

In house Testing and commissioning
team for building services as a part of
Facilities Management Strategies for
Government owned properties in Oman

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OMAINTEC, Novamember,2018 Egypt, Cairo.

Introduction:-

- ▶ A project is an investment made on a package of interrelated time bound activities. Every project has two phases; the first phase is preparation and construction and second is its operation or Facilities Management (FM). Testing and Commissioning (T&C) is an important activity which links these phases of a project. Building Division (BD, is the Engineering wing of the Government department of Oman.

- ▶ FM department encompasses all services required to assure the assets will perform the functions throughout their life cycle for which a facility was designed and constructed.
- ▶ T&C process of building services is a crucial activity of the life cycle of a property/building. FM of a building/estates is different from a shop floor/process industries .
- ▶ A modern building / estates includes the facilities such as HVAC, Power supply, UPS, DG Sets, Water treatment plants, Security systems, Fire Alarm Systems, Electronic and IT Services, Kitchen and Laundry services etc.

Commissioning objectives:

- ▶ To ensure that all the equipment and systems are installed according to the manufacturer's recommendations and best practices and standards for the industry.
- ▶ Authorization will include documentation Design intention, followed by activities in the stages of construction, acceptance and warranty of the project. The participation of contractors in the commissioning activities will follow Specified in the specification requirements.



Commissioning plan:

- ▶ The purpose of the commissioning plan is to provide guidance for the commissioning process during construction, and the provision of the resolution to issues such as scheduling, roles, responsibilities and lines of communication, reporting and approvals.
- ▶ Regular process to ensure the performance of building systems according to the intentions of design and operational requirements of the owner.

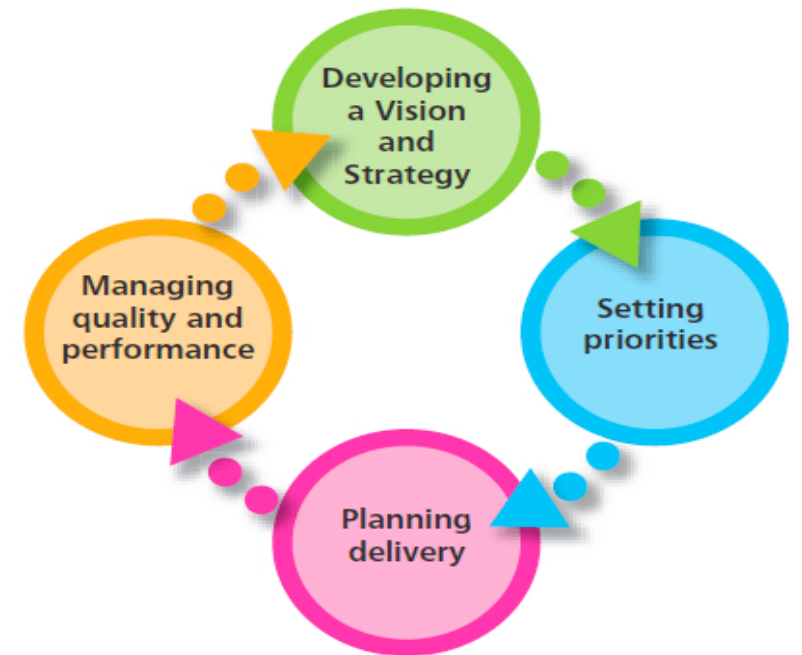


Building services commissioning:

- ▶ Building services commissioning is the systematic process of ensuring that a building's complex array of energy-related systems are designed, installed, and tested to perform according to the design intent and the building owner's operational needs.
- ▶ T& C process can be applied not only to new projects /buildings but also to modules and systems that are scalable, renewable or existing.
- ▶ T & C processes apply to all stages of a project commencing from concept till handing over of the project.



- ▶ The commissioning process can be broken down into four phases: Design, Construction, Occupancy and Operations .
- ▶ Each step in the process has different responsibilities for each member of the commissioning team.
- ▶ This process involves an integrated application of a set of techniques and procedures to verify, examine and test each operational component of the project, from individual tasks, such as machines and equipment, to complex integration such as modules, engineering subsystems and systems etc.



Testing during services installation:

- ▶ Testing during services installation called as static testing such as pressure testing of duct& pipework and undertaking resistance checks on cabling etc.
- ▶ These types of tests are to be carried out to prove the quality and workmanship of the installation.

- ▶ These activities are generally carried out by Project consultant along with owner's representative & contractors.
- ▶ Proper documents are to be maintained for such tests. Upon completion of static testing, dynamic testing which is known as commissioning is undertaken. Commissioning is carried out, as explained earlier, to prove that the installed systems operate and perform to the design intent and specification.

