviewed and commented upon by the CxP prior to implementation on site and be used as a reference when conducting the functional testing of the systems.

[To be completed and issued by: General Contractor]

Commissioning Plan

The commissioning plan is written to allow the project understanding of how the testing and commissioning works will be completed and carried out from an off-site, on-site, and documentation point of view.

The plan will be updated throughout the project programme and each commissioning stage until the final revision at the Occupancy & Operation Stages, where it will be submitted within the Final Commissioning Report.

[To be completed and issued by: Owner Commissioning Consultant]

Commissioning Specification

A commissioning specification will be issued that outlines the requirements, procedures, and standards for commissioning and testing of the project and its systems.

[To be completed and issued by: Owner Commissioning Consultant]

Commissioning Programme

A commissioning programme is to be issued that outlines the tasks, activities, sequence, resources and timeframe for delivering the commissioning works for the project.

[To be completed and issued by: General Contractor]

Testing Strategies

Testing strategies will be produced, where deemed necessary, that detail and outline the scope and objectives of the testing, the systems to be tested, integrations, and define the methods and procedures for conducting the tests with any risks and their control analysed.

[To be completed and issued by: General Contractor]

Final Testing Information

Final testing information or ‘testing packs’ will be developed to ensure that all pre-functional and functional testing is completed correctly with the required supporting information.

[To be completed and issued by: General Contractor]

Issues and Resolution Log

A document should be produced and managed that documents any issues or problems that arise during the commissioning process, as well as the steps taken to resolve them.

This will serve as a formal and ongoing record throughout the project and ongoing commissioning phases.

[To be completed and issued by: General Contractor]

Electrical Discrimination Study

An electrical discrimination study report will be issued that analyses the full electrical systems to ensure that protective devices are appropriately sized and set to isolate faults or short circuits, minimizing downstream damage or hazards.

[To be completed and issued by: General Contractor]

Arc Flash Study

An arc flash study will be issued that analyses the electrical systems to identify potential risks associated with arc flashes caused by energy release from a fault or short circuit, the study will determine incident energy levels and assess the adequacy of protective measures, including circuit breakers, fuses, and personal protective equipment.

[To be completed and issued by: General Contractor]

Lock Out Tag Out Procedure

A Lockout/Tagout (LOTO) procedure is to be issued that clearly outlines and details the steps and controls that are to be taken for the energization, powering-up, isolation and de-energization of any equipment, machinery, and systems throughout the project delivery.

The document should be fully in line with local codes, regulations, and industry wide best practices.

[To be completed and issued by: General Contractor]

Plant Settings Document

A comprehensive ‘plant settings’ document will be issued, for each piece of equipment, to ensure that the mechanical and electrical plant, equipment, and systems are set, documented, able to be maintained and operating at the specified settings for optimal performance and energy efficiency.

[To be completed and issued by: General Contractor]

Temporary Load Bank & Equipment Plan

A temporary load bank & equipment plan will be written to clearly detail the requirements and provisions for temporary load banks and other necessary equipment, cabling, connections, switching, and instruments that will be required to test the data centre’s power and cooling systems under simulated operating conditions.

[To be completed and issued by: Owner Commissioning Consultant]

Computational Fluid Dynamics Study

A Computational Fluid Dynamics [CFD] study will be completed to model and analyse the flow of air and heat within each data hall when under normal working conditions, and generator room when the generators are running.

The analysis will help to identify design issues, hot spots, temperature gradients, and areas of low airflow, and test some critical simulated scenarios.

[To be completed and issued by: MEP&F Designer]

Project Fire Safety Report

A ‘Project Fire Report’ shall be written and issued, with its intention being to document and summarize the fire protection measures and systems for the project, it is sometimes also required by local authorities for review and approval.

The report will typically include information on the type and location of the fire protection systems, such as sprinklers, alarms, and smoke control systems, details on fire-rated walls, doors, evacuation assessments, hazard analysis and simulated fire scenarios.

[To be completed and issued by: General Contractor]

Project Fire Cause & Effect Matrix

A fire cause and effect matrix will be provided to identify and evaluate the causes and effects of a fire within the facility.

The matrix will map the relationship between the potential causes of a fire and its controlled effects, such as the spread of fire, smoke, and heat, as well as the activation of fire protection systems and the movement of occupants.

By identifying and evaluating these potential causes and effects, fire protection engineers can develop effective fire safety strategies and systems to prevent or mitigate the impact of a fire. The matrix can also be used to identify areas of high risk and prioritize fire safety measures.

[To be completed and issued by: General Contractor]

Factory Testing Reports

For each piece of equipment that is ‘Factory Tested’, a report will be provided to document the test results and that the equipment meets the design expectations prior to shipment.

It should be formatted and include information as per the commissioning guideline expectations.

[To be completed and issued by: General Contractor]

Construction Checklists

Construction checklists will be utilized by the Commissioning Team to ensure that the necessary materials and components are present, installed correctly, functional, and in compliance with the Owner's Project Requirements and Manufacturer’s needs.

[To be completed and issued by: General Contractor]

Level 1, 2, 3, 4 & 5 Procedures & Scripts

Comprehensive test procedures will be written and issued that outline the methods, personnel, and expectations for testing various components, equipment, assemblies, systems, and interfaces among systems within a construction project.

Their purpose will be to verify that the installation and operation of the systems are following the Owner’s Project Requirements, Basis of Design, Design and Manufacturer’s expectations.

[Level 1 Procedures - To be completed and issued by: General Contractor]

[Level 2 Procedures - To be completed and issued by: General Contractor]

[Level 3 Procedures - To be completed and issued by: General Contractor]

[Level 4 Scripts - To be completed and issued by: Owners Commissioning Consultant]

[Level 5 Scripts - To be completed and issued by: Owners Commissioning Consultant]

General Reporting

Monthly and weekly reports shall be issued, providing an overview of the commissioning progress and identify any issues that may require attention.

The reports shall be submitted in writing and include a description of the work performed during the reporting period, the work planned for the next reporting period, and any changes to the project schedule.

[To be completed and issued by: Owners Commissioning Consultant / General Contractor]

Training Manual

A facility training manual will be written and issued to provide detailed instructions for the operation and maintenance of each system, including safety procedures, troubleshooting guides, and preventive maintenance schedules.

It is an important resource for the facility management team, as well as for the training activities and any contractors or technicians who may be performing work on the systems during operations.

[To be completed and issued by: General Contractor]

Systems Manual

The systems manual will be issued upon the conclusion of the project, written in line with ASHRAE Guideline 1.4 ‘Preparing Systems Manuals for Facilities’.

It will serve as a comprehensive resource for the facility engineers and occupants to understand the design and construction of the facility, how to operate and maintain it, and how to improve its performance over time.

[To be completed and issued by: Owners Commissioning Consultant]

Building Logbook

Where the project is in the UK, there will be a requirement to write and issue a ‘building logbook’ under ‘part L’. It is intended to provide building operators and facility managers a clear understanding of their building, services, and how they all operate.

[To be completed and issued by: Owners Commissioning Consultant]

Final Commissioning Report

A Final Commissioning Report, in accordance with ASHRAE Guideline 0 and 202 will be issued at the conclusion of the project.

[To be completed and issued by: Owners Commissioning Consultant]

10. System Studies

System studies will cover any documentation that will be required to be developed and analysed to complete the overall testing and commissioning activities.

10.1. Electrical Discrimination Study

An electrical discrimination study will be completed to ensure that a full analysis has been completed on the electrical systems to ensure that the protective devices, such as circuit breakers and fuses, are properly sized and able to be set, isolating any faults or short circuits, and minimizing tripping downstream devices causing unwanted power outages, equipment damage, or even safety hazards.

The study is to be completed by the General Contractor who is to employ a qualified consultant utilizing the latest industry specialized software to model the system and determine the optimal settings required for each protective device.

Once complete, the study should be issued to the Owners Commissioning Consultant and Designer for review and approval.

[To be completed and issued by: General Contractor]

Protective Devices Settings

Once the installations are complete and prior to the Level 2 testing of cables each protective device should be set, documented, and verified.

[To be completed and issued by: General Contractor]

10.2. Arc Flash Study

An arc flash study will be completed to analyse the electrical systems, identifying any potential risks associated with arc flashes, which are a type of electrical explosion caused by a sudden release of energy due to a fault or short circuit.

The study is conducted to determine the incident energy levels that may be generated in the event of an arc flash and to evaluate the adequacy of existing protective measures such as circuit breakers, fuses, and personal protective equipment such as gloves, helmets, suits, and tools.

The study is to be completed by the General Contractor who is to employ a qualified consultant utilizing the latest industry specialized software to model the system.

Once complete, the study should be issued to the Owners Commissioning Manager and Designer for review and approval.

[To be completed and issued by: General Contractor]

Displaying Arc Flash Information

After the installations have been installed and prior to energization, signage should be used to warn the operatives of the electric arc flash hazards, with the labels meeting the guidelines as noted within NFPA 70e, with information being included as a minimum:

- Warning Sign
- Working Distance
- Voltage
- Arc Flash Distance
- PPE Level
- Locations and Equipment Number
- Arc Energy Level

[To be completed and issued by: General Contractor]

Scope of Arc Flash Study

- Arc flash incident energy - calculated based on latest IEEE 1584
- Arc flash boundary - according to NFPA 70e
- Limited approach boundary – in line with latest NFPA 70e
- Restricted approach boundary - according to latest NFPA 70E
- Arc flash risk level – in line with the PPE requirement as described in latest NFPA 70e.

10.3. Computational Fluid Dynamics Study

A Computational Fluid Dynamics (CFD) study will be completed to model and analyse the flow of air and heat within each data hall under normal operating conditions, and generator room when the generators are running, allowing for a detailed understanding of airflow patterns, temperature distribution, and heat transfer within the space.

Potential issues can be identified such as hot spots, temperature gradients, and areas of low airflow within the data hall, providing valuable insights into the performance and efficiency of the cooling system, helping to optimize its design and operation.

The study will also be used for testing various critical simulated scenarios, enabling the evaluation of different cooling strategies and the assessment of the spaces ability to handle unusual or extreme operating conditions such as failed plant and equipment.

[To be completed and issued by: MEP Designer]

11. Building Information Modelling [BIM]

The General Contractor should review the general contract to fully understand the BIM expectations for the overall project.

They should then follow these requirements with regards to any commissioning tasks and activities that will need to be deployed and completed under BIM requirements.

[To be completed by: General Contractor]

12. Commissioning Strategies

To aid in planning and programming the commissioning work, the General Contractor will develop strategies, for approval by the Commissioning Authority, that will focus on specific aspects of the testing and commissioning works, with the following areas given particular attention.

12.1. Energization and Power On

The strategy will outline the steps and schedule for safely energizing the electrical systems, ensuring that power is supplied to the required areas at the appropriate time. This includes coordinating with utility companies and adhering to safety protocols during the energization process.

Where not available, temporary solutions would be then investigated.

[To be completed by: General Contractor]

12.2. Cleaning of Pipework Systems

The strategy will detail the procedures for thoroughly cleaning the pipework systems to remove any debris, contaminants, or construction residues. Proper cleaning is crucial to ensure optimal performance, prevent blockages, and maintain the integrity of the systems.

[To be completed by: General Contractor]

12.3. Drainage Connection to the Utility

This strategy will address the proper connection of the building's drainage system to the utility infrastructure. It will outline the necessary steps, inspections, and coordination required to establish a functional and compliant drainage connection, ensuring it is ready and available for the commissioning activities to commence.

Where not available, temporary solutions would be then investigated.

[To be completed by: General Contractor]

12.4. Water Connection to the Utility

This strategy will address the connections and availability of the utility water ensuring it is ready and available for the commissioning activities to commence.

Where not available, temporary solutions would be then investigated.

[To be completed by: General Contractor]

12.5. Early Availability of Cooling for Load Testing

The strategy will focus on ensuring early availability of cooling systems to facilitate load testing of electrical equipment [generators, UPS, LVSB etc] and systems. This allows for comprehensive performance testing before the final handover, ensuring that the cooling systems can effectively handle the anticipated loads.

[To be completed by: General Contractor]

12.6. Early Handover Areas

The strategy will identify specific areas within the project that can be handed over early, enabling earlier occupancy or use. This requires careful coordination between trades and stakeholders to ensure that the necessary systems and components in those areas are fully functional and meet the required standards.

[To be completed by: General Contractor]

13. Training of Facility Staff

Training the building operations team is essential to ensure a smooth transition and effective operation of the facility after project handover.

The objectives and benefits of Facilities Staff Training are diverse and significant, with some key benefits being:

[To be completed by: General Contractor]

Preparation

The training aims to fully equip the team to take over and operate the building efficiently, by gaining a thorough understanding of the building's systems, equipment, and emergency procedures, ensuring a seamless operation.

Building Confidence and Competence

By offering hands-on training and practice opportunities, team members can develop the necessary skills and confidence to proficiently operate and maintain the building's systems and equipment. This promotes a competent and capable workforce.

Clear Roles and Responsibilities

Training helps establish clear roles and responsibilities within the team, enhancing communication, coordination, and teamwork. This clarity ensures efficient operation and a collaborative work environment.

Safety Promotion

Thorough training on emergency procedures, protocols, and proper equipment operation and maintenance reduces the risk of accidents and mistakes, ensuring the safety of all occupants and stakeholders within the facility.

Enhanced Building Performance

Equipping the building operations team with the knowledge and skills to effectively manage and maintain the facility results in improved performance. Optimal operation leads to enhanced comfort, efficiency, and satisfaction for the building's end users.

Culture of Continuous Learning

Training fosters a culture of continuous learning and improvement within the team. Ongoing training and development opportunities keep the staff updated on the latest technologies and best practices, enabling them to continually enhance their performance and the overall operation of the building.

Long-Term Time and Resource Savings

Investing in upfront training reduces risks, minimizing future mistakes and accidents. This not only saves time and resources but also can help avoid the need for costly corrective measures and repairs.

Cost Savings

By providing the necessary skills for effective building operation and maintenance, reliance on external consultants, contractors, and service providers can be reduced. This results in cost savings, as well as increased autonomy and responsiveness within the facility management team.

13.1. Training Manual Format

A training manual will be written that provides the project and building operations teams with the necessary knowledge, skills, and resources to effectively and efficiently take over and operate the building, equipment, and its systems.

The manual should cover the following information:

- the training objectives,
- project information,
- contact details,
- roles and responsibilities of staff involved in the training process,
- training content and methods,
- systems and equipment covered,
- training schedule
- emergency procedures,
- evaluation process to determine the success of the training, and
- references and resources for further information of the facilities staff.

[To be completed by: General Contractor]

13.2. Training Roles & Responsibilities

When considering the specific roles and responsibilities for the training tasks and activities, the following table can be used as reference:

Task	Owner	Facilities	CxP	Des	GC
Create **Initial** Training Requirements	Support	Support	Create	Support	n/a
Approval of the Initial Training Requirements	Approve	Approve	Support	Support	n/a
Inclusion of the Initial Training Requirements within the Tender Documentation	Support	Support	Manage	Support	n/a
Write **'Construction'** Training Manual & Programme	Support	Support	Support	Support	Create
Comment on Training Manual & Programme	Comment	Comment	Comment	Comment	n/a
Approve Training Manual & Programme	Support	Support	Approve	Support	n/a
Review Training Manual throughout Commissioning Process	Support	Support	Review	Support	Review
Update Training Manual if Required	Support	Support	Support	Support	Update
Approve Training Manual Updates	Support	Support	Approve	Support	n/a
Update and Include Training Materials and Final Information for Handover	Support	Support	Support	Support	Update
Issue Manual as part of the Handover Documentation	Support	Support	Support	Support	Update

Task	Owner	Facilities	CxP	Des	GC
Approve Final Training Manual and Materials	Support	Support	Approve	Support	n/a
Periodic Reviews and **Updating** of Manual	Review	Review	n/a	n/a	n/a

13.3. Operational/Facility Staff Experience

The Senior Facility/Operations Manager will ensure that their facility team members attending the training sessions are fully experienced, knowledgeable, and where applicable, hold all relevant qualifications for the equipment and systems that they are being trained upon.

13.4. Training Methods

The specific training methods that will be utilized for the building operations staff will depend on the needs and preferences of the team, as well as the nature of the equipment and systems being trained upon.

It is likely that a combination of delivery models will be used to provide a well-rounded and comprehensive training experience, with some examples being:

Lectures

This will involve a trainer or subject matter expert providing information and instructions to the trainees in a formal setting, such as a classroom or conference room.

Hands-On Training/Simulations

This involves the trainees participating in hands-on/simulated activities or exercises to practice operating and maintaining the equipment and systems. It will be done in a controlled environment, such as a training room, a set up space, or it can be done on site.

Online Training

Trainees will participate in training sessions or courses online, using a computer or other device. Online training will be self-paced or facilitated by a trainer and tracked.

On-Site

This method will involve the trainees learning and practicing their skills while working on the job under the guidance of an experienced team member or trainer.

13.5. Evaluation and Assessment

Evaluation and assessment will be conducted, after the training, to help determine its effectiveness, and to identify areas where additional training may be needed.

[To be completed by: Owners Commissioning Consultant]

There are several ways in which the evaluation can be conducted, including.

Quizzes/Exams

Quizzes and exams can be used to assess the knowledge and skills of the operational staff during and after the training. These assessments will be in the form of written exams, online quizzes, or hands-on tests, depending on the nature of the training.

Observation and feedback

Observation and feedback from trainers will be a valuable way to evaluate the progress of the operational staff as they can observe them as they practice and perform tasks.

Self-assessment

Self-assessment will be a useful tool for operational staff to evaluate their own progress and identify areas where they may need additional training. This will be in the form of a self-assessment questionnaire.

Post-training evaluation

A post-training evaluation will be used to assess the effectiveness of the training once it is completed. This will be in the form of a questionnaire that asks the operational staff and attendees to evaluate the training and provide feedback on its content and delivery.

13.6. Training Records

Training records will be kept and filed for each session for future reference and to allow the facilities manager to document and log who within their team has been trained on which piece of equipment and/or system.

