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1 Summary

The chance for business success is significantly enhanced by preparing the end-user environment as an integral part of the Project. Operations Readiness is defined by the Operations Readiness Plan, which describes the various necessary steps and processes, and identifies the individuals, associated tasks, how and when within the overall Owner's Team and the Snowy Hydro Team to successfully prepare and operate the Facilities.

1.1 Introduction

One of the 'biggest challenges in the design and construction of new infrastructure facilities is the transition or handover from the Project to operations'.[1] At handover, there is a profound shift in structure, skills and culture from an executing organisation (***the Project***) to an operating organisation (***Snowy Hydro Operations***).[2]

A successful transition depends on incorporating operating expectations early in the design and construction process. These expectations need to be planned in detail and incorporated early in the Operations Readiness process.

The transition from execution to operations is potentially where high-value leakage occurs. Some case studies have found up to 30% of the initial expected value can be lost.[3] The relatively short duration of the ramp-up period in the overall Project lifecycle highlights how critical the handover management phase is in retaining as much of the value of the Project as planned.

Operations Readiness provides assurance that this element of the Project has been identified and defined, with system and supporting documentation required to deliver the Project on schedule, within budget, and with due consideration for health, safety, and the environment.

Operations Readiness can be broken down into:

1. Design input - Providing input to design, and safeguarding the implementation;
2. Planning - Developing an Operations Management plan in preparation for start-up and commissioning, covering the operations, maintenance, and integrity management;
3. Commissioning support - Providing Operations input and coordination for the commissioning and start-up leading to acceptance by Snowy Hydro Business-as-Usual (***BAU***) Operations (***Operations***); and
4. Securing the operating budget, organisational design, staff training and competency, materials and logistics provision, and other operational requirements needed to operate the Facilities.

[1] (Zerjav et al. 2015).
[2] Zerjav et al above, p.53.
[3] (DiStefano, Goetz, and Storino 2012).

To achieve Operations Readiness objectives, the Operations Readiness Team will consist of personnel with extensive experience in operations, maintenance, and asset management.

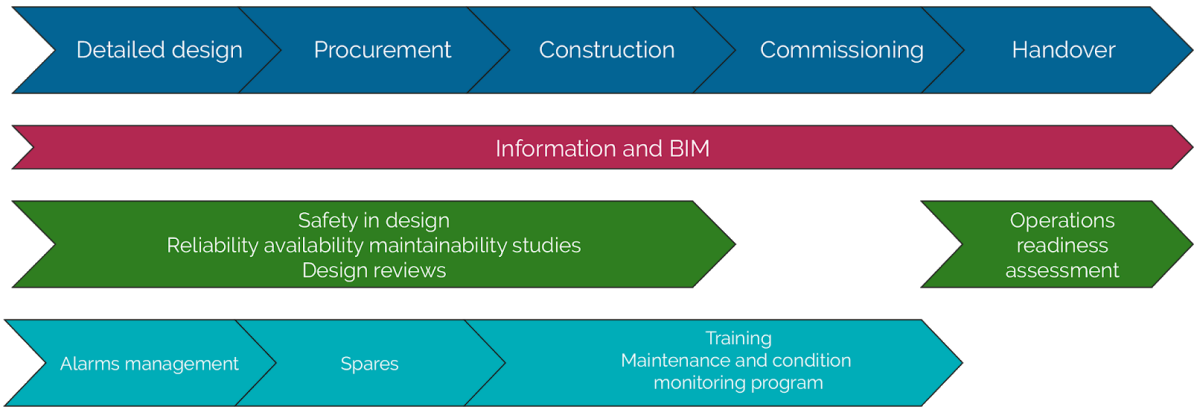

Figure 1: Project lifecycle

Reliability, risk and safety will be fundamental to the design process to eliminate major hazard risks and minimise the lifecycle cost. The Contractors will conduct the appropriate investigations and include in their design a 'safety-in-design' process to address the legal and organisational requirements. These design requirements, supporting systems and how the Contractors and the Owner's Team will interface and deliver the Facilities as a working asset are detailed below.

The development and implementation of the commissioning processes and systems to validate full operation of the Facilities are also described. The protocols for handover are set out with appropriate authorities, responsibilities and expectations.

The approach taken to commissioning is outlined in the Employer's Requirements within the Civil and Electrical / Mechanical (***E&M***) Contracts (see *Chapter Three - Contracts and legal* for structure). The Employer's Requirements set out Snowy Hydro's expectations of the Contractors for commissioning and handover. The approach will be further detailed by the Contractors when developing their design and construction methodology. The Contractors' design responsibilities are not included here but can be found in *Chapter Fifteen - Contractor's execution approach*. Interface responsibilities are outlined in *Chapter Fourteen - Project controls*.

1.2 Activities undertaken

Recent Snowy Hydro internal experience from a number of smaller projects highlighted the importance of ensuring the Facilities are operationally ready when the Project is ready for handover. Snowy Hydro's Operations Readiness approach incorporates the key lessons learnt from those projects. Key personnel in the operations and asset management teams helped contribute to the Employer's Requirements, which set out the Operational Readiness requirements for the Project.

1.3 Key interfaces between Operations and Project

Consultation with Operations, their engagement and input to the Project is necessary and important, but must be carefully managed through agreed processes. The key interface points are:

1. Change management process;
2. Operational readiness assessment - see the *Operational readiness assessment* section of the supporting chapter;
3. Pre-commissioning & commissioning - see the *Commissioning* section; and
4. Design reviews.

