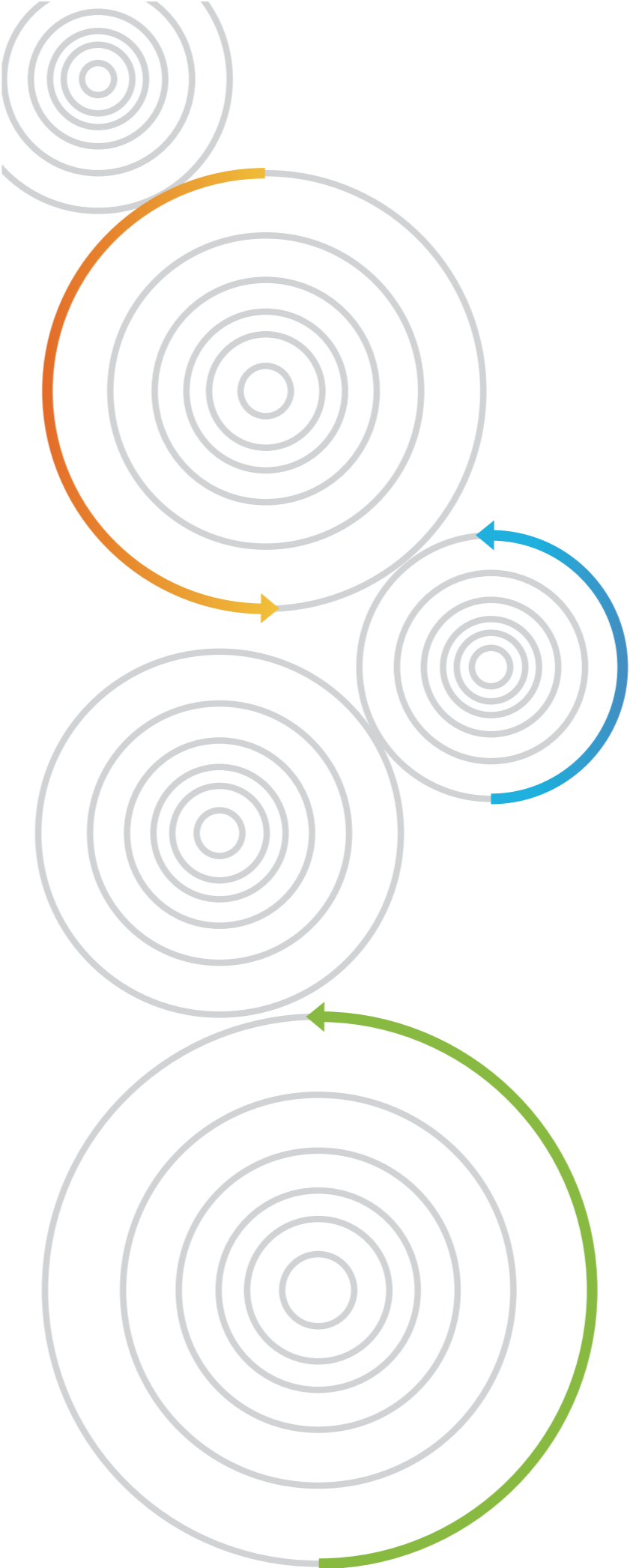With Smart Water Management Initiative,
K-water will open a smarter future!

SMART WATER
MANAGEMENT
TECHNOLOGY

K water

Mission & Vision

Smart water management
building on experts' own know-how
Smart water management
building on advanced water management
technologies

To stay on the
track to create
a happier world
with water

MISSION

VISION   Management
Principles

To grow into the
world's best
multi-sectoral water
service provider

To lead the next
generation's water
management
To realize people's
water welfare
To pursue customer-
oriented management
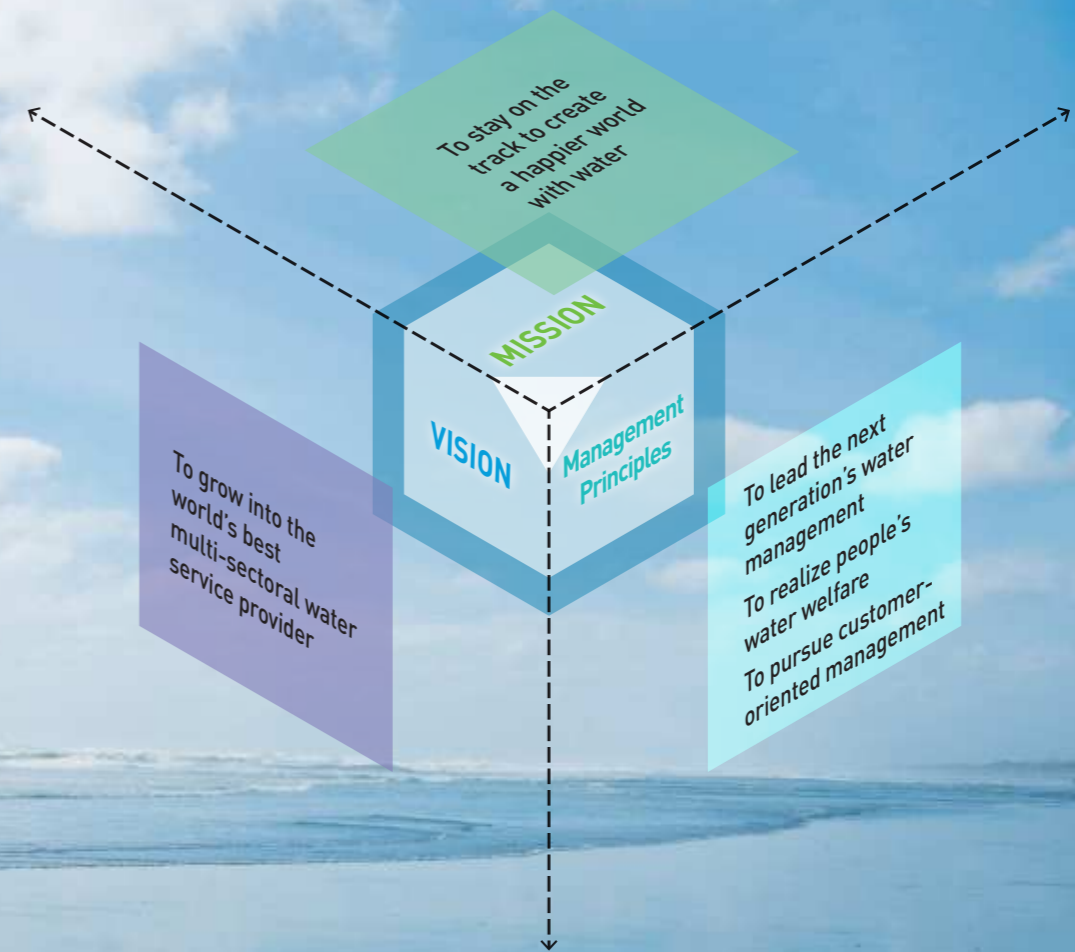
K-water's smart water management builds on experts' own know-how
and advanced water management technologies that the world can have an
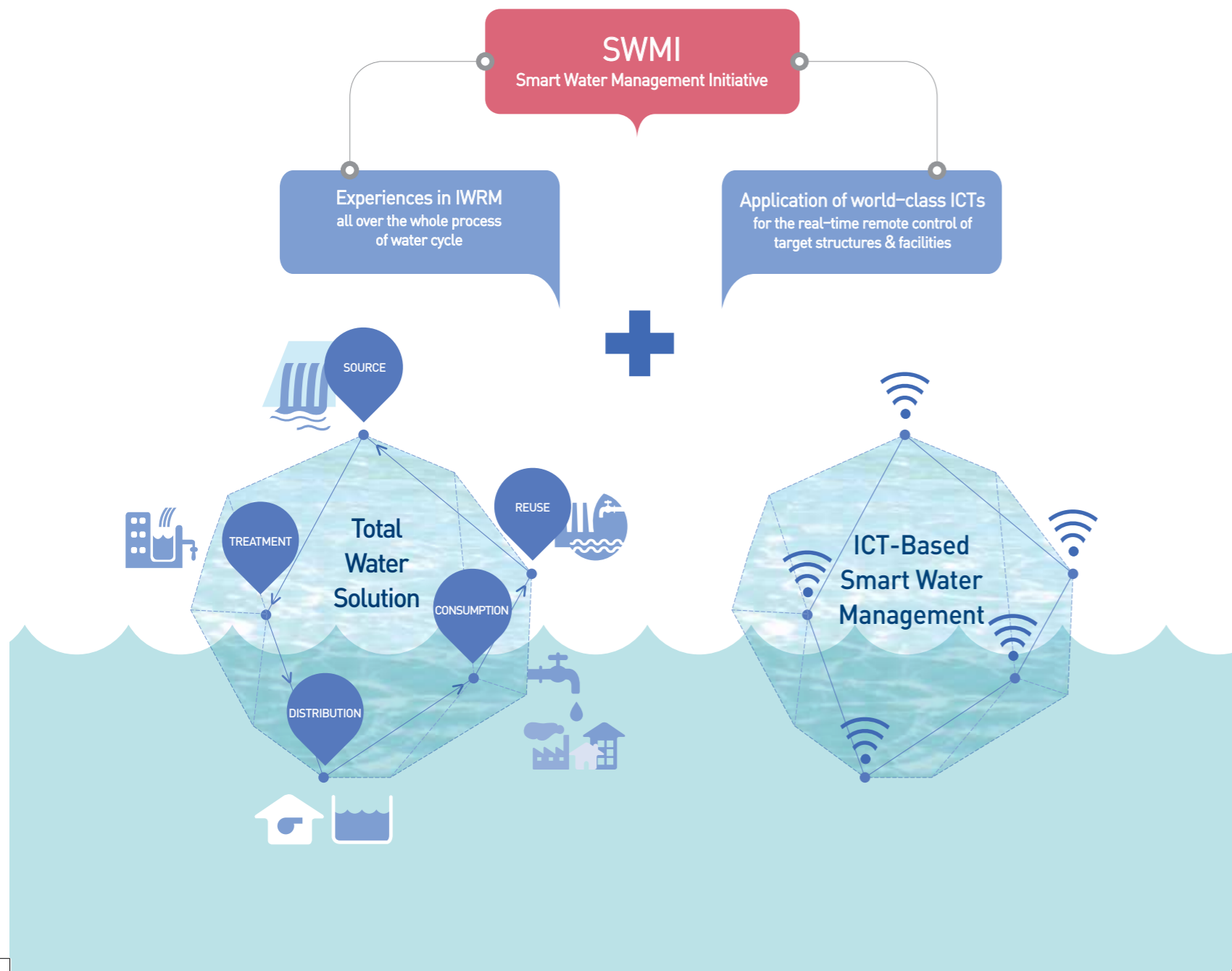unchanging trust in.