[To be completed by: Owners Commissioning Consultant]

14. Draft List of Documents

The following [draft] list of documents would be expected to be written and issued throughout the project to ensure that the commissioning activities are completed and recorded in line with expectations for Level 0 to Level 3 [General Contractor] and Level 4 to Level 6 *[Owner Commissioning Consultant].*

The numbering format will be as per the project requirements, that will be agreed and developed during the Level 0 tasks and activities.

[Level 2&3 documents can be merged and issued as a single document that clearly separates the two Levels.]

14.1. Level 0 Documentation

DESIGN & PLANNING

[Written & Managed by CxP / General Contractor]

The Level 0 stage is used for setting up the commissioning process, reviewing designs, writing, and issuing various documentation, programming and agreeing the overall delivery.

It equates to the pre-design / design stage that is described within the Commissioning Guideline produced by ASHRAE [Guideline 0 – The Commissioning Process].

Ref	Document Title	Notes
L0-1	Commissioning Documentation Index	Also, can be used as a document register.
L0-2	Data Centre Commissioning Guideline Document	This document.
L0-3	Commissioning Process Flow	To show the overall high level commissioning process.
L0-4	Commissioning Team Organigram	Create an initial one, then update throughout the project as people leave/join the team.
L0-5	Commissioning Plan	Based upon this Commissioning Guideline.
L0-6	Tag/Level Coloured Sticker	Create a template that is to be used and issue in line with project requirements.

Ref	Document Title	Notes
L0-7	Commissioning Issues Tracker	Create a template that is to be used and issue in line with project requirements.
L0-8	Daily Report	Create a template that is to be used when needed during Level 3 to 5.
L0-9	Weekly Report	Create a template that is to be used and issue in line with project requirements.
L0-10	Monthly Report	Create a template that is to be used and issue in line with project requirements.
L0-11	Commissioning Programme	
L0-12	Commissioning Logic Diagrams	These will be used if agreed instead of a standard Gant Chart.
L0-13	2 Week Look Ahead	Create a template that is to be used and issue in line with project requirements.
L0-14	Facilities Training Document	
L0-15	Facilities Training Programme	
L0-16	Commissioning Review Document	Review of the design for commissioning ability.
L0-17	Commissioning Strategy Documents	There could be multiple strategy documents written and created for the project.
L0-18	Testing Procedure Layout	Create a template that is to be used and issue in line with project requirements.
L0-19	Final Test Pack Layout	Create a template that is to be used and issue in line with project requirements.
L0-20	Temporary Load Bank and Equipment Plan	

Ref	Document Title	Notes
L0-21	Building Management System Points List	
L0-22	Building Management System Graphic Document	
L0-23	Electrical Lock Out Tag Out Procedure	
L0-24	Electrical System Discrimination Study	
L0-25	Plant and Equipment Settings Document	This is issued detailing the settings that will be validated for each piece of equipment.
L0-26	Arc Flash Study	
L0-27	Arc Flash Sticker Template	Create a template that is to be used and issue in line with project requirements.
L0-28	Computational Fluid Dynamics Study [CFD]	
L0-29	Fire Cause & Effect Matrix	
L0-30	Material Submission Document List	
L0-31	Condenser Water Sequence of Operation Logic Diagram	
L0-32	Chilled Water Sequence of Operation Logic Diagram	
L0-33	Heating Water Sequence of Operation Logic Diagram	
L0-34	Dx System Sequence of Operation Logic Diagram	

Ref	Document Title	Notes
L0-35	Primary Air Handling Unit (PAU) Sequence of Operation Logic Diagram	
L0-36	Air Handling Unit (AHU) Sequence of Operation Logic Diagram	
L0-37	General Fans Sequence of Operation Logic Diagram	
L0-38	Generator Sequence of Operation Logic Diagram	
L0-39	Fuel System Sequence of Operation Logic Diagram	
L0-40	CRAH / CRAC / Fan Wall Group Control/Teamwork Sequence of Operation Logic Diagram	
L0-41	Electrical Systems Sequence of Operation Logic Diagram	
L0-42	Gas Suppression System Sequence of Operation Logic Diagram	
L0-43	Pre-Action System Sequence of Operation Logic Diagram	
L0-44	VESDA Sequence of Operation Logic Diagram	
L0-45	Invitation to Test Template	
L0-46	Confirmation to Ship Certificate	Issued after factory testing successful.
L0-47	Factory Testing Functional Test Script Template	
L0-48	Factory Testing Report Template	

[For full responsibility see full matrix under the roles and responsibilities section]

14.2. Level 1 Documentation

FACTORY ACCEPTANCE TESTING

[Written & Managed by General Contractor]

Level 1 focuses on the factory testing requirements and any other quality assurance checks needed before the purchased equipment is dispatched to the site.

Ref	Document Title	Notes
L1-1	Confirmation to Ship Certificate	
L1-2	Building Management System [Factory Test Script]	
L1-3	Building Management System [Factory Test Report]	
L1-4.	Building Management System [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-5	HV Switch Gear [Factory Test Script]	
L1-6	HV Switch Gear [Factory Test Report]	
L1-7	HV Switch Gear [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-8	Transformer [Factory Test Script]	
L1-9	Transformer [Factory Test Report]	
L1-10	Transformer [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-11	Fuel Tank [Factory Test Script]	

Ref	Document Title	Notes
L1-12	Fuel Tank [Factory Test Report]	
L1-13	Fuel Tank [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-14	Generator [Factory Test Script]	
L1-15	Generator [Factory Test Report]	
L1-16	Generator [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-17	Generator Switchboard [Factory Test Script]	
L1-18	Generator Switchboard [Factory Test Report]	
L1-19	Generator Switchboard [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-20	LV Switch Board [Factory Test Script]	
L1-21	LV Switchboard [Factory Test Report]	
L1-22	LV Switchboard [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-23	Uninterrupted Power System [Factory Test Script]	
L1-24	Uninterrupted Power System [Factory Test Report]	
L1-25	Uninterrupted Power System [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.

Ref	Document Title	Notes
L1-26	Cooling Tower [Factory Test Script]	
L1-27	Cooling Tower [Factory Test Report]	
L1-28	Cooling Tower [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-29	Condenser Water Pumps [Factory Test Script]	
L1-30	Condenser Water Pumps [Factory Test Report]	
L1-31	Condenser Water Pumps [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-32	Water Cooled Chiller [Factory Test Script]	
L1-33	Water Cooled Chiller [Factory Test Report]	
L1-34	Water Cooled Chiller [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-35	Chilled Water Pumps [Factory Test Script]	
L1-36	Chilled Water Pumps [Factory Test Report]	
L1-37	Chilled Water Pumps [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-38	Variable Speed Drive [Factory Test Script]	
L1-39	Variable Speed Drive [Factory Test Report]	

Ref	Document Title	Notes
L1-40	Variable Speed Drive [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-41	CRAC Unit [Factory Test Script]	
L1-42	CRAC Unit [Factory Test Report]	
L1-43	CRAC Unit [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-44	CRAH Unit [Factory Test Script]	
L1-45	CRAH Unit [Factory Test Report]	
L1-46	CRAH Unit [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-47	Fan Wall Unit [Factory Test Script]	
L1-48	Fan Wall Unit [Factory Test Report]	
L1-49	Fan Wall Unit [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-50	In row Cooling Unit [Factory Test Script]	
L1-51	In row Cooling Unit [Factory Test Report]	
L1-52	In row Cooling Unit [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-53	Primary Air Handling Unit [PAU] [Factory Test Script]	

Ref	Document Title	Notes
L1-54	Primary Air Handling Unit [PAU] [Factory Test Report]	
L1-55	Primary Air Handling Unit [PAU] [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.
L1-56	Air Handling Unit [Factory Test Script]	
L1-57	Air Handling Unit [Factory Test Report]	
L1-58	Air Handling Unit [QA/QC Factory Inspection Report]	To be issued for all equipment purchased for the project.

[For full responsibility see full matrix under the roles and responsibilities section]

14.3. Level 2 Documentation

COMPONENT DELIVERY, INSTALLATION AND PRE-STARTUP

[Written & Managed by General Contractor]

Level 2 documents focus on writing, issuing, and reviewing multiple checklists that are to detail and verify that the components, equipment, and materials prior to acceptance of delivery delivered are in line with the material submission, order, and general project requirements.

Ref	Document Title	Notes
L2-1	Equipment and Instrument Sensor Calibration [Pre-Commissioning Checklist]	
L2-2	HV Switch Gear [Pre-Commissioning Checklist]	
L2-3	Bus Bar [Pre-Commissioning Checklist]	
L2-4	HV Cable [Pre-Commissioning Checklist]	

Ref	Document Title	Notes
L2-5	Transformer [Pre-Commissioning Checklist]	
L2-6	Fuel System [Pre-Commissioning Checklist]	
L2-7	Generator [Pre-Commissioning Checklist]	
L2-8	Load Bank System [Pre-Commissioning Checklist]	
L2-9	LV Switch Board [Pre-Commissioning Checklist]	
L2-10	LV Cables [Pre-Commissioning Checklist]	
L2-11	Earthing System [Pre-Commissioning Checklist]	
L2-12	Lightning Protection System [Pre-Commissioning Checklist]	
L2-13	Uninterrupted Power System [Pre-Commissioning Checklist]	
L2-14	Battery Monitoring System [Pre-Commissioning Checklist]	
L2-15	Automatic Transfer System [Pre-Commissioning Checklist]	
L2-16	Branch Circuit Monitoring [BCM] [Pre-Commissioning Checklist]	
L2-17	Electrical Panel [Pre-Commissioning Checklist]	
L2-18	General Lighting [Pre-Commissioning Checklist]	

Ref	Document Title	Notes
L2-19	Emergency Lighting [Pre-Commissioning Checklist]	
L2-20	LMCP Electrical [Pre-Commissioning Checklist]	
L2-21	Power Quality Monitoring & Energy Management [Pre-Commissioning Checklist]	
L2-22	Battery Charger System [Pre-Commissioning Checklist]	
L2-23	Generator LV Switch Board [Pre-Commissioning Checklist]	
L2-24	Electrical RMU [Pre-Commissioning Checklist]	
L2-25	Public Address System [Pre-Commissioning Checklist]	
L2-26	Close Circuit Television (CCTV) [Pre-Commissioning Checklist]	
L2-27	Access Control System [Pre-Commissioning Checklist]	
L2-28	Video Intercom System [Pre-Commissioning Checklist]	
L2-29	Structured Cabling [Pre-Commissioning Checklist]	
L2-30	FS Emergency Broadcast System [Pre-Commissioning Checklist]	
L2-31	Sprinkler Wet Systems [Pre-Commissioning Checklist]	
L2-32	Aspirating System [Pre-Commissioning Checklist]	

Ref	Document Title	Notes
L2-33	Pre-Action Systems [Pre-Commissioning Checklist]	
L2-34	Nitrogen Generator [Pre-Commissioning Checklist]	
L2-35	High Sensitivity System [Pre-Commissioning Checklist]	
L2-36	Fire Hydrant & Hose Reel System [Pre-Commissioning Checklist]	
L2-37	Automatic Fire Alarm System [Pre-Commissioning Checklist]	
L2-38	VAC Trip System [Pre-Commissioning Checklist]	
L2-39	Fire Cause & Effect [Pre-Commissioning Checklist]	
L2-40	Nitrogen Generator [Pre-Commissioning Checklist]	
L2-41	Chilled Water Hydraulic Pipework System [Pre-Commissioning Checklist]	
L2-42	Condenser Water Hydraulic Pipework System [Pre-Commissioning Checklist]	
L2-43	Heating Water Hydraulic Pipework System [Pre-Commissioning Checklist]	
L2-44	Pressure Testing and Evacuation of Refrigerant Systems	
L2-45	Water Leak Detection System [Pre-Commissioning Checklist]	
L2-46	Energy Meter [Pre-Commissioning Checklist]	

Ref	Document Title	Notes
L2-47	Cooling Tower [Pre-Commissioning Checklist]	
L2-48	Cooling Tower Sweeper System [Pre-Commissioning Checklist]	
L2-49	Cooling Tower Side Stream Filtration [Pre-Commissioning Checklist]	
L2-50	Water Cooled Chiller [Pre-Commissioning Checklist]	
L2-51	Water Pressurization System [Pre-Commissioning Checklist]	
L2-52	Water Differential Bypass System [Pre-Commissioning Checklist]	
L2-53	Condenser Water Pumps [Pre-Commissioning Checklist]	
L2-54	Condenser Water Pumps [Pre-Commissioning Checklist]	
L2-55	Chilled Water Pumps [Pre-Commissioning Checklist]	
L2-56	Chilled Water Pumps [Pre-Commissioning Checklist]	
L2-57	Variable Speed Drive [Pre-Commissioning Checklist]	
L2-58	Variable Speed Drive [Pre-Commissioning Checklist]	
L2-59	Buffer Tank System [Pre-Commissioning Checklist]	
L2-60	Chilled Water CRAC / CRAH Unit [Pre-Commissioning Checklist]	

Ref	Document Title	Notes
L2-61	CRAC / CRAH Group Control [Pre-Commissioning Checklist]	
L2-62	Dx Split Unit [Pre-Commissioning Checklist]	
L2-63	Fire Damper [Pre-Commissioning Checklist]	
L2-64	Fire Damper [Pre-Commissioning Checklist]	
L2-65	Primary Air Handling Unit (PAU) [Pre-Commissioning Checklist]	
L2-66	Ventilation System Balancing [Pre-Commissioning Checklist]	
L2-67	General Supply Fans / Makeup Fans / Extract Fans [Pre-Commissioning Checklist]	
L2-68	General Toilet Extract Fans [Pre-Commissioning Checklist]	
L2-69	Motorized Damper Logic [Pre-Commissioning Checklist]	
L2-70	Plumbing Pipework Systems [Pre-Commissioning Checklist]	
L2-71	Drainage Pipework Systems [Pre-Commissioning Checklist]	
L2-72	Condensate Pipework Systems [Pre-Commissioning Checklist]	
L2-73	Water Tanks [Pre-Commissioning Checklist]	
L2-74	Sump Pump [Pre-Commissioning Checklist]	

Ref	Document Title	Notes
L2-75	Instantaneous Water Heater [Pre-Commissioning Checklist]	
L2-76	Feed Water System [Pre-Commissioning Checklist]	
L2-77	Fresh Water System [Pre-Commissioning Checklist]	
L2-78	Irrigation Water System [Pre-Commissioning Checklist]	
L2-79	Flushing Water System [Pre-Commissioning Checklist]	
L2-80	Make Up Water System [Pre-Commissioning Checklist]	
L2-81	Bleed Water System [Pre-Commissioning Checklist]	
L2-82	Daily Commissioning [Report]	
L2-83	Electrical System Discrimination Setting Verification [Report]	
L2-84	Plant and Equipment Settings [Report]	

[For full responsibility see full matrix under the roles and responsibilities section]

14.4. Level 3 Documentation

SYSTEMS STARTUP

[Written & Managed by General Contractor]

Creating the documents that dictate the Level 3 site inspection requirements will ensure that the individual plant, equipment, systems, and components can be started up, tested, and operating in line with the design intent.

Ref	Document Title	Notes
L3-1	Data Hall Cleaning Method and Testing Script	
L3-2	HV Switch Gear [Pre-Commissioning Checklist]	
L3-3	Transformer [Pre-Commissioning Checklist]	
L3-4	Fuel System Pressure Test [inc Pipework & Tank] [Pre-Commissioning Checklist]	
L3-5	Fuel System including Leak Detection [Pre-Commissioning Checklist]	
L3-6	Generator [Pre-Commissioning Checklist]	
L3-7	Load Bank System [Pre-Commissioning Checklist]	
L3-8	LV Switch Board [Pre-Commissioning Checklist]	
L3-9	Lightning Protection System [Pre-Commissioning Checklist]	
L3-10	Uninterrupted Power System [Pre-Commissioning Checklist]	
L3-11	Battery Monitoring System [Pre-Commissioning Checklist]	
L3-12	Automatic Transfer System [Pre-Commissioning Checklist]	
L3-13	Branch Circuit Monitoring [BCM [Pre-Commissioning Checklist]	
L3-14	Electrical Panel [Pre-Commissioning Checklist]	

Ref	Document Title	Notes
L3-15	General Lighting [Pre-Commissioning Checklist]	
L3-16	Emergency Lighting [Pre-Commissioning Checklist]	
L3-17	LMCP Electrical [Pre-Commissioning Checklist]	
L3-18	Power Quality Monitoring & Energy Management [Pre-Commissioning Checklist]	
L3-19	Battery Charger System [Pre-Commissioning Checklist]	
L3-20	Generator LV Switch Board [Pre-Commissioning Checklist]	
L3-21	Electrical RMU [Pre-Commissioning Checklist]	
L3-22	Public Address System [Pre-Commissioning Checklist]	
L3-23	Close Circuit Television (CCTV) [Pre-Commissioning Checklist]	
L3-24	Access Control System [Pre-Commissioning Checklist]	
L3-25	Video Intercom System [Pre-Commissioning Checklist]	
L3-26	Structured Cabling [Pre-Commissioning Checklist]	
L3-27	FS Emergency Broadcast System [Pre-Commissioning Checklist]	
L3-28	Aspirating System [Pre-Commissioning Checklist]	

Ref	Document Title	Notes
L3-29	Pre-Action System [Pre-Commissioning Checklist]	
L3-30	Nitrogen Generator [Pre-Commissioning Checklist]	For Pre-Action System
L3-31	High Sensitivity System [Pre-Commissioning Checklist]	
L3-32	Fire Hydrant & Hose Reel System [Pre-Commissioning Checklist]	
L3-33	Automatic Fire Alarm System [Pre-Commissioning Checklist]	
L3-34	VAC Trip System [Pre-Commissioning Checklist]	
L3-35	Systems Chemical Treatment / Dosing [Pre-Commissioning Checklist]	
L3-36	Water Leak Detection System [Pre-Commissioning Checklist]	
L3-37	Energy Meter [Pre-Commissioning Checklist]	
L3-38	Cooling Tower [Pre-Commissioning Checklist]	
L3-39	Cooling Tower Side Stream Filtration [Pre-Commissioning Checklist]	
L3-40	Water Cooled Chiller [Pre-Commissioning Checklist]	
L3-41	Buffer Tank System [Pre-Commissioning Checklist]	
L3-42	Water Pressurization System [Performance & Functional Test Script] [Pre-Commissioning Checklist]	

Ref	Document Title	Notes
L3-43	Water Differential Bypass System [Pre-Commissioning Checklist]	
L3-44	Chilled Water CRAH Unit [Pre-Commissioning Checklist]	Include individual control logic, Include group control / teamwork logic
L3-45	Chilled Water CRAC Unit [Pre-Commissioning Checklist]	Include individual control logic, Include group control / teamwork logic
L3-46	Chilled Water Fan Wall Unit [Pre-Commissioning Checklist]	Include individual control logic, Include group control / teamwork logic
L3-47	Max Cool Panel [Pre-Commissioning Checklist]	
L3-48	Dx Split Unit [Pre-Commissioning Checklist]	
L3-49	Primary Air Handling Unit (PAU) [Pre-Commissioning Checklist]	Include air balancing of systems, Include motorized dampers, Include control logic.
L3-50	General Supply Fans / Makeup Fans / Extract Fans [Pre-Commissioning Checklist]	Include air balancing of systems, Include motorized dampers, Include control logic.
L3-51	General Toilet Extract Fans [Pre-Commissioning Checklist]	Include air balancing of systems, Include motorized dampers, Include control logic.
L3-52	Sump Pump [Pre-Commissioning Checklist]	
L3-53	Instantaneous Water Heater [Pre-Commissioning Checklist]	
L3-54	Feed Water System [Pre-Commissioning Checklist]	
L3-55	Fresh Water System [Pre-Commissioning Checklist]	

Ref	Document Title	Notes
L3-56	Irrigation Water System [Pre-Commissioning Checklist]	
L3-57	Flushing Water System [Pre-Commissioning Checklist]	
L3-58	Make Up Water System [Pre-Commissioning Checklist]	
L3-59	Bleed Water System [Pre-Commissioning Checklist]	

[For full responsibility see full matrix under the roles and responsibilities section]

14.5. Level 4 Documentation

FUNCTIONAL PERFORMANCE TESTING

[Written & Managed by CxP]

Managed and delivered by the Owners Commissioning Consultant with support of the General Contractor, the Level 4 works will bring systems together, integrating them and conducting a range of rigorous tests to ensure that they operate in line with the owner's project requirements [OPR], Basis of Design [BOD] and general contract documentation such as drawings, specifications, and control logics.

