Guidance Notes on Facility Upkeep of DCS Pipe Network

November 2026



機電工程署
EMSD

CONTENTS

Disclaimer P.1
SECTION 1: Model Design Specification of DCS Pipe P.2
1 Operation and Maintenance Strategy for DCS Pipe Networks P.3
2 Predictive Maintenance P.4
3 General Requirements - Leak Detection System P.5
4 Particular Specification - Leak Detection System P.6

SECTION 2: Model Operation and Maintenance Specification P.17
1 Operation Requirement P.18
2 Preventive Maintenance of Underground DCS Distribution Pipeworks P.21
3 Emergency Maintenance of Underground DCS Distribution Pipeworks P.24

APPENDIX 1: Guidance Notes on Handling of DCS Pipe Bursts and Emergency Maintenance and Operational Requirements P.31

DISCLAIMER

This document has been prepared for use in connection with the design, installation, operation, maintenance and facility upkeep of District Cooling System (DCS) pipe networks undertaken for or on behalf of the Electrical and Mechanical Services Department (EMSD) of the Government of the Hong Kong Special Administrative Region (HKSAR).

This document provides general guidance and model requirements for reference by DCS owners, project officers, designers, operators, contractors, maintenance personnel and other relevant parties. The guidance, specifications, procedures, performance criteria, technical data and arrangements contained herein shall be reviewed and, where appropriate, adapted to suit the particular circumstances of each DCS project, including its system configuration, operating conditions, asset condition, site constraints, risk profile and contractual arrangements.

No representation, warranty, undertaking or guarantee, whether express or implied, is given or intended by the Government of the HKSAR or EMSD as to the accuracy, completeness, adequacy, reliability, currency or fitness for any particular purpose of the information contained herein. Any person or organisation adopting, applying or relying upon this document shall do so at its own discretion and risk and shall be solely responsible for exercising independent professional judgement, undertaking appropriate due diligence, and carrying out all necessary investigations, calculations, risk assessments and verifications.

Users are responsible for obtaining all necessary professional advice, statutory approvals, permits and consents, and for ensuring compliance with all applicable legislation, statutory requirements, codes of practice, standards, authority requirements, permit conditions, contract provisions, manufacturers' recommendations and project-specific design and operational requirements.

The materials, equipment, systems, technologies, procedures, performance criteria and arrangements described in this document may not be applicable to, or fully representative of, every DCS pipe network, particularly DCS installations not owned or operated by the Government. The suitability and applicability of any provision shall be assessed and confirmed for the relevant project by suitably qualified and experienced professionals and, where appropriate, competent specialist contractors, manufacturers or system vendors.

To the fullest extent permitted by law, the Government of the HKSAR and EMSD expressly disclaim all liability and responsibility for any loss, damage, cost, expense, liability or claim of any nature whatsoever, whether direct, indirect, incidental, special or consequential, arising from or in connection with the use of, misuse of or reliance upon this document or any information contained herein.

Reference in this document to any product, material, equipment, technology, system, software, manufacturer, supplier, contractor or service provider is made solely for technical or illustrative purposes. Nothing contained in this document shall be construed as constituting any endorsement, approval, recommendation, certification, warranty or assurance by the Government of the HKSAR or EMSD in respect of the design, manufacture, selection, sale, supply, installation, testing and commissioning, operation, maintenance, performance or use of any such product, material, equipment, technology, system or service.

SECTION 1: MODEL DESIGN SPECIFICATION OF DCS PIPE

PARTICULAR SPECIFICATION

(THIS SHEET <u>SHOULD NOT</u> BE INCLUDED IN THE TENDER DOCUMENT)

<u>NOTES FOR USERS</u>

This specification covers leak detection technologies for the DCS distribution network, including Distributed Temperature Sensing (DTS) and correlating noise loggers with hydrophones. The Project Officer shall undertake a project-specific risk assessment according to the risk matrix as illustrated in Figure 2 to determine which/both technologies are included in the contract.

REQUIREMENTS TO COMPLY OPERATION AND MAINTENANCE (O&M) STRATEGY FOR UNDERGROUND DCS PIPES

1. O&M Strategy for Underground DCS Pipes

1.1. The *Contractor* shall comply with the comprehensive O&M strategy for underground DCS pipes, incorporating predictive, preventive, and emergency maintenance, as summarized in Figure 1. Predictive maintenance utilizes network sectorization, optimal instrumentation, and real-time monitoring with analytics to proactively anticipate maintenance needs. Preventive maintenance involves scheduled pipe condition assessments at defined intervals to maintain system integrity, while emergency maintenance ensures prompt response to unforeseen issues or pipe failures. This specification covers detailed design provisions related to predictive maintenance, and specifications related to preventive and emergency maintenance will be covered in the Particular Specification for the Operation under the Contract.

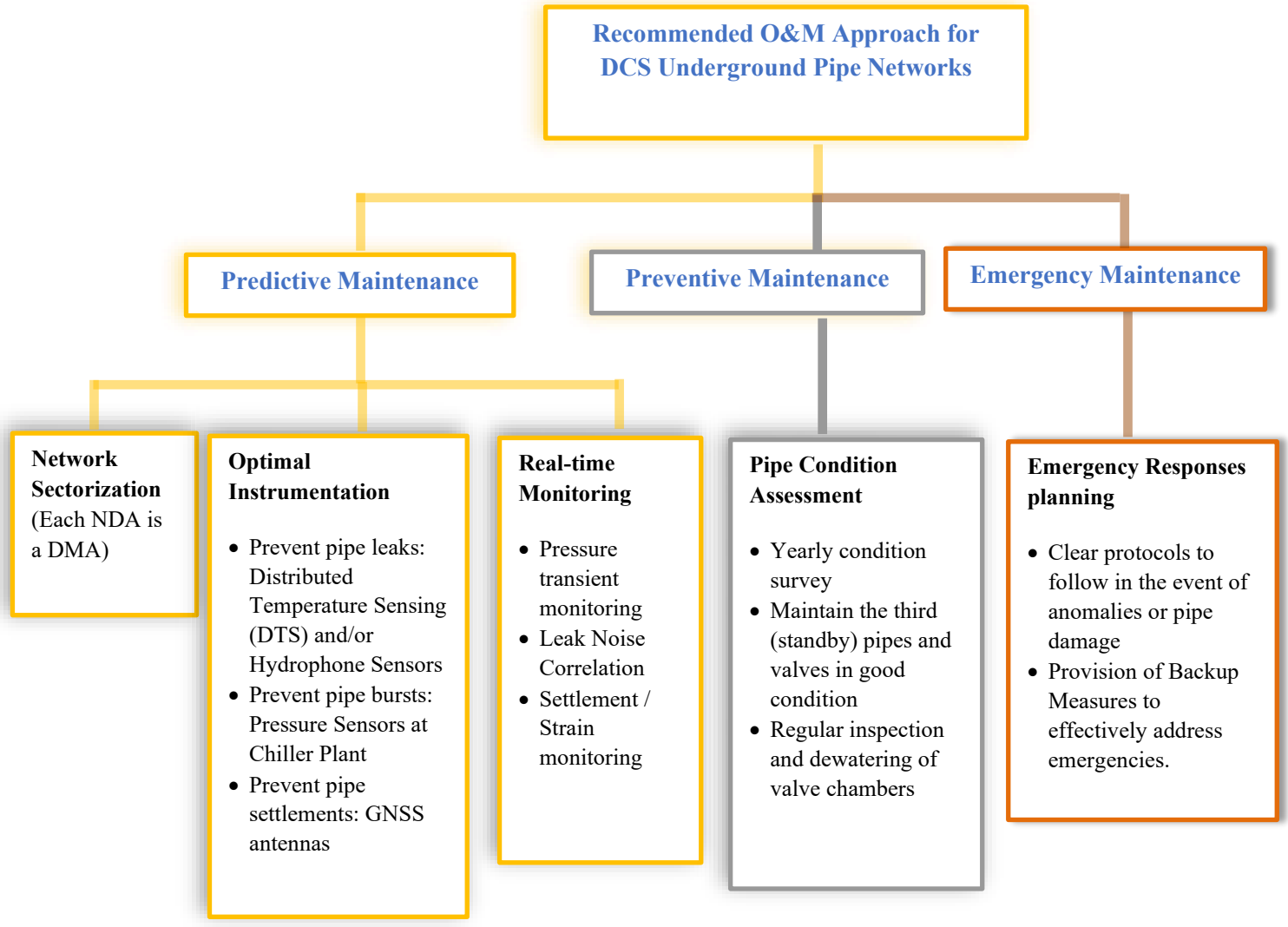


Figure 1: O&M Approach for DCS Underground Pipe Networks

2. Predictive maintenance

2.1. Design Specification for Instrumentation to prevent pipe leaks

2.1.1. The *Contractor* shall design the DCS pipe network to minimise the risk of leakage and maintain system integrity under the specified conditions, ensuring that the cooling liquid travels from the supplier to the end user with minimal thermal energy loss, even over extended distances. To support this objective, leak detection technologies shall be incorporated in the DCS pipe network capable of identifying multiple leaks, including minor weep or small leaks.

2.1.2. The *Contractor* shall incorporate the use of either Distributed Temperature Sensing (DTS) or correlating noise loggers with hydrophones for DCS pipes, or a combination of both technologies. The *Contractor/designer* shall conduct a feasibility study and submit a review report to the *Project Manager* proposing appropriate leak detection technologies, guided by an assessment of leak possibility within the DCS network and the associated consequences following the risk matrix, as illustrated in Figure 2. This risk-based approach ensures optimal economic value in the selection and implementation of leak detection technologies.

<table>
<tr><td></td><td colspan="3">Consequence</td></tr>
<tr><td>Leak possibility</td><td>High
(Substantial economic loss; and causes major inconvenience to the public)</td><td>Medium (Moderate economic loss, causing moderate inconvenience to the public)</td><td>Low
(Insignificant economic loss; with negligible or no inconvenience to the public)</td></tr>
<tr><td>High
(e.g., pipeline in densely populated areas and exposed to variable external load conditions^, corrosive soil, high water table)</td><td colspan="3">HIGH RISK*</td></tr>
<tr><td>Medium
(e.g., pipeline in moderately populated areas and exposed to variable external load conditions^, non-corrosive soil, moderate water table)</td><td></td><td colspan="2">MEDIUM RISK**</td></tr>
<tr><td>Low
(e.g., pipeline situated in sparsely populated areas under consistent external load conditions, with favourable ground)</td><td></td><td></td><td>LOW RISK**</td></tr>
</table>

***High Risk** – For new DCS pipe networks, prioritize the use of DTS wherever feasible, and supplement with hydrophones in locations where DTS installation is either not possible or impractical. For existing DCS pipe networks, install hydrophones at regular intervals, following the manufacturer's recommendations.

****Medium / Low Risk** – Install hydrophones at regular intervals, in accordance with the manufacturer's recommendations.

^ Examples of pipelines exposed to variable external load conditions include those installed along the Major Road Network, as defined by the Transport Department; those buried within reclamation areas where loads may change due to consolidation of newly reclaimed soils; and those located in areas subject to future development, where additional loads may arise from building foundations, structural elements, or fill placement above the buried pipelines.

Figure 2: Selection of Leak Detection Technology based on Risk Matrix

3. General Requirements - Leak Detection System

3.1. The following general specifications are provided for reference only. The Project Officer shall review and modify them as necessary when preparing project-specific specifications to suit the project conditions and contractual arrangements. These specifications apply to all DCS distribution pipelines, including but not limited to those installed underground, within enclosed areas, and along bridges, etc.

3.2. The *Contractor* shall engage a product specialist with proven track records in the installation of DTS and acoustic leak detection system for pinpointing the exact locations of all the hidden water leaking points for the entire underground DCS pipe network. The proposal shall be submitted by the *Contractor* and accepted by the *Project Manager* in accordance with the contract.

3.3. The Contractor shall provide qualified personnel, labour, tools, materials and equipment necessary for the installation of the Leak Detection System.

3.4. The Contractor shall prepare and submit all the proposed materials / equipment with catalogues, method statement, programme of works, sample of reports, etc. as necessary at least two (2) months prior to commencing any off-site and on-site fabrication and installation works.

3.5. The Leak Detection System shall be incorporated into the BIM model for the underground DCS pipes.

3.6. The Contractor shall supply, install and maintain all materials, equipment and necessary accessories, including water leakage detection devices, data transmitting devices, proprietary software programme provided by the manufacturer, etc. for permanent water leakage monitoring.

3.7. Sensors installed along the DCS pipelines shall be connected to a local monitoring/field control unit. The locations and configuration of the monitoring/field control units shall be proposed by the Contractor and submitted to the Project Manager for acceptance. Sensor signals shall be transmitted to the control room within the DCS plant via hardwired communication links or network interfaces and integrated with the BMS/SCADA system to enable real-time monitoring and alarm notification of leakage events. The signals shall be received at the control panel or SCADA/BMS workstation in the control room, where:

- Alarms are displayed on the monitoring interface.
- Operators receive visual and audible alerts.
- The system indicates the location and severity of the leak.
- The event is automatically logged for maintenance and diagnostic records.

3.8. All the Leak Detection System shall be executed in full compliance with, but not be limited to, the following Standards:-

- Code of Practice on Monitoring and Maintenance of Water-Carrying Services affecting Slopes issued by Environment, Transport and Works Bureau – November 2006.
- Guideline on Leak Detection on Underground Communal Service issued by Water Supplies Department – October 2017.
- Sample Contract Clauses and Specification for Procurement of Leak Investigation Services issued by Water Supplies Department – April 2019.
- Testing and Commissioning Procedure for Plumbing and Drainage Installation in Government Buildings issued by Architectural Services Department – Latest Edition.

4. Particular Specification - Leak Detection System

The following particular specifications are provided for reference only. The Project Officer shall review and modify them as necessary when preparing project-specific specifications to suit the project conditions and contractual arrangements. These specifications apply to all DCS distribution pipelines, including but not limited to those installed underground, within enclosed areas, and along bridges, etc.

4.1. Distributed temperature sensing (DTS)

4.1.1. DTS is typically employed to detect leaks that result in a temperature differential between the ambient environment and the escaping liquid. DTS is accomplished with fibre optic sensing systems that act as a sensor and measure temperatures along the entire length of an optical fibre.

4.1.2. Cooling water leaks alter the temperature of the surrounding insulation and optical fibre. Given that the pipelines operate under pressure, any leak results in a localized temperature deviation. Laser pulses are introduced into the fibre sequentially by the transceiver's transmitter. The intensity of the scattering light is measured by the transceivers, pinpointing temperature changes along the length of the fibre optic cable.

4.1.3. The *Contractor* shall propose the DTS which detects this variation in temperature with high sensitivity, triggering an alarm and pinpointing the exact location of the leak. A DTS system shall continuously measure temperature along the entire length of the fibre optic cable, at 1m intervals. The proposed fiber-optic sensors shall be sensitive only to temperature, and immune to electromagnetic fields or radio frequency interference, which could detect even subtle temperature variations.

