Engineering Standard

B-SPE-STD-003

Commissioning Requirements

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(Refer Controlled Document in REX for Author, SME, Owner and Approver details)

Contents

1 Purpose

Seqwater Engineering Standards are in alignment with the Seqwater Quality Management System. Their purpose is to provide a consistent approach to the development, modification, and management of Seqwater infrastructure that is fit for purpose and safe.

This Engineering Standard provides the minimum requirements for commissioning of Seqwater (the Principal) assets which are mainly associated with the water treatment plant and supply system processes. This document must be used in conjunction with the documents it references in order to assist in ensuring fit for purpose infrastructure assets.

The purpose of this Engineering Standard is to ensure that the infrastructure assets being handed over are functional, operational, maintainable, and safe as per the original design. This process provides a means of verifying that projects are delivered to meet project stakeholders and Seqwater's business needs. These needs are embedded in the Scope of Works, design and technical specifications, and regulations applicable to each project or contract.

The objectives of this standard are to define the requirements for:

a. Pre-commissioning, commissioning, and testing activities and outline the objectives of the commissioning aspects of projects.
b. The pre-requisites for commissioning activities at each stage of the project delivery.
c. The guideline methodology and inspection tests required to ensure that the contractual and technical requirements (if different) are verified, deficiencies are identified and rectified at the correct project stage, and the overall process is documented.
d. Acceptance criteria for process, efficiency, construction quality and stakeholder performance expectations.
e. Handover of project back to business as usual.

The commissioning process shall ensure the traceability of contractual, design, technical, functional, and operational requirements through inspection and test procedures so as to ensure that the project is delivered to meet its objectives and requirements, free from defects.

The commissioning process shall involve the development of several documents at different commissioning and project stages. Commissioning documentation shall be based on the design, contractual and applicable regulatory requirements.

2 Application of Engineering Standard

This Engineering Standard applies to all Seqwater employees, suppliers, contractors and consultants working for, or on behalf of, Seqwater unless otherwise stated. It applies to design and construction of all new water treatment plant and water supply system infrastructure and to all existing water treatment plant and water supply systems infrastructure undergoing refurbishment or modification. It must be used in conjunction with the Contract Terms and Conditions and other relevant Asset Standards and project specific documents to define the requirements for commissioning of these infrastructure assets.

Seqwater Engineering Standards detail Seqwater's minimum requirements and recommendations to provide infrastructure that will be fit for purpose, and safe to operate and maintain. However, at all times the design and/or construction Contractor remains responsible for ensuring infrastructure designed and/or constructed is fit for purpose and safe to construct, operate, maintain, and demolish. In doing so the Contractor must exercise appropriate due diligence to identify and manage hazards so far as is reasonably practicable.

Deviation from this standard is not permitted without prior written agreement from Seqwater in accordance with the deviation process detailed in *Procedure X-PRO-STD-008 Asset Standards Management and Application*, which requires:

- Completion of an Asset Standards Deviation Request Form, and
- Submission via the Seqwater Project Representative (for external parties) or via Seqwater's Engineering Mailbox (engineering@seqwater.com.au) (for internal parties).

In addition, proposed deviations from this Engineering Standard represent a proposed variation to the Contract so shall also be notified to the Contract Superintendent (where appointed) in accordance with the terms and conditions of the Contract. If approved, they will require formal confirmation to proceed from the Contract Superintendent as a variation under the Contract.

Where noted in this Engineering Standard that Seqwater approval or acceptance shall/must be sought, approval or acceptance must be gained through the Seqwater Asset Standard Deviation process, as identified above.

Responsibility for ensuring compliance with Seqwater Engineering Standards lies with those engaged in the management and execution of design, construction, and modification of Seqwater assets. This includes modifications to the functional design of the asset including technical changes made which would extend an asset outside of its design operating envelope and/or approved operation and maintenance practices.

Where no Australian Standard exists for a particular application, Work must conform to the most current version of an industry accepted international standard.

In the case that it is identified that a specific requirement within this Engineering Standard does not meet the requirements of project specific documents, another Seqwater Asset Standard or Australian Legislation, Standards, Codes or Guidelines, the conflict must be brought to the attention of the Seqwater Principal Engineering Standards and Assurance (or their delegate) via the Engineering Mailbox, and written agreement must be gained prior to application of the requirement.

Advice must be sought from the Seqwater appointed Representative or Superintendent (when appointed) to clarify any ambiguities regarding this Engineering Standard.

Seqwater undertakes regular updates of Asset Standards. At the commencement of a Contract the complete list of Seqwater Asset Standards should be reviewed to ensure currency and applicability of standards to be applied to the Works.

3 Definitions

The following definitions (Table 3-1) apply to this Engineering Standard.

Table 3-1 – Definitions

Term	Definitions
Acceptance Criteria	The description of technical requirements, performance limits, any tolerances and any other quantitative measures required of the project to demonstrate that the functional performance of Works delivered by the Contract has met the requirements of the Seqwater process requirements as specified in the Scope of Work.
Commissioning	A planning, testing and verification process to ensure that an asset or asset system functions and performs in accordance with the specified requirements. Commissioning Works include all Works related to: • Pre-commissioning (as defined) • Dry Commissioning (as defined) • Wet Commissioning (as defined) • Proof of Performance Testing
Commissioning Plan	A plan developed to describe the entire commissioning and testing process with all associated requirements and descriptions of interface, action or participation involving any Seqwater involvement.
Commissioning Schedule	A time-based program of the commissioning activities including the resources required to perform the tasks, that is reflective of the Commissioning Plan and which forms a part of the overall project schedule.
Contractor	The Contractor is the entity that, dependent on contracted scope, is responsible under a Contract for the management and/or execution of the design, construction, commissioning to demonstrate of compliance and/or performance of the infrastructure associated with and in accordance with the Contract.
Cutover Plan	A plan developed to connect the new asset to the current asset.
D&C Project	A project where the same Contractor carries out design and construction of the infrastructure.
D/C Project	A project where one Contractor/Designer carries out the design of the infrastructure, and a separate Contractor carries out the construction of the infrastructure.
Designer	The Registered Professional Engineer engaged under a Contract to perform design of the Works. This may include design changes during construction of the Works.
Drinking Water Quality Coordinator	A prescribed team member from the Principal who provides support and site-based directions following procedures and plans to maintain drinking water quality.
Dry Commissioning	Any Testing activities or process checks undertaken as part of commissioning that is carried out to ensure that equipment is operational, reliable and ready to go into the production environment without the introduction of water or any process fluids in the process system.
Factory Acceptance Test (FAT)	Test undertaken off site aimed at verifying that custom-made engineered equipment and/or subsystems meet technical, quality, functional and performance requirements in accordance with scope, technical, and design specifications.

Term	Definitions
Hold Point	A mandatory verification point beyond which work cannot progress without approval by the Principal's representatives.
Inspection and Test Plan	A plan developed to describe the detailed procedures, permits, location and dates to conduct an inspection and/or a test.
Interim Operation Design	Drawing that reflects any interim changes to the operating schematic to enable cutover and commissioning.
Mechanical Completion	The stage in construction when all construction Works are completed to the extent that: • The quality assurance checking and documentation confirms the installation of any equipment and sub-systems, • All drawings, operational manuals and any technical documentation required by the contract that is required for and is necessary for commissioning has in fact been provided, • It is demonstrated that all construction Works have been constructed to the requirements of the design, the design specifications and terms of the contract, • The Works are free from any construction defects that would prevent commencement commissioning, • All warranty information relating to special equipment necessary to maintain warranty during commissioning has been provided.
Manufacturer / Supplier / Vendor / Original Equipment Manufacturer (OEM)	The entity that manufacturers or supplies equipment to meet the specifications of the Contractor.
Owner's Engineer	A team of engineers from the Principal engaged with commissioning activities to ensure that project technical requirements are adhering with the project specification.
Practical Completion	The stage in the execution of the Work as defined in the terms and conditions of the head Contract when the Works have been completed in accordance with the Contract and have met all the requirements stated in the Contract requisite to the contractor reaching Practical Completion.
Pre-commissioning	Testing and verification activities carried out to make the system ready for commissioning if those cannot be covered during the construction period and includes all enabling works to undertaken during dry commissioning that confirms the state of readiness of any equipment, such as directional checks on electrical motors, valve actuation checks, bolt tensioning checks, and the like.
Principal / Owner / Customer / Seqwater	Queensland Bulk Water Supply Authority trading as Seqwater. The entity that engages the Contractor to undertake the Work and takes custody of the outcome. The Owner may delegate responsibilities to other entities to act on its behalf (e.g. a consultant).
Principal's Representatives	Members of the commissioning team who represent the Principal. The commissioning team members' roles and responsibilities are listed in Section 7.
Proof of Performance Test (POPT)	Tests aimed to verify that all the installed assets' function and perform as intended and can be operated in an integrated system and in a manner, that represents future determined operating environments/constraints.