Ref	Document Title	Notes
L4-1	Thermal Scanning Method and Locations Script	
L4-2	Thermal Scanning Method and Locations Report	
L4-3	Fire Cause & Effect Script	
L4-4	Fire Cause & Effect Report	
L4-5	L4 Electrical Performance and Functional Testing Script	

Ref	Document Title	Notes
L4-6	L4 Electrical Performance and Functional Testing Report	
L4-7	L4 Mechanical Performance and Functional Testing Script	
L4-8	L4 Mechanical Performance and Functional Testing Report	

[For full responsibility see full matrix under the roles and responsibilities section]

14.6. Level 5 Documentation

INTEGRATED SYSTEMS TESTING

[Written & Managed by CxP]

The Level 5 Integrated Testing documentation will help to ensure that all installed systems and equipment operate together and are validated in line with the owner's project requirements [OPR], Basis of Design [BOD] and general contract documentation such as drawings, specifications, and control logics, under normal and approved simulated failure scenarios.

Ref	Document Title	Notes
L5-1	L5 Electrical Integration Test List	
L5-2	L5 Electrical Integration Script	
L5-3	L5 Electrical Integration [Report]	
L5-4	L5 Heat Load & Mechanical Integration Test List	
L5-5	L5 Heat Load & Mechanical Integration Testing Script	
L5-6	L5 Heat Load & Mechanical Integration Testing Report	

[For full responsibility see full matrix under the roles and responsibilities section]

14.7. Level 6 Documentation

HANDOVER / TURNOVER

[Written & Managed by CxP / General Contractor]

Level 6 work documents will close out the project commissioning process.

Ref	Document Title	Notes
L6-1	Closeout and Turnover Report	
L6-2	Commissioning Final / Closeout Report	
L6-3	Lessons Learned Report and Meeting Minutes	
L6-4	Facility Training Documentation	
L6-5	Operating and Maintenance Manuals	
L6-6	Systems Manual	

[For full responsibility see full matrix under the roles and responsibilities section]

15. Onsite Sampling Rates

The responsibility for the installation and start-up of all MEP&F/ELV Systems and assemblies rests with the General Contractor and their Subcontractors/Vendors, including any Novated Contractors that they are managing.

For verification the General Contractor and their Subcontractors/Vendors, including any Novated Contractors that they are managing, along with the Owners' representatives are accountable for verifying that the systems and components adhere to the project design, specifications, and owners project requirement document.

Using a quality-based sampling strategy will allow for an unbiased evaluation of OPR achievement at any point during construction and commissioning activities.

The sampling rate for this project will vary based on factors outlined in the tables below, that offer general guidance for components, but further discussions among the Owners Commissioning Consultant, Owner's Team, and General Contractor are necessary to provide agreement and establish expectations.

The General Contractor is required to coordinate, organize, and manage all system demonstrations and witnessing by the Owners' Commissioning Consultant in accordance with the contract agreement.

[The General Contractor should ensure that, no matter the verification requirements of the Owners Commissioning Consultant, they complete 100% testing of all plant, equipment, components, and systems.]

15.1. Critical Systems & Components

[note that the below table can be modified in line with the owner's needs, for example there may only be a requirement for Level 2 & 3 of 'First of Kind' – update to suit]

Document Title	Notes
Critical Systems & Components [100%]	Anything that affects the operations of the data halls and critical spaces, either via plant, equipment, components, and systems directly installed within the halls, or plant, equipment, components, and systems housed outside of the data halls and critical spaces but serves them.

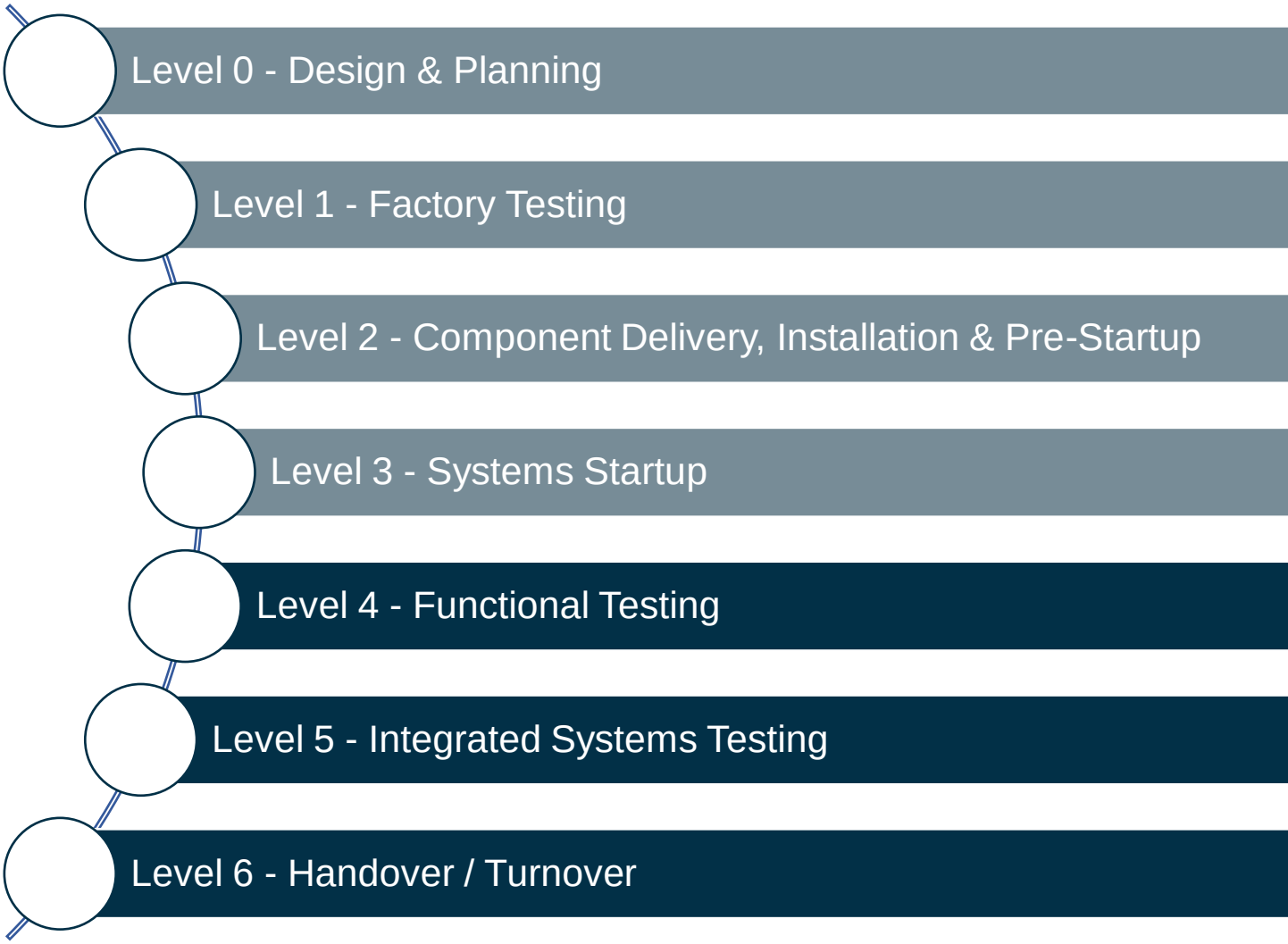
15.2. Non-Critical Systems & Components

Document Title	Notes
Non-Critical Systems & Components [20%]	Non-Critical Systems and Components would include plant, equipment, components, and systems individually serving toilets, cupboards, external corridors, office, meeting rooms etc.

16. Commissioning Process / Roles & Responsibilities

In this section, the roles and responsibilities are outlined, that will be established and executed for the project's success.

The process follows a 6-stage framework, inspired by the 'Data Canter Levels of Commissioning' approach.



16.1. Using the RASCI Matrix

We will utilize the RASCI format which provides a high-level tool used to define and communicate roles and responsibilities within the commissioning process, it helps provide a structured framework for clarifying who is Responsible, Accountable, Supportive, Consulted, and Informed for each task or decision.

By using the matrix, it will enhance the management and teamwork, promoting clarity, reducing confusion, and fostering effective communication.

Responsible	R	This is the person that is responsible for doing the work ensuring the activities are completed by the relevant team members, they can also provide comments as well.
Accountable	A	This person comments, approves and signs off and owns the activity.
Supportive	S	Persons who will provide support to the Responsible party, aiding in completion of the task.
Consulted	C	Opinion sought, where required.
Informed	I	This person is informed when a decision is made, or an activity is performed. They may be required to act because of the outcome.

16.2. Level 0 – Design & Planning

Level 0, managed by the General Contractor and Owners Commissioning Consultant, serves as the initial stage of the project commissioning process, where the primary focus is on laying the foundation for subsequent stages, evaluating, planning, and documenting the necessary information, tasks, and activities for successful commissioning.

It is important to note that while Level 0 primarily focuses on the below tasks, some of them will continue throughout the project and carry over into subsequent levels.

Formation of a Competent and Dedicated Commissioning Team:

- Assemble a skilled and dedicated commissioning team with the necessary expertise to execute the commissioning process effectively.
- Assign roles and responsibilities to team members to ensure clear accountability and efficient coordination.

Development of a Comprehensive 100% Design:

- Ensure that the design encompasses all aspects of the project, meeting the requirements and specifications defined in the project scope.
- Ensure that the design accounts for all systems, components, and interfaces necessary to allow successful commissioning and validation of the facilities systems.

Performing Meticulous Design Reviews:

- Conduct comprehensive design reviews to ensure that all systems and equipment are designed to facilitate functional testing and successful commissioning.
- Verify that the design meets the project requirements, industry standards, and regulatory guidelines.

Conducting Thorough Single Point of Failure Reviews:

- Perform detailed single point of failure reviews to identify potential vulnerabilities in redundant systems.
- Mitigate risks by implementing appropriate measures to enhance system resilience and minimize downtime.

Establishment of a Clear Commissioning Process:

- Define and establish a clear commissioning process that outlines the sequence of activities, milestones, and deliverables for each stage of the project.
- Obtain agreement and alignment among stakeholders on the overall commissioning approach.

Conducting Productive Meetings and Workshops to Facilitate Collaboration:

- Arrange productive meetings and workshops involving relevant project stakeholders to foster collaboration and exchange of ideas.
- Address design considerations, technical challenges, and potential integration issues during these sessions.

Discussion and Agreement on Commissioning Document Expectations:

- Engage in discussions and reach agreement on the expectations for commissioning documents, ensuring clarity, accuracy, and completeness.

- Establish templates and guidelines for documenting commissioning activities at all levels of the project.

Defining and Agreeing Upon Specific Requirements for Factory Testing:

- Clearly define and agree upon the specific requirements for factory testing to ensure that equipment is thoroughly tested prior to installation.
- Specify the testing protocols, acceptance criteria, and documentation expectations for factory testing.

Create, Issue, and Approval of Commissioning Documentation:

- Create comprehensive commissioning documentation that covers all levels of the project, including detailed plans, procedures, and records.
- Carefully review and issue the documentation to relevant parties for approval and ensure its accuracy and completeness.

[See the next pages for the responsibility matrix].

Level 0 – Design & Planning

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L0-01	Write and Issue Owners Project Requirements [OPR] Document.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**S**upport
L0-02	Oversee **Owners Project Requirements [OPR]** are being met throughout the contractor design stage, and issue updates to the project team.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**S**upport
L0-03	Write and Issue Basis of Design [BOD] Document.	**I**nformed	**I**nformed	**I**nformed	**A**pprove	**R**esponsible
L0-04	Ensure that the **Basis of Design [BOD]** is updated and reviewed by Main Contractor during the 100% design stage, and issue to the project team.	**I**nformed	**I**nformed	**I**nformed	**A**pprove	**R**esponsible
L0-05	**Develop design [30%, 60%, 90%, 100%]** and issue documentation for review and approval.	**I**nformed	**I**nformed	**I**nformed	**A**pprove	**R**esponsible
L0-06	Create, Develop, and Issue Computational Fluid Dynamics Study [CFD] Document.	**I**nformed	**I**nformed	**I**nformed	**A**pprove	**R**esponsible
L0-07	Complete **Commissioning Review** of Design [60% to 100% and **Issue Report.**	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**S**upport

Level 0 – Design & Planning

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L0-08	Conduct Short Circuit / Single Point of Failure Coordination Study	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**S**upport
L0-09	Issue **Commissioning Document List** covering all stages until handover.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**S**upport
L0-10	Write and Issue Data Centre Commissioning Guideline Document. [This document]	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**S**upport
L0-11	Agree on Sequencing and Duration of **Level 4 & 5 Requirements.**	**S**upport	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L0-12	Issue Initial Integrated and Sequenced **Commissioning Programme**.	**S**upport	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L0-13	Issue **Commissioning Process Flow Diagram** covering all stages until handover.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L0-14	Agree Commissioning Process and Responsibility Matrix. [This document]	**R**esponsible	**I**nformed	**A**pprove	**I**nformed	**I**nformed

Level 0 – Design & Planning

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L0-15	Issue Commissioning Team Organigram covering this stage. [This is 'Initial']	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L0-16	Agree equipment to be **Factory Tested.**	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**S**upport
L0-17	Create, Develop, and Issue **Load Bank & Metering Plan** for Level 4 & 5 works.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**S**upport
L0-18	Write and Issue Initial Commissioning Plan.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**S**upport
L0-19	Write and Issue Construction **Commissioning Specification.**	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**S**upport
L0-20	Upon contract award, **'Form Commissioning Team'** and issue organigram.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-21	Set up **Cx Electronic Platform** [Levels 1-6] for later input of commissioning checklists, test procedures and observations/issues.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport

Level 0 – Design & Planning

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L0-22	Set up and discuss use **Document Management System** and **Numbering Structures** for the testing and commissioning works.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L0-23	Conduct Commissioning Kick Off meeting.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-24	Create, Develop, and Issue Commissioning Communication Protocol.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-25	Create, Develop, and Issue Material Submission Document List.	**R**esponsible	**S**upport	**I**nformed	**I**nformed	**A**pprove
L0-26	Issue Integrated and Sequenced **Commissioning Programme**.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-27	Issue Integrated and Sequenced **Commissioning Work Logics**.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-28	Agree on method for Capturing **Site Issues and Observations.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed

Level 0 – Design & Planning

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L0-29	Agree on **Tagging Process** and design of tags to be used.	**R**esponsible	**I**nformed	**A**pprove	**I**nformed	**I**nformed
L0-30	Agree on format and content of **Factory Testing Scripts.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-31	Agree on format and content of **Factory Testing Reports.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-32	Plan / programme **Factory Testing.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-33	Agree on format and content of Confirmation to Ship Certificates.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-34	Agree Training Requirements and Write Training Manual.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-35	Develop Training Programme.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed

Level 0 – Design & Planning

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L0-36	Agree on format and content of **Pre-Start Up Checklists.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-37	Agree on format and content of **Functional Testing Procedures.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-38	Agree on format, content, and process for Inviting Owner Team for Witnessing and Verification.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-39	Agree **Final Testing Pack** information to be included in O&M.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-40	Agree on format and content of Daily, Weekly, Monthly Commissioning Reports.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-41	Agree on format and content of **2 Week Look Ahead Schedule.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-42	Agree on format and content of **Final Commissioning Report.**	**S**upport	**I**nformed	**R**esponsible	**A**pprove	**I**nformed

Level 0 – Design & Planning

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L0-43	Agree on format and content of **Systems Manual.**	**S**upport	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L0-44	Agree **O&M** Requirements.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-45	Write and Issue Final Commissioning Plan.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-46	Conduct Commissioning Focused **Meetings and Workshops,** issuing Minutes.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L0-47	Provide to CxP, Commissioning Focused Reports [monthly/weekly].	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-48	Provide to Client, Commissioning Focused Reports [monthly/weekly].	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L0-49	Review Information for **Gap Analysis** between Owner Specified Equipment and Main Contractor works.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport

Level 0 – Design & Planning

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L0-50	Create, Develop, and Issue Electrical Discrimination Study.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L0-51	Create, Develop, and Issue **Arc Flash Study.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L0-52	Agree on Arc Flash Sticker Template to be used.	**R**esponsible	**I**nformed	**A**pprove	**I**nformed	**I**nformed
L0-53	Agree Thermal Graphic Inspection locations.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L0-54	Create, Develop, and Issue **Thermal Graphic** Procedure and Plan.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L0-55	Create, Develop, and Issue Electrical Lock Out, Tag Out Process and Procedure.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L0-56	Create, Develop, and Issue **Plant Settings Report.**	**R**esponsible	**I**nformed	**A**pprove	**I**nformed	**I**nformed

Level 0 – Design & Planning

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L0-57	Create, Develop, and Issue Schedule of required **Work Permits** for commissioning activities.	**R**esponsible	**I**nformed	**A**pprove	**I**nformed	**I**nformed
L0-58	Create, Develop, and Issue **Commissioning Strategies.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L0-59	Agree Sequence of Operation [SOO] List.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-60	Create, Develop, and Issue Sequence of Operations [SOO].	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L0-61	Create, Develop, and Issue **BMS Graphic Document.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L0-62	Create, Develop, and Issue **BMS Points List Document.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L0-63	Create, Develop, and Issue **Fire Cause & Effect Matrix.**	**R**esponsible	**S**upport	**I**nformed	**I**nformed	**A**pprove

Level 0 – Design & Planning

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L0-64	Provide to Owner, Level Close Out Reports.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L0-65	Sign off Level.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport

16.3. Level 1 – Factory Testing

Level 1, managed by the General Contractor, is where a diverse range of roles and responsibilities come together from the commissioning team to ensure that the selected plant and equipment is factory tested.

