GTAA Testing, Commissioning, Acceptance and Turnover Standard

Airport Planning and Technical Services

Creation Date:	July 29 2019
Version:	2.0

Document Control

Version History

Version	Date	Changes	Stakeholder	Documentation
2.0	2019-03-31	• James Persaud's major changes and updated version. • Addition of Roles and Responsibilities of Commissioning Team • Update of Factory Acceptance Testing • Addition of RACI Matrix, Checklist, Compliance Matrix, Test Matrix and Specification.	M. Riseborough F.C. Naden M. Hamilton	A. Schwartz
1.8	2014-12-11	• Recovered James Persaud's minor changes and updated version	M. Riseborough	A. Schwartz
1.7	2014-08-27	• Added CMMS and EAM to definitions • Changed section 2.5.4.5 to read: • The contractor must provide updated asset data, as per the GTAA's standards outlined in "Guide for Contractors to Provide Data for Assets Requiring Maintenances" (available through the GTAA Project Manager). This includes the removal of all assets from service, as part of the project. These changes must be in place prior to Turnover, so the preventive maintenance program can be developed and initiated.	M. Riseborough	A. Schwartz

1.6	2014-06-02	• Added an extra field to sample forms, as per stakeholders • Added links in Standard to sample forms	M. Boyle R. Riseborough	A. Schwartz
1.5	2014-05-01	• Incorporated D. Kerrigan and Shaila D'Souza's edits, where applicable	M. Riseborough D. Kerrigan	A. Schwartz
1.5	2014-04-30	• Final cleanup and sanity check	M. Riseborough D. Kerrigan	A. Schwartz
1.5	2014-04-28	• Final technical input	M. Riseborough D. Kerrigan	Group update
1.4	2014-04-21	• Significant rewrite	M. Riseborough D. Kerrigan	M Boyle
1.4	2014-04-14	• Significant rewrite	M. Riseborough D. Kerrigan	M Boyle
1.3	2014-04-07	• Created T/C/A/T diagrams and added to beginning of relevant sections • Created high-level diagram & added to 1st section of document • Resequencing of sections	M. Riseborough D. Kerrigan	A. Schwartz
1.3	2014-04-04	Finalized changes and diagrams for working copy Ann to complete the following: • create Triangle diagram and add to document • finalize review changes from meeting • Marcus and Ann to meet 2014-04-11 to finalize draft and send to team for final review and sign off	M. Riseborough D. Kerrigan	A. Schwartz
1.2	2014-03-26	Realign content and edit document for review by the team	M. Riseborough D. Kerrigan	A. Schwartz

1.1	2014-01-23	Consolidated 19 chapters into one Document template for first draft review	M. Riseborough D. Kerrigan	A. Schwartz
1.1	2014-02-17	Reordered information in more logical order	M. Riseborough	A. Schwartz
1.1	2014-02-18	Deleted redundant information (not complete) Uploaded for Mike's review	M. Riseborough	A. Schwartz
1.1	2014-02-21	Mike completed a final draft review. Ann to do a final edit prior to Mike sending to team to sign off	M. Riseborough	A. Schwartz
1.1	2014-02-25	Final draft edit and reformat and sent to Mike for stakeholder review	M. Riseborough	A. Schwartz

Reference Documents

Title	Date	Description/Comments
Air Handling Unit.pdf	2014-06-02	Sample Form
Cables Low Voltage.pdf	2014-06-02	Sample Form
Heat Pump.pdf	2014-06-02	Sample Form
Pump.pdf	2014-06-02	Sample Form
Radiant Panel.pdf	2014-06-02	Sample Form
Switchgear Switchboard Assemblies.pdf	2014-06-02	Sample Form
Three Phase Dry-Filled Transformers.pdf	2014-06-02	Sample Form

Table of Contents

1 Overview

This standard summarizes the Testing, Commissioning, Acceptance and Turnover (TCAT) process for mechanical and controls, electrical (including related software or controls systems), lighting and controls, life safety (sprinkler, standpipe, fire alarm) site services, and architectural systems for new building construction, and renovations and/or modifications to existing buildings or systems; automated people movers (elevators, escalators, moving sidewalks), airfield electrical and lighting, high and low voltage power systems, distribution and controls, industrial controls (SCADA), baggage handling systems, passenger boarding bridges.

The TCAT process is intended to follow the CSA 320-11 Building Commissioning Standard and ASHRAE Standard 202-2018 Commissioning Process for Buildings and Systems for all building related systems. Consultants and Contractors are responsible for following the commissioning requirements as set out in these Standards. All requests for clarification of specific information in this standard will be directed to the Associate Director Technical Performance, or in his/her absence, the Greater Toronto Airports Authority (GTAA) Manager or Project Manager. All GTAA projects, large or small, must go through the TCAT process before they are turned over to the GTAA.

After the substantial performance of large-scale projects and, prior to opening, the facility will be maintained through normal operating processes, either directly by the GTAA or through a third party contractor. The predictive, preventative and corrective maintenance will be performed as though the facility was fully functional. Work orders will be issued though a Computerized Maintenance Management System (CMMS) and assigned accordingly. This process will help refine the frequency, task content and task times associated with each function, and provide valuable orientation and familiarization training for maintenance management and trades staff.

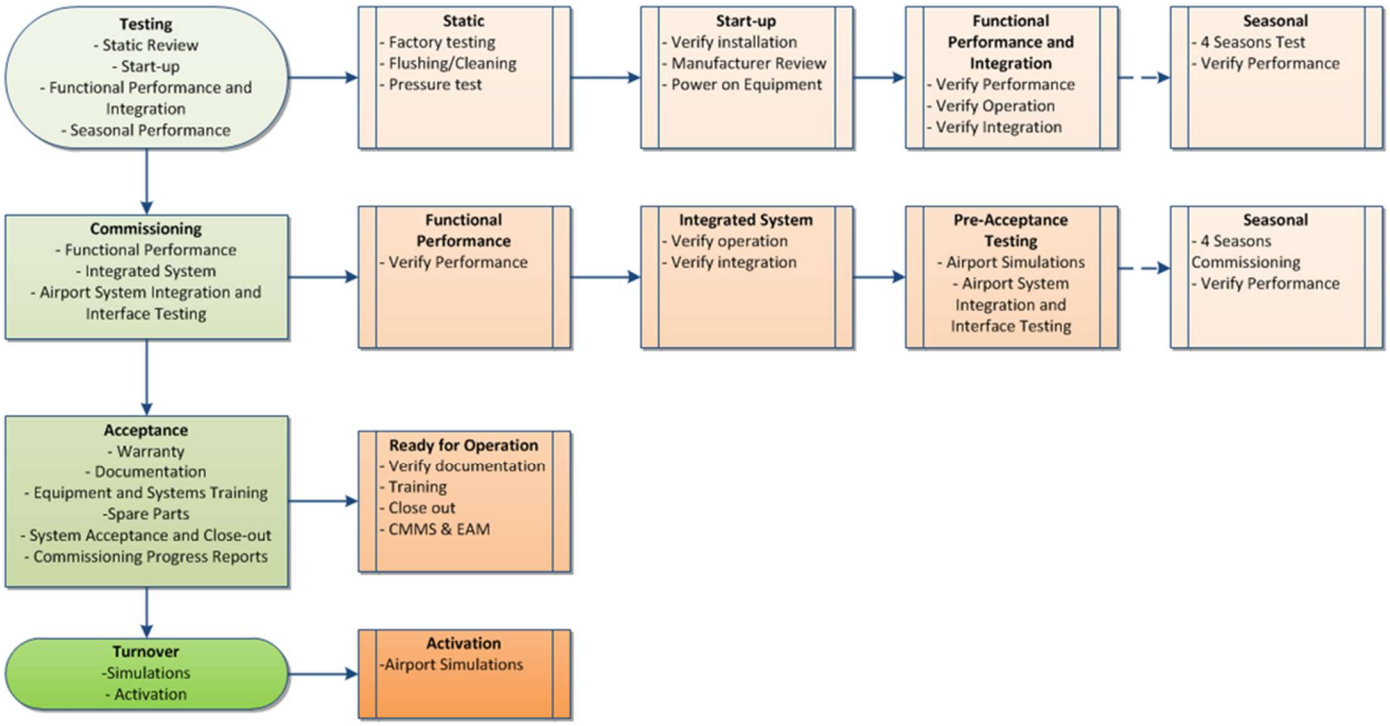
The TCAT process is an essential tool for the development of staff. The commissioning team will ensure the training and involvement of the GTAA staff will be sufficient for the GTAA staff to operate and maintain the systems that are being handed over to the GTAA. This includes answering questions from staff, resolving issues identified and updating systems during the TCAT process.

The designated GTAA Manager and Project Manager will define the level of compliance required for each project. The GTAA, consultants and contractors must be familiar with the TCAT process outlined in this document.

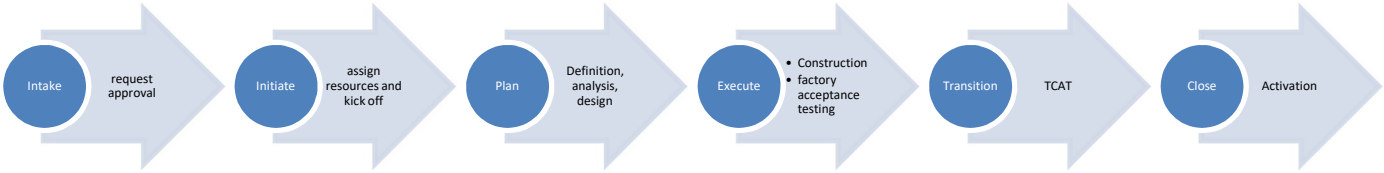
Note: This TCAT standard is a subset of the overall Quality Assurance Program that is expected of any project from the pre-design until acceptance and turnover.

Refer to the contract documents for details on the equipment and systems testing and commissioning requirements, roles and responsibilities of each member of the commissioning team and the deliverables for the project. The flowchart, below, identifies the TCAT process and deliverables for each stage of the TCAT process.

Summary of Testing, Commissioning, Acceptance and Turnover



Project Process Flow



1.1 Objectives

The objectives of the TCAT process are to verify the following:

a. The GTAA's Owner's Project Requirements (OPR) (i.e. the purpose) for the facility or systems have been documented and utilized in the development of the Basis of Design (BOD). The OPR shall define the User's needs and inputs provided by the GTAA.

b. The equipment and system performance meet the requirements of the contract documents, the OPR and the BOD.

c. GTAA Engineering and Building Maintenance has been engaged during the development of the OPR and BOD, the evolution of project design, and their requirements are incorporated into the Owner's Project Requirements (OPR) design documents.

d. Calibration of proposed designs or execution to ensure alignment with business objectives and project constraints – it is important that at each stage of the design (DD/CD) the documents are reviewed with the USERS and GTAA to ensure that the OPR are captured in the design documents and the agreed BOD are being followed by the consultants.

e. The installation meets the requirements of the contract documents.

f. The newly installed systems are integrated with the existing systems.

g. The energy target objectives meet the requirements of the contract documents.

h. The solution or project deliverables meet all performance metrics and design intent established at the onset of the project.

i. The operational project turnover, as defined in the contract documents and the TCAT Standard, has been completed.

j. Operation and maintenance data for the equipment and systems are provided for inclusion in the CMMS.

k. The documentation delivered to GTAA meets the requirements of the contract documents and the operational requirements.

l. The operation and maintenance training meet the requirements of the contract documents and the operational requirements.

m. Seasonal testing and correction of all deficiencies and warranty issues.

1.2 Benefits

The TCAT process provides several benefits, including:

- Coordination of the design and construction teams to bring the building systems to completion successfully.
- Ensuring systems are designed to meet GTAA Engineering and Facility Operations requirements.
- Ensuring integration of the new and existing systems.
- Introduction and overview of the system for familiarization of operations and maintenance staff.
- Making necessary technical information available to make operating staff capable of operating, troubleshooting and maintaining the building systems.
- The additional control of the documentation flow will ensure that essential documentation is delivered to the GTAA when it required.

- Reduction of the number of deficiencies and warranty repairs.
- Reducing the number of complaints and problems during the first year of operation and ongoing operation.
- Ensuring all relevant information is contained within the GTAA's Computerized Maintenance Management System (CMMS) prior to initiation of maintenance activities which will ensure a complete maintenance history of the asset(s).

It is the responsibility of the consultants and contractors to ensure that these benefits are realized.

