FY2025 Overseas Demonstration Project for Sewerage Technology

Demonstration project for air-cooled, Immersible motor pump in tropical regions

Demonstration Country / Location: Pakistan / Multan

Torishima Manufacturing Co., Ltd. ／Nippon Techno Co., Ltd. Joint Venture

Description Summary

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1. Overview of the Demonstration Project

◇Business name	Demonstration project for air-cooled, Immersible motor pump in tropical regions
◇Implementation period	Reiwa 6 (R6.8.28-R7.3.14) Reiwa 7 (R 7.4.1 to R8.3.14)
◇Implementers	Torishima Manufacturing Co., Ltd. ／Nippon Techno Co., Ltd. Joint Venture
◇Countries and cities where demonstrations were conducted	Islamic Republic of Pakistan, Multan
◇ Demonstration Technology	Air-cooled, Immersible motor pump
◇Details of the demonstration	○ This study will verify the durability of motors and pumps during high-temperature periods in summer. ○ We will conduct on-site installation and maintenance inspections to verify the ease of maintenance and inspection. ○ Using DX technology, we will provide operational data from within Japan to support maintenance and inspection.

2. Business Challenges and Needs (1/4)

Local challenges

1. Rapid urbanization and climate change

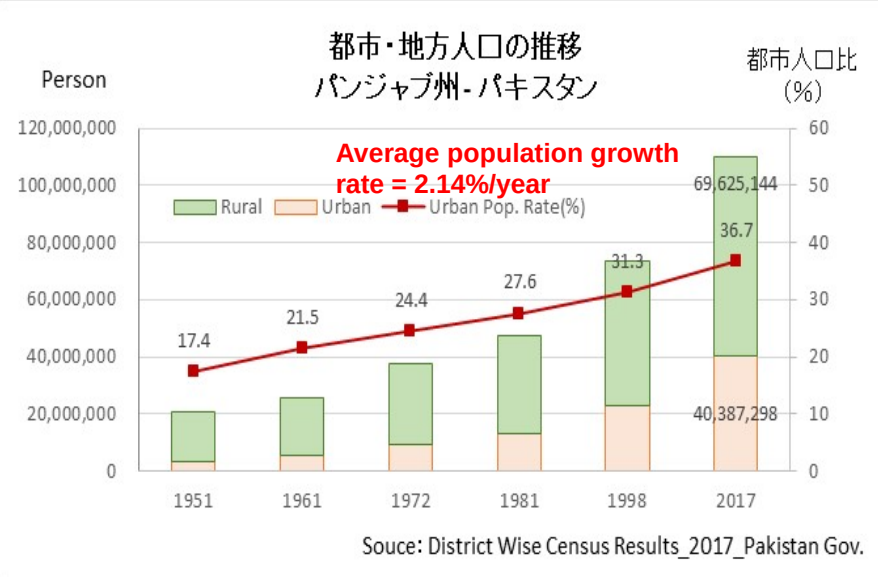
- Due to rapid population growth → Urban areas expand onto flat land.
- Drainage pipes become clogged due to the accumulation of sediment and garbage, affecting a wide area of the city.

Frequent flooding (roads being submerged) poses a public health risk.

Climate change → Increased heavy rainfall leads to more frequent flooding.

- Drainage capacity exceeded → Unable to withstand the sewage flow due to population growth

They are not present and are facing a chronic flood and public health crisis.

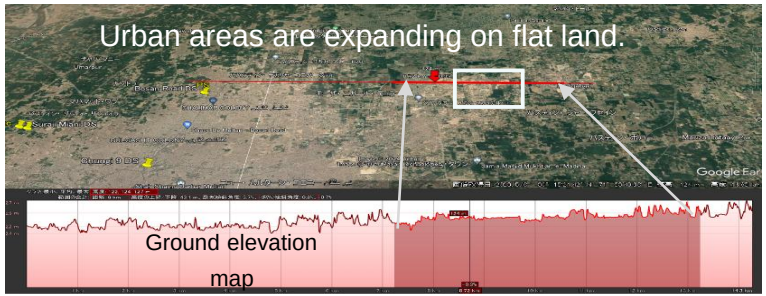


2. Aging infrastructure

Many sewage and drainage facilities remain unchanged since the 1970s.It is deteriorating.- Frequent malfunctions (especially during heavy rain or extreme heat above 40°C)