Although this stage is relatively short and uncomplicated, it necessitates the dedicated efforts of individuals with specialized tasks and expertise.

The following provides an overview of the key responsibilities and activities undertaken during Level 1:

Conducting Equipment Factory Testing:

- Execute comprehensive testing procedures on the specified equipment to validate its functionality, performance, and adherence to project requirements.
- Document the testing process, including test plans, procedures, and results, to provide a comprehensive record of the equipment's performance.

Performing Equipment Quality Assurance/Quality Control Checks:

- Implement rigorous quality assurance and quality control measures to verify that the equipment meets the specified design and operational requirements.
- Conduct meticulous visual inspections to identify any defects, damages, or inconsistencies that may impact the equipment's performance or longevity.
- Adhere to industry standards, codes, and regulations, ensuring compliance at every stage of the quality assurance process.

Generating Reports and Gathering Data:

- Compile detailed reports that encompass the results and findings of the factory testing and quality assurance checks.
- Capture and analyse relevant data, including performance metrics, test outcomes, and compliance documentation, to provide a comprehensive overview of the equipment's capabilities.
- Create a robust documentation package that serves as a valuable resource for future reference and analysis.

Coordinating Equipment Shipping:

- Oversee the logistical aspects of shipping the tested equipment, ensuring proper packaging, handling, and transportation.
- Collaborate with relevant stakeholders to coordinate delivery schedules and ensure smooth transit to the project site.
- Confirm the receipt and acceptance of the equipment at the designated location, ensuring proper documentation and verification.

Attaching the Appropriate Level 1 Tag:

- Prior to acceptance of delivery, when the equipment arrives at site, attach the Level 1 [Red] Tag.
- Follow established protocols and guidelines for tagging, allowing for efficient equipment management and traceability.

[See the next pages for the responsibility matrix].

Sampling Rate

The anticipated sampling rate for Level 1 Factory Testing is projected to involve testing each model of equipment and being witnessed by two representatives from the Owners Team [Owners Commissioning Consultant and Designer].

Resources, Travel and Accomodation

Resources

The following resources should be allowed for, as a minimum by the General Contractor ensuring the Owner is represented at the testing:

	General Contractor	1No. [minimum]
	Owner Commissioning Consultant	1No. [minimum]
	Owner or General Contractor Designer	1No. [minimum]

	Supplier or Vendor	As required

Travel

The General Contractor should allow for the following when considering travel plans for the Owners Team.

		>	8hrs	Business or Equivalent
		<	8hrs	Premium Economy or Equivalent

Accommodation

The General Contractor should allow for the following when considering accommodation for the Owners Team.

	Hilton 4-5 Star rating or Equivalent

Equipment Being Factory Tested

The following equipment will be factory tested under this project:

[Update as per actual project needs]

	Electrical	HV Switch Board	One of Each Type
	Electrical	Transformer	One of Each Type
	Electrical	LV Switchboard	One of Each Type
	Electrical	Diesel Generator	One of Each Type

	Electrical	Generator Switch Board	One of Each Type
	Electrical	Uninterruptable Power System	One of Each Type
	Electrical	Ring Main Unit	One of Each Type
	Mechanical	Cooling Tower	One of Each Type
	Mechanical	Water Cooled Chiller	One of Each Type
	Mechanical	Centrifugal Pump	One of Each Type
	Mechanical	Air Cooled Chiller	One of Each Type
	Mechanical	CRAC Unit	One of Each Type
	Mechanical	CRAH Unit	One of Each Type
	Mechanical	Fan Wall Unit	One of Each Type
	Mechanical	Air Handling Unit	One of Each Type
	Mechanical	Plate Heat Exchanger	One of Each Type
	Controls / BMS	Sequence of Operations	One of Each Type

Level 1 – Factory Testing

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L1-01	Fix and confirm dates of **Factory Testing.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L1-01	Create, Develop, and Issue **Factory Testing Scripts**.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L1-01	Conduct Commissioning Focused **Meetings and Workshops,** where required.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L1-01	Organize Transportation and Accommodation for Factory Testing.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L1-01	Conduct **Factory Acceptance Testing** with owner team at factory or remotely.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L1-01	Add any issues to **Observation Register** and managing to close.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**I**nformed
L1-01	Create, Develop, and Issue **Factory Testing Reports** for all equipment.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed

Level 1 – Factory Testing

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L1-02	Obtain and Issue **Factory QA/QC** documents for record and filing.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L1-03	**File and manage** Factory Testing information and records within the Project electronic filing system.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L1-04	Install all **Red Tags** where applicable.	**S**upport	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L1-05	Issue Confirmation to Ship Certificate.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L1-06	**Ship** equipment to site.	**A**pprove	**R**esponsible	**I**nformed	**I**nformed	**I**nformed
L1-07	Provide to Owner, Level Close Out Reports.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L1-08	Sign off Level.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport

16.4. Level 2 – Component Delivery, Installation & Pre-Start-up

Level 2, managed by the General Contractor, is a crucial stage in the data centre commissioning process, aimed at ensuring that all equipment, plant, and components are successfully delivered, installed, and thoroughly checked via pre-start-up activities to meet the project requirements.

This stage sets the foundation for the subsequent energization phase at Level 3, with the primary focus during Level 2 includes the following:

- Component, Equipment, and Material Compliance
- Verify that all components, equipment, and materials delivered to the project site align with the material submission, purchase order, and general project requirements.
- Ensure that the received items are in proper condition, undamaged, and meet the specified standards.
- Cross-reference the delivered components with the project documentation to confirm their accuracy and suitability.
- Installation Conformance and Quality:
- Validate that the installations adhere to the construction drawings, complying with the project specifications and requirements.
- Conduct quality checks to ensure that the workmanship, craftsmanship, and overall installation quality meet the project's expectations.
- Pre-Start-up Checks and Readiness:
- Perform comprehensive pre-start-up checks to ensure that all systems are ready to progress to the next level of commissioning.
- Verify that all connections, settings, and configurations are properly completed and in alignment with the design and operational requirements.
- Validate the functionality of various systems and subsystems, ensuring they are prepared for the subsequent energization phase.
- Completion of Static Works and Testing:

- Ensure the completion of critical static works such as pressure testing, pipework cleaning, dead testing, and earthing testing.

Sampling Rate

See sampling section within this document.

Level 2 – Component Delivery, Installation & Pre-Start-up

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L2-01	Write and **Issue Level 2 Checklists and Scripts** that will be used to facilitate the works.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-02	Plan and **Manage Deliveries** of plant, equipment, and materials. [If not, Factory Tested]	**A**pprove	**R**esponsible	**I**nformed	**I**nformed	**I**nformed
L2-03	Complete **Delivery and Storage Checklists** when plant, equipment and materials arrive on site.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L2-04	Complete Installation Checklist Inspections.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L2-05	Complete Pre-Start-up / Energization Inspections.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-06	Conduct any **First of Kind [FOK] Inspections** if noted in the project process with the owner's CxP.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-07	For Electrical Panels ensure **Arc Flash Stickers** are attached and **Breakers Set** in line with the Arc Flash Report and Discrimination Study.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport

Level 2 – Component Delivery, Installation & Pre-Start-up

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L2-08	Complete **Foreign Object Detection [FOD] Inspection** for all electrical panels and equipment.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-09	Update **Commissioning Tracking** to reflect actual status and progress. [Manually or as per Commissioning Electronic Platform]	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-10	Manage the **Overall Programme** for the Commissioning Tasks and Activities.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-11	Add any issues to **Observation Register** and managing to close.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-12	**File and manage** documentation and records within the Project electronic filing system.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-13	Issue regular **2 Week Look Ahead Schedules** for Commissioning Team Resource Planning.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-14	Conduct Daily Morning Coordination Workshop.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed

Level 2 – Component Delivery, Installation & Pre-Start-up

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L2-15	Provide Daily Commissioning Updates.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-16	Conduct Commissioning Focused **Weekly Meetings and Workshops.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-17	Provide Commissioning Focused Reports. [Monthly / Weekly]	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-18	Install all **Yellow Tags** where applicable.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L2-19	Provide to Owner, Level Close Out Reports.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L1-20	Sign off Level.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport

16.5. Level 3 – Systems Start-up

Level 3, managed by the General Contractor, encompasses tasks and activities aimed at ensuring that the individual plant, equipment, systems, and components are successfully started up, tested, and operating in accordance with the design intent and approved testing scripts/procedures.

This stage serves as a crucial step before bringing the different systems together for Level 4 and Level 5 works.

The following provides a high-level overview of Level 3:

Energization & Start-up of Equipment:

- Methodically energize and start up the designated equipment, following the specified procedures and safety protocols. *[Lockout Tagout]*
- Ensure that all equipment is powered up correctly, and necessary adjustments and configurations are made as per the design requirements.

Inputting and Validating Specific Settings:

- Input and validate the specific settings for the equipment and systems, such as parameters, thresholds, and operational limits, as defined in the design documentation.
- Verify the accuracy and functionality of the inputted settings through appropriate testing and monitoring.

General Site Testing:

- Perform comprehensive site testing to verify the overall functionality, integration, and performance of the systems and equipment, assessing factors such as power supply, cooling, networking, and environmental controls to ensure their effective operation.

Documenting All Level 3 Tasks and Activities:

- Maintain the documentation of all Level 3 tasks and activities, ensuing they are accurate, including start-up procedures, test results, configuration changes, and any adjustments made.

Closure of Issues and Observations:

- Address and close out any issues or observations identified during Level 3, as well as those related to Level 2 and Level 1 tasks and activities.

Readying Systems for Level 4 Functional Testing:

- Prepare the systems for Level 4 functional testing, ensuring that they are in an optimal state to undergo rigorous testing of their intended functions.
- Verify that all prerequisites and readiness criteria for Level 4 testing are met, including equipment stability, configuration accuracy, and operational reliability.
- Ensure temporary equipment and instruments are set up for the Level 4 works in line with the Load Bank & Equipment Plan.

Sampling Rate

See sampling section within this document.

Level 3 – Systems Start-up

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L3-01	Write and **Issue Scripts/Start-up Plans** that will be used to facilitate the start-up and testing works.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-02	Write and **Issue Work Permits** as noted in Level 0 that will be used to facilitate the start-up and functional testing works.	**R**esponsible	**S**upport	**I**nformed	**A**pprove	**I**nformed
L3-03	Install **Temporary Equipment and Instruments** to facilitate the testing and Level 4 Works in line with the Load Bank & Equipment Plan.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L3-04	Ensure **BMS and Control Logics** are ready and available. [Point to Graphic]	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L3-05	Ensure **Control Room** and equipment is ready and available, for testing to commence.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-06	Plan and **Manage Energization, Site Testing and Acceptance** of plant, equipment, and materials in line with approved procedures, scripts, and programme.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**S**upport
L3-07	Conduct any **First of Kind [FOK] Testing** if noted in the project process with the Owner's Commissioning Consultant.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed

Level 3 – Systems Start-up

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L3-08	Update **Commissioning Tracking** to reflect actual status and progress. [Manually or as per Commissioning Electronic Platform]	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-09	Manage the **Overall Programme** for the Commissioning Tasks and Activities.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-10	Add any issues to **Observation Register** and managing to close.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-11	**File and manage** documentation and records within the Project electronic filing system.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-12	Issue regular **2 Week Look Ahead Schedules** for Commissioning Team Resource Planning.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-13	Conduct Daily Morning Coordination Workshop.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-14	Provide Daily Commissioning Updates.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed

Level 3 – Systems Start-up

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L3-15	Conduct Commissioning Focused **Weekly Meetings and Workshops.**	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-16	Provide Commissioning Focused Reports [Monthly / Weekly]	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-17	Issue Operation and Maintenance Manuals.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-18	**Complete Clean** of Data Halls and critical areas.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-19	Install all **Green Tags** where applicable.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-20	Provide to Owner, Level Close Out Reports.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L3-21	Sign off Level.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport

16.6. Level 4 – Functional Testing

Level 4, managed and delivered by the Owners Commissioning Consultant, with support from the General Contractor, focuses on bringing the systems together, integrating them, and conducting a series of rigorous tests to ensure their alignment with the Owner's Project Requirements [OPR], Basis of Design [BOD], and relevant contract documentation such as drawings, specifications, and control logics.

This stage plays a pivotal role in verifying the functional performance of these integrated systems with the following providing a high-level overview of the works:

Operating Modes of Equipment Performing as Expected:

- Validate that the ‘normal’ operating modes of the equipment function as intended and meet the specified performance criteria outlined in the project requirements.
- Execute a comprehensive range of tests to assess the equipment's ability to perform under different operational scenarios including failure scenarios.

Interlocks of Equipment and Systems Performing as Expected:

- Verify that the interlocks within the equipment and systems operate correctly, ensuring that safety mechanisms, control logic, and protective features are functioning as designed.

Sequence of Operations of Equipment and Systems Performing as Expected:

- Perform comprehensive tests to evaluate the sequence of operations of the installed equipment and systems to ensure that they follow the predetermined sequence outlined in the design and control documentation.

Documenting All Level 4 Tasks and Activities:

- Maintain the documentation for all Level 4 tasks and activities, ensuing they are accurate, including start-up procedures, test results, configuration changes, and any adjustments made.

Closure of Issues and Observations:

- Address and close out any issues or observations identified during Level 4, as well as those related to Level 3, Level 2 and Level 1 tasks and activities.

Readying Systems for Level 5 Integrated Testing:

- Prepare the systems for Level 5 integrated testing, ensuring they are adequately configured, optimized, and ready to undergo comprehensive testing of their integrated functionalities.

Conducting Training

- Comprehensive training sessions are conducted in alignment with the training plan for the facilities teams. This ensures that the team members are equipped with the necessary knowledge and skills to operate and maintain the data centre effectively.

Level 4 – Functional Performance Testing

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L4-01	Write and **Issue Scripts** that will be used to facilitate the testing works.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L4-02	Write and **Issue Work Permits** as noted in Level 0 that will be used to facilitate the works.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L4-03	Ensure that **Temporary Equipment and Instruments** are installed in line with the approved Load Bank & Equipment Plan as noted in Level 0 works.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L4-04	Operate Temporary Equipment and Instruments to facilitate the testing works.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L4-05	**Plan and Manage Testing and Acceptance** of plant, equipment, and systems in line with approved procedures, scripts, and programme.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**I**nformed
L4-06	Complete **Thermographic Studies** and create report as noted in Level 0 works.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**I**nformed
L4-07	**Download Data** and Information for review after testing.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**I**nformed

Level 4 – Functional Performance Testing

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L4-08	Update **Commissioning Tracking** to reflect actual status and progress. [Manually or as per Commissioning Electronic Platform]	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L4-09	Add any issues to **Observation Register** and managing to close.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**I**nformed
L4-10	**File and manage** documentation and records within the Project electronic filing system	**S**upport	**S**upport	**R**esponsible	**A**pprove	**I**nformed
L4-11	Issue regular **2 Week Look Ahead Schedules** for Commissioning Team Resource Planning.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L4-12	Conduct Daily Morning Coordination Workshop.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L4-13	Provide Daily Commissioning Updates.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L4-14	Conduct Commissioning Focused **Weekly Meetings and Workshops.**	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport

Level 4 – Functional Performance Testing

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L4-15	Provide Commissioning Focused Reports [Level 4 / Monthly / Weekly]	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L4-16	Issue Final Operation and Maintenance Manuals.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L4-17	Start **Facility Operatives Training** in line with the documents noted in Level 0 works.	**R**esponsible	**S**upport	**A**pprove	**S**upport	**I**nformed
L4-18	Install all **Blue Tags** where applicable.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L4-19	Provide to Owner, Level Close Out Reports.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L4-20	Sign off Level.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport

16.7. Level 5 – Integrated Systems Testing

The Level 5 Integrated Testing phase, managed by the Owners Commissioning Consultant, with support from the General/Main Contractor and is the final step in validating the performance of the installed systems.