With its own smart management system and future-oriented water
management technologies,
K-water will grow into the world's best multi-sectoral water service provider

Future & Technology

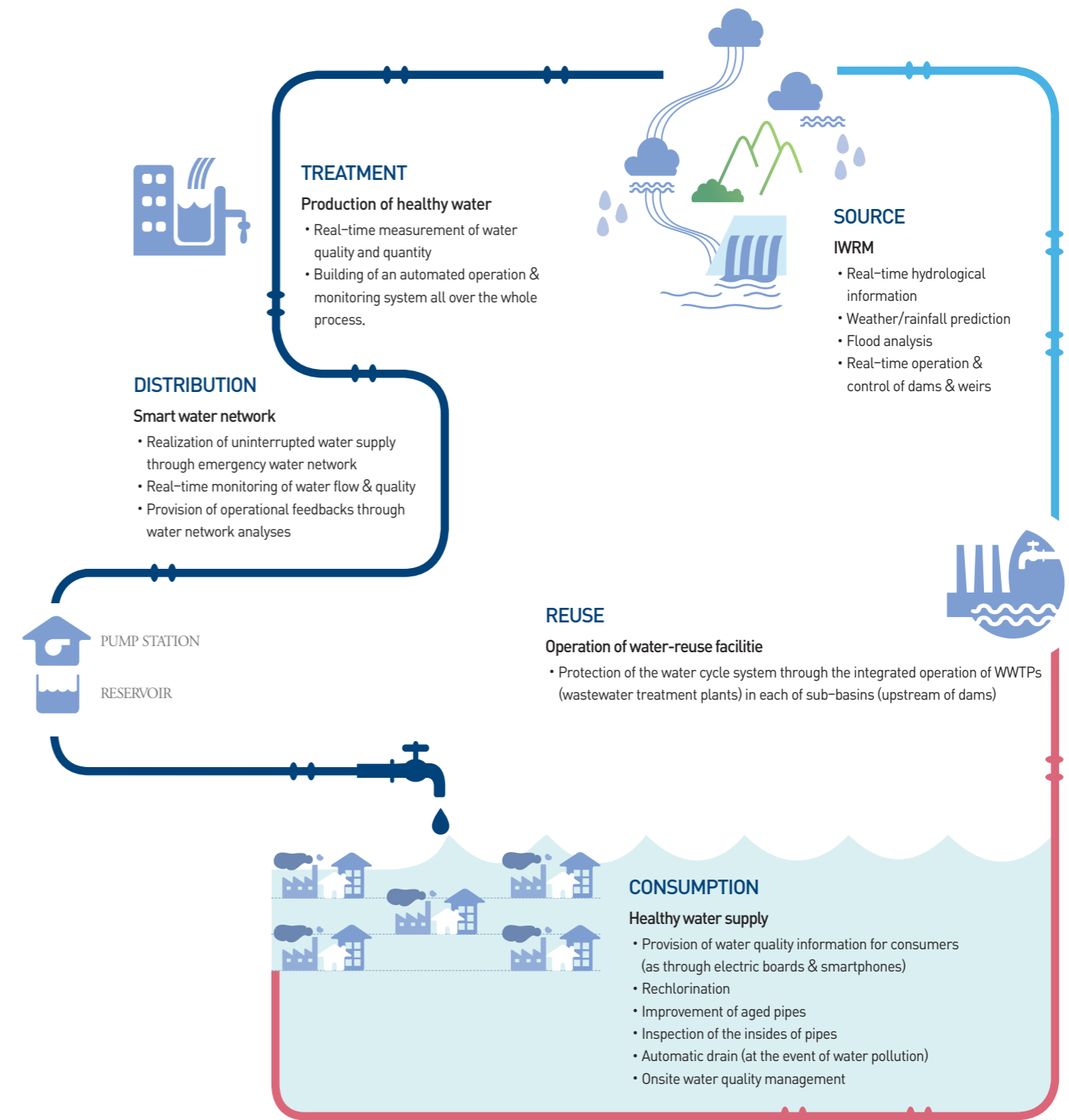## K-water will open the future of water management with its own smart technologies.