Term	Definitions
Quality Assurance	The evidence from inspection/s and measurement/s that demonstrate/prove the engineering, operating and/or asset performance and functionality to achieve design requirements.
REX	Seqwater Electronic Documents and Records Management System.
Scope of Work (SoW)	Contains the required operating, engineering and/or equipment performance criteria and future determined operating environments/constraints that will be proved at commissioning and POPT.
Seqwater Approval / Acceptance	Written sign-off gained via the deviation process, as detailed in X-PRO-STD-008 Asset Standards Management and Application.
Shall / must	Indicates a mandatory requirement.
Should	Indicates a recommendation.
Site Acceptance Test (SAT)	Tests aimed to verify that site construction, installation, and fully integrated Works, meet technical, quality, functional and performance requirements in accordance with scope, technical, and design specifications.
Superintendent	The person specified in the Contract, nominated by the Principal, to exercise the functions of Superintendent under the Contract.
Testing	Testing involves the verification process conducted by the Contractor during execution of the Contract to demonstrate compliance with the Technical Specifications requirements. Testing includes (but is not limited to): • Manufacturer's Factory Acceptance Test (FAT) • Site Acceptance Test (SAT) • Pressure testing of pipework • Non-destructive weld testing • Crack testing • Concrete testing • Electrical point-to-point testing, etc.
Trial Operation	Operate all equipment and sub-systems in an integrated manner for a short period prior to the start of POPT.
Waternet	Seqwater's intranet
Wet Commissioning	Testing activities carried out to ensure that equipment is operational, reliable and ready to go into the production environment with the introduction of water or any process fluids in the process system. Wet commissioning is intended to progressively bring the completed and tested system up to intended design operating levels of performance in readiness for performance testing to progress.
Work / Works	Infrastructure to be designed and/or constructed under the Contract to meet the requirement of the Scope of Work.

4 Abbreviations

The following abbreviations (Table 4-1) apply to this Engineering Standard.

Table 4-1 – Abbreviations

Abbreviation	Description
AM	Asset Management
DOL	Direct On Line - Motor Control
ES	Engineering Statement
FAT	Factory Acceptance Test
FD	Functional Description
GA	General Arrangement
IFC	Issued for construction
ITP	Inspection and Test Plan
ITR	Inspection and Test Report
IFR	Issued for Review
IFU	Issued for Use
JSEA	Job Safety & Environmental Analysis
MC	Mechanical Completion
MCC	Motor Control Center
O&M	Operation and Maintenance Manual
QA	Quality Assurance
PFD	Process Flow Diagram
P&ID	Piping and Instrumentation Diagram
POPT	Proof of Performance Test
RPEQ	Registered Professional Engineer of Queensland
SAT	Site Acceptance Test
SCADA	Supervisory control and data acquisition system
SoW	Scope of Work
SS	Soft Starter - Motor Control
SWMS	Safe Work Method Statement
TSI	Technical Support and Improvement

5 Reference Documents

The documents listed in Table 5-1and the requirements therein, are relevant to this Engineering Standard. In their latest editions, these documents form a part of this Engineering Standard. Note that this is not an exhaustive list of documents relevant to the works.

Table 5-1 – Reference Seqwater Documentation

Asset Standard Document Number	Document Title	Seqwater Controlled Document Reference
N/A	PLC & SCADA Interface Guidelines	D20/63266
N/A	Disinfection of Water Mains	PRO-01554
N/A	Disinfection of Bulk Water Supply Reservoirs (Method 2)	PRO-01559
N/A	Tools & Equipment Disinfection Procedure	PRO-01560
X-PRO-STD-009	Engineering Design, Construction, Operation and Maintenance	PRO-01617
M-PRO-STD-001	Commissioning of Electromagnetic Flow Meters for Potable Bulk Customer Supply Procedure	PRO-01845
N/A	Disinfection of Pumps, Hoses, Vac Trucks and Jet Rodding Equipment	PRO-01869
N/A	Underwater Inspections in Drinking Water Assets	PRO-01870
N/A	Disinfection of Small Reservoirs in Free Chlorine Systems (Method 1)	PRO-02019
N/A	Disinfection of Filters and Granular Media	WIS-00006
E-SPE-STD-001	Electrical Design and Construction	SPE-00352
I-SPE-STD-015	Instrumentation	SPE-00353
I-SPE-STD-011	Control Systems Testing	SPE-00360
I-SPE-STD-013	Control Systems Design and Construction	SPE-00361
M-SPE-STD-001	General Mechanical Standard	SPE-00367
M-TMP-STD-003	Electromagnetic Flow Meter Commissioning Inspection and Test Plan Template	TEM-00153
X-TMP-STD-006	Engineering Statement Template – ES2 - Construction	TEM-00217

6 Commissioning and Testing Requirements

6.1 General

The general requirements of this document shall apply for the commissioning and testing of a system at the Contractor's premises and subsequent commissioning and testing of the system and its component elements at Seqwater's sites.

Commissioning commences at the design stage and Testing physically begins during the project construction stage. The framework for commissioning shall be developed at the project design stage. The framework should set out the fundamental criteria and requirements for commissioning and testing that the Scope of Work (SoW) has been delivered i.e. the construction methodology and newly installed assets are reliable, maintainable and fit for purpose as designed.

During construction, the Contractor shall, at designated and agreed Hold Points, provide verifications of the design specifications through to Mechanical Completion (MC), and certify that the constructed plant/facility and its components conform to the design drawings and comply with requirement of Seqwater technical specifications and standards. Once MC is achieved and the Superintendent confirms this to the Contractor, the plant/facility may be considered to be ready for commissioning and can be handed over to the commissioning team, if applicable. See Section 6.1.1 for further information on Mechanical Completion.

The Contractor shall provide all labour necessary to perform the commissioning of the Works and maintain overall co-ordination and project management of the commissioning process. The Contractor shall provide, at all times and, on a 24 hour call out basis, the necessary personnel and skilled labour to respond to any issues that may arise during the commissioning periods. This shall include but not be limited to all process, mechanical, electrical and control systems issues or any other faults with the assets being commissioned and/or during Proof of Performance Testing (POPT).

Disinfection of equipment, reservoirs and mains, hydrostatic pressure testing and flushing of mains and pipes are construction activities that must be completed to achieve Mechanical Completion. Therefore, details of these activities are not covered in this document.

Where the pressure testing, cleaning, flushing and disinfection processes need to be employed immediately prior to commissioning, this shall align with the Seqwater's Procedures and Standards, Australia Standards and WSAA Codes. For any commissioning and/or testing of infrastructure that could potentially come into contact with drinking water and/or have an impact on drinking water quality the Seqwater Project Manager must first obtain approval from the Drinking Water Quality Coordinator via waterqualityproduct@seqwater.com.au.

Commissioning and testing constitute several stages and components of the commissioning process and require a formal agreed system of co-ordination and control. The whole commissioning and testing processes are detailed in the subsequent sections.

This document does not constitute a test specification for any part of the system.

6.1.1 Mechanical Completion

Commissioning of the plant/facility will not be able to commence until the Contractor provides to the Superintendent evidence that satisfactory Mechanical Completion has been achieved. This is to the extent that:

- Quality Assurance (QA) checking and documentation confirms the installation of any equipment and sub-systems,
- All drawings, operational manuals and any technical documentation required by the contract and necessary for commissioning have been provided,

- The Contractor has demonstrated that all Construction Works have been constructed to the requirements of the design, the design specifications and terms of the Contract,
- Completed Works are free from any construction defects that would prevent commencement commissioning.
- All warranty information relating to special equipment necessary to maintain warranty during commissioning has been provided.

The Contractor shall use Seqwater form X-TMP-STD-006 *Engineering Statement Template - ES2 – Construction* TEM-00217 to certify that the Works have reached MC following the form usage guidelines provided in X-PRO-STD-009 Engineering Design, Construction, Operation and Maintenance PRO-01617. The Contractor shall use the ES2 form for this purpose for each phase or part of the Works if a project is completed in different phases or parts and handed over for commissioning, accordingly.

Civil Works Inspection and Testing and many activities related with Dry Commissioning shall generally be part of Mechanical Completion. The details of these activities are provided in Section 6.13.1 and Section 6.13.2.

6.2 Commissioning Stages

This section describes in detail the commissioning structure into several commissioning and testing steps or stages. The process is shown in the diagram in **Error! Reference source not found.**:

As described in **Error! Reference source not found.**, the commissioning and testing process shall have the following main stages:

- Develop Commissioning Strategy (Commissioning Brief)
- Develop Commissioning Plan
- Perform Factory Acceptance Test (FAT) for Equipment
- Conduct Site Acceptance Test (SAT) for Equipment and Systems
- Carry out Trial Operation for Systems
- Perform Proof of Performance Test (POPT) for Systems.