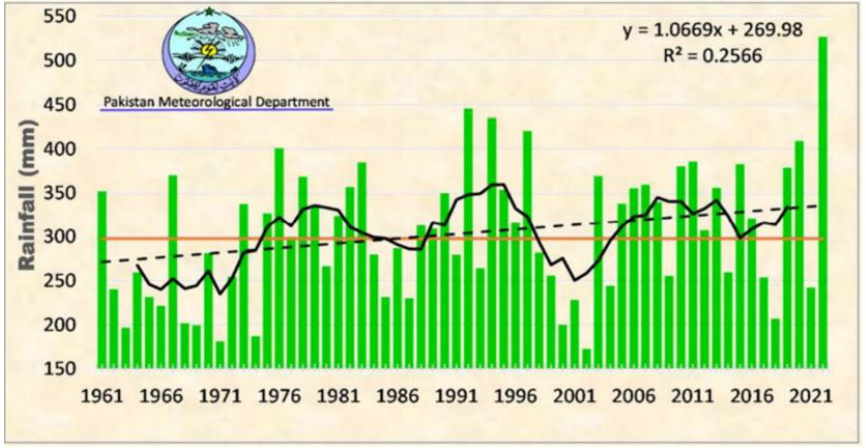
- System failure at critical junctures

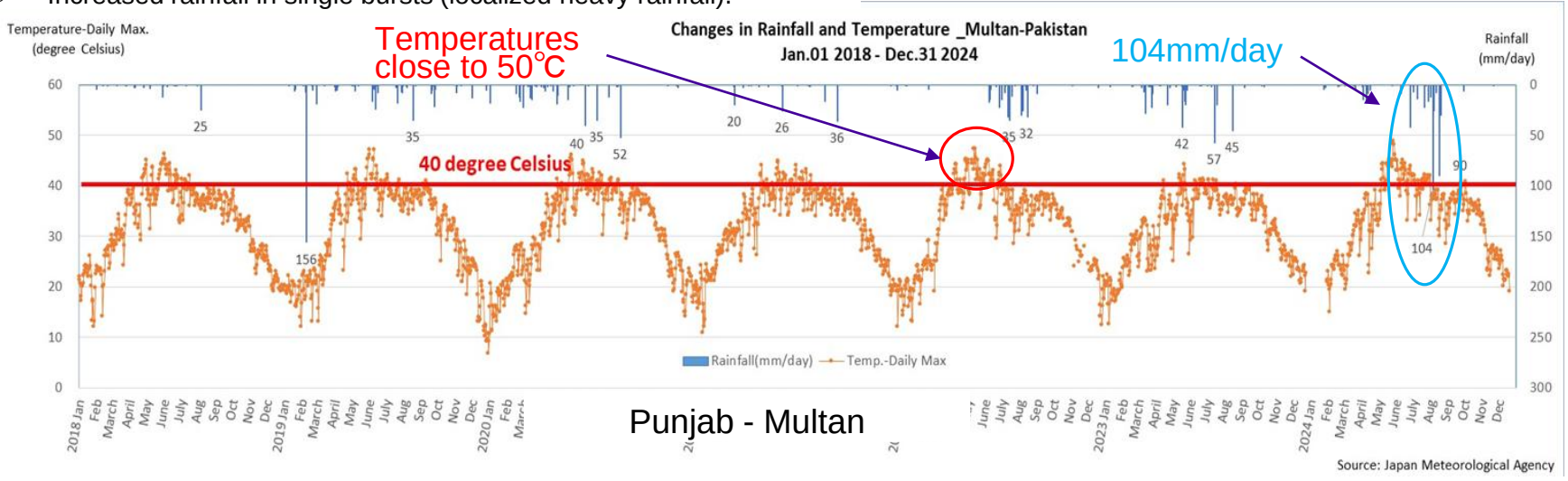
→ Risk of urban flooding (inundation)



2. Business Challenges and Needs (2/4)

- **Rainfall and temperature changes in Multan**
- There has been an increase in cases where rain equivalent to several days' worth of rain falls in a short period during the dry season (October to March). Predicting these events has become difficult in recent years.
- Cloudbursts, which are events during the monsoon season (June to September) where extremely heavy rain is concentrated in specific areas, are becoming more frequent.
- Increased rainfall in single bursts (localized heavy rainfall).





Punjab - Multan

2. Business Challenges and Needs (3/4)

Flooding damage in Multan

Flood damage (March 28, 2023)

Multan records heaviest rainfall in 48 years - August 28, 2024

On Tuesday, monsoon rains continued across the state, with Multan experiencing a torrential downpour of 172 mm, breaking the city's previous record of 134.5 mm set in 1976—a record that had stood for 48 years.

