地下鉄の安全対策：各種訓練の実施

交流実績都市：台湾新北市

目的：災害等の異常事態に対する即応力の維持・向上

公共交通機関は、安全を確保するための必要な設備投資とともに、万が一、不測の事態が生じた場合においても、迅速な対応が求められるため、様々な状況に応じた訓練を実施することにより、災害等の異常事態に対する即応力の維持・向上を図る。

概要：大規模な災害や異常時を想定した総合訓練の実施

災害等の異常事態に対する即応力の維持・向上を図るため、日頃から職場単位で個別に訓練を行うとともに、大規模な災害や異常時を想定し、各職場が連携・合同した総合訓練を定期的に実施している。

詳細：各種訓練

（1）異常時総合訓練

異常時を想定し、列車防護、利用者の避難誘導、救出援護、連絡通報、脱線復旧、施設復旧などを内容とした大規模で実践的な訓練を 1970 年より年 1 回実施。

（2）自然災害防止訓練

集中豪雨による、駅出入口からの浸水を想定した大規模訓練を、1990 年より年 1 回実施。

また、この他にも各駅においても浸水対策訓練を実施。

①異常時総合訓練

（3）NBC（Nuclear Biological Chemical）対処訓練

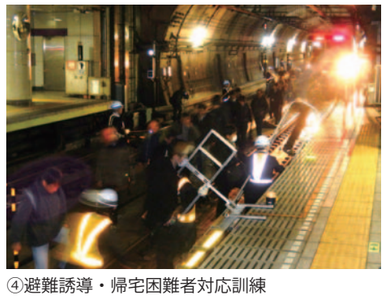
警察・消防と連携して、化学剤散布時の避難誘導や、不審物検知・採証・除去対策訓練を実施。

②自然災害防止訓練

（4）避難誘導・帰宅困難者対応訓練

東京 23 区に直下型大地震が発生し、列車が運転を見合わせたことにより、多数の帰宅困難者が発生した状況を想定。乗客の避難誘導、一時待機場所での備蓄品の配布訓練を実施。

③ NBC 対処訓練



④避難誘導・帰宅困難者対応訓練

Training and Preparedness for Toei Subway Safety

Exchange with New Taipei

Objective: To maintain and improve emergency response capabilities

Along with making the capital investment needed to ensure safety, public transportation services must also be fully prepared to provide a prompt response in the unlikely event of an accident or disaster. As such, transportation providers conduct drills based on a variety of scenarios with the aim of maintaining and enhancing emergency response capabilities.

Overview: Comprehensive drills for a large-scale disaster or accident

In addition to each office independently conducting routine training, joint comprehensive drills that simulate large-scale disasters and emergencies are conducted on a regular basis through the cooperation of various offices.

Details: Types of training drills

(1) Comprehensive Emergency Drill

Based on an emergency scenario, this is a large-scale, practical training exercise held annually since 1970, in which staff practice train protection, evacuation of passengers, rescue support, communications, derailment recovery, and restoration of facilities.

(2) Natural Disaster Preparedness Drill

This large-scale drill, which simulates floodwater entering a station through the station entrances/exits due to a torrential downpour, has been held annually since 1990. In addition, each station holds drills for flood prevention.

Comprehensive emergency drill

(3) NBC (Nuclear Biological Chemical) Drill

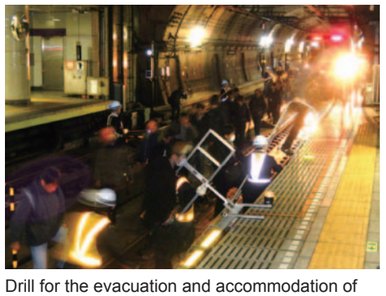
This drill, conducted with the police and fire departments, prepares staff to lead evacuations in the event of dispersion of chemicals, and to detect, collect, and remove suspicious objects.

Natural disaster preparedness drill

(4) Drill for the Evacuation and Accommodation of Stranded Commuters and Others

This drill simulates what will occur when many people become stranded due to the suspension of train services following a major earthquake directly striking Tokyo. Exercises to lead passengers to safety and distribute emergency supplies to those stranded at temporary accommodation sites are held.