4.1.4. Loose-buffered fibres are ideally suited for temperature-sensing applications. Buffer tubes shall be water-blocked with either gel or water-swellable yarns. Gel-filled tubes transfer heat more efficiently than air-filled dry water-blocked cables; therefore, filled cables are generally recommended. Fibre optic cables shall be 4-core MM cables, rodent-resistant or steel wire armoured, 50/125 μm graded-index MM (OM3/OM4), conforming to ITU-T G.651.1 or an approved equivalent. The cable shall be embedded beneath the insulation at approximately the 5 o'clock or 7 o'clock position of the pipeline. The *Contractor* shall propose the DTS system vendor for the *Project Manager*'s approval, who shall provide guidance on suitable fibre types, cable designs, and installation positions applicable to their system. The proposed fibre optic cables shall generally comply with the following specifications, unless otherwise approved by the *Project Manager*.

Technical Parameters	Technical Data
Optical fibre core diameter	50μm
Cladding diameter of the core	125μm
Insulation sleeve diameter	0.6mm
Minimum bending radius	60mm
Outer jacket material	Waterproof HDPE (or equivalent approved material)
Sheath material	Metal armoured spiral sheath or fibre optic cables installed within corrosion-protected metal conduits and concealed within the pipe insulation
Tensile strength	500N during installation 300N during application
Compressive strength	5000N/10cm during installation 3000N/10cm during application
Deformation stress	300N/cm causes 0~0.3mm deformation

Figure 3: Design Specifications of Fibre Optic Cables

4.1.5. The *Contractor* shall submit a method statement to the *Project Manager* for approval at least two (2) months prior to commencing off-site and on-site fabrication of the fibre optic cables. In consultation with the vendor, the *Contractor* shall address practical installation issues that may degrade data quality, including but not limited to connector and splice failures, sharp bends, cable strain, and mechanical damage. The sensing fibre shall be installed in accordance with the vendor's recommended bending radius to prevent signal discontinuities that could result in erroneous distributed temperature measurements. The *Contractor* shall also propose interface details around valves and transition details at abrupt changes in pipe profile, in line with the vendor's recommendations.

4.1.6. The proposed DTS technology shall comply with the following performance objectives:-

- **Real-time leak detection and localization** for faster and more accurate diagnosis and repair
- **Highly Accurate Localization:** Detects leaks with precise spatial resolution, often within a few meters (1-4m). Able to detect temperature changes as small as 0.1°C to 1°C upon system resolution and calibration. Accurately locates seepage (slow leaks ~20L/hour), at weld points and pipeline fittings, as well as sudden leaks (pinholes and significant cracks or ruptures).
- **Multi-Point Pinpointing:** Capable of performing multi-point pinpointing of water leaks.
- **Long Distance Coverage:** Effective for monitoring pipelines over hundreds of kilometres. One interrogator unit shall be able to link up to minimum 80km of fibre optic cable length.
- **Minimal Maintenance:** Fibre optic cables have a design lifespan of minimum 30 years, can survive a harsh environment, such as heat, dirt, dust and corrosion and require minimal maintenance.
- **Detection time**: 24/7 Detection.

4.1.7. The *Contractor* shall propose the DTS system architecture, in alignment with the vendor's recommendations and as illustrated in Figure 4 below as an example, for review and approval by the *Project Manager*. The *Contractor* shall design, supply, install, and maintain the complete DTS system, including all necessary hardware (e.g., interrogator) and software (e.g., cloud-based platform, analysis software), etc. The *Contractor* shall arrange annual servicing of the DTS system by the vendor or an approved specialist to ensure proper functioning and compliance with

the specified performance objectives. A copy of the servicing report, detailing the servicing activities, problems identified, and improvement works carried out, shall be submitted to the *Project Manager* for record.

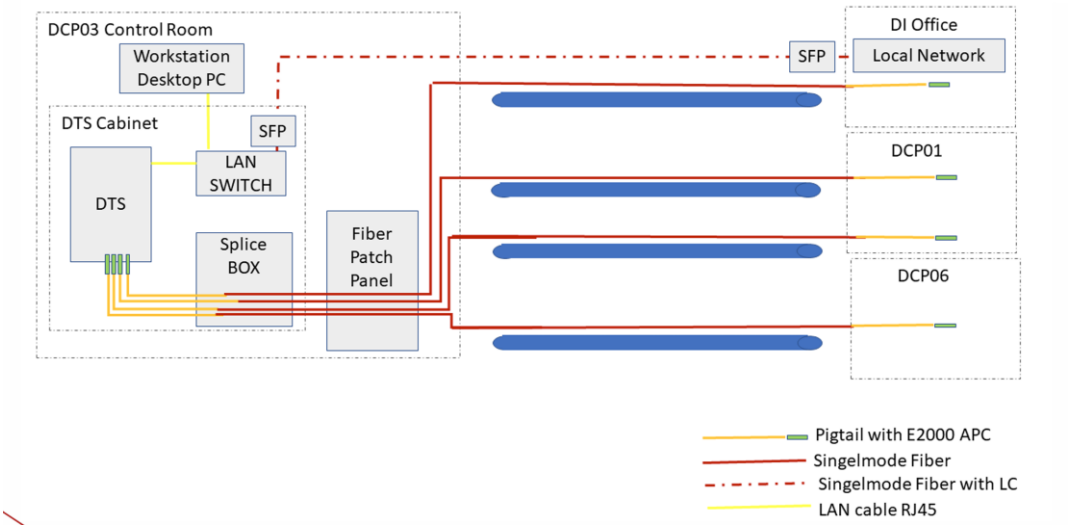


Figure 4: Example DTS System Architecture

4.1.8. The appointed DTS vendor shall design the software to be compatible with multiple Windows operating systems and capable of performing the following functions:

- Collect and store real-time temperature data from the monitoring area.
- Display real-time temperature distribution curves and temperature change curves for the monitoring area.
- Enable each area to be configured with three types of alarms: fixed temperature alarm, temperature rise rate alarm, and area temperature difference alarm.
- Divide the system into multiple monitoring zones based on measurement length, with the ability to designate key areas for differentiated monitoring.

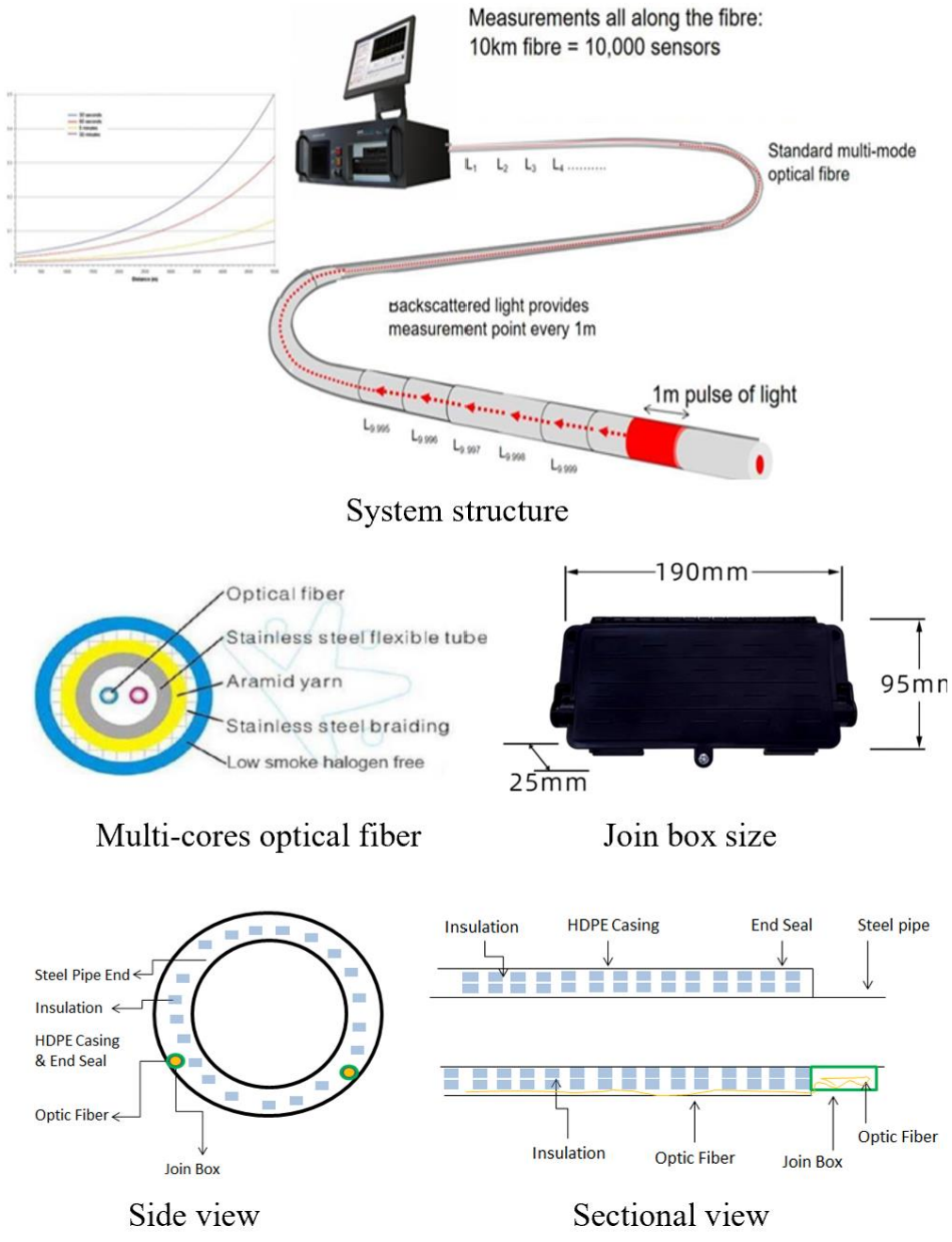


Figure 5: System structure of distributed fibre optic sensing technology for pipeline health monitoring

4.2. Acoustic Techniques using Correlating Noise Loggers (Hydrophones)

4.2.1. Hydrophones to be installed shall incorporate submersible noise sensors capable of detecting leak-generated acoustic signals traveling through the water column. These devices may be conveniently positioned at pipeline fittings, such as valves. When a pressurized pipeline develops a leak, the escaping fluid produces acoustic emissions that propagate through the water. Hydrophones detect these water-borne acoustic waves, which can travel considerable distances. To enhance detection sensitivity, advanced filtering technology, particularly at very low acoustic frequencies, shall be employed, enabling hydrophone-based acoustic correlation techniques to identify even small leaks at early stages.

4.2.2. The *Contractor* shall propose a leak detection sensor assembly, including associated pipe fittings, to be installed on the DCS pipeline with access through manholes. The fittings shall be of minimum Grade 316 stainless steel and shall be provided with a ball valve of the same stainless steel grade with a minimum pressure rating of 16 bar to allow maintenance and removal without shutting down the DCS network.

4.2.3. The proposed acoustic technology shall comply with the following performance objectives:-

- **Optimal Acoustic Conditions**: Acoustic data sampled at night when optimum acoustic conditions exist
- **Multi-Point Pinpointing**: Capable of performing multi-point pinpointing of water leaks.
- **Real-Time Monitoring**: Daily data gives reduced leak run time
- **Improved Pinpointing Accuracy**: A leak may be detected by multiple loggers, improve pinpointing accuracy
- **No shutdown required**: No need to close off valves or empty pipes
- **Simple installation**: Particularly easy when communications are cellular-based
- **Remote Data Access**: Data available at any location via web browser
- **Leak Confirmation**: Leak record listening for confirmation of leak noise

4.2.4. The proposed acoustic techniques using hydrophones shall generally comply with the following specifications, unless otherwise approved by the *Project Manager*.

Considerations	Design Specification for Hydrophones
Network	Sensor layout at typical spacing up to 500m, according to manufacturer's recommendations
Pipe size	Effective for pipe size >500mm
Localization accuracy	Can pin-point leak events up to +/-5m
Sensitivity to ambient noise level	Less sensitive (can detect small leaks)
Multi point pinpointing	Capable of performing multi-point pinpointing of water leaks
Alert time	Alerts are monitored over a period of 24-48 hours to confirm existence of developing leak
Frequency	Variable logger sample rate from 1s to 24hrs
Storage temp./Operating temp.	-40 to 60°C / -20 to +60°C
Environmental	IP68 submersible
Power	Lithium Thionyl-Chloride, typical 5 years (depending on settings and signal condition) or external power connection for battery box and DC input.
Expected battery life	Up to 8 years of operation at standard conditions and 1 sample per day

Considerations	Design Specification for Hydrophones
Memory	Primary recording: 1 million readings (non-volatile memory)
Fast logging (secondary channel)	Secondary, fast channel supports sampling up to 100 Hz and record average, minimum, maximum, standard deviation or time interval between pulses (for data smoothing)
Alarms	Multiple alarm options including Rate of Change, Profile, Minimum Night Flow and Threshold.
Internal cellular modem	Cellular modem supporting 4G/LTE/5G
Sound file	Automatically recorded on alarm or manual request
Safety tested	16 bar
Life in service	Over 20 years
Material body	Stainless Steel 316

Figure 6: Design Specifications of Hydrophones

Leak Noise Correlation

4.2.5. The *Contractor* shall implement correlation processing within the proposed acoustic techniques using hydrophones to accurately pinpoint leaks. Utilizing accurate time synchronization enables immediate identification of leak locations, thereby significantly reducing leak run time. Multi-logger correlation shall be performed to enhance leak location accuracy, with acoustic samples recorded simultaneously by multiple loggers—typically at night when background noise is minimal. These samples shall be transmitted to a server for multi-point correlation analysis. Logger positions and leak location results, along with historical data for comparison, shall be accessible on any internet-enabled device.

4.2.6. The *Contractor* shall propose a vendor with a proven track record in utilizing acoustic techniques with correlating noise loggers (hydrophones) for pipe leak detection, subject to the *Project Manager*'s approval. The selected vendor shall provide comprehensive technical support, including sensor spacing recommendations, software platform provision, system calibration, operator training, and any other services necessary to meet the specified performance objectives.

4.2.7. The selected vendor shall provide a secure, web-based portal to facilitate remote identification of network leakage. The software platform shall enable access to devices and their collected data, maintain a comprehensive database of all installations and site details, and present data with options to set and view alarms. Additionally, the software shall support acoustic correlation, leak detection, and logger programming. It must offer connectivity with multiple loggers and provide various methods for viewing collected data. The selected vendor shall provide ongoing assistance to the *Contractor* for the proper setup, testing and commissioning of the system, as well as throughout the maintenance period.