1.3 Documentation of the TCAT Process

The TCAT process commence with the development of the OPR and subsequent BOD. On all projects the OPR and BOD should be documented and reviewed by the Users and GTAA and sign off provided prior to proceeding to the development of the BOD and the design stage. The specifications and drawings will provide more details on the OPR and BOD. The TCAT process through the various stages captures the pass/fail criteria via the construction checklist, commissioning tracking logs, startup test, factory acceptance test, pre-functional (static) test and functional test forms. These documents are required to be completed by the contractor and received signoff by the GTAA, commissioning provider and/or consultants prior to the commissioning and integration testing phase. The commissioning tracking log tracks (traceability matrix) monitor the correction of deficiencies noted during the TCAT process. Deficiencies are required to be corrected prior to proceeding to the next step.

The construction checklist, commissioning tracking logs, pre-functional (static) test and functional test forms are prepared by the commissioning provider and reviewed by the GTAA and consultants. The contractor is required to use the forms prepared by the commissioning provider to document the test results. The forms are required sign off by the contractor, consultants, commissioning provider and GTAA engineering in the appropriate columns. The commissioning provider will prepare the commissioning reports on the tests and note any issues during the testing. The GTAA, commissioning provider and consultants will determine the pass/fail criteria for the test. All resulting issues are documented in the commissioning tracking log and only removed once the deficiency has been corrected. The commissioning provider will update and review the commissioning tracking logs at the commissioning meetings. The consultants shall prepare the System Operating Manuals (SOMs) and the commissioning provider shall prepare and issue the final commissioning report. The project is now considered ready for acceptance and turnover to the GTAA for activation.

Where the commissioning provider has not been retained on a project, it is the responsibility of the contractor to prepare the pre-functional (static) test and functional test forms and submit for review by the GTAA and consultants. The forms are required sign off by the contractor, consultants and GTAA engineering in the appropriate columns. The consultants shall be responsible for the review of the contractors testing and commissioning, equipment start-up and test reports and provide a report to the GTAA. The consultants are required to confirm that all deficiencies are corrected prior to the acceptance and turnover to the GTAA.

1.4 The TCAT Team

The TCAT team is assembled at the beginning of a project to maintain oversight of the TCAT process for a project from beginning to end. The TCAT team may consist of the following people:

- GTAA Functional Manager

- GTAA Terminal Infrastructure/Infrastructure Aviation
- GTAA Project Manager
- GTAA Engineering
- GTAA Architecture
- GTAA Technical Training
- GTAA Facility Operations
- GTAA Facility Maintenance
- Commissioning Provider
- Prime Consultant (architect and/or engineer)
- Construction Manager or General Contractors (all associated subcontractors and suppliers, as required)

The GTAA Project Manager will co-ordinate the responsibilities of the TCAT team, who will, in turn, provide the following services:

1. Assist the Commissioning Provider (if in place) to coordinate the project commissioning requirements with the contract documents.
2. Prepare the contract documents detailing the project requirements.
3. Assist the GTAA to develop the Owner's Project Requirements
4. Provide input on the preparation of the commissioning plan by the Commissioning Provider based on the OPR, BOD and the design documents requirements.
5. Verify that the mechanical, electrical, site services and architectural systems and their installation meet the contract document requirements.
6. Verify that the contractors have completed all static, start up, functional performance and systems integration tests.
7. Provide the test requirements in the contract documents on the mechanical, electrical, site services and architectural systems to verify that they achieve the basis of design performance.
8. Participate in the final performance and systems integration testing of the mechanical, electrical, site services and architectural systems, to be conducted by the contractors.
9. Verify that the contractors have provided the training specified in the contract documents.
10. Verify that the as-built documentation meets the requirements of the contract documents.
11. Verify that operation and maintenance data for the equipment and systems are provided.
12. Co-ordinate with the Commissioning Provider, the construction manager or the general contractor and the contractors.
13. Verify that seasonal testing is completed and all warranty and deficiencies items are corrected.
14. Provide an overall assessment report associated with acceptability of installation and performance of equipment.

1.5 The TCAT Team Roles and Responsibilities

1.5.1 GTAA Manager or Project Manager

1. The Manager or Project Manager shall provide the following, but not limited to:
    - Provide the Owner's Project Requirements (OPR) to the design team and Commissioning Provider.
    - Ensure a Basis of Design (BOD) and associated design documents are reviewed and accepted by GTAA stakeholders.
    - Support and administer procurement processes for products, services or solutions.
    - Coalesce comments on the equipment and system installation.
    - Ensure the final Commissioning Plan is reviewed and accepted by stakeholders.
    - Attend, take meeting notes during, and facilitate commissioning meetings.
    - Coordinate staff for training with Facility Operations on the operation and maintenance of the systems.
    - Arrange for any third-party certification that may require for certification of Owner supplied equipment.

1.5.2 GTAA Terminal Infrastructure, Engineering, Architecture, Technical Training, Facility Operations and Facility Maintenance

1. GTAA Engineering and Technical Staff shall provide the following, but not limited to:
    - Review and provide input on the Owner's Project Requirements (OPR). The GTAA Project Manager shall review the OPR with GTAA Engineering and when required get GTAA Engineering to sign off on the OPR.
    - Review and provide input on the Basis of Design (BOD). Depending on the complexity of the project, GTAA Engineering will review and sign off on the BOD. The GTAA Project Manager shall review the OPR with GTAA Engineering and when required get GTAA Engineering to sign off on the BOD.
    - Review and provide input on the design documents during the Design Development and Construction Document Stages.
    - Review and provide input on the Commissioning Specifications.
    - Review and provide input in to and attend Factory Acceptance Testing. This includes providing editorial on test scripts, conditions and pass/fail criteria above and beyond what a vendor may provide.
    - Review and provide input on the commissioning pre-functional (static) and functional test procedures.
    - Review and comment on contractor's submittals and shop drawings.
    - Attend Commissioning meetings and provide technical insight.
    - Review and comment on the equipment and system installation.
    - Review and comment on the commissioning tracking log.

- Review and comment on commissioning reports.
- Review and comment the System Operation Manual.
- Attend Factory Acceptance Tests, Startup and contractor's tests, as required.
- Attend contractor's equipment startup and testing, as required.
- Attend equipment and system commissioning.
- Attend system integration testing.
- In the absence of an external Commissioning Provider on a project or initiative, the GTAA Infrastructure Activation Team and/or Functional Manager will assume the role of the CA and its associated responsibilities.
- Perform decommissioning of existing assets (when/where applicable) with the consultant/contractor prior to the commencement of any work on equipment.

1.5.3 The Commissioning Provider

This section describes the function and responsibility of the Commissioning Provider (CxP). The ADTS Manager and the project manager will determine, at the beginning of the project, if a Commissioning Provider is required.

1. The Commissioning Provider will be hired directly by the GTAA and report to the GTAA Manager or Project Manager.
2. The GTAA project manager will determine for each project the scope of work for the commissioning provider and at what point in the project the commissioning provider is brought into the project.
3. The Commissioning Provider shall provide the following services:
    - Lead the Testing, Commissioning, Acceptance and Turnover (TCAT) team in the commissioning of the project.
    - Setup, chair and minute commissioning meetings, attend construction meetings.

    <u>Stage1 Design: Schematic Design and Design Brief (Development of OPR and BOD)</u>
    - Assist with the development of the Owner's Project Requirements (OPR).
    - Attend meetings with the Users, document project specific requirements and update the OPR.
    - Review the Basis of Design (BOD) prepared by the consultant and provide feedback.

    <u>Stage2 Design Development (DD)Design</u>
    - Attend design meetings with the Users, Project Manager and Consultants.
    - Assist the consultants to coordinate the project commissioning requirements with the contract documents.
    - Prepare the project specific commissioning specifications (019100) detailing the project commissioning requirements to be included in the contract documents and reviewed by the GTAA and consultants.
    - Prepare the commissioning plan based on the OPR, BOD and the design documents requirements. Commissioning plan shall include as a minimum the following:
        - Commissioning objectives and a description of the commissioning process.

  - TCAT team roles and responsibilities.
  - Overview of the commissioning activities, scope and systems to be commissioned.
  - Training plan.
  - Documentation and reports.
  - High level commissioning schedule of activities.
- Perform reviews on the design documents using the OPR and BOD and provide feedback to the consultants. Reviews to be performed at 30%, 60% and 100% DD stage.
- Develop and implement a commissioning tracking log to identify a summary of the commissioning deficiencies and corrective measures taken to rectify the commissioning deficiencies.
- Verify inclusion of Terminal Infrastructure, Facilities Operations, Engineering and Users training requirements in the construction documents. Review that the design consultant has included the training requirements in the contract document.

Stage 3 Construction Document (CD) and Tender

- Attend design meetings with the Users, Project Manager and consultants.
- Finalize the commissioning specifications detailing the project commissioning requirements.
- Update the commissioning plan.

  Perform reviews on the design documents using the OPR and BOD and provide feedback to the consultants. Reviews to be performed at 30%, 60% and 90% CD and Tender stage.

Stage 4 Construction

- Attend construction meetings.
- Setup and chair commissioning meetings and prepare meeting minutes.
- Perform decommissioning of existing assets (when/where applicable) with the consultant/contractor prior to the commencement of any work on equipment.
- Update and implement the commissioning plan.
- Develop construction checklists. Prepare the construction checklist for the equipment and systems with input and documents provided by the design consultants and contractors.
- Update the commissioning tracking log.
- Review contractors' submittals, shop drawings, test reports and provide feedback to the TCAT team.
- Perform site review of the mechanical and electrical systems installation as related to the commissioning.
  - Review the installation for accessibility for maintenance.
  - Witness start-up of major equipment.
  - Review the balancing report and verify the balancing (10%) with the balancer on site.
- Assist the consultants to verify that the contractors have completed all pre-functional, start up, functional performance verification and system integration tests.
- Review and provide input on the construction and commissioning schedule.
- Review third party test reports and provide feedback to the TCAT team.
- Review the pre-functional test forms prepared by the contractors for the equipment and systems.
- Prepare the functional test forms and procedures for the equipment and systems.
- Provide independent functional performance verification and systems integration tests on the mechanical and electrical systems to verify that they achieve the basis of design performance.

  - Perform functional testing of the BAS (100% of the points) controls sequence of operation under normal, emergency, occupied and unoccupied modes of operation. Testing shall include temperature, humidity and pressure.

- Participate and lead the final performance verification and systems integration testing of the mechanical and electrical systems, to be conducted by the contractors.
- Coordinate, attend and verify that the contractors have provided the training specified in the contract documents.
- Prepare and issue commissioning reports.
- Review the System Operation Manual (SOM).
- The Commissioning Provider will co-ordinate with the consultant and contractor, including:
    - Verify that the as-built documentation meets the requirements of the contract documents.
    - Verify that operation and maintenance data for the equipment and systems are provided.
    - Verify that CMMS data for the equipment and system are provided.
    - Verify that seasonal testing is completed
    - Verify all commissioning deficiencies are corrected.
- Provide an overall assessment report associated with acceptability of installation and performance of equipment.
- Review building operations 10 months after substantial completion, as required Review performance of the building with Facilities Operations.
- Develop an ongoing commissioning plan for the equipment and systems (if applicable).
- Where the project is to be certified by Canada Green Building Council (CaGBC), the Commissioning Provider shall provide commissioning services to meet the requirements of the following:
    - EA Prerequisite: Fundamental Commissioning and Verification
    - EA Credit: Enhanced Commissioning
    - Complete and sign all commissioning documents required by CaGBC.

1.5.4 The Design Consultants (Architect and/or Engineer)

1. This section describes the roles and responsibilities of the Consultants.

- Assist the Owner to identify, articulate and validate the Owner's Project Requirements (OPR).
- Prepare the Basis of Design (BOD) and schematic design (design brief).
- Assist the Commissioning Provider to coordinate the project commissioning requirements with the contract documents.
- Prepare the contract documents for tender and construction, detailing requirements of the project. The specifications shall be project specific and identified all codes and standards as applied to the project.
- Perform decommissioning of existing assets (when/where applicable) with the consultant/contractor prior to the commencement of any work on equipment.
- Co-ordinate with the GTAA, Commissioning Provider, the construction manager or the general contractor and the contractors.
- Provide input on the preparation of the commissioning plan by the Commissioning Provider based on the OPR, BOD and the design documents requirements.
- Provide input on the commissioning and construction schedule.
- Attend commissioning meetings.
- Review commissioning progress and deficiency reports, including the commissioning tracking log.
- Review and provide input on the pre-functional test form prepared by the contractors.
- Review and provide input on the functional test procedures prepared by the Commissioning Provider.
- Verify that the mechanical, electrical, site services and architectural systems and their installation meet the contract document requirements.