1.4 Design

The Contractors must ensure that the engineering design is safe, reliable, available, maintainable and operable through various studies and design reviews. See *Supporting Chapter Fifteen - Contractor's execution approach* for further details.

1.5 Operations and maintenance requirements

Snowy Hydro's operational data, systems and processes will need to be created, updated or modified to successfully incorporate the new Facilities as a working asset. This includes the development of the maintenance program and condition monitoring plans, alarms, critical and routine spares, detailed training programs and operations and maintenance manuals.

Snowy Hydro must update multiple operating systems to incorporate the Facilities, including:

1. Enterprise Resource Planning (**ERP**);
2. Asset Performance Management (**APM**);
3. SCADA Generation Management System (***GMS***);
4. Outage Management System (***OMS***);
5. Historian (historical real-time monitoring data); and
6. Various market and bidding systems.

The Contractors will:

1. Define the asset hierarchy and classification of all equipment in the Project and will provide the information in a format suitable for integration with Snowy Hydro systems;
2. Develop a Reliability, Availability and Maintainability (***RAM***)-based maintenance strategy and program to integrate with Snowy Hydro systems;
3. Undertake Hazard and Operability (***HAZOP***) and maintenance strategy work to determine the condition monitoring requirements for non-generation assets;

4. Design alarms to conform to the requirements of Snowy Hydro's alarm philosophy and IEC 62682;[4]
5. Identify and recommend necessary spares (including insurance and capital spares) for commissioning, warranty period and ongoing operation;
6. Provide a comprehensive inventory of all spares either supplied or recommended for ongoing operation, including an appropriate storage and preservation regime;
7. Provide suitable operation and maintenance manuals for the Facilities;
8. Provide the overall SCADA/GMS requirements for the Facilities;
9. Provide all information deliverables to Snowy Hydro (including from all Subcontractors) in alignment with Snowy Hydro systems and procedures; and
10. Provide a comprehensive Building Information Model (***BIM***).

1.6 Commissioning

Commissioning and Start-up is defined as the transitional phase between facility construction completion and commercial operations. It encompasses all activities bridging these two phases, including systems turnover, checkout of systems, commissioning of systems and performance testing. The approach taken to commissioning is outlined in the Employer's Requirements and will be further detailed by the Contractors when developing their design and construction methodology.

The Contractors are responsible for providing assets compliant to requirements, as demonstrated through testing. Contractors will provide detailed test and commissioning plans and all necessary equipment and personnel required to carry out the tests. Snowy Hydro, the Australian Energy Market Operator (***AEMO***) and the Network Service Providers (***NSP***) will be present to observe and participate in tests at site as necessary.

The commissioning sequence will depend on the installation and energisation sequence developed by the Contractors in alignment with sections of Works outlined in the Contract. The Works will be commissioned and taken over progressively.

The Works will be gated by a sequence of tests (preliminary, commissioning, reliability and performance) defining the main stages of acceptance through performance, reliability and safety.

1.7 Operational handover

Transition and handover activities will commence ~18 months prior to the completion of the Project. The Project will not be operationally taken over until the Whole of Works is complete. As each individual Section of Works is complete. the Contractor will maintain control and risk of the individual Sections including maintenance and physical operations.

[4] (International Electrotechnical Commission 2014).

The Owner's Team is expected to continue to operate and lead the Project until formal handover is made and the Facilities are under the full control of Snowy Hydro BAU operations.

Snowy Hydro may commercially operate and bid individual generating units into the electricity market after Completion, while the Contractor continues to maintain the Facilities until Snowy Hydro is best placed to assume control and risk of the Site.

A Handover Plan will set out responsibilities for handover and documents to be supplied. As each section is completed and handed over or closed-out, the Contractors will deliver the associated information to Snowy Hydro, along with the necessary updates to the BIM model, Geographic Information System (***GIS***) model or other IM models in use on the Project.

The Contractors will facilitate progressive delivery of manufacturing data for major equipment items to inform operations readiness planning.

An independent entity will undertake an Operations Readiness Assessment at a suitable time. This assessment will:

1. Verify completeness of required documentation;
2. Outline criteria for unit acceptance; and
3. Review readiness of internal processes, procedures and documentation.

The Contractors will train nominated operations personnel to operate and maintain the Facilities. Personnel being trained will join the Contractors' testing and commissioning teams.

A Defects Notification Period (***DNP***) (the period for notifying Defects and/or damage in the Works) will apply for up to two years from Completion of the Works. The Owner's Team will develop a clear process for management of defects during the DNP.

At Project closure, the Contractors will produce a closeout report. The Owner's Team will ensure that all Project-related matters have been closed-out, including:

1. Documentation;
2. Contracts;
3. Residual materials and construction equipment;
4. Environmental works; and
5. Financial close.

1.8 Staffing of facilities

The Operations team will take over the Whole of Works once the Project is closed-out and the Facilities are handed over to Snowy Hydro Operations.

While the (pre-)commissioning and handover stages require a sizeable contractor workforce on-site, the operations team forming part of the Snowy Hydro Operations organisation will be comparatively small (~8 - 10 people). This staffing level is consistent with the Snowy Hydro Operations philosophy of stations being unstaffed, with the exception of required attendance by maintenance and

operations personnel. This will be primarily during normal business hours and for on-call response.

The operations team will operate as per Snowy Hydro Operations working conditions, arrangements, and under current workplace agreements.

