Fact Sheet on PUB's Request for Proposal (RFP) on Low-Energy Seawater Desalination Solutions (ref. no.: LLW-DIVP)

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Present Call

1. Water demand in Singapore is projected to almost double by 2065. To meet the nation's needs amidst the challenge of climate change, weather-resilient sources of water such as seawater desalination is expected to become a major source of Singapore's water in the future. It is hence critical to ensure the sustainability and reliability of this water resource for the long-term and continued growth of Singapore.

2. Seawater desalination is an energy-intensive treatment process. With the anticipated growing dependence on this resource, improving the energy efficiency for desalination has been a key research priority for Singapore. Seawater desalination plants comprising the typical process shown in Appendix 1 consume about 3.5 kWh/m^3 at a recovery of about 50%. PUB's goal is to reduce the energy consumption for seawater desalination to less than 2 kWh/m^3 at the entire desalination plant level through technology and process innovation. To achieve this, significant research efforts have been directed to improve various desalination steps through innovative solutions, such as ceramic membranes for the pre-treatment, ultra-permeable membranes for both Seawater Reverse Osmosis (SWRO) and Brackish Water Reverse Osmosis (BWRO), and blue energy harvesting by Pressure Retarded Osmosis (PRO). Appendix 2 summarises the seawater desalination technologies that have been tested by PUB and the corresponding potential energy reduction.

3. While substantial investigation has been made at individual unit process level, one R&D gap lies in integrating the technologies and optimising them together at the system level. Under the Centre of Excellence (CoE) Programme as part of RIE2025, PUB in partnership with the Separation Technologies Applied Research and Translation (START) Centre will design and operate a Desalination Integrated Validation Plant (D-IVP). The D-IVP aims to integrate state-of-the-art technologies, and configure and optimise them at the system level to push the lower bound of energy needed for seawater desalination. The technologies identified and demonstrated at scale will form the design basis for building new full-scale desalination plants in Singapore in the future.

4. There are two parallel trains at D-IVP, namely Train A and Train B, each with a production capacity of 2,250 m^3/d. Train A will be retrofitted with commercially available technologies, including ceramic membrane (for pre-treatment), best-in-class reverse osmosis (RO) membranes and energy recovery device. A schematic of the process is shown in Appendix 6. The train will be operated as a baseline train for comparison with Train B, which is available for modification under the scope of this RFP (Train A is outside the scope of this RFP).

5. This RFP solicits solutions on low-energy seawater desalination systems that cover the entire desalination process from after seawater intake to before post treatment, to be installed and tested at Train B of D-IVP. Applicants are requested to propose innovative total system technologies/solutions that can lead to a breakthrough in seawater desalination domain and meet the following criteria:

    a. Use seawater with typical quality listed in Appendix 3 as the feedwater;

    b. Produce water that meets the target product water quality standards in Appendix 4 before post treatment with chemical dosing;

    c. Demonstrate a total system energy consumption of 2 kilo-watt hour per cubic meter of water produced (2 kWh/m^3). The total system energy shall comprise of energy consumption for all processes from seawater intake to before post treatment.

6. Proposed solutions shall achieve a total energy consumption of 2 kWh/m^3 and meet the product water quality standards in Appendix 4. Solutions which are able to meet the total energy consumption but not the stringent operational water quality requirements in Appendix 4 may still be considered in this RFP, if the product water meets the Environmental Public Health (Water Suitable for Drinking) Regulations 2019[1]. The expected product water quality shall be mentioned in the proposal.

7. The following areas could be considered in the proposed solution:
    a. Innovations in SWRO design and operation, for example,
        - Using novel 8-inch SWRO membranes of higher permeability without significant compromise to salt rejection
        - Optimising recovery rate
        - Reducing the energy consumption from intake to high pressure pumps
        - Improving the energy efficiency of pumps and motors
        - Designing plant hydraulic profile to minimize number of pumping steps
    b. Alternatives to the first-pass and second-pass RO
    c. Innovations in pre- and post-treatment, for example,
        - Alternatives to coagulation and ultrafiltration
        - Post-treatment for a one-pass RO design
    d. Innovations in energy recovery device (ERD)
    e. Innovations in digital solutions, for example,
        - Preventing fouling and biofilm formation
        - Optimizing recovery, energy, chemicals, maintenance or the total system as a whole

8. Proposals using renewable energy (e.g., solar, wind, nuclear) and waste heat beyond what can be reasonably generated within the land footprint of D-IVP will be viewed less favourably in this RFP. Proposals using such energy sources are to articulate the feasibility of the approach in the wider Singapore's context.

9. Applicants are expected to collaborate with various technology providers to propose a total system solution comprising the entire desalination process from after seawater intake to before post treatment. **Proposals covering only a unit process or part of the desalination process will not be considered in this RFP.**

10. The proposed unit processes in the total system level seawater desalination solution shall be at Technology Readiness Level (TRL) of 6 or higher, and ready to be installed at demonstration scale in the D-IVP for testing. All the proposals submitted shall articulate how the proposed technologies require less energy consumption against the current state-of-the-art. At the end of the project, the TRL is expected to progress by at least two levels, unless otherwise justified in the proposal. Please refer to Appendix 7 for the definitions of TRLs.

11. Despite focusing on energy consumption, the proposal is required to address the proposed solution's anticipated performance in other aspects as well, such as chemical usage (kg/m^3), water recovery (%), water quality, sludge generation (kg/m^3), land footprint (m^2/m^3), capital cost (S$/mgd) etc. This performance shall form part of the project deliverables. A techno-economic analysis should also be provided in the proposal.

[1] Details can be found in following website:
https://www.pub.gov.sg/Documents/Singapore_Drinking_Water_Quality.pdf.

12. The proposal shall articulate how the unit processes would work together to enable the achievement of the energy target and the impact on individual unit processes when one of them is optimised for energy. In addition, the proposal shall consider the site conditions and constrains at D-IVP. Please refer to Appendix 5 for information on the existing D-IVP. **A site showround will be conducted on 20 April 2023, 9.30am** at D-IVP, 62 Pasir Ris Drive 3, Singapore 519499. Attendance at the site showround is not compulsory.

13. As START is operating the D-IVP on behalf of PUB, applicants would need to include START as a collaborator during the proposal finalisation at the end of the Full Research Proposal evaluation stage. During the project, START would be involved in facilitating the installation, commissioning and operation of the proposed system. After the project ends, START would take over the new train to continue with the optimisation if needed. The project team may discuss with START on their roles during the Full Research Proposal stage and include other scopes of collaboration with START in the final proposal.

General Requirement

14. All research activities must be carried out in Singapore. Cross-disciplinary and multi-disciplinary research proposals are strongly encouraged, as well as proposals from research consortia involving partners drawn from different private and public organisations and academic institutions, including international collaborations with renowned experts to introduce new research capabilities and transfer of technical expertise to Singapore. Proposals with industry collaborators, especially those with good track record in desalination plant design, and commitments in the form of industry spending will be viewed favourably.