- Review with the contractor that abandoned services impacted by the project are terminated, capped and/or removed as per the contract documents.
- Prepare and issue site report.
- Witness start-up and testing (including integration testing) of equipment and systems.
- Verify that the contractors have completed all pre-functional, start up, functional performance and systems integration tests.
- Provide the test requirements in the contract documents on the mechanical, electrical, site services and architectural systems to verify that they achieve the basis of design performance.
- Participate in the final performance and systems integration testing of the mechanical and electrical to be conducted by the contractors.
- Verify that the contractors have provided the training specified in the contract documents.
- Provide the training to Terminal Infrastructure and Facilities Operations on the Design Intent.
- Verify that the as-built documentation meets the requirements of the contract documents. If not, review with the contractor to correct all deficiencies and provide an updated copy.
- Verify that operation and maintenance data for the equipment and systems are provided. If not, review with the contractor to correct all deficiencies and provide an updated copy. This shall include for the asset inventory as required by the GTAA.
- Verify that seasonal testing is completed, and all warranty and deficiencies items are corrected.
- Provide an overall assessment report associated with acceptability of installation and performance of equipment. Provide sign off to the Owner and recommend acceptance.
- Prepare the System Operation Manual (SOM).
- In the absence of an external Design Consultant on a project or initiative, the GTAA Engineer will assume the role of the DC and its associated responsibilities.

1.5.5 The Construction Manager or Contractor (Subcontractors)

1. This section describes the roles and responsibilities of the Contractor (General, Mechanical, Electrical, Controls, TAB and other Sub-Contractors.

    - Obtain a copy of the TCAT Standard and become familiar with all the requirements and deliverables.
    - Co-ordinate and cooperate with the Owner, Project Manager (PM), Design Consultants (DC) and Commissioning Provider (CxP).
    - Perform decommissioning of existing assets (when/where applicable) with the owner representative/commissioning provider/consultant prior to the commencement of any work on equipment.
    - Attend commissioning meetings.
    - Develop and update the construction and commissioning schedule. The Contractor shall prepare and issue the draft commissioning schedule three (3) weeks after issuing the draft construction schedule. Provide copies to the Owner, Design Consultants and Commissioning Provider for review and input. The Contractor shall prepare and issue the revised commissioning schedule three (3) weeks after receiving feedback from the Owner, Design Consultants and Commissioning Provider. Integrate all commissioning activities into the commissioning schedule and overall construction schedule.
    - Provide labor and material to perform start-up, pre-functional, functional, integrated system tests for all equipment and systems.
    - Ensure all abandoned services impacted by the project are terminated and capped. Remove all abandoned services as required by the contract documents.
    - Provide qualified technicians to operate all equipment and systems during functional

performance tests, integrated systems tests, commissioning reviews and training sessions

- Prepare the equipment and system pre-functional test and start-up test forms. Provide for review and input by the design consultant and commissioning provider.
- Complete the equipment and system pre-functional test, start-up test and pre-functional datasheets. Provide for review and input by the design consultant and commissioning provider.
- Document all verification and functional performance tests by completing all checklists for approval by the DC and CxP.
- Complete functional test and integrated system tests using procedures and documents provided by the CA for equipment and systems installed on the project. The contractor shall advise the GTAA/commissioning provider/consultant the time and date for such testing.
- Issue a statement and certify that testing and balancing work has been completed; and submit the final testing and balancing reports for review prior to the DC and CxP review of the TAB work.
- Issue a statement and certify that the BAS system controls and security/access system controls have been calibrated, checked-out, and that the control of equipment and systems are fully operational and functionally tested in all sequences and operating modes prior to the DC and CxP review of the systems.
- Issue a certificate of readiness that functional test and integrated system test performed by trade contractors have been completed and tested including all BAS control requirements and other control or monitoring systems have been reviewed and observed and are fully operational, functionally tested and ready for demonstration to the DC and CxP. The DC, CxP, PM and Owner shall be the vehicle to determine systems are ready. Additional commissioning costs shall be chargeable to the Contractor if equipment and systems are not ready as claimed for scheduled commissioning reviews (reference commissioning specifications for further details).
- Provide written notification to the PM, DC and CxP that testing and commissioning activities and documentation have been completed in accordance with the contract documents, and that the equipment, systems and sub-systems are operating as required.
- Responsible for the correction of all deficiencies noted during the commissioning and scheduling of all retesting of equipment and systems. Cooperate with CxP for resolution of issues recorded on the commissioning deficiency log.
- Evaluate any performance deficiencies identified in the Functional Performance Testing report for non-performance with contract documents.
- Verify that the mechanical, electrical, site services and architectural systems and their installation meet the contract document requirements.
- Verify and document the completion of all pre-functional, start up, functional performance and systems integration tests on the appropriate forms.
- Participate in the final performance and systems integration testing of the mechanical, electrical, site services and architectural systems, to be conducted by the contractors and oversee by the CxP.
- Prepare and issue the training agenda. Provide all required training documents at the training session.
- Provide the training of the Terminal Infrastructure and Facilities Operations staff as specified in the contract documents. Provide the O&M manuals and as-built drawings prior to arrangement of any training sessions.
- Provide training to the Users Group on equipment and devices as required by the End Users.
- Prepare the as-built documentation to meet the requirements of the contract documents.
- Prior to closing of walls and ceilings, the contractor shall review the red-line as-built drawings

with the consultants, commissioning provider and Facilities Operations.

- Prepare the operation and maintenance manuals for the equipment and systems.
- Provide the CMMS asset inventory data for the equipment and systems.
- Perform the seasonal testing and ensure all warranty and deficiencies items are corrected.
- Provide information as required by the Design Consultants in the preparation of the System Operation Manuals.

1.6 Definitions

Words and terms used in this manual, not included in the list of definitions, will have the meaning that is commonly assigned to them in the context in which they are used. This excludes specialized use of terms by the various trades and professions to which the terminology applies, in which case common industry use shall prevail.

1.6.1 Primary Definitions

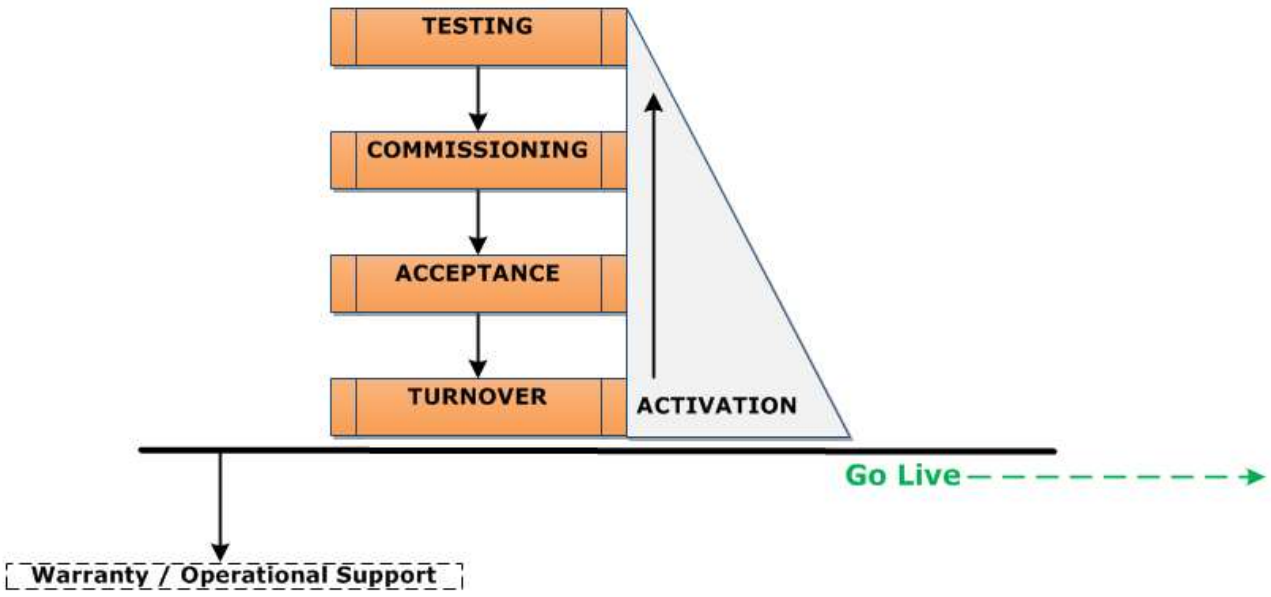
The following words or terms in this manual have the following meaning. See the diagram below for a summary of how they inter-relate.

A. Testing: This stage includes testing components and individual systems against a set of design criteria.

B. Commissioning: This stage includes the systematic verification, documentation, and training, as applied to all activities during the design, construction, static verification, start-up, functional performance testing and integration testing of equipment and systems in a facility to ensure that the facility operates in conformity with the owner's project requirements and the basis of design in accordance with the contract documents.

C. Acceptance: The purpose of this stage is for the Project Manager to verify the deliverables from the vendor based on the project requirements. This process is mostly related to substantial performance.

D. Turnover: The purpose of this stage is for the project team to hand the deliverables over the operations and maintenance groups and for the facility to be operationalized. This includes validating the facility/system is fit for its intended purpose and all deliverables such as drawings, manuals, tools and training have been made available to stakeholders. Though preparation for activation occurs in all steps of the TCAT process the active part of it is during Turnover.



1.6.2 Additional Definitions

Activation – Activation is defined as the transition process from the construction of the new facility to full operation. While the proper operation of the physical asset is assured by the successful implementation of the design, construction and commissioning of the facility for its intended use, it is vitally important that all stakeholders involved in the terminal are properly oriented and trained to operate the new facility seamlessly and continuously. Activation addresses this facet of the development.

Basis of Design (BOD): This is a document, prepared by the consultants, that records the rationale, concepts, calculations, decisions, product selections, schemes and systems complete with narrative describing the design approach to achieving the Owner Project Requirements and to satisfy applicable regulatory requirements, standards and guidelines.

Building Management System (BMS): The BMS is a computerized system, which controls and monitors the various building systems. Several workstations are connected to the GTAA (airport wide) LAN. These workstations allow operators access to the BMS database. Note that the BMS is a term that is used to refer to any combination of Building Management System, Building Automation System, or Facility Monitoring System, jointly referred to as the BMS.

Close out Procedures: The close out procedures will be defined in the contract document. They will define the contractor's requirements to achieve substantial performance, total performance, and the contractor's requirements during the warranty period.

Commissioning Provider: (CxP) An individual or company identified by an owner to lead the TCAT team in the implementation of the commissioning process (for more information, see section 1.4 The Commissioning Provider).

Commissioning Specifications: This is a document, prepared by the consultants, that describes the project commissioning requirements and details the roles and responsibilities of the TCAT team members in the execution of the commissioning process.

Commissioning Team: The commissioning team is part of the Contractor's team and shall be responsible for ensuring that all building systems work with one another to produce an integrated facility that functions as per the contract documents. For more information refer to section 1.4.

Commissioning Plan: This is a document which describes the commissioning process to be created and implemented by the commissioning team. A project commissioning plan shall be prepared and shall include:

- Objectives
- Team roles and responsibilities
- Commissioning process
- Schedule
- Static verification
- Start-up
- Functional performance testing (including post-occupancy, seasonal, and deferred testing)
- Training
- Documentation

- Final acceptance.

CMMS: Computerized Maintenance Management System

Construction Stage: the construction process from contract award to substantial performance and total performance.

Consultant: the person/company that is responsible for the design of the work being done, including the preparation of the contract documents. The consultant shall participate in the TCAT process as required to ensure that the Owner's Business Requirements are met.

Contractor: the person/company that is responsible for implementing the contract documents, including the appropriate stages of the TCAT process.

Design Stage: The process of the design of the building and its systems, from identifying the OPR for the building to preparing the design to meet these requirements and preparing the contract documents for construction.

