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1 Summary

This chapter describes Snowy Hydro's approach to managing controls for the Project, including requirements on the Contractors, with an emphasis on Earned Value Management (***EVM***) principles.

1.1 Introduction

The Project Controls function centralises and analyses progress data from contractors and internal departments (such as Accounts Payable) to monitor, support and report on the management of status, risk, change, deliverables, and other information affecting Snowy 2.0 (the Project), within the Project's governance framework (see *Supporting Chapter Twenty - Governance*). Performance reports, change requests, escalated issues and risk, and information about outcomes flow up to the Project's governing body as a result of Project Controls.[1]

1.2 Scope and exclusions

The specific elements considered within the scope of Project Controls for the Project are:

[1] See (Project Management Institute 2016).

1. Activities undertaken;
2. Project controls principles;
3. Work Breakdown Structures (***WBS***);
4. Schedule;
5. Time-phased budget;
6. Performance measurement and reporting;
7. Management action;
8. Change management;
9. Supporting systems;
10. Commitments;
11. Project accounting;
12. Contract closeout;
13. Deliverables by phase; and
14. Risk.

See *Supporting Chapter Two - Procurement* for discussion of contract administration and the contractual treatment of claims (other than progress claims).

See *Supporting Chapter Four - Schedule, cost estimate and contingency* for the development of the Project cost estimate.

The link between risk and trend is only briefly described here. See *Supporting Chapter Seventeen - Risk management* for a detailed discussion of risk approach.

1.3 Activities undertaken

The Project requires a dedicated Project Controls function. Pre-Final Investment Decision (***FID***), objectives were identified and Earned Value (***EV***) adopted as the preferred approach. Pre-FID effort addressed fitness-for-purpose, systems, critical BAU interfaces, exploratory works requirements, capability, scalability and alignment.

1.4 Project controls principles

The EV management approach is based on the project management triangle of scope, time and cost and provides accurate tracking and forecasting of project performance and identifying potential variances.

Project controls concentrates on cost and schedule management and management of variance. The Project will follow general project management principles, especially Earned Value Performance Management (***EVPM***) as defined in *AS 4817-2006 Project performance measurement using Earned Value*.[2]

EVPM requires that project managers determine the work to be done, establish resource requirements, measure work and cost, report deviations from the plan, forecast completion date and cost, plan and implement corrective actions as required, and authorise changes.

[2] (Standards Australia 2016).

Contractors are expected to operate an Earned Value Management System (***EVMS***).

The primary focus of Project Controls is the tracking and management of the Project's cost and schedule and the analysis and mitigation of variance.

The project manager directs the work of the project team while Project Controls advises the team and the project manager of possible cost and schedule risks or variances and recovery plans as identified by the contractors.

Project controls interprets data from the contractors and generates the Project's cost and schedule status and variances with potential impacts and mitigations or recovery plans. Project management consumes the information generated and makes decisions for the Project.

1.5 Work Breakdown Structures

The Project's scope of work is divided into deliverable-oriented elements making up the WBS, agreed by the leadership team and assigned to the appropriate management levels via an Organisation Breakdown Structure (***OBS***) and a Responsibility Assignment Matrix (***RAM***).

The WBS established for pre-FID works will be superseded by a new structure that will address the Exploratory Works remaining at FID and main works.

Control accounts are defined by the intersection of the WBS and the OBS and are maintained by the project cost control function.

1.6 Schedule

The Owner's Team needs to understand and follow work progress and manage owner-controlled milestones. The baseline schedule will be developed following FID. The Contractors will develop detailed schedules. The schedule will be baselined and then managed against that baseline.

1.7 Time-phased budget

The Project baseline budget that will be used for ongoing cost and change management will be finalised after FID but before the commencement of any approved works. Project activities will have assigned budgets to an appropriate level of granularity for the activity to be managed. These budgets will be time-phased by period over the duration of the activity, or over the duration of the Project where activities are not yet planned in detail.

A contingency/management reserve budget will be established that is not assigned to any activity and will be drawn down on as needed.

1.8 Performance measurement and reporting

Each activity will have an assigned metric to monitor with the performance measurement set against a formalised baseline and planning parameters. The

baseline provides the reference against which progress is measured and reported. The measurement model to track individual scope elements will be selected from available methodologies suited to the Scope of Work.

For the EWR and the Main Works, quantities and job hours will be tracked along with contractor-supplied data.

Performance data is aggregated up through the WBS to allow a strategic view. Project Controls will provide a regular dashboard representation and reports of the aggregated data from each discipline.

The data is to be analysed (at least) monthly against the performance metrics by contractors and Project Controls and identify and verify variances. The forecast will need to be maintained for accurate EVM and effectively manage cash flow.

1.9 Management action

Through a series of potential options, Project management can take action over variances detected through Project Controls.

1.10 Change management

Management of scope and change is a critical element of project management. Scope changes detected through the trend program or Project Controls tools record the effect on the project cost and schedule from the baseline.

Change control procedures should ensure proper management notification and corrective action is taken to regain the project cost, scope and schedule.

Action on all change requests carried out through Change Orders (***CO***) must be deliberate, timely, and carried out without interfering disproportionately with project progress.

1.11 Supporting systems

The primary Project Controls suite of applications was selected from industry-standard tools and tested through 2018 on a standalone basis.

The current suite of systems is sufficient to address contract and risk management but may require further consideration during the evaluation and implementation of the EWR contract.

Project reporting/dashboards will be further investigated.

1.12 Commitments

Commitment tracks and covers the financial obligation documented by contracts, purchase orders or service order. For Project Controls, a commitment is an item with a forecast value, duration and associated contractor or supplier.

New contracts or contract variations must be committed based on an Executed Change (***EC***), supported by an approved Contract Change Order (***CCO***). The full

expected value of each purchase order, assignment or contract (to completion) should be carried as a commitment control.

Project controls will forecast planned commitments in alignment with the Schedule, and track actual commitments within the project cost management system as they are incurred.

1.13 Project accounting

Prior to each financial month-end closure within the Finance business unit, each Control Account Manager (***CAM***) will work with the Project accountant to compile the accruals for their responsible control accounts.

The Project is likely to fall within the scope of the NSW security of payment legislation with requirements reflected in the payment terms of the contracts and in contract administration procedures.

The Owner's Team must keep tight control over the contract and ensure that the payment cycle is managed efficiently.

The Owner's Team will be responsible for the development and maintenance of the Project cash flow forecast. The cash flow forecast will provide an estimate of the monthly commitment and expenditure forecasts for the project and will be based on the project schedule and progress information. Snowy Hydro will use the cash flow forecasts as a basis for management reporting and to make the necessary cash calls.

1.14 Contract close-out

On notification of a contract close-out, the contract commitment must be released from the Project Controls tools with residual funds returned to the parent account.

1.15 Deliverables by phase

The Project Controls function and supporting systems will be progressively implemented.

2 Activities undertaken

The Project requires a dedicated Project Controls function. Pre-FID, objectives were identified and EV adopted as the preferred approach. Pre-FID objectives addressed fitness-for-purpose, systems, critical BAU interfaces, exploratory works requirements, capability, scalability and alignment.

The activities required to deliver a quality Project Controls function concentrated on creating a solid process to identify requirements and objectives and establish the foundations for scalability and capability.

Snowy Hydro management decided a dedicated Project Controls function was needed to manage the Project due to its size and complexity. The Project

Controls objectives were identified leading to the functional specifications of the systems, processes, interfaces with BAU and flexible capability, which aligns with contractors' systems and plans. These objectives identified an EVMS as the most appropriate approach to monitor and manage the Project. The ten steps outlined within an EVMS fall broadly into two categories:

1. **Tracking the Project** - The elements are broken down into the work and organisational breakdown structures covering the who and what, the schedule and budget covering when and how much.
2. **Managing the Project** - Performance covers the analysis of the tracked metrics and trends with Management making decisions about the results leading into Change Management to address any variations.

Contractors will be required to develop their own Project Controls function in alignment with the Project to minimise conflicting data and systems while increasing efficiency and transparency.

2.1 Objectives

Snowy Hydro BAU has a mature Project Management Office (***PMO***) responsible for sustaining capital projects. However, Management considered the scale and complexity of the Project demanded a dedicated controls function.

Design and establishment of the Project Controls function began in early 2018. The objectives were to address:

1. **Fitness-for-purpose** - a solution which provided adequate control of pre-FID activity but was scalable for execution;
2. **Systems** - to implement and test the Information and Control Systems (***ICS***) applications required for execution;
3. **Critical BAU interfaces** - to identify, design and test critical BAU interfaces (both procedural and systemic);
4. **Exploratory works** - sufficient to control the EWR activity immediately after FID;
5. **Capability** - trained and capable Project Controls personnel available at execution;
6. **Scalability** - would scale to full execution scope with minimal rework;
7. **Alignment** - would be aligned with the execution contracting strategy.

These objectives are further detailed below.

2.2 Fitness-for-purpose

With the exception of field geotechnical work, most pre-FID expenditure was on professional services/consultants. Therefore the controls focus was on hours and reimbursable expenses, with limited need to manage quantities and materials.

During execution, there will be a much greater focus on measurement and value, particularly for the EWR contract and against the Geotechnical Baseline Report (***GBR***) in the main Civil Contract. See *Supporting Chapter Thirteen - Early and*

exploratory works for the scope of the EWR Contract and *Supporting Chapter Three - Contracts and legal* for further discussion of the operation of the GBR.