2 Activities undertaken

Key personnel in the operations and asset management teams helped contribute to the Operational Readiness requirements for the Project.

3 Key interfaces between Operations and Project

It is important to clarify how roles and responsibilities for Operations Readiness are apportioned between Snowy Hydro Operations, the Owner's Team, and the Contractors executing the Works.

While these activities will require a high level of engagement, coordination and collaboration in practice:

1. Snowy Hydro Operations is responsible for identifying and communicating the standards, conventions, and expectations for Operations Readiness to the Project;
2. The Owner's Team is responsible for incorporating the standards, conventions, and expectations in contract specifications (i.e. the Owner's Requirements), and undertaking any Operations Readiness work not in the Contractor's' scope;
3. The Contractors are responsible for complying with Snowy Hydro's Requirements;
4. The Owner's Team is responsible for ensuring that the agreed Operations Readiness deliverables are delivered to Snowy Hydro Operations; and
5. Snowy Hydro Operations is responsible for identifying, planning and undertaking necessary changes to Snowy Hydro operating systems, processes, standards, and controls as a result of any Project outcomes.

Snowy Hydro's Requirements must detail the operating requirements for the Contractors (through design, construction, documentation or otherwise) along with protocols for development and potential changes during the Project.

Regardless of who executes the work, the Owner's Team retains the responsibility to ensure the requirements are met.

During the execution phase of the project, there are key interface points between Snowy Hydro Operations and the Owner's Team. Uncontrolled changes directed by operations pose a material interface risk for projects. While the engagement and input of Snowy Hydro Operations personnel in the Project is necessary and valued, it must be planned and coordinated by the Owner's Team through agreed processes and at defined interface points to ensure the smooth running of the Project and avoid claims of interference by the Contractors.

Information exchange, direction or change requests from Operations must be mediated through the Owner's Team. The key interface points are:

1. Change management process;
2. Operational readiness assessment - see the *Operational readiness assessment* section;
3. Pre-commissioning & commissioning - see the *Commissioning* section; and
4. Design reviews.

During the Project's design phase, Snowy Hydro Operations will be consulted on design decisions that influence how the Facilities will be maintained and operated in accordance with the design review meetings.

4 Design

One of the key aspects of ensuring the Project is operationally ready is assuring that the engineering design is safe, reliable, available, maintainable and operable. The Contractors will be responsible for the design work and submit a Design Management Plan to the Employer for approval. See *Chapter Fifteen - Contractor's execution approach* for further details.

5 Operations and Maintenance Requirements

5.1 General

The Owner's Team is expected to execute the required changes to the following systems and processes to ensure the Project is operationally ready and to successfully incorporate the new Facilities as a working asset.

Note that the systems listed below are current Snowy Hydro systems that may be superseded and replaced in the course of the Project, but are listed here to illustrate the general requirements.

5.2 Operational systems

The following list is a summary of the major operational and asset management systems that the Project is required to align with and integrate into. These requirements are set out in the Employer's Requirements (see *Supporting Chapter Fifteen*).

The business processes and data that are established in these systems are interdependent and interlinked:

1. **ERP -** The new assets will be fully integrated into the Enterprise Resource Planning system, Ellipse. Ellipse is the master for the Equipment Register and all costs and financial transactions against the assets;
2. **APM -** The new assets will be fully integrated into the APM system, Meridium. Meridium is the master for the maintenance and condition monitoring system and will be used to fully digitise the maintenance data collection process;

3. **SCADA Generation Management System** - the new assets will be fully integrated into the OSII SCADA system in accordance with the Employer's Requirements;
4. **Outage Management System (*OMS*)** - all affected plant will be incorporated into the appropriate Outage Management System; and
5. **Historian** - all available analogue and status points will be incorporated into Snowy Hydro's current corporate historian, PI, and also the SCADA historian, Chronus, in accordance with the Employer's Requirements.

Figure 2: Systems

5.3 Operational Processes

5.3.1 Asset functional breakdown and criticality analysis

The Contractors will define the asset hierarchy and classification of all equipment in the Project. This will be carried out in collaboration with Snowy Hydro using the Kraftwerk-Kennzeichen-System Identification System for Power Plants (***KKS***) system.

The results of the process will include a register of the physical assets which define the plant structured number, taxonomy and other classification data of the

equipment. The Contractors are required to provide the information in a format that is suitable for integration with Snowy Hydro's ERP systems.

5.3.2 Maintenance Program

Maintenance will be based on reliability and risk principles to achieve a prescriptive and condition-based outcome, rather than calendar fixed-time and manual-based inspections.

The Contractors will develop the maintenance program. For all safety and operational critical assets the maintenance program will be primarily be based on the RAM study to be undertaken by the Contractors during the design phase (see *Supporting Chapter Fifteen*). It will use reliability and risk principles to optimise station availability, reduce failure risk and life-cycle costs.

The maintenance strategy will also be used to determine the maintenance spares.

The maintenance program will integrate with Snowy Hydro's ERP and APM Systems.

5.3.3 Condition Monitoring

The in-development ISO standard 19283:2018 will be used as the basis to determine the condition monitoring requirements for the generation plant.[5]

HAZOP and maintenance strategy work will be used to determine the condition monitoring requirements for non-generation assets.

Condition monitoring requirements address:

1. Condition data;
2. Condition data collection;
3. Vibration;
4. Thermography;
5. Oil sampling;
6. Online electrical machine condition monitoring; and
7. Alarms.

