Tuas Water Reclamation Plant (TWRP) Digital Journey

SAFETY • SCHEDULE • BUDGET • QUALITY

PUB SINGAPORE'S NATIONAL WATER AGENCY

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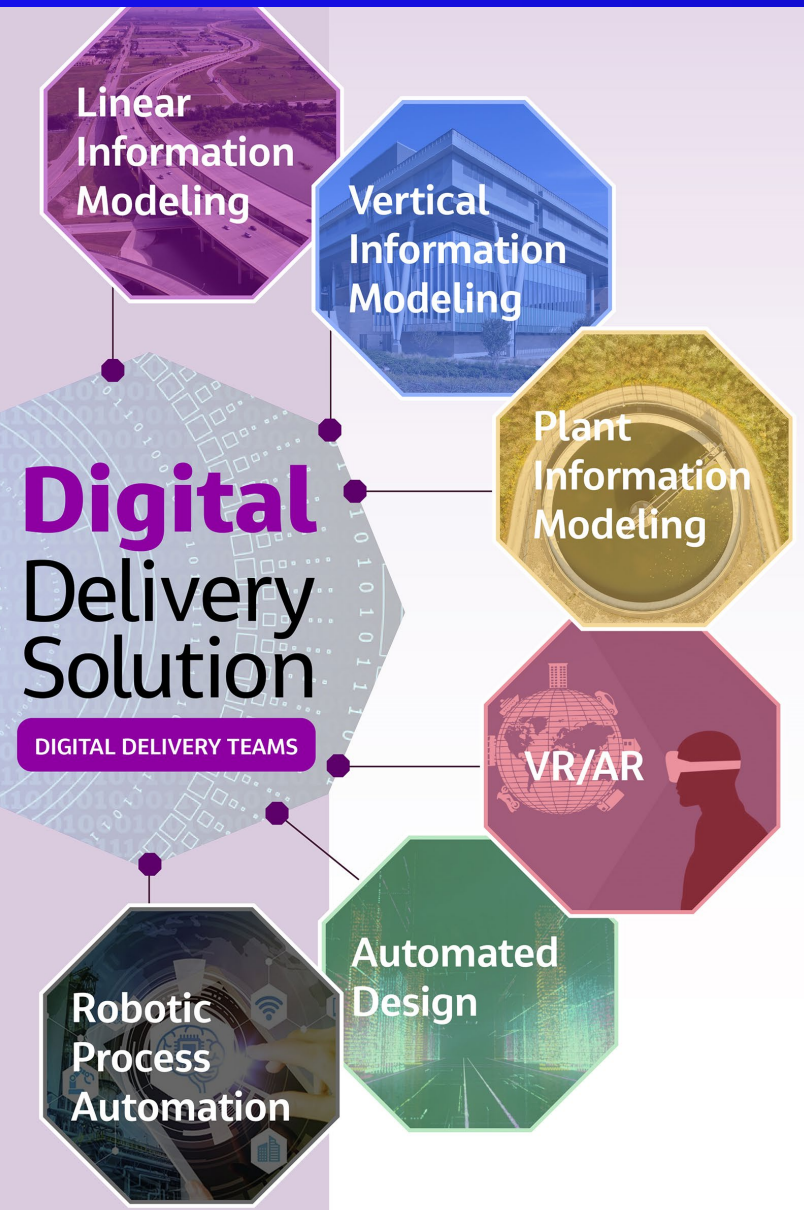
Jacobs Digital Delivery Solution



The Digital Delivery Global Solutions continues to drive innovation by connecting, leading, and growing our internal capabilities and external market presence. Leaders supporting our Linear, Vertical, and Plant Information Modeling as well as Automated Design, Robotic Process Automation, and VR/AR initiatives aide the mission of the greater Digital Market.