Pre-commissioning ,testing & commissioning:

- ▶ In general a standard for T & C provides procedures, methods, and, documentation requirements for each activity for project delivery from design through occupancy and operation.
- ▶ This type of standard should include:
 - information such as Overview of Commissioning Process activities.
 - Description of each process step's minimum activities.
 - Minimum documentation requirements, Acceptance requirements .

- ▶ In Oman Electrical power generation and distribution organizations such as Muscat Electricity Distribution companies (MEDC), Rural Electrification Company and Petroleum development of Oman (PDO) have developed their own standards applicable to their nature of business.
- ▶ No standard formats and procedures for testing and commissioning of Building services of a typical government building project is established. International professional organizations such as ASHRAE, [3], CIBSE, prepare such standards and update it regularly.
- ▶ Professional organizations such as Oman Society of Engineers (OSE) etc. to play crucial role to prepare and standardize such documents in consultation with academics and industry experts.

static testing:

- ▶ **Testing and Inspection during Construction:** - It is also called as static testing. The purpose of these tests is to ensure that:
 - ❖ All components and systems are in a satisfactory and safe condition before start up.
 - ❖ Preliminary adjustment and setting of equipment at this stage shall also be carried out at the same time to pave way for the coming functional performance tests.
 - ❖ Before carrying out any test, the Contractor shall ensure that the installation complies with all relevant statutory requirements and regulations.

► Functional Performance Tests

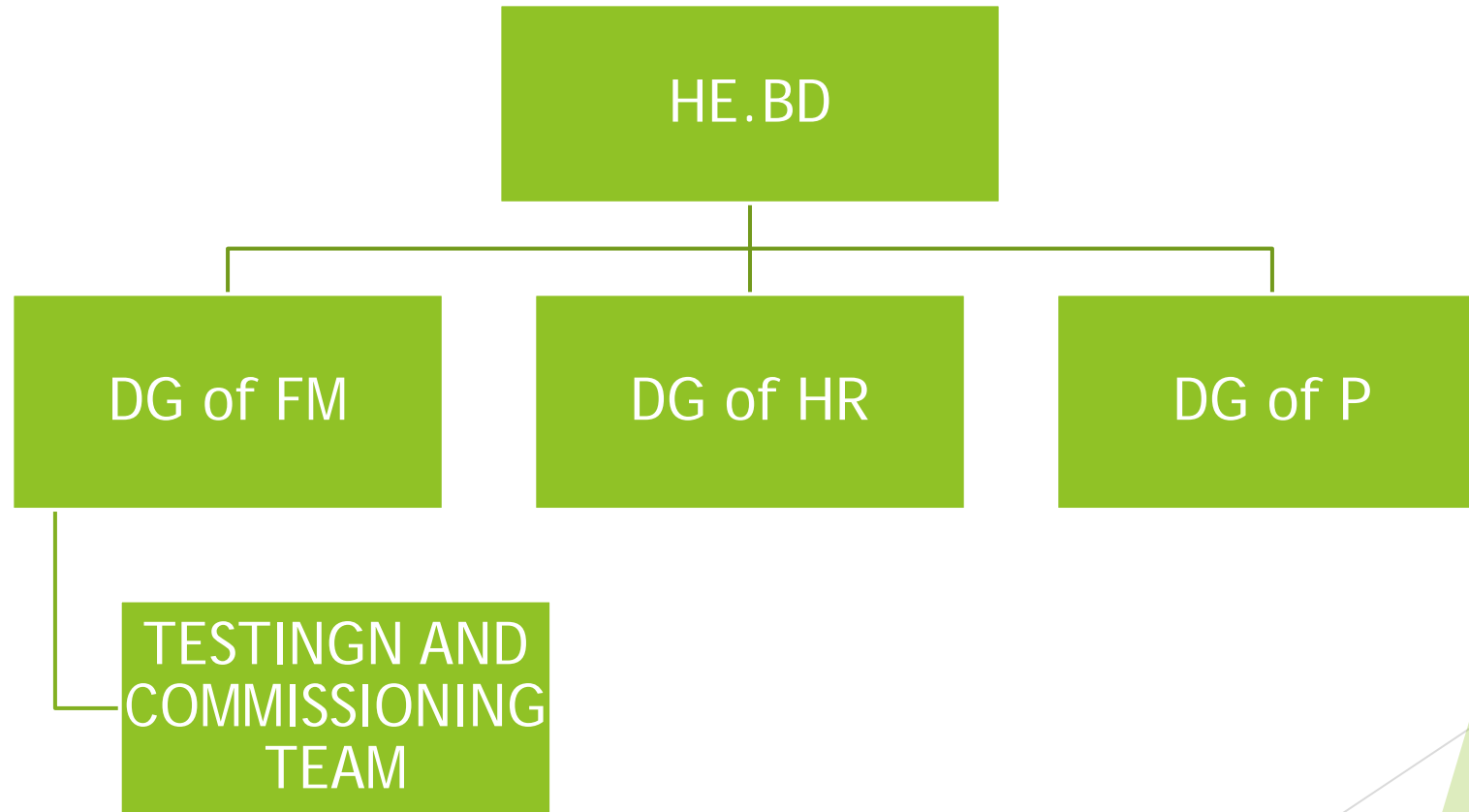
The purpose of functional performance tests (dynamic testing) is to demonstrate that:

- ❖ The equipment/installation can meet the functional and performance requirements as specified in the General/Particular Specifications.
- ❖ Functional performance test should proceed from the testing of individual components to the testing of different systems in the installation.