All the tests mentioned above shall be conducted with Inspection and Test Plans (ITPs) endorsed by the Principal's representatives. The inspection and test results shall be documented in Inspection and Test Reports (ITRs).

For the avoidance of doubt, at all times the Contractor retains responsibility for ITPs and Commissioning activities.

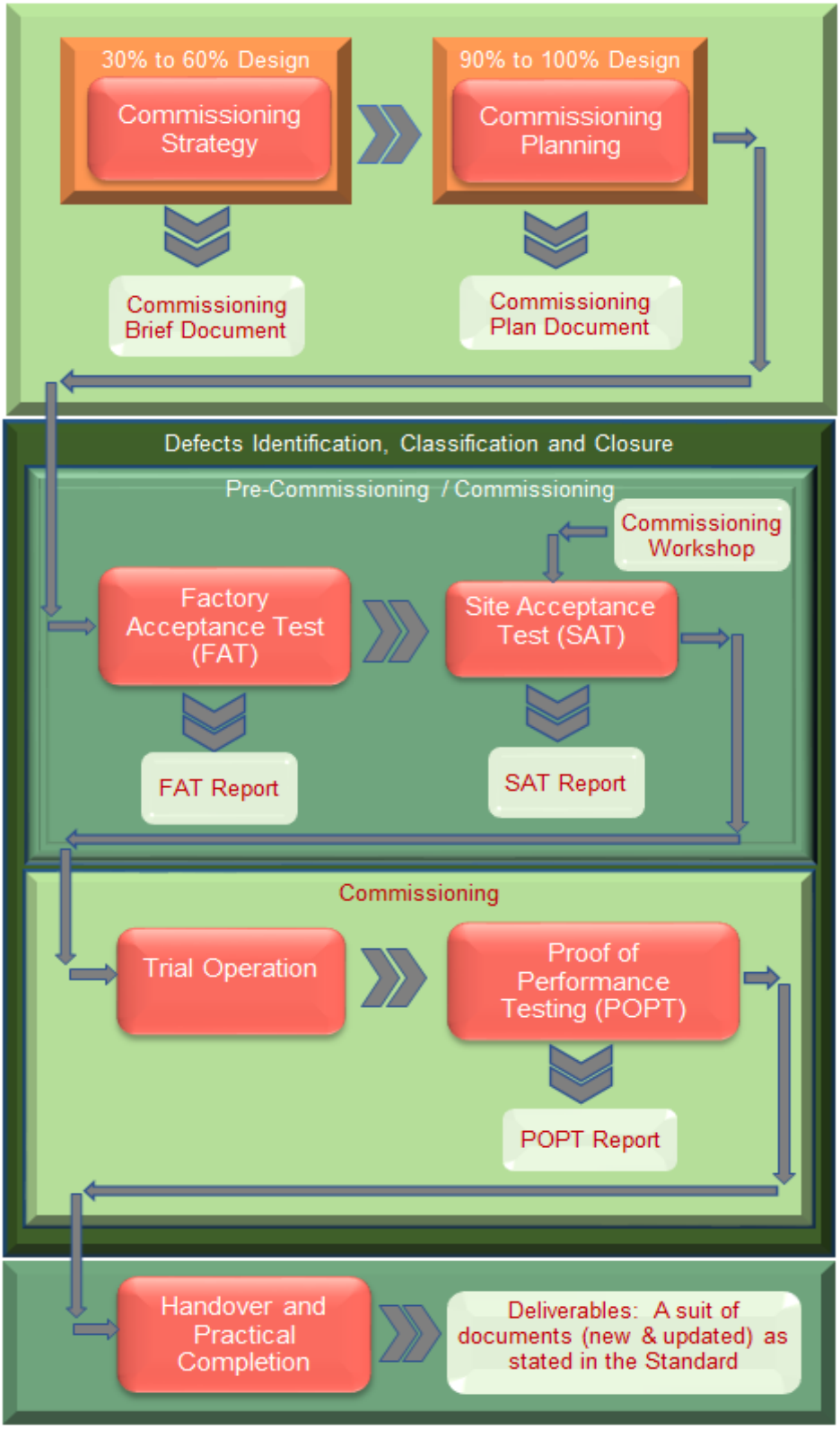

Figure 6-1 Key Commissioning and Testing Stages

6.3 Commissioning Documentation and Deliverables

This section lists the commissioning documentation with other deliverables for the whole commissioning process as outlined above.

Serial No.	Commissioning Deliverables	Project Stages	Due Date
1	Commissioning Brief	30% to 60% Design	N/A
2	Commissioning Plan (Issue for Review)	90% Design	N/A
	Commissioning Plan (Issue for Use)	100% Design**	N/A
3	Factory Acceptance Test (FAT)^ Plan	Construction/ Pre-commissioning	2 weeks prior to commencement of each FAT
4	Factory Acceptance Test (FAT)^ Report	Construction/Pre-commissioning	Within 2 days of completing each FAT
5	Pre-FAT Code/SCADA Review	Pre-commissioning / Commissioning	2 weeks prior to commencement of each FAT
6	Cutover Plan	Construction/ Pre-commissioning / Commissioning	2 weeks prior to commencement of cutover
7	Commissioning Workshop	Pre-commissioning / Commissioning	4 weeks prior to commencement of any SAT
8	Draft Operations and Maintenance Manual	Commissioning	After MC and prior to commencement of any SAT
9	Site Acceptance Test (SAT)^ Plan	Commissioning	2 weeks prior to commencement of each SAT
10	Site Acceptance Test (SAT)^ Report	Commissioning	Within 1 week of completing each SAT
11	Training	Commissioning	Prior to trial operation and POPT
12	Trial Operation	Commissioning	After completion of the SAT
13	Proof of Performance Test (POPT)^ Plan	Commissioning	2 weeks prior to commencement of POPT
14	Proof of Performance Test (POPT)^ Report	Commissioning	Within 1 week of completion the POPT
15	Final Operations and Maintenance Manual	Practical Completion	After incorporating findings from the SAT, Trial Operation and POPT
16	Handover Documents	Practical Completion	

below includes the list of key commissioning deliverables with project stages and due dates.

Table 6-1 –Commissioning Deliverables and Project Stages

Serial No.	Commissioning Deliverables	Project Stages	Due Date
1	Commissioning Brief	30% to 60% Design	N/A
2	Commissioning Plan (Issue for Review)	90% Design	N/A
	Commissioning Plan (Issue for Use)	100% Design**	N/A
3	Factory Acceptance Test (FAT)^ Plan	Construction/ Pre-commissioning	2 weeks prior to commencement of each FAT
4	Factory Acceptance Test (FAT)^ Report	Construction/Pre-commissioning	Within 2 days of completing each FAT
5	Pre-FAT Code/SCADA Review	Pre-commissioning / Commissioning	2 weeks prior to commencement of each FAT
6	Cutover Plan	Construction/ Pre-commissioning / Commissioning	2 weeks prior to commencement of cutover
7	Commissioning Workshop	Pre-commissioning / Commissioning	4 weeks prior to commencement of any SAT
8	Draft Operations and Maintenance Manual	Commissioning	After MC and prior to commencement of any SAT
9	Site Acceptance Test (SAT)^ Plan	Commissioning	2 weeks prior to commencement of each SAT
10	Site Acceptance Test (SAT)^ Report	Commissioning	Within 1 week of completing each SAT
11	Training	Commissioning	Prior to trial operation and POPT
12	Trial Operation	Commissioning	After completion of the SAT
13	Proof of Performance Test (POPT)^ Plan	Commissioning	2 weeks prior to commencement of POPT
14	Proof of Performance Test (POPT)^ Report	Commissioning	Within 1 week of completion the POPT
15	Final Operations and Maintenance Manual	Practical Completion	After incorporating findings from the SAT, Trial Operation and POPT
16	Handover Documents	Practical Completion	

^ *Hold Point*

** *For D/C projects, a draft commissioning plan should be ready at 100% design stage.*

The Contractor shall be responsible to provide all commissioning deliverables. The Seqwater Project Manager / Commissioning Supervisor for the Principal shall ensure receiving of all commissioning deliverables.

In addition, Appendix A provides more detailed explanation of project and commissioning stages with the highlights of commissioning activities.

6.4 Commissioning Strategy

The Contractor responsible for the design of the Works shall prepare a Commissioning Brief document outlining the commissioning strategy for review by the Principal's representatives during 30% to 60% design stage.

Commissioning Brief document shall include but not be limited to the following information:

I. Overview of commissioning strategy (methodology, practicality and replicability for validity and reliability of data).