NBC drill



Drill for the evacuation and accommodation of stranded commuters and others

無人運転システム（新交通システム）の運用

目的：既存市街地に新たに、道路渋滞に影響されない輸送機関を導入

既存の市街地にも大きな用地買収を要さず導入可能で、バスよりも大きな輸送力を持つ公共交通機関により、道路渋滞に影響されずに安全に定時での移動を実現。

概要：鉄道とバスの中間程度の輸送能力を持つ中量輸送軌道システム

・道路の中央分離帯に支柱を建設し、その支柱上に専用軌道を設けることから道路を立体的に利用でき、地下鉄（約 250 ～ 350 億円／複線 km ※）に比べ安価（約 70 ～ 120 億円／複線 km ※）である。
・道路の交差点内でカーブすることも可能であり、既存の街並みを活かした後発の再開発計画においても導入が可能である。
・無人自動運転であり、イベント等による需要増に合わせた臨時増発ダイヤの際も、運転士の人数に制約されない。

※「まちづくりと連携した LRT の導入に関する調査」平成 15 年 3 月（財）運輸政策研究機構

詳細

（1）無人運転
1. 自動列車運転装置（ATO：Automatic Train Operation）が列車の走行・停止、駅でのドア開閉および列車の出発などの制御を行う。
2. 速度制限は自動列車制御装置（ATC：Automatic Train Control）にて行っており、先行する列車との間隔、距離の条件等に応じて列車に速度制限信号を与えている。
3. 自動列車運転装置および自動列車制御装置は二重系で構成し、列車の安全運転を確保している。

（2）車両の特徴
1. 鉄道車両に比べ車体が小型で、ゴムタイヤで走行する車両である。
2. 最小曲線半径は 30 m（営業区間では 45 m）、最急勾配は 60‰（営業区間では 50‰）での走行が可能である。

（3）駅の特徴
1. 駅員がいない無人駅で、駅の各所にインターホンと監視カメラを設置し、旅客への対応を指令所で一括して行っている。
2. ホームには全面ホームドアを設置しており、旅客の接触事故や転落事故を防いでいる。

Operation of AGT (Automated Guideway Transit) Systems

Objective: To introduce a new means of transportation to built-up areas

It is possible to introduce this system in existing built-up areas without any need to purchase large pieces of land. Through the development of public transportation that has greater capacity than buses, a form of transportation that is safe, runs on time, and is not affected by traffic congestion is realized.

Overview: Medium-capacity rail transport system

• Constructing support pillars on median strips and special rails on top of those pillars allows the use of space above roads. At approx. 7-12 billion yen/double track km*, the cost is more reasonable than that of subway lines (approx. 25-35 billion yen/double track km*).
• It is possible to have the tracks curve at intersections, and this system can be introduced in redevelopment plans that make use of the existing cityscape.
• The systems are driverless. When there is the need to run extra trains to meet an increase in demand due to an event, etc., operation of the system will not be restricted by the number of drivers available.

*Source: Survey on the Introduction of Light Rail Transit Integrated with City Planning, March 2010, Institution for Transport Policy Studies

Details

(1) Driverless trains
1. ATO (Automatic Train Operation) controls operations such as running and stopping the train, opening and closing doors at stations, and train departure.
2. Speed control is achieved through ATC (Automatic Train Control). The system sends train signals to control speed based on conditions such as the distance between trains.
3. Both ATO and ATC are dual systems to ensure the safe operation of trains.

(2) Train car characteristics
1. The cars are compact in comparison to railway cars, and run on rubber tires.
2. The train’s minimum curve radius is 30m (45m within the operating area), and steepest gradient is 60% (50% within the operating area).

(3) Station characteristics
1. At stations with no attendants, intercoms and security cameras are installed throughout the station, and customer service is handled collectively by the control center.
2. Full-length platform doors are installed at all stations to prevent passengers from making accidental contact with trains or falling onto the tracks.

バスロケーションシステム

交流実績都市：中国甘粛省

目的：きめ細かな運行情報の提供

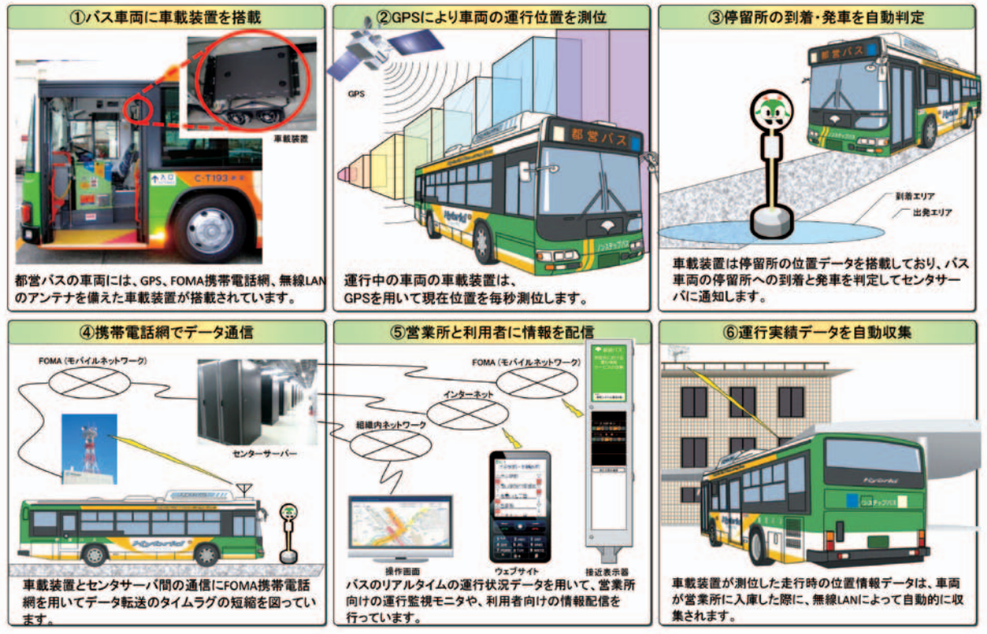
バス停留所でのバスの接近状況やバスの所要時間の目安など、きめ細かな運行情報を利用者に配信し、サービスの向上を図る。