Organization structure of FM division of Building department of iconic projects of Oman:-

- ▶ Facilities Management (FM) as a concept is new in Oman market.
- ▶ Facilities management concept has been effectively implemented in developing countries many years ago.
- ▶ Besides concept of Facilities management to government assets is different from of private assets.
- ▶ Profit is the main criteria for private properties whereas a qualitative service is basic requirement in government assets.
- ▶ Facilities Excellence Model in general comprises key building blocks such as Management Systems, Policies and Procedures; Maintenance Work Management; Maintenance Tactics; Continual Improvement; Reliability Centered Maintenance; Process Redesign etc.

Organization structure of Building Department (BD) department:



T& C section is a part of BD department and its brief roles and responsibilities:

- ▶ Reviews the project technical documentation and the contractual requirements.
- ▶ Defines commissioning work packages and prepare the relevant procedures with the assistance of discipline engineers.
- ▶ Supervises commissioning field activities.
- ▶ Ensures safe execution of all commissioning activities through the application of the work permit procedure.
- ▶ Coordinates activities of vendor representatives and subcontractors.

Challenges faced the commissioning team:

- ▶ Commissioning is a quality process of checks and balances for ensuring building systems are designed, constructed, and operated for peak performance.
- ▶ The project team not handover to FM team probably.
- ▶ The FM team not check the design parameter.
- ▶ FM forced to takeover the system from project with out proper checking because of the time.
- ▶ Another big challenge is not getting the commissioning team engaged in the project early enough.

CASE STUDY 1: Multipurpose Hall at Salalah project:



- ▶ Salalah is the second-largest city in the Sultanate of Oman, and the largest city in the Dhofar Province. Salalah attracts many people from other parts of Oman and the Persian Gulf region during the monsoon/khareef season, which spans from July to September. Salalah is known as the home of some of the best football clubs in Oman. In order to develop the skills of younger generation further Government of Oman has recently completed the construction of multipurpose hall at Salalah.

Built up area of Multipurpose complex:

- ▶ The Multipurpose hall which is also called as Sultan Qaboos Youth Complex comprises of 2 Main complexes - Assembly & Sports Hall and Culture & Heritage Complex. In addition to these complexes there are many other ancillary buildings to accommodate various services. These buildings include Service Yard Building, 2 no's of electrical panel rooms, 2 nos. Public Stands, 5 nos. Guard House & 2 nos. Irrigation tanks + Pump rooms etc. Built up area of this complex is given in table .

Assembly & Sports Hall	38,000m ²
Cultural & Heritage Centre	10,200m ²
Service Building	2,700m ²
Public Stands	2,000m ²
Misc. Buildings (Guard Houses, Etc.)	1,300m ²
TOTAL BUILT UP AREA	54,200m²
	-

Brief details of few major building services of this complex:

S.N	Name of services	Brief description
0		
1	HVAC	Chillers(4no,McQuay,Capacity-1445 KW,Power-516 KW) AHUs (McQuay)- more than 40 Nos and many FCUs
2	D.G.set	1250 KVA DG set for Essential power backup
3	Electrical Substation and other electrical works	The11KV/433Vsecondary substations 1MVA - 6Nos. Street light, Bollard light, Sports field lighting & related cabling, Hard and Soft Court area lighting.
4	Fire Fighting system	It includes Fire hydrants.
5	PA/AV system	Public Announcement and Audio Visual system.

HVAC system

► Chillers(4no, McQuay, Capacity-1445 KW, Power-516 KW)

► AHUs (McQuay)- more than 40 Nos and many FCUs





Desal generators.