The WBS for Pre-FID was services-oriented, with limited consideration of the structure of the assets to be constructed in execution. A new WBS will need to be implemented, first for Exploratory Works and then for the Main Works (though the ex-works WBS will be a subset of the main works WBS). See *Supporting Chapter Four* for the structure of the execution WBS on which the Project Estimate has been based.

2.3 Systems

See the *Supporting systems* section below.

2.4 Exploratory works

2.4.1 Cost

Formal cost control has been running since mid-2018. Weekly and monthly reporting are considered to give a reliable rear-view of project cost status, with forecasting and variance analysis are progressively being implemented. At least two whole-of-budget re-forecasts were undertaken prior to FID.

While EV is not being captured, a process around month-end accruals is being developed, providing a detailed and calculated provision for accruals, and giving a higher degree of integrity and accuracy of month-end figures.

A basic, security of payment legislation-compliant, progress claim, invoice and payment process has been designed.

A period of implementation is expected to be necessary with the EWR contractor, with additional control and progress reporting information to be configured.

2.4.2 Schedule

No schedule information was used in cost management other than high-level time-phased information for the control accounts. Time-phased information for the control accounts was based only on a forecast cost basis.

Further design work is required to determine how the schedule will be managed between the exploratory works and main scope, and the extent to which schedule should be integrated with cost for execution. However, an EV approach is preferred.

2.5 Capability

Prior to FID, cost estimating, scheduling and establishment of the Project Controls systems and function was undertaken by integrated in-house and consultant resources. This was done with the intent to progressively transition the function in-house as Snowy Hydro capability developed.

Management appointed a dedicated Project Accountant in July 2018. This role will continue with the Project post-FID, and additional capability will be added as appropriate.

2.6 Scalability

2.6.1 Systems

Systems adopted for pre-FID are generally widely-used and well-supported industry-standard systems with a track record of use on major projects. Though perhaps 'overkill' for pre-FID requirements, the cost impact of early implementation was modest, and it was decided to implement these systems well prior to FID to allow for design, familiarisation, and improvement in a low-risk context.

2.6.2 Processes

Though still a work in progress, processes adopted to date have generally been designed with execution requirements in mind and should require elaboration and extension, but not significant rework, to be suitable for execution. Work instructions are being progressively developed, to facilitate onboarding and training of new personnel.

2.7 Alignment

In undertaking an Engineer-Procure-Construct (***EPC***) project, there is a trade-off between gaining assurance of the contractor's performance and over-controlling the works. The role of the owner is not to check and re-measure every progress report. Rather, the owner should be able to rely on the contractor's reporting but have the tools and the data to hand to quality check or identify and subsequently question inaccurate or misleading information if necessary, as well as to evaluate and resolve claims.

Contractors will have a different interpretation of their data based upon their own performance metrics, and reports will reflect this. The Owner's Team will need to have access to the data to perform their own analysis and potentially produce their own reports. Discrepancies with the contractor can be addressed through the Project Controls function with potential variations assessed and resolved by management before being passed to change management for adjustments in the scope of works (see *Supporting Chapter Two - Procurement* for contract change management).

The EWR Contract is a mixed fixed-price and re-measurable construct-only arrangement. Therefore, there is a much greater onus on the Owner's Team to monitor and manage progress against deliverables and milestones than there will be for the EPC Main Works contracts (including the balance of Exploratory Works) (see *Supporting Chapter Three - Contracts and legal*). The intention is to design the controls systems to fully support the EWR, with the capacity to scale back

supervision and control for the main contracts if appropriate. However, there will be an ongoing need in the Main Works contract to manage the GBR.

3 Project controls principles

3.1 Overview

The EV management approach is based on the project management triangle of scope, time and cost and provides accurate tracking and forecasting of project performance and identifying potential variances.

Project controls concentrates on cost and schedule management and management of variance. The Project will follow general project management principles, especially EVPM as defined in AS 4817-2006.

EVPM requires that project managers determine the work to be done, establish resource requirements, measure work and cost, report deviations from the plan, forecast completion date and cost, plan and implement corrective actions as required, and authorise changes.

Contractors are expected to operate an EVMS.

The primary focus of Project Controls is the tracking and management of the Project's cost and schedule and the analysis and mitigation of variance.

The project manager directs the work of the project team while Project Controls advises the team and the project manager of possible cost and schedule risks or variances and recovery plans as identified by the contractors.

Project controls interprets data from the contractors and generates the Project's cost and schedule status and variances with potential impacts and mitigations or recovery plans. Project management consumes the information generated and makes decisions for the project.

3.2 Earned value approach

Snowy Hydro intends to apply an EV-based project management approach, as described, for example, in *AS 4817-2006.*

The Project will follow general project management principles including the establishment of a performance measurement baseline, utilisation of EV management techniques, risk management, and a formal closeout process.

The Contractors have been directed to adopt an EVPM system consistent with *AS/NZS 4817-2006*.[3]

As set out in *AS 4817-2006,* EVPM requires that project managers:

1. Determine the work to be done;
2. Establish resource requirements;
3. Measure work and cost;

[3] (Project Management Institute 2012).

4. Report deviations from the plan;
5. Forecast completion date and cost;
6. Plan and implement corrective actions as required; and
7. Authorise changes.

The standard identifies three keys to success in using EVPM:

1. Work is planned to be objectively measurable;
2. Objective measures for each piece of work are selected in advance; and
3. Cost, schedule and technical achievement are measured in an integrated system.

Setting up for EVPM requires:

1. A WBS;
2. Allocation of responsibilities;
3. A Project schedule; and
4. Resource allocation.

A Project baseline is established in the form of a time-phased budget (see Figure 1) which establishes Planned Value (***PV***) by activity by time period (monthly).

For each reporting period, PV, EV, and Actual Cost (***AC***) are determined, and cost and schedule variances can be measured and analysed, to refine the Estimate to Complete (***ETC***), and the Estimate at Completion (***EAC***).

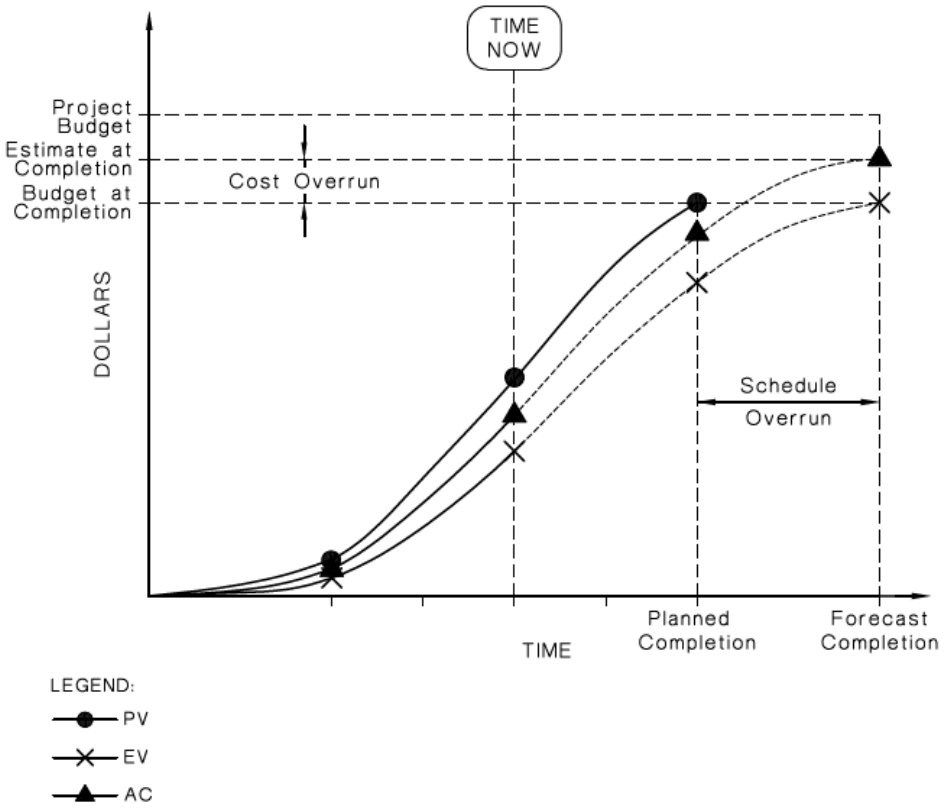

Figure 1: Budget, AC, EV with forecasts (from AS4817-2006).