15. R&D proposals already funded by other agencies or being considered for funding by other agencies will not be considered under the present call. PIs will need to declare other funding sources in the application.

Eligibility and Funding Support

16. This call is open to Institutes of Higher Learning (IHLs), public sector entities and private sector companies based locally in Singapore or overseas. Non-Singapore entities are required to meet the additional condition in para 19.

17. Under this RFP, the total funding support received by private sector entities would be up to 70%. IHLs and public sector entities will qualify for 100% funding support of approved qualifying costs and 20% overheads.

18. For the funding portion from NRF[2], the support for non-Singapore entities is up to 30%, Large Local Enterprises up to 50%, Singapore Small Medium Enterprises, start-ups and not-for-profits up to 70%. Please refer to Appendix 8 for the definitions of different enterprise segments. Other funding sources may be available to offset the remaining funding, but would be capped at the levels indicated in para 17.

[2] One of the funding schemes with NRF is Living Lab (Water) under the Urban Solutions & Sustainability (USS) domain as part of RIE2020. The aim of Living Lab (Water) is to accelerate the commercialisation of new water technologies by reducing the risk involved in early adoption of technologies that are close to operational stage.

19. Funding for non-Singapore entities will be conditional on the appointment of a local Singapore Technology Licensing Office (STLO) (e.g., IHL IEOs and A*STAR) to manage the foreground Intellectual Property (IP) in Singapore for maximum utility, and also help to provide fair access to Singapore entities in the public and private sector. The STLO will carry out IP management services, including responsibilities and obligations necessary to file, prosecute and/or protect the IP applications, manage and license the sponsored IP minimally in Singapore. This is regardless of whether a public research performer is involved in the project.

Application Procedure

A. Stage 1 – White Paper

20. To apply, the applicant **MUST FIRST** submit a White Paper of not more than 15 pages using the 'Living Lab (Water) Research Proposal Form_White Paper' which can be downloaded from the online Integrated Grant Management System (IGMS)[3] system. Please refer to **Annex A** for detailed guidelines for the submission of the White Paper.

21. The White Paper shall include, but not limited to:

    a. Proposal description: a succinct elaboration of the proposed technologies and how it can fulfil the aforementioned criteria, including

        i. Process design and its novelty, including innovative system optimisation solution(s)

        ii. Technology and scientific principles for each unit process and system optimisation solution, including comparison with current global state-of-the-art, a brief technology review and its impact to energy of upstream and downstream processes

        iii. Potential technology providers for each unit process and system optimisation solution

        iv. Preliminary plan for retrofitting the proposed technologies at D-IVP

        v. Projected energy consumption at unit process and system level, and basis of the estimation/calculation, including preliminary results from desktop simulation of the proposed system where possible

        vi. Techno-economic analysis

    b. Organisation of the development team including consultants, if any. Details on the key personnel, their responsibilities, background, work experience and their qualifications relevant to the project are to be provided. Additional sheets (outside the 15-page limit) can be attached to include the proposers' CVs and selected publications, the list of cited literature, etc.

    c. Expected outcomes and proposed quantitative technical key performance indicators (KPIs) for the project, including energy consumption and other aspects

    d. Timeline for the project

[3] https://researchgrant.gov.sg

e. Estimated budget required

f. Other relevant information as determined by the PI

22. Promising White Papers short-listed will be **INVITED** to develop a Full Research Proposal. These short-listed applicants will be given approximately **2 months** to develop the Full Research Proposal.

23. The deadline for the White Paper submission is on **16 May 2023, 4:00 pm** (Singapore time, GMT +08:00)

B. Stage 2 – Full Research Proposal [For information for successful applicants proceeding to Stage 2]

24. The Full Research Proposal shall include, but not limited to:

a. Finalised process design, technologies and technology providers

b. Detailed scientific principles of the proposed technologies, including detailed comparison with current global state-of-the-art and a brief technology review

c. Detailed consideration of how the unit processes would work together and the impact on individual unit processes when one (or more) of them is (are) optimised for energy

d. Full technical details on the methodology and technological development of the proposal, including P&ID, layout drawings of the equipment retrofit at D-IVP, equipment specification, etc.

e. Detailed energy consumption projection at unit process and system level, including results from desktop simulation of the proposed system

f. A system level optimisation plan to minimise energy consumption

g. Detailed techno-economic analysis

h. Project team member's expertise, previous related work and experience (2-page CVs shall be submitted each for the Lead Principal Investigator (PI), co-PIs and all other collaborators in the format specified in Annex F)

i. Timeline for the project, showing intermediate milestones to be achieved

j. Expected research outcomes, and proposed KPIs for the project, including energy consumption and other aspects

k. General business plan: how the Intellectual Property (IP) created will be owned and commercialised, and how this will benefit Singapore

l. Detailed budget required for the project (broken down into individual categories of manpower, equipment, consumables, travel, consultancy services, others)

25. A separate form (with further details) for the Full Research Proposal submission would be made available to invited applicants for the shortlisted White Papers.

Evaluation Criteria

26. White Papers received will be evaluated by PUB R&D Project Evaluation Panel (PEP), which comprises domain experts from PUB.

27. The proposals may be sent to peer reviewers for technical/scientific merit review. Where appropriate, proposals from academia may also be sent to Industry Resource Persons (for commercial viability) and relevant national agencies (for national relevancy) for additional review. This is then followed by evaluation by PUB R&D PEP. The PEP shall evaluate the Full Research Proposals based on the criteria given in para 28, referencing reviews from international peer reviewers (if any), and recommend the proposals for funding.

28. All White Papers and Full Research Proposals are evaluated against the following criteria:

    i. Excellent science and cutting-edge technology, with proposed activity involving scientifically sound and implementable solutions that brings together the best R&D talent available to meet the objectives of this RFP.

    ii. Significant economic or social benefits, to be accrued to Singapore through either tangible measures (creation of intellectual property, start-up companies, spin-out enterprises, etc) or potential for commercialisation into new products/services/ technologies deployed to solve national needs.

    iii. Robust management and governance, with project team having adequate research experience and necessary expertise/knowledge, as well as reasonable milestones and deliverables.

    iv. Reasonableness of the proposed budget.

29. PUB is under no obligation to award the research grant in whole or in part to any proposal. PUB may require proposals to be revised as it sees fit to enhance research outcomes, facilitate integration of research concepts and technologies, and optimise funding resources. PUB's decision on the proposals selected and the funding support will be final and shall be abided by the applicants.

Maximum Project Budget and Duration

30. The total qualifying cost for each Research Proposal awarded will not exceed **S$8 million**. The Applicant should contribute both cash and in-kind services towards the proposed project. In-kind services can include labour, materials, and other services. Cash and in-kind contributions demonstrate the participation and commitment of the applicants to the project.