With its own ICT*–based smart water management, K–water will tackle various water problems by providing IWRM services over the whole process of water cycle.

* ICTs: Information & Communications Technologies

SWMI
Smart Water Management Initiative

Experiences in IWRM
all over the whole process of water cycle

Application of world–class ICTs
for the real–time remote control of target structures & facilities

Total Water Solution

SOURCE
TREATMENT
REUSE
CONSUMPTION
DISTRIBUTION

ICT-Based Smart Water Management

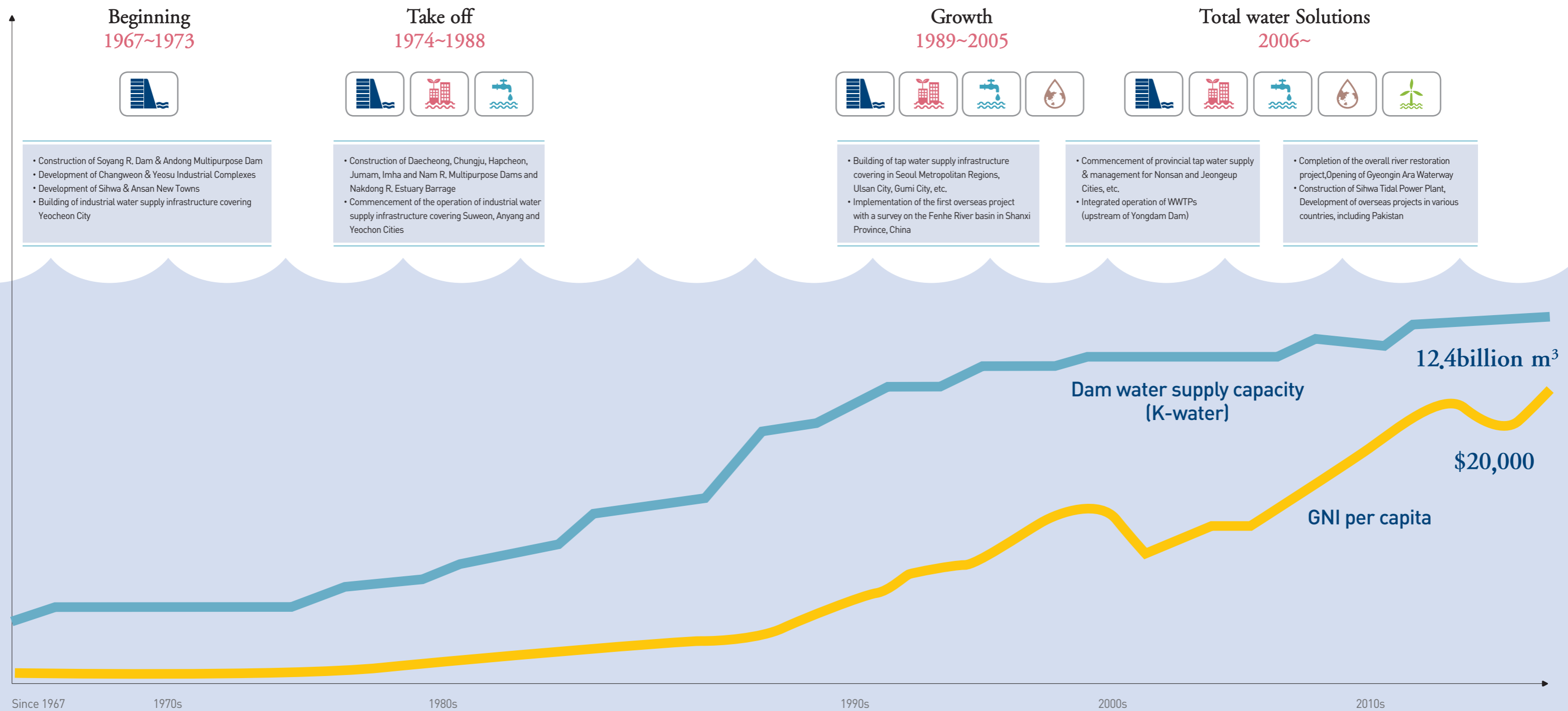## SWMI (Smart Water Management Initiative)

SWMI, an IWRM model involving in the whole process of water cycle that was designed by K–water, helps improve the reliability, soundness and efficiency of water management with ICT–based water management systems all over the water cycle, which ranges from water sources to end users.

TREATMENT
Production of healthy water
• Real–time measurement of water quality and quantity
• Building of an automated operation & monitoring system all over the whole process.

SOURCE
IWRM
• Real–time hydrological information
• Weather/rainfall prediction
• Flood analysis
• Real–time operation & control of dams & weirs

DISTRIBUTION
Smart water network
• Realization of uninterrupted water supply through emergency water network
• Real–time monitoring of water flow & quality
• Provision of operational feedbacks through water network analyses

PUMP STATION

RESERVOIR

REUSE
Operation of water-reuse facilitie
• Protection of the water cycle system through the integrated operation of WWTPs (wastewater treatment plants) in each of sub-basins (upstream of dams)

CONSUMPTION
Healthy water supply
• Provision of water quality information for consumers (as through electric boards & smartphones)
• Rechlorination
• Improvement of aged pipes
• Inspection of the insides of pipes
• Automatic drain (at the event of water pollution)
• Onsite water quality management

History

K-water, which has grown together with the Korean economy

Pathways K-water has walked along are the very history of Korea's economic development.

Beginning
1967~1973

• Construction of Soyang R. Dam & Andong Multipurpose Dam
• Development of Changweon & Yeosu Industrial Complexes
• Development of Sihwa & Ansan New Towns
• Building of industrial water supply infrastructure covering Yeocheon City

Take off
1974~1988

• Construction of Daecheong, Chungju, Hapcheon, Jumam, Imha and Nam R. Multipurpose Dams and Nakdong R. Estuary Barrage
• Commencement of the operation of industrial water supply infrastructure covering Suweon, Anyang and Yeochon Cities

Growth
1989~2005

• Building of tap water supply infrastructure covering in Seoul Metropolitan Regions, Ulsan City, Gumi City, etc.
• Implementation of the first overseas project with a survey on the Fenhe River basin in Shanxi Province, China

Total water Solutions
2006~

• Commencement of provincial tap water supply & management for Nonsan and Jeongeup Cities, etc.
• Integrated operation of WWTPs (upstream of Yongdam Dam)

• Completion of the overall river restoration project,Opening of Gyeongin Ara Waterway
• Construction of Sihwa Tidal Power Plant, Development of overseas projects in various countries, including Pakistan

12.4billion m³

Dam water supply capacity (K-water)

$20,000

GNI per capita

Since 1967 　　1970s 　　　　1980s 　　　　1990s 　　　2000s 　　　2010s

Business Areas

With its own advanced smart water management practices & technologies, K-water has faithfully been doing its part as a government-owned water management corporation which provides IWRM services all across the national water industry, and further leads the global water industry

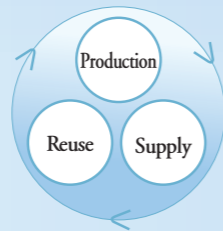Sustainable
water cycle based on
**Total Water
Solution**