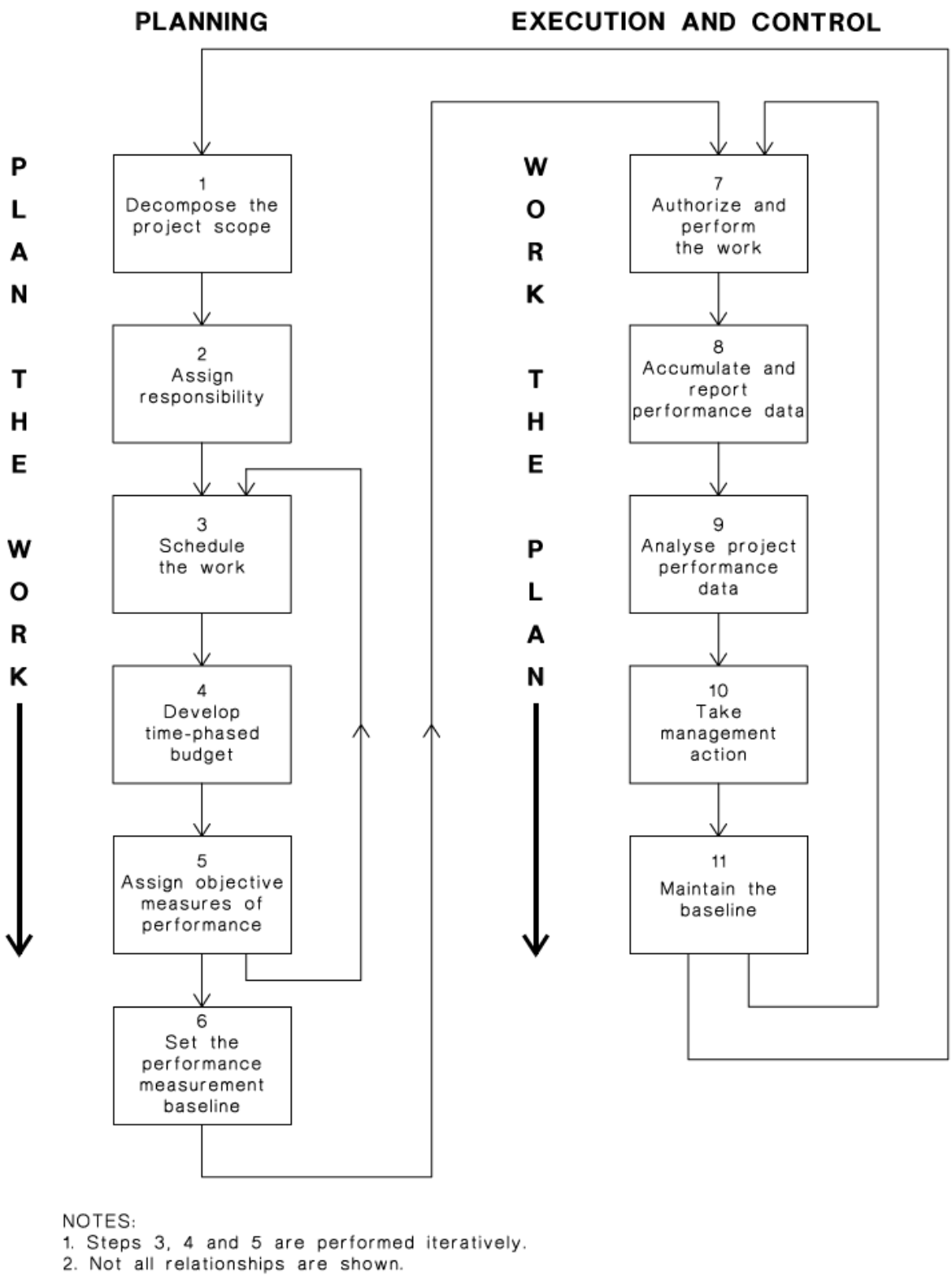

Figure 2: EVPM method (from AS4817-2006)

3.3 Expectations for contractors' EVMS

Contractors are expected to operate an EVMS. An EVMS is

> an integrated set of policies, procedures, and practices necessary to provide reliable and accurate project and program information to support project management as a decision-making tool and a critical component of risk management.[4]

Both Snowy Hydro and the contractors benefit from EVM.

The contractor benefits include increased visibility and control, allowing them to quickly and proactively respond to issues, making it easier to meet the project schedule, cost, and technical objectives.

Snowy Hydro benefits include confidence in the contractor's ability to:

1. Manage the project;
2. Identify problems early; and
3. Provide objective, rather than subjective, contract cost and schedule status on a timely basis.

Based on generally accepted approaches to implementing EVM, contractors' internal systems should be able to provide:

1. PV, EV and AC;
2. Budget at Completion (***BAC***);
3. EAC which comprises the cumulative-to-date AC of work performed plus the estimate to complete the remaining work;
4. Cost Variance which is calculated as PV minus AC. A result greater than zero is favourable (an underrun), a result less than zero is unfavourable (an overrun);
5. Schedule variance;
6. Variance at completion (***VAC***) which is calculated as BAC minus EAC. A result greater than zero is favourable, a result less than zero is unfavourable.[5]

Where applicable, Snowy Hydro will provide formats for required reporting.

The Contractors have been directed to put in place Project Controls and systems to demonstrate that they are in control of all aspects of the contract including:

1. Cost;
2. Schedule;
3. EV;
4. Variations;
5. Claims;
6. Forecast to completion; and
7. Change management.

Where significant variances from the plan are detected, commentary will be added by the Contractor with accompanying mitigation.

[4] (US Department of Energy 2012).
[5] (Subramani et al. 2014).

They have been directed to ensure that where applicable the output from the Contractors' systems will match seamlessly with the Owner's Team's administration and systems.

4 Work and Organisation Breakdown Structures and control accounts

4.1 Overview

The Project scope must be broken down into a WBS, which provides a hierarchical decomposition of the work to be executed. The WBS used for Pre-FID will be retired and a new WBS established at FID for execution. An OBS and RAM will be progressively defined in the same way as the WBS above, with the first iteration addressing the EWR delivered at FID. Where the WBS (what) and OBS (who) intersect is what defines a control account, a key management control point. The person responsible for the work effort (scope, schedule, and budget) is the CAM. The control accounts will be identified by WBS and OBS in PRISM.

4.2 Work Breakdown Structure

The first step in EVM as identified in *AS4817-2006* is to decompose the Project scope, namely to break the Project scope down into a WBS.

The Statement of Work (***SoW***) identifies the work scope requirements for a project. The major portion of the scope definition is done during the proposal and contract negotiation phase. The SoW is used as a basis for the schedule and budget development.

The Project WBS provides a project-specific, deliverable-oriented, hierarchical decomposition of the work to be executed at a task or activity level.[6] The Project WBS is the basis of the reporting structure for all Project Controls systems and deliverables and is heavily utilised by other project processes. The WBS references all scope for the life of the project. The level of WBS detail must reflect the current level of scope definition.

The WBS is used to divide the statement of work into definable product elements and related services into appropriate elements for cost account and work authorisation. A *WBS Dictionary* to describe each WBS element must be developed for each iteration of the WBS. The scope of each element will include the individuals responsible and accountable for its execution, progress reporting and cost and schedule inputs. The WBS dictionary links the portion of the statement of work to the WBS elements.

As a minimum standard, all Schedules should be broken down into at least level two of the WBS, with a decision to be made about the appropriate level of detail for cost management. Subsequent levels of the WBS are at the discretion of the

[6] (Project Management Institute 2013).

organisations responsible for the component scopes. Responsibility activity codes are required for sorting and reporting purposes.

Contractors are required to structure their activities and report in accordance with the Project WBS.

Once the WBS and other coding structures are agreed by the leadership team, codes will be assigned to the appropriate activities within each project and sub-project.

WBS and codes will be applied to categorise control accounts, contracts, schedule activities, and other key records in project systems.

4.2.1 Progressive approach to WBS

Pre-FID

A WBS was established for the Pre-FID phase. However, while fit-for-purpose for this phase, the Pre-FID WBS was optimised for the delivery of professional services across the seven Pre-FID workstreams, and did not take into account factors such as asset capitalisation requirements, facility, commodity or asset structure.

The Pre-FID WBS is expected to be retired and a new WBS established at FID.

Exploratory Works - Access Roads

Prior to contract award, the WBS for the EWR Contract and related activities will be finalised, costed and ready to be loaded to project systems.

Balance of Exploratory Works and main works contracts

As at FID, the WBS for the balance of Exploratory Works and the main contracts and related activities is at a draft stage, consistent with the level of maturity of the overall Project Estimate (see *Supporting Chapter Four*). This WBS will be finalised, costed and loaded to project systems at the time of award of the main contracts. It is expected that the EWR WBS will form a defined subset of the main Project WBS.

4.3 Organisation Breakdown Structure

Step Two of EVM is to assign responsibility for all work elements at an appropriate management level.

An OBS and RAM will be progressively defined in the same way as the WBS above, with the first iteration addressing the EWR delivered at FID. The RAM should be developed in alignment with the Project governance model and the agreed financial delegations.

The OBS groups together similar project activities or work packages and relates them to the organisation's structure. OBS is used to define the responsibilities for project management, cost reporting, billing, budgeting and project control. The OBS provides an organisational rather than a task-based perspective of the project. The hierarchical structure of the OBS allows the aggregation (roll-up) of

project information to higher levels. When project responsibilities are defined and work is assigned, the OBS and WBS are connected.

The purpose of establishing the OBS is to map the WBS to people/roles responsible for delivering each part of the WBS. The roles may be individual (eg the Accountable Individual for a contract or a scope element), or organisational, eg the contractor responsible for delivering a defined scope comprised of specific WBS elements.

OBS can be applied in project systems to:

1. Enable subtotalling, filtering, sorting and searching by organisations or individuals; and/or
2. Control access to records - hiding or preventing modification of portions of the project by certain organisations or individuals.

4.4 Control accounts

Where the WBS (what) and OBS (who) intersect is what defines a control account: a key management control point. The person responsible for the work effort (scope, schedule, and budget) is the CAM.

The control accounts (***CA***) are identified by WBS and OBS. The CA record is the focus of project cost control and is the level at which project cost control is done. Each CA must be uniquely identified and defined to avoid ambiguous designation of the WBS and OBS. Other systems must be referenced to the control account or WBS/OBS to enable integration.

Pre-FID, there was no distinction made between WBS and OBS (ie, each top-level WBS element had a corresponding accountable lead in the organisation structure). However, the more complex nature of the next phase requires a more structured approach.