5.3.4 Alarms

Alarms will conform to the requirements of Snowy Hydro's alarm philosophy and the requirements of IEC 62682.[6] After all HAZOPs, failure mode, effects and criticality analysis and condition monitoring plans are complete and all other alarm requirements have been compiled, an Alarm Rationalisation process will be completed. The key output is a complete up to date set of alarm information for the Snowy Mountain Control Centre (***SMCC***) and relevant and engineering and operations personnel.

[5] (International Organization for Standardization 2018).
[6] (International Electrotechnical Commission 2014).

5.3.5 Spares

Spares İdentification

It is important to identify insurance and capital spares that must always be available in stock. Insurance spares are intended to replace a failed identical part in operating equipment whose penalty cost for downtime is very high, ie an insurance against high-cost failures. Capital spares are vital spares for critical equipment. The stock-out and unit cost for such spares may be very high. The number of items consumed during the lifetime of the equipment may be very limited in number. A spare may be both insurance and capital. Insurance and/or capital spares will be identified from the RAM study and supplied to meet the overall facility performance requirements for the design life of the normal operation. Insurance spares are recommended by the Contractor.

Maintenance spares and consumables will be based on the maintenance program.

Spares Management

1. Contractors will recommend spare parts that are in their opinion required to meet the overall Project availability and reliability metrics for the required period.
2. The Contractors will prepare and maintain a comprehensive inventory and database of all spare parts provided under the Contract to record details of spare parts delivery, storage, and handover to Snowy Hydro. The spare parts database will enable accurate tracking and tracing of each spare part to their storage location. The spare parts database will be handed over to Snowy Hydro in a format compatible with Snowy Hydro's ERP systems. This will also include information required for the ongoing service, maintenance and supply contracts after handover.
3. Spare parts to be held will be supplied with a procedure for storage and suitable protection that ensures their operational integrity. The need for spare parts maintenance will be included in the RAM study and maintenance program requirements.

5.3.6 Operation and maintenance manuals

The Contractors will provide operation and maintenance manuals, the scope of which will be suitable for fully informing Snowy Hydro on all aspects of the structures and erection, operation and maintenance of the Facilities.

The operation and maintenance manuals will be subdivided on a structure and plant feature basis in accordance with Snowy Hydro's KKS convention, The instruction content for each of the operation and maintenance manuals will comprise the following separate sections:

1. **Contents** - a brief descriptive introduction to the structure, component, plant, equipment or system;
2. **Preface** - the spare part location;

3. **Functional description** - a comprehensive functional description, including a brief statement of the history of the design, manufacture and erection;
4. **Specifications** - all performance data, ratings and charts;
5. **Operating instructions** - to be used by the SMCC controller and coordinators and regional operation personnel. They will provide the instructions, which address operational conditions and demands taking account of hydraulic and plant performance;
6. **Isolation and restoration** - comprehensive information concerning isolation and restoration procedures;
7. **Inspection and diagnosis maintenance instructions** - describe and illustrate the procedures for dismantling, diagnosing, adjusting and reassembly; and
8. **Life cycle strategy** - a table summary of forecast operational and capital expenditure for the entire lifecycle.

5.3.7 SCADA/Generation Management System

The Contractor will provide the overall SCADA/GMS requirements for the Facilities. This will include:

1. Integration of the Project into Snowy Hydro's SCADA/GMS system;
2. Provision of Station, Unit and GIS Remote Terminal Units in the power station;
3. Provision of Frequency Control Ancillary Services recording equipment in the power station; and
4. Provision of SCADA terminals/workstations in the power station.

Integration of the Project into Snowy Hydro's SCADA/GMS facilities will include:

1. Configuration of all project assets data into Snowy Hydro's central SCADA system Database;
2. Configuration of all operation and maintenance data and metadata into Snowy Hydro's central SCADA system database;
3. Configuration display screens for all project assets; and
4. Integration of the Project into the SCADA GMS.

5.3.8 Information Management and BIM

Objectives

Snowy Hydro's intent is to build a modern power station, fully ready for future asset optimisation and enabling 'industry 4.0' and 'Digital Twin' philosophies.[7] [8] A key aspect of this is ensuring that all information created throughout the Project is structured and integrated with the BIM systems adopted by the Contractors.

Information Management

The Contractors will provide all information deliverables to Snowy Hydro, including from all Subcontractors. This information will align with the Snowy

[7] The name given to the current trend of automation and data exchange in manufacturing technologies. https://www.industry.gov.au/funding-and-incentives/manufacturing/industry-40
[8] A digital replica of physical assets (physical twin), processes, people, places, systems and devices.

Hydro standards and procedures as documented in Volume 4 of the Employer's Requirements.

Key documentation to be submitted to Snowy Hydro will include:

1. Final design reports;
2. Design calculations and notes;
3. Drawings/BIM records;
4. Manuals;
5. Test plans and records;
6. Photo and video records; and
7. Commissioning records;

Building information management

The adoption of BIM and an integrated information management system is important to Snowy Hydro to achieve a number of strategic priorities and objectives, in particular, a 'digital twin' of the entire Project for asset visualisation and enhanced operations and maintenance capabilities.