2. Business Challenges and Needs (4/4)

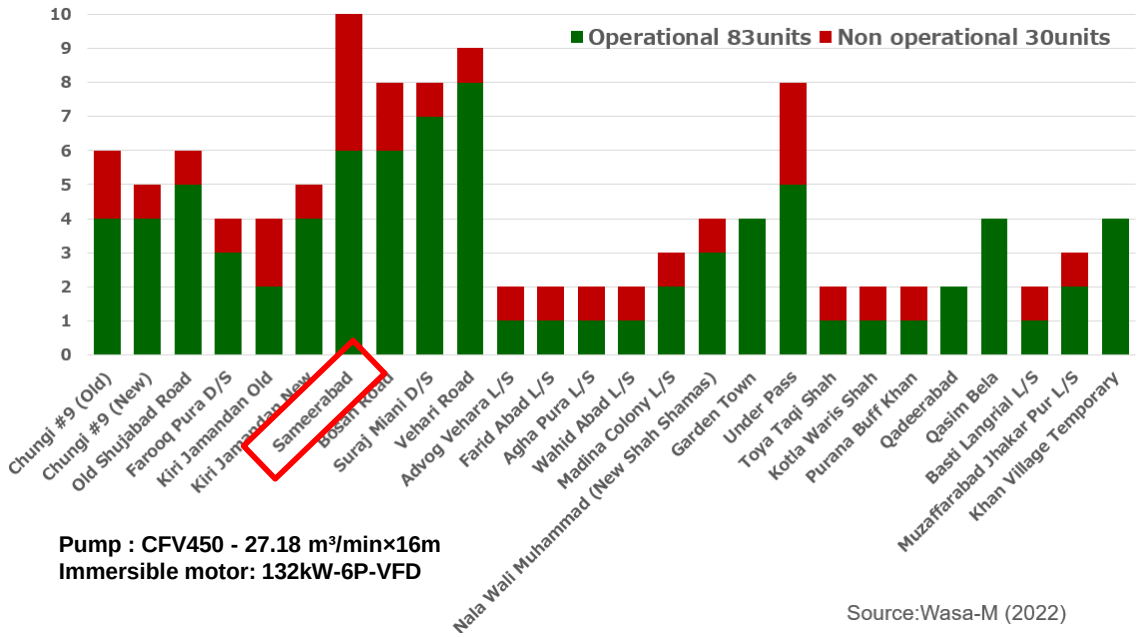
Challenges of Disposal Pump Stations in Pakistan

- **Current challenges**
- Frequent pump failures and damage at disposal pump stations.
- Drainage stopped due to pump failure.

Increased risk of flooding due to frequent malfunctions

- **Proposed countermeasures**
- Replacement and update of faulty pumps
- Installation of vibration sensors (DX/IoT technology) on pumps in operation
- Reducing downtime through predictive maintenance (reactive maintenance)
- Improving the reliability of pumping stations during heavy rain and floods.

Operational status of the Disposal Pump Station in Multan

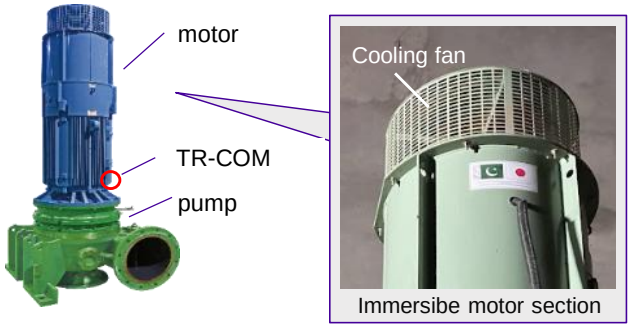


Pump : CFV450 - 27.18 m³/min×16m
Immersible motor: 132kW-6P-VFD

Source:Wasa-M (2022)

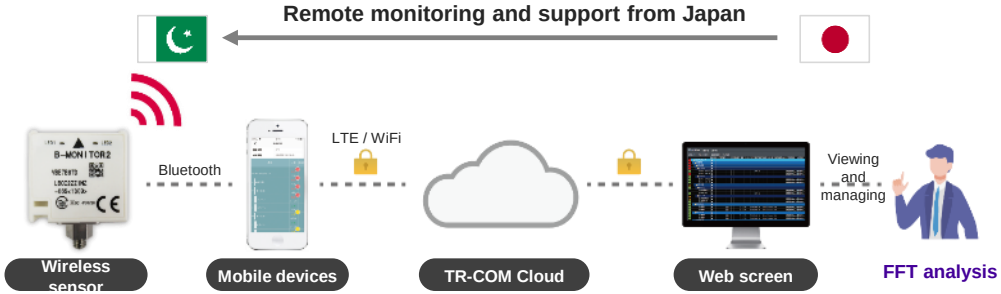
3. Details of the demonstrated technology (1/3)

❶ Air-cooled, Immersible motor pump



Immersibe motor section

❷ TR-COM sensor

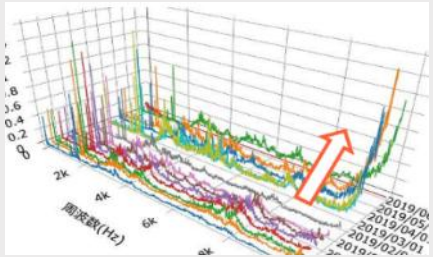


system configuration diagram

Details of the demonstration

This demonstration test will examine the heat resistance and cooling performance of the motor and pump in a high-temperature climate different from Japan, using the ❶ **air-cooled, Immersible motor pump**, which has a proven track record in rainwater and sewage pumping stations, and will also verify the effectiveness of maintenance and inspection support from within Japan by conducting remote monitoring using the ❷ **TR-COM sensor** (DX/IoT technology). In addition, the test will confirm the effect of reducing life cycle costs (LCC) through optimal operation using a VFD panel.