概要：GPS 等を利用した都バス運行情報の提供

- GPS 等を用いてバスの位置情報を収集し、停留所に設置している表示装置や携帯電話、パソコンといった情報端末で利用者に情報提供
- 「地図を用いた停留所検索」「GPS 機能付き携帯電話向けの近隣停留所案内」「都営交通経路検索」などの情報端末向けサービスも展開

詳細：システムの具体的な技術

以下の６つのシステムを連動させ、運行情報を配信。



Bus Location System

Exchange with Gansu province (China)

Objective: To provide detailed information on bus operations

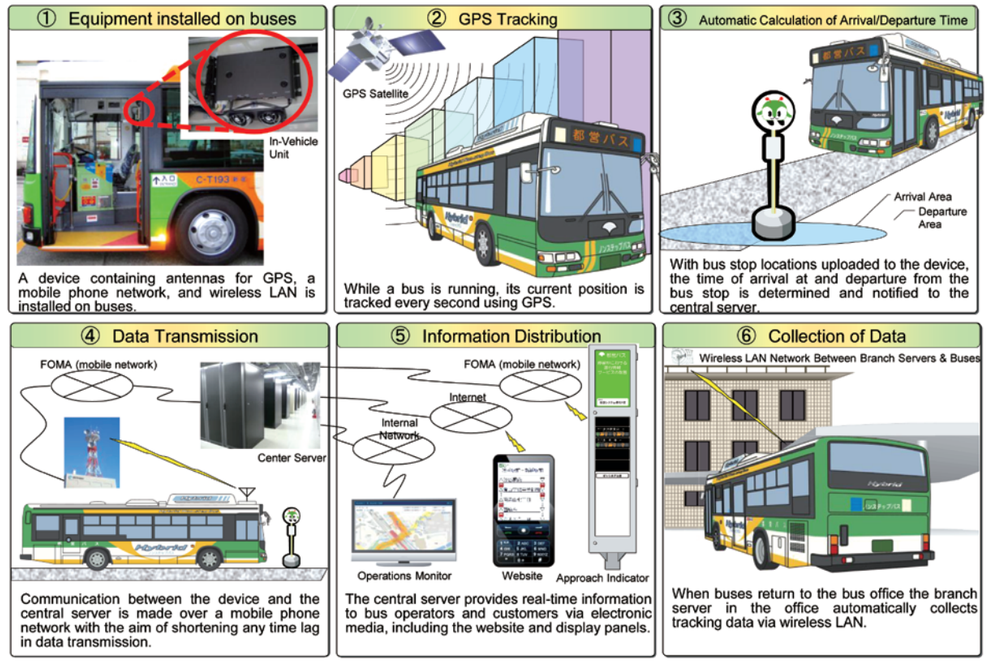
With the aim to enhance services, the system distributes detailed information on bus operations such as the location of approaching buses and the estimated amount of time required to reach a destination.

Overview: Provision of information on Toei Bus operations collected by GPS

- Data on the location of Toei buses (operated by the TMG Bureau of Transportation) is collected using GPS and other systems, and then shared with users through information terminals such as display panels at bus stops, mobile phones, and computers.
- Other services are also provided for these devices, including a search function that displays bus stops on a map, an application that guides users of GPS-equipped mobile phones to the nearest bus stop, and a Toei Transportation route search function.

Details: Specific technology utilized

Information on bus operations is transmitted by linking the following six systems.