It focuses on integrating all the systems, conducting rigorous tests to evaluate and verify their functionality, interoperation, and response to simulated failure scenarios, demonstrating that they operate seamlessly together, in accordance with the owner's project requirements [OPR], Basis of Design [BOD], and other contractual documentation such as drawings, specifications, and control logics.

Once the testing has been completed, data will be collected and analysed from the systems and instruments systems, to ensure that critical data hall and other space ambient conditions are maintained during different testing scenarios.

Once successfully completed, the process will move to Level 6 – Handover / Turnover to the Owners Team.

Integrated Testing Scripts:

- Develop and issue integrated testing scripts, aligned with the project expectations, that outline the specific procedures and scenarios to be executed during the testing phase.

Meetings, Workshops, and Reporting:

- Conduct productive meetings and workshops involving relevant stakeholders, including the Owner, Commissioning Consultant, Designer, General Contractor, Vendors, and Sub-Contractors.
- Collaboratively review progress, address any concerns, and report on the status of the integrated testing activities.

Organization of Permits:

- Apply for the necessary permits and approvals required for conducting the integrated systems testing.

Load Bank Plans and Temporary Instruments/Equipment:

- Ensure that the load bank plans, and temporary instruments align with the testing objectives and accurately replicate the anticipated load demands.

Resource Schedules:

- Establish comprehensive resource schedules that outline the availability of personnel, equipment, and materials required for the integrated testing activities.

Integrated Systems Testing:

- Execute rigorous testing procedures that evaluate the performance, functionality, and interoperation of various integrated systems.
- Verify that the systems meet the design requirements, perform as intended, and respond appropriately to simulated failure scenarios.

Document Filing:

- Maintain documentation throughout the Level 5 activities, including test plans, test results, data trends, and any adjustments made during testing.
- Ensure that all relevant documents are accurately filed and readily accessible for reference, analysis, and future auditing purposes.

Final Level 5 Integrated Testing Report and Closeout Meeting:

- Prepare a comprehensive final report that consolidates the findings, observations, and results of the Level 5 integrated testing activities.
- Conduct a closeout meeting to review the report, address any outstanding issues or observations, and gain consensus among stakeholders.

Completing Training

- Training sessions are concluded with the facilities teams, ensuring that the team members are equipped with the necessary knowledge and skills to operate and maintain the data centre effectively.

Sampling Rate

See sampling section within this document.

Level 5 – Integrated Systems Testing

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L5-01	Write and **Issue Scripts** that will be used to facilitate the testing works.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L5-02	Write and **Issue Work Permits** as noted in Level 0 that will be used to facilitate the works.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L5-03	Ensure that **Temporary Equipment and Instruments** are installed in line with the approved Load Bank & Equipment Plan as noted in Level 0 works.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L5-04	Operate Temporary Equipment and Instruments to facilitate the testing works.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L5-05	**Plan and Manage Testing and Acceptance** of plant, equipment, and systems in line with approved procedures, scripts, and programme.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**I**nformed
L5-06	**Download Data** and Information for review after testing.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**I**nformed
L5-07	Remove **Temporary Equipment** after testing has been agreed complete.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed

Level 5 – Integrated Systems Testing

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L5-08	Update **Commissioning Tracking** to reflect actual status and progress. [Manually or as per Commissioning Electronic Platform]	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L5-09	Add any issues to **Observation Register** and managing to close.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**I**nformed
L5-10	**File and manage** documentation and records within the Project electronic filing system.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**I**nformed
L5-11	Issue regular **2 Week Look Ahead Schedules** for Commissioning Team Resource Planning.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L5-12	Conduct Daily Morning Coordination Workshop.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L5-13	Provide Daily Commissioning Updates.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L5-14	Conduct Commissioning Focused **Weekly Meetings and Workshops.**	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport

Level 5 – Integrated Systems Testing

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L5-15	Provide Commissioning Focused Reports. [Level 5 / Monthly / Weekly]	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L5-16	Complete **Facility Operatives Training** in line with the documents noted in Level 0 works.	**R**esponsible	**S**upport	**A**pprove	**S**upport	**I**nformed
L5-17	Install all **White Tags** where applicable.	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L5-18	Provide to Owner, Level Close Out Reports.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L5-19	Sign off Level.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport

16.8. Level 6 – Handover / Turnover

Managed and executed by the Owners Commissioning Consultant, with the support of the General Contractor, Level 6 is the final stage, where the Commissioning Process is completed with the systems transitioning to the Owner and Facilities Team, ensuring that the data centre is fully prepared and optimized for operation, and all commissioning-related activities are concluded in a systematic and well-documented manner.

The key objectives and outcomes of Level 6 are as follows:

Completing Final Handover Documentation

- All required documentation, including operation and maintenance manuals, as-built drawings, warranties, systems manuals, and other relevant records, are compiled and organized to facilitate a smooth handover process.

Conducting Site Walk and Final Inspection

- A thorough site walk, and final inspection is carried out to ensure that all areas of the data centre meet the required standards and specifications. Any outstanding issues or discrepancies are addressed and rectified.

Closing out Issues and Observations

- Any outstanding issues or observations related to previous commissioning levels [Level 5, Level 4, Level 3, Level 2, and Level 1) are addressed and resolved, ensuring that all tasks and activities are satisfactorily completed.

Deep Cleaning of Data Hall

- If not completed during the Level 3 tasks and activities, the data hall is subjected to a comprehensive deep cleaning process to ensure a pristine environment for the operation of critical equipment and systems.

Verification of Plant and Equipment Settings

- The settings and configurations of all plant and equipment are verified to ensure they align with the design intent and operational requirements.

Lessons Learned

- A lessons learned session is conducted to evaluate the commissioning process and identify areas for improvement. Valuable insights and recommendations are documented to enhance future projects.

Conducting Closeout Meeting

- A closeout meeting is held with relevant stakeholders to review the commissioning process, discuss the results, and obtain necessary approvals.

Issuing Final Commissioning Report

- A comprehensive final commissioning report is prepared, documenting the entire commissioning journey, including the activities performed, results obtained, and any relevant recommendations. This report serves as a valuable reference for future operations of the facility.

Level 6 – Handover / Turnover

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L6-01	Write and Issue Closeout Script.	**I**nformed	**I**nformed	**R**esponsible	**A**pprove	**I**nformed
L6-02	Complete Clean of Data Halls and critical areas. [If not completed under Level 3 tasks and activities]	**R**esponsible	**S**upport	**A**pprove	**I**nformed	**I**nformed
L6-03	Conduct Final Site Inspection.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L6-04	Inspect and Document all Plant Settings.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**I**nformed
L6-05	Conduct Lessons Learned Workshop and document.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L6-06	Ensure all **Issues and Observations** have been closed out for the project.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L6-07	Ensure all **Commissioning Documentation** is complete and uploaded to the relevant electronic platforms.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport

Level 6 – Handover / Turnover

R – Responsible | **A** – Approve | **S** – Supportive | **C** – Consulted | **I** - Informed

Level	Task/Activity	General Contractor	Supplier	Cx Agent	Owner	Designer
L6-08	Conduct Closeout Meeting.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L6-09	Issue Final Commissioning Report.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L6-10	Write and Issue **Systems Manual.**	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L6-11	Provide to Owner, Level Close Out Reports.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport
L6-12	Sign off Level.	**S**upport	**S**upport	**R**esponsible	**A**pprove	**S**upport

17. Tools and Instruments

The below provides an example of the calibrated and non-calibrated tools and instruments that will be required to complete the overall commissioning works, that should be provided by the General Contractor, their Sub Contractors, Suppliers and Vendors.

The list should be further developed and updated in line with the specific project requirements, design, and testing expectations.

Equipment	Type of Testing
	Accelerometer *Vibration Testing*
	Andersen Multi-hole Impactor Samplers *Indoor Air Quality Measurement*
	Anemometer [with pitot] *AHU Function Test | Building Management System Function Test | CRAC Unit Function Test | Dx Coil / System Function Test | Fan Coil Unit Function Test*
	Anemometer [with vane] *AHU Function Test* **|** *Building Management System Function Test* **|** *CRAC Unit Function Test | Dx Coil / System Function Test | Fan Coil Unit Function Test*

Equipment	Type of Testing
	Balometer *AHU Function Test | Fan Coil Unit Function Test | Gas Extraction System Function Test | VAV / CAV Box Function Test | Ventilation Balancing*
	Belt Tensioning Tool *AHU Function Test | Fan Coil Unit Function Test | Ventilation Fan Function Test*
	Black Magnetic Ink *Magnetic Particle Inspection Test*
	Calibrated Door Fan *Room Integrity Test*
	Chlorination Test Kit *Flushing and Chlorinating of Domestics*

Equipment	Type of Testing
	Clamp Ammeter *Addressable Central Battery Function Test | AHU Function Test | Building Management System Function Test | Chemical Dosing Function Test | CHW / CDW Pump Function Test | CRAC Unit Function Test | Distribution Board Test | Dx Coil / System Function Test | Dx Split Unit Function Test | Electric Heater Function Test | Fan Coil Unit Function Test | Fire Pump Performance Function Test | Fuel Pump Function and Performance Test | Gas Extraction System Function Test | Generator Function Test | Heat Pump Function Test | Humidifier Function Test | LV Switch Board Function Test | Power Distribution Unit [PDU] Function Test | PQM & BEMS Function Test | Pressurization Unit Function Test | Side Stream Filter Function Test | Smoke Extraction System Function Test | Sump Pump Function Test | Thermal Infrared Scanning | Up feed, Booster, Transfer and Circulation Pump Test | UPS Function Test | VAV / CAV Box Function Test | Ventilation Fan Function Test | VRV System Function Test | VSD Function Test*
	Continuity Tester *Earthing System Function Test | Final Circuit Test | Lighting Function Test | Lightning Protection Function Test*
	Contrast Aid Paint *Magnetic Particle Inspection Test*
	**Data Logger** *Temperature / Humidity Testing | Ambient conditions Monitoring*
	Dial Gauge *CHW/CDW/LTHW Pump Function Test | Fire Pump Performance Function Test | Fuel Pump Function and Performance Test*

Equipment	Type of Testing
	Duct Leakage Tester *Duct Leakage Test*
	Earth Loop Impedance Tester *Earthing System Function Test | Final Circuit Test | Lighting Function Test | Lightning Protection Function Test*
	Earthing and Ground Resistivity Tester *Earthing System Function Test | Lightning Protection Function Test*
	Electronic Micromanometer *AHU Function Test | Building Management System Function Test | Coil Performance Test | CRAC Unit Function Test | Dx Coil / System Function Test | Dx Split Unit Function Test | Fan Coil Unit Function Test | Gas Extraction System Function Test | Heat Wheel Function Test | Smoke Extraction System Function Test | VAV / CAV Box Function Test | Ventilation Balancing | Ventilation Fan Function Test | VESDA / HSSD Performance Function Test | VRV System Function Test*
	Electro Magnetic Yoke [AC] *Magnetic Particle Inspection Test*

Equipment	Type of Testing
	Electro Magnetic Yoke [DC] *Magnetic Particle Inspection Test*
	Flow Measurement Cup *Electric Water Heater Function Test | Flushing and Chlorinating of Domestics | Sanitary Fittings Function Test*
	Hand Pump *Pipework Pressure Test*
	Harmonic/Power Quality Analyzer *Power Distribution Unit [PDU] Function Test | UPS Function Test | Low Voltage Switch Board Function Test | High Voltage Switch Board Function Test | Variable Speed Drives Function Test | Transformers Function Test | Distribution Boards Function Test*
 	Temporary Load Banks [Resistive, Reactive & Server Emulator] *Power Distribution Unit [PDU] Function Test | UPS Function Test | Low Voltage Switch Board Function Test | High Voltage Switch Board Function Test | Variable Speed Drives Function Test | Transformers Function Test | Distribution Boards Function Test | Busbar Function Test | Data Hall Load Testing | Generator Functional Testing | Chiller Testing | CRAC/CRAH Functional Testing | Level 3 Testing | Level 4 Testing | Level 5 Testing*

Equipment	Type of Testing
	
	High Voltage Flash / Hipot Tester *Low Voltage Switch Board Function Test*
	Humidity Sensor *Building Management System Function Test | Coil Performance Test | Dx Split Unit Function Test | Heat Wheel Function Test | Humidifier Function Test | VRV System Function Test*
	Incline Manometer *Ductwork Pressure Testing*
	Infrared Thermometer *Power Distribution Unit [PDU] Function Test | UPS Function Test | Low Voltage Switch Board Function Test | High Voltage Switch Board Function Test | Variable Speed Drives Function Test | Transformers Function Test | Distribution Boards Function Test | Busbar Function Test | Data Hall Load Testing | Generator Functional Testing | Chiller Testing | CRAC/CRAH Functional Testing*

Equipment	Type of Testing
	Insulation Tester *Addressable Central Battery Function Test | AHU Function Test | Building Management System Function Test | Bus Bar Function Test | CHW / CDW Pump Function Test | CRAC Unit Function Test | Electric Heater Function Test | Electronic Descaling Unit Function Test | Fan Coil Unit Function Test | Final Circuit Test | Fire Pump Performance Function Test | Fuel Pump Function and Performance Test | Gas Extraction System Function Test | Generator Function Test | Heat Pump Function Test | Humidifier Function Test | Lighting Function Test | LMCP Function Test | LV Cable Test | LV Switch Board Function Test | Power Distribution Unit [PDU] Function Test | Smoke Extraction System Function Test | Sump Pump Function Test | Ultraviolet Sterilizer Function Test | Up feed, Booster, Transfer and Circulation Pump Test | UPS Function Test | Ventilation Fan Function Test | VSD Function Test*
	Laser Range Meter *Thermal Scanning*
	Low Resistance Ohmmeter / Ductor Tester *Addressable Central Battery Function Test | Bus Bar Function Test | LV Switch Board Function Test | Power Distribution Unit [PDU] Function Test | UPS Function Test*
	Lux Level Meter *Lighting Control Function Test | Lighting Function Test*
	Magnet / Detector Tester *Automatic Fire Alarm Function Test | Clean Agent Extinguishing System Function Test | Pre Action-System Function Test | Smoke Extraction System Function Test | VAC Trip Testing | VESDA / HSSD Performance Function Test*

Equipment	Type of Testing
	Multi Tester *Active Harmonic Filter Function Test | Addressable Central Battery Function Test | Automatic Fire Alarm Function Test | Building Management System Function Test | Bus Bar Function Test | Chemical Dosing Function Test | Clean Agent Extinguishing System Function Test | Dx Coil / System Function Test | Dx Split Unit Function Test | Electric Water Heater Function Test | Electronic Descaling Unit Function Test | Feed and Expansion Tank Function Test | Final Circuit Test | Fire Damper Drop Test | Fuel Control System Function Test | Generator Function Test | Humidifier Function Test | Lighting Control Function Test | Lighting Function Test | LV Cable Test | LV Switch Board Function Test | Power Distribution Unit [PDU] Function Test | PQM & BEMS Function Test | Pre Action-System Function Test | Pressurization Unit Function Test | Refrigerant Leak Detection Function Test | Side Stream Filter Function Test | Ultraviolet Sterilizer Function Test | UPS Function Test | VAC Trip Testing | VESDA / HSSD Performance Function Test | VRV System Function Test | Water Leak Detection Test | Water Tanks Function Test*
	Passive IAQ Sampling *Indoor Air Quality Measurement*
	Permanent Magnets *Magnetic Particle Inspection Test*
	Phase Rotation Meter *AHU Function Test | Bus Bar Function Test | CHW / CDW Pump Function Test | CRAC Unit Function Test | Final Circuit Test | Fire Pump Performance Function Test | Fuel Pump Function and Performance Test | Gas Extraction System Function Test | Generator Function Test | Heat Pump Function Test | Lighting Function Test | LMCP Function Test | LV Cable Test | LV Switch Board Function Test | Power Distribution Unit [PDU] Function Test | Smoke Extraction System Function Test | Ventilation Fan Function Test*

Equipment	Type of Testing
	Power Analyser *Active Harmonic Filter Function Test | Generator Function Test | Power Distribution Unit [PDU] Function Test | UPS Function Test*
	Pressure Gauge *Building Management System Function Test | CHW / CDW Pump Function Test | Coil Performance Test | Condensate Drainage Test | CRAC Unit Function Test | Fire Hydrant and Hose Reel | Fire Pump Performance Function Test | Fuel Pump Function and Performance Test | Generator Fuel Tanks Function Test | Generator Function Test | Heat Pump Function Test | Pipework Pressure Test | Plate Heat Exchanger Function Test | Pre Action-System Function Test | Pressurization Unit Function Test | Side Stream Filter Function Test | Sprinkler System Function Test | Sump Pump Function Test | Up feed, Booster, Transfer and Circulation Pump Test | Water Balancing Test*
	Primary Current Injection Tester *Low Voltage Switch Board Function Test | High Voltage Switch Board Function Test*
	Raised Floor Lifter *Water Leak Detection Testing*
	RCD Tester *Final Circuit Test | Lighting Function Test*

Equipment	Type of Testing
	Real Time IAQ Monitor *Indoor Air Quality Measurement*
	Refrigerant Pressure Gauge *Dx Coil / System Function Test | Dx Split Unit Function Test | Refrigerant Pipe Strength, Leak and Evacuation Test*
	Refrigerant Leak Detector *Dx Coil / System Function Test | Dx Split Unit Function Test | Refrigerant Pipe Strength, Leak and Evacuation Test*
	Secondary Current Injection Tester *Low Voltage Switch Board Function Test | High Voltage Switch Board Function Test*
	Smoke Generator *Room Integrity Test*
	Sound Meter *Acoustic Testing | Automatic Fire Alarm Function Test | Clean Agent Extinguishing System Function Test | Pre Action-System Function Test*