5 Schedule

5.1 Overview

The Owner's Team needs to understand and follow work progress and manage owner-controlled milestones. Therefore the Owner's Team has adopted Primavera P6 and required its use by the Contractors. The baseline schedule will be developed following FID. The Contractors will develop detailed schedules. The schedule will be baselined and then managed against that baseline.

Step Three of EVM is to create a schedule for the Project identifying activities, durations, milestones and interdependencies. The schedule is the vehicle for planning, performing and monitoring the Project.

The contractors submitted detailed programmes with their tenders that were aligned with the Project WBS. However, a number of critical milestones within

these schedules, such as access and approvals, are within Snowy Hydro's control rather than the Contractors.

Although schedule management is the responsibility of the Principal Contractors (for their scope), the Owner's Team needs to understand and follow the progress of the work and be assured that the time programme is being followed. Certain aspects of the project schedule such as approvals are also the Owner's Team's responsibility.

Snowy Hydro intends to maintain the master schedule at an appropriate level of detail to:

1. Track critical Project milestones;
2. Assess and validate contractors' reported EV; and
3. Manage its owner's work.

As with the WBS and OBS above, as at FID, the schedule is finalised for EWR and draft for the balance of the Works.

The Civil and Electrical/Mechanical (***E&M***) contract conditions require that the Contractor must submit an updated program on commencement, and update again whenever needed. The Employer (Snowy Hydro) must review the update and raise any issues within ten Business Days (15 Business Days for the first update).

5.2 Schedule setup

The Contractors will create and model cost/resource loaded project schedules and capture actual time information for progress reporting purposes.

Within the first quarter following FID, the Owner's Team will develop the detailed baseline Project schedule for the Main Works and progressively integrate it with the Contractors' schedules. To enable a fully integrated and workable schedule, a set of key milestones will be agreed and all contractors' schedules must emulate these so there are key tie-in points and interdependencies can be monitored. This will be a challenging and iterative process involving many stakeholders.

See *Supporting Chapter Four - Schedule, cost estimate and contingency* for the planned timing of this activity.

The Contractors' schedules will be fully resource loaded and will show all logic links.

The Contractors will identify the critical path(s) of the schedule and will provide an individual detailed schedule for the critical path.

Their schedules will:

1. Include for all engineering and design work and all major fabrication and procurement including all offsite or offshore fabrication;
2. Indicate dates required for delivery of built-in items from the E&M Contractor or other contractors;

3. Detail all erection of site facilities including offices; stores; quarries; batch plants; explosive storage; accommodation facilities; etc.
4. Clearly highlight the Baseline Schedule related to the GBR,
5. Present all of these areas on a separate schedule; and
6. Indicate key milestone dates as per Snowy Hydro's Requirements and demonstrate handover dates to the E&M contractor and back from them.

The Schedule will be organised by WBS and the project scope for each work package into component activities.

In addition, an Executive Summary Schedule (***ESS***) is developed which runs in parallel with the Master Schedule. The ESS is for the life of the Project. This schedule is developed by the Project Controls function for Senior Management / Board Members.

The ESS will be managed separately; however, the data for the major activities will align with the current main schedule data. The Owner's Team will issue this schedule when required other than on a monthly basis.

5.3 Schedule Baseline & Monitoring

It is essential to freeze the dates to create a 'baseline' once the Schedule has been reviewed and approved by the Project Director.

A baseline is a stored copy of a Schedule which is maintained behind each schedule update.

Each stored baseline can be restored from within each project schedule and produced as a standalone project schedule.

The baseline schedule will be used to integrate with the cost control system to establish the EV baseline curve.

The monitoring and review of the planning outputs is an essential process undertaken by the leadership team and the Master Control Schedule Planner.

The purpose of this monitoring and review is to confirm:

1. The required stakeholders are involved in activities associated with the monitoring and review process;
2. The planned schedule logic and methodologies are current and updated in line with the overall objectives;
3. The critical path remains relevant and is clearly understood by all stakeholders;
4. Key deliverable milestones are achievable and drivers understood;
5. Learnings from significant delay events are analysed, recorded and compared to baselines; and
6. Team leads must update the results from the monitoring and reviewing process, and the Master Control Schedule planner must reflect activity adjustments in the Schedule.

5.4 Schedule maintenance

The Contractors will update and issue the schedule by the agreed monthly deadline to the Owner's Team to reflect the actual progress of the Works:

1. The updated schedule will be used to review the Contractor's payment application;
2. The updated schedule will Indicate:
    a. Major milestones reached;
    b. Actual dates for activities which have been completed;
    c. Activities in progress or to be performed in the future demonstrating the time for completion;
    d. The critical path for the project based on the latest update data; and
    e. The actual quantities and remaining quantities against key resources.

The Contractors will provide detailed extracts from the schedule on a monthly basis indicating key activities to be carried out over the following 90 days.

The Contractors will include a detailed programme report in their monthly reports, including:

1. Changes in logic, construction sequence and activity duration, including an explanation of why the changes are necessary;
2. Proposed actions by the Contractor to restore the schedule, including what is being done or what is planned to be done in each problem area;
3. Anticipated problems or changes and plans to deal with them so as to minimise or prevent delays;
4. A comparison of the actual work status against the Contractor's previous programme;
5. Look ahead schedules; and
6. Critical path report.

5.5 Planning & Scheduling Program

The objective for the planning and scheduling program is to communicate relevant and timely project status to the Owner's Team. The Schedule is reviewed, baselined, updated, monitored for performance and reported on a weekly/monthly basis as required. It will:

1. Meet Snowy Hydro and project reporting needs and requirements;
2. Provide a clear and concise representation of the Project Scope;
3. Measure the progress of work to manage delays and interface drivers;
4. Communicate critical activities; and
5. Contain adequate allowances for time contingency to achieve the acceptable probability of completion.

5.6 Scheduling Tools

The Schedule will be developed and maintained for critical path method scheduling.

6 Time-phased budget

6.1 Overview

Step Four of EVM is to develop the time-phased budget.

The Project baseline budget will be finalised from the Estimate after FID but before the commencement of any approved works.

Project activities will have assigned budgets to an appropriate level of granularity for the activity to be managed. These budgets will be time-phased by period over the duration of the activity, or over the duration of the Project where activities are not yet planned in detail.

Where activities are based on provisional sums or re-measurable quantities, hours, labour, material or other units will be set up in project systems.

A contingency/management reserve budget will be established that is not assigned to any activity and will be drawn down on as needed.

As with the WBS, OBS and schedule above, as at FID the time-phased budget will be finalised for EWR and estimated for the balance of the Works.

6.2 Budget establishment

6.2.1 Overview

The baseline budget will be established after FID but before the commencement of any approved works. The baseline budget will be developed through the critical review of the Project estimate (see *Supporting Chapter Four*) and the Project Procurement and Contracting Plan (***PCP***)). This process will ensure that all estimate line items are assigned to either a work package or to management reserve within a control account.

6.2.2 Contingency

Contingency is the portion of the baseline budget that is available for uncertainty within the project scope. Contingency is budget withheld by Snowy Hydro for management control purposes. It may or may not be time-phased. See *Supporting Chapter Four* for how the Project contingency was developed. Contingency management was implemented in pre-FID, and the ongoing management process is expected to be similar.

The approved values for control accounts are without contingency. A contingency work order will be created in Ellipse which will have a budget but will not accept costs. Costs will be transferred between control accounts or between

contingency and control accounts using Control Account Change Orders (***CACO***). CACOs are used as the basis for updating commitments in Ellipse.

The drawdown of contingency must be strictly controlled on the Project and is to be processed via approved Change Orders. A contingency drawdown curve and supporting narrative will be included in the Monthly Report and is required to show the planned/actual drawdown and remaining contingency required to complete the Project in line with the outstanding risk profile.

The Owner's Team will evaluate the remaining scope risks and the associated contingency requirements monthly and include within the EAC.

7 Performance measurement and reporting

7.1 Performance measures

Step Five of EVM is to assign objective measures of performance or Rules of Credit (***RoC***). These measures will be established for each activity before the activity commences.

7.1.1 Performance

The Project Controls Management Plan (***PCMP***) will include a performance measurement model which specifies the earning methodologies that will be utilised on the Project. One or more of the following methods will be used to calculate physical progress for individual scope elements:

1. **Weighted Milestones** - Progress is earned based upon completion of pre-defined incremental tasks or 'milestones' for an activity, deliverable, or groups of activities or deliverables, with appropriate weighting factors used to reflect relative effort expended in the completion of the activities or deliverables. This is also defined as 'rules of credit'.
2. **Direct Measurement/Quantities/Units Completed** - This measurement method applies when work package scope can be further decomposed into fairly homogenous units of work, for example, units of material and drawings, that each require approximately the same level of effort to produce. Work is completed and measured for some units while work continues on others.
3. **Weighted/Equivalent Units** - This measurement method is a hybrid of units completed and weighted milestones. It is used when the work package scope includes non-homogenous units of work and/or work tasks that overlap such that the other methods do not work well. In this case, based on estimates or past experience, a percent completion value is earned for completion of specific scope components or units.
4. **Zero-One Hundred/Fifty-Fifty Methods** - This method is used for low value and/or short duration activities without readily definable intermediate milestones. Either no progress or some limited progress is earned when the activity is started, and remaining progress is earned at the

completion of the activity (0 at start / 100% at completion, or 50% at start / 50% at completion).

