SDP Capital Works Project Summary

Project Title / Asset	Drinking Water Pumping Station - Additional Pump
Project Driver	Reliability / Availability

Purpose

The purpose of this document is to provide a high-level overview for major projects, further detailed information is available on request. Major projects have been defined as any capital expenditure that includes the addition of new assets to the Sydney Desalination Plant (Plant).

Information/justification on other elements of the proposed capex program (e.g. refurbishments and replacements of existing assets) are available on request.

Project Background

Inherent in the original design of the Plant, the Drinking Water Pumping Station (DWPS) capacity and reliability presents a risk that has the potential to impact on water security during operations. The DWPS was constructed by an Alliance between Sydney Water Corporation and other private sector constructors/designers and was designed to a different standard and a lower availability (85%) than the balance of the Plant (94%). Therefore, the DWPS has a higher probability of failure and can potentially restrict the Plant from achieving its required water production rate. The effect of a failure in the DWPS is not accounted for in the assumptions of Plant availability and therefore in the Plant's nameplate capacity of 250 ML per day on average or 91.25 GL per annum. As a result, the system is theoretically under-designed to meet its water supply requirements.

Improved DWPS availability is necessary to fully achieve the obligations placed upon Sydney Desalination Plant Pty Limited (SDP) through its current operating licence obligations to maximise the production of drinking water, and its new operating licence obligations to produce up to 250 ML per day (250 ML/d) on average over a year, and to be readily available and flexible to respond to other production requests through the year to provide resilience/security of Sydney's water supply. Installing an additional (stand-by) pump is the most effective action to manage the water security risk related to maintaining supply, by reducing the potential for supply to fall below the required Plant output.

The need to improve the reliability of the DWPS was first raised by SDP in its 2017-2022 Regulatory Submission which proposed installing a supplementary low flow pump (ref Advisian 2017 Price Reset Water Security report dated 13 Oct 2016). Whilst the justification for the capital expenditure was endorsed by IPART, the proposal to install the extra pump in Water Security Mode was not deemed efficient and instead the installation and subsequent maintenance cost allowances were to be deferred until a Plant restart (triggered by dam storage levels).

In late 2018, as dam storage levels fell towards the restart dam level trigger, SDP initiated the project and an extensive optioneering review and basis of design was undertaken to assess the most economic and practical solution. The selected option and proposed scope involves installing a supplementary Nijhuis pump that is the same size and model as the existing pumps, only with a smaller impeller to meet a lower duty of 101ML/d and a theoretical minimum flow of 85ML/d (ref KBR Options Report - SEG850-0005-TD-WE-REP-0001 _0, KBR Basis of Design & Concept Drawings)

The proposed solution had an estimated delivery timeframe of 70 weeks, which could not be accommodated within the restart period and hence presented risks to production that were not accepted by SDP.

Options were investigated to expedite the delivery timeframe taking into consideration time, cost and risk. The analysis concluded that even if every acceleration measure was adopted (estimated at an additional $250,000 and considerable risk) the delivery timeframe could be reduced to 38 weeks. This would have placed the final cut-over of the new pump into the existing delivery pipework in the final month of the restart period. SDP concluded that proceeding with the design and installation of the additional pump would not be prudent nor efficient, would be detrimental to the restart and ultimately conflict with the objective of maximising the production of drinking water during a period of drought.

A decision was made by SDP to cease with the installation of the third pump, and to mitigate the risk of operating the DWPS at a lower availability, conduct a reliability assessment in the form of a Failure, Modes and Effects Analysis (FMEA). The original consultant Covaris, used by Sydney Water during the design of the DWPS, was engaged to perform these works. The assessment identified several severe risks to production and proposed some key recommendations and opportunities to improve the performance of the DWPS (ref FMEA report). A number of recommendations from the FMEA were implemented in the 2017-2023 Regulatory Period following the SDP Capital Works procedure.

Whilst improvements have been investigated and/or implemented on some of the high-risk assets identified in the FMEA (such as completing periodic maintenance on the variable speed drives, upgrades of shaft 11 analysers, internal inspections of existing pump assemblies, etc.), the long-term water security risk has not been addressed and the need to install a stand-by pump remains.