無収水削減技術

交流実績都市：バンコク市、台北市、ヤンゴン市、デリー市

目的：水道事業の健全経営に不可欠な漏水等の無収水を削減する技術

無収水削減を行うことで、貴重な水資源の有効利用、環境負荷の低減、事業効率の向上を図る

概要：無収水を削減するための漏水防止技術

東京水道は、漏水防止対策を積極的に進め、無収水率３％を実現

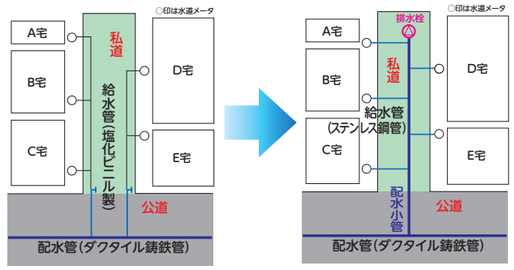
詳細：

（1）水道管路の取替及び材質改善

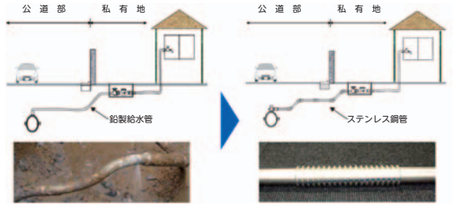
漏水を未然に防止するとともに、残存する地下漏水をなくすための予防対策

〈老朽管路の取替え〉

〈給水管整備〉



〈給水管のステンレス化〉



（2）効率的に漏水を発見・修理する作業方法

- 地下漏水を発見、早期修理する計画作業　（区画毎に計画的な漏水調査等を実施）
- 地上に現れた漏水を迅速に修理する機動作業　（24 時間対応できる体制を構築）

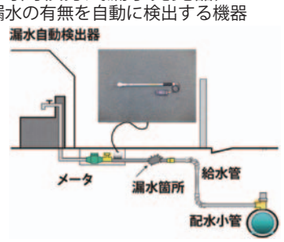
〈漏水探知する機器〉

◆音聴棒

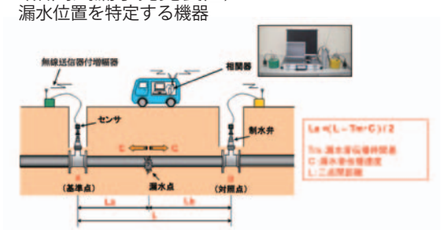
◆電子式漏水発見器

（3）漏水を防止するための高度な技術開発

〈時間積分式漏水発見器〉
漏水の有無を自動に検出する機器



〈相関式漏水発見装置〉
漏水位置を特定する機器



Technology for Non-Revenue Water (NRW) Reduction

Exchange with Bangkok, Taipei, Yangon, Delhi

Objective: To reduce NRW, which is essential for the sound management of water utilities

Through technologies to reduce NRW, Tokyo works to achieve effective use of precious water resources, reduce environmental impact, and improve the efficiency of operations.

Overview: Leakage prevention technology to reduce NRW

Tokyo Waterworks has actively promoted leakage prevention measures, and has reduced the percentage of NRW to just 3 percent.

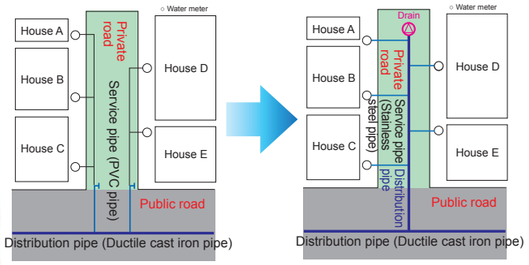
Details:

(1) Replacement of water pipes and improvements in materials

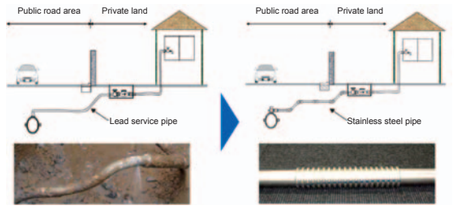
Preventive measures are taken to prevent water leakage before it happens, as well as to eliminate any existing underground leakage.

Replacement of old pipes

Upgrading service pipes



Introduction of stainless steel service pipes

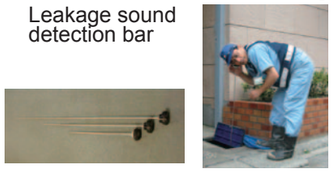


(2) Methods of effectively finding and repairing leakage

- Scheduled work to detect and repair underground leakage early on. (Implementation of planned leakage tests by district.)
- Mobile emergency work to promptly repair leakages that appear above ground. (A system capable of 24/7 response has been built.)