EAM: Enterprise Asset Management

Functional Performance Testing: The objective of Functional Performance Testing is to ensure all mechanical/electrical assemblies and components perform in accordance with the design intent. Tests should be selected during the design stage and be appropriate to the operational requirements. Functional Performance Testing shall include, as a minimum, the following: a full range of tests under actual load, conducted to verify that specific systems, subsystems, components, and interfaces between systems conform to a given criteria. These tests are typically used to verify that a sequence of operation is correctly implemented and that the design intent has been met. They are typically performed after equipment is placed in full operation.

Includes: Any use of the terms includes, including, include, etc. shall be interpreted to have the meaning "includes, but not limited to".

Independent Performance Testing and Operational Testing: The GTAA may determine a need to conduct these tests independent of the project team using either GTAA or a 3rd party commissioning consultant resource to verify that the installation and the systems comply with the GTAA Project Requirements and that the design meets current operational requirements.

Integration/Interface Tests: The process of ensuring that the systems and sub-systems components through their respective interfaces are linked together and to any supervisory system in such a way as to achieve a facility/system that functions and operates as per the intended design.

Integrated System Testing: When functional testing of individual systems has been completed, Integrated System Testing will commence. This includes data transfer verification from system to system to confirm proper reaction and functionality. It also includes testing of multiple integrated systems performance to verify proper functional interface between systems. Typical Integrated Systems Testing includes all regular, failure mode and contingency operations, verifying that systems respond properly to partial system loss, loss of utility, transfer to emergency power sources, re-transfer from emergency power source to normal utility source; interface between HVAC controls and fire alarm systems for equipment shutdown, interface between fire alarm system and elevator control systems, interface between fire alarm system and security access to control access to spaces during fire alarm conditions and other similar tests as determined for each specific project, etc.

Operating and Maintenance Manuals (O&M): This is a document provided by the contractor that provides the operation and maintenance requirements and associated data for safe and efficient operation of specific pieces of equipment and systems.

Owner's Project Requirements: This is a document, provided to the prime consultant, which describes the GTAA project requirements for the building and desired methods to meet those requirements. These will range from architectural, structural, mechanical, electrical and operational requirements. A dynamic document that provides the explanation of the ideas, concepts, and criteria that are considered to be very important to the owner. The OPR should cite specific measurable goals for the owner's objective to the greatest extent possible.

Post Construction Stage: the contractor's responsibility for the warranty period, starting from the date identified in the contract documents to the end of the warranty period.

Seasonal Performance Testing: The deferred testing that the contractor will conduct over the four seasons after substantial performance to verify that the installation and the systems meet the consultant's basis of design under varying load conditions.

Start-up: Progressive start-up of equipment and systems, beginning at the power source and moving outward systematically. The purpose of the tests are to ensure that all equipment and systems are ready for operation and functional performance testing. Prior to start-up the following shall be completed, witnessed and documented:

- Safety tests
- Inspection and acceptance by authorized safety authority
- Emergency power tests
- Firefighters' operation tests.

Static Testing: All tests required to be completed to ensure that the equipment is ready and safe to be energized, prior to start-up.

Subject Matter Expert (SME): is an individual who is an expert in a particular subject field, building system or process.

Substantial Performance: The criteria for achieving substantial performance shall be defined in the contract documents for the project.

Systems Operating Manual: This manual is provided by the consultants and describes, in lay terms, the operating intent of each system, including design performance and operational data. It is to include diagrams for that illustrate the sequence of operation for each system and interaction between individual systems. An operational manual details modes of operation and includes associated diagrams that illustrate the sequence of operation for each system and interaction between individual systems. This is verified by the commissioning team during the TCAT process.

Testing Commissioning Acceptance Turnover (TCAT): Testing, Commissioning of systems, Acceptance and Turnover (TCAT) of a facility system or component. The process utilized by the GTAA to ensure the equipment and systems are ready for activation and use for the purpose intended [**see** **Definitions a – d**].

Total Performance: The criteria for achieving total performance shall be defined in the contract documents for the project.

2 Testing, Commissioning, Acceptance and Turnover (TCAT)

This section provides a general summary of the TCAT process. The TCAT process describes the responsibilities of the design, construction and GTAA teams during all stages of a project. The Testing, Commissioning, Acceptance and Turnover process ensures the OPR, BOD and contract requirements are achieved and the facility can be used for its intended purpose. The consultants and contractors will facilitate and support the GTAA and/or commissioning provider to participate or observe in all stages of the TCAT process.

2.1 General Requirements

The following are common requirements for all stages of the TCAT process:

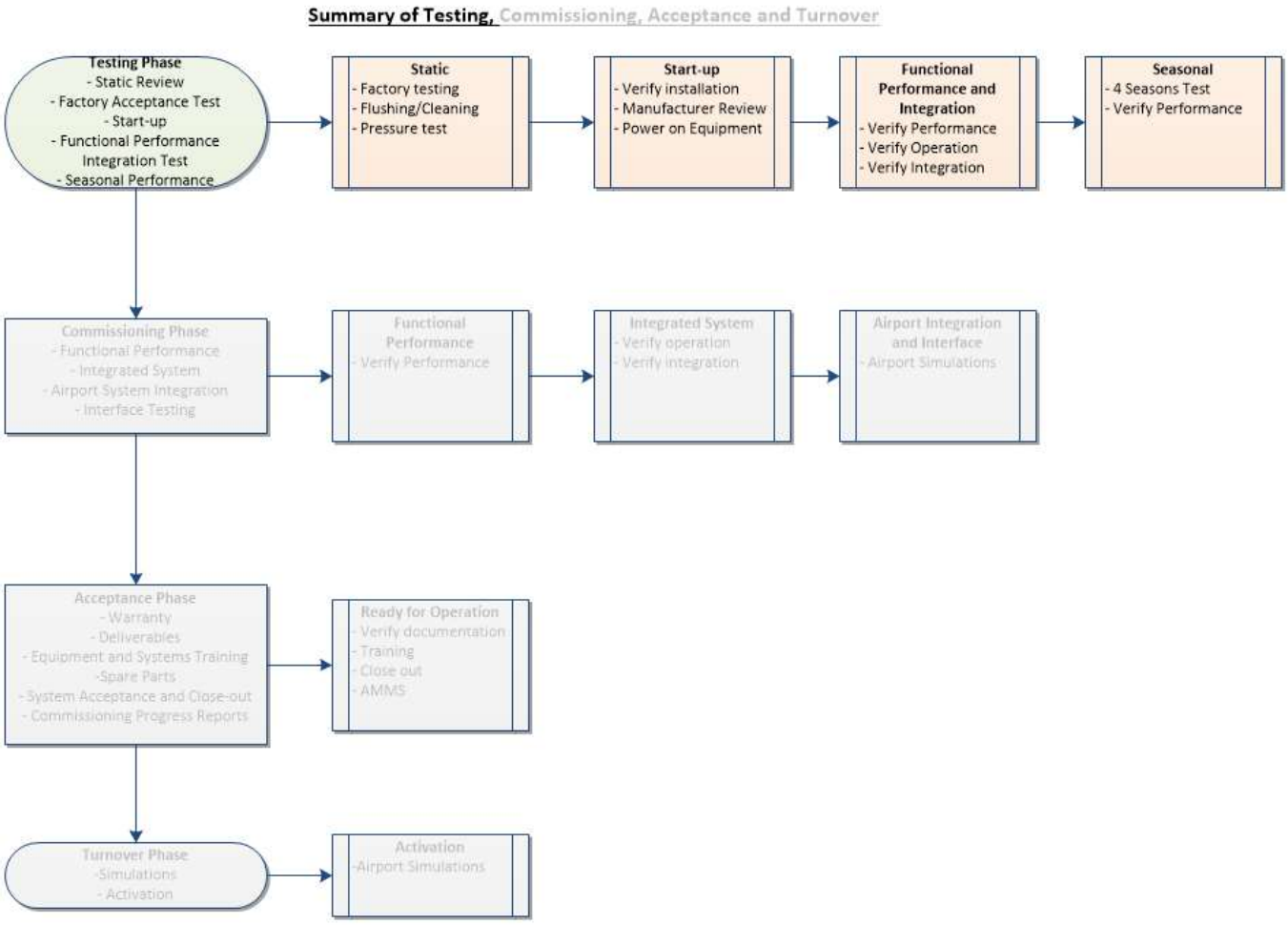
1. The current status and results of the TCAT process will be documented at the construction meetings by the commissioning team and the contractor will update the TCAT activities in the construction schedule in advance of each meeting.
2. Completion of the associated TCAT forms by the commissioning team. The completed forms will be forwarded to the consultants and commissioning rprovider for review against requirements in general and the Basis of Design specifically.
3. The commissioning team will provide a report, identifying compliance or non-compliance to the basis of design and contract documents at the end of each state and sub-stage.
4. The consultant will issue a compliance or non-compliance letter to the GTAA project manager, detailing any issues that may remain at the Testing, Commissioning and Acceptance phases.
5. The commissioning provider will issue a report to the GTAA project manager, detailing any issues that may remain at the Testing, Commissioning and Acceptance phases.
6. The BMS will be programmed with historic trend logs for a minimum of 3 months. The Commissioning Provider will review these logs to evaluate the performance of the mechanical system.

2.2 Systems

1. The TCAT forms and tests will include, but not limited to the following systems. Refer to the contract drawings and specifications for all equipment and systems.
    a. Boilers.
    b. Chillers.
    c. Cooling Towers.
    d. Pumps.
    e. Air handling units
    f. Fans
    g. Fan coil units.
    h. Heat pumps.
    i. Computer room units.

j. Variable speed drives.
k. Building Management System.
l. SCADA and Industrial Controls.
m. Central Utility Plant Management and Control System.
n. Computerized Maintenance Management System.
o. Plumbing systems, including pumps and hot water heaters.
p. Fire protection, including pumps, standpipe, sprinklers, pre-action, dry, glycol systems.
q. Baggage handling systems, including controls.
r. Passenger boarding bridges, including GPU, PWC and PCA.
s. Power distribution (distribution panels).
t. Emergency power (generators, automatic transfer switch).
u. Uninterrupted power supply (UPS).
v. Transformers
w. Airfield power distribution and lighting.
x. Lighting system.
y. Fire alarm system.
z. Smoke venting and smoke control.
aa. Fire Protection.
bb. Communication system.
cc. IT systems as defined by GTAA and in the contract.
dd. Security and access system.
ee. Airport Traffic Information System.
ff. Apron Fuel Shutdown System.
gg. Building lighting management and control system.
hh. Lightning Prediction System.
ii. Power Management and Control System.
jj. Ramp Services Management System.
kk. Vertical and Horizontal Transportation System (elevators, escalators, moving sidewalks automated people movers).

2.3 Testing



Testing incorporates the various methods the contractor will use to verify that components of a specific system are correctly installed and functioning, and that they work in concert with each other to form the specific system (e.g. all electrical, mechanical and fire alarm components within a system).

The Testing Phases includes the following:

a. Factory Acceptance Testing.

b. Static Testing.

c. Start-up Testing.

d. Functional Performance and Integration Testing.

e. Seasonal Performance Testing.

For all stages of testing, the contractor shall prepare a construction schedule, which includes all factory acceptance testing, testing specified or required by the contract documents. The contractor shall provide confirmation of the test dates, with a minimum of 48 hours' notice or as specified in the contract documents.

2.3.1 Factory Acceptance Testing

The Factory Acceptance Test (FAT) shall follow the TCAT process outlined for the Testing Phase of the project. The FAT shall include the Static Review, Startup, Functional Performance and Integrated tests as described in the sections below. It is the responsibility of the equipment manufacturer to prepare the equipment at the manufacturer facility for the FAT and provide all required equipment data, test procedures and calibration certificates for the test equipment prior to the test for review by the GTAA commissioning provider and consultants.

Factory Acceptance Testing shall be performed on all major equipment as specified in contract documentation. Equipment Manufacturer will provide written FAT procedures for review by the consultants, commissioning prprovider and/or GTAA Engineering and Infrastructure Aviation a minimum of 3 weeks prior to the testing. FAT procedures shall at a minimum include test scenarios, description of set up, pass/fail criteria and variations to be assessed. Equipment vendors are accountable for producing FAT procedures, hosting GTAA representatives during FAT, executing test scripts and capturing test results. consultants, commissioning pprovider, equipment vendor, contractor and GTAA representatives are accountable to ensure that documentation is comprehensive and safe guards all of GTAA's interests.

During FAT testing, any variations, deficiencies or non-compliance will be recorded by the equipment vendor. The GTAA Engineer, or an authorized delegate, will negotiate an acceptable disposition or remedy.