5. **Apportioned Effort** - This method is used for work where the planning and progress are tied to other efforts. The budget for apportioned work is time-phased in proportion to the related work.
6. **Level of Effort (*LOE*)** - This method is used for work scope of a general or supportive nature for which performance cannot be directly measured or is impractical to measure. The budget for LOE work is time-phased in accordance with the time the support will likely be needed, and progress is earned only by the passage of time.
7. **Subjective Assessment/Judgement** - This method is used only where other methods are not practical or reliable to accurately reflect activity completion. This method must be used with caution, as it is subjective and progress can be misrepresented.

7.2 Performance measurement baseline

Step Six of EVM is to set the performance measurement baseline, to formally establish the planning parameters for the Project.

The baseline provides the reference against which progress is measured and reported.

For both the EWR and the Main Works, both quantities and job hours will also be tracked. This is essential to support EVM.

7.3 Authorisation and performance

Step Seven of EVM is to authorise and perform the work. Provided that the work is within Project scope, all work will be authorised by the Project Director or authorised delegate. An authorisation is required when:

1. Budgeted work is committed;
2. Committed work is changed;
3. A budget must be reallocated;
4. Payment requests are made; or
5. Performance deviates outside agreed parameters.

7.4 Performance reporting

Step Eight of EVM is to accumulate and report performance data. Schedule progress, EV and AC are recorded and accumulated for each activity. Performance data is aggregated up through the WBS to allow a strategic view but also the capability to drill-down to the detail.

Project Controls will provide a dashboard representation of the aggregated data from each discipline (eg cost, schedule, risk, forecasting) to the Owner's Team on a monthly basis, and maintain a visible history of the Project's progress.

The scope of work for the EWR Contract requires that the Contractor must prepare monthly progress reports, including program and risk.

The EWR contract conditions state that the Contractor may be required to provide and comply with a construction program and require the Contractor to give prompt notice of delay and claim for extension of time (***EoT***).

The civil and E&M contract conditions require that the Contractor must prepare detailed monthly progress reports.

Cost management information will be reported at the specified reporting periods, nominally monthly.

Snowy Hydro will provide the Contractor with the format in which the monthly cost breakdown from the interim payment claims will be presented to the Owner's Team.

The Contractors will establish their costing system to provide for a seamless transfer of this information to Snowy Hydro systems.

Project reporting is based upon a monthly cycle. The cycle requires determining the status of work, updating and forecasting the schedules, assigning the actual costs to the appropriate charge number and control account, incorporating internal and external changes, and updating the EAC. The status, forecasting, and assignment of actual costs originate at the detail level and are summarised to the total Project level. Dates of the reporting submissions from contractors to the Owner's Team will be mutually agreed, and be available as soon as the data can be presented as verified and authorised.

A detailed reporting calendar will be established in discussion with the contractors and BAU post-FID.

For managing, monitoring, and reporting purposes, the Owner's Team will use a proprietary cost management system along with detailed accounting cost reports.

The Owner's Team is also responsible for reviewing any variances to the plan. This includes the review of cost variances, schedule variances, and variances at completion.

A communication matrix will be developed that describes the frequency of meetings for the Contractors to update the Owner's Team.

The following indicative reports will be produced by the Owner's Team from internal data and data supplied by all contractors:

1. **Weekly** - detailing progress to plan, emerging risks and control options;
2. **Monthly** - summarising the month's progress, current financial position, financial forecast, trending analysis, risks, issues, safety statistics, overall project health, progress against baseline (S-curves, EV analysis);
3. **Annual** - Financial year-end, calendar year-end and anniversary reporting as required by Snowy Hydro to support various regulatory obligations, eg Australian Industry Participation Plan (***AIPP***) reporting.

The Contractors will prepare periodic progress reports and submit to the Employer in accordance with the Conditions of Contract. The Contractor's progress report will include the information listed in the Contract, and additional information as listed in the Project Execution Requirements including:

1. Key decisions required from Snowy Hydro;
2. Changes or additions to Contractors' supervisory personnel since the preceding progress report;
3. Planned and forecast resources over project lifecycle;
4. The value of work performed and the remaining expenditure forecast to Completion;
5. Planned versus progress s-curves and histograms, including a forecast for intended progress;
6. EV Report;
7. Cash flow forecast;
8. Records of delays and stoppages with reasons therefore;
9. Request For Information (***RFI***) status;
10. Payments status;
11. Risk, issue and opportunity management register;
12. Design deliverables report;
13. Any other information which Snowy Hydro may reasonably require.

The Schedule report assists the Project Director to effectively manage the Project. Its content should include (but not be limited to):

1. **Project performance** – a level 1 bar chart report showing the updated activities against the previously updated contract baseline for comparison of their completion variances in the column area;
2. **Critical path report** – providing a list of activities currently on the critical path or near critical paths; and
3. **Key milestone report** – for use by the leadership team responsible for managing internal and key deliverables milestones.

The Master Control Planner is responsible for producing the scheduling section of the internal Schedule reports. The Schedule report should include the latest Schedule to be uploaded into Aconex in PDF format.

Internal project milestones and interface project milestones will be established at the appropriate OBS level. A milestones narrative will be included in the Schedule Report.

7.5 Cost reporting

Snowy Hydro will generate Cost Reports monthly from a single source. These reports will include:

1. Multiple reporting levels using the WBS (rolled up to summary levels and/or detailed as required);
2. Detailed (supporting) reports including cost reports at the Facility, Commodity and Package level;

3. System generated reports complemented by an analysis that comments on variances and any other relevant information;
4. The impact of variances due to foreign exchange rates (reported separately); and
5. Monthly cost reports including relevant and sufficient details focused on the Project area.

7.6 Performance analysis

Step Nine of EVM is to analyse project performance data. Cost and schedule variances are identified and analysed to determine ETC, EAC and completion dates.

Performance measurement is done consistently and periodically, at a minimum monthly.

Contractors will be expected to forecast and to report their cost performance on an EV basis. Accurate forecasting is essential for the Owner's Team to effectively manage cash flow.

The US DoE recommends that variance analyses:

1. Identify cost, schedule, and EAC deviations from the Performance Measurement Baseline (***PMB***) and are reviewed to ensure that their causes, Corrective Action Plans (***CAPs***), and impacts to the project are clear, meaningful, and attempt to recover negative deviations from the plan and address reasons for significant positive deviations from the plan;
2. Are accurately reported for the current month, cumulative-to-date, and against the BAC and variance analysis reports and the effectiveness of corrective actions are monitored;
3. Records of historical performance against the plan are not erased or modified, unless to correct errors, routine accounting adjustments, effects of customer or management directed changes, or to improve the baseline integrity and accuracy of performance measurement data; and
4. Together with the remaining contingency, updated EACs, and other factors, it is critical to understand whether a project is in danger of exceeding the PB.[7]

A project forecast is a periodic reassessment of the project's scope, cost and schedule. All project participants are to provide monthly updates to the remaining ETC and the EAC. Cost forecasting takes into account:

1. AC;
2. Accruals (see *Project Accounting*); and
3. Estimate to Complete, including items such as:
    a. Approved trends;
    b. Performance impacts;
    c. Forecasted escalation; and
    d. Foreign exchange effects.

[7] (US Department of Energy 2012).

The initial forecast expenditure profile for the project duration is achieved by comparing the month by month project schedule with the baseline budget and should include contract progress payments and key milestones. This profile will be updated each month and is used in the calculation of the project ETC and EAC.

As part of the regular project cost management process, the Project Controls function will estimate AC, including incurred costs (accruals). Accruals will be estimated by the Project Accountant based on inputs received from the contractors and owner's team in accordance with the project reporting cycle (see *Accruals* below).

The Project Controls function will time-phase the EAC for the Life of Project (irrespective of fiscal years) based on the Schedule using known or expected payment terms for each work package.

8 Management action

Step Ten of EVM is to take management action in response to past or forecast variances. Such action may include:

1. Direction to accelerate or take remedial measures;
2. The authorisation of additional resources;
3. Change in approach;
4. Additional scope to be undertaken;
5. Direction for work to be performed by others; or
6. Relaxation of requirements, obligations or constraints.

9 Change management

9.1 Overview

Step Eleven of EVM is to maintain the baseline, by controlling change and ensuring only approved changes are made to the baseline.

The scope of work for the EWR Contract requires that the Contractor must maintain a change register.

Management of scope and change is a critical element of project management. Scope changes record the effect of changes in scope on the project cost and schedule from the baseline.

Establishment and approval of baseline change proposals are among the most important aspects of project control. Change control procedures should ensure proper management notification of changes and that if necessary, corrective action is taken to regain the project cost, scope and schedule.

Action on all change requests must be deliberate and timely and carried out without interfering disproportionately with project progress. The scope, schedule, and technical impacts of proposed changes should be developed and

considered by all appropriate stakeholders. All appropriate parties will be informed in a timely way regarding proposed changes and their disposition.

Baseline documentation should be controlled and updated as appropriate to reflect approved changes. Changes introduced to the Project which require implementation of the change control process include items such as:

1. **Technical** - Significant changes from the authorised scope of work including such items as:
    a. Any potential change in programmatic purpose (with a significant effect on physical parameters, operational capacity, or total estimated costs);
    b. Any significant change in operational capacity (productive capacity, number of people, energy, footprint effect on the Facilities, storage capacity, etc.);
    c. Changes in the features of the Facilities affecting the end purpose of the Project;
    d. A substantial increase in one functional area and a corresponding decrease in another;
    e. Adding capacity for the express purpose of providing for expansion when such expansion was not in the original scope or estimate.
2. **Schedule** – changes in the baseline schedule elements as defined by the project authorisation.
3. **Cost** - Changes in the baseline cost elements as defined by the project authorisation.