II. Commissioning and testing objectives (including performance criteria).

III. Listing of the various phases of the commissioning starting from the QA with construction through to FAT/SAT, IO testing, point to point testing, dry commissioning, wet commissioning, plant start-up, performance trial operation, POPT test and handover.

IV. Acceptance criteria for tests.

V. Operational impacts.

VI. Significant cutovers.

VII. Requirements to enable test operation of the equipment over the full range of operation required by the contract.

VIII. Key risks by any nature and its mitigation strategy.

6.5 Commissioning Plan

A Commissioning Plan shall form the basis of the entire commissioning and testing process and structure. The commissioning plan shall be prepared in order to:

a. Provide the logical sequential tests for each component and the asset as a whole;

b. Identify and address risks related to the commissioning of processes, the execution of inspection and testing activities, with important consideration to risks associated to water safety, quality and continuity of supply (with the specific plant/equipment, job safety, water quality and operational requirements);

c. Verify that the output meets specification and performance requirements of the SoW;

d. Document the evidence requirements and format that provides clarity and ease of interpretation;

e. Document the rectification process; and

f. Document how the performance of the new/modified asset will be proved over the full range of operation required by the specification.

The Contractor shall prepare a Commissioning Plan following the commissioning strategy specified in the Commissioning Brief document. The plan shall be submitted to the Principal for review when the project at the stage of 90% design completion.

For D&C projects, the commissioning plan shall be available for use at the stage of 100% design completion. For D/C projects, the draft commissioning plan shall be ready for review at the stage of 100% design.

The commissioning plan shall include but not be limited to the following information:

I. Commissioning and testing objectives.

II. Outline of proposed activities required to deliver the Works as-commissioned, according to all contractual, performance and legislative requirements.

III. Program of commissioning and testing to be performed, including test sequence and duration of tests.

IV. Commissioning schedule with timeline.

V. Listing of the various phases of the commissioning starting from the FAT/SAT, Input Output (IO) testing, point to point testing, dry commissioning, wet commissioning, plant start-up, performance trial operation, POPT testing and handover, performance target during POPT.

VI. Testing schedules with number of samples, locations.

VII. Performance target and acceptance criteria (as defined in design and contract documents) for each phase of testing.

VIII. Method of recording results for evaluation and certification (e.g. ITRs).

IX. Potential time, cost and operational impacts to other processes.

X. Contractor and Principal commissioning team organizational structure and resourcing.

XI. Communications protocols.

XII. Risk identification, analysis and risk mitigation plans related to construction, installation, testing and commissioning activities, as applicable.

XIII. Isolation plan.

XIV. Waste management and environment management plans.

XV. Any Statutory testing requirement.

XVI. Identification and engagement of Seqwater and Contractor representatives required to take part in the commissioning process.

XVII. The required number of cutovers and the duration of each.

XVIII. Fall-back mechanism if the cutover is not successful.

XIX. Disinfection and flushing of equipment and piping (where needed) in alignment with Seqwater procedures if not covered during the construction phase. This will include detail requirements of equipment, volume of water needed, water disposal method, potential cost, time, impact to other processes.

XX. Description of energy isolation, partial and/or total plant shutdowns, operational arrangements, and provision of equipment or special arrangements required to undertake construction, installation, testing and commissioning activities, as applicable.

XXI. Preparation of work method statements and permit systems applicable to construction, installation, testing, and commissioning activities, as applicable.

XXII. Preparation of Inspection and Test Plans, and Inspection & Test Records.

XXIII. Scope of documents to be created and/or updated, and provided as a result of the commissioning process.

XXIV. Proposed handover and training plan/outline.

XXV. Where needed a traceability matrix to assess the achievement of contractual, design, technical, functional and operational requirements during inspections and tests.

The Commissioning Plan shall be reviewed and certified by a Registered Professional Engineer Queensland (RPEQ) including registration number from the Contractor before submission to the Principal.

Commissioning shall not commence in the absence of a certified Commissioning Plan document.

6.6 Commissioning Workshop

The Contractor shall convene a Commissioning Workshop between the Contractor's commissioning team, the Superintendent's Representative, and the Principal's Representative(s), a minimum of four (4) calendar weeks prior to the commencement of any SAT. The workshop shall be held at a site/venue agreed by the Principal's Representative

The purpose of commissioning workshop shall include but not be limited to the following:

I. Discussion of review comments or any outstanding issues about the commissioning plan.

II. Review of FAT and link with SAT.

III. Confirm the plant and systems commissioning and testing objectives.

IV. Confirm the format of the plant and systems testing checklists and commissioning procedures.

V. Review the general level of detail and structure of the commissioning plan document.

VI. Review organizational chart and communications protocols.

VII. Review methodology and tests which will be implemented during the SAT, commissioning, and POPTs to prove the new asset associated process / plant operates in accordance with the Design Specifications, Contract and Scope of Work. This shall include but not be limited to, fault simulation, plant shutdown, flow variations, set point variations, process monitoring, and water quality monitoring etc.

VIII. Confirm the classification system for ranking plant faults and failures during SAT and POPT.

IX. Review on the roles of the Contractor's commissioning team and the Principal's Representatives during the plant and systems testing and commissioning.

X. Complete a Commissioning Plan Risk Assessment to identify key risks and risk mitigation measures.

XI. Confirmation of impacts on operations and details on inputs required from operations as part of the commissioning activity.

XII. Review of defect rectification expectations.

6.7 Cut-overs

During the commissioning process, cut-overs may be required to connect the new asset to the current asset. Prior to any required cutover, the Contractor shall submit a cutover plan to the Principal for acceptance within two (2) weeks from completion of the commissioning workshop. The cutover plan shall include:

I. Isolation plan and preparation works required to undertake cutover;

II. Maximum time that any service, process, drive or combination of drives may be out of service;

III. Responsible Parties involved;

IV. Detailed procedures with unique step ID;

V. Extent of assets impacted by cutover;

VI. Details of activities associated with cutover works;

VII. Risk assessment and JSEA/SWMS;

VIII. Reinstatement plan;

IX. Verification tests to confirm satisfactory completion of cutover works; and

X. Fall back mechanisms which will be followed if the cutover is not successful specifically what measures are in place to restart the process or plant again.

Where the duration of the service, process, drive or combination of drives may be out of service is deemed by the Seqwater Operational Representative to be of significant effect of the operation of the plant, the Contractor will be required to consider options to reduce the time to an acceptable duration before the cutover will be allowed to commence.

The Seqwater Operational Representative has the final approval of the cutover.

6.8 Inspection and Test Plan

The Contractor shall prepare Inspection and Test Plans (ITPs) for review by the Principal's Representatives at least two (2) weeks prior to the commencement of inspection and testing of a component or system. The Inspection & Test Plans include the plans for FAT, SAT, Trial Operation and POPT.

As a minimum, the test plan shall include the following:

I. Reference drawings identifying the affected systems,

II. Detailed design documents (for example Functional Specification, Equipment List etc.),

III. Requirements for permits,

IV. The tests to be carried out (scope of work),

V. The detailed procedures of how the tests will be conducted with unique step ID,

VI. Inspection and test schedule with dates,

VII. The location (FAT only), duration and timing of the testing,

VIII. The test sheets to be completed during the testing.

Test plan formats shall be endorsed by the Principal's Representatives. The Seqwater Commissioning Supervisor and nominated Owner's Engineers shall review the Test Plan within one (1) week of receiving the plan from the Contractor.

The Contractor shall consider any additional requirements to prepare the plan as specified in Seqwater Control Systems Testing, Electrical, Instrumentation and Mechanical Standards.

Appendix B provides an example of Inspection and Test Plan Checklist Template. In addition, Section 5 includes the reference of Seqwater electromagnetic flowmeter commissioning ITP Template and Procedure.

6.9 Inspection and Test Report

Subsequent to the completion of the FAT, SAT and POPT tests, the Contractor shall prepare Inspection and Test Reports (ITRs) for each test, which shall be a complete record of:

I. The actual tests carried out,

II. Process and ambient conditions at which the tests were carried out any assumptions or considerations made,

III. The results obtained & whether they are acceptable or not in against of "acceptance criteria",

IV. Lists of any reservations noted during the tests and the manner in which they were corrected,

V. Records of every test, whether witnessed or not.

The test and inspection reports shall include a 1-2-pages summary of the results of the testing along with the testing schedules and detailed results from the testing. Test and Inspection Report formats shall be approved by the Principal's Representative.

6.10 Notice and Witnessing of Tests

The Contractor shall provide a plan showing the scheduled dates of testing and shall provide updates to this plan regularly as changes occur and report to the Principal for communicating with Seqwater stakeholders.