Equipment	Type of Testing
	Stopwatch *Electric Heater Function Test | VESDA / HSSD Performance Function Test*
	Tachometer *AHU Function Test | CHW / CDW Pump Function Test | CRAC Unit Function Test | Fire Pump Performance Function Test | Fuel Pump Function and Performance Test | Generator Function Test | Heat Pump Function Test | Smoke Extraction System Function Test | Sump Pump Function Test | Up feed, Booster, Transfer and Circulation Pump Test | Ventilation Fan Function Test | Vibration Testing*
	Temperature Sensor [air] *AHU Function Test | Building Management System Function Test | Coil Performance Test | Condensate Drainage Test | CRAC Unit Function Test | Drainage System Test | Dx Coil / System Function Test | Dx Split Unit Function Test | Electric Heater Function Test | Fan Coil Unit Function Test | Generator Fuel Tanks Function Test | Generator Function Test | Heat Pump Function Test | Heat Wheel Function Test | Humidifier Function Test | Lightning Protection Function Test | LV Switch Board Function Test | Refrigerant Pipe Strength, Leak and Evacuation Test | Room Integrity Test | VAV / CAV Box Function Test | Ventilation Balancing | VRV System Function Test*
	Temperature Sensor [water contact] *Dx Split Unit Function Test | Magnetic Particle Inspection Test | Sanitary Fittings Function Test | VRV System Function Test | Water Balancing Test*
	Temperature Sensor [water insertion] *AHU Function Test | Building Management System Function Test | CHW / CDW Pump Function Test | Coil Performance Test | CRAC Unit Function Test | Electric Water Heater Function Test | Fan Coil Unit Function Test | Fire Pump Performance Function Test | Flushing and Cleaning | Heat Pump Function Test | Pipework Pressure Test | Plate Heat Exchanger Function Test | Sanitary Fittings Function Test | Water Balancing Test*

Equipment	Type of Testing
	Thermal Imaging Camera *Power Distribution Unit [PDU] Function Test | UPS Function Test | Low Voltage Switch Board Function Test | High Voltage Switch Board Function Test | Variable Speed Drives Function Test | Transformers Function Test | Distribution Boards Function Test | Busbar Function Test | Data Hall Load Testing | Generator Functional Testing | Chiller Testing | CRAC/CRAH Functional Testing*
	Torque Wrench *Bus Bar Function Test | Generator Function Test | Lightning Protection Function Test | LMCP Function Test | LV Cable Test | LV Switch Board Function Test | Power Distribution Unit [PDU] Function Test | UPS Function Test*
	Transformer 140v to 6v supplying minimum 15A. *VESDA / HSSD Performance Function Test*
	Tryptic Soy Agar Plates *Indoor Air Quality Measurement*
	U Tube Manometer *Condensate Drainage Test | Drainage System Test*

Equipment	Type of Testing
	Ultra-Sonic Flow Meter *Flushing and Chlorinating of Domestics | Flushing and Cleaning | Water Balancing*
	Ultrasonic Weld Testing Equipment *Ultrasonic Weld Testing*
	Vacuum Gauge *Refrigerant Pipe Strength, Leak and Evacuation Test*
	Voltmeter *Addressable Central Battery Function Test | AHU Function Test | Building Management System Function Test | Bus Bar Function Test | Chemical Dosing Function Test | CHW / CDW Pump Function Test | CRAC Unit Function Test | Electric Heater Function Test | Electronic Descaling Unit Function Test | Fan Coil Unit Function Test | Final Circuit Test | Fire Pump Performance Function Test | Fuel Pump Function and Performance Test | Gas Extraction System Function Test | Heat Pump Function Test | Lighting Function Test | LMCP Function Test | LV Cable Test | LV Switch Board Function Test | Power Distribution Unit [PDU] Function Test | PQM & BEMS Function Test | Pressurization Unit Function Test | Side Stream Filter Function Test | Smoke Extraction System Function Test | Sump Pump Function Test | Ultraviolet Sterilizer Function Test | Up feed, Booster, Transfer and Circulation Pump Test | UPS Function Test | Ventilation Fan Function Test | VSD Function Test*
	Water & Cloths *Water Leak Detection Test*

Equipment	Type of Testing
	Water Flow Meter *Fire Hydrant and Hose Reel | Pre Action-System Function Test | Sprinkler System Function Test*
	Water Box Manometer *AHU Function Test | Building Management System Function Test | CHW / CDW Pump Function Test | Coil Performance Test | CRAC Unit Function Test | Fan Coil Unit Function Test | Fire Pump Performance Function Test | Flushing and Chlorinating of Domestics | Flushing and Cleaning | Heat Pump Function Test | Plate Heat Exchanger Function Test | Sump Pump Function Test | Up Feed, Booster, Transfer and Circulation Pump Test | Water Balancing Test*
	Water Quality Sampling Kit *Pipework Flushing and Cleaning*
	Weld Gauge and Steel Rule *Magnetic Particle Inspection Test*
	0.1mm Wire *VESDA / HSSD Performance Function Test*

18. Document Formats

This section outlines the minimal expected requirements for the General Contractor, Consultants, and Project Managers involved in creating any critical commissioning documentation, focusing on the format, information content, and quality expectations.

The purpose is to ensure consistency across all projects and enough information is available for future reference and provide a standardized approach.

18.1. Commissioning Documentation Register

Number	Revision	Description	Current Status	Type	Level	Issued Date

18.2. Commissioning Team Organigram

The Project Organigram is a visual representation of the project team's structure and hierarchy, providing a clear overview of roles, responsibilities, and reporting lines within the project.

To ensure consistency and facilitate effective communication, the format and look of it should meet the following minimal requirements:

Clarity and Readability

The Project Organigram should be easily understandable, allowing stakeholders to quickly understand the project team's structure and relationships.

Clear labels and descriptions of roles and responsibilities should be included, with a standardized format established for displaying roles and responsibilities consistently throughout.

Visual cues such as icons or symbols can be incorporated to represent different roles or responsibilities, further enhancing understanding.

Hierarchical Representation

Visually illustrate the hierarchical structure of the project team, highlighting reporting lines and dependencies.

Different visual elements [shapes and colours etc] should be used to distinguish between different levels.

Clear indicators, such as arrows or lines, be employed to represent reporting lines and dependencies, providing a clear visual representation of the relationships within the project team.

Logical Grouping

Logically group related roles or departments, making it easy to identify different functional areas or teams within the project.

This grouping can be based on project phases, disciplines, areas of expertise, or other relevant criteria.

The grouping should be intuitive and logical.

Scalability and Flexibility

The organigram should be scalable and flexible that allows to include additional team members as the project evolves.

Digital Accessibility

It should be readily available in a digital format, enabling effortless distribution, sharing, and updates, and compatible with widely used software or tools like project management platforms or presentation software.

Version Control

As the project progresses and team compositions change, the organigram should be regularly updated to reflect the latest information and implement a clear version control system that includes version numbers, timestamps, or revision history to indicate changes made over time.

18.3. Owners Project Requirements [OPR]

The purpose of the OPR is to establish a comprehensive document that serves as the foundation for all design, construction, acceptance, and operational decisions. It is crucial that the OPR is agreed upon and finalized before drafting the Basis of Design Document (BOD), Commissioning Plan, and other relevant Commissioning/Project Documents.

OPR Format

The following format for the OPR is suggested.

Example Section	Description
Executive Summary	Provide a high-level overview of the full document, focusing upon the most critical information. Include a section on what should be achieved to deem the project a success.
Project Description	Include detailed information about the building. – Project Description – Building Type – Size – Floors – Usage / Area / People – Systems to be installed – Green Building Requirements
Project Schedule and Budget	Describe the owner's approach to allocating resources for the project. This should include a narrative of the importance of capital investment, the life of systems, operating costs, maintenance costs, and the use of life cycle costing for the selection of the systems. Relative to the schedule, enough time must be allocated for design, construction, proper start-up, testing, and tuning of HVAC&R systems.
Commissioning Process Scope and Budget	Provide a schedule of the HVAC&R components and systems that are the focus of the commissioning process. Systems may include energy supply, heat generation, refrigeration, HVAC &R distribution, terminal, and package units, HVAC &R instrumentation and controls, testing, adjusting, and balancing, and other special HVAC &R systems and equipment.
Project Documentation Requirements	Provide a description of what documentation is required to properly install, start-up, operate, troubleshoot, and maintain the HVAC&R systems for the life of the building/facility.

Example Section	Description
	The description should also include the format of the documentation, either electronic or paper, and any specific features such as numbering/filing systems and any electronic platforms that are to be utilized.
Owner Directives	The owner could have pre-defined requirements on what systems, components, or operating conditions will be required. It is critical, when requirements are given, that the owner's intent be understood. For example, if an owner requires a specific manufacturer or type of system, it is important to understand that this requirement relates to, for example, "the need to simplify maintenance due to the use of this manufacturer on their other 20 facilities." Give a reason why, so that later if any application is made to change the reviewer can understand the current needs.
Restrictions and Limitations	Identify and document specific pre-existing or new restrictions and limitations on the HVAC &R systems. For example, it should be noted if a facility is being added to a campus loop that has an excess capacity of only 500 tons or if there are concerns from the local community about noise generation from a cooling tower.
User Requirements	Provide an understanding of how the users (those with short-term occupancy of the facility, including visitors) define comfort (temperature, humidity, air movement, or non-mechanical control features of the facility's OPR requirements) and indoor air quality.
Occupant Space Use Requirements and Schedules	Provide an understanding of how the occupants (those with long-term occupancy of the facility) define comfort, indoor air quality, controllability, and interface with the operation and maintenance staff. Additional environmental needs may be required for animal, plant, or process operations. Document the initial schedules for occupancy/process, including numbers and hours for normal, holiday, and unique days, the occupant types, and activity levels. As applicable, include environmental conditions and schedules for special space use applications (e.g., refrigerated warehouse, museum).
Training Requirements for Owner's Personnel	Document the current level of knowledge of the owner's personnel and the intent to provide an adequate level of training on new HVAC &R technologies. This is important to enabling the design of HVAC &R systems within the owner's current or future (additional training) capabilities.

Example Section	Description
Warranty Requirements	Produce a listing of the requirements for warranties on the HVAC &R systems and components, including the start of warranty, period, and conditions.
Benchmarking Requirements	Produce a list of targets or benchmarks for future comparison and optimization of the HVAC &R systems. This includes energy usage, efficiencies, performance information, and capabilities of the HVAC &R systems and components.
Statistical and Quality Tools	Note the sampling frequency to be used for the various systems and components during the Design and Construction Phase, including the need for re-sampling or second review and the reasoning for the rates chosen. For example, it should be noted that during site visits 'x%' of the recently completed construction checklists are verified, or that during testing of the systems 'y%' of the chillers and 'z%' of the air-handling units are verified.
Operational and Maintenance Criteria	Create a description of how the HVAC &R systems are to be operated and maintained, including how the operation and maintenance personnel will approach the resolution of problems (i.e., fix upon fail, manufacturer's recommendations, or owner-specified periodic frequencies), and the source (in-house or contracted) and expected level (current, new, additional) of manpower for the operations and maintenance staff, and known frequencies of maintenance items.
Equipment and Systems Maintainability Expectations	Provide a summary of the assumptions for accessibility to HVAC &R systems and equipment (e.g., the maintenance space should be according to the manufacturer's recommendations or 'x%'greater). Further, special requirements for maintenance and access should be listed (e.g., gauges, test ports, permanent ladders, catwalks, and cranes).
Quality Requirements of Materials and Construction	Describe the level of quality, in relation to the life cycle cost approach, of the HVAC &R materials (e.g., the use of galvanized, stainless steel, or ceramic cooling towers), including the durability and time expectancy between failures/replacement. Document the general expectations of the Owner for the quality of construction (e.g., industry average, above average, or best workmanship).
Allowable Tolerance in Facility System Operations	Document the tolerance that will be allowed in the operation of the HVAC &R systems. For example, the temperature in the space shall not vary more than +/- [x] deg F, the chiller plant shall operate at +/- [x.xx] kW/ton at full load, or the system airflow shall be +/- [x] %.

Example Section	Description
Energy Efficiency Goals	Energy efficiency goals must always be defined by the OPR to provide adequate guidance and clear requirements for the design team and the operations team after occupancy. This should include the minimum acceptable energy efficiency level, which is typically local code or owner's established criteria. Additional requirements may be stated as a percentage better than code or as a first-cost economical evaluation, such as: "first-cost investment that will provide a simple economic payback in energy and operations cost that is less than six years should be implemented in the design."
Environmental Sustainability Goals	Relative to the HVAC &R systems, document how the owner defines efficiency and sustainability. This could be an energy usage per area, a percent value better than standard average usage (e.g., EnergyStar™ or school-district average), a minimum value (code or owner's internal targets), or the amount of recycled material to be used in the systems. In some projects, there may be specific requirements to obtain a green rating, such as LEED.
Adaptability	Document the adaptability requirements for the existing HVAC &R systems to be modified, expanded, or relocated for future needs.
Systems Integration Requirements	Discuss the need to integrate the HVAC &R systems with others, such as fire, life safety, envelope, daylighting control, and security, over and above code requirements.
Applicable Codes and Standards	Detail the known HVAC &R codes and standards that will be followed for the project, including the year of the publication and the specific option to be used (e.g., the indoor air quality versus the ventilation rate procedure in ASHRAE Standard 62-20**). Also include a narrative on the Owner's approach to codes, standards, guidelines, and best practices (e.g., exceed Standard 90.1 by 10%, or achieve a comfort satisfaction of 92%). A list of standards/guides that could be used is listed below: – ANSI / ASHRAE / IES Standard 90.1 Energy Standard for Buildings Except for Low-Rise Residential Buildings – ANSI/ASHRAE 55 – Thermal Environmental Conditions for Human Occupancy – ANSI/ASHRAE 62.1 – Ventilation for Acceptable Indoor Air Quality – ASHRAE Standard 189.1 – Standard for the Design of High-Performance Green Buildings Except for Low-Rise Residential Buildings – ASHRAE Guideline 0 – The Commissioning Process

Example Section	Description
	– ASHRAE Standard 202 – Commissioning Process for Buildings and Systems – ASHRAE Guideline 1.1 – HVAC &R Technical Requirements for The Commissioning Process – Applicable Local, National Building Codes – ASHRAE Thermal Guidelines for Data Processing Environments – ASHRAE Advanced Energy Design Guide for Zero Energy Office Buildings
Health, Hygiene, and Indoor Environment	Include a narrative for the HVAC &R systems for items such as: – Location of intakes – how to avoid the introduction of pollutants from outdoor sources or exhaust air into the outdoor air intake. – Local exhaust – the use of local exhaust for such areas/items as kitchen, storage, laboratories, and copiers. – Materials in contact with airstream – the materials that the supply air stream will be in contact with and the potential for problems related to moisture and dirt accumulation. – Filtration – the level and type of filtration relative to the use of the space and the type of occupants. – Air exchange rates – the volume of outdoor air, including variations over time and the ability of the distribution system to deliver outdoor air to the occupied space. This should also include a discussion of the need for outdoor air to minimize the build-up of pollutants from material off-gassing in the space.
Acoustics	Document the acoustic requirements for each space type (e.g., no noise production in a concert hall, background noise production in an open office space, or a maximum of RC30 in a private office). This should focus on the production of noise from the HVAC &R systems, either from the distribution of fluid or from the mechanical systems.
Vibration	Document an understanding of the vibration limitations of the facility and any critical use of spaces.
Seismic	Document an understanding of the seismic requirements, and expectations for the HVAC &R systems.
Weather	Document an understanding of the weather requirements, and expectations for the HVAC &R systems. For example, in Typhoon areas, what should the ultimate position of the louvers be and generator

Example Section	Description
	intake?
Accessibility	Document any unique requirements for placement of HVAC &R system components to meet the needs of occupants, such as the location of sensors, switches, and emergency cut-offs.
Security	Include a narrative on the need for security of the HVAC &R systems relative to the use of the facility and potential threats to the facility and equipment.
Functionality	Include a description of the interface to the HVAC &R systems by the operations and maintenance personnel and by the occupants for the purpose of maintaining desired conditions.
Aesthetics	Include a description describing the relative location of the major HVAC &R systems and the exposure of HVAC &R components within the building (e.g., use of exposed ductwork or the type of diffusers) and outside the building (e.g., cooling towers and condensers).
Constructability	Include a description of any known restrictions that would limit the size of equipment that could be transported to the site (e.g., the only access road has a low bridge) or installed at the site (the use of high cranes or helicopters is prohibited).
Communications	Include a narrative on the use of one or multiple backbone systems and accessibility to automatic controls and building automation systems from outside the facility.
Controls of HVAC&R Systems	The OPR needs to clearly define the level of control and interoperability of systems. Control system performance needs to be defined during the Pre-Design Phase. In some facilities, this may require a brief preliminary control pre-design workshop. This is required for both the project cost budget and providing programming information for the design team and the commissioning team during all phases of the project delivery.

18.4. Basis of Design [BOD]

The Basis of Design Document (BOD), authored by the Designer, serves as a comprehensive reference for all project participants. It outlines the selection and design process of the HVAC/Electrical/Plumbing and Fire equipment, systems, and integrations based on the Owners Project Requirements (OPR). The BOD provides a baseline narrative and overview, ensuring that everyone involved understands how the final design has been developed to align with the project's objectives and requirements.

The document should cover the following.

Intended usage of the building and spaces

Type of occupancy, how it affects the design and operation of the building. Unique challenges

System operation and maintenance expectations

How will the different systems operate? How it will be maintained, facilities staffing, etc.

Design methods implemented

Method of Calculations for loadings, lighting, cooling, heating, people, u-values, etc. Software used or will use.

Narrative of the design

For all systems and types, provide a general description, explain why it was selected, what equipment will be used, and integrate environmental systems. Types of materials to be used for the installations. Decentralized systems etc.

Narrative of the operation of the systems

Explain the intended operation of the systems Sequence of operations Time clocks Plant changeovers.

Codes Guides Standards

To cover design, construction & commissioning of the HVAC / Building Services for the project.

Ambient Conditions

Outdoor Design Conditions Room / Space Conditions [temp, humidity, noise etc].

List performance criteria

Describe any specific design/performance criteria that have been stipulated by the OPR / Client Comfort Levels Air Quality Lux Levels Energy Requirements Specific maintenance requirements Ventilation rates.