Basins
Water resources
Stream
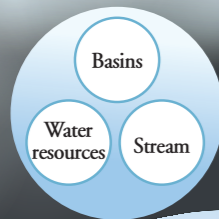
Plays a leading role in water management for central & municipal governments Introduces IWRM practices

Integrated Water Resource Management

Integrated Water Management Center
Operation of weirs, rivers, estuaries
and dams Status survey of water resources
Safety management for hydraulic
structures

• Integrated water management center
• Operation of Weir, stream, Estuary barrage, dam
• Survey & management of water resource information
• Safety management for facilities

Develops environment-friendly leisure space along waterfronts

Waterfront Development Projects

Develops environment-friendly
cities along waterfronts

• Waterfront cities
• High-tech industrial complexes

| **IWRM(Integrated Water Resource Management) Projects**

Realizes the one-stop water management of dams & rivers with the IWRM system

| **Healthy Water Supply Projects**

Supplies healthy water with the intelligent water management system

| **Waterfront Development Projects**

Develops environment-friendly cities along waterfronts

| **Clean Energy Projects**

Leads the energy industry by developing new & renewable energy with water

| **Overseas Projects**

Provides the world with total water solutions involving in the whole process of water cycle

Production
Reuse
Supply

**Manages water
from water sources to end users**
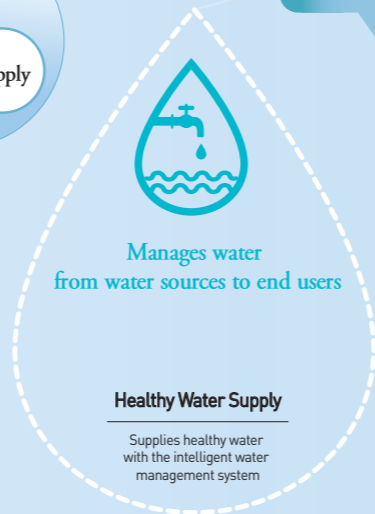
Healthy Water Supply

Supplies healthy water
with the intelligent water
management system

• Regional Water Supply & Distribution Networks
• Municipal & provincial water supply & distribution networks
• Customized industrial water
• Wastewater works

• Hydropower
• Tidal Power
• Floating Solar Power

Global Network

Overseas Projects

Provides the world with
total water solutions

Produces environment-friendly energy from water

Clean Energy Projects

Leads the new &
renewable energy industry

Chungju Dam

# FAITH**FUL**
MANAGEMENT

IWRM (Integrated Water Resources Management) Project
To pursue and ensure the sustainable development of reliable water supply

K-water will always be there for the integrated water management of dams, weirs and rivers. K-water's own competitiveness lies in the safe integration & management of water resources. K-water will do its best to pursue & ensure the sustainable development of reliable water supply through its own IWRM practices.

IWRM projects

Sustainable development

Clean, reliable water supply

IWRM Projects

IWRM Projects

IWRM Projects
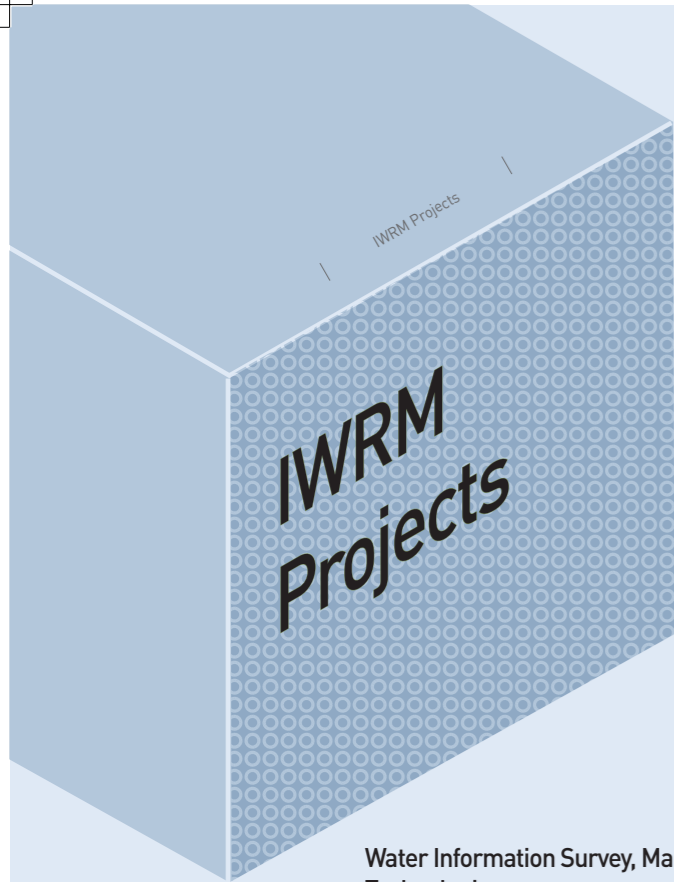
K-water has applied IWRM (integrated water resource management) practices across the whole process of water cycle, which would enable the efficient use and management of water resources, including rainfall and water flowing from basins and rivers.

Water Information Survey, Management and Analysis Technologies

Acquisition & analysis of real-time hydrological data
Survey & management of basin, river and groundwater data
Customized status survey & analysis of water resources

Hydrological survey and basin survey

Survey & management of groundwater data

Water Management Forecasting & Decision-Making Technologies

Real-time data analysis & decision-making
Rainfall forecasting
Flood control
Water supply
Water quality management
Power generation

Water Resources Operations Center

Hydraulic Infrastructure Maintenance & Safety Management Technologies

Integrated safety management system for hydraulic structures
Dam risk analysis & assessment
Improvement of flood control capacity
Improvement of aged dams' capacity

Operation & maintenance of dam structures

Operation & maintenance of hydraulic structures in rivers

Integrated Water Quality Management

Integrated water quality prediction system for target basins & rivers
Real-time monitoring of water pollution
Water ecology restoration technologies
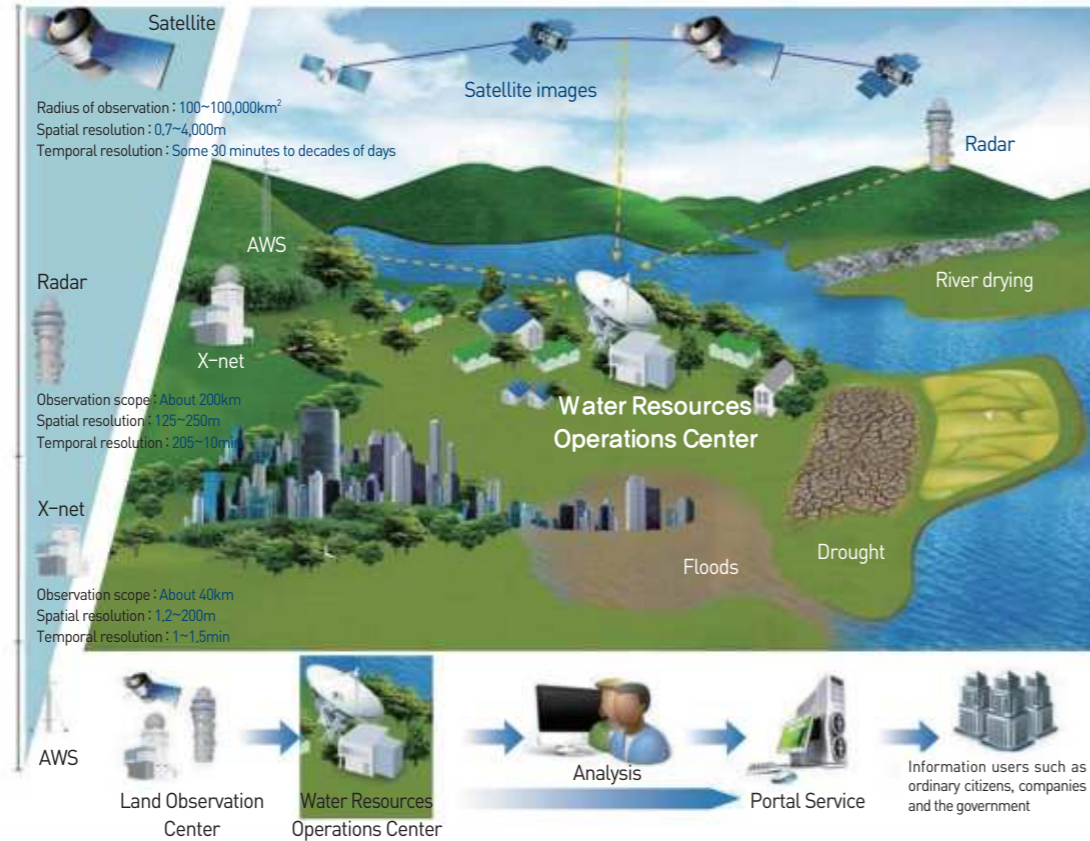
Water quality management for target and rivers