The Principal shall have the right to defer the scheduled dates of testing, in writing, if:

I. The Contractor has not provided adequately comprehensive test plans in accordance with this specification, or

II. The schedule conflicts with other high priority operational commitments

The Contractor shall advise the Seqwater Project Manager, in writing, of the date of commencement of every stage of testing at least two (2) weeks before their commencement. However, the complete program shall be issued along with the test plan. The two (2) weeks' notice shall only be a confirmation of the date in the ITP.

The Seqwater Project Manager will communicate the date of commencement through to Seqwater stakeholders within two (2) days of receiving notification.

The Seqwater Commissioning Supervisor, nominated Seqwater Engineers and other nominated Seqwater Persons shall have the right to witness any test. Such inspection shall not relieve the Contractor of the responsibility for compliance with the requirements and satisfactory operation of the equipment.

The Principal's Representatives shall have the right to access all original documents, calculations and drawings.

6.11 Defects Management and Register

In order to ensure the effective close out of defects identified during the construction and commissioning phases, a defects management system shall be utilized. The purpose of this system is to capture all defects throughout the construction and commissioning phases and to provide a controlled platform in closing out the defects. The Seqwater Project Manager shall keep a register of all defects throughout the construction and commissioning process.

Defects shall be classified into the following categories:

a. High priority (A classification): A classifications are defined as a substantive defect, affects integrated operation, not meeting performance requirement, no standby/backup equipment, multiple similar fault/failures, structural fault/failure, unstable control, unacceptable safety risk.

b. Medium priority (B classification): B classifications are defined as force-majeure event, Seqwater operational issue, one-off equipment fault/failure, controller tuning, unavailability of commissioning resources, minor safety risk, condition/quality.

c. Low priority (C classification): C classifications are defined as one-off fault/failure of backup/standby component, doesn't affect integrated operation, labeling, signage, brackets etc.

After the defect is resolved by the Contractor, the Seqwater Project Manager shall approve the closure of the defect and confirm that the defect has been resolved adequately. The Seqwater Project Manager shall seek assistance from the Seqwater Commissioning Supervisor and Seqwater Engineers to classify and close a potential defect.

To avoid any doubt, the Superintendent (where appointed) has final decision on the classification and closure of a defect.

Appendix C provides an example of Defects Register Template.

6.12 Defects During Testing Stages

During the FAT, SAT and POPT, the below actions are required should the following occur:

a. High priority (A classification) failure/non-conformance: FAT/SAT/POPT is automatically failed and the test will need to be repeated from the beginning when the issue is resolved to the satisfaction of the Principal.

b. Medium priority (B classification) failure/non-conformance: FAT/SAT/POPT is paused until the issue is resolved and then can be continued.

c. Low priority (C classification) failure/non-conformance: FAT/SAT/POPT continues and the issues will need to be rectified prior to plant handover.

The FAT, SAT and POPT will not be accepted as complete until all A and B classified defects are rectified and retesting completed, as appropriate.

6.13 Inspection and Testing Items

This section classifies lists of inspection and testing items with different engineering disciplines.

The testing items as listed under Civil Works, Dry Commissioning under mechanical and hydraulic systems will normally be covered during the construction and/or pre-commissioning stage and should be completed as part of Mechanical Completion.

The electrical and control system testing items shall be covered during the stage of FAT, SAT and POPT.

6.13.1 Civil Works Inspection and Testing

These tests shall include but are not limited to:

I. Testing of all new water retaining structures, tanks, reservoirs, above and underground pipework as required by Australian Standards to demonstrate water tightness.

II. Flood testing of reservoir roofs (before disinfection of reservoirs).

III. Compaction testing of pipeline bedding material.

IV. Testing of concrete cure strength.

V. Pressure-testing of all new pipelines, including cut-in interfaces with existing mains to demonstrate water and air tightness. Leakage tests shall be carried out in accordance with the technical specification.

VI. Inspections to confirm satisfactory materials, quality/workmanship/condition and safety aspects.

6.13.2 Mechanical and Hydraulic Systems Inspection and Testing

These tests shall include but are not limited to engineered and custom-made equipment and/or sub-systems. These tests may include dry and wet tests as often specified as dry commissioning and wet commissioning.

Dry Commissioning

Dry Commissioning is done without the introduction of water or any process fluids in the process system. This should include, but are not limited to the following:

a. The initial checking of all equipment and ancillaries to confirm that they have been supplied and installed in accordance with the Design.

b. A static and dimensional inspection to establish that all items of equipment are complete and that the equipment is ready for no-load operation.

c. Checking the operational integrity of safety devices, valves, stop-boards and penstocks.

d. Drive, pump alignments and rotational checks of all drives.

e. Checking the operation of lifting equipment, hoists and cranes.

f. Setting weir plates and stop boards.

g. Hydrostatic / leakage tests of pipework, joints, valves, pumps, vessels and extremities, leak tests of double containment lines.

h. Mechanical equipment or sub-system functional and performance tests.

Wet Commissioning

Wet Commissioning should demonstrate the operation of the plant and all field equipment using field mode from local panels. This shall be carried out in two stages:

I. In the first stage, the water is purged into the process system to check for any leakages and to ensure the integrity of the process lines.

II. In the second stage, process fluids (or chemicals) are mixed with water or sometimes pure process fluids (or chemicals) are introduced into the process system.

In the first stage, when the equipment operating on reclaimed effluent or potable water, the following mechanical checks will be carried out and fully documented:

a. Adjustments and setting of all no flow, overpressure devices, torque limit switches, electronic shear pins etc.

b. Noise and vibration level measurements (if possible, prior to commissioning).

c. Hydraulic grade measurements.

d. Demonstration of maintenance activities where appropriate.

Wet commissioning site tests should demonstrate the operation of the plant and all field equipment using field mode from local panels.

6.13.3 Electrical Equipment Inspection and Testing

Testing of the electrical equipment shall be carried out in accordance with Standard Specification E-SPE-STD-001 Electrical Design and Construction.

The testing shall be comprehensive and shall include power failure and equipment faults at a system and a device level.

6.13.4 Control System Inspection and Testing

Testing of the Programable Logic Controller (PLC), Supervisory Control and Data Acquisition (SCADA) and other control system components shall be carried out in accordance with Standard Specification I-SPE-STD-011 Control Systems Testing.

The control system testing shall be comprehensive and shall include power failure and equipment faults at a system and a device level.

6.14 Factory Acceptance Test (FAT)

The Factory Acceptance Test (FAT) is the testing of equipment and equipment components during production in the manufacturing company or in similar conditions. FAT is a major project milestone in a project where the Contractor demonstrates that the supply of individual components and equipment meets the design and the overall project specifications. The FAT shall provide for a full-scale integrated functional check of the system. The system functional tests shall include performance checks of all redundancy features, fault diagnostic and reporting features of the system.

The FAT shall be conducted formally and be witnessed by the Principal and all nominated subject matter experts, with a formal record of discrepancies and non-conformities and how they are to be handled. FAT normally is conducted at the manufacturer's premises but can take place at the contractor's premises for certain equipment.

If due to logistic constraints, the complete system or sub-system cannot be tested together, the Contractor shall prepare individual test plans for each component and include specific methodologies to ensure final system coherence.

It is expected that the system has undergone rigorous tests internally by the Contractor using the FAT plan and procedure prior to the formal demonstration to Seqwater personnel.

Should critical defects or non-compliances be found that prevent the FAT from being completed, these shall be amended and re-tested in order to complete the FAT at no cost to the Principal.

The completion and acceptance of the FAT constitute a Hold Point prior to the transport and installation of equipment on site.

6.14.1 Pre-Factory Acceptance Test

The Contractor shall conduct un-witnessed FAT testing to ensure that the equipment meets the requirements prior to conducting the witnessed FAT. The Contractor shall make available the documented evidence of this testing for the Principal's Representatives to review at the FAT.

Equipment which requires Pre-FAT testing includes but is not limited to the following:

a. MCC boards
b. Electrical switchboards and switchgears
c. Transformers
d. UPS Changeover
a. Soft Starters
b. Solar Systems
c. Pumps
d. Valves
e. VSD
f. DOL motors
g. Control panels
h. SCADA system
i. Chemical Dosing skids
j. Centrifuges
k. Screens
l. UV units
m. DAF saturators
n. PLC controllers and remote IO drops.

Pre-FAT testing does not need to be witnessed by the Principal's Representatives.

6.14.2 General Requirements for Conducting FAT

The Contractor shall plan, specify, schedule, conduct and record all factory acceptance tests.

The minimum requirements for the FAT include, but are not limited to the following:

I. Performance testing of equipment and components including power usage.
II. Pressure testing of pipe spools manufactured off-site.
III. Leak testing and operational testing of all equipment and components
IV. Checking the operational integrity of safety devices.
V. Where practical, the operation of all mechanical, electrical and process equipment.
VI. Calibration of all instrumentation.
VII. FAT simulation testing of the PLC, SCADA and other control system components shall be carried out at Contractor's premises in accordance with I-SPE-STD-011 Control Systems Testing and in an environment as close as possible to the operational environment.