Sources of energy / fuel / supply

Explain the fuel sources that the building will utilize: Water Electric Solar Natural Gas Propane Diesel Oil Borehole.

List of manufacturers

Provide a full list of equipment and expected manufacturers that will be used.

18.5. Commissioning Plan

The Commissioning Plan is a written document outlining the steps, tasks, activities, and responsibilities to be conducted and adhered to, ensuring that the overall project commissioning process is understood and delivered by all parties involved.

Cx Plan Format

The following format for the OPR is suggested.

Section	Description
1.0	Introduction
2.0	Overview
3.0	Project Information
4.0	References
5.0	Definitions
6.0.	Important Information
70	Commissioning Team Information
8.0	General Communication
9.0	Commissioning Process Activities / Roles and Responsibilities
9.1	Stage 1: Pre-Design Stage & Responsibilities
9.2	Stage 2: Design Stage & Responsibilities
9.3	Stage 3: Construction Stage & Responsibilities
9.3.1	3a. Pre-Construction

Section	Description
9.3.2	3b. Construction
9.3.3	3c. Commissioning
9.4	Stage 4: Occupancy & Operations Stage & Responsibilities
9.5	Stage 5: Continuous Commissioning
10	Commissioning Documentation
10.1	Code/Guides & Standards
10.2	Project Specifications
10.3	Project Drawings [Layouts/Schematics]
10.4	Project Control Logics
10.5	BMS Points List
10.6	BMS Graphics
10.7	Discrimination Study Report
10.8	Arc Flash Report
10.9	Project Fire Report
10.1	Project Fire Cause and Effect Matrix
10.11	Commissioning Plan
10.12	Commissioning Specification

Section	Description
10.13	Documentation Review and Sampling Rate
10.14	Commissioning Documentation Numbering System
10.15	Electronic Filing Systems
10.16	Hard Copy Filing Systems
10.17	Calibration Certification
11.0	Factory Testing
11.1	Factory Testing Witnessing and Sampling Rate
11.2	Factory Testing Method Statements
11.3	Notification of Factory Test
11.4	Factory Testing Reporting
12.0.	Pre-Commissioning
13.0	Functional Testing
13.1	Functional Test Witnessing and Sampling Rate
13.2	Functional Testing Method Statements
13.3	Notification of Functional Test
13.4	Functional Retesting
13.5	Commissioning Certification

Section	Description
14.0	Systems Requiring to be Commissioned / Tested
15.0	Training Plan & Records
16.0	Peak Season Testing
17.0	Building Integrated Testing
18.0	Warranty Review
19.0	Lessons Learned
20.0	Commissioning Programme
20.1	Commissioning Programme and Sequence of Works
20.2	2 Week Look Ahead
20.3	Daily Schedule
20.4	Early Handover of Areas
20.5	Recovery Programme
21.0	Commissioning Meetings
21.1	Commissioning Kick-Off Meeting
21.2	Commissioning Bi-Weekly Meeting
21.3	Weekly Commissioning Meeting
21.4	Construction Meetings

Section	Description
22.0	Commissioning Workshops
22.1	Documentation Numbering Workshop
22.2	Controls Logic / Sequence of Operation Workshops
23.0	Commissioning Reports
23.1	Weekly Progress Reports
23.2	Monthly Progress Reports
23.3	Final Commissioning Report
23.4	Systems Manual
23.5	Building Logbook
24.0	Tracking
24.1	Commissioning Risk Register
24.2	Commissioning Issues Log
24.3	Request for Information Log
24.4	Variation Log
24.5	Asset Register Log
25.0	Resource Levels
Appendix A	Owner's Project Requirements [OPR]

Section	Description
Appendix B	Basis of Design Document [BOD]
Appendix C	Project Specifications
Appendix D	Commissioning Team Organigram
Appendix E	Commissioning Process Flow Chart
Appendix F	Commissioning / Construction Check Lists
Appendix G	Commissioning Stage Sign-Off Certificates
Appendix H	Drawing Register
Appendix I	Control Logic Register

18.6. Commissioning Programme

A detailed commissioning programme shall be developed and issued showing all commissioning activities that need to be completed to achieve the project completion date,

The programme sequencing will be calculated back from the planned completion date of the project configuring all commissioning process activities, for all systems and equipment, into a logical, interrelated sequence of events.

Whilst the specific scope and technical requirements of the commissioning process need to be considered when preparing a commissioning programme, so do many other project activities and project constraints.

These include, but are not limited to the following criteria:

- Post-handover activities
- The date of project handover
- Any requirements for phased handover or building occupation,
- Any requirements that the Client has for beneficial use of systems,
- Any requirements for phasing of construction works,
- The sequencing of construction works,
- The construction methodology used; Is it traditional construction or an approach using widespread prefabrication, for example,
- Availability of utilities, such as electricity, gas, water, drainage, and telecommunications,
- Procurement times for plant, equipment, and materials,
- The time required to tender work packages,
- The design programme for the project,
- Site constraints that may slow down progress– within the site boundary and external to the site,
- Other constraints, such as restrictions on working hours, public holidays, and weather,
- Project logistics, including work area access & distribution of materials, plant, and equipment,
- Availability of workforce,
- Availability of crucial equipment, such as load banks or test instrumentation,
- The critical path for project works,

- The need to incorporate float in the project programme,
- The need to maintain safe methods of working,

The commissioning programme shall be coordinated with the overall project delivery programme. This co-ordination will enable the needs of both construction and commissioning personnel to be met.

It is crucial that all parties understand that commissioning works shall not be considered inferior to construction works.

Like construction works, they need to be undertaken in a particular order and require a specific amount of time to perform to the appropriate standard.

Construction works and commissioning process works are inextricably linked, so any changes in the sequencing of construction works or any deviations from the master construction programme need to be identified as early as possible. This will enable the commissioning team to determine if commissioning process activities are affected, assess any impact on the planned project handover date, and propose to the project team what action needs to be taken.

If programme delays occur and the planned handover date to the Client is under threat, the project team shall consider reconfiguring construction works rather than compressing the time to execute commissioning and pre-handover works.

If no reconfiguration of construction or commissioning works is possible, the project team shall discuss with the Client the possibility of moving the handover date rather than deliver a facility that is not operationally ready.

The project commissioning programme shall typically include dates for the following activities:

- Production of the project commissioning plan,
- Production of the commissioning specification for the project,
- Reviews of the design for commission ability, accessibility, and maintainability – 30%, 60%, and 90% design stages,
- Issue of guidelines for the preparation of factory acceptance test method statements,
- Preparation of tender documentation that clearly describes the project's commissioning requirements,
- Selection of construction specialists,
- Pre-start commissioning workshops,

- Approval of construction drawings and technical submittals for the different engineering services in the building,
- Approval of the commissioning process documentation before the installation work commences; project-specific commissioning method statements, checklists, and test sheets for the different engineering services in the building, 1st draft O&M manuals,
- Factory acceptance testing,
- Off-site Testing and Commissioning,
- Water-tight completion of the building envelope,
- Airtightness testing of the building envelope or building zones,
- Completion of building elements that are critical for the start of commissioning activities, such as partitions, raised floors and suspended ceilings,
- Delivery of significant items of building services plant,
- Electrical power activation for different elements of the project, including,
- Primary high voltage substations,
- High voltage ring mains distribution,
- Main low voltage switch rooms and power distribution,
- Motor control centres to mechanical plant,
- Individual building services plant items,
- Lifts and escalators,
- Building management system equipment,
- Fire alarm equipment,
- Security equipment,
- Lighting,
- Temporary power supply requirements,
- Supply of critical utilities, such as water, gas, and telecommunications,
- Foul and surface water drainage system availability,

- Installation completion for the different engineering services in the building,
- Static testing of different engineering services in the building,
- Site acceptance testing of plant and equipment,
- Commissioning dates for the different engineering services systems defined in the commissioning plan for the project, including,
- setting to work,
- regulation of air and water systems,
- performance tests on individual systems,
- Integrated systems testing,
- Delivery of O&M manuals,
- Delivery of a building users guide,
- Delivery of a building manual,
- Delivery of a commissioning report,
- Delivery of as-built drawings,
- Production of training courses for building users and operators,
- Delivery of training courses for building users and operators,
- Building handover,
- Lessons-learned review of the commissioning process,
- Initial occupancy support, including fine-tuning,
- Post-handover training,
- Seasonal Commissioning,
- Post-occupancy evaluation,

18.7. Temporary Load Bank & Equipment Plan

A "load bank plan" typically refers to a documented strategy or outline that details the procedure for testing and validating the performance and capacity of power systems within the data centre environment using permanent or temporary load banks.

The plan would specify the steps and procedures for conducting load bank testing and should detail the following information:

Load Bank Plan Format

The following format is suggested.

Section	Description
1.0	Introduction
2.0	Overview
3.0	Project Information
4.0	References
5.0	Definitions
6.0	Level 3 Testing and Commissioning
6.0.1	Roles and Responsibility Matrix
6.0.2	Load Level Table [including times and sizes]
6.0.3	Chilled Water or Temporary Cooling Requirement
6.0.4	Records, Reports and Documentation
6.0.5	Tools and Equipment

Section	Description
6.0.6	Load Types [Resistive/Reactive]
6.0.7	Load Bank Quantity and Layout
6.0.8	Power Quality Analysers and Layout
6.0.9	Data Loggers and Layout
6.1	Switch Board Testing Scenarios
6.2	Generator Testing Scenarios
6.3	Ring Main Unit Testing Scenarios
6.4	Power Train Unit [PTU] Scenarios
6.5	Busbar Testing Scenarios
6.6	Ups System Testing Scenarios
6.7	Chiller Load Testing Scenarios
7.0	Level 4 Functional Testing and Commissioning
7.0.1	Roles and Responsibility Matrix
7.0.2	Load Level Table [including times and sizes]
7.0.3	Chilled Water or Temporary Cooling Requirement
7.0.4	Records, Reports and Documentation
7.0.5	Tools and Equipment

Section	Description
7.0.6	Load Types [Resistive/Reactive]
7.0.7	Load Bank Quantity and Layout
7.0.8	Power Quality Analysers and Layout
7.0.9	Data Loggers and Layout
7.0.10	Infrared / Thermal Scanning Strategy
7.1	Electrical System Load Testing Scenarios
7.2	Mechanical System Load Testing Scenarios
8.0	Level 5 Integrated Testing and Commissioning
8.0.1	Roles and Responsibility Matrix
8.0.2	Load Level Table [including times and sizes]
8.0.3	Chilled Water Requirement
8.0.4	Records, Reports and Documentation
8.0.5	Tools and Equipment
8.0.6	Load Types [Resistive/Reactive]
8.0.7	Load Bank Quantity and Layout
8.0.8	Power Quality Analysers and Layout
8.0.9	Data Loggers and Layout

Section	Description
8.0.10	Infrared / Thermal Scanning Strategy
8.1	Electrical System Integrated Testing Scenarios
8.2	Mechanical System Integrated Testing Scenarios

18.8. Testing Documentation

All final testing information shall have the following information included and consolidated as a minimum:

Ref	Description
1	Approved Testing Procedure,
2	Approved Material Submission,
3	Marked-up and approved as built drawing [can be red line],
4	Inspection Forms [Level 1, 2 & 3]
5	Current calibration certificate
6	All testing data and certificates, completed
7	Any laboratory reports created for or during the testing
8	Printouts from any equipment or instruments
9	Photographs of testing

18.9. Issue Resolution Log

Number	Level	Issued Date	Raised by	Description	Current Status	Notes

18.10. Training Manual

The training manual should be written and used on the project to provide detailed instructions for training the facility/operational staff before handing over the building and its equipment/systems to them.

Training Manual Format

The following format is suggested.

Section	Description
1.0	Overview
2.0	Training Objectives
3.0	Project Information
4.0	Contact Information [personnel, contractors, and suppliers]
5.0	General roles and responsibilities
6.0	Expected experience and knowledge of operational staff. [General statement of requirements]
7.0	Training methods [lectures, hands on, online, site]
8.0	Systems, equipment, and components that
9.0	Evaluation and assessment [quizzes, exam, observations, feedback, self-assessment, post training evaluation]
10.0	Resources and reference materials
11.0	Training records
12.0	Ongoing updating and training

Section	Description
13.0	Trainer assessment and evaluation [form]
14.0	Engineer assessment and evaluation [form]
15.0	Equipment systems and training materials [include all information, forms and materials used for training]

18.11. Systems Manual

The Systems Manual is a comprehensive resource that provides information on the facilities building systems. It should include details about the planning, design, construction, and commissioning of the building, as well as operational requirements, maintenance information, training, and testing documentation.

Systems Manual Format

The following format is suggested.

Section	Description
1.0	Executive Summary [The executive summary should present a clear overview of the building's design, construction, and operational requirements. Its purpose is to provide instructional guidance on how the building should be operated, ensuring performance and maintenance align with the Owner's Project Requirements and/or Current Facility Requirements (CFR)].
2.0	Facility Design and Construction
2.1	Owners Project Requirements [OPR] [Include the finalized version of the Owners Project Requirements [OPR], which was developed and revised throughout the project and commissioning process. This section aims to provide the operations and maintenance (O&M) staff, as well as future owners, with clear information regarding the original design intent and intended use of the facility.]
2.2	Basis Of Design Document [BOD] [Include the final version of the BoD document and any other relevant design information that was developed throughout the project and commissioning process. This section ensures that the O&M staff and future owners have access to comprehensive information regarding the facility's design.]
2.3	Design drawings [Include the final design documents in this section, and clearly indicate or describe the locations of the drawings and documents].
2.4	Equipment Specifications [Include the final specification documents in this section, and clearly indicate or describe the locations of these documents.]

Section	Description
2.5	Facility Record Documentation [Include the final program and construction documents in this section, and clearly indicate or describe the locations of record drawings and documents].
3.0	Facility, Systems and Assemblies
3.1	Contract Changes [Contract Changes: Provide a comprehensive list of all contractual and design changes that have been implemented throughout the project].
3.2	Approved Submittals [Include the final copies of approved submittals in this section, arranged according to the specification section sequence. This should encompass the approved and commissioned sequences of operation for equipment and systems, along with any limitations to their operation. Additionally, include a copy of the final approved sequences of operation for reference.]
3.3	Coordination Drawings [Include a copy of the system installation coordination drawings in this section or clearly designate their location. Additionally, provide any related information that is relevant to the coordination drawings].
3.4	Manufacturers Operations and Maintenance Data [Insert the manufacturer-provided installation and operation manuals that have been verified and localized to the installed building systems or equipment. Arrange them according to the specification section sequence for easy reference].
3.5	Warranties [Include the system and equipment warranties in this section, arranged according to the specification section sequence. Ensure that the warranties are organized for easy reference].
3.6	Contractor/Supplier Listing and Contact Information [Contractor/Supplier Listing and Contact Information: Provide a comprehensive listing of all contractors and major suppliers involved in the project. Include their respective addresses, phone numbers, and email addresses to facilitate any necessary repairs or replacements. Additionally, insert the Design Team members' listing along with their contact information to facilitate smooth information transfer regarding the original designs, as well as maintenance and optimization activities].
4.0	Facility Operations

Section	Description
4.1	Facility Guide (including Operating Plan; Facility and Equipment Operating Schedules; Set Points, Ranges, and Limitations; Systems Operation Control Sequences of Operation; and Emergency Procedures) [1. Include a copy of the completed facility operating plan, providing detailed explanations of the intended use and operation of the facility | 2. Insert a copy of the final commissioned sequences of operation for all operating equipment. | 3. Include a copy of the final commissioned set points of all equipment, along with operational adjustments. Specify the set-point normal intended ranges and limitations. | 4. Insert a copy of the routine maintenance requirements. | 5. Include a copy of the emergency procedures and indicate the locations of applicable controls].
4.2	Maintenance Plans, Procedures, Checklists, and Records [Insert comprehensive procedures, forms, and checklists for the ongoing operation and maintenance (O&M) of the facility. Ensure to include updating requirements for these documents. Describe the routine inspections and testing that are required, as well as any standard forms that need to be utilized for these activities].
4.3	Maintenance Schedules [Maintenance Schedules: Include the recommended maintenance schedules for the various systems and equipment within the facility. Ensure to provide clear guidelines for the frequency and scope of maintenance activities. Additionally, specify any requirements for updating the maintenance schedules to reflect changes or improvements in the facility's systems and equipment].
4.4	Ongoing Commissioning Operational and Maintenance Record Keeping [Ongoing Commissioning Operational and Maintenance Record Keeping: Include procedures and documentation for ongoing commissioning (Cx) and optimization. This should cover the monitoring and improvement of the performance of facility systems. Provide clear instructions on how to carry out ongoing Cx activities and record any relevant data to ensure continuous operational efficiency and maintenance optimization].
4.5	Janitorial and Cleaning Plans and Procedures [Janitorial and Cleaning Plans and Procedures: Insert a copy of the facility's cleaning and janitorial plan, including detailed procedures and the intended chemicals and equipment to be used. This plan should provide clear instructions on how to maintain cleanliness and sanitation within the facility].
4.6	Utility Measurement and Reporting [1. Describe the utility metering and monitoring systems implemented within the facility | 2. Provide document formats and procedures for tracking utility usage and

Section	Description
	reporting this information, ensuring compliance with the Owner's requirements and any jurisdictional regulations | 3. If available, include a copy of the facility's measurement and verification (M&V) plan, which outlines the methods and protocols for measuring and verifying the facility's energy performance].
5.0	Training
5.1	Training Plans and Materials [1. Provide instructions and procedures for utilizing the relevant sections of the Systems Manual for training building operations and maintenance (O&M) personnel, as well as occupants | 2. Insert copies of the training plans used for each type of equipment, along with the session syllabus employed during training sessions | 3. Include the training materials used, arranged according to the specification sequence. Additionally, describe the location or sources of any additional training materials that are available].
5.2	Training Records [1. Insert records of training, including schedules, sign-in sheets, and any other relevant documentation | 2. Include copies of the training documentation and training recordings related to the operation of the systems and equipment | 3. Ensure that the training materials provide appropriate troubleshooting instructions for the systems and equipment].
5.3	System Manual Maintenance and Documentation, including Operator’s Ongoing Documentation of Modifications and Adjustments to the Facility Systems and Assemblies. [1. Include training and documentation on the updating and continued use of the Systems Manual. | 2. Provide a copy of the operator's ongoing documentation of modifications and adjustments made to the facility systems and assemblies. These documents should be regularly updated to ensure the Systems Manual remains current and relevant].
6.0	Commissioning Project Reports
6.1	Executive Summary [The executive summary should be written in a way that stands alone, independent of the rest of the report. It should be engaging, capturing the reader's attention, and conveying the key insights and outcomes of the report effectively].
6.2	Commissioning Plan [Insert the final Commissioning (Cx) Plan, which outlines the comprehensive