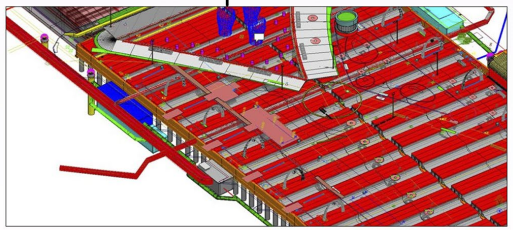
Developing a strong bond between these subject matter experts will allow Jacobs to collectively deliver the most forward leading technologies to our clients as well as recruit and retain a talented diverse workforce while continuing to establish our core strategic pillar of Digital Connectivity.

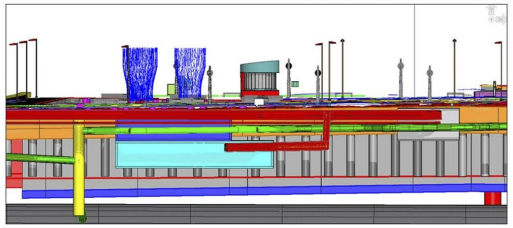
Linear Information Modeling

WHAT IS IT?
Linear infrastructure and assets, such as highways and railways, from planning through construction.

EXAMPLE: Making the most of the Bentley application suite and leveraging all available modeling data, this multi-discipline project has the greatest chance for success.

This deck park project (over a TxDOT system highway) includes designs from transportation, built environment, transportation and non-transportation structures, water infrastructure and utilities. The best and only way to adequately check and mitigate design conflicts is to have a fully developed, all-inclusive 3D model with which anyone can complete proper design verification and conflict assessment.





Vertical Information Modeling

WHAT IS IT?
The Built Environment and Advanced Facilities markets through building modelling and related architectural and engineering automation.

EXAMPLE: Building Modeling and Digital Solutions are crucial to designing for our client's requirements. Visualizations Tools such as Augmented Reality and Virtual Reality coupled with Reality Capturing give Architects and Engineers the tools to present their innovative work. Tools like these can be used in various fields such as Infrastructure, Municipality, Federal, Highrise, and many others.

Plant Information Modeling

WHAT IS IT?
Water, Energy and Power, and related markets as well as process mechanical, piping modeling, and P&ID automation.

EXAMPLE: With collaboration and reliability of the design environment, the following projected results from the use of the Bentley tool set and custom automation solutions and workflows summarize key efficiencies:

- Titleblock management of over 5600 sheets via ProjectWise and Bluebeam saved the project over 400 hours per submittal.
- Persistent model referencing of all discipline content using a structured container model approach for each facility, saves the design teams countless hours per submittal in searching and referencing cross discipline content.
- Efficiencies gained in the automation applied to the replication of the four parallel treatment trains saved the design team an estimated 4,800 hrs over manual duplication.

Automated Design

WHAT IS IT?
Generative design, computational design, parametric design, rapid prototyping, software scripting driven design, or advanced automated analysis capabilities.

VR/AR

WHAT IS IT?
The future of work and distributed workforce through digital interaction and advanced visualization of designs and data, remote assist, and virtual learning/mentoring/training.

Robotic Process Automation

WHAT IS IT?
End-to-end automated workflows connecting tools to systems, automating data capture and extraction (migration)/analytics (calculation), and predictive asset management (alerting/reporting/validation) (ex. environmental impact assessment through data capture, sensoring, and connected environments).