Meteorological radar

Water Information Survey, Management and Analysis

Stage gauge
Water quality monitoring

Rain gauge

CCTV

AWS

Water Management Forecasting & Decision-Making

Water Resources Operations Center

Warning station

Rain gauge

Operation & maintenance of dam structures

CCTV

Dam instrumentation device

Warning station

Stage gauge
Water quality monitoring

Stage gauge
Water quality monitoring

Operation & maintenance of hydraulic structures in rivers

Stage gauge
Water quality monitoring

Multi-functional weir

CCTV

Warning station

CCTV

Water quality monitoring
Stage gauge

Warning station

Estuary barrage

Water Information Survey, Management and Analysis Technologies

K-water is the only organization in Korea that is equipped with professional capabilities to perform various surveys & investigations on all areas of water resources, including hydrological survey, basin survey, groundwater survey, etc. All water-related information and data acquired on a real-time basis are accessible to all people via the ICT-based RHDAPS (Real-time Hydrological Data Acquisition & Processing System) or the national water-related portal systems. These data are also used to develop new policies on water resources or new water-related project opportunities.

Water Management Forecasting & Decision-Making Technologies

K-water has been continuously developing its own precipitation forecasting & decision-making technologies to ensure the efficient management of water resources even under unfavorable water management environment unique to Korea where regional & seasonal variations in precipitation are very substantial with the frequent occurrence of extreme weather events (e.g., flood accompanying a typhoon, abnormal drought). Also, K-water is capable of providing packaged, customized water management solutions from those technologies for different kinds of end users.

Big-data-based water resource information management system linked to satellite images and real-time measured data

Satellite
Radius of observation : 100~100,000km²
Spatial resolution : 0.7~4,000m
Temporal resolution : Some 30 minutes to decades of days

Satellite images

Radar

AWS

Radar

X-net

Observation scope : About 200km
Spatial resolution : 125~250m
Temporal resolution : 205~10min

X-net

Observation scope : About 40km
Spatial resolution : 1.2~200m
Temporal resolution : 1~1.5min

AWS

River drying

Water Resources Operations Center

Floods   Drought

Land Observation Center   Water Resources Operations Center   Analysis   Portal Service   Information users such as ordinary citizens, companies and the government

RHDAPS (Real-time Hydrological Data Acquisition and Processing System)
A-1

RHDAPS is a customized portal system based on web-DB to acquire, transmit, store and process real-time hydrological data, and thereby produce & supply quality hydrological data.

Riverflow Measurement Technology(RMT)
A-2

RMTs, which include multi-depth flowmeters, microwave surface velocity meter and gyro ball, are used to acquire reliable basic water resources data, and thereby perform relevant surveys in a timely manner

M-WAS(Mobile Water Analysis System)
A-3

M-WASs are multi-purpose river survey vehicles used to conveniently accommodate and transport such river survey equipment or instruments as flowmeters, suspended load samplers, S-boats, etc.

HOPTC (Hydrological Observation Performance Test Center)
A-4

HOPTC is a proven performance test center with capabilities to perform overall performance tests on hydrological monitoring systems in terms of their performance, compatibility, applicability, reliability, etc.

WROC(Water Resources Operations Center) functioning as a hub for IWRM practices

K-HIT (K-water Hydro Intelligent Toolkit)
A-5

K-HIT is a decision support package converged with advanced ICTs and linked with individual water management technologies, which will ensure flood control & reliable water supply and monitoring of real-time data.

PFS (Precipitation Forecasting System)
A-6 A-7

PFS is a system to produce quantitative long- and short-term precipitation forecasting information optimized for specific physical environments and detailed geometry conditions based on a digital map dividing the Korean territory into 3km×3km grids

FAS (Flood Analysis System)
A-8 A-9

FAS is a system to support flood analysis and decision-making process based on real-time hydrological conditions and precipitation forecasts (COSFIM for multi-dam flood analysis, K-DRUM for distributed river basin rainfall-runoff analysis)

RWSS (Reservoir Water Supply System)
A-10

RWSS is a system to estimate optimal discharge for ensuring the linked operation of target dams and weirs considering expected flow into each of them and water demand within the same water system, and thereafter apply the optimal discharge estimates to a water budget analysis model and a water quality analysis model to estimate discharge availability at the event of water pollution and analyze the effects of water quality improvement.

GIOS (Generation Integrated Operation System)
A-11

GIOS is a system used for the real-time remote supervisory control of dam & weir generation, transmission and distribution systems and gates, and the production & provision of relevant data covering overall operation status and other statistical analysis data.