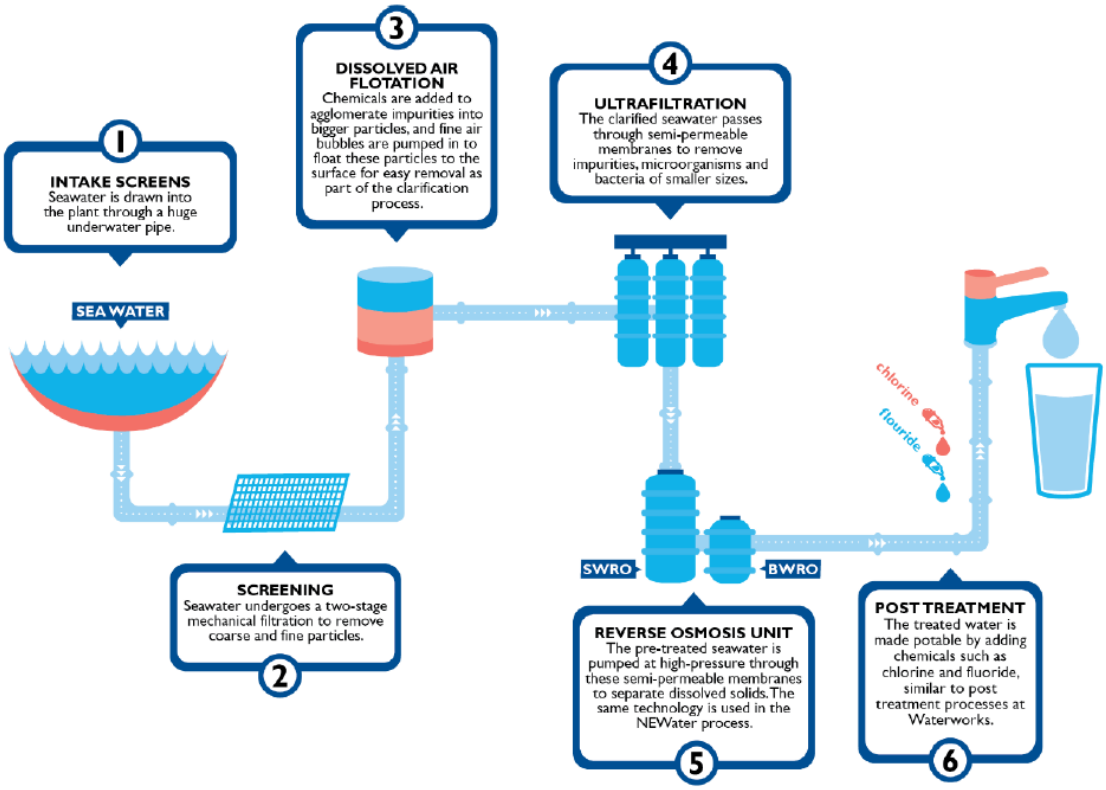
31. The maximum funding period for the Research Proposal is **2 years**.

Point of Contact

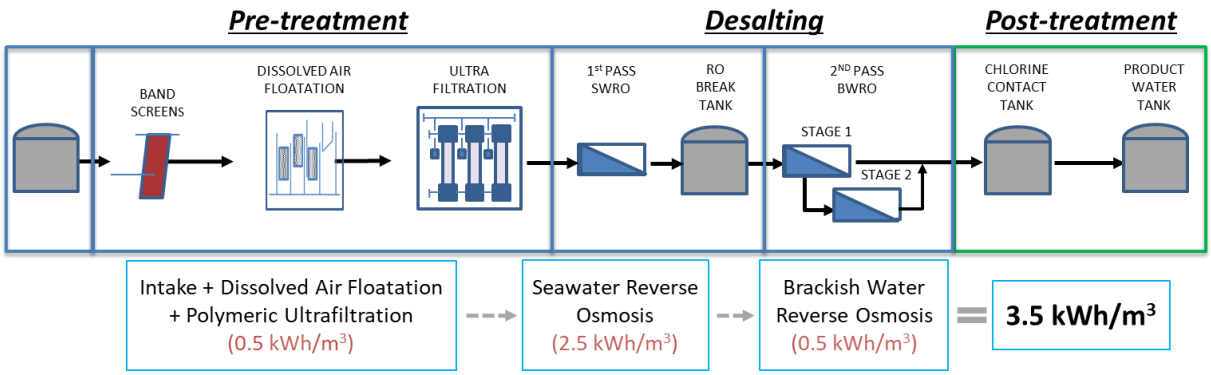
32. For more information, please contact:
    - Dr Cai Qinqing (CAI_QinQing@pub.gov.sg)
    - Dr Azhar Ismail (Azhar_ISMAIL@pub.gov.sg)

Appendix 1: Flowchart of typical seawater desalination process

Typical Process:



Typical Energy Requirement:



Appendix 2

Seawater desalination technologies*	Potential energy reduction as compared to conventional process	Scale of testing
SWRO pre-treatment with ceramic membranes	- 0.3 kWh/m^3	Pilot Scale
SWRO with Closed Circuit Reverse Osmosis (CCRO)	- 0.5 kWh/m^3	Pilot Scale
SWRO with biomimetic membranes	- 0.2 kWh/m^3	Pilot Scale
BWRO with biomimetic membranes	- 0.2 kWh/m^3	Pilot Scale
Energy recovery with Pressure Retarded Osmosis (PRO)	- 0.5 kWh/m^3	Pilot Scale
Electrochemical deionisation	- 0.17 kWh/m^3	Demonstration Scale

Appendix 2: Seawater desalination technologies being tested by PUB

(*Above technologies are piloted in relevant environment and are pre-commercial.)