4.2.8. The *Contractor* shall propose the system architecture, in accordance with the vendor's recommendations for the *Project Manager*'s approval. The *Contractor* shall design, supply,

install, and maintain the complete acoustic leak detection system, including all necessary hardware and software (e.g., cloud-based platform, analysis software), etc. The *Contractor* shall arrange annual servicing of the system by the vendor or an approved specialist to ensure proper functioning and compliance with the specified performance objectives. A copy of the servicing report, detailing the servicing activities, problems identified, and improvement works carried out, shall be submitted to the *Project Manager* for record.

4.3. Instrumentation to prevent pipe bursts

4.3.1. The *Contractor* shall incorporate pressure sensors into the DCS pipe network to monitor pressure transients and harmful surges that may lead to pipe bursts. Wireless pressure sensors shall be strategically placed at supply pipes near chiller plants to collect data on pressure anomalies, enabling analysis for surge detection and assessment of pipeline integrity. The objective is to identify areas at risk of bursts and leaks early, allowing for prompt corrective actions to mitigate flow transients and to prioritize repair efforts by evaluating leak severity before escalation to pipe bursts.

4.3.2. The *Contractor* is required to use multiple pipe leakage indicators, including pressure sensors and acoustic data from hydrophones, to detect bursts, leaks, and losses in pipes. A data management and analytics engine shall be implemented to analyse and identify pressure transients, as illustrated in Figure 8 below as an example, acoustic noise, and other anomalies associated with potential pipe breaks, and accurately localize these events to the faulty pipe. The automated detection process shall also assess the severity of potential leaks, enabling repair crews to effectively prioritize their response and ensure efficient repairs.

4.3.3. The *Contractor* shall propose a vendor with a proven track record in utilizing similar techniques for harmful surges detection, subject to the *Project Manager*'s approval. The selected vendor shall provide comprehensive technical support, including software platform provision, system calibration, operator training, and any other services necessary to meet the specified performance objectives.

4.3.4. The Contractor shall propose a sensor assembly, including associated pipe fittings, for installation on the DCS pipeline with maintenance access. The fittings shall be of minimum Grade 316 stainless steel and shall include a ball valve of the same grade with a minimum pressure rating of 16 bar to allow maintenance and removal without shutting down the DCS network.

4.3.5. The proposed pressure sensors shall generally comply with the following specifications, unless otherwise approved by the *Project Manager*.

Considerations	Pressure Sensors / Transient Loggers
Network	Long Distance up to 1.0 Km
Detection Time	24/7 Detection
Localization Accuracy	Leak Localization Accuracy up to +/- 50m — with each sensor covering several KM of pipe.
Alert Time	Alert sent within minutes of the occurrence of pipe burst
Type of Leaks	Detect newly occurring bursts

Figure 7: Summary of Optimal Instrumentation to prevent pipe leaks / bursts

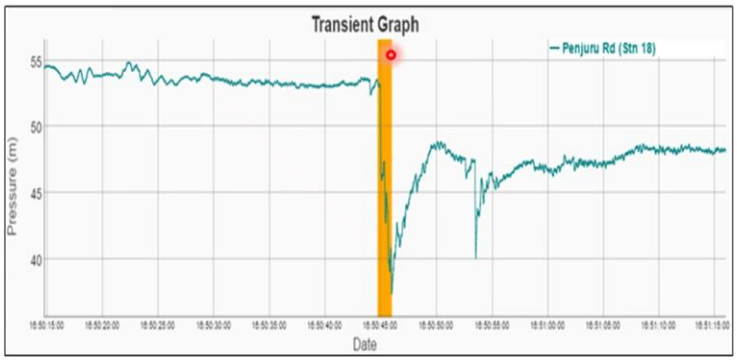
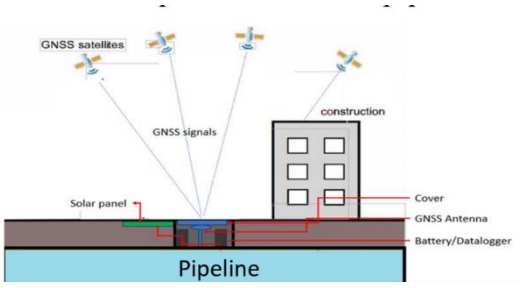


Figure 8: Pressure sensors

4.4. Instrumentation to monitor settlements - Global Navigation Satellite System (GNSS) technology

4.4.1. By leveraging satellite constellations such as GPS, GLONASS, Galileo, and BeiDou, Global Navigation Satellite System (GNSS) technology has emerged as an effective solution for monitoring the settlement of underground pipelines. The *Contractor* shall propose a GNSS settlement monitoring system comprising a data collection system, data processing server, web-based data visualization platform, and all necessary site infrastructure and installations. The GNSS antenna should be mounted on a steel stand welded to the pipe and positioned as close to ground level as possible within a manhole. Additionally, the *Contractor* shall propose a specialized manhole cover to ensure the antenna can effectively receive satellite signals for accurate ground settlement monitoring. All collected data shall be integrated with advanced analytics and IoT platforms to enable real-time monitoring of pipe settlement, as illustrated in Figure 9 below.

4.4.2. The *Contractor* shall propose a vendor with a proven track record in utilizing GNSS technology for monitoring pipeline settlements, subject to the *Project Manager*'s approval. The selected vendor shall provide comprehensive technical support, including software platform provision, system calibration, operator training, and any additional services necessary to meet the specified performance objectives.





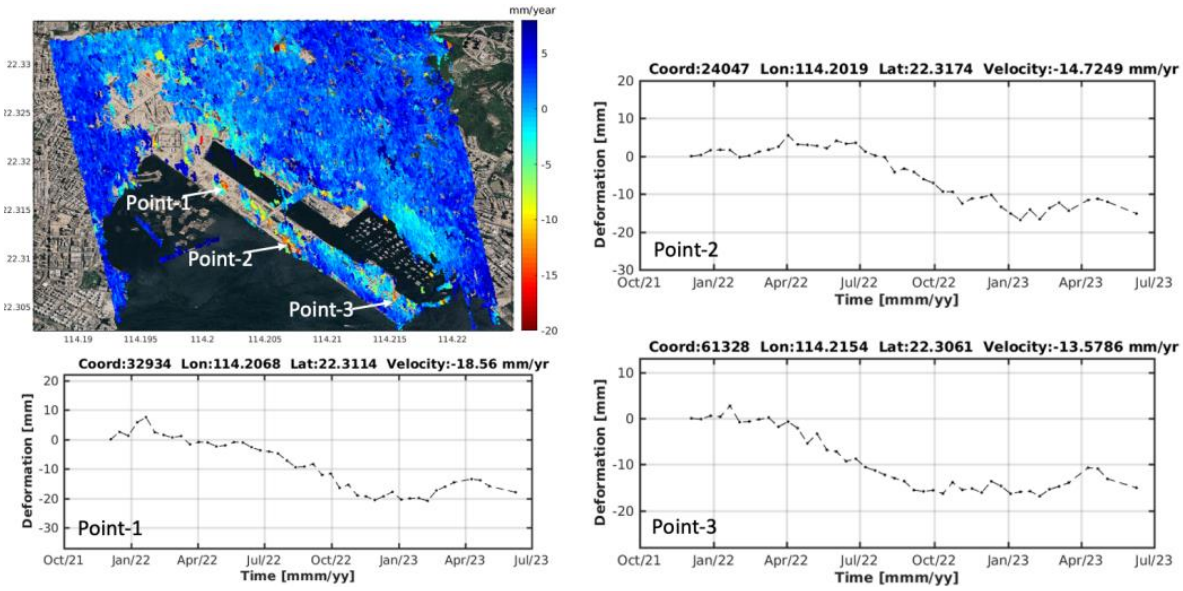


Figure 9: An example dashboard for real-time monitoring of pipe settlement (with reference of Kai Tak DCS)

4.4.3. The system shall meet the following performance objectives: -

- **High Precision:** GNSS technology delivers 1-2mm horizontal and 2-4mm vertical precision.
- **Real-time Monitoring:** GNSS systems integrate with predictive analytics and IOT platforms to enable real-time monitoring. When the data meets the triggering logic set, an automatic alert is triggered to notify the user.
- **Fully Automated:** The system requires no human intervention, ensuring continuous and uninterrupted data collection.
- **Power Supply:** Each sensor location requires a power source to function effectively. This can be addressed using rechargeable batteries connected to solar panels. If installation of solar panels is not feasible, batteries are to be - installed and replaced every 6 to 8 months to ensure reliable operation**.**
- **Manhole Cover Design:** Each sensor shall be installed beneath a manhole cover with a proven design that ensures effective satellite signal reception by the antenna.
- **Blocked signals:** GNSS signals may be obstructed by tall buildings in urban environments, resulting in dead zones where signal reception is poor or non-existent. This can limit the effectiveness of the monitoring system in certain areas. The *Contractor*, in consultation with the approved vendor, shall ensure that proposed sensor locations are not situated within any dead zones.

4.4.4. To facilitate pipe integrity monitoring, GNSS shall be deployed at strategic locations with a high risk of differential settlement, particularly where there are abrupt changes in the pipe's longitudinal profile, such as transitions between different installation depths (e.g., pipes installed by open trench versus pipe jacking) and at connections where pipes enter buildings. Based on this principle, the *Contractor*, in consultation with the approved vendor, shall propose GNSS deployment locations for the DCS system for the *Project Manager*'s approval. As part of the monitoring process, the *Contractor* shall correlate settlement data to ensure that the maximum longitudinal strain along the pipe alignment does not exceed 0.5%, thereby safeguarding pipe integrity. If any strain limit exceeds 0.5%, the *Contractor* shall promptly notify the *Project Manager* for further review. A qualified engineer shall be appointed by the *Contractor* to assess the need for ground improvement or other remediation measures to maintain pipe integrity, and all findings shall be summarized in a report submitted to the *Project Manager* for review.

4.5. Testing and Commissioning

4.5.1. Testing and commissioning of the leak detection system shall include verification of proper installation of sensors and cables, correct configuration of the control panel, and simulated leak tests to confirm alarm accuracy. Pre-commissioning checks (including wiring, and power supply), functional tests (covering cable break detection, leak localisation, alarm relay operation, pressure/hydraulic transient simulation, etc.), and documentation of system performance in a commissioning report shall be carried out by the specialist contractor/vendor appointed by the *Contractor.* The *Contractor* shall ensure system completeness and readiness prior to the commencement of any commissioning activities and shall supervise and review all commissioning works before submission for witnessing and approval. In the event of any test failure, the specialist contractor/vendor shall rectify the deficiencies and re-offer the test for re-witnessing and approval. The final testing and commissioning report for the Water Leak Detection System shall be prepared, signed, and submitted by the specialist contractor/vendor to the *Project Manager*.

4.6. Operator Training

4.6.1. The specialist contractor/vendor shall provide training to the owners and operators to minimise false alarms and ensure effective response, comprising both classroom-based instruction and practical, hands-on sessions. The training for operators shall, as a minimum, include the following. The *Contractor* shall submit the proposed training programme and syllabus to the *Project Manager* for approval.

- System Familiarization: Understanding the layout, zone mapping, and technology (e.g., acoustic, fibre optic).
- Alarm Interpretation and Verification: Differentiating between real leaks and noise/false alarms.
- Operational Procedures: Learning how to reset alarms, silence the panel, check cable integrity, and run system tests.
- Emergency Response: Training on appropriate actions to take once a leak is located.
- Data Recording: Meticulous recording of test data

4.6.2. The owner(s) will take over the leak detection system only upon acceptance of the final Testing and Commissioning report and completion of the required training in accordance with Clauses 4.6.1 and 4.7.1.

4.7. Operation and Maintenance (O&M) manual

4.7.1. The Contractor shall submit the O&M manual for all installed Leak Detection Systems. As a minimum, the manual shall include the following:

- System overview describing the leak detection system type, purpose, and installation locations.
- Inventory of system components including control panels, sensors, cables, probes, alarm modules, and accessories with manufacturer and model details.
- As-built drawings and schematics showing sensor locations, zones, control panels, and wiring arrangements.
- Technical data sheets and specifications for all system components.
- Procedures for system startup, commissioning, and normal operation.
- Alarm handling procedures including interpretation, acknowledgement, silencing, and

system reset.
- Information on system integration with BMS/SCADA and sensitivity adjustment for different environments.
- Routine maintenance schedule and procedures for functional testing, calibration, inspection, and cleaning of sensors and cables, and testing and replacement procedures for batteries.
- Troubleshooting guidance and emergency response procedures for leak detection, fault diagnosis, and system shutdown if required.
- Administrative and safety information including warranty details, spare parts list, safety procedures, and maintenance records/logs.

4.8. Twelve (12) Months Maintenance Services

4.8.1. The *Contractor* shall provide Twelve (12) Months Maintenance Services for the leak detection system commencing from the date of completion of installation and commissioning. During the maintenance period, the *Contractor* shall ensure that the system operates reliably and in accordance with the Contract requirements. The maintenance services shall include, but not be limited to, the followings:

- Routine inspection of all system components, including sensors, sensing cables, control panels, communication interfaces, and associated equipment.
- Functional testing of the leak detection system at regular intervals to verify proper operation of sensors, alarm functions, and communication with the BMS/SCADA system.
- Troubleshooting and rectification of faults, including repair or replacement of defective components to restore normal system operation.
- System configuration checks and updates, where necessary, to ensure reliable communication and integration with the BMS/SCADA system.
- Maintenance of records and submission of reports documenting inspections, testing, faults identified, corrective actions taken, and overall system performance.
- Technical support to operating staff, including guidance on system operation, alarm interpretation, and basic troubleshooting where required.
- Upon completion of the maintenance period, the Contractor shall carry out a final inspection and functional test of the leak detection system and submit a report confirming that the system remains fully operational and compliant with the Contract requirements.

*****

SECTION 2: MODEL OPERATION AND MAINTENANCE SPECIFICATION

PARTICULAR SPECIFICATION

(THIS SHEET <u>SHOULD NOT</u> BE INCLUDED IN THE TENDER DOCUMENT)

<u>NOTES FOR USERS</u>

These Model Operation Specifications are for reference only. The Project Officer should refer to the relevant part(s) of them for preparing the project specific specifications to suit different situations.

1. OPERATIONAL REQUIREMENTS

1.1. Operation Plan

(a) Emergency Repair Procedures of DCS – overall framework to carry out emergency repair works including but not limited to detailed emergency repair procedures, organization of emergency repair team including specialist contractor/ subcontractor, etc, availability of construction plant, availability of materials and independent checking of *Contractor*'s repair works and design. The repair works or procedure for Facilities shall strictly follow the requirements as stated in the *Client*'s Requirement unless otherwise proposed by the Operator and accepted by the *Service Manager*. The detailed engagement of Subcontractor or direct labour, including Plant and Materials, for the emergency repair works should also be included in the Operation Plan and updated annually unless otherwise accepted by the *Client*. The Operator shall enter a formal sub-contract or sub-consultancy if the repair works are not carried out by their direct labour or staff and guarantee their services within the time as stated in the repair plan upon request. The repair works shall include disciplines of civil engineering, traffic engineering, electrical and mechanical engineering, geotechnical engineering, structural engineering, architecture, landscaping and arborist, etc. The proposal shall include the procedures and relevant People, Equipment and materials for maintaining the Facilities in all conditions, including but not limited to:

i. Under public roads;
ii. Private owned area;
iii. Areas managed/owned by other Government Departments;
iv. Open space/landscaped area;
v. Within a common utilities enclosure/tunnel; and
vi. Confined Space.