TWRP Project Introduction

PUB DEEP TUNNEL SEWERAGE SYSTEM PHASE 2

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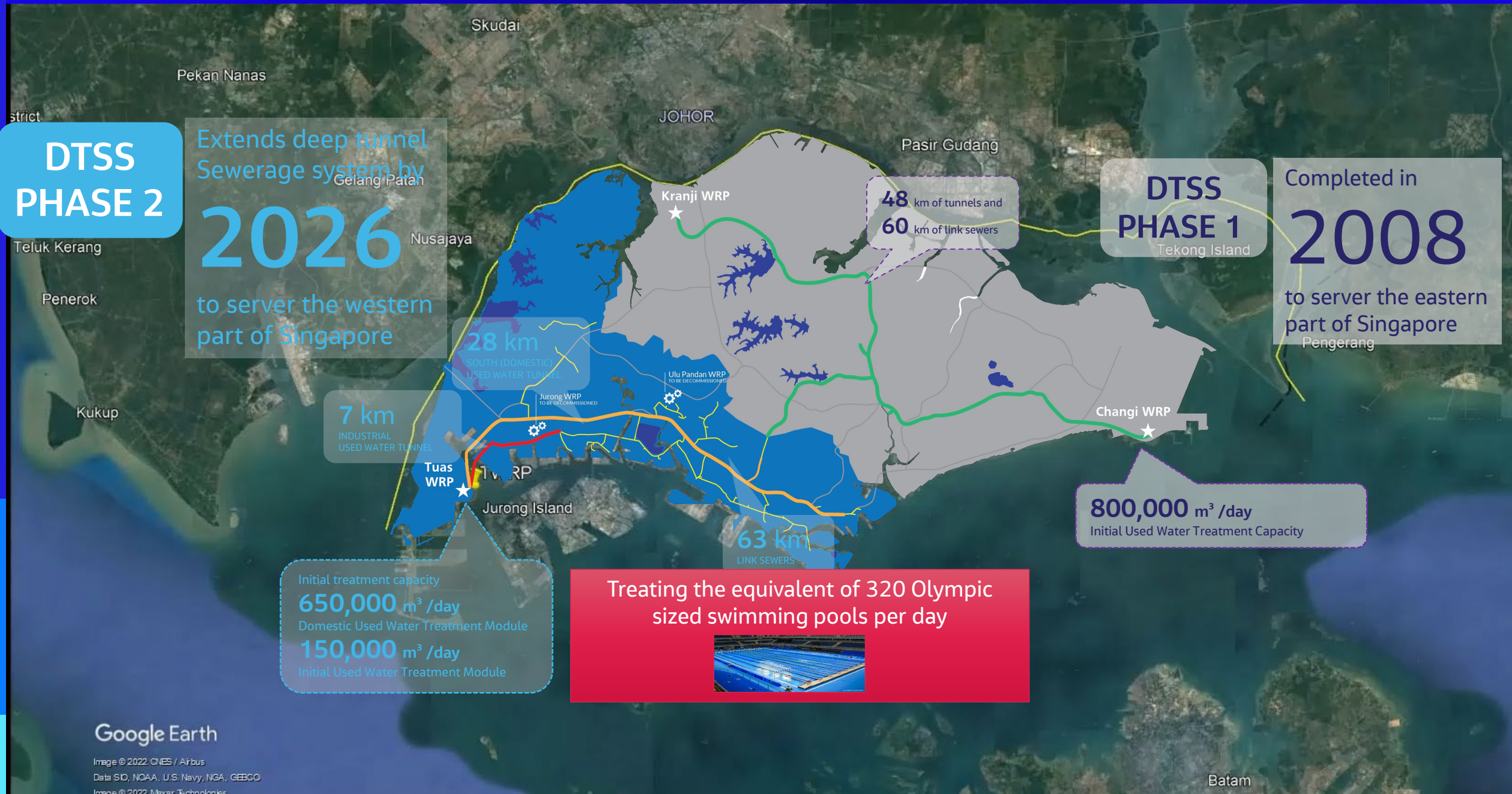
Deep Tunnel Sewerage System (DTSS)