Appendix 3: Typical Water Quality of Raw Seawater

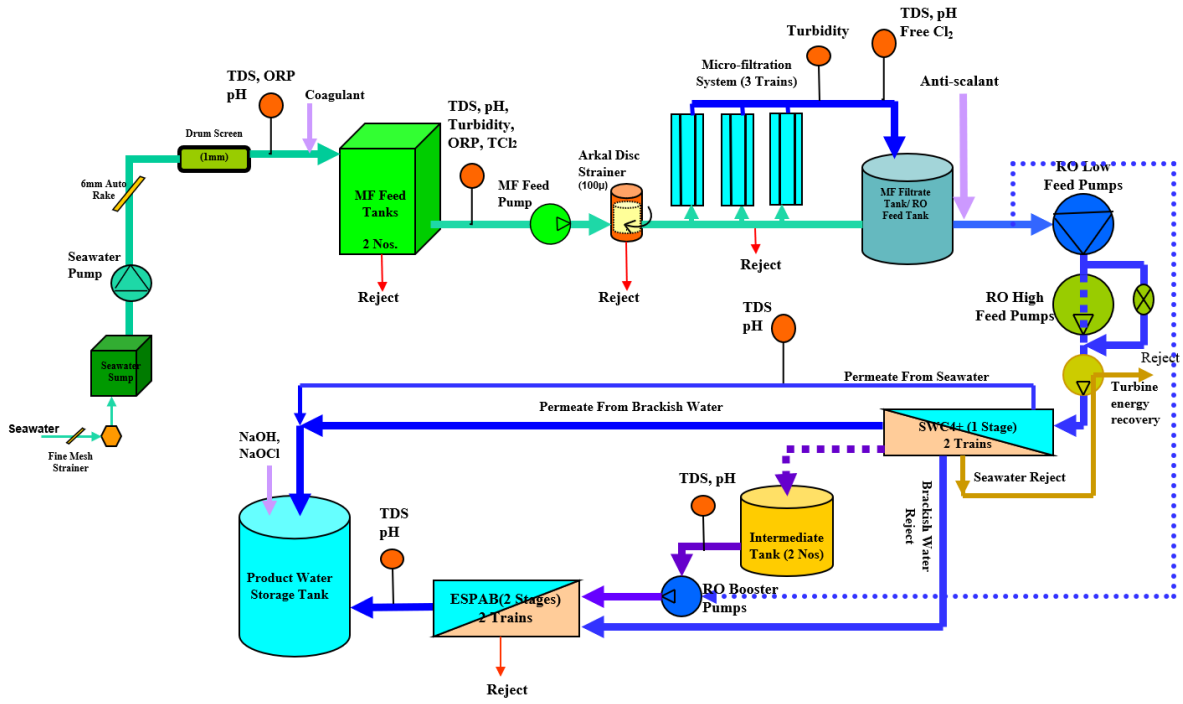
S/N	Parameter	Unit	Value
1.	pH	-	8.0 – 8.3
2.	Total Dissolved Solids	mg/L	30,600 – 35,700
3.	Specific Conductivity	µS/cm	47,089
4.	Total Suspended Solids	mg/L	2.8 – 49.3
5.	Turbidity	NTU	0.4 – 27.2
6.	Chemical Oxygen Demand	mg as O2/L	6.0 – 72.0
7.	5-day, 20ºC Biochemical Oxygen Demand	mg as O2/L	2.00 – 10.00
8.	Total Organic Carbon	mg/L	0.08 – 4.22
9.	Dissolved Organic Carbon	mg/L	1.60
10.	Total Nitrogen	mg/L	< 1.00
11.	Nitrite	mg as N/L	< 0.02
12.	Nitrate	mg as N/L	0.50 – 4.97
13.	Total Phosphate	mg as P/L	0.13 – 1.00
14.	Dissolved Phosphate	mg as P/L	0.06 – 0.82
15.	Total Alkalinity	mg/L	101 – 116
16.	Total Hardness	mg/L as $CaCO_3$	5,360 – 7,910
17.	Bicarbonate	mg/L as $CaCO_3$	99 – 114
18.	Oil & Grease (via method infrared absorption)	-	0.3 – 3.3
19.	UV absorbance (254 nm)	-	< 0.05
20.	Aluminium	mg/L	0.70 – 2.33
21.	Ammonia	mg/L as N	< 0.05 – 0.11
22.	Barium	mg/L	< 0.01 – 0.515
23.	Boron	mg/L	1.81 – 7.44
24.	Calcium	mg/L	366 – 552
25.	Chloride	mg as Cl^-/L	14,300 – 19,200
26.	Fluoride	mg as F^-/L	0.42 – 1.00
27.	Iron	mg/L	< 0.19 – 0.74
28.	Manganese	mg/L	< 0.05 – 0.58
29.	Magnesium	mg/L	1060 – 1620
30.	Potassium	mg/L	352 – 593
31.	Silica	mg/L as SiO_2	0.11 – 1.05
32.	Sodium	mg/L	8,290 – 13,400
33.	Strontium	mg/L	6.3 – 10.3
34.	Sulfate	mg as SO_4^{2-} /L	2,350 – 3,450
35.	Heterotrophic Plate Count	cfu/mL	10 – 16,100
36.	Total coliforms	cfu/mL	46 – 37,000
37.	Fecal coliforms	cfu/mL	6 – 79
38.	*E. coli*	cfu/L	< 416

Appendix 4: Target Product Water Quality

Parameter	Unit	Control Limits
Colour	Hazen	< 5
Turbidity	NTU	0.5
Conductivity	uS/cm	300
Threshold Odour Test	TON	< 1
Boron	mg/L	0.5
Bromide	mg/L	0.2
Nitrate (as N)	mg/L	3.39
Nitrite (as N)	mg/L	0.06
Total Organic Carbon (TOC)	mg/L	0.5
Aluminium	mg/L	0.055
Copper	mg/L	0.03
Iron	mg/L	0.03
Manganese	mg/L	0.03
Zinc	mg/L	1
Escherichia coli (E. Coli)	cfu/100mL	< 1
Total coliforms	cfu/100mL	< 1
Heterotrophic Plate Count (HPC)	cfu/mL	< 1

Appendix 5: Information on PUB Desalination Integrated Validation Plant

Process Flow Schematic



Key Equipment Summary

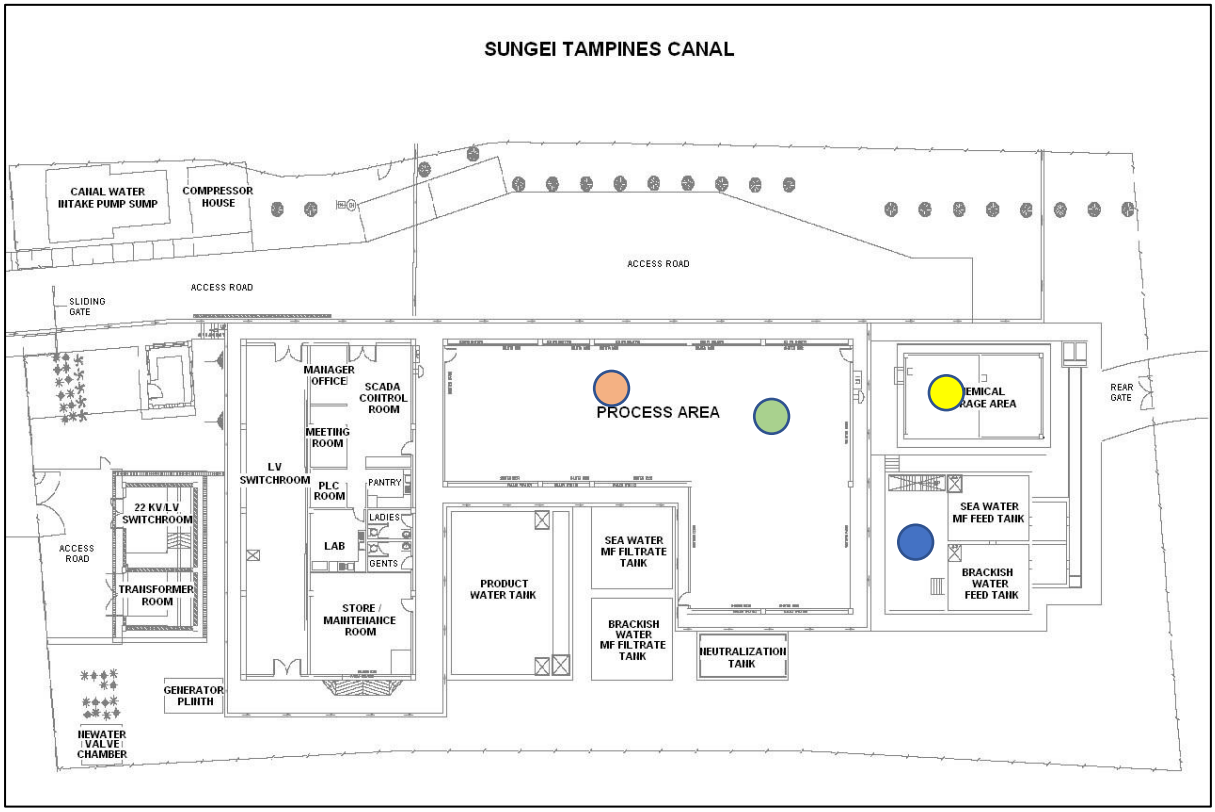
Equipment	Capacity (per equipment/ tank)	Remarks
Seawater Intake System		
Sea Water Intake Pump (1 duty, 1 standby) Brand: ABS Model: AFP2001 SX-ME550/4-51	625m^3/hr	
Pre-MF		
Drum Screen (1 duty, 1 standby) Brand: E. Beaudrey & Cie Model: TF170/80	1500 m^3/hr	Mesh Size: 1mm
Arkal Filter (2 duty, 1 standby) Brand: Arkal Filtration Model: Galaxy 4 Inch X 5 External Backwash	270 m^3/hr	100 Micron Filter Max Pressure: 10 BAR
MF		
MF Feed Pumps (2 duty, 1 standby) Brand: KSB Model: Mega-Chem CX100-160	270 m^3/hr	
MF Membranes (2 duty racks, 1 standby) Brand: Hydranautics Model: Hydracap AM 2.5	Min: 2.2m^3/h Max: 6.8m^3/h	Pore Size: 0.08 micron Membrane Area: 50 m^2

