Annex

S/N	Challenge Title & Statement	Description
1	**Internal Repair Method for Leaking Underground Potable Water Pipelines** How might we develop an internal repair solution for leaking underground potable water pipelines that maintains structural integrity and water quality whilst minimising excavation and service interruption?	Singapore's water supply network comprises an extensive system of underground pipelines requiring regular maintenance to ensure uninterrupted water supply. The current leak repair methodology presents significant challenges, being labour-intensive and affecting public convenience. Upon discovering a leak in the water pipeline network, the team in charge of repairs must follow a complex, multi-step procedure. The process begins with isolating and dewatering the affected pipeline section, which temporarily disrupts water supply to the surrounding area. Teams must then excavate the road or soil to reach the underground pipeline—a particularly demanding task in Singapore's densely developed urban landscape. Repairs typically involve either fitting external repair clamps or replacing leaking pipe sections completely. Subsequently, the site requires careful backfilling and road surface restoration to its original state. This process is not only resource-intensive and expensive but also causes prolonged disruption to water supply and traffic flow. In Singapore's context, where urban density is high and underground space increasingly congested, the current repair methods present substantial logistical challenges. The situation demands innovative solutions to minimise excavation requirements, shorten repair times and reduce potential disruption to both water supply and urban activities.

2	**Building Practical 3D Printing Capabilities for Water Utility Applications** How might we harness the transformative potential of 3D printing to create practical solutions for water utility operations while building future-ready capabilities?	3D printing represents a transformative technology that could address key challenges in operational resilience and efficiency for water utilities. While 3D printing has revolutionised aerospace, defence, and medical sectors, its game-changing applications in water infrastructure remain largely untapped. Our water infrastructure demands constant vigilance and maintenance to ensure uninterrupted service delivery. A critical challenge we face is maintaining a resilient supply chain that can provide reliable access to spare parts for our water infrastructure. While our in-house inventory management system serves us well, we see opportunities for improvement. When unexpected equipment failures occur or components deteriorate prematurely, the traditional supply chain can face delays in delivering urgent replacement parts. 3D printing offers an opportunity to develop on-demand, rapid manufacturing capabilities for critical components to minimise operational disruptions. Furthermore, we see opportunities to use 3D printing to produce smart equipment or components that can improve our operations. We envision transformative possibilities in how we monitor and maintain our infrastructure. Imagine 3D printed pipe fittings that can also detect pressure anomalies, 3D printed sensors that can be printed on demand, 3D printed wearables for personnel health and safety monitoring or 3D printed rotating elements/components with embedded sensors. These enhanced components could enhance our approach, allowing for customisation and parts to be printed in-house in future.

3	**Early Detection of Weak Spots in Glass Reinforced Plastic (GRP) Pipelines** How might we detect or monitor potential weak spots and joints in Glass Reinforced Plastic pipelines to enable proactive maintenance and prevent failures?	Desalination plants in Singapore utilise GRP pipelines extensively in their water treatment processes, primarily due to their corrosion resistance properties. These pipelines, ranging from 150mm to 2,400 mm in diameter, play a crucial role in the desalination process by transferring both seawater and treated water between different treatment stages to accommodate various flow requirements. However, GRP pipelines are susceptible to premature deterioration when exposed to prolonged sunlight and poor lamination workmanship during installation. Desalination plants face significant operational challenges when the pipelines fail, with repairs requiring a minimum of 24 hours due the time needed to cure the laminations. Early detection of weak spots and joints is crucial for preventing GRP pipe failures and ensuring the continued efficient operation of desalination plants. While PUB has established capabilities for leak detection and condition assessment of metal and concrete pipelines, there remains a specific need to explore cost-effective technologies in GRP pipeline assessment. Addressing this challenge within the next few years is crucial to reduce unforeseen pipeline failure, which may become more frequent due to ageing assets. The current situation threatens plant operations through rising operational costs, and the risk of emergency shutdowns. Implementation of preventive measures would safeguard the plant's ability to meet its water supply commitments.