FAT results and negotiated outcomes will be formally recorded, and the results report will be used as an input in to subsequent testing initiatives.

2.3.2 Static Testing

It is the contractor's responsibility to advice the commission team of the time and date for the static tests. Responsibilities are as follows:

- GTAA Stakeholders – Optional Attendance
- GTAA Terminal Infrastructure/Infrastructure Activation – Optional Attendance
- GTAA Project Manager – Optional Attendance
- GTAA Engineering – Optional Attendance
- Commissioning Provider – Optional Attendance
- Consultant – Optional Attendance
- Contractor - Responsible

The requirements for static testing will be identified in the specifications. They will include, but not limited to the following:

a. Factory acceptance tests.
b. General Site Services.
c. Electrical Cable testing.
d. Switchboard testing.
e. Cable and equipment conductivity tests.
f. Communications Cable testing.

g. Mechanical Drainage testing.

h. Plumbing testing.

i. Piping testing.

j. Duct pressure testing.

k. Flushing/cleaning piping systems, chemical water treatment, domestic water sanitization and water sample testing, inspection by authorities having jurisdiction.

l. Verification of documentation.

2.3.3 Start-up Testing

Responsibilities include:

- GTAA Stakeholders – Optional Attendance
- GTAA Terminal Infrastructure/Infrastructure Activation – Optional Attendance
- GTAA Project Manager – Optional Attendance
- GTAA Engineering – Optional Attendance
- Commissioning Provider – Optional Attendance
- Consultant – Optional Attendance
- Contractor – Responsible.

Start-up Testing consists of the following:

1. The Start-up tests will be performed when there is permanent power in the building, or a temporary power source that is acceptable to the GTAA.
2. The contractors will progressively energize the equipment and systems, beginning at the power source and moving outward systematically. Tests include: power phasing, switchgear, protective devices, calibrations, alignments and motor rotations.
3. A systematic start-up of each component of the system until the entire system is operating. Each component is checked and all deficiencies rectified prior to starting the next component.
4. The contractors and equipment manufacturers will verify the installation of the equipment meets the manufacturers and specification requirements and conducts the start-up process.
5. The contractors will conduct the start-up tests and complete the associated test form. The completed forms and tests results will be forwarded to the consultant and Commissioning Provider for review.
6. Observe initial systems operation and visual inspections after operation.
7. Temperature measurements for hydronic and air systems.
8. Voltage measurements.
9. Operation of safety controls and interlocks.

2.3.4 Functional Performance and Integration Testing

Responsibilities include:

- GTAA Stakeholders – Optional Attendance
- GTAA Terminal Infrastructure/Infrastructure Activation – Optional Attendance
- GTAA Project Manager – Optional Attendance
- GTAA Engineering – Optional Attendance
- Commissioning Provider – Partial Attendance
- Consultant – Optional Attendance
- Contractor – Responsible.

Functional Performance and Integration testing includes:

1. The purpose of Functional Performance Testing is to verify that the basis of design for the building systems have been achieved in all areas of the building, including as much as possible due to the time of the year of the testing, the operation during different seasonal modes.
2. The systems functional performance and integration testing will be conducted when the static testing and start-up is completed. These tests will be designed to verify the basis of design of the mechanical and electrical systems have been met at all levels of the system.
3. The integrated system tests will be conducted when all mechanical and electrical equipment is operating and when all relevant system testing has been completed.
4. The systems are started and tests are performed through a full range of operating conditions through simulations and monitoring of equipment functions. Corrective actions are recorded and applied.
5. "End to End" tests which tests all functionality from the device level up to, and including the Building Management/Monitoring and Automation systems (BMS). These are performed or repeated at this level, as necessary, to ensure that all functionality is working between the device and the BMS.
6. All failure modes and contingency modes that are applicable to the functional performance testing, including testing of all alarms.
7. The contractors will issue a document to the consultant and commissioning provider that the systems are ready for commissioning.
8. The Commissioning Provider will review the results of the testing with the consultants. The consultants will confirm whether all the results meet the basis of design performance and issue a report to the GTAA project manager.
9. The tests that the mechanical contractor will have completed include:
    - Pressure testing of all piping and ductwork
    - Start-up of all equipment and systems
    - Point to point verification of all controls points
    - Balancing of the air and hydronic.
10. The Air and Hydronic Balancing Contractor will co-ordinate with the BMS Contractor to verify operation of equipment and instrumentation calibration.
11. The mechanical consultant and the Commissioning Provider will witness the final performance demonstration of these systems.

12. The electrical contractor and the electrical testing contractor will have completed the following tests at this stage:
    - Cable testing
    - Switchboard and transformer testing
    - Ground fault protection testing
    - Co-ordination study
    - Voltage measurements.
13. Thermographic testing of the electrical distribution system of 460 Volts and above.
14. Load measurements at all electrical distribution panels and review the results with the consultants.
15. Harmonics readings and review the results with the consultants and Commissioning ProviderProvider.
16. The electrical contractor will have completed testing on the diesel generator, automatic transfer switching and the UPS. The mechanical contractor will have completed testing on the oil delivery system.
17. The electrical contractor will conduct a four hour test to verify the system's ability to provide the basis of design performance.
18. The electrical contractor will have completed the testing on the lighting system.
19. The electrical consultant and the Commissioning Provider will witness a final performance test of the operation of the computerized lighting control system and lighting level measurements for each zone of the facility.
20. The electrical contractor and the fire alarm contractor will complete all the required testing and conduct their final verifications. The Fire Department and the code consultant will then attend and witness the testing and demonstration of the fire alarm system and its sub-systems. The sub-systems will include the following:
    - Voice communication system
    - Electro-magnetic locking devices
    - Elevators, escalators and moving walkways
    - Emergency lighting system
    - Sprinkler systems
    - Fire pumps
    - Fire hydrants
    - Fire suppression systems for exhaust hoods
    - Standpipe systems.
21. The electrical consultant and the Commissioning Provider will witness the final performance demonstration of the fire alarm system and its interface with the mechanical systems.
22. The electrical contractor and the security system contractor will have completed testing and verification of the security system.

23. The electrical consultant and the Commissioning Provider will witness the final performance demonstration of the security system and its interface with other systems.
24. The electrical contractor and the associated systems manufacturer will have completed testing and verification of the systems.
25. The electrical consultant and the Commissioning ProviderProvider will witness the final performance demonstration of these systems.
26. The contractor and manufacturer will have completed the specified tests and code tests appropriate for any elevator, escalator or moving walk. The consultant, provider having jurisdiction and the Commissioning Provider will witness the final performance demonstration of these systems.
27. The contractor and manufacturer will have completed appropriate tests for any dock leveler. The consultants and the Commissioning Provider will witness the final performance demonstration for any dock leveler.
28. The contractor and manufacturer will have completed the specified tests for door hardware. When the door hardware is utilized by the security and/or the final alarm system the contractor will have tested the door hardware with these systems.
29. The consultants will witness the final performance demonstration of door hardware not associated with the security and/or the fire alarm system.
30. Other items architectural covered by the architectural section of the specifications to also be tested as required.

2.3.5 Seasonal Performance Testing

Responsibilities include:

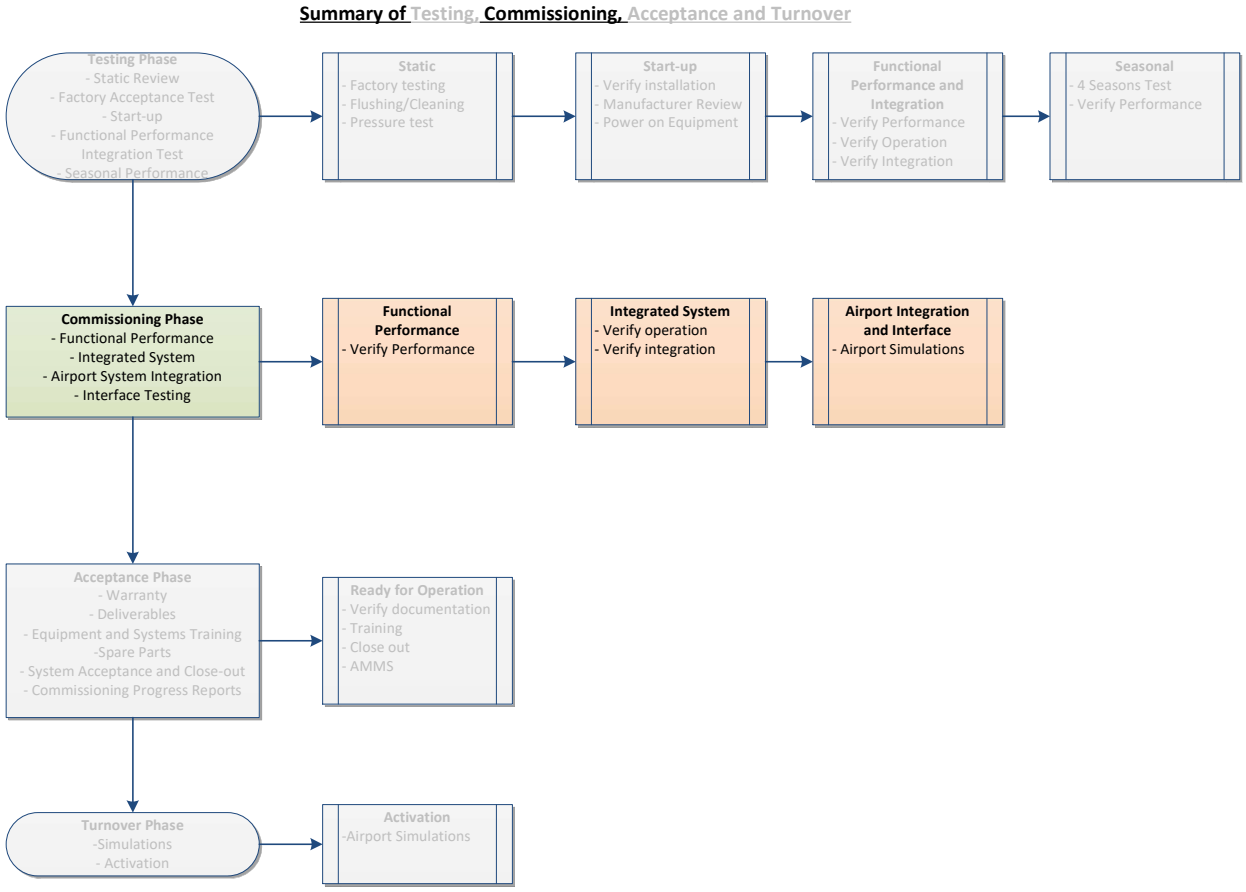
- GTAA Stakeholders – Optional Attendance
- GTAA Terminal Infrastructure/Infrastructure Activation – Optional Attendance
- GTAA Project Manager – Optional Attendance
- GTAA Engineering – Optional Attendance
- Commissioning Provider – Attendance
- Consultant – Attendance
- Contractor – Responsible.

Seasonal Performance testing includes:

1. The contractors, consultants and Commissioning rProvider will conduct seasonal performance tests so as to allow testing for all 4 full seasons. The intention is to validate operations with full operational loads during extreme conditions as well as shoulder seasons where systems are in transition.
2. The seasonal performance tests will be a continuation of the performance tests conducted prior to substantial completion.
3. The tests will be designed to verify the operation of the mechanical system throughout the four seasons with a building load.

4. The test results will be documented and compared to the basis of design and contract documents requirements. The Commissioning Provider will issue a letter of acceptance.
5. The electrical system does not require systems seasonal performance testing. A power system load balance and harmonics test may be necessary if the building occupancy increases during the first year of operation.
6. The consultants will witness the emergency power start-up tests, once during the warranty period and verify the results with the performance requirements.
7. The consultants will review the results of the seasonal performance testing to verify that the basis of design has been achieved.

2.4 Commissioning



2.4.1 Functional Performance Commissioning

Responsibilities include:

- GTAA Stakeholders – Optional Attendance
- GTAA Terminal Infrastructure/Infrastructure Activation – Attendance
- GTAA Project Manager – Optional Attendance
- GTAA Engineering – Optional Attendance
- Commissioning Provider – Attendance
- Consultant – Attendance
- Contractor - Responsible

Functional Performance Commissioning testing includes:

1. When the commissioning team has received notice that the contractors have completed testing, the facility is clean and ready for continuous operation, they will begin the commissioning process. The GTAA

will assign, where possible, operational staff to participate in the commissioning process. The BMS will also be used to verify that the basis of design performance is provided at all stages of the mechanical system and in every room of the building. The tests will be based on loads that are available at the time of testing.