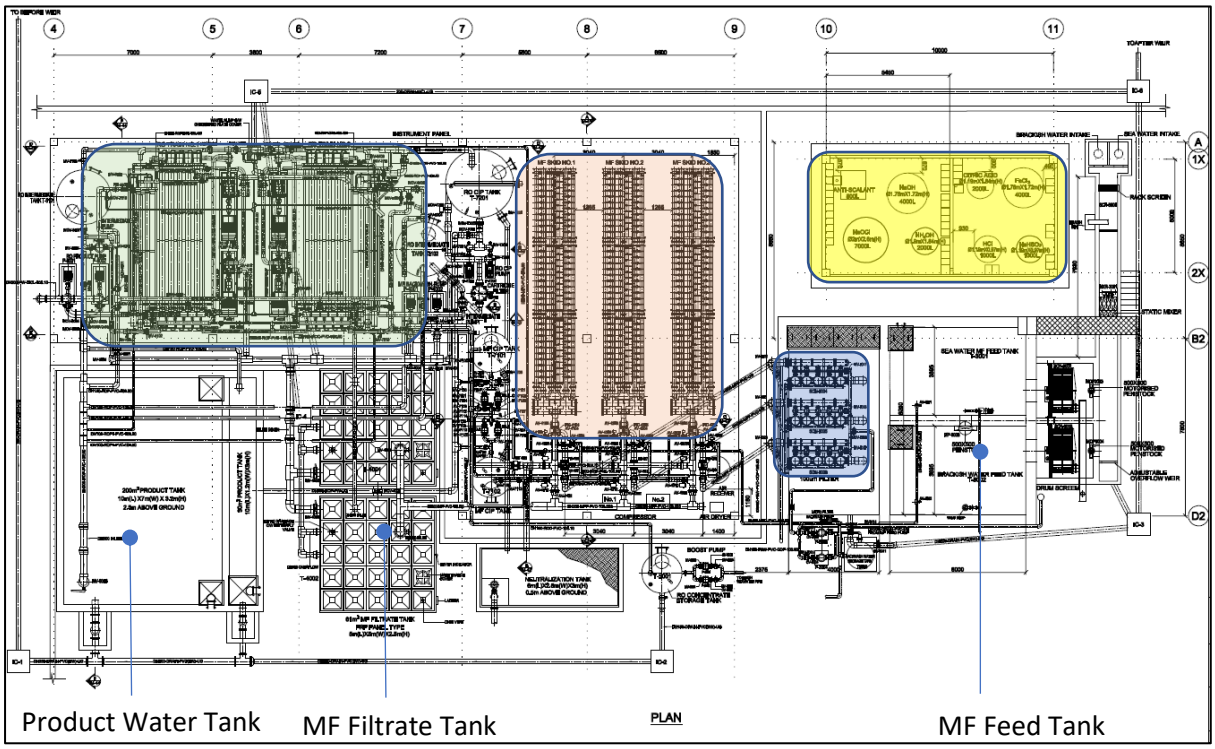
MF Filtered Water Tanks	62.5 m^3	-
MF Feed Water Tanks (SW + BW)	69 m^3	-
RO		
SWRO (2 trains) Brand: Hydranautics Model: SCW4+	25 Vessels x 7 Elements	
BWRO (2 trains) Brand: Hydranautics Model: ESPA-B	Stage 1: 7 Vessels x 6 Elements Stage 2: 3 Vessels x 6 Elements	
RO Low Pressure Feed Pump (2 sets) Brand: Duchting Pumpen Model: ROWA-HP100-211X2	223 m^3/hr	
RO High Pressure Feed Pump (2 sets) Brand: Duchting Pumpen Model: ROWA-HP100-265X3	223 m^3/hr	
Energy Recovery System (Turbocharger) Brand: Pump Engineering Inc. Model: Halo-900	170.4 to 238.5 m^3/h @ 69 bar	-
Available Chemical Facilities (shared for all trains/racks)		
Antiscalant	2 m^3	Refer to P&ID attached for dosing points
Poly Aluminium Chloride	2 m^3	
Sodium Bisulphite	4 m^3	
Sodium Hydroxide	4 m^3	
Ammonium Sulphate	2 m^3	
Citric Acid	2 m^3	
Chemical Dosing Pumps		
Antiscalant Brand: Grundfos Model: DME2-18A-PP (2 Nos.)	2.5l/h @ 18 bar	
Poly Aluminium Chloride Brand: Grundfos Model: DME60-10AR-PP (2 Nos.)	60 l/h @ 10 bar	
Sodium Bisulphite Brand: Grundfos Model: DME12-6A-PP (2 Nos.) DME150-4AR-PP (2 Nos)	 12l/h @ 6 bar 159l/h @ 4 bar	
Sodium Hydroxide Brand: Grundfos, Yamada Model: DME2-18A-PP (2 Nos.) DME8-10A-PP (2 Nos.) DMX765-3-AR-PP (2 Nos.) NDP-5FPT (4 Nos.)	 2.5 l/h @ 18 bar 7.5 l/h @ 10 bar 765 l/h @ 3 bar 240 l/h @ 0.5 mPa	
Ammonium Sulphate Brand: Grundfos Model: DDA12-10AR-PP	12 l/h @ 10 bar	
Citric Acid Brand: Grundfos, Yamada Model: NDP-15FPT-EX (2 Nos.) NDP-5FPT-EX (2 Nos.)	 1800 l/h @ 0.5 mPa 249 l/h @ 0.5 mPa	