<Instruments used to detect leakage>

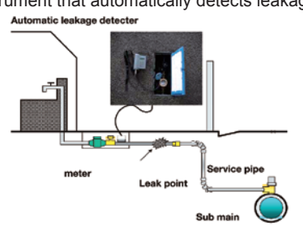
Leakage sound detection bar



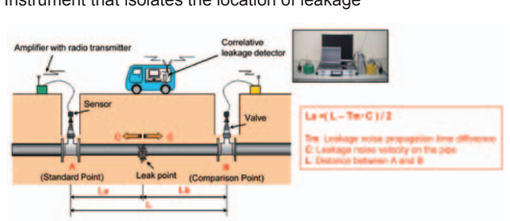
Electronic leakage detector

(3) Development of advanced technologies to prevent leakage

<Time integral type leakage detector>
Instrument that automatically detects leakage



<Correlative leakage detector>
Instrument that isolates the location of leakage



浄水処理技術と水質管理手法

交流実績都市：台北市

目的：安全でおいしい水道水の供給

安全でおいしい水道水を供給することで、公衆衛生の向上と生活環境の改善を図る

概要：あらゆる水道水源に対応できる浄水処理技術及び水質管理手法

河川水、湖沼水、地下水などあらゆる水源に対応できる浄水処理技術及び水質管理手法

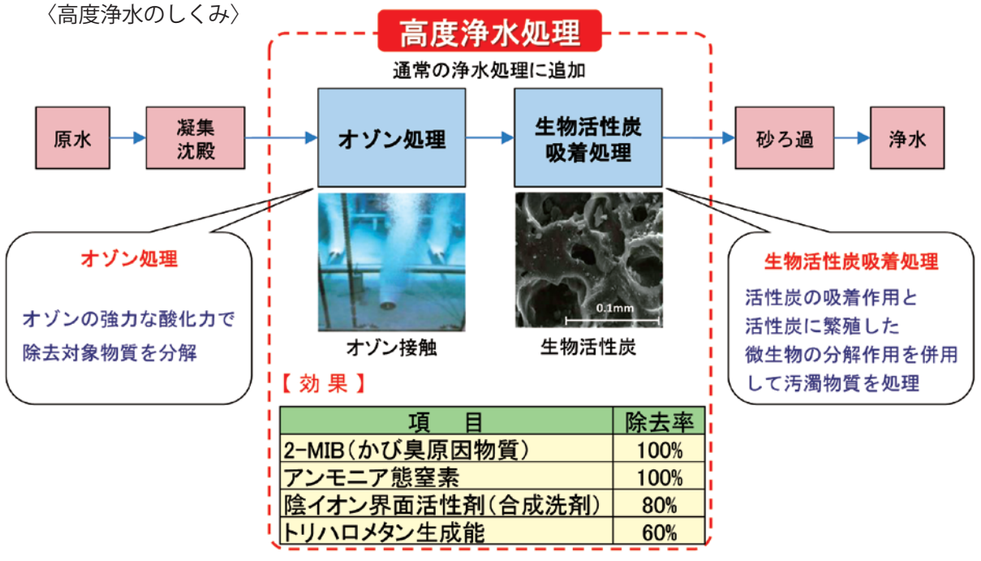
詳細：

（1）東京水道が現在導入している浄水処理技術

浄水処理技術：急速ろ過、高度浄水※、緩速ろ過、膜ろ過、除鉄・除マンガン、エアーレーション等

※高度浄水とは、通常の浄水処理では対応できない物質等の除去を目的とした浄水処理

〈高度浄水のしくみ〉



項　目	除去率
2-MIB（かび臭原因物質）	100%
アンモニア態窒素	100%
陰イオン界面活性剤（合成洗剤）	80%
トリハロメタン生成能	60%

（2）総合的な水質管理手法

高品質な水道水を提供するため、水源から蛇口までの水質を総合的に管理

Water Purification Technology & Water Quality Management System

Exchange with Taipei

Objective: To supply potable and delicious tap water

To improve public health and the living environment by supplying potable and delicious tap water.

Overview: Technology and system capable of accommodating all water resources

Water purification technology and a water quality management system for water from all kinds of water sources such as river water, lake water, and ground water.