VFD (Inverter) Panel



Temperature, vibration, and frequency analysis can be monitored remotely.

FFT (frequency analysis) screen

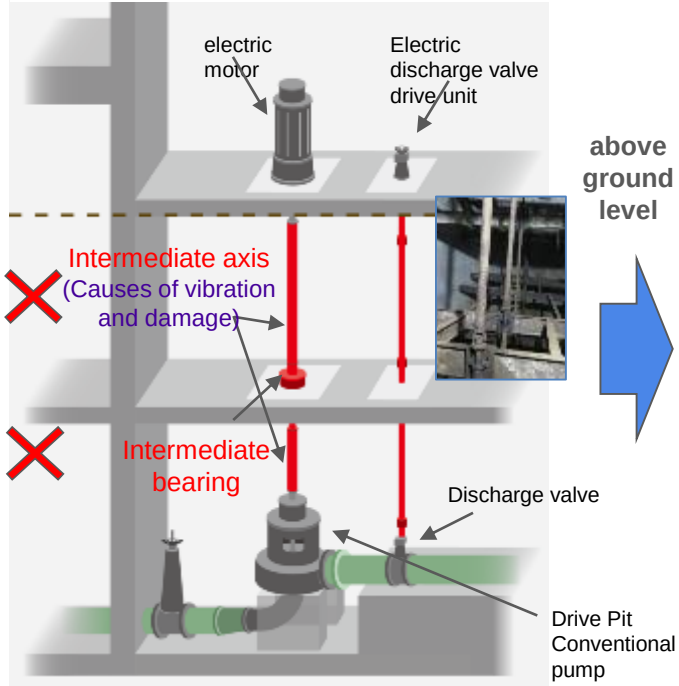
3. Details of the demonstrated technology (2/3)

Effects of next-generation pumping stations

Conventional pumping stations are positioned above ground or higher to prevent the electric motors from being

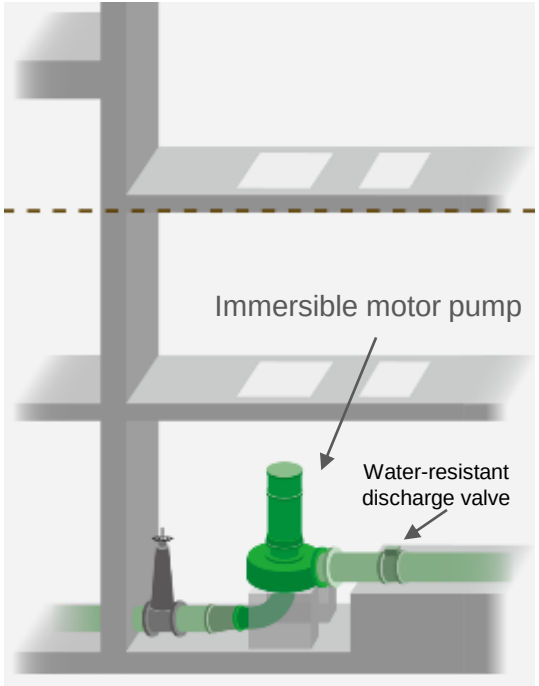
Immersible motors can operate even when submerged in water, making them suitable for underground installation.

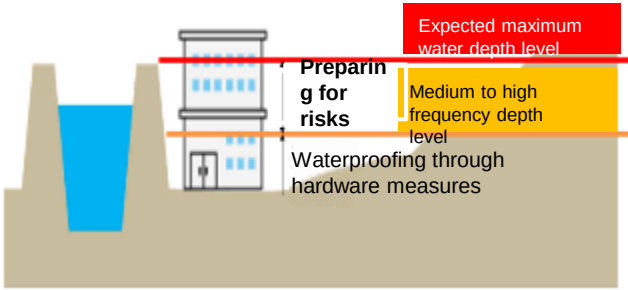
Conventional pumping station



above ground level

Next-generation pumping station





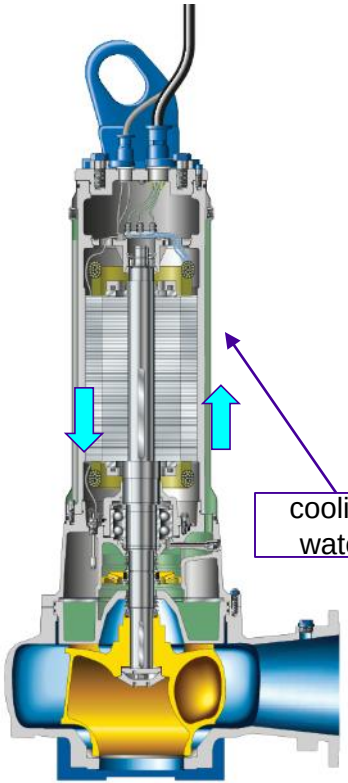
A simple design that does not require an intermediate shaft or intermediate bearing.