Plant Layout

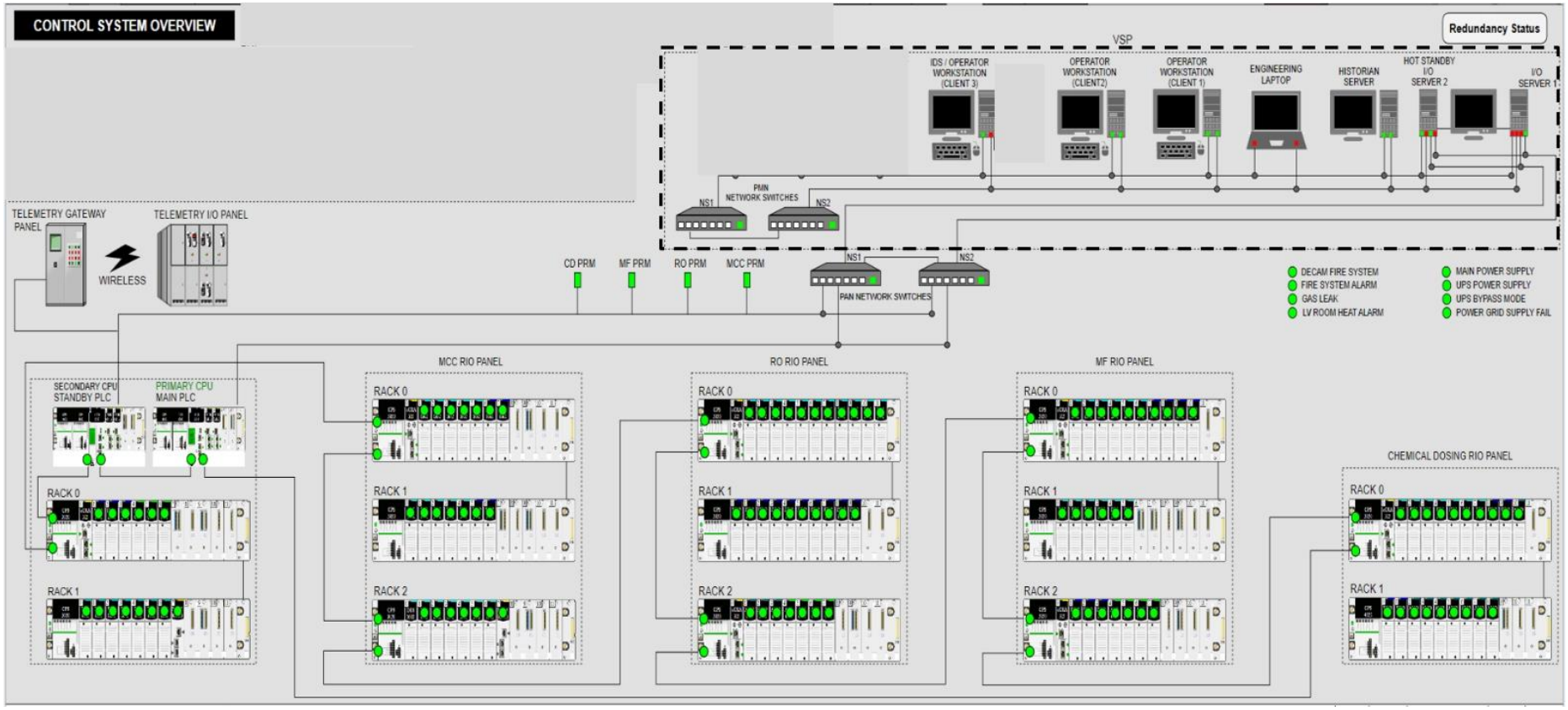
Legend:

- Disc Filters (MF Pumps in the dry well beneath the filters)
- MF
- RO System
- Chemical Dosing System (Tanks and Pumps)