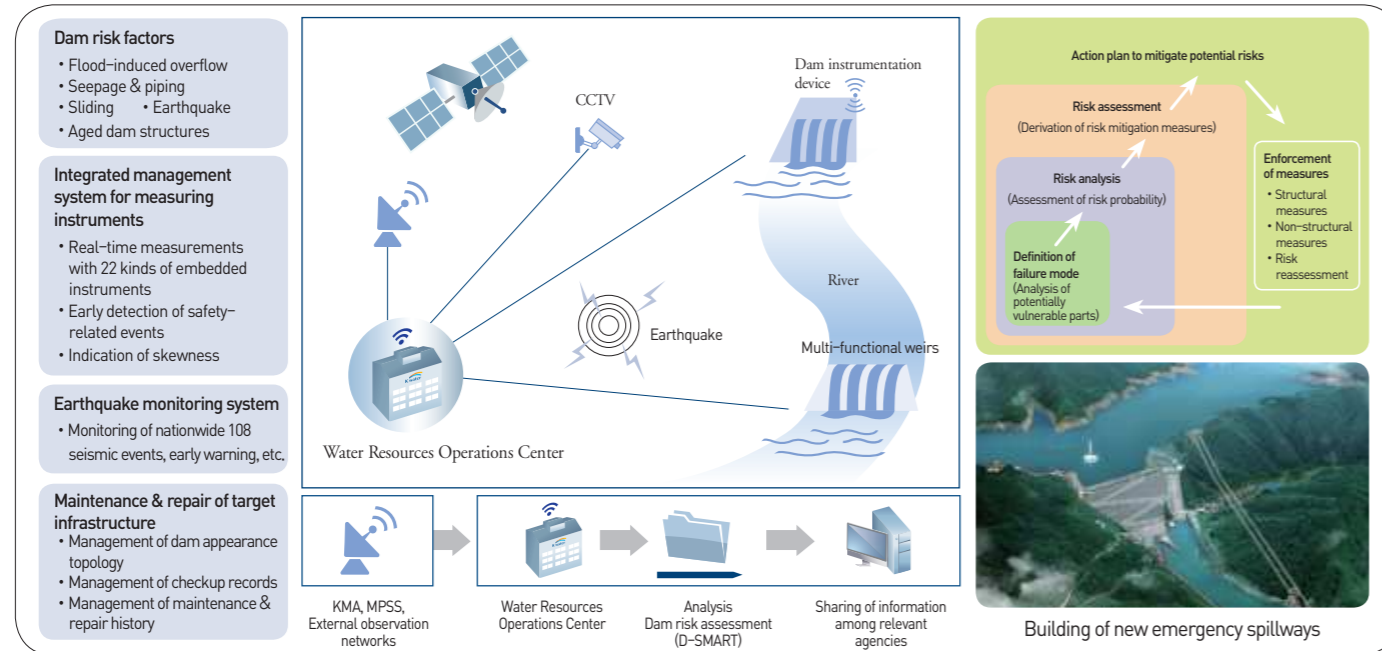**K-FAT (K-water Frequency Analysis Tool)**
A-12

K-FAT is a tool with which it's possible to acquire & preprocess hydrological data online and make frequency analyses of flood and drought through estimating 14 types of probability distributions, perform a goodness-of-fit test and determining an optimal probability distribution.

Hydraulic Infrastructure Maintenance & Safety Management Technologies

As part of efforts to ensure the stability & safety of water resource management infrastructure against various risk factors (e.g., extreme storm events, earthquake, aged structures, etc.), K-water has been making efforts to improve its own flood control capacity, as through building new emergency spillways and connecting dams for their integrated operation. Also, K-water has applied prevention-oriented safety management practices by developing & building the ICT-based integrated safety management system which allows real-time measurements with various kinds of embedded instruments and real-time monitoring of seismic events, and adopting quality dam risk analysis & assessment methods.

Dam risk factors
• Flood-induced overflow
• Seepage & piping
• Sliding   • Earthquake
• Aged dam structures

Integrated management system for measuring instruments
• Real-time measurements with 22 kinds of embedded instruments
• Early detection of safety-related events
• Indication of skewness

Earthquake monitoring system
• Monitoring of nationwide 108 seismic events, early warning, etc.

Maintenance & repair of target infrastructure
• Management of dam appearance topology
• Management of checkup records
• Management of maintenance & repair history

CCTV

Dam instrumentation device

Action plan to mitigate potential risks

Risk assessment
(Derivation of risk mitigation measures)

Risk analysis
(Assessment of risk probability)

Enforcement of measures
• Structural measures
• Non-structural measures
• Risk reassessment

Definition of failure mode
(Analysis of potentially vulnerable parts)

River

Multi-functional weirs

Earthquake

Water Resources Operations Center

KMA, MPSS, External observation networks

Water Resources Operations Center

Analysis Dam risk assessment (D-SMART)

Sharing of information among relevant agencies

Building of new emergency spillways

ICT-based IWRSMS
(Integrated Water Resource Safety Management System)

WRIS (Water resources Integration System)
A-13

A system for the methodical management of real-time big-data on water resources (e.g., hydrological & meteorological data, water supply, etc.) and the integrated management of information required to operate & maintain dams and weirs.

IWRSMS (Integrated Water Resource Safety Management System)
A-14

IWRSMS is a system with which it's possible to trigger an early warning in any emergency situation through monitoring and analyzing information about the maintenance records of relevant infrastructure assets (in terms of regular inspection, repair and reinforcement) and nation-wide seismic events and ensuring real-time measurement with dam instrumentation devices.

KEMS (Korea Earthquake Monitoring System)
A-15

KEMS is a system with which it's possible to receive & analyze real-time information about seismic event through ensuring the integrated management of seismometers at hydraulic structures (dams and weirs) and spread & share information about any emergency situation in a timely manner.

D-SMART (Dam risk assessment tool)
A-16

D-SMART is a dam safety management decision support system to assess risks through the hydrological, geotechnical probability analysis of various possible risk factors inherent in dams, and thereby improve their performance.

Large Geotechnical Centrifuge(LGC)
A-17

LGC is the world's largest modeling equipment used to evaluate the design appropriateness & stability of large-scale structures, identify their flood- or earthquake-specific damage & failure mechanism, and evaluate the viability of any countermeasures

SMART-TM
A-18

SMART-TM is a system into which the whole disaster management practices (including the acquisition & sharing of relevant information among water management organizations and remote control) are integrated with a standard information delivery platform optimized for the development of disaster management system.

Water-Quality Management of Basins, Rivers and Reservoirs

K-water has developed and applied SURIAN(Supercomputer-based River Analysis Network), a real-time water-quality forecasting & monitoring system, which allows linkage among weather, basin, dam and river models to maintain a sound water ecosystem where human beings and nature can coexist harmoniously. With SURIAN, K-water has made lots of efforts to minimize the impacts of water-quality changes on the ecosystem and ensure the sustainable development of water resources & hydraulic infrastructure using various water ecosystem restoration technologies.

Emergency response & information sharing
• Sharing of real-time information
• Perception or recognition of accident(s) or its occurrence
• Development of optimal scenario(s)

Supervision & monitoring
• Major pollutants (CCTV)
• TMS integration of real-time water quality data
• Basinwide real-time tracking of variations in pollutants
• Supervision of water pollution & monitoring of trends

Project prospect & evaluation
• Development of IWRM goals
• New development proejcts & water quality improvement measures
• Prediction & pre-evaluation of project benefits

Water pollution response

Management & supervision of pollutants

Integrated monitoring, forecasting & response system of water-quality

Prediction of reservoir water quality

Management of pollutants
• GIS-based pollutant history management
• Onsite checkup & pre-mitigation of pollutants

Satellite images
• Tracking of basin land & pollutant variations
• Analysis of reservoir & river water quality (once per day)

Basin model
• Evaluation of basinwide pollutants
• Prioritization of protection areas

Hydraulic prediction of water quality
• Optimal operation based on the results of hydraulic analyses
• Formulation of optimal water abstraction plans, as through gate operation

SURIAN (Supercom-based River Analysis Network)
A-19

SURIAN is a system that is used to supply highly accurate water quality prediction data through linking among meteorological elements and target basins & reservoirs, and thereby help make a timely decision about water pollution accidents.

K-water GATe Water Combine (to remove algal blooms)
A-20

K-water GATe Water Combine is a system that is used to timely and directly remove algal blooms present in rivers and reservoirs through coagulating and floating them with physical and chemical methods.

Operational Status of Hydraulic Infrastructure

With an aim to increase the value of water despite changing environment for water resource management as accompanied by extreme weather events, K-water has pursued the integrated operation of various water resource management infrastructure with its own advanced technologies.

In Korea, two thirds of gross rainfall is concentrated in the wet season, along with extreme variations in river discharge, which is why it is very necessary to control water storage and discharge with dams and other hydraulic structures.