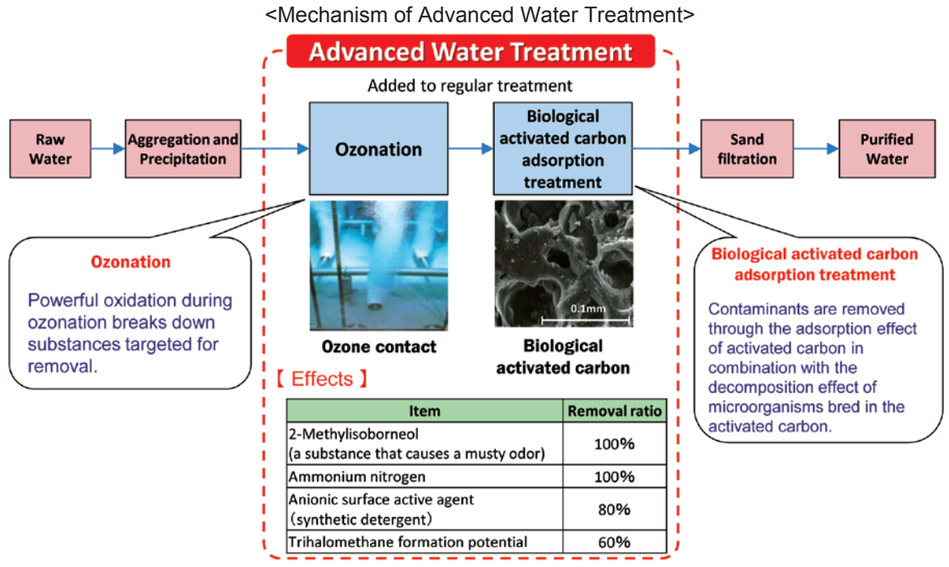
Details:

(1) Water purification technology currently used by Tokyo Waterworks

Rapid sand filtration, advanced water treatment*, slow sand filtration, membrane filtration, deferrization/demanganization, aeration, etc.

*Advanced water treatment is water purification with the objective of removing matter that cannot be removed through regular treatment.

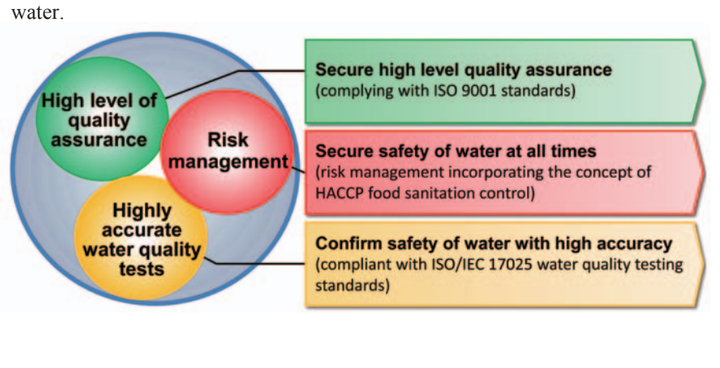
<Mechanism of Advanced Water Treatment>



Item	Removal ratio
2-Methylisoborneol (a substance that causes a musty odor)	100%
Ammonium nitrogen	100%
Anionic surface active agent (synthetic detergent)	80%
Trihalomethane formation potential	60%

(2) Comprehensive Water Quality Management System

Water quality from water resources to the taps is managed comprehensively in order to supply high quality tap water.



水運用コントロール

交流実績都市：台北市、デリー市

目的：水源から供給先に至る水の流れを効率的に常時コントロール

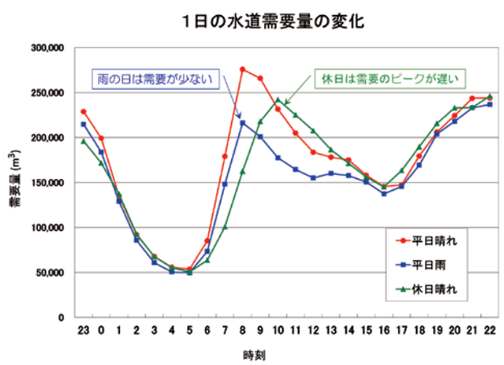
・日々の水道需要の変動に対しても効率的で安定的な水道水を常時供給
・常時監視により、事故や水質異常等を早期にキャッチし、迅速な事故対応を図る

概要：大規模な広域水道を総合的にコントロールする水運用システム

・広範囲に及ぶ給水区域に水道水を安定的に供給するために、水量・水圧・水質などの情報を一元的に収集し、水量・水圧などを総合的に運用コントロールするシステム

詳細：総合的な水運用コントロールを実施

・1 日の水道需要の変化に追従したポンプ等の運転による水量・水圧の確保
・事故時における他系統への迅速な切替等による給水の確保
・効率的なエネルギー使用・低コストな水運用