Document Control will be maintained by following the Project Information Management (***IM***) Plan (see *Supporting Chapter Fifteen*).

Changes will be reported by the Owner's Team at the specified reporting periods, nominally monthly.

The Conditions of Contract prescribe how claims and variations will be managed (See *Supporting Chapter Two*).

The Contractor will establish and maintain a change management register to reflect all changes to the Project Schedule and/or cost.

9.2 Trends

9.2.1 Definition

A Trend is a potential change to cost or schedule. Trends are normally used to give advance notice and seek approval of a forecast change.

A trend program will be established by the Owner's Team to identify and evaluate deviations from the budget and schedule in a timely manner. Trending analysis tools that monitor project progress and performance are to include S-Curves, EV Analysis, Schedule Performance Indicators (***SPIs***) and Cost Performance Indicators (***CPIs***). Timeliness in identifying and resolving trends is a key element to support effective corrective action by the project team.

The primary objective of the trend program is early identification of real and potential changes to the project scope, quality, cost and schedule baseline in order to mitigate adverse trends and maximise favourable trends.

The trend program is used as the vehicle to communicate and manage project scope, quality, cost and schedule. A thorough understanding of the contract, endorsed/original budget, schedule, and the current baseline by all project team members is key to the success of the trend program since all are responsible for identifying changes and deviations.

The Project Controls function is responsible for the coordination, evaluation, submittal and administration of the trend program. The trend program will be managed and monitored through PRISM G2.

Resolved and unresolved trends impacting the Current Budget / Forecast of the Project will be shown in the monthly cost report.

9.2.2 Trend sources

Claims

Claims arise when a contractor has identified a change for which it wishes to be compensated, either by payment or through an EoT. A claim may arise without prior warning, in which case it will be a new trend, or it may be associated with one or more existing trends.

The EWR contract conditions require that parties must notify claims with a prescribed notice. If further particulars are not given within the notice period, the notice is the claim. The Superintendent must assess the notice within the prescribed number of days of receipt. If there is no notice of dispute within a further prescribed number of days, the Superintendent will certify the assessment.

The Civil and E&M contracts allow that the Contractor may claim for additional payment, an EoT or other entitlement. Claims must be made within a prescribed number of Business Days, but may still be valid if sent later and the Employer does not issue a notice stating that the claim is late. A fully detailed claim must be made within a prescribed number of Business Days or the claim will be barred.

See *Supporting Chapter Two* for a discussion of the contractual approach to claims. This chapter treats a claim only as one potential reason for a trend.

Risks

Project risks and risk mitigations can be captured in PRISM and associated with change orders.

9.3 Change orders

Change orders are used to formally approve a cost change and commit it against the approved budget. A change order can affect either contracts or control accounts (often both). A change order is used when:

1. A contract's commitment value is varied, eg when a claim is approved through a CCO; or
2. Funds must be transferred between control accounts (including drawdown on contingency) through a CACO.

9.4 Scope change (Level 1 change)

9.4.1 Definition

A Scope Change arises from trends or variations which, if approved, will change the overall scope of the Project in some fundamental way. In the Snowy Hydro context, a Scope Change is a material change to the Project that cannot reasonably be accepted as falling within the approved scope as documented in the original Recommendation for Approval.

A clearly defined scope book/WBS Dictionary is essential to understanding whether a scope change has occurred.

9.4.2 Process

While a Scope Change may arise from a trend or a direction issued by Snowy Hydro to a contractor, it may (rarely) also arise from a direction by Snowy Hydro Management.

When a potential scope change is identified, the Owner's Team will promptly bring it to the attention of the Steering Committee.

The Steering Committee will assess the potential change on its merits and, if it considers the change necessary and justified, will direct the Owner's Team to thoroughly evaluate the change and submit a Scope Change Request.

Not all scope changes will require the contractors to be involved. It is at Snowy Hydro's discretion whether to involve the contractors in developing a Scope Change Request. However, if the contractors are actively involved and must do additional out-of-scope work to evaluate the change, they should be issued with a direction and be compensated for the work in accordance with the contract, regardless of whether the scope change is formally approved.

Once the potential impact of the change has been quantified and documented, a formal scope change request is submitted to the Steering Committee.

The Scope Change Request should include:

1. The reason for the Scope Change;
2. What aspects of the Project fundamentals are affected by the Scope Change;
3. A summary of the Variations (if any) that will be required against the various contracts to execute the Scope Change (including any new contracts);
4. The schedule, capital expenditure and operating expenditure impact of the Scope Change compared to not executing the Scope Change;
5. Any additional Study funds (or reduction in funds) required to execute the Scope Change;

6. The risks and consequences of not undertaking the Scope Change.

The Steering Committee will have some discretion to approve the change, subject to delegated authority limits (to be established post-FID). Any changes that fall outside approved limits will be submitted to the Board (and if necessary the Shareholder) for approval with the necessary support documentation.

If the Board approves the change, then the Owner's Team will implement the change in accordance with the direction. This may or may not include a change of scope (and variation) for the contractors.

9.5 Budget

The approved budget reflects the baseline budget as amended by approved CACOs. The approved budget is maintained consistently in project systems. Baseline work order values will be adjusted in response to approved CACOs when required.[8]

The Owner's Team initiated formal cost management prior to FID.

10 Management plans and procedures

Project controls must be developed collaboratively with the contractors. The contractors were given the Employer's Requirements and directed to provide a detailed PCMP with their tender that details how they will manage controls; what systems they will use; and how they will integrate with the Owner's Team's systems.

Project controls for the execution phase of the Project will be governed by an overarching PCMP. The PCMP will set out Snowy Hydro's expectations for commercial oversight and financial management of the Project and outline the procedures for controlling cost and schedule functions for the Project.

The Contractors were required to put in place project controls and systems to demonstrate that they are fully in control of all aspects of the contracts including:

1. Cost;
2. Schedule;
3. EV;
4. Variations;
5. Claims ;
6. Forecast to completion; and
7. Change management.

The Contractors were required to submit a PCMP as part of their tender. Given the EPC contracting strategy, and that contractor selection will not be final as at FID, the PCMP cannot be final as at FID. It must be developed in stages.

[8] Because the control accounts in PRISM are held at a greater level of detail than in Ellipse, at times an approved CACO may cause changes in control accounts but no corresponding change in work order value.

The scope of work for the EWR Contract requires that the Contractor must have a PCMP. Progress claims must be in a prescribed format. The Contractor must provide a monthly cash flow forecast. The Contractor must provide detailed reporting, which will be used as a basis to evaluate the progress claim.

The Contractors were required to provide a detailed PCMP with their tender that details how they will manage each of the areas described in this chapter, what systems they will use; and how they will integrate with the Employers systems.

Where applicable the output from the Contractors systems will match seamlessly with the Employer's administration and systems.

Following the award of the main civil and E&M contracts, the Owner's Team will implement an integrated PCMP. This PCMP will be developed through aligning and conforming the existing Owner's Team controls to the Contractors' proposed PCMP.

11 Supporting systems

11.1 Overview

The primary Project Controls applications that will be required in execution are:

1. **Primavera P6** - schedule management;
2. **PRISM G2** - cost and change management;
3. **Aconex** - document control;
4. **Ellipse ERP (as a supporting application)** - financial reporting and Accounts Payable.

All of the above systems were implemented by mid-2018 on a standalone basis. As at FID, basic workflows are in use, with manual information exchange and reconciliation between systems. This was considered adequate for pre-FID but insufficient to manage the EWR Contract (see *Supporting Chapter Thirteen* for EWR Contract scope). Further work is required immediately post-FID to increase integration, particularly of cost and schedule information.

Consideration was also given to contract management and risk management. Given the EPC contracting strategy, and the low number of contracts thus to be directly administered by the owner's team, a full project contract management system (eg Omnicom/PIMS or Primavera Contract Management) was not considered necessary for the Project. The inbuilt contract administration functionality in PRISM G2 is considered to be sufficient, though this may require further consideration during the evaluation and implementation of the EWR contract.

Standalone risk management software has not been evaluated as at FID. The inbuilt risk management functionality in PRISM G2 is potentially sufficient for execution, though this will require further consideration following the evaluation of the contractors' risk management approach.

Project reporting/dashboards is an area that had only limited attention prior to FID and requires further attention prior to the commencement of the EWR.

11.2 Primavera

Snowy Hydro expects that its contractors will report in a manner consistent with generally accepted international standards for project progress reporting, eg the *Project Management Institute Practice Standard for Scheduling* or *AS 4817-2006 (2016)*.[9]

In line with the above standards, Snowy Hydro, therefore, expects contractors to document and communicate to Snowy Hydro their basic assumptions and management approach for cost and schedule reporting, including for example:

1. Shift lengths (for both people and resources);
2. Treatment of weekends and public holidays when calculating durations;
3. Coding structures applied (other than the WBS), eg corporate responsibility, location, or resource type, if any;
4. Whether activities are effort or duration-driven;
5. When and on what basis the schedule will be re-baselined;
6. How work/effort by activity will be baselined and reported;
7. How the baseline budget will be assigned to activities and at what level of detail;
8. How trends will be identified and incorporated in progress updates;
9. How budget shifts arising from trends will be managed;
10. Management of contingency;
11. Whether an approved trend is expected to trigger a re-baseline;
12. How resource unit rates are determined and applied;
13. How the contractors will obtain and incorporate Snowy Hydro progress updates on activities within Snowy Hydro's scope; and
14. How progress is calculated and reported for the various types of activities.