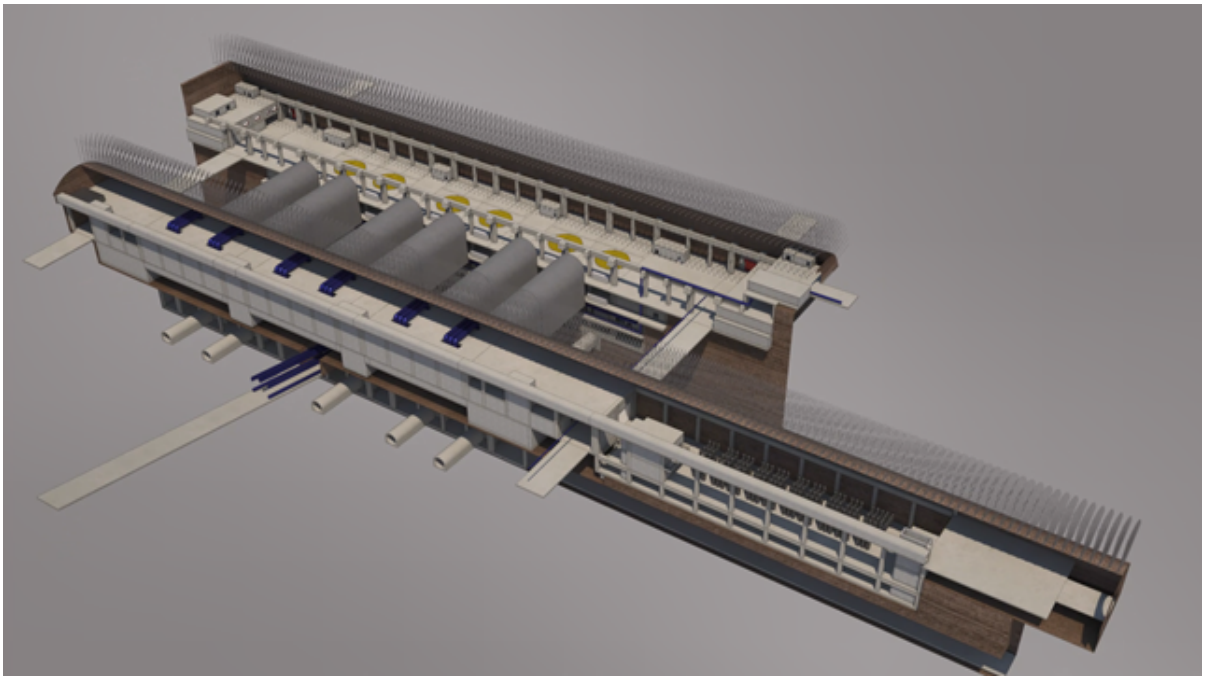

Figure 3: 3D model of Power Station, Transformer Hall and Gas-Insulated Switchgear Hall, including E&M plant

Figure 4: Surface View of Talbingo intake and intake gate structure, an example of how the BIM system could look at the end of the Project

The Building Information Model supplied by the Contractors at the end of the Project will include all geometry and physical characteristics needed to describe the entire Project; for example, all live operational information including all physical Mechanical, Civil and Electrical elements.

5.3.9 Market systems

To prepare for commercial operation of the Project, there are a significant number of market systems that will require updating.

6 Commissioning

6.1 Overview

This section describes the commissioning processes and systems that will be developed and implemented to validate the full operation of the Facilities. The approach taken to commissioning is outlined in the Employer's Requirements and will be further detailed by the Contractors when developing their design and construction methodology.

The Contractors are responsible for providing assets fully compliant with the Employer's Requirements. To achieve this, the Works will have to pass tests for acceptance, commissioning, reliability and performance. Snowy Hydro's requirements identified some of these, but the Contractors will be expected to provide plans that will fully detail the tests and requirements needing to be met. The Contractors will provide all equipment and personnel required to carry out the tests at Site, including the provision, installation and removal of all test

instruments, the connection and disconnection of plant items and obtaining of all records.

Snowy Hydro will observe and participate in the tests at Site and invite the AEMO and the NSPs to be present to observe and participate in tests at the site as appropriate.

The commissioning sequence will depend on the installation and energisation sequence developed by the Contractors in alignment with Sections of Works outlined in the Contract.

6.2 Sections of Works

6.2.1 Preparing the Sections

For a Section of Works, the Contractor will take the following steps in preparing the Section for Commercial operation by Snowy Hydro Operations:

1. Tests on Completion and related inspections completed;
2. All training of Snowy Hydro's personnel completed for this Section of the Works;
3. Handover to Snowy Hydro of all spare parts and maintenance equipment for this Section of the Works;
4. Submission of all information deliverables as outlined in Volume 4 of the Employer's Requirements, BIM and Operations and Maintenance (***O&M***) manuals for this Section of the Works; and
5. Taking over of Section.

6.2.2 E&M and Civil Works Sections

The E&M and Civil Works will be commissioned and taken over progressively in the following sequence.

1. Cable Yard;
2. Intake Structures;
3. Power Waterway;
4. Gas-Insulated Switchgear Switching Station;
5. Generating Unit No. 1;
6. Generating Unit No. 2;
7. Generating Unit No. 3;
8. Generating Unit No. 4;
9. Generating Unit No. 5;
10. Generating Unit No. 6;
11. Power Station; and
12. Whole of Works.

6.3 Submission of programs, plans and procedures

The Contractor will prepare and submit to Snowy Hydro comprehensive testing and commissioning plans and procedures and a proposed overall program for Site testing and commissioning activities for each Component of the Works.