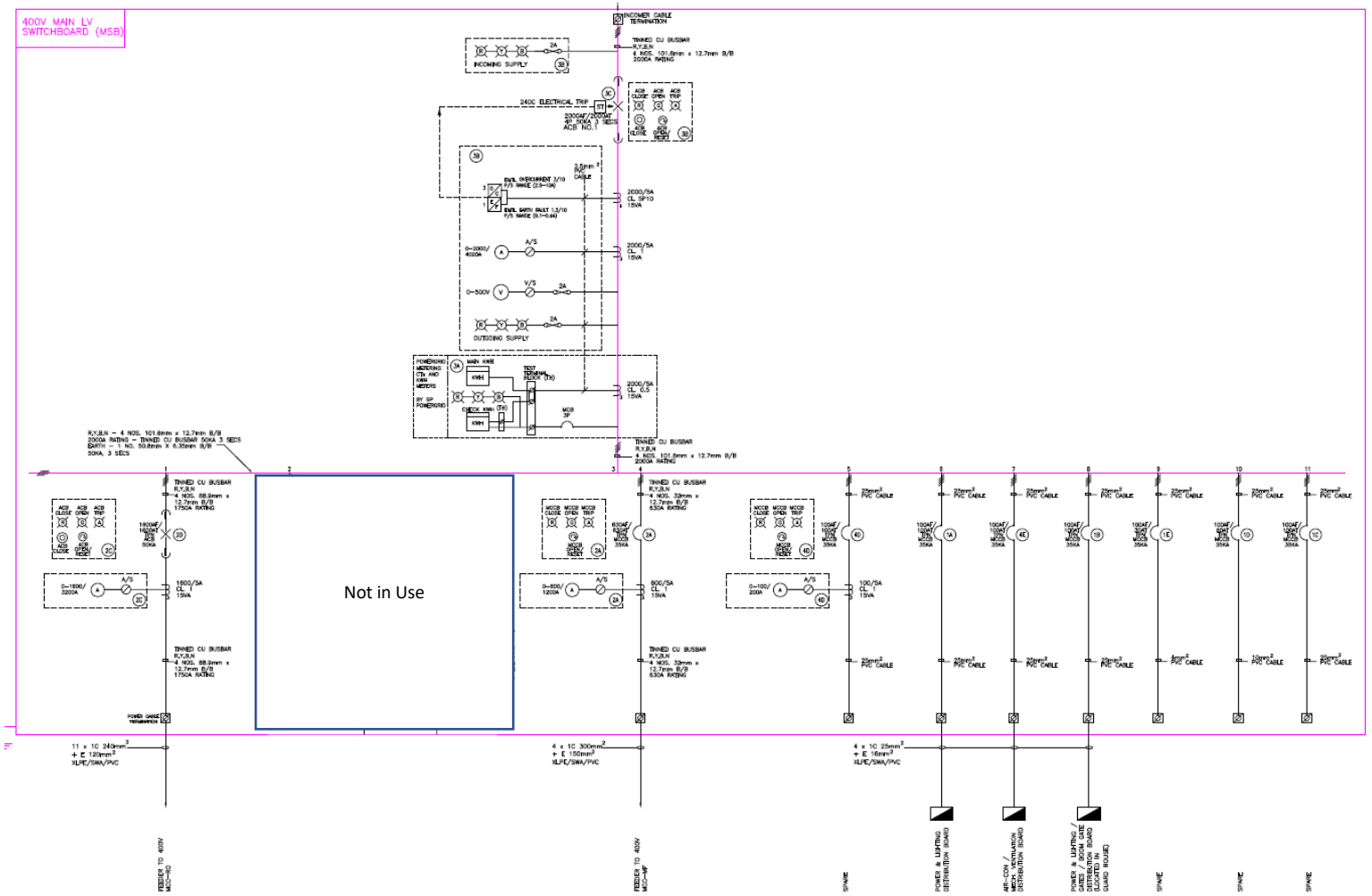


SCADA System Architecture

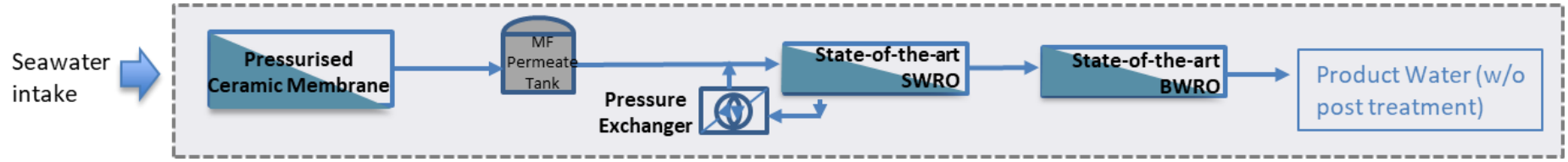


	SCADA Component	Hardware/Software
a	PLC	Schneider Modicon M580 Series
b	SCADA	Mitsubishi MC-WORX
c	Rack Mount IO Servers	Dell Precision 3930
d	Tower Historian Servers	Dell Poweredge T440

Electrical Single-Line Diagram



Appendix 6: Train A at Desalination Integrated Validation Plant



Appendix 7: Technology Readiness Level (TRL) Definitions

Technology Readiness Level (TRL) is a widely used indicator of degree of development of a technology toward deployment on a scale of 1-9.

TRL	Definition	PUB's Context
1	**Basic research: basic principles observed and reported.** Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include fundamental investigations and paper studies.	The project is completed with formulations of basic theories / principles which have the potential to be further developed into applied research. The project may be limited to literature review and fundamental investigations.
2	**Applied research: Technology concept and/or application formulated.** Once basic principles are observed, practical applications can be formulated. Examples are limited to analytic studies and experimentation.	The project is completed with the conceptual development of application and technology. The project may involve analytic studies such as numerical simulations to support the basic theories.
3	**Critical function: proof of concept established.** Active research and development is initiated. Laboratory studies aim to validate analytical predictions of separate components of the technology. Examples include components that are not yet integrated or representative.	The project is completed with the proof of concept established through laboratory studies. The project may include laboratory studies on separate components of the overall technology that are not integrated.
4	**Laboratory testing of prototype component or process.** Design, development and lab testing of technological components are performed. Here, basic technological components are integrated to establish that they will work together. This is a relatively "low fidelity" prototype in comparison with the eventual system.	The project is completed with lab-scale tests on the prototype where separate components of the technology have been integrated.
5	**Laboratory testing of integrated system.** The basic technological components are integrated together with realistic supporting elements to be tested in a simulated environment. This is a "high fidelity" prototype compared to the eventual system.	The project is completed with bench-scale tests in a simulated environment (e.g., laboratories or other environment under controlled conditions) for optimisation/performance enhancement of the technology/prototype.
6	**Prototype system verified.** The prototype, which is well beyond that of level 5, is tested in a relevant environment. The system or process demonstration is carried out in a reelvant operational environment.	The project is completed with pilot-scale tests in a relevant operational environment and the prototype system verified.

TRL	Definition	PUB's Context
7	**Integrated pilot system demonstrated.** Prototype is near, or at, planned operational system level. The final design is virtually complete. The goal of this stage is to remove engineering and manufacturing risk.	The project is completed with demo-scale tests in the actual operational environment.
8	**System incorporated in commercial design.** Technology has been proven to work in its final form under the expected conditions. In most of the cases, this level represents the end of true system development.	The project is completed with successful implementation of demo-scale tests where true system development is achieved.
9	**System ready for full-scale deployment.** The technology in its final form is ready for commercial deployment.	The project is completed with spin-offs / commercial deployment.
N/A		E.g. scientific studies, literature reviews or development of toolboxes.

Appendix 8: Definitions of different enterprise segments

S/N	Type	Criteria
1	Non-SG entities	• <30% local shareholding, determined by the ultimate individual ownership
2	LLEs	• ⩾30% local shareholding; and • More than $100M in annual turnover
3	SMEs	• Have Group Annual Sales Turnover of not more than $100M, or maximum employment of 200 employees • To qualify as an SG entity, they must also have at least 30% local shareholding, i.e. local equity held directly or indirectly by Singaporean(s) and/or Singapore PR(s)
4	Start-ups	• Registered for less than 5 years at time of grant application • Has individual ownership of more than 50% at reference year; and • Employs at least 1 worker • To qualify as an SG entity, they must also have at least 30% local shareholding
5	Not-for-profits	• Registered as a public Company Limited by guarantee, society or charity trust • Main purpose is to support or engage in activities of public or private interest without any commercial or monetary profit, and are prohibited from distributing monetary residual to their own members • To qualify as an SG not-for-profit, the entity must meet all 3 of the following criteria: (1) Registered and physically present in Singapore; (2) Core funding (i.e. excl. competitive grant funding) is derived entirely/mostly from SG entities; (3) Managed by a Board, which is at least half appointed by SG entities

Annex A: Guidelines for Submission of White Paper

Closing Date: 16 May 2023

1. The White Paper should be submitted in MS Word document or Adobe PDF format, 12-point font size, single-spaced, and not longer than 15 full pages.

2. The preparation of White Paper should be done using the 'Living Lab (Water) Research Proposal Form_White Paper' which can be downloaded from the online Integrated Grant Management System (IGMS).

3. Applicants are required to lodge the application via the online IGMS system before the stipulated closing date and time for the RFP. Separate submission outside of IGMS will not be considered. All relevant sections of the IGMS proposal online application form should be filled completely, with the Living Lab (Water) Research Proposal Form and supporting documents uploaded as separate attachments. **The on-line application process may take time and hence please refer to IGMS website for full details of the application process. For new IGMS user from private companies, account registration is required for first time application. Please refer to Annex B below. New users would need to ensure his/her CorpPass account has been set-up, using his/her SingPass account.**

4. At the White Paper stage, it is not necessary for all Co-PIs and collaborators to sign up for IGMS User ID; only the Lead PI submitting the application needs to do so. The Co-PIs and collaborators may simply be listed as part of the research team in the proposal itself.