Water Supply Control and Management

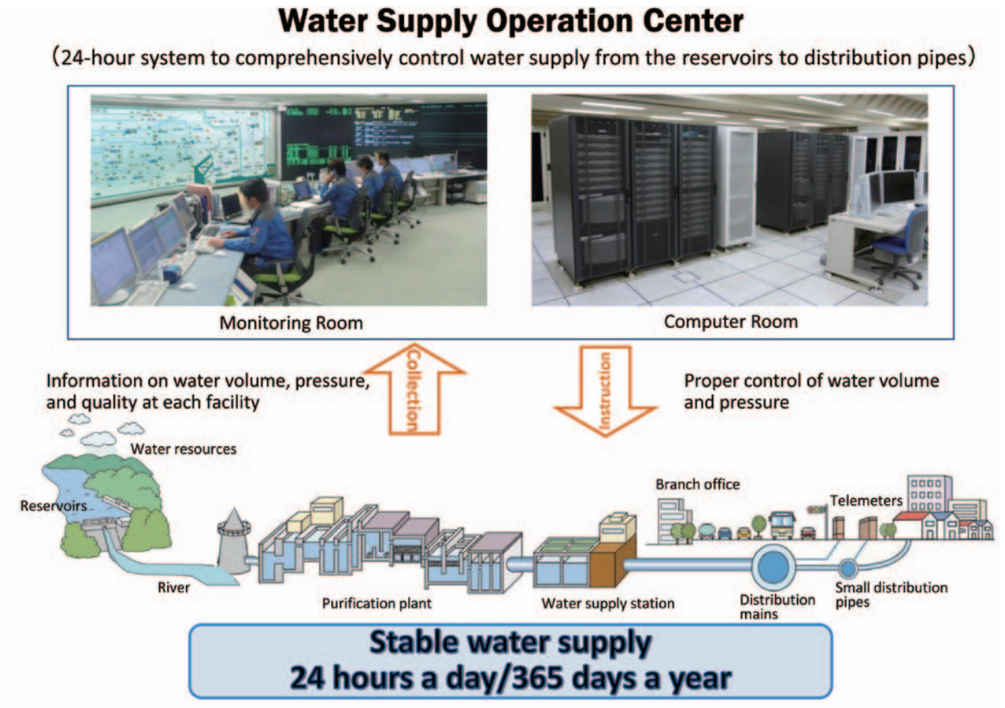
Exchange with Delhi, Taipei

Objectives: To efficiently control the overall flow of water at all times

•Provide a constant supply of water in an efficient and stable manner even with day-to-day shifts in water demand
•Through constant monitoring, Tokyo works to spot trouble and irregularities in water quality early on and promptly respond to incidents.

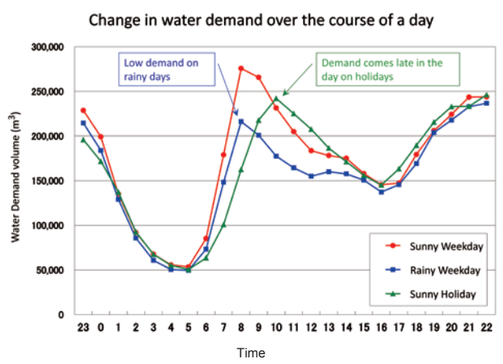
Overview: Comprehensive control over waterworks for a large area in Tokyo

•In order to provide a stable supply of water to a water district that covers a wide area, the system consolidates collection of information on factors such as water volume, pressure, and quality, and comprehensively controls and manages water volume and pressure.



Details: Implementing comprehensive control of water

•Water volume and pressure are secured through the operation of pumps synchronized to changes in water demand over the course of a day and other means.
•Water supply is ensured through measures such as the ability to quickly switch over to a different river system when trouble occurs.
•Efficient use of energy and low cost operations.