The testing and commissioning plans and procedures will detail the following:

1. Method of testing;
2. Equipment to be used for testing;
3. Acceptance criteria;
4. Parameters or guarantees to be established; and
5. The sequence of tests to be performed.

6.4 Scope of Site tests

6.4.1 General

The Works will be gated by a sequence of tests (preliminary, commissioning, reliability and performance) defining the main stages of acceptance through performance, reliability and safety. The Contractor will successfully test all plant and equipment to the required level of completion. Completion is defined by the successful demonstration of commissioning, performance and reliability tests.

6.4.2 Site preliminary tests

Preliminary tests will be conducted on all plant, equipment, systems and facilities, and will comprehensively demonstrate mechanical Completion and readiness for the commencement of the tests on Completion.

6.4.3 Site commissioning tests

Site commissioning tests, including all necessary functional and performance tests, will be conducted by the Contractor. The Contractor will be responsible for the coordination and performance of commissioning activities with AEMO and the NSPs for all interface systems and equipment at and across the connection point to the external power system network.

The Contractor will be fully responsible for meeting AEMO and NSP connection requirements such as National Electricity Rules Chapter 5.8, all Generator Performance Standards and R2 testing including the provision of all test reports, certifications and test data in a format acceptable to Snowy Hydro, AEMO and the NSP.

The Contractor will allow representatives of Snowy Hydro to be involved in the commissioning as embedded members of the commissioning team.

6.4.4 Site reliability tests

The reliability test period for each Section of the Works will commence when the Section of the Works has passed all other prerequisite commissioning tests and performance tests.

Should any failure or interruption occur in the operation of the Section of the Works due to faulty design, materials or workmanship under the Contract, the related Reliability Test Period will re-commence after the Contractor has remedied the cause of the Defect. The onus of proving that any Defect is due to causes other than faulty design, materials or workmanship will lie with the Contractor.

6.4.5 Performance tests

Performance tests will be carried out after successful Completion of the Site reliability tests as a part of tests after Completion.

6.4.6 Inspection by Snowy Hydro

Before taking over, at the request of Snowy Hydro the Contractor may open up or dismantle any part of the Works for inspection by Snowy Hydro.

After taking over and prior to the expiration of the Defect Notification Period and before issue of the Final Certificate, Snowy Hydro may open up or dismantle any part of the Works for inspection. If so notified by Snowy Hydro, such opening-up or dismantling for inspection may be witnessed or carried out by the Contractor if so requested in writing by the Contractor.

7 Operational handover

7.1 Handover Philosophy

Project operations will not be taken over until the Whole of Works is complete. As each individual Section of Works is completed, the Contractor will maintain control and mitigate the risks of the individual Sections in accordance with a Management Services Operating Protocol. The protocol will be defined by the Contractor and approved by Snowy Hydro prior to completion of a particular Section. The protocol will allow Snowy Hydro to commercially operate and bid a generating unit into the electricity market after Completion while allowing the unit to be maintained by the expertise of the Contractor until Snowy Hydro is best placed to assume control and risk of the Site at the end of the Project.

7.2 Handover planning

A key aspect of planning the handover process (as shown in Figure 5) is agreeing on the documentation requirements and integrating them into Project schedules and milestones in the form of a Handover Plan. The purpose of a Handover Plan is to provide confidence to Operations that the Facilities are adequately prepared for Operations Readiness. The Handover Plan will be the responsibility of the

Contractors with input from the Owner's Team. It also serves as a planning document for the Project Team, to list the certification and documentation required to prove Operations Readiness, and also the required documents for final Asset Handover.

The Handover Plan will identify responsible parties for agreement between the Owner's Team, Contractors, Operations Representatives, and the Asset Manager. The Operations Representatives will assess the impact of the new Asset (or element of the Facilities) on processes, people, equipment, and systems. The Operations Representatives will review and provide comment on the plan, prior to the pre-commissioning stage of the Asset (or element of the Facilities).

Where multiple elements are to be handed over at different times, a single Handover Plan may be used; however, it must clearly show the separate elements, and where appropriate, the separate documents. Following pre-commissioning, items identified in the Handover Plan as requiring action (punch list items) will be included on the Project schedule (or open item list) by the Project Manager.

The Handover Plan will contain the following:

1. The appropriate content of the Operations Readiness Document list; and
2. The appropriate documents for Asset Handover.