K-water has operated & maintained 17 multipurpose dams, 14 dams dedicated to water supply, and Nakdong R. Estuary Barrage with its own ICT-based water management system to ensure the optimal management of water storage & discharge. Their flood control capacity account for 95% of the gross domestic flood control capacity or 4.9 billion tons, with their water supply capacity explaining 66% of the gross domestic water supply capacity or 12.4 billion tons.

On top of that, K-water has operated & maintained 16 weirs in the 4 major river systems, playing a pivotal role in national water resource management.

The Arc, a 4 major rivers museum

Daecheong Multipurpose Dam

Ipo Weir

Imjin River basin

Han River water system

Geum River water system

Nakdong River water system

Youngsan River water system

Seomjin River water system

Multipurpose dam
Water power generation dam
Water supply dam
Weir
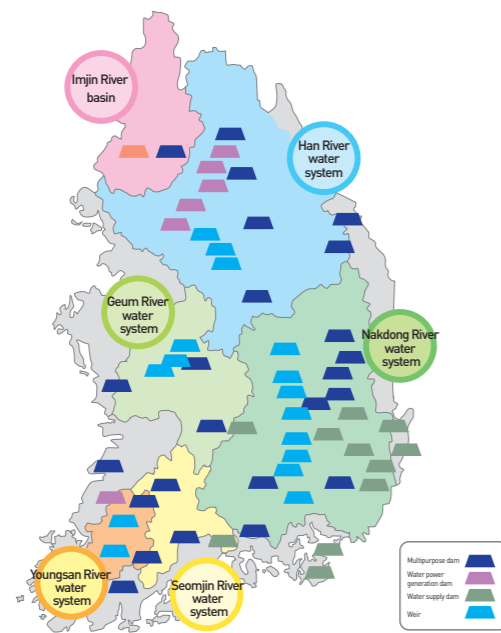
Hwasoon Flood Control Center

Nakdong R. Estuary Barrageage

Seongnam Water Treatment Plant

Clean,
Reliable Water Supply

HEALTH**FUL**
WATER

Clean,
Reliable Water
Supply

Drink in health

With healthy water!

With healthy water supply projects,
K–water will always be there for you
to supply healthy water.

K–water will always be there anywhere you can see water supply projects
underway to supply healthy water.
K–water will always be there anywhere you can see the development of a
sound, efficient water cycle system underway to supply healthy water.
K–water will always be there for you to supply healthy water.

| Water Supply Projects |

Water Supply Projects

K-water has been operating the integrated water management system for reliable water supply, which functions as a total solution to the whole water supply processes ranging from source water to tap water.

K-water has also been implementing healthy water supply projects to build a sustainable, efficient water cycle system through ensuring customized industrial water supply and operating a sound wastewater treatment system for the protection of source water.

Integrated monitoring & control

K water

Water quality led display board

Door-to-door water quality test

Water quality mobile app

Source water quality management
- Integrated water quality prediction & response system
- Real-time algae & odor-causing substance monitoring & measuring system
- Online algae-poisonous substance measuring system

Optimization of water treatment system
- WSP (Water Safety Plant) as global water security technology
- Dr.Water+ (Knowledge-based WTP diagnosis program)
- Integrated control logic program for WTP
- KMWTP (K-water Mobile Water Treatment Plant)
- Vertical-type water treatment technology & decentralized water supply system
- Water & sewage demonstration plants

Dam

Groundwater

Intake station

Water Treatment Plant

Pipe network for emergency

Improvement of aged pipes

Booster Pumping Station

Storage reservoir

Rechlorination

Water Treatment Plant

Automatic drain (at the event of water pollution)

Customized industrial water supply
- Production & supply of RO-treated water
  * RO : Reverse Osmosis
- Design of ultra-pure water treatment process & development of its operating technologies

Operation of smart waterpipe networks
- water-NET (diagnosis, operation and management system for water distribution networks)
- iWater 5(SE) (standard water operating system)
- Water-INFOS (waterworks integrated information system)
- Flowmeter calibration & performance test technology
- Smart cleaning & spray-on lining technology (rehabilitation technology for medium- and large-diameter pipeline)

Inspection of the insides of pipes

Storage Reservoir

Storage reservoir

Water fountain

Efficient operation of water treatment processes
- Self-diagnosis & management system for WWTP
- KSMBR (K-water Ssangyong Membrane Bio-Reactor)

Wastewater Treatment Plant

Pipe network for emergency

Quality management of water sources

K-water has developed a prediction system with which it's possible to monitor algae-induced taste and odor compounds in advance, and thereby build a proactive water safety management system. Also, it has established a preemptive response system against any pollution in water sources by operating a real-time, online measuring system to detect algal odors and toxins.

Technology of water treatment system optimization

K-water has been practicing various water safety and diagnosis programs (e.g., WSP (Water Safety Plan)) for water treatment to ensure healthy tap water supply. It has also tried to introduce a next generation water supply system by implementing such new technologies as multi-story-type water treatment plants and decentralized water supply systems.

Dae Chung Dam

Seongnam Water Treatment Plant

SURIAN(Supercom-based River Analysis Network)
A-19

SURIAN is a system to supply highly accurate water quality prediction data through linking among meteorological elements and target basins & reservoirs, and thereby help make a timely decision about water pollution accidents.

RAOMS (Real-time Algal Odor Measuring System)
B-1

RAOMS is a system to automate the entire process ranging from sampling to analysis by merging existing experimental devices (odor sample degassing & concentration) and saving measuring time

OATMS (Online Algal Toxin Measuring System)

OATMS is a system is used to automate the entire analysis process by merging existing experimental devices (toxins in sample extraction and concentration) and saving measuring time

WSP (Water Safety Plan)

WSP is a water safety management technique developed and optimized by K-water for domestic situation to diagnose potential risk factors that can cause negative impacts on water safety, and to provide any required improvement measures.

Dr. Water⁺
B-2

Dr. Water$^+$ is a program dedicated to the technical inspection of WTPs (water treatment plants) and their water treatment processes. This program functions to derive any constraints in the performance of the water treatment processes, and thereby develop an operation & maintenance plan for ensuring efficient water treatment.

ICLP-WTP (Integrated Control Logic Program for WTP)
B-3

ICLP-WTP is a program for the smart monitoring of water treatment processes using a conventional control method and a data mining technique (to ensure the supervisory control of major water treatments (e.g., chlorination) and effluent treatment processes).

KMWTP (K-water Mobile Water Treatment Plant)
B-4

KMWTP is a relocatable water treatment plant to evaluate and select an optimal water treatment process when there is a change in the quality of raw water accompanied by climate change or small modicums of pollutants flow in (newly).

Decentralized Water Supply System(DWSS)
B-5

DWSS is a safe, reliable advanced water supply system to ensure the distributed relocation of water treatment plants around customers and secure emergency water using a vertical-type water treatment technology (which is a brand-new concept of compact vertical-structured water treatment design technology).

Water & Sewage Demonstration Plant(WSDP)
B-6

WSDP is a technology to ensure the timely provision of onsite supports with a model plant and test beds, and thereby validate each of various water treatment processes and capacities.