- **Reduction of initial costs**
(Equipment costs, installation costs)

- **Reduce running costs**
(Daily inspections, maintenance, (Bearing replacement, etc.)

3. Details of the demonstrated technology (3/3)

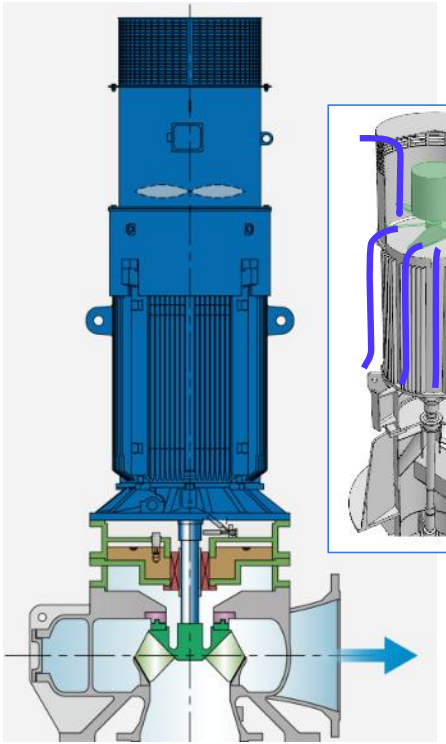
water cooled



	First-generation water-cooled pump	Next-generation air-cooled pump
Cooling method	Cooling jacket type water cooling	Cooling fan
Pump bore diameter	Maximum φ900*	φ200～800
Motor output	Maximum 850kW*	～400kW
Motor pole count	4P to 8P※	4P～18P
Outside temperature	**40°C**	**50°C**
Motor efficiency	**89～90%**	**94～95%**
maintenance	OH: Once every 1.5 years	OH: Once every 4 years