2. The functional performance test will commence starting at the equipment and then to the systems.
3. Final performance testing of the mechanical systems. These will include chillers, boilers, air handlers, BMS, pumps, air and water distribution, supplemental cooling, fire protection and plumbing systems.
4. Final performance testing of the electrical systems. These will include switchboards, electrical distribution, ground fault protection, emergency generators, automatic transfer switches, voltage and harmonics measurements, the lighting system, the fire alarm system and the security system.
5. The commissioning team will provide a report, identifying compliance or non-compliance to the basis of design.
6. The commissioning team will verify whether the operational requirements have been provided.
7. The commissioning team will verify the air and Hydronic Balancing.
8. The commissioning team will witness the final performance testing of the various mechanical and electrical systems.

2.4.2 Integrated System Commissioning

Responsibilities include:

- GTAA Stakeholders – Optional Attendance
- GTAA Terminal Infrastructure/Infrastructure Activation – Attendance
- GTAA Project Manager – Optional Attendance
- GTAA Engineering – Attendance
- Commissioning Provider – Attendance
- Consultant – Attendance
- Contractor – Responsible.

Integrated System commissioning includes:

1. When every individual system has been commissioned and verified, the systems integration commissioning will begin. The primary purpose is to ensure that all systems integrate with all other systems such that overall system provides the desired functionality.
2. These tests will be set up to demonstrate that all systems operate in concert. For example, when the fire alarm system is activated all associated systems that receive this data will be activated and verified.
3. These tests will verify that data from and to the individual systems has been successfully transferred from and to the BMS.
4. The information displayed at the BMS will be verified.
5. The systems to be integrated will be defined in the individual contracts and may include the following:

- Airport Traffic Information Management System
- Apron Fuel Shutdown System
- Baggage Handling Computer System
- HVAC Systems
- Central Utility Plant Management and Control System
- BMS
- Fire Alarm System
- Fire Protection

- Smoke Control and Smoke Venting
- Lighting Management System
- Lighting Prediction System
- Power Management and Control System
- Ramp Services Management System
- Vertical and Horizontal Transportation Management System
- Security System
- IT System
- Architectural Systems.

2.4.3 Pre-Acceptance Commissioning (GTAA)

Responsibilities include:

- GTAA Stakeholders – Partial Attendance
- GTAA Terminal Infrastructure/Infrastructure Activation – Attendance
- GTAA Project Manager – Attendance
- GTAA Engineering – Optional Attendance
- Commissioning Provider – Partial Attendance
- Consultant – Partial Attendance
- Contractor – Responsible.

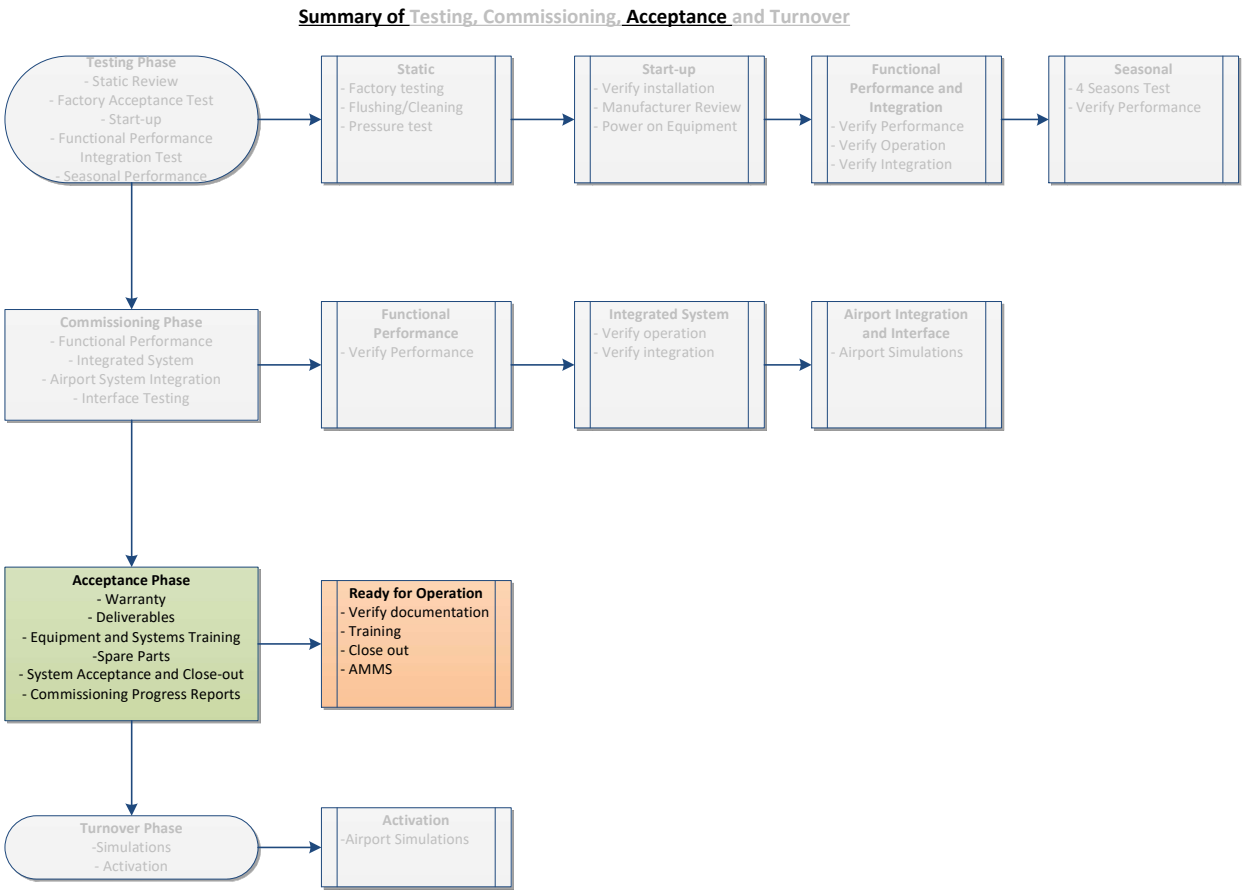
Pre-Acceptance testing includes:

1. Life safety commissioning to ensure that they are ready for the AHJ.
2. Security commissioning to ensure that systems are ready for operational requirements.
3. Elevating device (Elevators, Escalators, Moving Walkways) commissioning.
4. Aircraft fit checks.
5. Emergency and UPS power systems.

2.4.4 *Seasonal Performance Commissioning*

Refer to section 2.3.5 Seasonal Performance Testing

2.5 Acceptance



The requirements for acceptance will be detailed in the contract documents. The Commissioning Team will co-ordinate with the consultants to verify that the contractor has completed its requirements to achieve substantial and/or total performance.

2.5.1 *Verify Documentation*

As a minimum, the documentation required for each project is the operation and maintenance manuals, training documents, and as-built drawings. This documentation must be created in an acceptable format, be received in a timely manner, and maintain a high- degree of accuracy and quality of content. These documents provide the foundation of knowledge required to manage the facility. Documentation shall include:

- Commissioning Reports

- Commissioning Issues Tracking Report
- Seasonal Performance Testing Report
- As-Built Record Drawings
- Operating and Maintenance Manuals
- Systems Operating Manual (prepared by the consultants)
- Systems and Equipment Training
- Spare Parts (recommended and approved by Terminal Infrastructure)
- CMMS Asset Inventory
- Warranty Documentation.
- Close-Out Procedures
- Airport Simulations.

2.5.2 Testing and Commissioning Report(s) (T&C Report)

1. Further requirements for T&C Report may be identified in the GTAA Construction Code and the contract documents.
2. The T&C Report is the responsibility of the contractor and their commissioning team. This report is a condition of substantial performance.
3. The commissioning team will prepare the final T&C Report which will identify that the testing and commissioning stages have been completed successfully and whether the results meets the basis of design. The report will include copies of all test and commission results.
4. The T&C Report will identify any outstanding deficiencies and how they affect the performance of the building.
5. The TCAT team will provide input to the consultants and contractors to establish the data required to prepare this documentation.
6. The contractors reports shall include:
   - Testing schedule
   - Completed test forms
   - Completed equipment start-up forms including maintenance information for each piece of equipment.
7. The commissioning team reports shall include:
   - Comments and recommendations of testing schedule.
   - Comments and recommendations of testing forms received.
   - Comments and recommendations of systems performance test results.
   - Comments and recommendations of integrated systems test results.
   - Deficiency list completion.
   - Confirmation of training schedule.

- Issues tracking report.

8. The consultants reports shall include:
   - Conformation that testing results received meets the basis of design.
   - Confirmation that commissioning test results received meets the basis of design.
   - Confirmation that shop drawings and as-built drawings meets the specification requirements.
   - Issuing of deficiency lists and confirmation that they have been completed.
   - Confirmation that the turn over procedure has been completed.

2.5.3 As-Built (Record) Drawings

1. Further requirements for as-built drawings may be identified in the GTAA Construction Code and the contract documents. The methodology for quality control during the preparation of these documents must be followed.
2. The red-line drawings are the responsibility of the contractor. They shall be provided at least 30 business days in advance of substantial performance and are a condition of substantial performance.
3. The as-built drawings are the responsibility of the consultant. They are based on the red-line drawings and must be provided, and approved by the GTAA and the consultant, prior to substantial performance.
4. A final update of the red-line drawings and as-built drawings may be required as a result of changes made during final deficiency clean-up. If so the update of the as-built drawings would be a condition of total performance.
5. The TCAT team will provide input to the consultants and contractors to establish the data required to prepare this documentation.

2.5.4 Operation and Maintenance Manuals (O&M Manuals)

1. Further requirements for O&M Manuals may be identified in the GTAA Construction Code and the contract documents. The methodology for quality control during the preparation of these documents must be followed.
2. The O&M Manuals are the responsibility of the contractor. A working draft shall be provided at least 20 business days in advance of training, or at least 30 business days in advance of substantial performance, whichever comes earlier. Final draft version of the O&M Manuals, approved by the GTAA, is a condition of substantial performance.
3. A final update of the O&M manuals may be required as a result of changes made during final deficiency clean-up. If so the update of the O&M manuals would be a condition of total performance.
4. The TCAT team will provide input to the consultants and contractors to establish the data required to prepare this documentation.
5. The contractor must provide updated asset data, as per the GTAA's standards outlined in "Guide for Contractors to Provide Data for Assets Requiring Maintenances" (available through the GTAA Project Manager). This includes information on the removal of all assets from service, as part of the project.

These changes must be in place prior to Turnover, so the preventive maintenance program can be developed and initiated.

2.5.5 Systems Operating Manual

1. See Appendix C for more detail on the Systems Operating Manual (SOM).
2. The SOM is a reference source for operations staff, which describes the design parameters and operating performance of the systems.
3. Further requirements for SOM may be identified in the GTAA Construction Code and the contract documents. The methodology for quality control during the preparation of these documents must be followed.
4. The SOM is the responsibility of the consultants with input from the commissioning provider and contractor. A working draft shall be provided at least 20 business days in advance of training, or at least 30 business days in advance of substantial performance, whichever comes earlier.
5. A final update of the SOM may be required as a result of changes made during final deficiency clean-up. If so the update of the SOM is to be provided prior to total performance.
6. The TCAT team will provide input to the consultants and contractors to establish the data required to prepare this documentation.

2.5.6 Systems and Equipment Training

1. Training shall be provided for all new technology, systems, operational methods or maintenance methods.
2. Further requirements for training may be identified in the contract documents.
3. The contractor will develop a training schedule in co-operation with the GTAA APTS Manager, Project Manager and Commissioning Provider. The dates and duration for each day, and required attendees, will be confirmed with the GTAA. The schedule will include for multiple classes to suit operator shift requirements.
4. The schedule will be orderly in that mechanical, electrical and general disciplines are not scheduled on the same days.
5. The contractor will develop a course agenda which will be reviewed by the TCAT team for acceptability. The trade contractor or manufacturer will ensure all training is of acceptable quality and content and that it meets the owner's requirements. The contractors and manufacturers will follow the approved agenda.
6. A typical agenda shall include:
    a. Introduction to the manufacturer or contractor.
    b. A list of contacts and phone numbers etc., will be provided.
    c. Hand out material will be provided
    d. The design of the equipment or system will be reviewed.
    e. The operation of the equipment or system will be reviewed.

f. The maintenance requirements of the equipment or system will be reviewed.

g. The emergency procedures will be reviewed.

h. The operating and maintenance manual will be reviewed.