5. Please note that applicants can only submit multiple files with maximum file size of 2MB each in the IGMS system.

6. Should there be revisions to the submitted proposal, Lead PI is to delete previous submission(s) and only keep the final proposal in the system. Failing to do so may lead to evaluation of wrong version of the proposal.

7. The link to the online IGMS is given here: https://researchgrant.gov.sg.

Annex B: IGMS account creation

1. Before you begin, please familiarise yourself with the various training guides on navigating the IGMS system.
2. The various guides and manuals will help you understand the roles of various users in the IGMS and the application process. These documents can be downloaded from: https://researchgrant.gov.sg/Pages/TrainingGuides.aspx
3. The registration of the company or institution within IGMS is mandatory as part of the proposal submission workflow.
4. Please refer to the steps below for the creation of a new company/institution within IGMS.

Creation of account for local users

Step 1:

To register a new entry in IGMS, companies/institutions will need to send an e-mail to Ms Chay Peck Si at PUB_GLOBALHYDROHUB@pub.gov.sg, by **28 April 2023**, with the following details:

Subject: Creation of new Company/Institution in IGMS for RFP2301

Details of the New Company/Institution to be Created in IGMS

- Full Name of Company:
- Indicate Local Company or Foreign Company:
- Indicate Public Company or Private Company:
- UEN (for local company) or Unique Identifier (for foreign Company):

The Secretariat will inform the companies/institutions when their accounts have been created.

Step 2:

For Lead PI who will be submitting the application under their company/institution, the role of HI Admin is necessary for the assignment of relevant roles ("ORE" and "DOR")[4] to other IGMS users in the company/institution.

After the company/institution has been created in IGMS, IGMS would grant him/her the Principal Investigator (PI) role by default. The Secretariat will inform them to nominate an HI Admin and arrange with IGMS to change the role of the person from a Principal Investigator (PI) to an HI Admin. The following steps will apply:

1. The company/institution will need to nominate an HI Admin. The HI Admin (including all other intended IGMS users) will need to ensure that his/her CorpPass account has been setup.
2. The HI Admin will need to login to IGMS using his/her CorpPass account to register/update his/her profile inside IGMS.
3. After the HI Admin has been successfully registered in IGMS, the HI Admin will notify the Secretariat with the information below:
    - Full Name of HI Admin:
    - E-mail Address of HI Admin:

[4] Note: To complete a proposal submission, 3 distinct roles are required from any company or institution to endorse the proposal, namely: Lead Principal Investigator (PI), Office of Research (ORE) and Director of Research (DOR).

- Designation of HI Admin in his/her company:

Once granted the role as an HI Admin, he/she can proceed to assign the relevant roles (e.g. “DOR”, “ORE”, etc.) to the various users within his/her organisation.

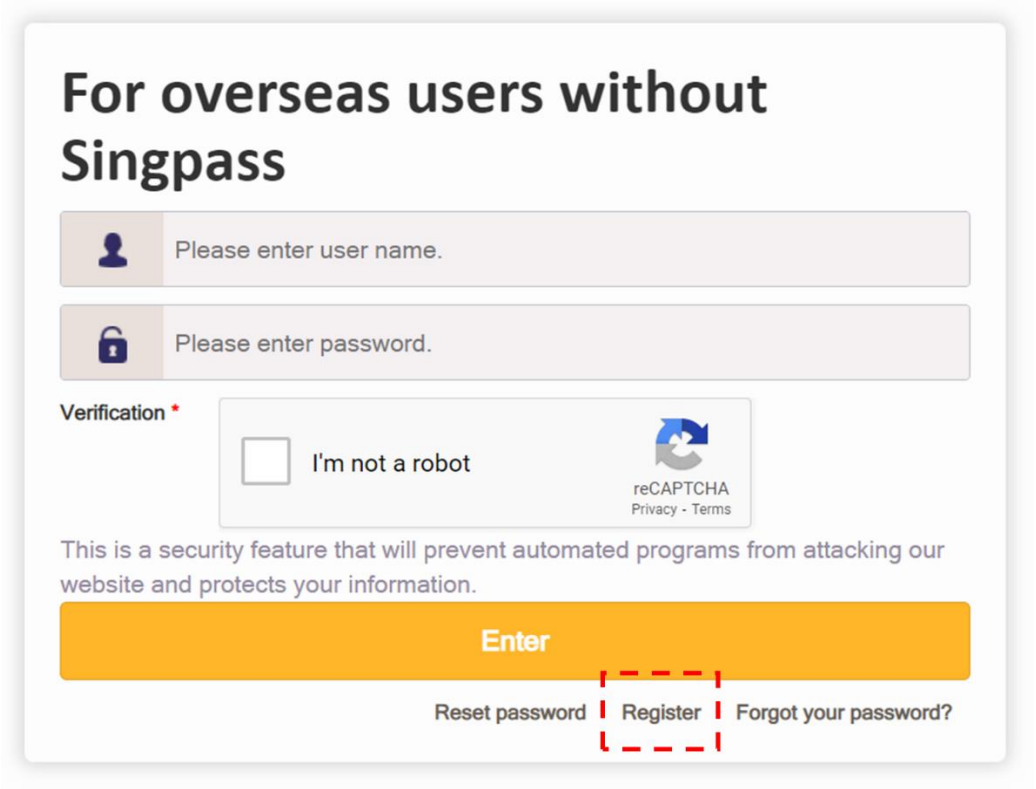
Since an HI Admin can concurrently hold the role of Lead PI, he/she will be able to select different profiles upon login to IGMS:

- Login as HI Admin – to maintain institution & user profiles
- Login as PI – to apply for grant call

Creation of account for foreign users

For local companies/institutions with foreign staffs without access to CorpPass/SingPass. The following steps apply:

1. All foreign users from the company (i.e. HI Admin, DOR, ORE, PI) will “Register” themselves in IGMS via “Login for overseas users without CorpPass/SingPass”.



2. After all the foreign users have been successfully registered in IGMS, the HI Admin will notify the Secretariat with the information below:
   - Full Name of HI Admin:
   - E-mail Address of HI Admin:
   - Designation of HI Admin in his/her company:
   - Full Name of DOR (if DOR is foreign user):
   - E-mail Address of DOR (if DOR is foreign user):
   - Designation of DOR in his/her company (if DOR is foreign user):
   - Full Name of ORE (if ORE is foreign user):
   - E-mail Address of ORE (if ORE is foreign user):

- Full Name of Foreign Lead PI/Co-PI(s)*:
- E-mail Address of Foreign Lead PI/Co-PI(s)*:

**list down all the foreign users that requires tagging to a company/institution*

3. The Secretariat will follow up with IGMS to tag the foreign user to your company.
4. Once the above foreign users have been added, tagged and assigned in IGMS, they can then proceed to login to IGMS via the "Login for overseas users without CorpPass/SingPass" section.

   Note: The HI Admin cannot add a new foreign user. However, the HI Admin can change the role of a user or delete an existing user in his/her company.