This testing is carried out when:

a. The system or sub-system is fully assembled, developed and verified by the Contractor.
b. The equipment is ready for shipment to site.
c. All hardware, software and installation documentation are complete.
d. Should high priority defects or non-compliances be found that prevent the FAT being completed, these shall be corrected and re-tested in order that the FAT is complete and approved by the time the equipment is delivered.
e. At conclusion of the FAT, provided there are no major defects and an acceptance is given by the Principal, then the equipment can be delivered and installed on site.

6.15 Operation and Maintenance Manual

As a minimum, electronic and hard copies of draft Operation and Maintenance Manual (O&M) shall also be made available after MC or before any SAT test. The manual, in electronic format, shall include an index in a searchable format and will contain, but not limited to the following:

I. Safety notes,
II. Troubleshooting instructions,
III. Technical description of the plant,
IV. Drawings and schedules,
V. Special operating instructions,
VI. Operating parameters,
VII. Schedule of routine tests,
VIII. SCADA operating instructions,
IX. Schedule of alarms and trips,
X. Normal/Start-up and Shutdown operating procedures for each mode of operation,
XI. Abnormal Start-up and Shutdown operating procedures for each mode of operation,
XII. Local panel operating instructions,
XIII. Manufacturers proprietary equipment details,
XIV. Manufacturers contact details,
XV. Spare parts list, including a list of critical spares and consumables,
XVI. List of recommended spare parts stock holding for each asset,
XVII. Schedule of routine maintenance requirements,
XVIII. Maintenance procedures,

XIX. Isolation mechanism for electrical and mechanical equipment.

6.16 Site Acceptance Test (SAT)

Site Acceptance Test is the stage when all the installed equipment and sub-systems shall be tested on site. Site Acceptance Tests shall be carried out by the Contractor when MC is achieved. SAT tests are to verify functionality and performance of all installed components, equipment or sub-system delivered by the project meet their corresponding requirements and specifications.

I. As a minimum, the SAT shall be carried out with participation of the nominated Seqwater Commissioning and Operation Representatives, however, Process, Electrical, and SCADA Seqwater Representatives might also be required as applicable to the project.

II. SAT protocols and/or inspection and test sheets shall be prepared for civil/structural, mechanical, process, electrical, instrumentation, software and any other engineering discipline aspect of the Works to be delivered by the project. These protocols and test sheets shall be provided to the Seqwater Project Manager as per Section 6.8. As a minimum, the SAT inspection sheet should validate all sections of the process operating and control philosophy. If the Contractor does not have their own SAT testing documentation for small projects, the functional description may be used as a template for recording and sign off the tests, subject to the approval of the Principal's Representatives.

III. As a minimum, the SAT shall include the following:

a. Directional testing of drives and operation of actuated valves etc. Integrity testing and setting up of all field mounted instrumentation, including on-line instruments through calibration against known standards.

b. Noise, heat, vibration checking, lubrication etc.

c. Pump performance testing.

d. SAT testing of the PLC, SCADA and other control system components shall be carried out in accordance with I-SPE-STD-011 Control Systems Testing.

e. Operation of all electrical and mechanical equipment.

f. When site inspection, testing and commissioning activities require the temporary isolation of existing mechanical, electrical and data/communication equipment; all persons, equipment and processes likely to be affected shall be identified and notified in order to coordinate the implementation of measures to ensure that a safe working environment is maintained and that all disturbances are kept to a minimum.

g. Should critical defects or non-compliances be found that prevent the SAT from being completed, these shall be amended and re-tested in order to complete site commissioning activities at no cost to the Principal.

The completion and acceptance of the SAT constitutes a Hold Point for plant start-up.

6.16.1 Pre-Site Acceptance Test

Prior to conducting the Site Acceptance Testing, the following shall be completed:

I. Operation and Maintenance (O&M) Manual will be produced in draft form prior to commencement of the commissioning and submitted to Principal's Representatives. This will be used and verified as part of the commissioning process.

II. A full set "For Construction" design documentation shall be made available to the Principal's Representatives prior to undertaking SATs, as defined in the project and Contract documentation, applicable to the equipment or sub-system being tested. These include, but are not limited to the following:

a. Construction Drawings (Including P&IDs, civil, mechanical, electrical, control system drawings),
b. Draft Operation and Maintenance manuals,
c. Construction IO list,
d. Technical Data Sheets,
e. Functional Description (furnished with a suite of initial set points),
f. PLC Software Archive Backup Copy,
g. SCADA Configuration Archive Backup Copy,
h. Spare Equipment Delivery Docket / Transmittal,
i. Instrument and Equipment Calibration/Setup Values,
j. Other design documentation items as applicable,
k. Electrical Installation Certificate of Compliance.

III. Risk assessments shall be undertaken prior to the SAT to establish the risks associated with the SAT. These assessments will produce mitigation actions to reduce the risks and also develop contingency and response plans.

IV. The installation of equipment will be checked to ensure it is in accordance with specification and scope of works.

V. Equipment will be checked to ensure that it is in a safe condition to operate including all safety signs and labels identifying hazards.

VI. Where possible and practical to do so, wet commissioning shall be completed with potable water. Process units can be operated with potable water to test the equipment, for example, the filling of new chemical dosing tanks and operating the system in field mode.

VII. Where the new process requires the use of chemicals, the Contractor shall provide those which are compliant to the Principal's quality standards. The Contractor shall provide the Principal with the quality specifications of the chemical prior to delivery to site.

VIII. The following general electrical tests shall also be completed and fully documented (where relevant):

a. The initial checking of all equipment and ancillaries to confirm that they have been supplied and installed in accordance with the specification and Scope of Work.
b. Checking and adjustment of transmitter and instrument ranges and scaling for all instruments and verify that PLC/SCADA inputs match field device outputs.
c. Condition/quality inspection.
d. Safety assessment.

6.17 Independent Inspections

The Principal reserves the right to conduct independent evaluations and inspections of any work item and to verify the adequacy of the Contractor's inspection activities. Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause shall be removed and replaced in an acceptable manner by the Contractor, when found during the Principal's independent inspection.

6.18 Maintenance

The Contractor shall undertake all scheduled and unscheduled process, civil, mechanical and electrical maintenance of new equipment during the Testing, Commissioning, and POPT.

Maintenance of existing equipment will remain the responsibility of the Principal during these periods.

6.19 Training

After the completion of the SAT, the Contractor shall provide comprehensive classroom and field training to the Principal's Operations, Maintenance and other nominated technical representatives. Where necessary, the contractor shall run several training sessions to facilitate participation of all nominated Principal's staff.

The Contractor shall develop an electronic and hard copied training module covering all aspects of operations, control and SCADA features, troubleshooting and maintenance. The Contractor shall involve manufacturer's representatives to propose training programs applicable to the new asset they have supplied. The training module shall include, but is not limited to, all aspects of the process and respective plant and equipment, in detail demonstration of SCADA and control system features.

This is important that the training of operational staff shall be conducted prior to the start of trial operations and POPT. This will offer the opportunity to Seqwater Operations to test the system while the contractor is on site.

Official handover of any section (or part) of the asset shall not occur unless training has been satisfactorily completed.

6.20 Trial Operation

Trial Operation or commissioning test run provides the opportunity to run the plant as a whole in an integrated manner and provide any fine tuning of settings prior to the official start of Proof of Performance Test (POPT). Trial operation or test run can only start when the SAT has been completed and there are no outstanding high priority and medium priority defects.

The Test Run shall include:

I. Manual Operation with water
II. Automatic Operation with water

After successful run with the water, where applicable, the system shall be tested with chemical with the followings:

III. Manual Operation with Chemical
IV. Automatic Operation with Chemical

During the trial operation, the plant may be run by Seqwater Operators (as part of training and familiarization) under the instruction of the Contractor.

6.21 Proof of Performance Test (POPT)

The POPT is undertaken to demonstrate that the asset functions as intended and can operate in an integrated manner in a predicted operating conditions and environment and that it is capable of meeting performance requirements. During this stage, the plant may be run by Seqwater Operators under the instruction of the Contractor.

The Contractor shall prepare the POPT Plan as per Section 6.8 for review by the Principal at least two (2) weeks prior to the commencement of POPT. The Seqwater Commissioning Supervisor, Process Engineer and Operation Representative shall review the POPT Plan within one (1) week of receiving the plan from the Contractor.

The POPT can only start when:

I. POPT Plan has been approved by the reviewers

II. Trial operation has been completed and there are no defects and risks identified.

The Seqwater Commissioning Supervisor, Process Engineer and the Operational Representative for the Principal shall have the right to defer the POPT if the Contractor does not satisfy the requirements or due to high priority commitments.