The *Contractor* shall submit the emergency team / requirement for the DCS which can deploy the sufficient workers, machinery/equipment and material in a short period of time to tackle the emergency repair to satisfy the requirements and performance target in Clause 3.1.1 or elsewhere described in the contract.

(b) Contact list for the maintenance personnel including those under sub-contractor and/or sub-consultant shall be consolidated in a contact list as an appendix and update on a regular basis for the *Service Manager*.

(c) Plan for Regular Inspection of DCS – overall framework to carry out regular inspection on DCS installations including but not limited to DCS plant and Chilled Water Pipeworks. The plan shall include detailed inspection procedures, scope of inspection, organization of the inspection team, details of inspection equipment and frequency of inspection, etc.

(d) Operation and Maintenance Requirements for DCS pipes.

(e) The *Contractor* shall include the following details in the Operation Plan and submit to the *Service Manager* for acceptance:-

- Operation procedure manual on how to rectify the system component failure and resume/ maintain the services to the consumers
- Equipment and pipework changeover procedure and time required under normal and failure condition
- Resilience study and measures to avoid and minimize the impact

(f) Crisis Management Plan in handling different scenarios such as flooding, fire outbreak, and bomb threat or terrorist attack. The Plan shall iron out issues with a view to avoid human injury and property damage.

(g) Proposed plan and action of provision of advance chilled water supply.

1.2. Operation and Maintenance

1.2.1. Inspection and preventive maintenance schedules

Category	Descriptions of works
Water System Management	- Check for insufficient water pressure or flows - Check for rusty pipe - Check the pump operation or any noisy operation - Check for dirty supply tanks, defective water tanks
Gates / Valves & Operation stems	- Periodic cleaning to maintain smooth operation - Periodic painting to maintain appearance - Cycling to alleviate sticking at minimum 30 days intervals for gates - Thrust nut shall be removed every year and inspected for wear - Stem shall be kept clean and greased at least once every six months
Chilled water distribution network	*The following requirements are provided for reference only. The Project Officer shall review and modify them as necessary to suit the project conditions and contractual arrangements. These specifications apply to all DCS distribution pipelines, including but not limited to those installed underground, within enclosed areas, and along bridges, etc.* - Real-time settlement / strain monitoring using Global Navigation Satellite System (GNSS) technology - Periodic ground settlement monitoring at minimum 30 days intervals. - Quarterly inspection and dewatering of critical valve chambers if needed (Bimonthly inspections during the rainy season), refer to Clause 2.3 - Yearly Drill / Switch-over to the standby DCS pipe, refer to Clause 2.4 o an annual switch-over exercise to test the standby pipe (e.g. to rotate as duty supply and return pipe at maximum operating pressure) for a minimum of 10 working days / rotation o Check and exercise all isolation valves along the three-pipe system o Identifying any potential vulnerabilities and carry out appropriate rectification works. - Yearly condition survey

(b) The above Schedule is not exhaustive in nature. The *Contractor* shall agree with the *Service Manager* the detailed inspection and preventive maintenance schedules with comprehensive checklist for effective management of the Facilities before commencement of the Operation. The *Contractor* shall submit a comprehensive maintenance plan for *Service Manager*'s acceptance.

(c) Upon identification of any defect, the *Contractor* shall rectify and make good the defect without undue delay or imposing unacceptable hazard to the operators, workers, staff or visitors at the Facilities.

(d) All the operation and maintenance works shall be carried out by registered /licensed technicians or personnel with qualification recognized by HKSAR. The *Contractor* shall submit the qualification to the *Service Manager* for acceptance.

1.2.2. Equipment Availability & Serviceability, Undue Down Time of Units

(a) The Contractor shall ensure reliable operation of the DCS.

(b) Availability of spare parts for repair and replacement of damaged parts, readiness of the standby units to replace the duty units in the event of out of service and avoidance of undue down time shall be assured at all times by the Contractor.

For the avoidance of doubt, down time of unit is considered unduly long and unacceptable at the sole discretion of the Service Manager unless the Contractor could provide substantiation to the satisfaction of the Service Manager that it is totally out of the Contractor's control.

1.2.3. The Contractor shall uphold the reputation of the Client during the Operation without causing disrepute to the Client. The Contractor shall indemnify the Client against any damages or condemn arising from the acts of the Contractor.

2. PREVENTIVE MAINTENANCE OF UNDERGROUND DCS DISTRIBUTION PIPEWORKS

The following specifications are provided for reference only. The Project Officer shall review and modify them as necessary to suit the project conditions and contractual arrangements. These specifications apply to all DCS distribution pipelines, including but not limited to those installed underground, within enclosed areas, and along bridges, etc.

2.1. Pipe condition assessment (offline inspection approach)

2.1.1. The *Contractor* shall engage a qualified operator and company to carry out the pipework condition surveys on a yearly basis for the DCS three-pipe system. The *Contractor* shall submit the method statement, including pipe isolation plan and valves to be exercised and programme for the *Service Manager*'s approval.

2.1.2. Site works shall only commence until permits regarding the Lighting, Signing and Guarding of Road Works or Footway works have been issued in compliance with the Code of Practice for Lighting and Guarding published by the HyD. The Contractor shall comply with all statutory regulations and enactments and any particular specific instructions from the Service Manager.

2.1.3. The recordings and report shall clearly show circumferential condition of the DCS pipeline. The defects and abnormalities in the pipelines shall be clearly described. The pipelines shall be hydraulically cleaned before inspection. This is to enable existing defects to be clearly recorded on video. The Contractor shall re-clean and re-inspect the pipeline if the recorded view is obstructed or not clear.

2.1.4. The Contractor shall ensure all pages in the reports shall be clearly and systematically annotated in relation to the following. All documents, including PDF reports, video files and image files), must be submitted to the Service Manager for approval.

- Project Reference Number/ Contract Number
- Pipe diameter, pipe material, direction of unit travel
- Date and time of survey
- Road name/location
- Name of qualified operator and company
- Upstream and downstream (or "from" and "to") of inspected pipe segment Automatic update of the unit's chainage position in the pipeline from adjusted zero
- Running footage (distance travelled in meter)

2.1.5. Video screenshots shall be produced in the following circumstances:

- All suspected defects and abnormalities, which may include: pipe deformation, displaced, sunken, infiltration, pipes with joint displacement and abnormalities. Where there are bends/kinks/drops found in the pipeline, it shall be indicated clearly in the report.

- Where a video screenshot is taken to illustrate a specific defect, it shall occupy the central part of the screen and be in focus. The *Contractor* shall ensure that all submissions of all videos and photographs are of good clarity.

2.1.6. All photographs of pipe defects shall be printed and inserted behind the relevant page in the survey report, thus providing the Service Manager with an instant view of the pipe defects. The digital file will be enclosed in an envelope at the back of the report.

2.1.7. Submission format of video and image should only be in MP4 with the codec listed in MPEG-4 Part 10 with minimum resolution of 640 x 480 and in JPEG/GIF/PNG or BMP formats. Maximum submission size (including all videos and reports) shall not be more than 3GB.

2.1.8. The Contractor shall also make recommendation and submit method statements and programme to the Service Manager to rectify all identified pipe defects. Upon receiving instructions from the Service Manager, the Contractor shall promptly carry out the necessary repairs and rectifications to ensure the reliability of the DCS pipeline system.

2.2. Pipe condition assessment (inline inspection approach using robotic)

2.2.1. The Contractor shall provide an inline free-swimming robotic pipeline inspection system for the condition assessment of DCS pipeworks, capable of detecting and locating leaks, gas pockets, and other anomalies under normal operating conditions where shutdown of the DCS pipeline is not feasible or operationally undesirable. The system shall comprise a miniaturised, neutrally buoyant, flow-driven robotic in-pipe device equipped with acoustic, temperature, and pressure sensors, suitable for operation in chilled water systems. The robotic device shall be capable of traversing long pipeline sections, including bends, fittings, and diameter changes, and shall be constructed of non-corrosive, non-contaminating materials compatible with DCS water quality and temperature conditions.

2.2.2. The robotic inspection system shall achieve a high level of detection sensitivity and positional accuracy, typically capable of identifying small leaks and locating them within approximately ±1.0 m along the pipeline alignment. The integrated sensor suite shall enable multi-parameter detection, including:

- Acoustic sensors for identifying leak noise and structural anomalies
- Temperature sensors for detecting localised thermal deviations associated with leakage or abnormal heat exchange
- Pressure sensors for identifying pressure fluctuations, transients, or anomalies indicative of leakage or flow disturbances

2.2.3. A surface tracking system shall be provided to monitor the movement of the robotic device and determine the position of detected anomalies using acoustic receivers and/or equivalent positioning techniques integrated with pipeline reference data. Deployment and retrieval of the robotic device shall be carried out via existing pipeline access points, such as air valves or flanged connections, wherever practicable, without requiring system shutdown. The Contractor shall provide all necessary insertion, tracking, and retrieval arrangements, including contingency measures to ensure safe and reliable recovery of the robotic device.

2.2.4. The Contractor shall be responsible for the detailed planning and execution of the inspection works, including submission of method statements, inspection plans, and risk assessments that take into account pipeline hydraulics, operating conditions, and access constraints. Data

collected by the robotic inspection tool shall be processed and analysed using validated methodologies to identify and classify anomalies based on combined sensor outputs. Data fusion of acoustic, temperature, and pressure measurements shall be carried out to improve detection accuracy and reduce false positives. Where applicable, the results shall be correlated with other monitoring systems, including Distributed Temperature Sensing (DTS), pressure monitoring, and SCADA/BMS data, to enhance detection reliability and support an integrated, smart asset management approach.

2.2.5. Upon completion of the inspection, the Contractor shall submit a comprehensive report detailing the pipeline sections inspected, inspection conditions, and all identified anomalies, including their locations, estimated severity, and confidence levels. The report shall include clear recommendations for repair, further investigation, or continued monitoring. In addition, the Contractor shall provide all raw and processed data, GIS-compatible outputs, and annotated pipeline drawings. The Contractor shall ensure that all robotic inspection equipment is properly calibrated, maintained, and operated in accordance with approved procedures, and shall provide training and technical support to the Owner's personnel where required.

2.3. Inspection of underground DCS networks

2.3.1. Inspection of underground distribution networks shall be maintained at minimum quarterly intervals throughout the service period, particularly at chambers and fittings areas which have a high susceptibility to leaks. Bimonthly inspections shall be carried out during the rainy season. Dewatering of valve chambers shall be carried out as necessary to ensure that valve operation during emergency situations is not impacted. A copy of the report, detailing the inspection activities, identified issues, and recommended improvement works, shall be submitted to the Service Manager for review. Upon receiving instructions from the Service Manager regarding any identified issues, the Contractor shall promptly carry out the necessary repairs and rectifications to ensure the reliability of the DCS pipeline system.

2.4. Annual drill / switch-over to the standby DCS pipe

2.4.1. To prevent a single point of failure in the DCS pipeline network, the third standby DCS pipe must be properly maintained. An annual switch-over exercise shall be conducted by the Contractor's designated turncock crew, during which the standby DCS pipe will operate as the sole duty supply pipe for at least 10 working days, or until the DCS system demonstrates stable performance under various operating conditions. This shall be followed by another 10 working days with the standby pipe serving as the return pipe, until system stability is confirmed. The Contractor should consider combining the annual drill with the pipe condition assessment to improve work efficiency and minimize repeated switch-overs of the chilled water flow.

2.4.2. The Contractor shall undertake a comprehensive review of the entire DCS system to develop a detailed switch-over plan, taking into account the operational constraints, including variations in pipe sizes, pump pressures, and water balancing requirements, etc. A feasible proposal shall be submitted for approval. The proposed switch-over plan shall ensure the

reliability of the chilled water supply to customers and overall system stability are not compromised. It shall also avoid any disruption to, or adverse impact on, the existing DCS system, including those arising from harmful pressure surges or transients. Any deviation from the specified requirements shall be subject to the approval.

2.4.3. The Contractor shall inspect and operate all isolation valves along the three-pipe system, both to familiarize themselves with valve locations and to verify that each valve can be fully opened and closed. This procedure will confirm valve functionality and enhance the overall reliability and resilience of the DCS pipeline system.

2.4.4. Throughout the exercise, the Contractor shall monitor and record the performance of the DCS system, identify any weaknesses or vulnerabilities, and recommend appropriate improvement measures. All activities conducted during the annual drill or switch-over exercise must be thoroughly documented, including the locations of all valves exercised (such as isolation and washout valves), the number of turns required to manually fully open and fully close each valve within the three-pipe system, and the condition of each valve, with detailed records of any anomalies or irregularities observed. This documentation will support ongoing system reliability and facilitate future maintenance planning. For any weaknesses or vulnerabilities identified, the Contractor shall, upon receiving instructions from the Service Manager, promptly carry out the necessary repairs and rectifications to ensure the reliability of the DCS pipeline system.

2.4.5. Upon completion of the annual drill, or as otherwise agreed with the Service Manager, the Contractor shall restore water flow to the designated duty pipes while maintaining the third DCS pipe on hot standby. The Contractor shall also ensure that all isolation valves associated with the standby pipe are returned to their appropriate standby positions.

3. EMERGENCY MAINTENANCE OF UNDERGROUND DCS DISTRIBUTION PIPEWORKS

3.1. Repair Pipe Leaks

3.1.1. When a leak detection alarm is triggered, the *Contractor* shall immediately investigate the situation and submit a Leak Detection Report to the Service Manager within 3 working days. The Contractor shall also submit a method statement detailing the procedures for secondary on-field confirmation and localization of pipe leaks, as well as the proposed isolation plan for the affected main, including the isolation and washout valves to be exercised.

3.1.2. Concurrently, a method statement for pipe repair, including the TTA plan, Excavation and Lateral Support (ELS) plan, water management plan with washout and drainage methods, and the pipe repair method with all necessary weld tests to verify workmanship quality, etc. shall be prepared and signed by qualified engineers appointed by the Contractor and submitted to the Service Manager for approval.

3.1.3. Upon approval of the method statement by the Service Manager, the Contractor shall, within 10 working days, deploy the turncock crew to conduct secondary onsite confirmation of pipe leaks, isolate the affected main, and divert chilled water flow to the DCS standby pipes. The Contractor shall also coordinate with relevant government departments, including HKPF and TD, to obtain approval for an Urgent Excavation Permit (XP) to begin repair works.

Additionally, the Contractor must refer to the HyD's guideline for the XP application details and Guidance Notes on Handling DCS Pipe Leaks/Bursts and Emergency Maintenance and follow the prescribed procedure for repairing DCS pipe leaks.