DTSS PHASE 2

Extends deep tunnel Sewerage system by

2026

to server the western part of Singapore

28 km
SOUTH (DOMESTIC) USED WATER TUNNEL

7 km
INDUSTRIAL USED WATER TUNNEL

63 km
LINK SEWERS

48 km of tunnels and
60 km of link sewers

DTSS PHASE 1
Tekong Island

Completed in

2008

to server the eastern part of Singapore

800,000 m³ /day
Initial Used Water Treatment Capacity

Initial treatment capacity
650,000 m³ /day
Domestic Used Water Treatment Module
150,000 m³ /day
Initial Used Water Treatment Module

Treating the equivalent of 320 Olympic sized swimming pools per day

TWRP – Jacobs Scope

Regulatory Authority Approvals Management

Information Management

Project Management

Commercial Management

Construction Management

Prelim. & Detail Design

Project Controls

6D Delivery/ Digital Twin Enablement

Design & Tender Management

Comms., PR and Media

17 Tier-1 Contract Packages

Meeting UN Sustainability Development Goals

TWRP Integrated Digital Delivery

PUB DEEP TUNNEL SEWERAGE SYSTEM PHASE 2

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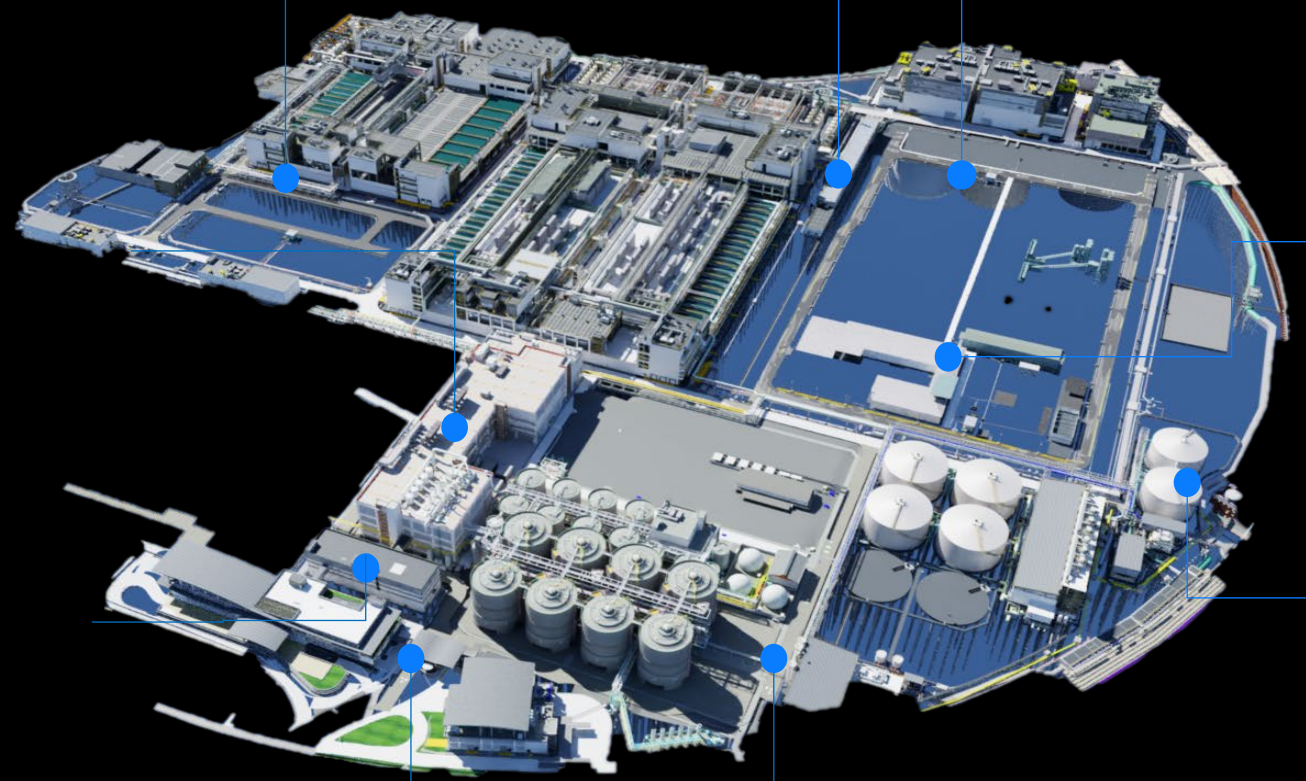
TWRP Integrated Digital Delivery