7. The contractor will ensure that each trainer has provided an agenda and has experience with the training process.
8. The trainer for each session will be experienced with the operating and maintenance procedures for this particular equipment or system and have the necessary presentation skills to perform the training effectively.
9. Sufficient hand-out material will be provided by the contractor such that all participants will have training materials.
10. The trainer will prepare an attendance list for each training session. A copy of these lists will be forwarded to the GTAA Project Manager.
11. Training will be a condition of substantial performance, and total performance, depending on the timing of the training requirements as specified by the GTAA.
12. The contractor will provide electronic training material which duplicates the scope of each training session.

2.5.7 Spare Parts

1. The contractor is to submit the recommended spare parts list to the consultant and GTAA Terminal Infrastructure for review and acceptance.
2. The consultants and Terminal Infrastructure will verify that the spare parts turned-over by the Contractors are in accordance with the contract documents.
3. Spare parts handover are a condition of substantial performance.

2.5.8 Warranty

1. The GTAA will report warranty issues to the Contractor or directly to the installation contractor or manufacturer who will conduct repairs and retest the associated equipment and system if required. (See Appendix B)
2. Just prior to the end of the warranty period the contractors, consultants and the commissioning team will meet at the facility to review and provide recommendations on:
   - Outstanding deficiencies
   - Warranty issues
   - Operating issues
   - Maintenance issues
   - System performance issues.

2.5.9 Acceptance

1. Acceptance procedures are outlined in the contract documents.

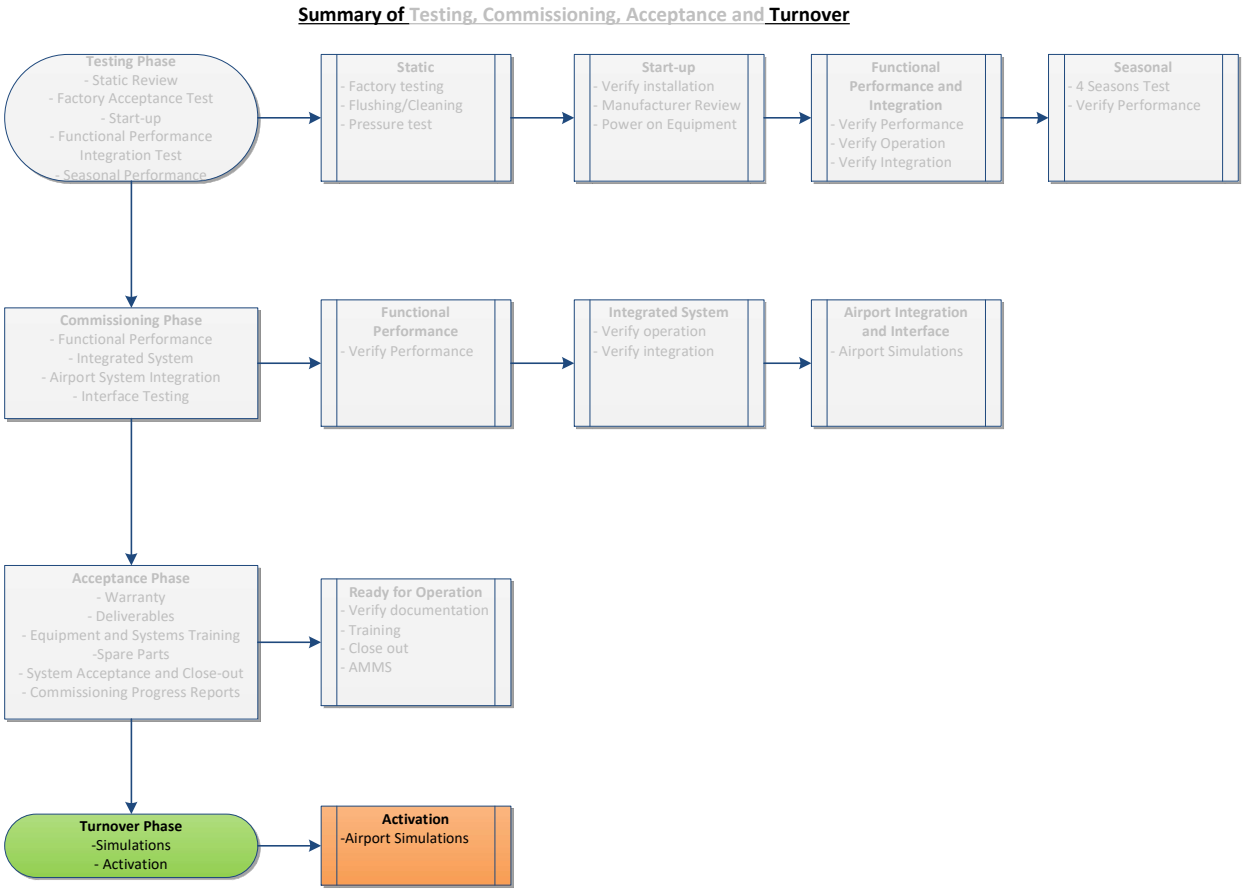
2. The commissioning provider will provide recommendation to the GTAA Project Manager for acceptance.
3. The consultant shall provide recommendation to the GTAA Project Manager for acceptance.
4. The GTAA Project Manager will seek approval from the GTAA stakeholders prior to acceptance.
5. The GTAA Project Manager will accept the system/facility on behalf of the GTAA.

2.5.10 Roles and Responsibility Matrix

Below is a summary of the roles and responsibility matrix of the commissioning team.

Commissioning Responsibility Matrix

2.6 Turnover



The purpose of the turnover phase is to ensure that the system or facility is fit for the purpose intended, including the operational requirements.

For simpler systems this may be as simple as a sign off process between the GTAA Project Manager and the business stakeholders. For more complex system there may be an entire activation process.

Responsibilities include:

- GTAA Stakeholders – Responsible
- GTAA Terminal Infrastructure/Infrastructure Activation – Support
- GTAA Project Manager – Support
- GTAA Engineering – Support
- Commissioning Provider – Advisory
- Consultant – Advisory

- Contractor – Support.

2.6.1 Activation

The activation of a facility is a process that follows the project from its inception through completion to opening day. The objective of the process is to deliver a fully functional facility, compliant with all of the terms and conditions of the contract documents including codes standards and requirements to obtain occupancy and the airport license.

The activation process also establishes the facility meets the current operational needs. All staff must be fully trained and intimately familiar with operating and maintaining the facility. All operating and technical documentation must be accurate and effectively stored to allow easy access.

As part of the activation process simulation of actual airport requirements may be required.

2.6.2 Simulations (GTAA)

The GTAA may perform Airport Simulations to verify all operational and maintenance procedures are adequate and that the facility and equipment meet the operational requirements. During this period the equipment will be operated on a continuous basis to resolve operational difficulties and to refine operating and maintenance activities. Various real life scenarios will be enacted using volunteers as mock passengers to demonstrate functional responses to the facilities, and systems.

2.6.3 Simulation Tests

As part of the Simulations all or part of the commissioning tests may be enacted including:

- Security and Life Safety
- Passenger access to and from the Airport,
- Processing of passengers through the terminal facilities including baggage, Customs, Immigration controls and security requirements.
- Efficiency of directional signage and graphics including ATIMS, FIDS, BIDS.
- All Airfield systems including apron equipment, Passenger boarding Bridges, 400 Hz power, point of use water, guidance systems and emergency response.
- Baggage Handling Systems and all related processes and procedures.

2.6.4 Simulation Training

Simulation provides the opportunity for extensive orientation and training of staff that will operate the facility. Response to emergency and other situations will be analyzed and improved. Although the training program is a continuous process throughout construction this stage of the training is paramount to success.

2.6.5 Airport Simulations

When the systems have been accepted the GTAA will conduct Airport Trials and Simulations. The commissioning team may be requested to assist with this process. The Project Manager will determine the level of involvement of the Commissioning Team. Airport Simulations (trials) will be led by Terminal Infrastructure and Facility Operations.

2.6.6 Independent Testing

Simulations provide an ideal opportunity to fine tune the systems and to performance test all of the systems under load.

The commissioning team will performance test selected components and systems during this stage to ensure effective and reliable operation beginning opening day.

2.6.7 Acceptance

As part of the activation process the business owner will identify, to the GTAA Project Manager, deficiencies, warranty issues or requested changes to the system or facility. The GTAA Project Manager will act on these as appropriate.

Once all items have been rectified or resolved the business owner will accept the system from the GTAA Project Manager.

2.6.8 Go-Live

Once all systems have been accepted and all documentation is in place, the system or facility will be able to "Go-Live".

A TCAT Test Forms

This section describes the requirements for test forms to be produced and to be utilized as record documentation of the TCAT process. Where required the documentation is to be compliant with all applicable Provincial and Federal Regulations e.g. the Federal Halocarbon Regulations (FHR).

1. Some sample test forms are attached for reference. All forms are to be submitted to the GTAA for approval before being used.
2. The static and start up test forms are to be completed by the contractor. A copy is to be forwarded to the construction manager or general contractor on a monthly basis in electronic form. The originals are to remain in a hard covered binder, which will be turned over to GTAA at substantial performance. A complete set of completed test forms are to be turned over to the GTAA in electronic form prior to substantial performance and total completion.
3. Testing shall be done “end to end” in that all tests shall include operation of the end device (field device or logical trigger) and shall include tracking for correct response at the Building Management/Automation Systems.
4. The contractors will enter the test results on the forms. If the tests do not achieve the results required by the specifications or regulations the contractors will correct the problem and repeat the test.
5. The contractors and equipment manufacturers will conduct the contractor’s performance tests. They will complete the forms provided by the manufacturers, which verifies the installation and operation of the system.
6. The tests will be witnessed either by the appropriate GTAA representative, the consultant, and or Commissioning Provider and the construction manager or general contractor.
7. The contractor and the witnessing body will sign the test forms.
8. The functional performance and integration test shall commence once all static and start-up testing has been completed and the system operation has been confirmed by the contractor.
9. The commissioning provider with input from the commissioning team shall develop the performance test procedure for all equipment and systems to be tested.
10. The commissioning providerprovider with input from the commissioning team shall develop an integration test matrix listing all the systems to be tested and expected results during the integration test.
11. The commissioning provider shall direct the commissioning team and contractor in the implementation of the integration test and document the test results.
12. Responsibilities:
    - GTAA Stakeholders – None
    - GTAA Project Manager – Advisory
    - GTAA Terminal Infrastructure/Infrastructure Activation – Review
    - GTAA Engineering - Review
    - GTAA Project Manager – Review

- Commissioning Provider – Review
- Consultant – Review
- Contractor – Responsible.

A.1 Test Form Categories

1. Test forms are to be created for each stage of testing including:
   - Static tests
   - Start-up tests
   - Functional Performance and Integration tests
   - Seasonal Performance, tests Airport Integrated Interface System tests.

A.1.1 Mechanical Test Forms

1. Mechanical test forms and tests will include the following tests:
   - Drainage tests
   - Domestic piping pressure tests
   - Duct leakage pressure tests
   - CHW piping pressure tests
   - HW piping pressure tests
   - Air and hydronic flow tests
   - System temperature tests
   - Sprinkler piping pressure tests
   - Halocarbon refrigerant system leak test
   - Vertical Sortation Unit Inspection.

A.1.2 Electrical Test Forms

1. Electrical test forms and tests will include the following tests:
   - Cable testing
   - Electrical distribution testing
   - Co-ordination study
   - Electrical Field Devices Inspection.

A.2 Static Tests

1. Static test forms and tests will include:
   - Completion of piping fittings and field installed devices
   - Piping and ductwork pressure leak test

- Cable testing
- Shipping bolts removed
- Vibration isolators unrestrained

- Equipment identification completed
- Thermal insulation completed
- Conduit and cable fire-stopping completed
- Grounding completed.

A.3 Start-up Tests

1. Start-up test forms and tests will include:
    - Correct motor rotation
    - Check for excessive vibration
    - Inspection for gland and seal leaks
    - Pump, fan and equipment startup
    - Check breaker size and whether it trips
    - Check motor overload size and whether it trips.