3.1.4. The repair of DCS pipe leaks is classified as Urgent Works—Applicable to Water Supplies, involving urgent repairs to water mains and/or valves with minor leakage. These repairs do not require immediate action but should be performed as soon as practicable, per HYD Excavation Permit Processing Manual, Section 11, Appendix 4.11.1. The applicant must provide justification acceptable to the relevant HYD Regional Office for the urgency. Once the application is accepted by HYD and all necessary approvals from other government departments are obtained, the XP will be issued within 5 working days of receipt. The Contractor's O&M Manager shall take the lead and be responsible for assisting and facilitating the Service Manager in all submissions and liaison with HYD and relevant government departments to obtain the XP. This includes preparing all relevant documents, such as the TTA, ELS and tree removal plans, signed by qualified engineers appointed by the Contractor, as well as handling all administrative work related to the application. The following briefly describes the XP application procedures that the Contractor shall follow to support the applicant i.e. the Service Manager, in securing XP approval; additional details can be found in the HyD's Excavation Permit Processing Manual.

- Registration and Permit Application: The registration and permit application process requires the applicant to create a plan in the Excavation Permit Management System (XPMS), complete necessary details, check the "Apply for urgent work" box, and provide supporting justification. The HyD's Inspector of Works (IOW) will assess whether the works qualify as ‘’urgent." If approved, the application receives priority processing; if rejected, it will be returned and processed as a standard application.

- Seek Traffic Advice: The applicant must submit a proposal via the Excavation Permit Management System (XPMS). If works do not affect the carriageway, a lighting, signing, and guarding (LSG) proposal should be submitted to HKPF for approval. If works impact the carriageway, a TTA plan—with work staging, traffic impact assessments, drawings, and calculations—must be provided and signed by a qualified engineer appointed by the Contractor. Submission is required for works involving opening a carriageway on TIA or DTB routes, lane closures, traffic flow changes, or pedestrian diversions. HKPF and TD typically respond within five working days.

- Other Necessary Approvals: Along with the "Seek Traffic Advice" procedure, the applicant must apply for a Construction Noise Permit (CNP) from the EPD if working during restricted hours, following the CNP checklist. They should also verify impacts on LRT, MTR, railway infrastructure, roadside trees, or Old and Valuable Trees (OVT), obtaining consent from relevant authorities such as LCSD, AFCD, and LU/HyD. For unleased government land outside streets maintained by HyD, approval from LandsD is needed. Any issues should be addressed by contacting the appropriate agencies.

- Permit Period Assessment: The IOW will assess the permit period like normal

- Coordination of Works: The IOW reviews plans for conflicts. If coordination with other plans is needed and can be specified in permit conditions, the IOW may designate the plan as "coordinated" under a "single plan" case. If not, the plan is marked "uncoordinated," and the applicant must handle the necessary coordination.

- Issue of Permit: If work does not affect the carriageway, the applicant can submit the permit application in XPMS without waiting for HKPF's agreement on the LSG proposal. The E/CTO will issue the permit within five working days of receipt. If works impact the carriageway, the applicant must first obtain approvals from HKPF and TD before submitting in XPMS. The E/CTO will incorporate their comments on temporary traffic management (TTM) into the permit conditions.

- Advance Notification of Commencement of Works: An Advance Notification (AN) is still required for urgent excavation permits (XPs). However, for urgent work, the Permittee can submit the AN via XPMS with less than two working days' notice before starting.

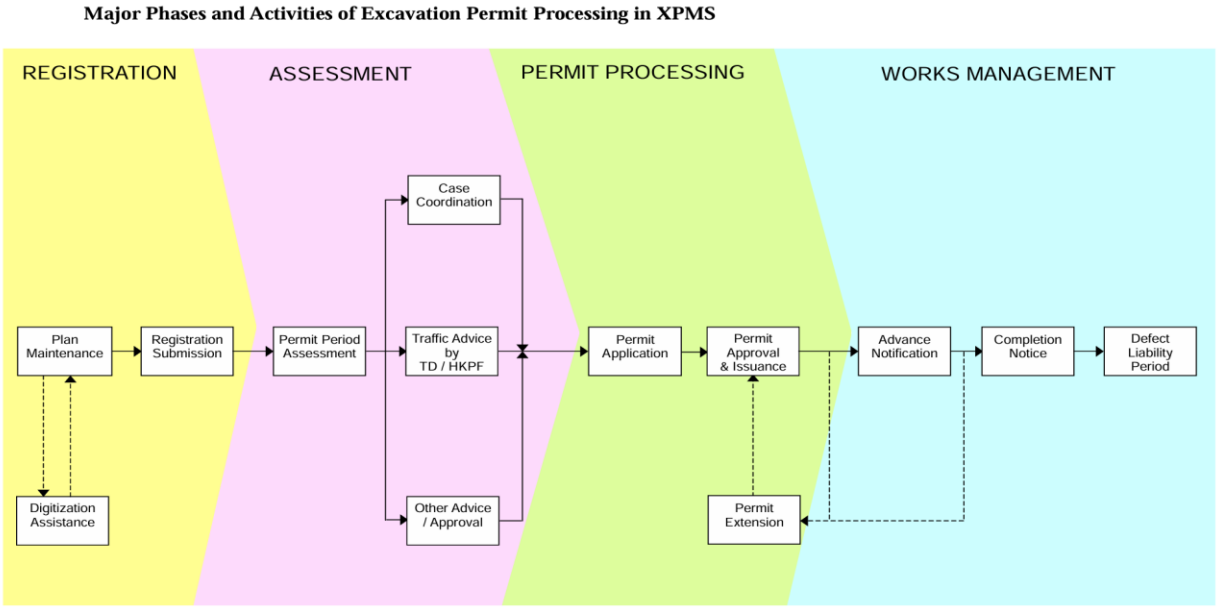


Figure 1: HyD's Excavation Permit Processing Procedure (ref: Excavation Permit Processing Manual)

3.2. Repair pipe burst

3.2.1. The procedure for repairing DCS pipe bursts generally follows the same approach as for pipe leaks, as outlined in the Guidance Notes on Handling DCS Pipe Leaks/Bursts and Emergency Maintenance. Priority should be given to isolating the burst and reducing water outflow within 2.5 hours of receiving a fault complaint, as well as diverting water flow to standby pipes to maintain the chilled water supply. However, in unusual circumstances, such as unsuccessful diversion of chilled water flow, inability to contain the leak, or failure to maintain alternative supply to customers or the public, emergency repairs must be initiated immediately using the Emergency Excavation Permit (EXP).

3.2.2. In the event that the Owner deploys other contractors or additional resources to respond to emergency situations or to carry out pipe repair works, the Contractor shall fully cooperate and closely coordinate with the contractors appointed by the Owner to facilitate the timely and safe execution of the works. Such coordination shall include, but not be limited to, providing safe and unobstructed access to the site, implementing necessary traffic and site management measures, and making available adequate resources, including manpower, plant, equipment, and temporary facilities. The Contractor shall also coordinate site activities,

interface arrangements, and sequencing of works, and provide all necessary assistance, supervision, and information to ensure smooth integration of the works. All support shall be maintained until the works are completed and accepted to the satisfaction of the Owner.

3.2.3. The emergency repair of DCS pipe bursts shall be classified as Emergency incident — Applicable to Waterworks - Emergency works essential for the resumption of the existing water supply upon the receipt of a failure incident. The List of emergency Excavation could be found in Appendix 4.2.2 per HYD Excavation Permit Processing Manual, Section 2, that Emergency Excavation Permit (EXP) can be used. The List of Emergency Excavations was endorsed by the Utilities Technical Liaison Committee (UTLC) chaired by the Deputy Director of Highways (DDHy).

3.2.4. The Contractor shall provide all necessary support to the Owner, the EXP permittee, to ensure that the EXP remains valid throughout the contract duration and complies with all EXP administration procedures mandated by HyD. Key EXP requirements include, but are not limited to, the following:

- An EXP will be valid for 6 months and cover the maintenance districts under the respective Chief Highway Engineer (CHE). For renewal of an EXP, the applicant should submit the application through XPMS one month in advance of the expiry date of the current EXP to the respective CHE.

- When the need for an emergency excavation arises, the EXP permittee shall immediately obtain an emergency serial number from HYD as stipulated in Conditions of EXP and complete the emergency plan registration before 4:00p.m. on the working day following the emergency incident.

- If the works are completed within the 7-day allowable EXP period, the permittee should report completion through XPMS. If the permittee anticipates that the emergency works will not be finished within the 7-day allowable EXP period, he shall submit a completion notice (CN) for the current EXP and state that a continuing emergency XP (CEXP) is required for continuing the emergency excavation works before the expiry of the initial 7-day period.

- Upon receiving the CN, the HYD regional office's E/CTO will inspect within 7 working days to confirm work completion and reinstatement acceptance. The IOW will then inform the permittee via XPMS if the reinstatement is satisfactory. If more time is needed, the permittee can apply for a rectification permit. If the 7-day EXP period expires before notification, the permittee should register a small-scale work (SSW) job under a block permit or apply for a rectification permit to complete the works

- The DLP period of the original permit will start when the CN of the SSW job / rectification permit is accepted by the IOW. The start date will be the submission date of the CN of the SSW job/rectification permit.

- The EXP permittee shall keep all as-built records in respect of level and alignment of the underground services and installations laid or placed for 7 years from the date of submission of CN. These records shall be certified by a recognized professional. The EXP permittee shall provide the certified as-built records upon request by the E/CTO of the respective HYD Regional Office.

- Excavation must be reinstated to its original condition. The permittee must submit a

certified copy of the material delivery slip for bituminous surfacing when submitting the CN. For permanent reinstatement by the Authority, the permittee remains responsible for maintenance of backfilling and temporary reinstatement for 7 working days after CN submission. If subsidence or deterioration occurs within 12 months of CN submission or the last day of the EXP period (whichever is earlier), the permittee must carry out remedial works at their own expense unless they can prove the defect was caused by a third party.

3.3. Provision of Backup measures for Emergency Maintenance

3.3.1. With the third (standby) pipe providing built-in redundancy in the DCS distribution networks and with proper maintenance of the standby pipe as described above, mobile chillers are currently not required as emergency stock. However, as the distribution networks age and the frequency of leaks increases, the Contractor shall review the necessity of this emergency provision in consultation with the Service Manager. The inclusion of mobile chillers as part of the emergency stock may become necessary, especially for end users operating essential services such as fire stations and hospitals.

3.3.2. The Contractor shall maintain the following emergency stock in good operating conditions throughout the entire service periods. This includes: -

- 2 sets of turnkeys, portable electric actuators to facilitate valve operation
- 2 standby pumps to facilitate dewatering works
- 2 standby mobile generators
- One set of safety equipment including ventilation ducts and fans to facilitate works inside confined space
- 5 nos. of 6m long insulated steel pipes
- 5 nos. of 6m long HDPE jackets
- 4 nos. of steel collars
- Insulation material sufficient to repair 4 nos. of field joints

3.3.3. The *Service Manager* will conduct quarterly inspections of the backup measures to ensure they remain in proper working condition. Repeated failure by the Contractor to maintain the emergency stock adequately will be reflected in the Contractor's performance reports.

3.4. DCS Data Format

3.4.1. Two sets of as-built drawings of the DCS system shall be kept in the maintenance office, with all water shutoff valves and pumps clearly labelled to minimize the time required to locate and shut off water.

3.4.2. After each annual drill /switch-over of chilled water flow to the standby pipe, records shall be maintained to document the following details:

- Names of emergency team members who participated in the annual drill.
- Isolation and drain valves exercised, including the number of turns required to fully open and fully close each valve within the three-pipe system.
- Operation sequence of isolation valves for switching over the chilled water flow to the standby pipe, including the duration of the operation.
- The condition of each valve and any anomalies observed during the exercise.

- Confirmation and sign-off by the O&M Manager verifying that all valves have been returned to their standby positions after testing.

3.4.3. The following attachments should be included in the emergency response plan.

- As-built drawings of the DCS network and valve list including all isolation and drain valves
- List of key contractors / vendors to be deployed during any incident
- Updated emergency contact lists

3.5. Emergency Response Plan

3.5.1. Organization and Resources

The *Contractor* shall establish the organizational structure illustrated in Figure 2 and maintain the following minimum resources throughout the service period to effectively address any anomalies and emergencies. The roles and responsibilities of each personnel are summarized below.

3.5.2. Operation and Maintenance (O&M) Manager

The O&M Manager under the DBO contract shall be the overall person-in-charge in the event of any emergencies or reported anomalies. All incidents must be reported first to the O&M Manager, who will serve as the primary responder and directly liaise with the *Service Manager*.

3.5.3. Supervisor

A designated supervisor under the DBO contract shall be appointed to assist the O&M Manager in coordinating repair works and liaising with relevant authorities, such as the HKPF, TD, HyD, and utility companies.

3.5.4. Community Relations Officer

The Community Relations Officer (CRO) under the contract shall be responsible for managing all fault calls and liaising with affected customers and stakeholders. The CRO shall provide regular updates to the O&M Manager on the status of inquiries and complaints received, and coordinate with both the O&M Manager and Service Manager to ensure timely responses to affected customers and stakeholders.

3.5.5. Turncock Crew

A minimum of four technically competent operations staff, designated under the DBO contract, shall be assigned to each work shift to form the turncock crew. This crew is responsible for operating valves to isolate affected water pipes during anomalies or emergencies. All crew members must participate in the annual drill or switch-over exercise and be thoroughly familiar with all valve locations.

3.5.6. Emergency repair team (subcontractor with active WSD contract)

The Contractor shall nominate a subcontractor with active WSD contracts (Group B and above) and an emergency repair team capable of rapid deployment to address emergencies and perform necessary pipe repairs. The emergency repair team shall be led by the subcontractor's designated site agent, supported by a site supervisor or foreman trained in DCS pipe repair under public roads and footpaths, as well as in construction and confined space safety. A competent person shall be appointed to conduct a comprehensive assessment of the work environment, procedures, and associated items to ensure compliance with all safety rules and regulations prior to commencement of work. The repair team shall include at minimum:

- Two pipe welders/fitters with a minimum of three years' experience in pressurized pipe repair and at least one year of experience in DCS pipe repair
- Four general workers
- Two traffic controllers
- One health and safety supervisor
- A roadworks subcontractor with relevant project experiences in public road reinstatement
- Operators for excavation, backfilling, lifting, and ELS works, etc.

3.5.7. Other Professionals

Additionally, the *Contractor* shall engage relevant specialists or engineering consultants to support the design and implementation of ELS/geotechnical works, TTA, and any other necessary activities such as tree removal and landscaping works to comply with all authority requirements.