► Electrical Substation and other electrical works



Fire Fighting system

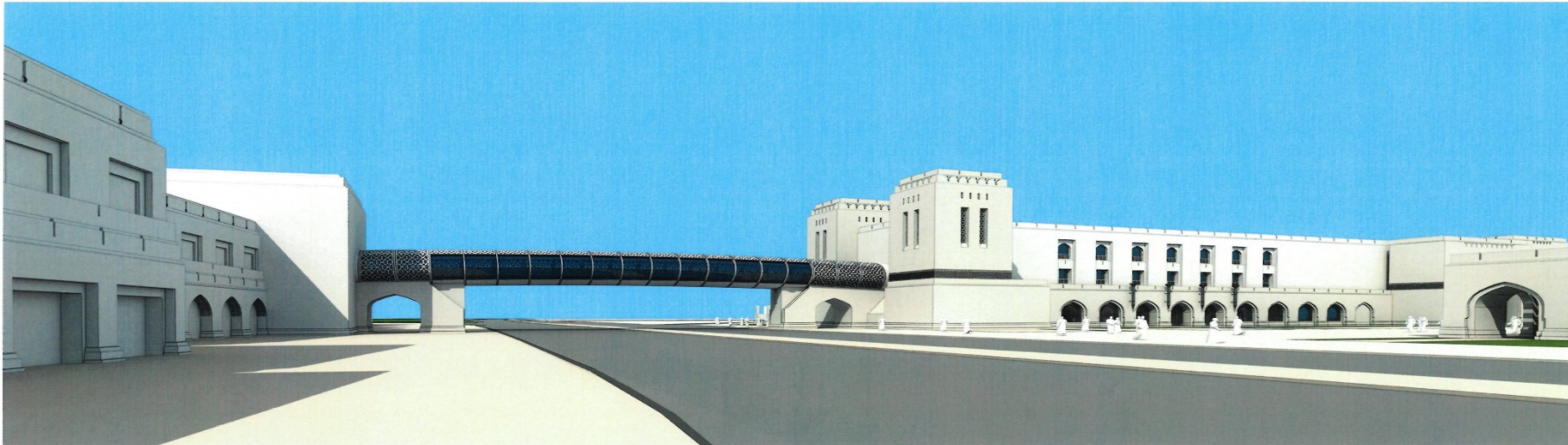


Details of T & C process of this project

S.No	Activities	Details
1	Total numbers of site meetings	25 Nos
2	Numbers of O & M manuals	125Nos
3	Numbers of A built drawings	125 Nos
4	Special tools used for T & C	Mostly special tools were used by the contractor.
5	Difficulties encountered	Contractors attendance and documentation

CASE STUDY 2: Extension of Royal Opera House- Muscat Project

Exterior View from East



ROHM

Supplementary Theatre Facilities

June 2015

- ▶ This project is taken for reporting as it is special building and different from the building considered in case study 1. The Royal Opera House Muscat (ROHM) is Oman's premier venue for musical arts and culture. The opera house is located in Shati Al-Qurm district of Muscat on Sultan Qaboos Street. Built on the royal orders of Sultan Qaboos of Oman, the Royal Opera House reflects unique contemporary Omani architecture, and has a capacity to accommodate maximum of 1,100 people.

- ▶ The opera house complex consists of a concert theatre, auditorium, formal landscaped gardens, cultural market with retail, luxury restaurants and an art center for musical, theatrical and operatic productions.
- ▶ ROHM was commissioned during the year 2011. As demand for cultural activity increases extension of another building near to the existing ROHM with seating capacity of 500 seats was proposed in year 2017. Project is almost completed and end user will use it from the beginning of December 2018.

Built up area of Extension of Royal Opera House- Muscat

Main theater	674 m²
Galleria	3600 m²
Culture center	1715 m²
Offices	1850 m²
TOTAL BUILT UP AREA	- 14194 m²

HVAC system





Electrical equipments and other electrical works



Fire Fighting system

Details of T & C process of this project

S.No	Activities	Details
1	Total numbers of site meetings	20Nos
2	Numbers of O & M manuals	80 Nos
3	Numbers of A built drawings	80 Nos
4	Special tools used for T & C	Mostly special tools were used by the contractor.
5	Difficulties encountered	Contractor's attendance and documentation.

Conclusion and recommendations

- ▶ Testing and commissioning process of building services, as a part of FM department, is new concept on Oman. In this paper necessity of in-house T& C team as a part of FM team is emphasized. Developed T & C process document is implemented in two different iconic building projects. Brief details of these two projects are reported as case studies.

- ▶ Inclusions of certain technical clauses in project tender specifications about T& C process without any ambiguity so that the contractor & consultant executes this process professionally
- ▶ Inclusion of in- house T& C team as a part of FM department with well-defined roles accountabilities to be established. Also required special tools for testing & commissioning to be procured. Team to be trained to use these special testing equipment Data base to be created to record all test data for analysis ad reporting
- ▶ The prepared document to be suitably revised and tested to another few projects.
- ▶ These procedures, as a part of quality control process at government owned buildings is to be standardized. For that for different types of building projects which are under progress are to taken as few more case studies. From these case studies further analysis is to be done and give input to frame standards for T& C of building services of projects in Oman.

The End