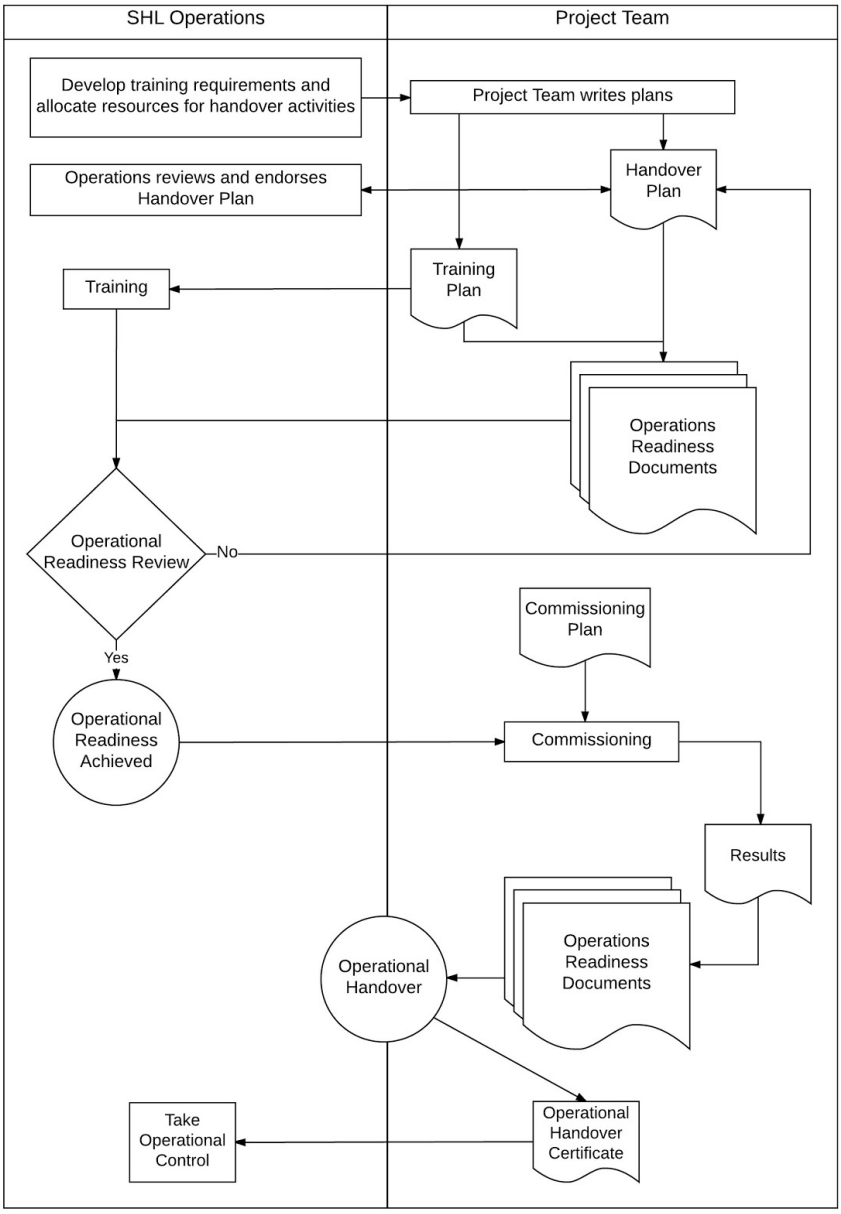

Figure 5: Handover process

7.3 Operations Readiness Assessment

The Operations Readiness Assessment process provides assurance that plant personnel, equipment, and all systems and processes are prepared for start-up, commissioning and asset operation. Operations Readiness assurance is essential to project success. The methodology is outlined below.

An independent entity, to be nominated by the Operations Readiness team, will conduct the Operations Readiness Assessment, prior to completion of a relevant section of the Works, to ensure impartiality and objectivity in the assessment. It will consist of:

1. A review of the completeness of the required documentation. It is a review of the internal processes, procedures, and documentation needed from an operational perspective once the plant is handed over; and
2. Internal processes and procedures including training for supervisors, operators, and support staff, environmental compliance procedures, documentation management processes and protocols.

Operations Readiness is achieved upon successful completion of this assessment.

The primary objective of Operations Readiness is to ensure the plant is turned over in the best possible operational condition, and the delivered plant conforms with all Snowy Hydro specifications and the terms of contract(s).

The Operations Readiness Assessment is also designed to clearly outline the criteria for unit acceptance and minimise the number of punch list items when the unit is handed over for plant operations. In addition to the specification of unit acceptance criteria, there must be a clear process for management of deficiencies and also for handling any as-built changes to drawings, whether system flow charts, piping and instrumentation diagrams, or electrical drawings.

Achievement of Operations Readiness must occur prior to the energisation of any asset (or element of the project) for commissioning or operational use.

Operations Readiness of the asset or an element of the asset confirms:

1. It is safe to be energised and/or restarted and can be operated safely within the boundaries of authorisation;
2. It is physically ready to be energised or restarted;
3. It meets the approved design requirements;
4. Operations has adequate budget and resources to operate and maintain the asset;
5. All pre-commissioning has been completed;
6. Operations personnel have adequate training to operate and maintain the asset;
7. It will be operated in compliance with relevant legislation and safety management programmes; and
8. Documentation is provided as required by the handover plan and is adequate to prove Operations Readiness in accordance with relevant legislation, regulations, codes of practice, and relevant documents.

Once Operations Readiness is achieved, Operations will assume control of the asset (or element of the Project), by accepting an Operational Handover Certificate. The Project or Commissioning Manager will provide the certificate to the Operations Representative.

After control of the asset (or element of the Facilities) is assumed by Operations, access to the asset (or component) will only be through access permits as granted by Operations.

7.4 Operations and Maintenance Training

7.4.1 Training requirements and purpose

The Contractors will provide comprehensive and effective O&M training for Snowy Hydro personnel who are nominated and intended by Snowy Hydro to manage, operate and maintain the Facilities after taking over. The O&M training will be designed and implemented to enable the nominated personnel to effectively, safely and reliably perform all necessary O&M functions to ensure the reliability and performance of the Project for the duration of the required service life.

7.4.2 Structure of the training

The Contractors will provide three basic types of training courses as follows:

1. Operations and maintenance management personnel training;
2. Operator personnel training; and
3. Maintenance personnel training.