A.4 Functional Performance and Integration Tests

1. The functional performance and integration test is performed with the system in full operation. The system is exercised through all possible scenarios.
2. The functional performance and integration test forms will be prepared by the Commissioning Provider with input from the commissioning team. The functional performance and integration tests will be conducted by the Commissioning Provider with assistance from the contractors.

B Hydronic and Air Balancing

This section includes the requirements for hydronic and air balancing of the mechanical system. The requirements for air and Hydronic Balancing will be included in the specifications by the mechanical consultant and shall comply with the requirements of NEBB and /or AABC.

B.1 Typical Project Structure

1. The hydronic and air balancing contract will be tendered by the mechanical contractor. The balancing contractor will report to the mechanical contractor.
2. The balancing contractor is an integral part of the commissioning team and will co-ordinate with the Commissioning Provider.
3. The mechanical specifications identify the work that the mechanical contractor must complete prior to the balancing contractor starting their work.

B.2 System Balancing

B.2.1 Hydronic Systems Testing, Adjusting and Balancing

1. The balancing contractor will have reviewed the piping installation and provided reports regarding balancing valves and their locations. They will have received the shop drawings for the mechanical equipment to obtain the necessary data to balance the piping system, i.e. pump curves, equipment pressure drops, etc. The remaining data that they require will be documented in the construction drawings and specification.
2. The mechanical contractor will have flushed the piping systems and under the direction of the chemical treatment contractor, treated the water. Final samples will have been tested and the results reviewed by the consultant.
3. The balancing contractor will proceed to set balancing valves to the desired settings and verify hydronic flows throughout the systems.
4. Should the balancing contractor find major discrepancies with their measurements and the basis of design, they will immediately inform the consultant. The problem will be rectified as soon as possible.
5. The balancing contractor will, on a daily basis, provide deficiency reports to the contractor and the Commissioning Provider. It is important that these deficiencies are corrected immediately to maintain the construction schedule.
6. The balancing contractor will provide an interim balancing report within two working days of completion of a system. This report will be reviewed by the consultants and the Commissioning Provider. Any discrepancies with the results and the basis of design must be corrected immediately.
7. The final balancing report will be provided within two weeks of completion of balancing of all the hydronic systems.
8. The balancing procedures and data required to be entered into the report are documented in the specification.

B.2.2 Air Systems Testing, Adjusting and Balancing

1. The balancing contractor will have reviewed the ductwork installation and provided reports regarding balancing dampers and their locations. They will have received shop drawings for the mechanical equipment to obtain the necessary data to balance the ductwork systems, i.e. fan curves, equipment pressure drops, etc. The remaining data that they require will be documented in the construction drawings and specification.
2. The mechanical contractor will have pressure tested the ductwork and completed the equipment start up procedures.
3. The contractor will have cleaned the ductwork and facility so that it is ready for continual air handling unit operation.
4. The balancing contractor will proceed to balance the ductwork systems. The procedures are documented in the specifications.
5. Should the balancing contractor find major discrepancies with their measurements and the basis of design they will immediately inform the consultants. The problem must be rectified as soon as possible.
6. The balancing contractor will, on a daily basis, provide deficiency reports to the contractor and the Commissioning Provider. It is important that these deficiencies are corrected immediately to maintain the construction schedule.
7. The balancing contractor will provide an interim balancing report within two working days of completion of a system. This report will be reviewed by the consultant and the Commissioning Provider. Any discrepancies with the results and the basis of design will be corrected immediately.
8. The final balancing report will be provided within two weeks of completion of balancing of all the ductwork systems.
9. When balancing is complete the balancing contractor and the Commissioning Provider will conduct performance testing on the air handling unit.
10. The mechanical consultant will review the balancing report and compare the data to the basis of design and specification performance data.

B.2.3 Balancing Contractor & Controls Contractor Co-ordination

1. The controls contractor must be available when the balancing contractor is conducting their work. The co-ordination will be for all required functionality including:
    - Commanding control valves open and closed
    - Setting up mixing dampers
    - Setting up pressure and differential pressure controls
    - Setting up fan tracking controls
    - Setting up VAV box minimum and maximum set points
    - Setting up static pressure controls.

C Systems Operating Manuals (SOMs)

This section describes the requirements for the Systems Operating Manuals (SOM). The SOM shall be prepared by the consultants. The SOM is intended to provide an understanding of how a system is intended to function inclusive of the design assumptions. This will provide for design review ease and better understanding of how the system performs under different conditions.

C.1 Application

1. The consultants will provide construction, CAD (micro station format) drawings on a disk or on CD. The contractors will provide copies of the as-built shop drawings and equipment operating and maintenance manuals. The contractors will also provide information regarding equipment locations and schedules.
2. The SOM is to be used as a training tool and should be initially assembled early in the construction stage. It is recognized that the SOM will evolve as construction progresses. The SOM first draft will be available for review, by the GTAA, 20 business days prior to start of training. The second draft will be available 3 weeks after the commissioning provider completes the performance testing. The final document will be available after the seasonal performance testing has been completed.

C.2 SOM Structure

The Systems Operating Manual will be divided into volumes, with each volume sub-divided into chapters.

Volume Structure – Large Projects

The Volume structure for large projects will consist of the following:

- Volume 1 – Building Services (energy sources, plumbing and drainage, fire protection, building HVAC)
- Volume 2 – Electrical Systems (Emergency Power System, Lighting System, Fire Alarm System, Security System, Communications and Monitoring Systems)
- Volume 3 – Heating Systems
- Volume 4 – Chilled Water Systems
- Volume 5 – Controls Systems
- Volume 6 – Equipment Data Sheets / Commissioning Records
- Volume 7 – Preventative Maintenance Program.

Volume 7 does not form part of the Commissioning Program. Each Volume will consist of an individual binder, complete with spine and front covers graphics, to be approved by the GTAA Project Manager.

Volume Structure – Small Projects

Small Projects will follow the large project Volume structure, except that Volumes may be combined in one or more binders. Where multiple Volumes are provided in one binder, they will be separated with a labeled tabbed divider.

C.3 Chapter Structure – All Projects

1. Each Volume will be sub-divided into chapters, the number and title of which will depend on the requirements of each project. Example chapters may include:
    - Building exhaust systems
    - Air conditioning systems
    - Normal power distribution
    - Emergency power distribution.
2. Each chapter will include the following information, and be presented in a format acceptable to the GTAA, or will be completed on a form to be provided by the GTAA:
    - Table Data
    - General system description
    - Design Criteria
    - System Location
    - System Redundancy
    - Energy Source
    - Emergency Power Operation
    - Emergency Procedures
    - Operating Schedule
    - Drawing Reference (list of design drawings)
    - Operating and Maintenance Manual Reference
    - System Setpoint Parameters
    - BMS/Controls Sequence of Operation
    - Operating Instructions
    - Operator's Notes
    - Schematic diagram of system operation
    - Interface/interaction with other systems.

C 3.1 SOM Content

C.3.1.1 Table Data

Provide a summary table which includes the following information:

- System name
- Reference Number

C.3.1.2 General Description

- An expansion of the system abstract, the general description will provide a brief overview of the system.

C.3.1.3 Design Criteria

- The basis of design data will be obtained from the construction documents, shop drawings and the equipment operating and maintenance manuals. The consultants will provide any data not identified in these documents.

C.3.1.4 System Location

- The system location will identify the location of major equipment. A reproduction of the CAD drawings will also identify the location.
- The areas in the building served by the system will be identified. In some cases it may be possible to add CAD drawings which have been color coded.

C.3.1.5 System Redundancy

- Provide a description of redundancy levels provided by the equipment in the event of equipment failure.

C.3.1.6 Energy Source

The energy sources section will identify what energy sources service the equipment or system. For example:

- Air Handling Unit #1
- Heating water, converted to glycol
- Chilled water
- Steam for humidification
- 600V power from MCC #1
- 120V power from panel #001, circuit #02, circuit #04, circuit #06.

C.3.1.7 Emergency Power Operation

- A description of all of the systems and/or parts which may operate on emergency power.

C.3.1.8 Emergency Procedures

- The emergency procedures will identify the recommended procedures which are contained in the main equipment manufacturers' documentation.

C.3.1.9 Operating Schedule

- Describe the operating schedules applicable to the system, including automatic time clock operation, and methods for manual or remote "after-hours" operation.

C.3.1.10 Drawing Reference

- Provide a reference list of As-Built drawings.

C.3.1.11 Operating and Maintenance Manuals Reference

- Provide a cross-reference listing for equipment maintenance manuals.

C.3.1.12 Setpoint Parameters

- The systems parameters section will identify the equipment and systems environmental setpoints, time of day schedules, alarm limits, current setpoints, time of delays, etc.

C.3.1.13 Sequence of Operation

- The system operation section will describe how the system has been set up to operate. This section will reference other documentation where more detail can be found.

C.3.1.14 Operating Instructions

- Provide descriptions of system start-up requirements. This will be modified by the building operators as required.

D Training of Building Facility Operations Staff

This section describes the minimum requirements for the training of Terminal Infrastructure and Facility Operations staff. The intent is to provide an understanding of how a system is intended to function inclusive of the design assumptions. This will provide for better understanding of how the system performs under different conditions and maintenance requirements for the equipment and systems. Refer to the contract specifications for more details on the training requirements for the Terminal Infrastructure and Facility Operations staff.

D.1 Training Requirements

1. The contractor shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.
2. The contractor shall develop a training schedule in co-operation with the Project Manager and Commissioning Provider. The dates and duration for each day, and required attendees, shall be confirmed with the Owner. The schedule shall include for multiple classes to suit operator shift requirements.
3. The schedule shall be orderly in that mechanical, electrical and general disciplines are not scheduled on the same days.
4. The contractor shall develop a outline and course agenda which shall be reviewed by the commissioning team for acceptability. The trade contractor or manufacturer shall ensure all training is of acceptable quality and content and that it meets the Owner's requirements. The contractors and manufacturers shall follow the approved agenda. The agenda shall include:
5. Introduction to the manufacturer or contractor:
    - 5.1 A list of contacts and phone numbers etc., shall be provided
    - 5.2 Sufficient hand out material shall be provided
    - 5.3 The design of the equipment or system shall be reviewed
    - 5.4 The operation of the equipment or system shall be reviewed
    - 5.5 The maintenance requirements of the equipment or system shall be reviewed
    - 5.6 The emergency procedures shall be reviewed
    - 5.7 The operating and maintenance manual shall be reviewed
    - 5.8 Instructor and qualifications
    - 5.9 Include classroom session, site walk-through, actual operation, maintenance and troubleshooting demonstration.
6. The trainer for each session shall be experienced with the operating and maintenance procedures for this particular equipment or system and have the necessary presentation skills to perform the training effectively.
7. The trainer shall prepare an attendance list for each training session. A copy of these lists shall be forwarded to the Owner's Project Manager

8. The contractor shall provide electronic training material which duplicates the scope of each training session
9. The contractor shall provide videotaping of the training sessions, with tapes cataloged by the contractor and added to the O&M manuals
10. Provide a detail explanation and demonstration of the control of the VFD, the BMS system and the integrated operation of the systems.

E Sample Documents

E.1 Pre-functional Datasheets (Mechanical and Electrical Systems)


Air_Handling_Unit.pdf


Cooling_Towers.pdf


Pump.pdf


Switchgear_Switchboard_Assemblies.pdf


Three_Phase_Dry_Filled_Transformers.pdf


PCA Field Test Procedure template.pd

E.2 Functional Test Forms


RTU Functional.pdf


GTAA Gate 193 Project -CX CheckList

E.3 Commissioning Plan

T1 Gate 193
Improvements WP3A

E.4 Specification (Baggage Handling System)

BHS SPEC PART 1 -
GENERAL 20170427_

E.5 Checklist (Passenger Boarding Bridge)

PBB Checklist
v2.pdf

E.6 Commissioning Tracking Log

Commissioning
Tracking Log.pdf

E.7 Construction Checklist (SAT)

Sample Construction
Checklist.pdf

E.8 Compliance Matrix

Beumer Compliance
Matrix.pdf

E.9 Checklist (Passenger Boarding Bridge)

PBB
Decommissioning For

E.10 Airport Pavement

150-5380-7b -
Airport Pavement Mai

AC-302-011 - Airport
Pavement Bearing Str

ASTM - Standard Test
Method for Airport Pa

PCI-101.pdf