Asset Details

Asset	Drinking Water Pumping System, including; pumps, motors, variable speed drives, valves, pipework, electrical, civil and structural works.
Asset durability/ design intent/ asset management Strategy	Civil assets: 100 years Buildings structures: 50 years Mechanical assets: 25 years Electrical assets: 25 years Instrumentation / control assets: 15 years SCADA assets: 10 years Preventative maintenance will be required on the new assets, consistent with the current/existing maintenance schedules and original equipment manufacturers (OEM) recommendations.
Asset Function/ Subsystem/ System	A critical component of the Plant's delivery of water to Sydney's drinking water system is the DWPS. The DWPS transfers water from the Plant's drinking water tank into Sydney Water's distribution network at Erskineville via the Desalination pipeline that runs from the plant at Kurnell, across Botany

	Bay to Sandringham, then Tempe and eventually to Sydney Water's Shaft 11C into the City Tunnel at Erskineville. The DWPS consists of two horizontal split case Nijhuis pumps (137ML/d nominal capacity), driven by water cooled ABB electrical motors (rated at 1350kW). The two pumps operate in duty to deliver a nominal flow of 275ML/d, with a designed availability of 85%, which equates to 85.3 GL/y. Validation of the system during original build commissioning has shown that the DWPS has capacity to exceed 275 ML/d and provide as much as 310ML/d, however this does not mean that Sydney Water have the ability to accept flows at these higher rates.
Asset Failure and its consequence	Currently, there is no redundancy for the drinking water pumps, with both required to operate to meet the 250ML/d average supply requirement. As such, should one pump fail the remaining duty pump can only delivery a maximum flow of around 185ML/d (depending on system resistance).

Justification

There is currently no redundancy for the drinking water pumps - should one pump fail the remaining duty pump can only deliver a maximum flow of around 185ML/d. The DWPS has a higher probability of failure than the overall Plant and can potentially restrict the Plant from achieving an average annual water production rate of 250ML/d or from responding quickly and reliably to an emergency flow request from Sydney Water.

This water security risk was raised by SDP in the regulatory submission for the 2017-2022 Regulatory Period with the proposal based on providing a low flow pump. Whilst the justification for the capital expenditure was endorsed by IPART, it considered that the installation and subsequent maintenance cost should be deferred until a Plant restart (triggered by dam storage levels). However, in practice, this was not feasible due to lead times, the Plant restart process and the ongoing objective of maximising water supply.

Under SDP's new operating licence conditions, the requirement to meet an average production rate of 250 ML/d and produce 91.25 GL over the year remains. The operational expectation is that exceeding this during times of drought (i.e. maximising production) would be beneficial to customers even if this is not a defined licence condition. An additional requirement is that the Plant can respond in a timely manner to other requests from Sydney Water. Under the current two pump duty/duty configuration, the maintenance strategy is to undertake routine maintenance to limit failures, and in the event of a failure, to reduce capacity while it is rectified. This strategy is less risky when responding to an annual production order, but may put at risk any chance of exceeding 91.25 GL/a or reliably produce 250 ML/day over the shorter term. Arguably the driver for an additional pump in the DWPS is increasing under the new operating licence conditions and Greater Sydney Water Strategy (GSWS).

Given the proposed new operating regime the installation of a third pump can be planned and implemented in consultation with Sydney Water to minimise disruption to water supply during a

time where the Plant's availability is less critical, in order to provide resilience for when the Plant is required.

Options Considered

KBR were engaged to assess the options to provide a pumping solution, that in the event of one of the existing pumps being unavailable, would allow the Plant to maintain a 250 ML/d average supply.

The following options were identified and considered:

Option 1 – Extensive Inventory of Spares
Option 2 – Identical Spare Replacement Pump
Option 3 – A New Additional Supplemental Flow Pump within Existing Building
Option 4 – Two (2) New Pumps with Full Flow Capability within the Existing Building
Option 5 – A New Additional Supplemental Flow Pump within a Building Extension
Option 6 – A New Additional Identical Pump within the Existing Building
Option 7 – An Additional Identical Pump within Building Extension
Option 8 – Larger Impellers in Existing Pumps
Option 9 – Two (2) New Pumps with Full Flow Capability and Ultimate Uprating Option

A number of aspects for each discipline of Electrical, Civil, Mechanical, Structural and Piping were considered in each option and the options were assessed against the following criteria:

- Supply Security - ability to provide a minimum 266 ML/d @58m head with one pump offline, so that the 94% up time of the plant as a whole is not impacted by the DWPS.
- Low Flow ability – this figure is provided to show the lowest possible flow from the arrangement.
- Max Flow – this figure is provided to show the maximum possible flow from the arrangement with one pump not operational.
- Relative Cost – this figure is provided to give relative order of magnitudes and the values should not be considered absolute.
- The impact of the option on the 550 ML/d expansion – this only provides information on how the option impacts the expansion and not how retained existing installation might impact on or be impacted on by the expansion.