In addition to structured classroom training, the Contractors will provide Snowy Hydro's nominated personnel with appropriate on-the-job training associated with the following activities:

1. Manufacturing of plant, equipment and systems during factory assembly and testing;
2. The construction of civil works and particularly instrumentation and monitoring activities;
3. Erection of plant, equipment and systems on-site;
4. Testing and commissioning of plant, equipment and systems on-site; and
5. Training and authorisation in the operation of mobile plant.

The Contractors will include Employer's Personnel nominated for training in the Contractors' teams responsible for testing, commissioning, start-up and trial operation of the plant, and will allow Snowy Hydro's Personnel nominated for training to follow the associated activities.

Snowy Hydro's Personnel nominated for training will not be required to undertake any construction or installation activities. Such activities will be performed exclusively by and under the full responsibility of the Contractors.

The Commissioning Manager's in conjunction with the Contractors must ensure sufficient skilled and trained Snowy employees are engaged in the commissioning and handover process as specified in the commissioning plan.

7.5 Handover, knowledge transfer and transition phasing

The transition and handover activities will commence ~18 months prior to the completion of the Project. The Facilities will be at the closing stages of the E&M

works and the Owner's Team will onboard the new Operations Team that will be responsible for the successful maintenance and operation of the new Facilities.

The entire transition from the construction workforce to a small operations team will require a period of change management to support the team(s) with (process) changes. This support will enable the effectiveness of the Facilities coming online and being integrated into the Snowy Hydro operating business.

The Owner's Team is expected to continue to operate and lead the Project until formal handover is made and the Facilities are under the full control of Snowy Hydro BAU operations.

7.6 Warranties and defect liability

The DNP as currently stipulated in the Contract is the period for notifying Defects and/or damage in the Works, which is calculated from the Date of Completion of the Works or any one Section. The DNP is greater of the period following:

1. 48 months from Completion of any one Section, or
2. 2 years from Completion of the Works.

The Project Team will develop a clear process for management of warranties addressing all contractual defects and will identify the resources and management processes to be utilised in the management of the DNP.

The DNP may be managed by Snowy Hydro or a third party. Operations will plan to inspect assets (or elements of the asset) during the DNP, particularly those susceptible to early wear-out, or stressed by occasional events (eg, usage peaks, etc.).

6.7 Closeout and handover of information

Snowy Hydro intends to adopt a model of progressive handover and closeout to avoid the inevitable tail-end challenges of incomplete documentation and unresolved punch list items. As each separable portion is completed and handed over or closed-out, the Contractors will deliver the associated information to Snowy Hydro, along with the necessary updates to the BIM model, GIS model or other IM models in use on the Project.

The Contractors will facilitate progressive delivery of manufacturing data for major equipment items to inform operations readiness planning.

Project closure incorporates a number of activities to ensure that all project activities and records are complete and retained as appropriate. The Contractors will develop a Project closeout plan. The plan will include procedures and controls to ensure that at the Completion Date:

1. **Documentation** - all Contractor Documents are complete and have been provided to Snowy Hydro as and when required;
2. **Works Contracts** - all Works contracts and orders have been closed-out and all claims have been resolved;

3. **Subcontracts** - all subcontracts, leases, hire arrangements or other commitments that the Contractors have entered into in respect of the Works have been terminated, novated to Snowy Hydro or are otherwise no longer to the account of Snowy Hydro;
4. **Residual materials and construction equipment** - the ownership of all unused construction materials remaining on-site has been determined, and all materials have been removed by the Contractors, acquired by Snowy Hydro and put into inventory or disposed of in accordance with Snowy Hydro's asset disposal procedure;
5. **Environmental works** - all necessary rehabilitation and remedial works have been completed and the Site has been restored to the agreed condition specified in the Environmental Management Plan. Any ongoing monitoring arrangements have been established; and
6. **Financial close** - all Project accounts have been closed-out and a final account for the Project has been prepared and accepted by Snowy Hydro.

The Contractors will produce a Closeout Report.

The Contractors will ensure all closeout and archiving activities are carried out before the end of the Project and are conducted progressively as each discipline completes their Project functions.

8 Staffing of Facilities

The Operations team will take over the Whole of Works once the Project is closed-out and the Facilities are handed over to Snowy Hydro Operations.

While the (pre-)commissioning and handover stages require a sizeable contractor workforce on-site, the operations team forming part of the Snowy Hydro Operations organisation will be comparatively small. This staffing level is consistent with the Snowy Hydro Operations philosophy of the station being unstaffed, with the exception of required attendance by maintenance and operations personnel. This will be primarily during normal business hours and for an on-call response.

The local team will operate as per Snowy Hydro Operations working conditions, arrangements, and under current workplace agreements. Any deviations will need to be approved by Operations management. There will be normal work patterns applied with on-call arrangements and coverage, similar to current operations staff (Monday to Friday pattern).

The recruitment of any required staff will be performed in accordance with established Snowy Hydro policies and procedures and will need to occur ~18 months prior to commissioning.

9 Definitions and abbreviations

AEMO	Australian Energy Market Operator
APM	Asset Performance Management

BAU	Business-as-Usual
BIM	Building Information Model
DNP	Defects Notification Period
E&M	Electrical / Mechanical
ERP	Enterprise Resource Planning
GIS	Geographic Information System
HAZOP	Hazard and Operability
NSP	Network Service Providers
O&M	Operations and Maintenance
RAM	Reliability, Availability and Maintainability
SMCC	Snowy Mountain Control Centre

10 Bibliography

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