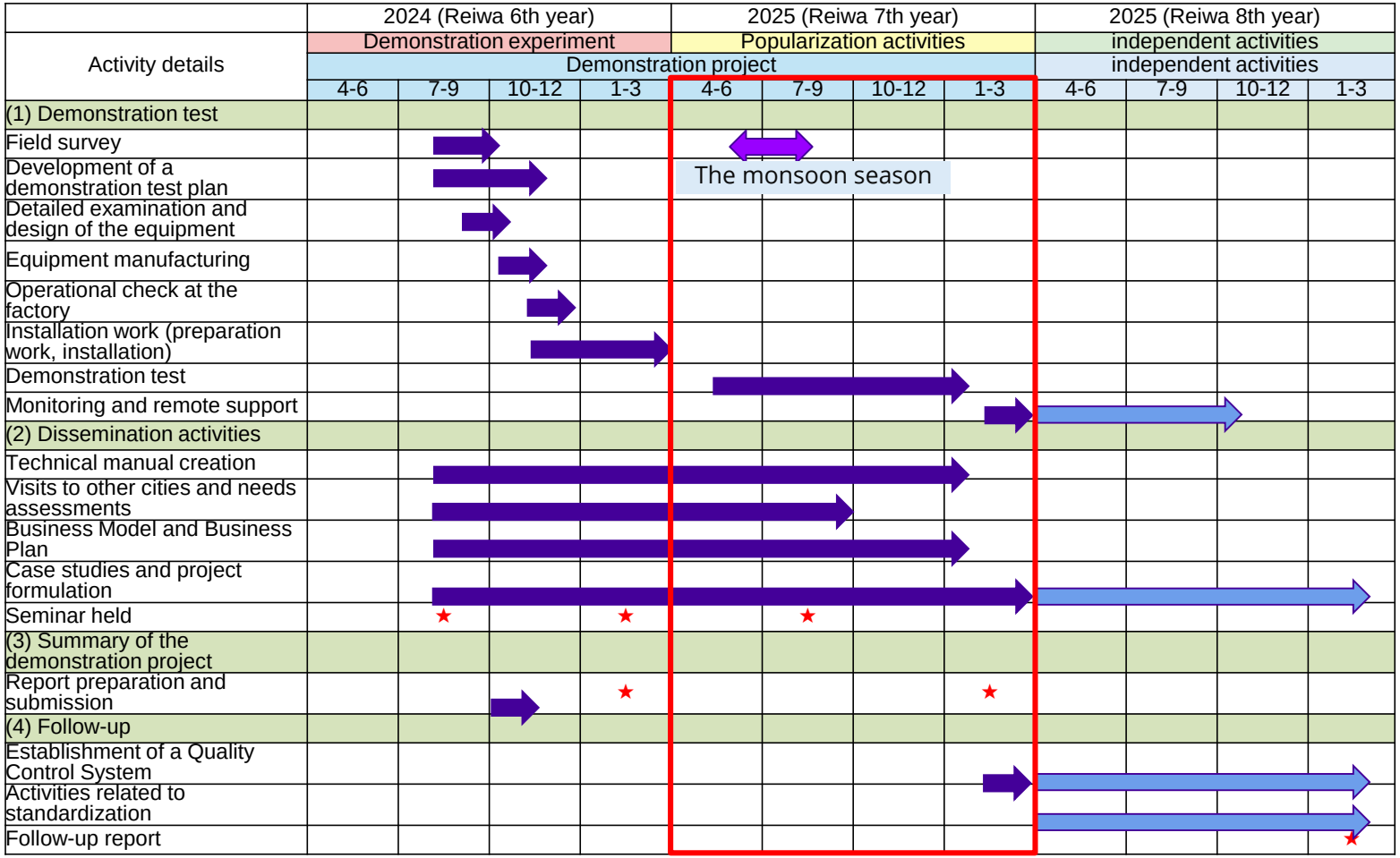
*Reference value

Air-cooled



Existing pumps fail due to motor failure caused by overheating and vibration of the intermediate shaft, requiring frequent replacement.

4. Demonstration Project Schedule

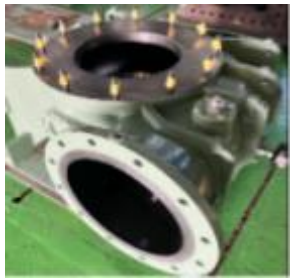


5. Details and Results of the Demonstration (1/5)

1. Pump manufacturing, performance testing, and shipment (Torishima Plant)

Pump manufacturing

Pump performance test (Water resistance test)



Pump transport (Immersible motor, Immersible fan, Pump unit)

2. Pump installation (On-site installation work will be carried out)

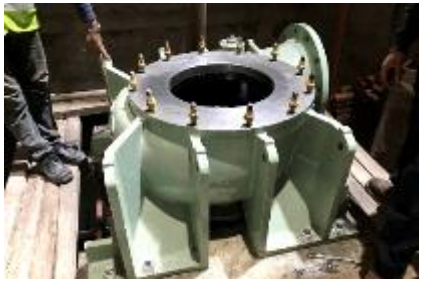
Removal of existing foundation

Construction of the pump foundation

Confirmation of pump foundation construction

5. Demonstration Details and Results (2/5)

3. Pump assembly, installation, and commissioning (Multan site)



Installation of the pump unit

Pump unit installation

Assembly and installation of the Immersible motor pump are complete.

Pump test run

4. Pump Operation and Maintenance

iew of Pump Maintenance Procedures

Lubrication oil filling process

Overview of pump maintenance work

5. Results of the demonstration test (3/5)

Monthly operating hours (calculated for 10 months from April 2025 to January 2025) by TR-COM

	April	May	June	July	August	september	October	november	december	January
Demonstrator (air-cooled)	358	421	440	420	427	286	152	3	3	488
Existing (water-cooled)	240	227	201	198	220	310	475	595	264	89

Total operating time and average daily operating time: Calculation record by TR-COM.

Reference: 10-month total time: 24 hours x 306 days = 7,344 hours.

	Total operating time	Average daily operating hours	Number of operating days*	Average daily operating hours (operating days)
Demonstrator (air-cooled)	2,998 hours	9.8 hours/day	204 days	14.7 hours/day
Existing (water-cooled)	2,819 hours	9.2 hours/day	237 days	11.9 hours/day

annotation
Number of operating days*:
Number of days on which you drove, even for a short time

	Operating days	Breakdown of operating days by month
Demonstrator (air-cooled)	17th	June 4th, July 1st, September 6th, October 6th
Existing (water-cooled)	10th	June 2nd, September 8th

Contribution to flood risk during heavy rain: Days with more than 20 hours of driving.

Red-bordered period: April-October, the monsoon season with heavy rainfall. Blue-bordered period: October 10th to late December, a period when operations were suspended due to hydrogen sulfide countermeasures, including the setting of protective circuits for direct-on-line operation.

5. Results of the demonstration test (4/5)

Motor surface temperature during motor operation

Date: June 7-14, 2025 (hottest period)

1. Driving tendencies (role division tendencies by day and night)

• Water-cooled pump: Operates at night • Air-cooled pump: Operates during the day (when the temperature rises)