PUB DEEP TUNNEL SEWERAGE SYSTEM PHASE 2 Jacobs

PHOTOGRAMMETRY
Construction progress review with Reality

DATA VISUALIZATION
Visualize model per data category for management

MODEL REVIEW
Navigate, Walkthrough, Data review, Sectioning



ENHANCED USER / OPERATOR EXPERIENCE
Immersive experience for operator/ owner feedback

MODEL BASED TENDERING
Improved tenderer understanding and increased accuracy of submissions

4D SEQUENCING
Integrate contractors' 4D for interface coordination and logistics

ADVANCED DESIGN AUTHORING
Intelligent plant design and collaboration

6D P&ID
Customized P&ID to provide intelligent data for Operation and Maintenance phase

INFORMATION MANAGEMENT
Adoption of Common Data Environment

Key VALUE ADDTIONS from digital delivery in TWRP

Reduced traditional timelines for multidisciplinary design tendering process of major contracts by **50%**

Digital platforms coupled with value engineering reduced over **5%** of the forecast capital expenditure

Removed the time and resource needs for over **1000+** 2D drawings

75% reduction in model federation time

- Upskilling of 300+ staff across all the organizations involved in the project
- Access to the right data at the right time for all estimated to be faster thanks to the digital tools adopted on the project
- Successes at TWRP now a benchmark for model-based tendering in Singapore
- Cultural change in the project – everyone accesses project information digitally
- Industry collaboration continues to bring better solutions to clients and markets

Democratize information accessible to everyone in TWRP

Conclusion

- Tools to be fit for purpose
- Proper collaboration is important
- The right people, processes and strategy are key for the success
- Digital transformation is continuous process
- Success in digital delivery = Success in the project delivery

Together with Jacobs, we have been able to create a collaborative platform and make step changes in the digital engineering application for our Tuas Water Reclamation Plant project. Coupled with the engagement of the supply chain from day one, we have been able to achieve the benefits of integrated planning, design and implementation. We hope to take our journey's success and lessons learnt and propel the industry forward in the space of digital delivery.

Mark Wong, Senior Deputy Director
PUB, Singapore's National Water Agency

CONTRACT 1A – SITE DEVELOPMENT WORKS

MCCONNELL DOWELL S.E.A PTE LTD

CONTRACT 2A – INFLUENT PUMPING STATIONS

KOH BROTHERS-CHINA HARBOUR JV

CONTRACT 2B – PRODUCT WATER PUMPING FACILITIES

CHINA HARBOUR (S) ENG. CO. PTE LTD.

CONTRACT 3A – INDUSTRIAL LM 1 & 2 – C&S WORKS

CHINA STATE CONSTRUCTION ENG. CO. LTD.

CONTRACT 3C – DOMESTIC LM 1 & 2 – CIVIL & BUILDING SVCS

SINOHYDRO CORPORATION LIMITED (SG BRANCH)

CONTRACT 3D1 – DOMESTIC LM 1 – MEICA & NEWATER

UES HOLDINGS PTE LTD

CONTRACT 4A – BIOSOLIDS & DIGESTERS

CES_SDC PTE LTD

CONTRACT 5A – PLANT MONITORING & CONTROL SYSTEM

ABB PTE. LTD.

CONTRACT 3B1 – INDUSTRIAL LM 1 – MEICA

KOH BROS BUILDING & CIVIL ENG. CON. (PTE.) LTD.

CONTRACT 3D2 – DOMESTIC LM 2 – MEICA

UES HOLDINGS PTE LTD

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