11.3 Prism

PRISM G2 from ARES was selected for cost and EV management from a small number of possible systems designed for large projects for the following reasons:

1. Compatibility with Snowy Hydro ICS strategy (hosted externally on a cloud service, accessible on Chromebooks);
2. Scalable with the addition of extra modules as/when required;
3. Licence fees not too high to implement early;
4. Well-recognised product for large construction projects;
5. Availability of local support;
6. Relatively standalone but also relatively easy to integrate with other systems;
7. Familiar to some members of the project team;
8. Support for EVM.

[9] (Project Management Institute 2011).

PRISM is designed with strong support for EVM, and supports most aspects of an EVMS with one exception: PRISM does not perform scheduling calculations. However, PRISM does integrate
schedule information from other systems. The schedule must be included in PRISM for each control account to generate a measurement baseline and forecast for the Project.[10] To provide schedule information, Snowy Hydro has also adopted Primavera (see above).

A number of additional items will need to be configured in PRISM for execution, including the WBS (see the *Roadmap to execution* below).

11.4 Aconex

Aconex was implemented late in 2017 to manage documentation related to engineering, environmental and geotechnical investigation activity.

While not strictly a Project Controls system, it is important because it is the primary Project information repository and means to exchange information between Snowy Hydro and third parties.

11.5 Ellipse

11.5.1 Project setup

To date, Snowy 2.0 has been set up as a single master project in Ellipse, with separate sub-projects and cost elements established for each phase. It is intended to continue the same approach going forward, with separate subprojects established for EWR and the main project.

11.5.2 Work orders

For Feasibility and Pre-FID, summary work orders were created that matched to one or more control accounts. The main value of work orders is to capture BAU costs and project costs that do not clearly land against a commitment, eg employee costs, leases. The principle of using summary work orders is sound and worked reasonably well in Pre-FID. However, fewer work orders are probably needed than were set up for Pre-FID and are mostly required in the owner's costs accounts.

11.5.3 Commitments

The timely setup of commitments in Ellipse was a challenge in Pre-FID. Given the increased exposure to the security of payment legislation in the next phase, it is essential that commitments for the major contracts are established in Ellipse immediately after contract award and well prior to the expected date of the first payment. Close, ongoing attention must be paid to commitment values, in response to variances.

[10] (PRISM 2018).

11.5.4 Interface with PRISM

The most critical interface between the Project and BAU (from a Project Controls perspective) is the exchange of financial information between PRISM G2 and Ellipse.

Figure 3 below shows the primary information being exchanged between these two systems. Information sent from Ellipse to PRISM is in the form of a CSV file manually validated and uploaded on a weekly/monthly basis as required. Information from PRISM to Ellipse is low-volume and is manually entered as required against authorised change orders.

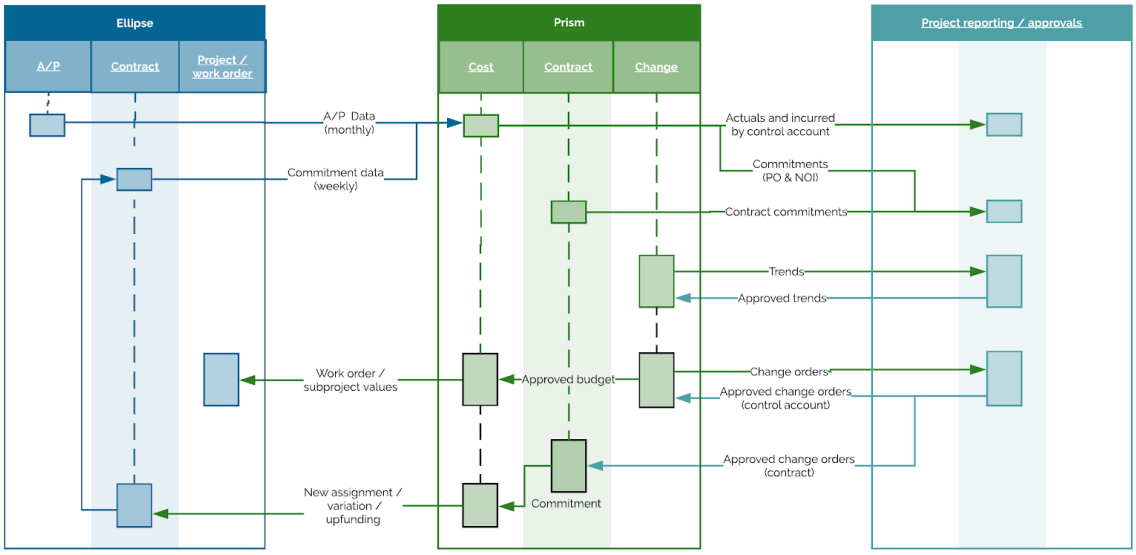

Figure 3: Ellipse-PRISM interface

12 Commitments

12.1 General

Commitment covers the obligation to spend money for goods and services, as documented by contracts, purchase orders or subcontracts, and for items such as non-committed expenses and credit card purchases, and the tracking of actual costs associated with those obligations.

In the Project Controls context, a commitment is an item with a forecast value, duration and associated contractor or supplier (may be multiple) that the Project expects to have completed and fully expended in the course of the Project.

This chapter considers only the cost and change aspects of commitments. See *Supporting Chapter Two* for a discussion of the procurement and contract administration aspects of commitments.

During the life of a commitment, Project Controls provides to Project Management the status of its associated budget, commitment, and cost. The following types of commitment documents are authorised for the Project:

1. Contract;
2. Purchase Order; and
3. Service Order.

All commitments must be authorised and loaded in Ellipse in advance of services or goods supply, unless the commitment falls in an agreed Non-Order Invoice (***NOI***) category.

Provided there is sufficient management reserve available against the relevant control account, minor purchase orders or service orders may be directly committed by requisition. New contracts or contract variations must be committed on the basis of an EC, supported by an approved CCO.

The basic definition applied for commitments is either:

1. The committed contract portion value in Ellipse (where a portion has been created); or

2. 'Commit-as-incurred' where the contract is actively incurring costs but has not yet been committed. 'Commit-as-incurred' is defined as the cumulative incurred value of a work package up to the end of the reporting month. 'Incurred' is defined as the value of invoices received or amounts paid related to activities performed within the reporting month, plus the best estimate of un-invoiced charges for the month.

The full expected value of each purchase order, assignment or contract (to completion) should be carried as a commitment for the following reasons:

1. Loading the full value into Ellipse ensures that funds will be available to process invoices up to the expected value of the contract without further intervention;
2. It provides a conservative, forward-looking view of what the project plans to commit, rather than simply what the project has actually spent;
3. It prevents the budget from being over-allocated, by sequestering the committed amount.

The progressive release of commitment on a monthly or other periodic basis is not permitted, unless:

1. The full scope of all assignments for the contract has been estimated up front; and
2. Each assignment is for a discrete and defined portion of work.

Project controls will forecast planned commitments in alignment with the Schedule, and track actual commitments within the project cost management system as they are incurred. Commitments should not include growth allowances (ie any uncommitted amounts against a work package), or contingency.

12.2 When is a commitment made?

Putting aside the legal definition of an agreement, for the purposes of this plan, a 'commitment' is made on behalf of Snowy Hydro when a Snowy Hydro person directs a supplier to provide goods or do work on behalf of Snowy Hydro for an agreed payment. A written contract is not essential to create an entitlement to payment, nor must the person directing the work necessarily be an authorised Responsible Officer to create an entitlement.

However, commitments should obviously be formalised in the form of a contract, or purchase order, assignment (for framework agreements), or contract direction/client instruction (for site works). This protects both Snowy Hydro and the supplier.

12.3 Prerequisites for commitment

12.3.1 General

The basic principle governing commitments management for the Project is that commitments are pre-approved. Before Procurement can be engaged to execute a contract or raise a purchase order, any commitment to be made on behalf of the Project must be:

1. Scoped;
2. Estimated;
3. Scheduled; and
4. Assigned to an Accountable Individual.

12.3.2 Scoped

The planned commitment must be identified, packaged, and described in the WBS Dictionary / Scope Book. Before a commitment can be finalised the full scope must be documented in the contract.

12.3.3 Estimated

A cost estimate must have been made for the commitment to an appropriate level of confidence and distributed over the timeframe for the commitment.

The planned commitment must be incorporated into the budget against the appropriate WBS element and work package. If there are insufficient funds remaining against the WBS to cover the commitment estimate, it cannot proceed without a request to draw from contingency (see the *Contingency* section below). Initiators of a commitment should discuss with the PMO to ensure the commitment is made at the appropriate place in the WBS and that funds can be made available.

12.3.4 Scheduled

The planned start date and completion date for the package must be identified so that the relevant activities can be incorporated in the Schedule (see the *Updating* section below).

12.3.5 Assigned to an Accountable Individual

The Accountable Individual for the commitment must be identified. As well as managing the commitment, the Accountable Individual will also be responsible for forecasting and progress reporting.

Every contract/order billing to the Project must be fully mapped against the WBS and associated with a work package.

12.4 Recognition of commitment

Commitments are recognised for the Project when the commitment value is recorded in Ellipse as a contract, assignment, or purchase order value. That value remains committed (and thus unavailable to use for other purposes) until it is released by the closeout of the contract, assignment or purchase order.