2. What was revealed from the acquired data

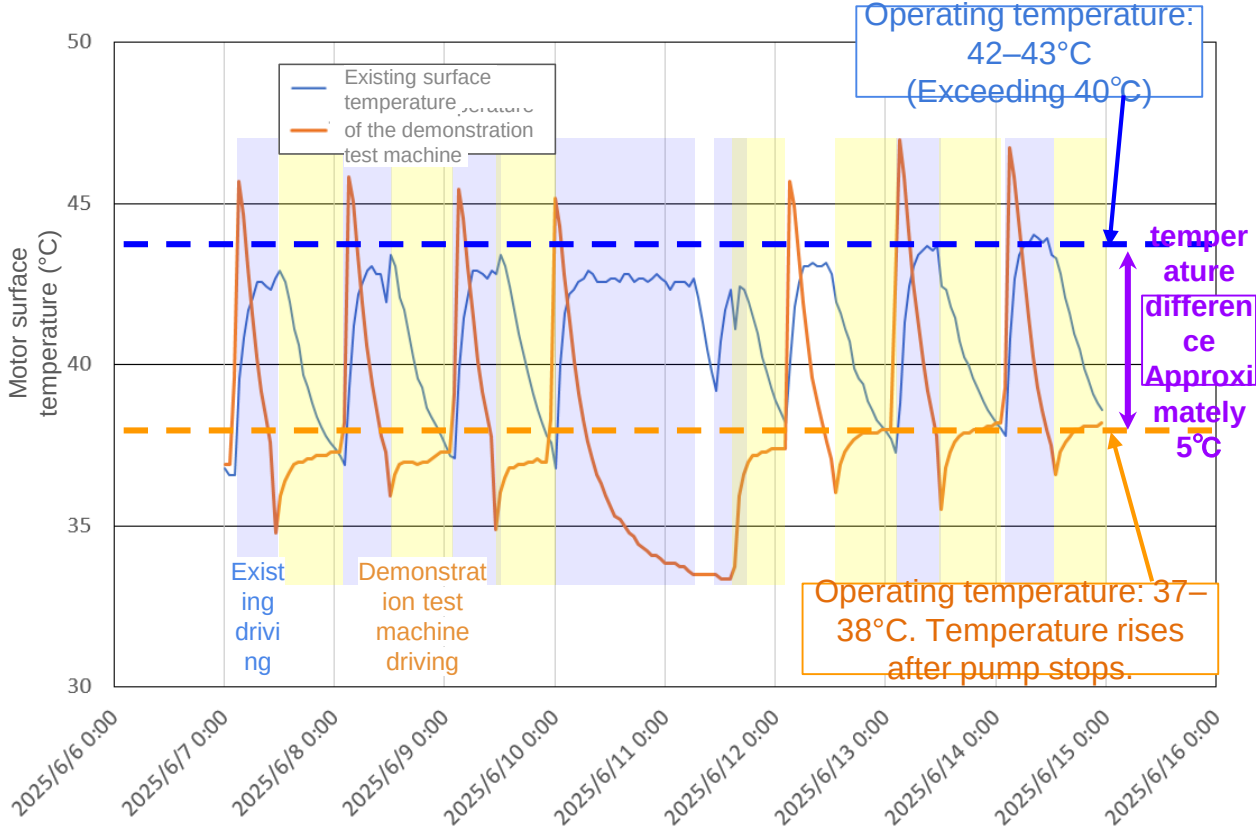
Air-cooled pump: Temperature difference reduced by 5 degrees (compared to water-cooled pump)

(Reference) The effect of motor temperature on equipment lifespan

⇒ Insulation degradation is slowed down, and the motor lifespan is extended.

3. Measures to prevent temperature rise after pump shutdown (air-cooled type)

⇒ Continue running the fan for several minutes after the pump has stopped.



5. Results of the demonstration test (5/5)

Pump vibration value measurement results (TR-COM sensor) - Records showing the trend over approximately 2.5 months, from May 7th to July 18th.

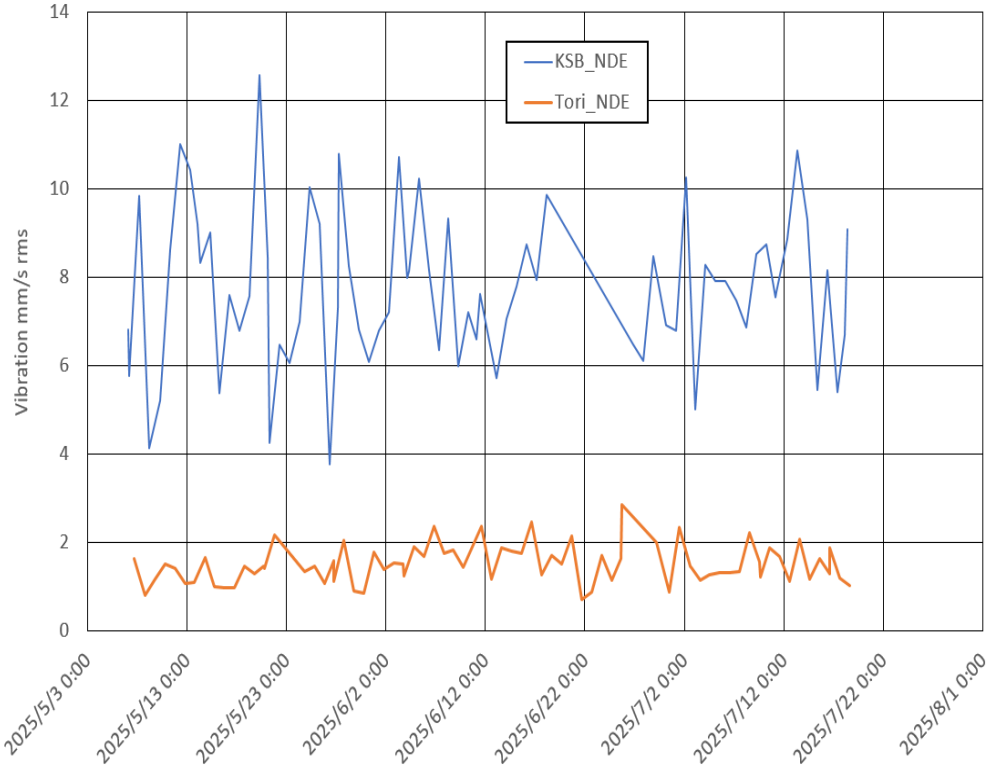
Measurements were taken at two points: DE (drive side = lower side) and NDE (non-drive side = upper side). The NDE value, which showed a larger reading, is shown in the figure on the right. The unit is vibration velocity (mm/s), and the normal value is 5 mm/s.