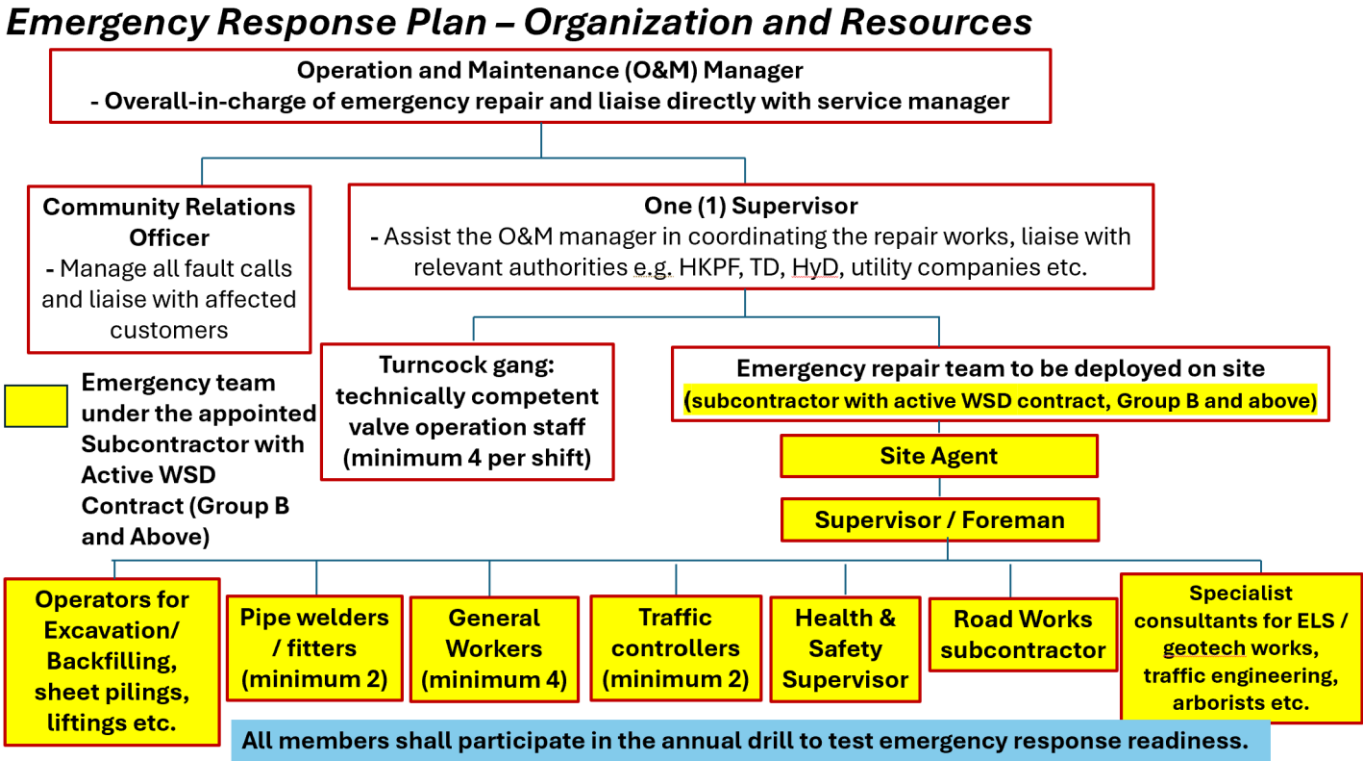


Figure 2: Organizational structure to be implemented to handle emergencies

APPENDIX 1: GUIDANCE NOTES ON HANDLING OF DCS PIPE BURSTS AND EMERGENCY MAINTENANCE

GUIDANCE NOTES

ON

HANDLING OF DISTRICT COOLING SYSTEM (DCS) PIPE LEAKS/BURSTS

AND

EMERGENCY MAINTENANCE

機電工程署
EMSD

Electrical and Mechanical Services Department (EMSD)
November 2026

FOREWORD

These Guidance Notes ("the Notes") are intended for the use of relevant officers responsible for the maintenance of DCS pipelines, the Operator(s) of the DCS Plant(s), and other pertinent parties involved in handling DCS pipe burst incidents and associated emergency maintenance works. The Notes apply to all DCS pipelines, including but not limited to those installed underground, within enclosed areas, and along bridges, etc. Particular emphasis is placed on incidents occurring along major road networks, as well as on the requirements for internal and external communication, notification, and reporting. All staff concerned should follow the procedures set out in the Notes.

The Notes provide guidelines and detailed procedures to our staff for handling underground DCS pipe bursts effectively and efficiently so as to meet the relevant departmental goals.

The Notes make particular reference to the procedures on the handling of emergency traffic and transport incidents as laid down in the ***Handbook on Handling of Emergency Traffic and Transport Incidents*** of Transport Department (TD) so as to provide guidance to our frontline staff to ensure that effective communications with TD, and other departments as well as public transport operators are maintained at all times whenever there are traffic and transport impacts due to main bursts.

The Notes also provide guidelines to classify the level of seriousness of a pipe burst, its consequential impact on chilled water supply to customers and relate them with corresponding procedures of upward reporting of major emergency incidents from Operator(s) to EMSD.

The Notes also provide concise guidance to staff for handling matters related to public complaints and media enquiries in case of main bursts.

Finally, the Operation Team of the underground DCS pipes, being responsible for advising and reviewing procedural matters related to the operation and maintenance of DCS pipeline, is responsible for the review and revision of the Notes. Hence comments and suggestions on the Notes should be forwarded to the Operation Team.

Electrical and Mechanical Services Department
November 2026

CONTENTS

Section	Title	Page No.
1	**Definition**	**1**
1.1	Bursts & Leaks	1
1.2	Emergency Maintenance	1
1.3	Major Road Network	2
2	**Immediate Actions upon Receipt of Fault Information**	**3**
3	**Repair Pipe Leaks**	**4**
4	**Repair to Pipe Burst**	**5**
4.1	General	5
4.2	Emergency Maintenance to handle pipe burst	5
4.3	Matters related to Noise Control Ordinance	6
4.4	Actions for Main Burst on Roads in the Major Road Network	6
4.5	Emergency Repairs in Expressways	7
4.6	Urgent Repair to DCS Pipe Leaks near Slopes	7
5	**Communication, Notification and Reporting**	**8**
5.1	Notification of EMSD's Emergency Work	8
5.2	Upward Reporting of Major Emergency Incidents to DEVB	10
6	**Public Relation Aspects**	**12**
6.1	Notification of Supply Interruption to Customers	12
6.2	Handling Mass Media	13
7	**Other Aspects**	**13**
7.1	Safe Working on or adjacent to Carriageways in Emergency Works	13
7.2	Records of Repair Activities	13

FIGURES

Figure 1 Workflow to repair pipe leaks

Figure 2 Workflow to repair pipe bursts

APPENDICES

I Preparation, Checking and Operation Procedures for Emergency Standby Duties at the Maintenance Office

II Communication, Notification and Reporting of DCS Pipe Bursts

Annex I Template - Pipe Burst Information for Reporting by Phone During an Incident

Annex II Template - Post-incident Report on Pipe Burst

III List of Contact Telephone/Fax Numbers for Emergency Repair of DCS pipes Affecting Slopes or Roads in the Major Road Network

Section 1 - Definitions

1.1 Bursts & Leaks

1.1.1 Escape of water from a DCS pipe may be due to "burst" or "leak". An incident is classified as a "burst" if there is an immediate need to isolate chilled water supply because of one or more of the followings:

(a) the outflow of water is significant in quantity;

(b) the velocity of water escaping from the fault pipe and/or location is high;

(c) there is an imminent danger of flooding the area, and/or causing significant traffic disruption or causing damage to adjacent roads, lands, structures, property or slopes, or affecting the safety of the public at large; and

(d) the pressure drop in the chilled water supply system caused by the fault is such that a continuous chilled water supply to the affected customer(s) can no longer be maintained.

1.1.2 "Leak" incidents refer to events other than those mentioned above for which an immediate isolation of supply is not normally required.

1.2 Emergency Maintenance

1.2.1 For emergency maintenance of DCS pipes, that involves excavation works, authorization to make or maintain such excavation must first be obtained under the "Emergency Excavation Permit" issued by HyD and Lands Department for excavation works occurring in streets and non-streets respectively. The emergency works related to the maintenance of water pipes include the following:

(a) burst pipe repairs;

(b) leaking pipe and valve repairs when there is evidence that the leak will soon develop into a burst;

(c) maintenance of chilled water supply system due to sudden failure of the system;

(d) works and repairs to DCS pipes in connection with landslips, road collapses and subsidence that will hold up traffic;

(e) any works for saving the life of and/or preventing injury to any person; and

(f) any works to locate and repair missing/subsided/broken manhole/draw-pit frame and cover which will otherwise cause injury to the public.

1.2.2 "Emergency maintenance work" includes also any planned work that cannot be completed on time to restore chilled water supply to customer(s).

1.2.3 "Leaking pipe repairs near slopes" should be considered as emergency maintenance works within the context of para. 1.2.1 (e) above, irrespective of whether the pipe is located in streets or non-streets. Such incidents must be attended to immediately with top priority as they may affect the stability of slopes or adjacent earth retaining structures adversely hence causing imminent danger to the public at large.

1.2.4 "Non-emergency maintenance of DCS pipe" refers to maintenance works other than those mentioned in paragraph 1.2.1 to 1.2.3 above.

1.3 Major Road Network

1.3.1 Traffic and transport emergency may arise following road closure brought about by a pipe burst. For the purpose of handling road emergencies that include road obstructions caused by severe traffic congestion, road collapse/blockage or accidents, Transport Department (TD) classifies the major road network into three categories as follows:

(a) Traffic sensitive routes: Red routes and Pink routes;

(b) Public transport sensitive routes; and

(c) Routes to vulnerable areas.

1.3.2 The routes of these categories are listed in https://www.hyd.gov.hk/en/technical_references/technical_document/guidance_notes/pdf/gn021a_annex1.pdf.

Section 2 - Immediate Actions upon Receipt of Fault Information

2.1 Upon notification of an incident e.g. anomalies in the leak noise correlation results, fault complaints, pressure transients, a significant decrease in network flow or pressure, or a lack of chilled water supply, the Contractor's O&M manager shall be notified, the situation shall be investigated immediately, findings and follow-up actions are to be taken to the EMSD's Service Manager within 30 minutes. The Contractor shall rectify the situation within an agreed timeframe with the Service Manager. The following steps should be followed upon notification of fault information:

- Deploy the site crew to the affected area to confirm the exact location of the fault. The requirements described in the guidelines attached at Appendix I shall be observed.
- Once the fault is identified, obtain authorization from the Service Manager to shut down the chilled water flow to the leak source.
- After receiving authorization, the Contractor shall deploy the turncock crew to isolate the affected DCS pipe and divert water flow to the standby pipe.
- The site crew shall implement the water management plan using washout and drainage methods. The affected pipe must be drained, and all excess water shall be pumped to the nearest drainage system to ensure proper discharge and to prevent flooding in the affected and surrounding areas.

2.2 After successfully diverting water flow to the standby pipe, the Operator's site crew shall verify that water flow is restored and operating at the required pressure.

2.3 After water flow has been stabilized, the Operator's O&M Manager shall notify EMSD. Once EMSD has agreed the relevant method statements and other required documents for pipe repair, the Operator may proceed with the work.

Section 3 – Repair Pipe Leaks

3.1 Typically, in the event of a pipe leak or burst, if the chilled water flow can be successfully diverted to the standby pipe and the leak is contained, emergency maintenance is not required. Pipe repair may then be carried out under an Urgent Excavation Permit (XP). The repair work does not need to commence immediately and may begin once approvals from the EMSD and relevant government departments have been obtained. The emergency response action for repairing DCS pipe leaks are summarized below and in Figure 1.

3.2 When a leak detection alarm is triggered, the Operator shall immediately investigate the situation and submit a Leak Detection Report to EMSD within 3 working days. The Operator shall also submit a method statement detailing the procedures for secondary on-field confirmation and localization of pipe leaks, as well as the proposed isolation plan for the affected pipes, including the isolation and washout valves to be exercised.

3.3 Concurrently, a method statement for pipe repair, including the TTA plan, Excavation and Lateral Support (ELS) plan, water management plan with washout and drainage methods, and the pipe repair method with all necessary weld tests to verify workmanship quality, etc. shall be prepared and signed by qualified engineers appointed by the Operator and submitted to EMSD for approval.

3.4 Upon approval of the method statement by EMSD, the Operator shall, within 10 working days, deploy the turncock crew to carry out secondary on-field confirmation of the pipe leaks, isolate the affected DCS pipe and divert chilled water flow to the DCS standby pipes on site. The Operator shall also liaise with relevant government departments, such as the HKPF and TD, to obtain approval for an Urgent Excavation Permit (XP) to commence the repair works.

3.5 The Operator shall commence pipe repair once all authority approvals are obtained, deploying sufficient resources in accordance with the specified established organizational structure, and ensuring necessary liaison with stakeholders throughout the process.

Section 4 - Repair to Pipe Burst

4.1 General

4.1.1 The procedure for repairing DCS pipe bursts generally follows the same approach as for pipe leaks. Priority should be given to isolating the burst and reducing water outflow within 2.5 hours of receiving a fault complaint, as well as diverting water flow to standby pipes to maintain the chilled water supply. However, in unusual circumstances, such as unsuccessful diversion of chilled water flow, inability to contain the leak, or failure to maintain alternative supply to customers, emergency repairs must be initiated immediately using the Emergency Excavation Permit (EXP). The emergency maintenance procedure for a DCS pipe burst is summarized in Figure 2.

4.2 Emergency Maintenance to handle pipe burst

4.2.1 Upon receiving a report of a pipe burst, the first priority is to isolate the affected pipe and divert chilled water flow to the standby pipe. The Operator's turncock crew should mobilize within 1 hour to contain the leak, aiming to isolate the burst and reduce water outflow within 2.5 hours. The Operator shall begin repairs within 12 hours of notification and complete the repair within 24 hours, or within a timeframe agreed upon with EMSD.

4.2.2 In the event of a known traffic jam, the Operator's O&M Manager shall notify EMSD, who will then contact the Police Traffic Console for advice on the best route to access the site. If necessary, the Police may be requested to escort emergency vehicles (carrying the turncock crew) and/or Operator's vehicles (transporting labor, equipment and materials) to the site. This coordination helps minimize delays caused by traffic congestion and reduces response time for supply isolation and emergency repairs.

4.2.3 Upon arrival at the scene, the Operator's turncock crew's first and most urgent action is to isolate the affected DCS Pipe. If isolation is not possible, they should temporarily stop or reduce the outflow of water from the burst pipe, such as by pumping, to minimize serious traffic disruption, flooding, property damage, and risk of injury.

4.2.4 The Operator's emergency crew shall immediately erect a display board stating "Emergency Repair Works in Progress" at a prominent location on site to inform the public. If widespread flooding occurs and the immediate control valves are submerged or inaccessible, the turncock crew shall proceed to close upstream valves, which are likely to be more accessible, to effectively reduce water outflow as quickly as possible. This may require isolating additional valves at locations farther from the scene. The Operator shall deploy additional turncock resources if the situation requires.