Every contract/order for the Project must be set up in Ellipse before work starts.

Every supplier cost against the Project is invoiced.

Every invoice (except for known special cases) must be matched to either a contract (>=threshold) or a purchase order (<threshold).

Invoices received with no matching contract/order will not be paid until a contract/order is set up in Ellipse.

13 Project accounting

13.1 Accruals

Accruals are a manual estimate of costs that have been incurred but not yet invoiced or journaled to the Project. Cost forecasts currently serve as the basis for accruals and variance analysis, with a vision that value of work done (***VOWD***) will eventually also be used in conjunction with cost forecasts.

Prior to each financial month-end closure within the Finance business unit, each CAM will work with the Project Accountant to compile the accruals for their responsible control accounts. This is achieved by going through each contractor and supplier that has been engaged in the month being completed, and approximations of a value that Snowy Hydro is likely to be invoiced for is calculated. The cost forecasts are used to start the conversations around which contractors were engaged and the likely amount of expenditure. This is captured at a WBS level.

Once all values are obtained for the Project as a whole, the information is then submitted to the BAU Finance team for upload into Ellipse.

The accruals are brought across to PRISM when the monthly import of actuals from Ellipse is completed.

13.2 Progress claims, invoice and payment management

As noted in Feasibility, the Project is considered likely to fall within the scope of the NSW security of payment legislation. The security of payment legislation in NSW consists of two acts: the *Building and Construction Industry Security of Payment Act 1999 (NSW)* (***BCISP Act***); and the *Contractors Debts Act 1997 (NSW)* (largely superseded). The Acts generally affect payment terms, including:

1. The payment claim process;
2. The principal's obligation to issue payment schedules;
3. Procedures in respect of withholding and disputed payment claims;
4. Obligations to submit to adjudication; and
5. Entitlement of subcontractors to recover debts.

These requirements are reflected in the payment terms of the contracts and in contract administration procedures. While not all Project contracts may fall within the remit of the legislation (broadly construction work and related goods and services), multiple payment processes are undesirable. Therefore, a single, BCISP Act-consistent approach will be adopted for invoice approvals for all Project contracts.

The Contractors will submit their Interim Payment Statement or progress claim in the form set out in the Contract or in a form that is otherwise approved by Snowy Hydro and will ensure all required prerequisites are met.

While the precise wording differs, both the EWR contract and the Civil and E&M contracts operate on a 15-day progress claim-to-payment cycle as shown in Figure 4.

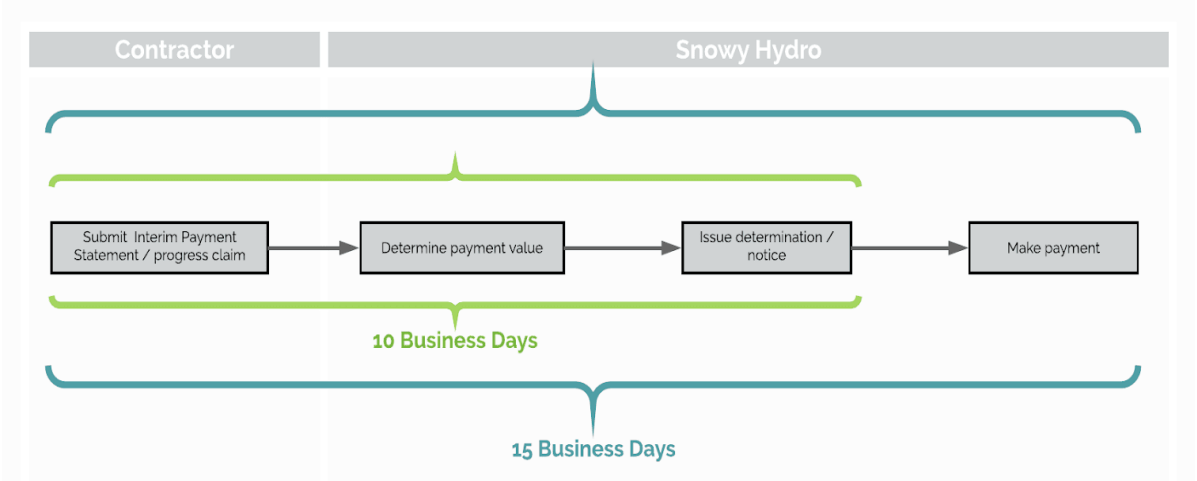

Figure 4: Payment cycle

Therefore the owner's team must keep tight control over the contract and ensure that the payment cycle is managed efficiently.

Note that the EWR contract conditions require that the Contractor must notify the Superintendent of any notice under Security of Payment Legislation. The Superintendent has the authority to respond.

The EWR contract conditions require that the Contractor makes progressive claims for payment. Progress certificate must be issued within ten business days of receipt of a claim or the claim is deemed to be the certificate.

The civil and E&M contract conditions require that an Advance Payment will be made within ten Business Days from receipt of the required documents, and will be repaid against interim payments. If there is no schedule of payments the Contractor must submit quarterly estimates.

Under the civil and E&M contract conditions, the Contractor issues statements for interim payment. A notice must be issued within ten Business Days of receiving a payment statement. Snowy Hydro must pay the Contractor within 15 days of receipt of the statement. If payment is delayed Contractor is entitled to financing charges. All payments are on account. The Contractor must promptly issue a tax invoice for the balance of the certificate, and Snowy Hydro must pay the Contractor within 15 days of receipt of the claim.

Payment claims should be submitted to Project Controls in the first instance for evaluation. Project controls will:

1. Receipt the claim in PRISM;
2. Note any gross errors on the claim, and resolve with the service provider if feasible (eg non-sequential or duplicate claim numbers, missing contract numbers, lack of supporting documents, calculation errors);
3. Identify and initiate resolution of any administrative issues (eg no assignment, insufficient funds);
4. Prepare the draft progress certificate and the payment schedule based on available information;
5. Send the draft to the Accountable Individual for valuation; and
6. Monitor timeliness.

The Accountable Individual for the contract is accountable for the detailed review and approval of progress claims/invoices submitted by their service providers/contractors. The Accountable Individual (with appropriate cost control, contracts, construction and engineering support) must review the service provider's supporting documents and either confirm the draft valuation or give an alternative valuation (with reasons).

The Accountable Individual must generally ensure:

1. Snowy Hydro is only being invoiced for work within the agreed scope;
2. Goods/services invoiced were actually provided and were of the expected quality;
3. Wastage and inappropriate expenditure is not charged to Snowy Hydro;

4. Service providers are properly contracted and claim in accordance with contract terms;
5. Any payment claim times or other security of payment obligations are being complied with; and
6. All subcontractors engaged by contracted parties are pre-approved by Snowy Hydro.

13.3 Cash flow reporting

The Owner's Team will be responsible for the development and maintenance of the Project cash flow forecast. The cash flow forecast will provide an estimate of the monthly commitment and expenditure forecasts for the Project and will be based on the Project schedule and progress information. Cash release will be forecast based on:

1. Contractors' forward estimates of cash flow;
2. Estimated lags between work completion and supplier invoicing under contractual payment terms;
3. Planned cash calls;
4. Neutral funding arrangements;
5. Pre-payments;
6. Joint venture/partner net contribution; and
7. Other factors as defined by local accounting practices.

Snowy Hydro will use the cash flow forecasts as a basis for management reporting and to make the necessary cash calls.

The contractors were required to provide a monthly estimated cash flow with their tender and then will update the forecast cash flow following every interim payment.

14 Contract close-out

See *Supporting Chapter Two* for the contractual aspects of close-out.

On notification of a contract closeout, the contract commitment must be released in project systems.

In PRISM the contract will be marked as complete. Any residual funds against the contract commitment are released back to the parent control account through an executed change to remove the unused balance.

In Ellipse the contract will be closed out following processing of the final invoice, and funds returned to the parent work order.

15 Supporting information

There is no supporting information for this chapter.

16 Definitions and abbreviations

AC	Actual Cost
AIPP	Australian Industry Participation Plan
BAC	Budget at Completion
BAU	Business-As-Usual
CA	Control accounts
CACO	Control Account Change Orders
CAM	Control Account Manager
CAP	Corrective Action Plans
CCO	Contract Change Order
CO	Change Orders
CPI	Cost Performance Indicators
DAAB	Dispute Avoidance and Advisory Board
EAC	Estimate at Completion
EC	Executed Change
EoT	Extension of time
EPC	Engineer-Procure-Construct
ESS	Executive Summary Schedule
ETP	Early Termination Provision
EV	Earned Value
EVM	Earned Value Management
EVMS	EV management system
EVPM	Earned Value Performance Management
EWR	Exploratory Works - Roads
FID	Final Investment Decision
GBR	Geotechnical Baseline Report
GST	Goods and Services Tax
ICS	Information and Control Systems
IM	Information Management
LOE	Level of Effort
NOI	Non-Order Invoice
OBS	Organisation Breakdown Structure
PCMP	Project Controls Management Plan
PCP	Procurement and Contracting Plan
PMB	Performance Measurement Baseline
PMO	Project Management Office
PV	Planned Value
RAM	Responsibility Assignment Matrix
RFI	Request For Information
RoC	Rules of Credit
SoW	Statement of Work
SPI	Schedule Performance Indicators
VAC	Variance at completion
VOWD	Value of work done
WBS	Work Breakdown Structure

17 Bibliography

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