強靭な水道システム

交流実績都市：台北市

目的：災害や事故等に備えた強靭な水道システムを構築

災害や事故等による水道施設の被害を最小限にとどめ、給水を可能な限り確保

概要：バックアップ機能の強化及び水道システム全体の耐震化

管路の二重化・ネットワーク化により事故時のバックアップ機能を強化するとともに、震災に備え水道システムを効率的に耐震化

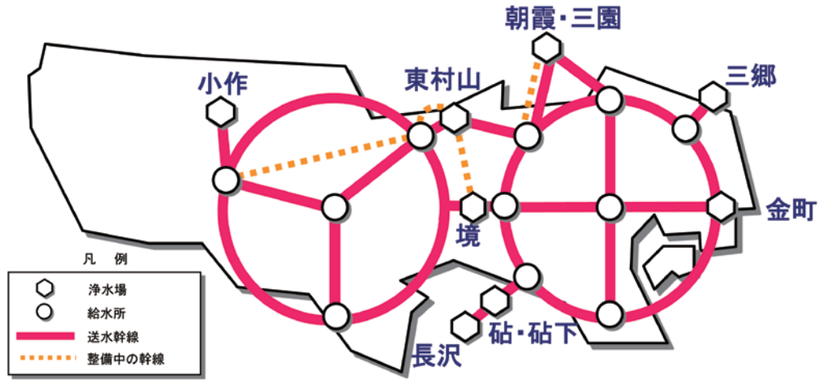
詳細：

（1）導水施設の二重化及び送水管の二重化・ネットワーク化

・停止することができない導水施設や送水管を二重化

・バックアップを可能とするための広域的な送水管ネットワークの構築

〈送水管ネットワーク（イメージ図）〉

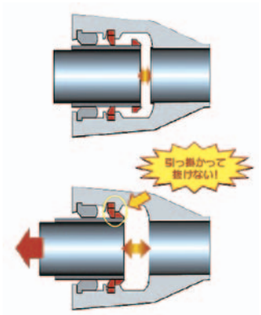


（2）水道システム全体の耐震化

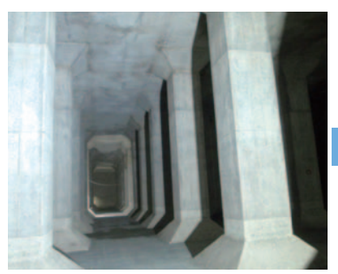
・震災時における被害を最小限にとどめ、給水を可能な限り確保するため、高い耐震性能を確保

・取水から配水までの連続性に配慮し、優先度の高い施設から耐震補強を行うなど、効果的な耐震化を実施

〈水道管路（耐震継手管）の構造〉



〈水道施設（配水池）の耐震化例〉


耐震補強前


耐震補強後（耐震壁設置）

Robust Water System

Exchange with Taipei

Objective: To build a robust water system in preparation for disasters and accidents

To minimize damages to water facilities in the event of a disaster or accident, and secure water supply to all possible extent.

Overview: Bolster backup functions and earthquake resilience

Along with bolstering backup functions in the event of an accident through the duplexing and networking of pipelines, efficient earthquake resistance of the water supply system will be implemented to prepare for disasters.

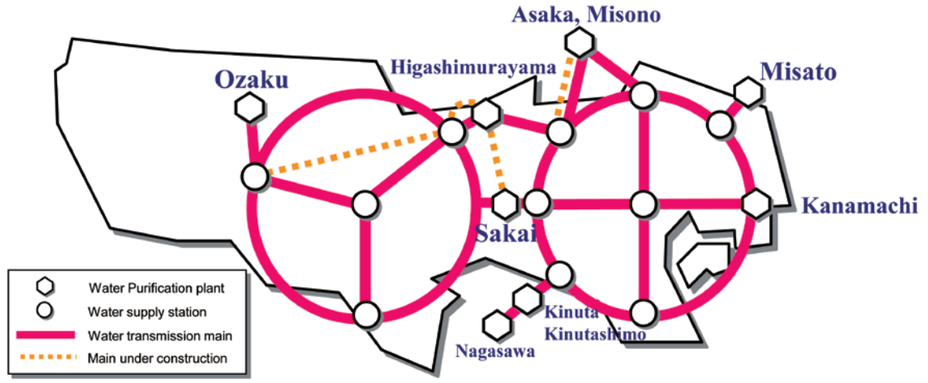
Details:

(1) Duplexing of conveyance facilities & duplexing/networking of transmission pipes

•Duplexing the conveyance facilities and transmission pipes, which must not stop operating

•Building a regional transmission pipe network that enables backup support

<Network of Water Transmission Pipes>

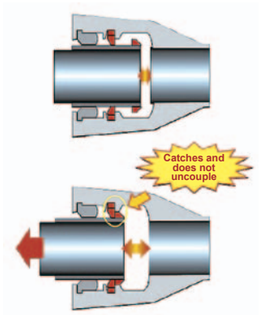


(2) Earthquake resilience of the water supply system overall

•Earthquake resistance is secured in order to minimize damage in the event of an earthquake and ensure water supply to all possible extent.

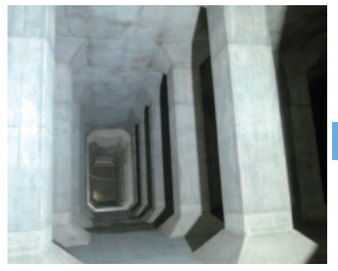
•To maintain continuity from water intake to water supply, enhancement of earthquake resistance is implemented effectively. These include setting priorities and implementing seismic retrofitting from key facilities.

<Earthquake-resistant joint pipe>



Joint with interlocking function

<Example of seismic reinforcement of distribution reservoir>


Before seismic reinforcement


After seismic reinforcement (installation of quake resistant walls)