Section	Description
	approach and strategies for the commissioning process. Include the completed Cx report, along with the evaluation and testing forms and records for each building and system involved in the project. These documents should provide a detailed account of the commissioning activities, including the testing procedures, results, and any necessary corrective actions taken].
6.3	Commissioning Design and Submittal Review Reports [Insert a copy of the Commissioning design and submittal review reports. These reports document the review and evaluation of the design documents and submittals related to the commissioning process. They provide an assessment of the design's compliance with the project requirements and ensure that the necessary documentation and materials are in place for successful commissioning].
6.4	Testing and Start-Up Reports, Permits, Inspections, Evaluation Checklists, and Testing Checklists. Completed for Commissioned Systems and Assemblies [1. Insert the completed Commissioning (Cx) Progress Report, along with the associated documents, verification and testing forms, and records for each building, system, and assembly included in the commissioning process. This compilation serves as a record of all the required testing outlined in the commissioning sections of the project contract documents and conducted throughout the project | 2. Include the reports provided by manufacturers, testing agencies, and contractors involved in the commissioning process. | 3. Insert the completed checklists from both the installers and the Owners Commissioning Consultant (CxP). These checklists document installation checks, observations, and performance evaluations for future reference. | 4. Include the completed performance checklists for assemblies, equipment, and integrated systems, conducted by the installers and the CxP. These checklists serve as records of performance checks, observations, and evaluations for future reference. | 5. Insert the relevant test reports for the commissioned systems and assemblies, which detail the results of the conducted tests and their outcomes].
6.5	Commissioning Progress Reports [Insert a copy of all Commissioning (Cx) Progress Reports. These reports provide a comprehensive overview of the commissioning activities conducted throughout the project. They document the progress, findings, issues, and resolutions related to the commissioning process. Including all Cx Progress Reports ensures that a complete record of the commissioning activities is available for reference and review].
6.6	Issues and Resolution Logs [Insert a copy of all issues and resolution logs, including the resolution or status of each item. This documentation serves as a record of problems and issues identified and resolved during the design and construction process. It provides valuable reference material for future projects and helps ensure that lessons learned, and

Section	Description
	solutions implemented are appropriately documented].
6.7	Item Resolution Plan for Open Items [Insert a list of any open items that require resolution, along with any seasonal or additional testing that may be necessary. This list helps track and prioritize the outstanding items that require attention or further action. By including this information in the Systems Manual, it ensures that the necessary steps are documented for addressing and resolving open items, as well as any specific testing requirements associated with them].

18.12. Final Commissioning Report

A Final commissioning report is created to provide a full historical document for any future reference needed for the building's operation of the commissioning tasks and activities.

Final Commissioning Report Format

The following format is suggested.

Section	Description
1.0	Executive Summary [The executive summary should present a clear overview of the final commissioning report for anyone who is wanting a high-level view].
2.0	Outstanding Works Schedule [Insert any outstanding works that are needing to be completed, these should then be closed out with the report being updated].
3.0	Project Information [Include the Project Information, take from the Commissioning Plan].
4.0	Description of Project [Include a Description of the Project, take from the Commissioning Plan].
5.0	Systems Overview [Provide high-level overview of each system that has been installed and commissioned within the facility]
6.0	Design Parameters [Include the design parameters that were used for the systems installed, or refer to section within the Basis of Design Document]
7.0	Commissioning Process [Include the commissioning process that was utilized for the project including the delivery of 'levels', could also refer to the relevant section within the overall commissioning plan].
8.0	Commissioning Team Information [Include the commissioning team organigram and description that was utilized for the project, could also refer to the relevant section within the overall commissioning plan].
9.0	Submittal and Sampling Rates [Include the submittal and site sampling rates that was utilized for the project, could

Section	Description
	also refer to the relevant section within the overall commissioning plan].
10.0	Commissioning Related Project Documents [Include a list of the project documents that were referred to and used throughout the project to allow the commissioning activities to be completed].
11.0	Appendix 1 – Owners Project Requirements [OPR] [Include a copy of the Owners Project Requirement Document or reference where can be found in electronic system].
12.0	Appendix 2 – Basis of Design [BOD] [Include a copy of the Basis of Design Document or reference where can be found in electronic system].
13.0	Appendix 3 – Commissioning Plan [Include a copy of the Project Commissioning Plan or reference where can be found in electronic system].
14.0	Appendix 4 – Commissioning Specification [Include a copy of the Project Commissioning Specification or reference where can be found in electronic system].
15.0	Appendix 5 – Commissioning Stage Sign Off [Include a copy of the Commissioning / Level Stage Sign Off Certificates / Reports, or reference where can be found in electronic system].
16.0	Appendix 6 – Control Logics [Include a copy of the Control Logics / Sequence of Operations, or reference where can be found in electronic system].
17.0	Appendix 7 – BMS Specification [Include a copy of the Specification, or reference where can be found in electronic system].
18.0	Appendix 8 – Electrical Specification [Include a copy of the Specification, or reference where can be found in electronic system].
19.0	Appendix 9 – ELV Specification [Include a copy of the Specification, or reference where can be found in electronic system].

Section	Description
20.0	Appendix 10 – Fire Systems Specification [Include a copy of the Specification, or reference where can be found in electronic system].
21.0	Appendix 11 – Mechanical Specification [Include a copy of the Specification, or reference where can be found in electronic system].
22.0	Appendix 12 – Public Health Specification [Include a copy of the Specification, or reference where can be found in electronic system].
23.0	Appendix 13 – Other Specifications [Include a copy of the Specification, or reference where can be found in electronic system].
24.0	Appendix 14 – Design Stage Commissioning Review [Include a copy of all Commissioning Reviews, or reference where can be found in electronic system].
25.0	Appendix 15 – Construction Stage Commissioning Review [Include a copy of all Commissioning Reviews, or reference where can be found in electronic system].
26.0	Appendix 16 – Commissioning Reports [Include a copy of all Commissioning Reports, or reference where can be found in electronic system].
27.0	Appendix 17 – Commissioning Meeting Minutes [Include a copy of all Commissioning Meeting Minutes, or reference where can be found in electronic system].
28.0	Appendix 18 – Workshop Minutes [Include a copy of all Commissioning Workshop Minutes, or reference where can be found in electronic system].
29.0	Appendix 19 – Factory Testing Procedures [Include a copy of all Factory Testing Procedures, or reference where can be found in electronic system].
30.0	Appendix 20 – Factory Testing Report [Include a copy of all Factory Testing Reports, or reference where can be found in electronic system].

Section	Description
31.0	Appendix 21 – Site Test Procedure Tracker [Include a copy of all Site Testing Procedure Tracker, or reference where can be found in electronic system].
32.0	Appendix 22 – Site Test Observation Tracker [Include a copy of all Site Observation Tracker, or reference where can be found in electronic system].
33.0	Appendix 23 – Site Test Documents [Include a copy of all Site Testing Documents, or reference where can be found in electronic system].
34.0	Appendix 24 – Integrated Testing Report [Fire] [Include a copy of Testing Report, or reference where can be found in electronic system].
35.0	Appendix 25 – Integrated Testing Report [Electrical] [Include a copy of Testing Report, or reference where can be found in electronic system].
36.0	Appendix 26 – Integrated Testing Report [Mechanical] [Include a copy of Testing Report, or reference where can be found in electronic system].
37.0	Appendix 27 – Building Enclosure Testing Report [Include a copy of Testing Report, or reference where can be found in electronic system].
38.0	Appendix 28 – Seasonal Testing Procedures [Include a copy of Testing Procedures, or reference where can be found in electronic system].
39.0	Appendix 29 – Seasonal Testing Report [Include a copy of Testing Report, or reference where can be found in electronic system].
40.0	Appendix 30 – Calibration Log [Include a copy of the Equipment Calibration, or reference where can be found in electronic system].
41.0	Appendix 31 – Final Training Report [Include a copy of Training Report, or reference where can be found in electronic system].

Section	Description
42.0	Appendix 32 – System Manual [Include a copy of the Systems Manual, or reference where can be found in electronic system].
43.0	Appendix 33 – Operating & Maintenance Manual [Include a copy of the Operating and Maintenance Manual, or reference where can be found in electronic system].
44.0	Appendix 34 – Performance Evaluation Report [Include a copy of the Performance Evaluation Report [10 month], or reference where can be found in electronic system].
45.0	Appendix 35 – Lessons Learned Document / Schedule [Include a copy of the Lessons Learned Document and Minutes, or reference where can be found in electronic system].

18.13. Level 1 - Factory Testing Reports

The final factory testing reports that will be written under the Level 1 tasks and activities should include the headings and information below, as a minimum:

Section	Description
1	Executive Summary
2	Introduction
3	List of Attendees
4	Table of observations/outcomes
5	Main Report
6	Conclusion
App 1	Sign Off Certificate
App 2	Design Intent/Performance Specification/Approved Method Statement
App 3	Test Results/Data Tables
App 4	Calculations
App 5	Computer Printouts
App 6	Calibration Certificates
App 7	Drawings
App 8	Record Photographs

18.14. Level 4 – Functional Testing Script

The Level 4 scripts that will be written under the Level 4 tasks and activities should include the headings and information below, as a minimum:

[note: the Level 4 & 5 testing procedures can be combined as both will utilize similar format and information]

Section	Description
1.0	Introduction [Introduce the document / Level 4 testing and why it is being issued and what it includes].
2.0	Integrations with Existing Systems [Include a list of integrations with any existing systems and how the risks will be managed].
3.0	Pre-Requisites [Include a full list of pre-requisites that are to be completed prior to works being conducted.].
4.0	Permits [Clearly detail any Permits that will be needed, including responsibilities and timeline]
5.0	Instruments and Equipment [Include a full list of equipment and instruments that will be needed to complete the works].
6.0	Testing Team and Resources [Include a list of persons and companies that would attend and provide support at the testing].
7.0	Design Parameters [Include tables that detail the design parameters for the following].
7.1	IT Load Design Load in Spaces [List the IT design loads for the space under test].
7.2	Ambient Conditions of Spaces [List the design ambient conditions of the spaces under test including all tolerances].
7.3	Data Hall Equipment Design Parameters [List the design parameters for all equipment and instruments within the spaces under test including all tolerances].

Section	Description
7.4	Chiller Equipment Design Parameters [List the design parameters for all major chilled water equipment and instruments within the spaces under test including all tolerances].
7.5	Electrical Equipment Design Parameters [List the design parameters for all major electrical equipment and instruments within the spaces under test including all tolerances, include any transfer switches etc].
8.0	Power Supplies [Include a full list of equipment that will be used during the testing and detail their preferred and alternate supplies].
9.0	Group Control [For the air conditioning units that are in the critical rooms [CRAH, CRAC, Fan Wall etc], include a description of control logic, individually and group].
10.0	Loading Plan [Include a copy of the Project Loading Plan].
11.0	Electrical Tests [Include the Electrical Testing that will be conducted, describing in detail]
12.0	Mechanical Testing [Include the Mechanical Testing that will be conducted, describing in detail]
13.0	Appendix [Include the following as appendices].
13.1	Appendix 1 – Temporary Equipment Layout [Include a layout of any temporary equipment that will be used during the testing].
13.2	Appendix 2 –BMS Schematics [Include a copy of the as built schematics].
13.3	Appendix 3 – BMS Points List [Include a copy of the as built BMS Points List].
13.4	Appendix 4 –Control Logic / Sequence of Operations [Include a copy of the as built control logics and sequence of operations].
13.5	Appendix 5 – Electrical Schematics [Include a copy of the as built schematics].

Section	Description
13.6	Appendix 6 – Fire System Schematics [Include a copy of the as built schematics].
13.7	Appendix 5 –Mechanical System Schematics [Include a copy of the as built schematics].
13.8	Appendix 6 – Plumbing and Drainage System Schematics [Include a copy of the as built schematics].

18.15. Level 4 – Functional Testing Report

The Level 4 scripts that will be written under the Level 4 tasks and activities should include the headings and information below, as a minimum:

Section	Description
1.0	Executive & High-Level Summary [The executive summary should present a clear overview of the testing and high-level summary for anyone who is wanting a high-level view].
2.0	Observations [Include a full list of observations that were noted during the testing, including how they were closed out].
3.0	Testing Results [Include the results for each test that was completed, the information included should be: Date | Time Start | Time Finished | Pass/Fail | Test Description | Test Expectation | Test Result | SLA Requirements Temperature | SLA Requirements Humidity | Required Load | Actual Load | Recorded Lowest Temperature | Recorded Highest Temperature | Recorded Average Temperature | Recorded Lowest Humidity | Recorded Highest Humidity | Recorded Average Humidity | Consolidated Line Graph/Trend of All Sensors detailing Temperature [specific time of test] | Consolidated Line Graph/Trend of All Sensors detailing Humidity [specific time of test] | Consolidated Line Graph of IT Load Achieved [specific time of test] | BMS Screen Shots [labelled for each test] | Power Quality Downloads and Analysis | Electrical Switching Diagrams | BMS Alarm Logs [labelled for each test]. Any sensors that are outside of the SLA should be listed and evaluated via including additional trend information being included.
4.0	Approved Level 4 Testing Scripts [Include a copy of the Approved Level 4 Testing Script]]

18.16. Level 5 – Integrated Testing Script

The Level 5 scripts that will be written under the Level 5 tasks and activities should include the headings and information below, as a minimum:

[note: the Level 4 & 5 testing procedures can be combined as both will utilize similar format and information]

Section	Description
1.0	Introduction [Introduce the document / Level 5 testing and why it is being issued and what it includes].
2.0	Integrations with Existing Systems [Include a list of integrations with any existing systems and how the risks will be managed].
3.0	Pre-Requisites [Include a full list of pre-requisites that are to be completed prior to works being conducted.].
4.0	Permits [Clearly detail any Permits that will be needed, including responsibilities and timeline]
5.0	Instruments and Equipment [Include a full list of equipment and instruments that will be needed to complete the works].
6.0	Testing Team and Resources [Include a list of persons and companies that would attend and provide support at the testing].
7.0	Design Parameters [Include tables that detail the design parameters for the following].
7.1	IT Load Design Load in Spaces [List the IT design loads for the space under test].
7.2	Ambient Conditions of Spaces [List the design ambient conditions of the spaces under test including all tolerances].
7.3	Data Hall Equipment Design Parameters [List the design parameters for all equipment and instruments within the spaces under test including all tolerances].

Section	Description
7.4	Chiller Equipment Design Parameters [List the design parameters for all major chilled water equipment and instruments within the spaces under test including all tolerances].
7.5	Electrical Equipment Design Parameters [List the design parameters for all major electrical equipment and instruments within the spaces under test including all tolerances, include any transfer switches etc].
8.0	Power Supplies [Include a full list of equipment that will be used during the testing and detail their preferred and alternate supplies].
9.0	Group Control [For the air conditioning units that are in the critical rooms [CRAH, CRAC, Fan Wall etc], include a description of control logic, individually and group].
10.0	Loading Plan [Include a copy of the Project Loading Plan].
11.0	Electrical Tests [Include the Electrical Testing that will be conducted, describing in detail]
12.0	Mechanical Testing [Include the Mechanical Testing that will be conducted, describing in detail]
13.0	Appendix [Include the following as appendices].
13.1	Appendix 1 – Temporary Equipment Layout [Include a layout of any temporary equipment that will be used during the testing].
13.2	Appendix 2 –BMS Schematics [Include a copy of the as built schematics].
13.3	Appendix 3 – BMS Points List [Include a copy of the as built BMS Points List].
13.4	Appendix 4 –Control Logic / Sequence of Operations [Include a copy of the as built control logics and sequence of operations].
13.5	Appendix 5 – Electrical Schematics [Include a copy of the as built schematics].

Section	Description
13.6	Appendix 6 – Fire System Schematics [Include a copy of the as built schematics].
13.7	Appendix 5 –Mechanical System Schematics [Include a copy of the as built schematics].
13.8	Appendix 6 – Plumbing and Drainage System Schematics [Include a copy of the as built schematics].

18.17. Level 5 – Integrated Testing Report

The Level 5 scripts that will be written under the Level 5 tasks and activities should include the headings and information below, as a minimum:

Section	Description
1.0	Executive & High-Level Summary [The executive summary should present a clear overview of the testing and high-level summary for anyone who is wanting a high-level view].
2.0	Observations [Include a full list of observations that were noted during the testing, including how they were closed out].
3.0	Testing Results [Include the results for each test that was completed, the information included should be: Date | Time Start | Time Finished | Pass/Fail | Test Description | Test Expectation | Test Result | SLA Requirements Temperature | SLA Requirements Humidity | Required Load | Actual Load | Recorded Lowest Temperature | Recorded Highest Temperature | Recorded Average Temperature | Recorded Lowest Humidity | Recorded Highest Humidity | Recorded Average Humidity | Consolidated Line Graph/Trend of All Sensors detailing Temperature [specific time of test] | Consolidated Line Graph/Trend of All Sensors detailing Humidity [specific time of test] | Consolidated Line Graph of IT Load Achieved [specific time of test] | BMS Screen Shots [labelled for each test] | Power Quality Downloads and Analysis | Electrical Switching Diagrams | BMS Alarm Logs [labelled for each test]. Any sensors that are outside of the SLA should be listed and evaluated via including additional trend information being included.
4.0	Approved Level 5 Testing Scripts [Include a copy of the Approved Level 5 Testing Script]