4.3 Matters related to Noise Control Ordinance

4.3.1 Under Section 6(1) of the Noise Control Ordinance (NCO), a Construction Noise Permit will be required for the use of powered mechanical equipment for the purpose of carrying out construction work other than percussive piling between the hours of 7 pm and 7 am or at any time on a general holiday (including Sundays) (restricted hours). If the Operator needs to perform urgent DCS pipe repairs at night that may cause significant noise nuisance to residents, they must consider the environmental impact of noise pollution. Appropriate working methods, such as using silenced powered mechanical equipment, acoustic enclosures or baffles, and other necessary noise control measures, shall be employed during emergency nighttime repairs to DCS pipes.

4.4 Actions for Main Burst on Roads in the Major Road Network

4.4.1 For pipe bursts occurring on roads in the major road network, the Police will be on site to coordinate remedial measures to minimize inconvenience to the public. The Traffic Console of the Police will take the role of a communication link among the site representatives of various concerned departments. The EMSD's Operation team shall act as EMSD site representative at the scene and should take actions as follows :

(a) The EMSD's Operation team shall notify the Operator to attend the scene immediately. The Operator's O&M manager can contact the Traffic Console for advice on the preferred route for access to site, and where necessary request the Police's assistance to escort the resources to site.

(b) Upon arrival on site, the EMSD's Operation team should report to the Police to provide details of his name, post title and mobile phone number to the policeman, requesting the policeman to transmit such details to the Traffic Console for registration record and to facilitate site communication. He should also call TD's Emergency Transport Coordination Centre (ETCC) to alert the duty officer of the pipe burst incident.

(c) The EMSD's Operation team and the Operator's O&M manager should attend a site coordination meeting to be arranged by the Police (with HyD and TD representatives if present), after the supply to the pipe main is isolated. The Police will notify him and site representatives of other departments to assemble at a convenient place for the meeting, via the Traffic Console.

(d) Under normal and fixed mode of ETCC of TD's (see Section 5.1.4), they should join the site representatives of concerned departments to discuss and decide on actions to be taken and plan for re-opening of the road to traffic as soon as possible and consider the requirement for provision of additional

details to the Transport Department First Contact Point (TDFCP), particularly if prolonged traffic disruption extending into the peak periods is anticipated.

(e) They are to work with Police/HyD/TD officers at the scene in all works required for re-opening of the road to traffic (e.g. site clearance, exploratory trial holes and implementation of temporary traffic diversion etc.) and provide regular update to Police/ETCC/HyD of the progress of work and any changes to the estimated re-opening time of the closed road section. ETCC will continue to update all relevant parties and the media on the latest traffic and transport situation.

(f) They may request HyD's assistance to provide urgent supply of asphaltic concrete (which will usually be available within 2 to 3 hours) for reinstatement of the damaged road, if required, in order to expedite the re-opening of the road to traffic.

4.5 Emergency Repairs in Expressways

4.5.1 The Expressway Legislation is effected by relevant provisions of the Road Traffic Ordinance Chapter 374 (the Ordinance) and the additional part – Road Traffic (Expressway) Regulations, which states that no person shall carry out any expressway works unless they shall have first obtained an expressway works permit (EWP) from the Director of Highways (DHy). Pursuant to Section 125(2) of the Ordinance, the requirement for an EWP does not apply to the carrying out an expressway works, which may be necessary in the event of an accident or emergency. However, the EMSD's Operation team must give notice to and obtain the consent of DHy and Commissioner of Police before carrying out the works, and shall within one working day of the emergency incident, apply to DHy for the issue of a covering EWP.

4.5.2 The procedures and criteria for obtaining EWP or RWP are described in HyD's Technical Circular No. 3/2005.

4.6 Urgent Repair to DCS Pipe Leaks near Slopes

4.6.1 On receipt of a report on pipe leak near a slope, both the EMSD's Operation team and the Operator's O&M manager should attend the incident immediately and strictly observe the following procedures:

(a) carry out immediate investigation, by isolating the concerned DCS pipe to locate the defective section including the leakage spot;

(b) if water leak is identified, isolate the supply to stop the leakage immediately;

(c) uncover the concealed leaking pipe by arranging emergency opening and complete the repair of the DCS pipe as expeditiously as possible; and the repair works shall be closely monitored till completion, by means of daily reports,

(d) carry out visual inspection by a qualified engineer appointed by the Operator along the concerned DCS pipe and its adjacent slopes and report the inspection results and progress of repair to the EMSD's Operation team; and if the leak is suspected to come from the buried service maintained by others, refer the case to the concerned maintenance party. If there is an apparent danger of slope instability after site inspection, the Operator's O&M's manager shall inform EMSD's Operation team immediately who will contact other relevant government departments for follow-up action. Should it be found that the slope involved is not maintained by EMSD, the maintenance parties and/or Geotechnical Engineering Office's District Engineer / Duty Engineer should be contacted promptly for immediate action.

Section 5 - Communication, Notification and Reporting

5.1 Notification of Emergency Work

5.1.1 A more comprehensive guide is given in the procedures at Appendix II, which covers communicating, notifying and reporting of the pipe burst incident to other departments/parties concerned, in respect of providing regular updates. With particular reference to various stages of an emergency incident laid down in TD's Handbook, the EMSD's Operation team with the support from the Operator O&M manager should give the following information during the communication:

5.1.2 **Identification and Verification Stages** – (the stage wherein an incident is being reported and investigated, and all site conditions and parameters are being identified and verified):

(a) nature, extent and location of the incident;

(b) whether a realistic assessment of the time required for remedial works is available, so that TD and the Police can devise suitable traffic and transport plans;

(c) what roads/lanes/movements are affected;

(d) expected duration of road obstruction; and

(e) any assistance required from other departments/parties.

5.1.3 **Response and Clearance Stages** – (the stages wherein response, remedial and recovery actions are being arranged, conducted and completed for the clearance of obstructions and reinstatement/reopening of site):

(a) updated estimates of time required for remedial works so that TD and the Police can make adjustments if necessary to traffic and transport plans;

(b) regular update of progress of work, any unforeseen factors which may affect the re-opening time;

(c) updated assessment on whether escalation of actions are required; and

(d) confirmation of completion of all remedial works, including reinstatement works, enabling safe re-opening of roads.

(**Note**: In case of serious incidents which are forecast not being able to be resolved before the peak periods (6 – 9 am and 5 – 8 pm on weekdays), the Operator shall deploy additional resources, including manpower and recovery equipment. Consideration should also be given to implementing temporary measures such as temporary resurfacing, decking over the carriageway by steel plates etc. to enable the re-opening of one or more lanes before the peak period without compromising safety.)

5.1.4 Traffic and transport impacts shall be managed according to TD's Handbook on Handling of Emergency Traffic and Transport Incidents, with the Emergency Traffic and Transport Control Centre (ETCC), operated 24/7 by TD's Transport Incident Management Division (TIMD), overseeing emergency response. The Transport Department First Contact Point (TDFCP) acts as the frontline contact for public emergency calls. The ETCC operates in three modes based on incident severity, which are briefly described as follows:

(a) Tier One Response – normal operation of ETCC: involves traffic or transport incidents that are minor and local.

(b) Tier Two Response – Fixed Mode (FM) ETCC Operation: involves small-scale planned events, serious road or tunnel incidents or major or widespread disruption or breakdown of public transport services.

(c) Tier Three Response – Joint Steering Mode (JSM) ETCC Operation: involves large-scale planned events or major road emergencies/incidents resulting in complete closure of part of the Major Roads for over two hours.

5.1.5 Senior officers from TD and the Police will provide joint steer on traffic and transport issues. Representatives from concerned government departments or public transport operators and agencies will be invited to station at ETCC or be

available on telephone to facilitate efficient communication and decision-making process. If pipe burst incident is involved, upon invitation by TD, EMSD's officer of at least Senior Engineer grade and above shall be nominated as representative of the Department in the JSM. ETCC will issue notices to parties when FM or JSM is activated. The Operator's O&M Manager shall provide full support to EMSD, including attending all coordination meetings and liaising with TD and other relevant government departments and stakeholders.

5.1.6 As far as traffic impact is concerned, reference has to be made to the procedures on the handling of traffic and transport incidents as laid down in TD's Handbook.

5.1.7 Depending on the severity and timing of the incident, the EMSD's Operation team responsible for the burst case must report the following details and regular updates to EMSD senior management and concerned EMSD officers as appropriate. A list of contact telephone numbers for all relevant officers and parties in Appendix III shall be maintained, regularly updated, and distributed to all parties concerned.

(a) time and location of burst;

(b) size and description of burst pipe;

(c) cause of pipe failure;

(d) Premises/supply zone/area affected;

(e) Traffic and transport impact - roads/lanes/movement affected and alternative route (if known);

(f) action being taken to effect repair and expected completion time;

(g) action being taken to ensure an emergency supply if required, details of such supply and expected time of supply resumption;

(h) expected time of opening the closed road section;

(i) a brief description of damage, if any, caused to public or private property; and

(j) other remarks, if any.

5.2 Upward Reporting of Major Emergency Incidents to DEVB

EMSD's Operation team shall consider whether reporting of the emergency works to DEVB is required according to ETWB TCW No. 20/2005.

Section 6 – Public Relation Aspects

6.1 Notification of Supply Interruption to Customers

6.1.1 If the supply of chilled water will be interrupted, the Operator's Community Relation Officer (CRO) shall contact affected tenants and management and other stakeholders to inform them on the status of the incident without delay. The Operator shall maintain updated list of phone numbers and email contacts of customers.

6.1.2 The Operator shall submit incident report describing the incident, root causes, follow-up actions taken, operation to resume the chilled water flow, and an inventory of damaged components which requires repair or replacement.

6.1.3 The CRO shall be responsible for logging the incident for future reference using the site incident logging system.

6.1.4 Following the incident, the emergency response plan should be reviewed to identify areas for improvement. Additions and revisions should be made as appropriate for the approval by the EMSD's Operation team.

6.2 Handling Mass Media

6.2.1 In the event of a major incident likely to attract media attention, all complaints and enquiries from mass media – including the press, radio, and television – must be directed to the designated EMSD spokesperson. The spokesperson will respond to all general verbal complaints and media enquiries on behalf of the Department, after obtaining the necessary information from the EMSD's Operation team.

Section 7 - Other Aspects

7.1 Safe Working on or adjacent to Carriageways in Emergency Works

7.1.1 When carrying out emergency repair of DCS pipes on or adjacent to carriageways, there is a potential hazard to the safety of road users. It is the duty of the Operator and those persons employed in carrying out the works to ensure that the effects of the works are mitigated or reduced to a minimum.

7.1.2 All EMSD's supervisory staff should observe and ensure that the works are properly lighted, signed and guarded in accordance with the safety requirements provided in the latest version of the "***Code of Practice for the Lighting, Signing and Guarding of Road Works***" ***(CoP)*** published by HyD.

7.1.3 Upon arrival on site, the Operator must provide temporary warning facilities (including traffic signs, reflective traffic cones and flashing beacons etc.) to

minimize risks to road users. The temporary arrangement shall further be replaced with proper traffic sign arrangement if requested by the traffic Police.

7.2 Records of Repair Activities

7.2.1 For repair works carried out, it shall be the Operator's responsibility to keep record of all activities and submit to the EMSD's Operation team for record.

7.2.2 For each case of DCS pipe damage, the Operator's turncock crew and the appointed sub-contractors by the Operator are required to make statements regarding their observations and actions taken at the scene for future reference. Details of the incident shall be properly recorded. Where a pipe burst has caused damage to public/private property and is likely to give rise to claims, the Service Manager should ensure all details relevant to possible claims are fully and properly recorded together with site photographs. All incident records and reports should be kept for one year by the Operator, but those related to more serious cases, should be kept for a longer period and in file as instructed by the EMSD's Operation team.

Repair of Pipe Leaks

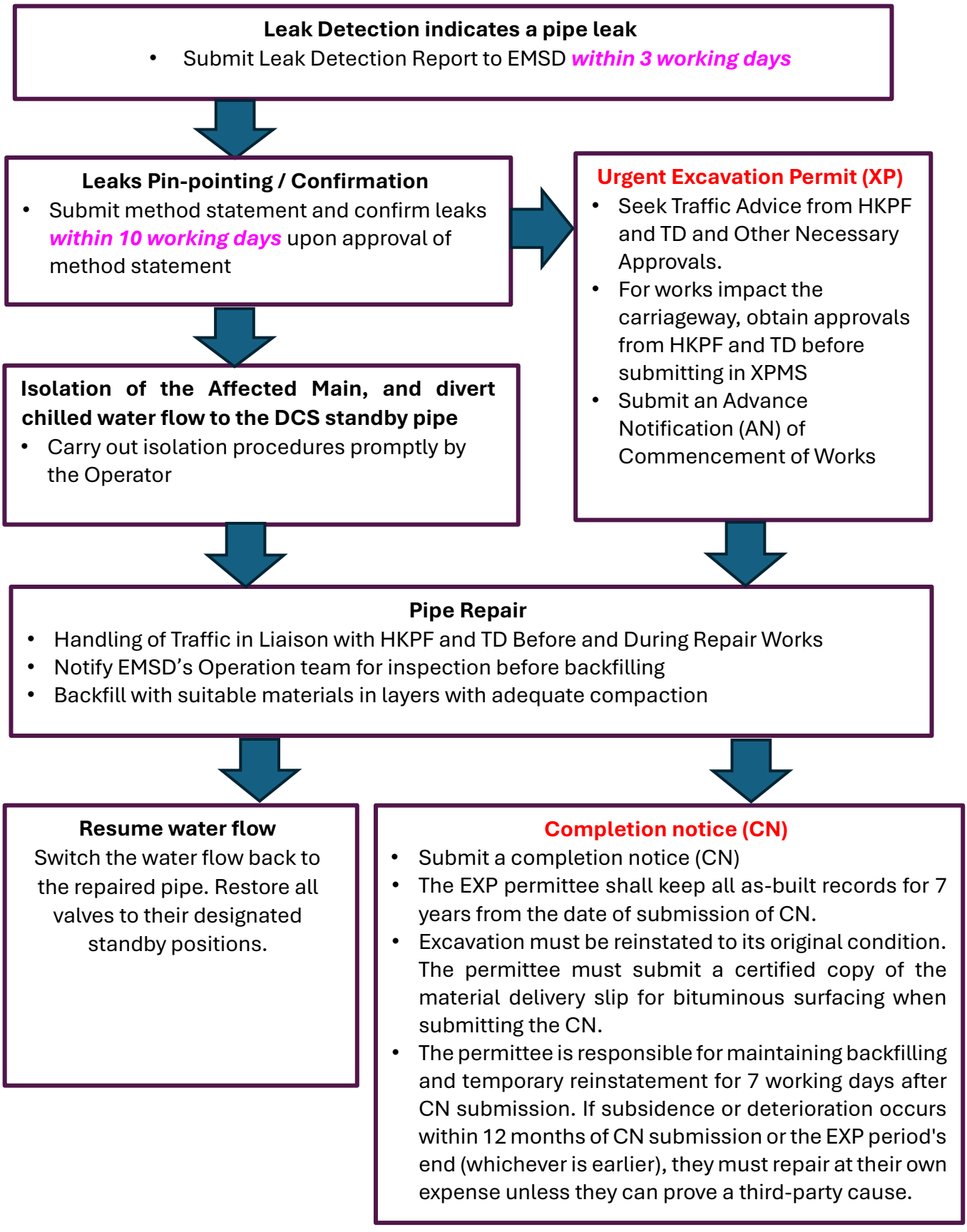


Figure 1: Workflow to repair pipe leaks

Repair of Pipe Bursts

A Fault complaint is received

Isolation of the Affected Main, and divert chilled water flow to the standby pipe by Operator

- Operator's Turncock gang depart for the spot ***within 1 hour*** to contain the leak, aiming to isolate the burst and reduce water outflow ***within 2.5 hours***

Is diversion successful and leaks are contained or alternative supply to customers/public could be maintained?