The other general requirements for POPT are given below:

III. The nominal period for the Proof of Performance Test is two (2) weeks however this may be varied to suit the level of data collection, complexity of the system and weather conditions. Any variances to the nominal period shall be approved by the Principal in advance of the POPT.

IV. This phase of the works requires full liaison and coordination of the program and activities with the operations group as well as the Seqwater subject matter experts, Commissioning Manager/Supervisor and Project Manager.

V. The POPT shall test the operation of all mechanical, electrical and control systems under process conditions that represent the anticipated operating conditions. Testing shall establish that the operation of the plant sub-section conforms with the specified requirements and the design intent.

VI. The Contractor must provide all required chemicals, bear all costs associated with any sampling, analysis, test works, performance reporting for the installed/upgraded equipment or process during the commissioning and POPT. All chemicals must meet the Principal's quality requirements. Chemicals for existing equipment and processes will continue to be provided by the Principal during the commissioning period.

VII. Upon completion of the POPT (and prior to asset handover), the Contractor shall submit a POPT test and inspection report to the Principal for review and acceptance within one (1) week after the completion of the POPT period. The report shall include the following:

   a. Summary of all failures/non-conformances during the POPT, and how they were rectified and retested.

   b. Performance against the acceptance criteria as defined in the contract document, including but not limited to:

      i. The design intent

      ii. Plant reliability, operability and functionality

      iii. Water quality (if applicable)

   c. Summary of the outstanding defects and their priority classification.

   d. Status of documentation handover.

The Seqwater Commissioning Supervisor and Process Engineer shall review the POPT report within one (1) week of receiving the report from the Contractor.

The completion and acceptance of the POPT constitutes a Hold Point in the project.

6.22 Handover

The acceptance criteria for hand-over of the System shall be as per the defined Scope of Work and Seqwater Project Assessment Framework Gateway 4 Handover Checklist Requirements. This shall include, but not be limited to, the following:

I. Successful completion of Site Acceptance Test.

II. Successful completion of the Proof of Performance Test and summary report accepted by the Principal.

III. All other commissioning testing has been completed.

IV. All documentation has been handed over and has been deemed of an acceptable quality by the Principal.

V. Training of personnel is complete.

VI. All major non-conformances (A and B classification) are rectified and retesting completed.

VII. Issue of all relevant test sheets and certificates.

VIII. Submission by the Contractor and acceptance of "As Constructed" process, civil, mechanical, electrical and control systems engineering drawings (i.e, PFDs, P&IDs, GA drawing, site plan, line diagram, loop diagram, logic diagram, input/output schedule, termination drawings etc.).

IX. Equipment and Instrument Data Sheets.

X. Functional Description Documents, Cause & Effect Diagrams.

XI. Issue of Operation & Maintenance Manual.

XII. Issue of all software and licenses.

XIII. SCADA instruction manual.

XIV. Issue of all licenses including safety compliance, environmental approval, discharge limits, drinking water quality compliance (where applicable).

XV. Plant and equipment license registration documentation

XVI. Photographic records of installation process.

XVII. Photographic records of As-Constructed assets.

XVIII. Updated program of scheduled maintenance.

XIX. Changes to HACCP Plan (where applicable).

XX. AS/ANZ 4020 Certificates (where applicable).

XXI. Equipment / Instrument Calibration certificates.

XXII. Building Certification (s) if applicable.

XXIII. Close out and project lessons learnt report.

Following the satisfaction of the acceptance criteria, the Superintendent shall issue the Certificate of Practical Completion.

6.23 Defects Liability Period

The defects liability period starts when the practical completion certificate is handed over to the contractor after the successful commissioning. The defects liability period shall be defined in the Contract Schedule.

Backup support shall be provided during the defects liability period and it includes on-site support followed by off-site on-call support. The period of time that this support is needed will be as specified in the Contract/Scope of Work. The hours and response time of support shall be discussed and agreed with stakeholders and specified in the Contract/Scope of Work.

7 Commissioning Team Roles and Responsibilities

The Commissioning Team shall include, but is not limited to, the following members:

I. Contractor's Project Manager,

II. Contractor's Commissioning Supervisor / Manager,

III. Contractor's Design Engineer / Manager / Principal, and other discipline-specific design engineers as required, such as:

   a. Civil Design Engineer,

   b. Electrical Design Engineer,

c. Control Systems Design Engineer,
d. Mechanical Design Engineer,
e. Process Design Engineer,

IV. Seqwater Project Manager,
V. Seqwater Commissioning Supervisor / Manager,
VI. Seqwater Operations Representative/s,
VII. Seqwater discipline-specific Owner's Engineers as required, such as:

a. Seqwater Process Engineer or Representative,
b. Seqwater Civil Engineer or Representative,
c. Seqwater Mechanical Engineer or Maintenance Representative,
d. Seqwater Electrical Engineer or Representative,
e. Seqwater Control System and SCADA Engineer or Representative.

7.1 Contractor's Project Manager

The Contractor's Project Manager shall:

I. Manage all aspects relating to the pre-commissioning, commissioning and process proving activities, including development and implementation of a commissioning plan.
II. Identify, manage and document risks and risk mitigation measures.
III. Report on the commissioning progress to the Seqwater Project Manager and Seqwater Commissioning Supervisor.
IV. Notify the Seqwater Operations Representative and Seqwater Project Manager of any commissioning activities, which may impact on the operability of the plant to ensure that no disruptions to supply of treated water are experienced.
V. Provide reports to Seqwater on the progress of commissioning as per the arranged timeframe in the Commissioning Plan.
VI. Ensure deliverables are produced in accordance with requirements from this document and distributed in a timely way.
VII. Review the commissioning plan and work with Seqwater to ensure its finalization.
VIII. Confirm that the Commissioning Plan has been executed fully.
IX. Ensure training is delivered.
X. Advise the Seqwater Project Manager when commissioning is complete.
XI. Manage handover of the commissioned works to Seqwater.
XII. Manage the rectification of defects in a timely manner.

7.2 Contractor's Commissioning Supervisor / Manager

The Contractor's Commissioning Supervisor shall:

I. Prepare the commissioning plan.
II. Identify, manage and frequently review risks and mitigation measures.
III. Liaise regularly with project personnel to ensure the commissioning objectives can be met.
IV. Ensure that the commissioning plan is executed correctly.
V. Witness and verify commissioning.

VI. Review and approve commissioning of deliverables.

VII. Maintain the commissioning log.

VIII. Manage the FAT, SAT and POPT.

7.3 Seqwater Project Manager

The Seqwater Project Manager shall:

I. Facilitate interfaces between all stakeholders to ensure timely completion of all the commissioning activities.

II. Ensure commissioning plan is prepared to Seqwater's requirements, seeking technical advice as required.

III. Ensure the rectification of defects is completed by the Contractor within the necessary timeframe, seeking technical advice as required.

IV. Endorse all commissioning deliverables with prior consultation of Seqwater Commissioning Supervisor and Owner's Engineers.

7.4 Seqwater Commissioning Supervisor / Manager

The Seqwater Commissioning Supervisor shall:

I. Review and accept the commissioning plan prepared by the Contractor.

II. Attend in the commissioning workshop.

III. Witness and verify the FAT, SAT, Trial Operation and POPT.

IV. Issue the FAT, SAT and POPT completion certificates.

V. Manage the defects register.

VI. Seek technical advice from Seqwater Engineers / subject matter experts.

7.5 Seqwater Operational Representative

The Seqwater Operations Representative shall:

I. Provide operations advice and guidance to the commissioning team as to the availability of equipment, processes and systems for testing and commissioning so that normal plant operations are not compromised.

II. Review the commissioning plan and attend in the commissioning workshop.

III. Advise on site-specific risks and participate in risk assessment activities.

IV. Configure the plant as directed by the Contractor's Commissioning Supervisor where required.

V. Ensure any isolation and shutdown requirements are provided during the commissioning period.

VI. Witness the FAT, SAT and POPT.

VII. Review of Operation and Maintenance Manuals.

VIII. Review of training requirements and timing.

IX. Identify operational constraints and requirements relating to commissioning.

7.6 Seqwater Owner's Engineers

7.6.1 Process Engineer / Representative

The Seqwater Process Engineering representative shall:

I. Review the commissioning plan, and where required take part in risk assessment activities and incident response.

II. Participate in the commissioning workshop.

III. Act as a contact point for Requests for Information (RFIs) that will arise during commissioning.

IV. Review FAT, SAT and POPT Plans.

V. Witness and verify the FAT, SAT, Trial Operation and POPT.

VI. Act as a point of contact for RFIs that will arise during commissioning related to process and performance parameters.