KBR's recommendation considered that option 3 would be the most advantageous and most likely to provide the best benefit as this option was deemed most efficient whilst providing the required availability and reliability. It was further recommended, as a subset of this option, that the impeller be modified to allow for greater flexibility in flow rates.

Full details are available on request in KBR Options Report - SEG850-0005-TD-WE-REP-0001 _0.

Proposed Scope

An additional pump will be installed in the existing pump hall. The pump will be of the same size as the existing pumps, utilising the existing spare rotor and the existing spare VSD to implement the design.

As part of the design it will be necessary to install the VSD in the existing electrical building in a similar manner to the current installations. A new high voltage (HV) switchgear and contactor panel

will also be required, and they will be to the same design as the existing. There is enough space to complete this alteration utilising existing trenches and cable trays.

A new pump control panel will be required, interfacing with the existing SCADA system. The current Functional Design Specification (FDS), which is the basis of the control system architecture for the process area, requires modification to determine any changes to the operational philosophy. It is expected this philosophy will be similar to the existing, with single pump operation, or only two pumps possibly running at once. Therefore, the FDS is expected to be changed to incorporate an additional pump, and to allow any combination of one or two pumps to operate simultaneously aligned to the existing control philosophy.

The design has considered measures to minimise the time and effort required to implement the changes. Where possible, existing infrastructure has been utilised to incorporate the modifications in an effort to minimise time and costs.

In order to fit the new pump into the existing building, one of the drinking water pumps (PMP11) would need to be modified by changing the side on which the motor sits. This requires that:

1. The motor has the fan reversed to allow for the changed operating direction.
2. The heat exchanger piping be altered to utilise the opposite side.
3. The terminal box on the opposite side of the motor be used.
4. A smaller coupling be used for the coupling of the motor to the pump.
5. The pump impeller be turned around on the shaft so that it alters the side on which the pump sits.
6. A new plinth be installed for the motor.
7. Alterations are made to the access ways.
8. A new cooling water pump is installed.

In addition to the changes to the existing pump, the following changes will be required for the existing spare motor:

1. The motor has the fan reversed to allow for the changed operating direction.
2. The heat exchanger piping be altered to utilise the opposite side.
3. The terminal box on the opposite side of the motor be used.
4. The existing motor would need the base support altered to fit on the existing anchor bolts that would remain behind after PMP11 motor is moved.
5. The existing PMP11 cooling water pump is utilised.

The new transfer pump will require:

1. A new plinth for the pump.
2. New access platforms.
3. New piping.
4. The direction of rotation and driven side nominated to suit the installation.

The key structural scope will require:

1. Penetrations in the concrete wall for the suction and discharge piping.
2. Additional footings for the existing pump PMP11 motor.
3. Additional footings for the new pump.
4. Additional footings for the support of the suction and discharge piping.
5. Minor footings for structure and cooling water pump.

Additional considerations include:

1. The piping arrangement for the pumps would reuse the existing piping design as much as possible to enable use for the expansion, and to make components identical for spares compatibility.
2. The piping tie-ins to the existing suction and discharge headers were located to align with one of the intended tie-in points for the expansion of the plant.
3. The layout of the structural walkways requires significant alteration.
4. Modification required to existing cable routes and trays, along with additional power and control cables.

Full details of the project are documented in the KBR Basis of Design Report & Concept Drawings and are available on request.

Cost Estimate

Estimated Capital Project Cost is [redacted] based on a mix of budget quotations from suppliers and estimated values. The project cost is subject to change based on a competitive tender process and is intended to be an indicative value only.

Estimated Opex Cost is [redacted] per year.

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Project Summary

Proposed Layout