- DE (drive side = lower side) is within normal range for both pumps.

- NDE (Non-Drive Side = Upper Side) values varied among the pumps (right graph). The existing water-cooled pump (KSB) recorded a high vibration value (10 mm/s).

- **Maximum vibration speed during pump operation (top of motor)**
- Air-cooled pump (demonstration unit: Torishima): 2.85 mm/s

Water-cooled pump (existing: KSB): 12.57 mm/s



Vibration velocity of the bearing at the upper NDE of the motor (mm/s)

6. Local dissemination strategies and activity results (1/2)

Demonstration content (objectives)	Demonstration details (results)
Popularization activities (2025)	
We will invite water and sewage officials from eight cities and the Punjab provincial government to conduct on-site verification seminars (three sessions).	Multan City Water and Sewerage Authority, Punjab Provincial Government water and sewerage officials We held two seminars.
We will create maintenance and inspection procedures and technical manuals to promote standardization of pumping stations.	A "Technical Manual" has been created using information obtained from work in 2024. Construction and O&M costs (including electricity consumption) will be reflected in the 2025 business figures.
We conduct needs analysis, propose ODA projects, and promote the dissemination of technology.	We visited Gujranwala, Faisalabad, and Lahore to introduce our technology and confirm their needs.
Voluntary activities (2026)	
We will establish a quality control system and promote standardization.	2025: Establish a quality control system. 2026: Standardization of maintenance procedures and other measures are planned.
We will analyze business risks and proceed with business partnerships.	We will verify the construction and management capabilities of partner companies and the Multan City Water and Sewerage Authority, as well as the supply chain of local materials and equipment.

6. Dissemination Strategies and Activities (Seminars and PR Activities) (2/2)

We visited water and sewage corporations and individually promoted the results of the WOW TO JAPAN demonstration project.
- Confirm the needs and suitability of the technology through a workshop format.
- Hearing about the challenges of the public procurement system, including LCC evaluation.

1st dissemination activity
Implementation in November 2025

2nd dissemination activity
Implementation in February 2026

7. Challenges and Independent Activity Plan for the Future

1. Results of the demonstration project and identified challenges

- Through this project, we confirmed the suitability of air-cooled, water-resistant motor pumps for the harsh environment unique to Pakistan, including continuous operation under extreme heat and maintaining operation during flooding. On the other hand, we clarified the following challenges for full-scale implementation.
- **Addressing unique water quality and solid matter: Further measures to mitigate the physical and chemical load on pumps caused by local sewage components and inflow materials.**
- **Fostering an understanding of life cycle costs (LCC): Reforming local procurement systems to reduce not only initial investment costs but also long-term operating and maintenance costs.**
- **Supply chain development: Establishment of a maintenance service network for wide-area deployment.**

2. Future Independent Activity Plan

- Based on the results of the demonstration, we will accelerate social implementation throughout Pakistan and in the South Asian market, with a "locally optimized model" as our main focus.
- **Based on knowledge gained from field tests, we have standardized the 'Pakistan Special Specification'—a unique, highly durable structure built to resist the harsh water quality and contamination of the local environment.**
- **Remote monitoring support using DX technology "TR-COM": Establishing an advanced remote monitoring system from Japan utilizing battery-powered sensors. Enables predictive maintenance through anomaly detection, even in sites lacking specialized knowledge.**
- **Through technical standardization in cooperation with local authorities and ODA projects, we will promote the superiority of "Japanese technology that is resistant to flooding and extreme heat" and work to have it adopted as a technical selection criterion (standard specification) for local public infrastructure.**
  Establishing a sustainable business model; strengthening collaboration with local partners and building a rapid after-sales service system; contributing to flood damage mitigation and sanitation improvement in Pakistan through both technology and services.