VII. Review relevant As-Constructed drawings (i.e. P&IDs) and other commissioning deliverables (i.e. test reports).

7.6.2 Control System and SCADA Engineer / Representative

The Seqwater Control System and SCADA Engineering Representative shall:

I. Review the commissioning plan, attend in the commissioning workshop and where required take part in risk assessment activities.

II. Review FAT, SAT and POPT Plans.

III. Attend in commissioning workshop

IV. Witness and verify the FAT, SAT and POPT.

V. Review the control system designs, PLC/SCADA programs and other commissioning deliverables (i.e. test reports).

VI. Act as a point of contact for RFIs that will arise during commissioning related to control system discipline.

7.6.3 Mechanical and Electrical Engineers / Representatives

The Seqwater Mechanical and Electrical Engineering Representatives shall:

I. Review the commissioning plan and, where required take part in risk assessment activities.

II. Act as a contact point for Requests for Information (RFIs) that will arise during commissioning.

III. Review relevant As-Constructed drawings and other relevant commissioning deliverables (i.e. test plans and reports).

IV. Witness and verify FAT, SAT and POPT (as applicable).

8 Changes from previous version

This Engineering Standard will be regularly reviewed and updated, including the consideration of requested alterations, in accordance with Seqwater Procedure X-PRO-STD-004 Development and Review of Asset Standards. Changes from the previous version of this document are summarised in Table 8-1 below.

Table 8-1 –Changes from previous version

Section Number	Change
General	Updated to new corporate template and organisational structure, plus minor clarifications throughout to remove ambiguities or provide additional information.
1 Purpose	Objectives updated to include definition of Acceptance Criteria and Handover requirements.
2 Application of Engineering Standard	Relationship to Contracts and role of Contract Superintendent in relation to Deviations under the Contract added.
3 Definitions	Definitions added for Acceptance Criteria, Commissioning, Interim Operation Design, Principals Representatives, Quality Assurance, and Scope of Work (SoW). Definitions updated for Designer, Mechanical Completion, Practical Completion, Pre-commissioning and Testing.
5 Reference Documents	References updated as required.
6.1 General and 6.1.1 Mechanical Completion	More detail provided regarding Commissioning requirements and new sub-section added detailing Mechanical Completion.
6.3 Commissioning Documentation and Deliverables	Item for “Pre-FAT Code/SCADA Review” added.
6.5 Commissioning Plan	Relaxation clause for small and low risk projects removed, with any such relaxations in the future to be controlled via deviation approval from this standard.
6.6 Commissioning Workshop	Items added for: • Review of FAT and link to SAT. • Review of defect rectification expectations.
6.15 Operation and Maintenance Manual	Requirement for searchable index plus item requiring list of recommended spare parts stock holding for each asset.

9 Verification

Compliance with this document may be verified by internal audit.

10 Further Information

For further information please contact the owner of this document.

Appendix A. Description of Commissioning Process with Project Stages

Table A-1 provides a further guideline for the Contractor of the Principal's expectations for the commissioning process at various project stages. But this does not reflect each type of contractual arrangement.

The Principal may approve on application from the Contractor for fabrication or manufacture of long lead items prior to completion of the FAT.

Table A-1 Description of Commissioning Process with Project Stages

Project Stage	Description
30% Design	The Project stage when around 30% of the project design is considered complete. In terms of commissioning deliverables, commissioning strategy should be developed and made available to all stakeholders in a document called Commissioning Brief - See Section 6.4.
60% Design	The Project stage when around 60% of the project design is considered complete. In terms of commissioning deliverables and if not developed at 30% design stage, commissioning strategy shall be developed and made available to all stakeholders in a document called Commissioning Brief - See Section 6.4.
90% Design	The Project stage when 90% of the project design is considered complete. In terms of commissioning deliverables, a draft commissioning plan shall be available for the Principal's representatives to review – See Section 6.5.
100% Design	The project stage when 100% of the project design is complete. In terms of commissioning deliverables, for D&C Projects, the final version of commissioning plan shall be available to use. For D/C project: a draft commissioning plan shall be ready.
Fabricate and Manufacture	At this stage, approval is provided to the Contractor to start fabricating and procuring equipment (pumps, motors, valves, PLC, SCADA etc.), panels (switchboards, MCC, control cabinets etc.) and any other electrical, process or mechanical items required to commission the project. The Principal's Representative reserves the right to provide this approval on a project to project basis based upon the quality and completeness of the electrical design documents (equipment list, GA/IGA drawings, schematic drawings, termination drawings etc.), mechanical documents (valve list, pipework drawing etc.) and process design documents (P&IDs, FD Part A and B etc.).
Configure (PLC & SCADA Programming)	In this stage, the Contractor is given the approval to start the PLC & SCADA programming. The Principal's Representative reserves the right to provide this approval on a project to project basis based upon the quality and completeness of the electrical design documents mainly IO list and alarm list.
Factory Acceptance Test (FAT)	The FAT stage is described in detail in section 6.14 of the document. The contractor has to produce a FAT plan within two (2) weeks prior to the commencement of the FAT testing. FAT inspection report has to be submitted to The Seqwater Project Manager within two days of completion of the FAT stage.
Cut-over Plan	Cut-over plan has to be produced within two (2) weeks from completion of the commissioning workshop. This stage is described in detail in Section 6.7.

Project Stage	Description
Install	This stage involves installation, connection and configuration of equipment at site
Mechanical Completion (MC)	This is the final phase of construction activities and is considered to encompass all engineering disciplines. This certifies that the constructed plant/facility and its components conform to the design drawings and specifications. All equipment has been subjected to its appropriate non-energised testing. Once MC is achieved the plant and its systems/sub-systems may be ready for pre-commissioning and commissioning and can be handed over to the commissioning team. This stage is described in detail in Section 6.1.1.
Pre-commissioning	The testing activities carried out to make equipment and systems ready for commissioning if those tasks cannot be carried out during the phase of construction. Section 6.13.1 and 6.13.2 include several tasks, many of them are generally carried out at pre-commissioning stage.
Site Acceptance Test (SAT)	The SAT stage is described in detail in Section 6.16 of the document. The contractor has to produce SAT plan within one (1) week prior to the commencement of the SAT. SAT inspection report has to be submitted to The Seqwater Project Manager within two days of completion of the SAT stage.
Plant Start-up	This stage involves start-up trials to operate the equipment and the process as a whole in the actual plant conditions. Sequential start-up and shut-down of the process area and/or of the entire plant is carried out in this stage.
Proof of Performance Test (POPT)	The POPT stage is described in section 6.21 of the document. The contractor has to produce POPT test plan and final version of O&M manuals within two (2) weeks prior to the commencement of the POPT testing. POPT inspection report has to be submitted to The Seqwater Project Manager within one (1) week of completion of POPT stage.
Handover	The Handover stage is described in section 6.22 of the document.
Defects Liability Period	The Defects Liability Period is described in section 6.23 of the document.

Appendix B. Inspection and Test Plan Checklist Template

Contractor Logo

Project No:		**Project Name:**					**Description:**		
ITP Document No:		**Client Contact:**					**Client Name:**		
Work Pack No:		**Date Opened:**					**Date Closed:**		
No.	**Operation**	**Procedure, Standard, Specification, Drawing**	**Verifying Document / Report**	**Responsibility**	**Inspection Code**		**Evidence of Compliance / Comments**	**Sign & Date**	
					Contractor	**Client**		**Contractor**	**Client**
A.	**Trial Operation**								
1	**Preliminaries / Documentation**								
1.1	Operator's training completed								
1.2									
2.0	**Trial Operation (3 days)**		**Date/Time:**		**Start:**		**Finish:**		
2.1	Complete power failure and confirm UPS backup time								
2.2									
B.	**Proof of Performance Test**								
3	**Preliminaries / Documentation**								
3.1									
4	**Proof of Performance Test (15 days)**		**Date/Time:**		**Start:**		**Finish:**		
4.1	Completion of Water Quality Testing and Analysis								
4.2									

Inspection Codes			**Responsibility Codes**			
H: Hold Point	M: Monitor	D: Dimension Inspection	PM: Project Manager	PE: Process Engineer	EE: Electrical Engineer/ Supervisor	RPEQ: Registered Professional Engineer of QLD
W: Witness	V: Visual Inspection	R: Review & Approve Documentation	CM: Commissioning Engineer	ME: Mechanical Engineer/ Supervisor	CE: Control System Engineer / Supervisor	C: Client / Superintendent

Appendix C. Defects Register Template

DEFECTS REGISTER

Project Name:	
Prepared By:	
Date:	

Last Reviewed By:	
Date:	

Item #	Project stage	Plant Area	Defect Category	Description	Priority	Raised by	Raised Date	Comment	Responsible	Expected Completion Date	Completion Date	Client Sign Off and Date	Consolidated Comments
1													
2													
3													
4													
5													

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