YES

Urgent Excavation Permit (XP)

- Seek Traffic Advice from HKPF and TD and Other Necessary Approvals.
- For works impact the carriageway, obtain approvals from HKPF and TD before submitting in XPMS
- Submit an Advance Notification (AN) of Commencement of Works

Pipe Repair

- Handling of Traffic in Liaison with HKPF and TD Before and During Repair Works
- Notify EMSD for inspection before backfilling
- Backfill with suitable materials in layers with adequate compaction

NO

Emergency Excavation Permit

- Obtain an emergency serial number from HyD and complete the emergency plan registration before 4:00 p.m. on the working day following the emergency incident.

Pipe Repair

- Begin ***within 12 hours*** of notification from EMSD and complete the repair ***within 24 hours***, or within agreed timeframe
- Handling of Traffic During Repair Works
- The contractor must allocate sufficient resources to repair the burst and reopen the road before peak hours (6-9 a.m. and 5-8 p.m. on weekdays),
- Notify EMSD for inspection before backfilling
- Backfill with suitable materials in layers with adequate compaction

Resume water flow

Switch the water flow back to the repaired pipe, and restore all valves to their designated standby positions.

Completion notice (CN)

- Submit a completion notice (CN)
- The EXP permittee shall keep all as-built records for 7 years from the date of submission of CN.
- Excavation must be reinstated to its original condition. The permittee must submit a certified copy of the material delivery slip for bituminous surfacing when submitting the CN.
- The permittee is responsible for maintaining backfilling and temporary reinstatement for 7 working days after CN submission. If subsidence or deterioration occurs within 12 months of CN submission or the EXP period's end (whichever is earlier), they must repair at their own expense unless they can prove a third-party cause.

Figure 2: Workflow to repair pipe bursts

Appendix I

Preparation, Checking and Operation Procedures for Emergency Standby Duties at the Maintenance Office

(A) Pre-planning

1. The Operator shall prepare an emergency contact list, including contact details for personnel authorized to shut off chilled water supplies for all shifts. Two sets of as-built drawings of the DCS system shall be kept in the maintenance office, with all water shutoff valves and pumps clearly labelled to minimize the time required to locate and shut off water. All critical shutoff valves, including isolation and washout valves, much be exercised annually to ensure proper operation. Records shall be maintained for each valve exercised, including the number of turns required to manually fully open and fully close each valve within the three-pipe system, the condition of each valve, and any anomalies observed. All valves must be returned to their standby positions after testing. The Operator's turncock crew on every shift shall receive training to ensure familiarity with valve locations. Annual pipe leak scenario drills shall be conducted to ensure that all involved personnel are fully aware of their responsibilities during incidents.

(B) During the Standby Duty Period:-

1. The Operator's O&M Manager shall allocate fixed vehicles (with radio) and duty drivers each day on standby for the use by his emergency crew. He shall ensure that the standby vehicles are parked at the Maintenance Office.

2. The Operator's O&M Manger shall ensure that the team members of the emergency crew are present and the following equipment/tools are loaded into the standby vehicle in preparing for mobilization at any time.

    (a) Valve keys including extension keys;
    (b) Valve cover keys;
    (c) Traffic warning lights, traffic cones, traffic signs and Display Boards Notifying Emergency Works in Progress;
    (d) A set of DCS pipe As-built / Record Plans in plastic boxes;
    (e) Torches; and
    (f) Safety helmets and reflective waist coats for all team members.

3. The Operator's O&M Manger shall check and ensure that their mobile phones for communication purpose are functionable and turned on at all times.

4. The Operator's O&M Manger shall report the name list of his emergency crew to the EMSD's Operation team.

(C) When a fault is received:-

1. The EMSD's Operation Team and the Operator's O&M Manger should be responsible for receiving the fault information through mobile phone and telephone.

2. After noting the details of the fault information, the Operator's O&M Manager shall immediately alert by phone his team members and drivers and inform them to go quickly to the standby vehicles.

3. The Operator's O&M Manager shall check and make sure that the team members assemble and get on the vehicles and **start to go out to work within 10 minutes upon receiving notifications from EMSD's Operation team or the Operator.**

4. All team members shall put on safety helmets and reflective waist coats. The driver shall turn on the radio on the vehicle.

(D) On arriving at site :-

1. The team shall isolate the burst pipe under the supervision of the Operator's designated supervisor. Before closing the valves, the Operator's supervisor shall assess and report to the EMSD's Operation team and the Operator's O&M Manager the area affected by the supply interruption.

2. For emergency maintenance of pipe burst, the Operator's supervisor shall inform his Emergency Repair Team to arrange for repair work.

3. In case of serious flooding or difficult site condition, the Operator shall deploy additional gangs to mitigate the situation.

4. After isolation of supply, the Operator's supervisor shall notify the Operator's O&M Manager.

(E) Important Notes :-

1. At all times on site, all team members must wear safety helmets, safety shoes and reflective waist coats with "EMSD" logo.

Appendix II

Communication, Notification and Reporting of DCS Pipe Bursts

Who to report	Report to/Alert Whom	When/how/what to report & Remarks
(A) For Pipe Bursts		
(I) The Operator's O&M Manager	The EMSD's Operation Team	- after inspecting the site - report the progress until supply is resumed
	TDFCP (if the pipe burst occurs on major roads or involves road closure or affects traffic)	- immediately by phone to provide initial report of the incident - provide regular updates of the incident on the progress of work, the estimated time of chilled water resumption, the estimated opening time of the closed road section and any subsequent changes
	Hong Kong Police Force (a) Traffic Police (at relevant District Headquarters)	- to obtain an Emergency Occurrence Book No., if traffic is affected - for traffic control and/or necessary public announcement via the Police Public Relation Brance (PRPB)
	(b) relevant Police Regional Command and Control Centre	- for emergency work to be carried out at night time or within the restricted hours, or at any time on a general holiday (including Sunday) - provide regular update of the incident on the progress of work, the estimated opening time of the closed road section and any changes to the

Who to report	Report to/Alert Whom	When/how/what to report & Remarks
	Highways Department : (a) relevant HyD's Regional Office (during office hours); or (b) HyD's Emergency Call Centre (ECC) (outside office hours)	estimated re-opening time To obtain an Emergency Serial Number for an emergency excavation in streets maintained by HyD : <u>During or Outside office hours</u> - via Internet Interface for Utility Management System (IIUMS) except during two daily data replication periods 05:30a.m. to 07:30 a.m. and 12:30 p.m. to 2:30 p.m.; or - report to HyD's Integrated Call Centre <u>Outside office hours</u>: - call ECC (HyD duty staff will decide to visit the site as necessary)
	The affected and/or relevant utility undertakings	- to alert them of EMSD's emergency work, if their services are affected - provide regular update of the incidents
	public transport operators (if affected by the incident)	- alert them of the incident - provide the estimated opening time of the closed road section and any changes to the estimated re-opening time

Who to report	Report to/Alert Whom	When/how/what to report & Remarks
	For emergency repair works located within the Expressway sections : (i) Traffic Police (relevant Road Management Office) (ii) Tsing Ma Division of HyD (if the work is located within Tsing Ma control areas) (iii) TDFCP (see Note 1)	- Immediately, to obtain verbal consent to carry out emergency works in Expressway (see Section 4.5.1)
(II) The EMSD's Operation Team	EMSD senior management as appropriate, depending on the seriousness of the main burst incident	- immediately by phone to provide initial report of the incident encompassing the essential information, as far as possible - provide regular updates of the incident on the progress of work, the estimated time of chilled water resumption, the estimated opening time of the closed road section and any subsequent changes - prepare EIR report, submit the EIR to CE for follow-up action - submit a Post Incident Report using the proforma in Appendix III- Annex II through the respective CE for onward submission to the relevant AD within 14 days
(B) For Pipe Leaks near Slopes :		
(I) The Operator's O&M Manager	The EMSD's Operation Team	- After the leakage is identified and supply to the leaking pipe is isolated
(II) The EMSD's Operation Team	(a) relevant District Engineer of GEO (during office hours); or	- to request for prompt assistance, if there is an apparent danger of

Who to report	Report to/Alert Whom	When/how/what to report & Remarks
	(b) relevant GEO Duty Engineer (outside office hours)	slope instability after site inspection

Note 1: Upon receipt of the message of the emergency incident, TDFCP will relay it to their Transport Incident Management Division duty officers and inform Information Services Department and the relevant public transport or tunnel/bridge operators where necessary.

Appendix II
(Annex I)

(Template)

Pipe Burst Information for Reporting by Phone During an Incident

(a) Time, nature, magnitude and location of the incident with details of DCS pipes, including size, materials and type (supply/return/standby)

(b) Probable cause of the incident

(c) Area/resident/customers affected

(d) Impact on traffic

(e) Temporary traffic arrangement

(f) Estimation on completion of repair work/resumption of supply

(g) Progress of remedial work

(h) Media Presence

(i) Damage to third party or injury/fatality

(j) Mobile phone of responsible engineer/senior engineer

Appendix II
(Annex II)

(Template)

Post-incident Report on Pipe Burst on DD-MMM-YYYY at [Location]

(1) Basic Information

Date of Pipe Burst	
Pipe burst serial no.	
Classification of level of seriousness	
Location with MRP	Attached in Appendix A
District Council/ Sub-District	
Critical DCS Pipe (yes or no)	
Within existing pipe burst hot spot (yes or no)	
Burst at carriageway/footpath/verge (Concrete/Flexible/Paving Blocks/etc)	
DCS pipe type (Supply / Return / Standby)	
Size (DN)	
Material (observed on site)	
Condition of external lining	
Condition of internal lining	
Ground condition (e.g. corrosive soil, stray current, high water table, etc)	
Age (Year)	
Cause of failure (with description)	
Nature of defect (with description)	
Site photos	Attached in Appendix B
Noise logger monitoring before burst (yes or no) [If yes, provide details.]	
Responsible EMSD personnel (Name and Post)	

(2) Consequential Implication

(A) Supply Interruption
(i) Premises/Areas/Essential Customers affected with details

(B) Traffic Disruption
Traffic Affected: Yes/No

	Description	No. of traffic lanes/direction of traffic affected	Duration
(i) Red/Pink/Sensitive Route			
(ii) Carriageway other than Red/ Pink/Sensitive Route			
(iii) MTR/Tram Service affected			

(C) Flooding
(i) Extent
(ii) Duration

(D) Damage to Third Parties

(E) Injury/Fatality

(3) Sensitivity

(A) Media interest
(B) Public concern and/or political sensitivity
e.g. repeated pipe burst case, enquiry by DC/LegCo Member

(4) Investigation

(A) Cause of pipe burst
(B) Identification of common issue(s)
(C) Review whether the location should become a pipe burst hot spot after this pipe burst incident
(D) Review on handling of pipe burst

(5) Lessons learnt

(6) Proposed enhancement measures

(A) Short term measures (with programme)

[To include any special preventive/improvement measures to be carried out in conjunction with the emergency repair work, if practicable, or with other planned/programmed works, for example: pressure reduction, replacement of sections of aged water pipe, laying of by-pass mains, and installation of additional valves at appropriate locations.]

(B) Long term measures (with programme)

Appendix III

List of Contact Telephone/Fax Numbers
for Emergency Repair of DCS pipes
Affecting Slopes or Roads in the Major Road Network

(1) Electrical and Mechanical Services Department

	Off. Tel. No.
E/EEC8/1	3155 3991
E/EEC10/1	3528 6332

(2) Electrical and Mechanical Services Department

	Off. Tel. No.
DEMS	2808 3601
DDRS	2808 3606
AD/EE	2808 3818
CE/EEC	3912 0635

(3) Hong Kong Police Force (HKPF)

(a) Police Regional Command and Control Centre :-

		Tel. No.
Hong Kong Island	Traffic Console	3472 7009
Kowloon Region (East)	Traffic Console	3661 7409
Kowloon Region (West)	Traffic Console	3661 7411
N. T. Region (South)	Traffic Console	3611 7209
N.T. Region (North)	Traffic Console	3611 7211

(b) HKPF Regional Commanders :-

Contact with the relevant Regional Commander should be made through the respective Regional Command and Control Centre at Tel. Nos. given in (a) above.

(4) Transport Department (TD)

(a) Transport Department First Contact Point (TDFCP) (24 hours)

(i) Tel. No. : 2410 0066 2410 0193
(ii) Fax No. : 2428 6502

(b) All messages of emergency traffic and transport incidents to TD should be directed to the TDFCP, which is manned round the clock throughout the year.

(5) Highways Department (HyD)

		Tel. No.	
(a)	Reporting Centre	2926 4333	9329 0326 (outside office hours)

(b) HyD/Regions :-

	Tel. No. Office Hrs.	**Tel. No. Emergencies**
Urban Region Hong Kong Office	2231 5742	2933 7766 (when ECC activated)
Urban Region Kowloon Office	2707 7208	2927 4400 (when ECC activated)
NT	2926 4211	2926 4333 (when ECC activated)
Tsing Ma Control Area & Tsing Ma Control Area	2495 4676	2927 4676 (when ECC activated)

(6) Geotechnical Engineering Office (GEO)

Emergency Contact Pager Telephone Nos. of Duty Engineer of GEO, in case of main bursts/leaks affecting the stability of slopes or earth retaining structures :

	HK Island	**Kowloon & NT**	
GEO	2762 5266	2762 5230	Office hours
Duty Engineer	9689 0082	9689 0073	Outside office hours
	7116 3388 - Call 4554	7116 3388 - Call 6780	

機電工程署
EMSD

機電工程署
中國香港九龍啟成街3號
Electrical and Mechanical Services Department
3 Kai Shing Street, Kowloon, Hong Kong, China
: (852) 3912 0642 : (852) 2890 6081
dcs@emsd.gov.hk
www.emsd.gov.hk