Smart Piping & Operation Technologies

K-water has developed and built *ICT-based water operation systems to acquire, monitor and control all relevant data on a real-time basis from the whole water supply systems ranging from water sources to tap water. The acquired data are analysed in terms of water quantity, water quality and energy management with the help of intelligent water network softwares that enable K-water to supply drinking water without service interruption and formulate an optimal plan to rehabilitate water supply infrastructure.
* ICT: Information & Communications Technology

Diagnosis support

Diagnosis Program

Irrigation diagnosis
• Bloc suitability assessment
• Water leakage and pressure diagnosis
• Water supply capability and water flow speed diagnosis

Water-quality diagnosis
• Residual chlorine forecasting
• Water quality safety assessment

Facility diagnosis
• Pipe state assessment
• Residual lifespan forecasting

Decision making support
• Comprehensive facility assessment
• Priority for pipe replacement
• Long-term and short-term improvement plans

water-NET

Facility operation information
(Linked to the systems like GIS and SCADA)

Tap water information management
• GIS, facility and meter management
• Customer relationship management and water utility bill management

Real-time monitoring and control
• TM : water volume, water influx, water level and water quality
• TM/TC : Valve, pump

GIS and facility D/B

Relational DataBase Management System

SCADA D/B

Operation support

O&M Program

Water quantity & pressure management
• Accounted water rate analysis
• Leakage quantity calculation and monitoring
• Observation on water pressure of each water network block

Water quality management
• Real-time observation on water quality
• Management of abnormal water quality section

Real-time operation optimizing
• Optimization of storage reservoir operation
• Real-time energy observation

Risk management
• Risk Management of interruption in water supply
• Risk Management of water pollution accident

💧 **water-NET (Diagnosis, Operation and Management System for Water Distribution Networks)** B-7
Water-NET is a water network operation system with which it's possible to collect real-time information about waterworks, ensure a GIS-based water network inspection, and manage water quantity, quality and crisis and energy.

💧 **iWater 5(SE) (Standard Water Operating Systems)** B-8
iWater 5(SE) is an HMI system for the supervisory control of all relevant facilities (including intake stations, water treatment plants, booster stations, pipelines, distribution reservoirs, water taps, etc.) at a remote integrated center.

💧 **RWIS (Real-time Water Treatment Information System)** B-9
RWIS is a system to querry and provide real-time operation data about waterworks on a basis of one minute.

💧 **Water-INFOS (Integrated Waterworks Information System)** B-10
Water-INFOS is an integrated waterwork solution for the management of municipal or provincial waterworks, including GIS-based infrastructure management, customer management, tariff policy management, public relation management, etc.

💧 **FCPTT (Flowmeter Calibration & Performance Testing Technology)** B-11
FCPTT is a technology to help with fluid flow performance tests on watermeters, valves, etc. through the precision correction of flowmeters (CMC: 0.08%).

💧 **SCSL(Smart Cleaning & Spray on Lining technology)** B-12
SCSL is a cleaning & spray lining rehabilitation technology for large-diameter water pipes (with D500mm to D1,650mm in diameter) that requires the use of equipment having a structure of polygonal hydraulic cylinder frame.

Customized industrial water treatment technology

Industrial water refers to treated water customized for companies' needs. K-water has enhanced global competitiveness by developing optimal water treatment technologies and saving water production costs with efficient operation and maintenance practices.
K-water has also ensured reliable water supply through linking among regional water supply networks.
※ Customized industrial water treatment : Process to produce and supply water meeting specific quality requirements for industrial sectors.
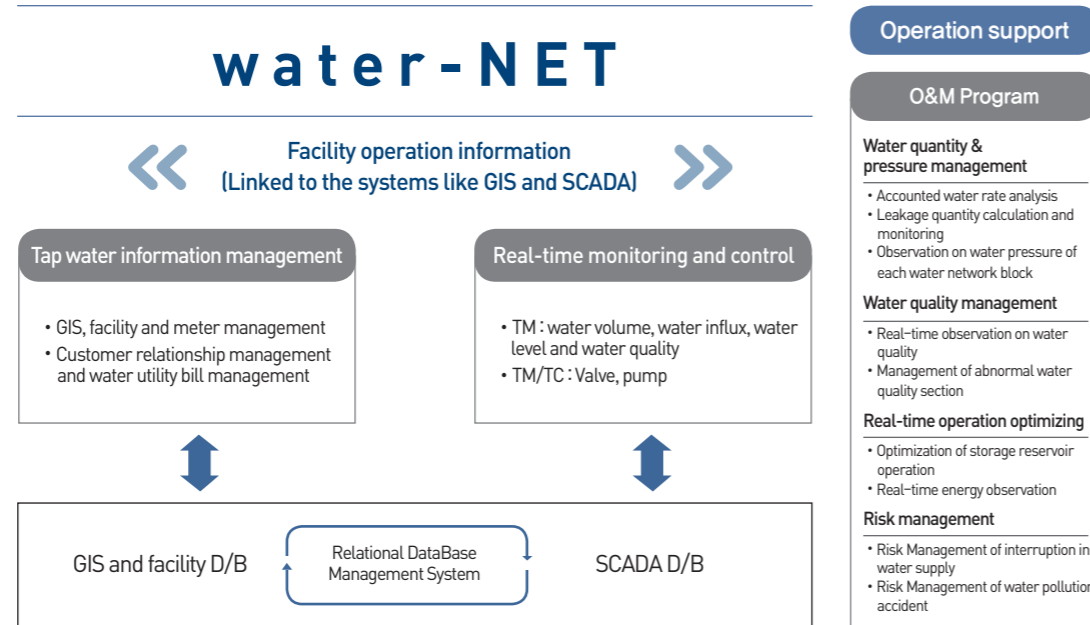
Types and purposes of industrial water

Constituents removed:
SS (Suspended Solid), Organic matter, Nonorganic matter, Inorganic + CO_2, Trace ion + Dissolved oxygen, Micro particles

Water quality classification:
Sedimented water 10^{-6}m — RO water 10^{-8}m — Pure water 10^{-10}m — Ultra pure water

Classification	RO water	Pure water	Ultra pure water
Resistivity*	Under 0.1 MΩ·cm	Under 0.1 MΩ·cm	More than 10 MΩ·cm
Process	Multi-layered filter, carbon adsorption	Ion exchange, CO_2 exhaustion	Dissolved oxygen exhaustion, ultra-filtration
Industrial Field	Steel companies, petrochemical companies	Power generation, automobile, wood pulp	Semiconductor makers, display makers, pharmaceutical firms

* Resistivity : electric resistivity per unit area or unit length

Customized ultra-pure industrial water treatment technology

• Having developed & secured optimal process combination technologies through operating ultra-pure water pilot plants, K-water plans to develop new relevant processes and technologies until 2016.

Efficient wastewater treatment & operation technology

K-water has developed and built an integrated water cycle management system by constructing and operating sewerage infrastructure upstream of dams to enhance public benefits.
K-water has also tried to maximize the synergetic effects of its own businesses by participating in a build-transfer-lease program, and thereby develop into a world-class company dedicated to water resource management.

💧 **KSMBR (K-water Ssangyong Membrane Bio-Reactor)** B-13
KSMBR is an advanced wastewater treatment technology to maximize the utilization efficiency of organic matters with an aeration/non-aeration parallel swing reactor and a microfiltration membrane.

💧 **Dr. Wastewater (Self-Diagnosis & Management System for WWTP)** B-14
Dr.Wastewater is a web-based self-diagnosis wastewater operation & maintenance system with which it's possible to predict the water quality of inflow and outflow on a real-time basis, and thereby manage wastewater treatment processes.

Status of water supply infrastructure

K-water has continued its efforts to ensure reliable water supply by successfully building a water supply system considering water cycle.

Raw water, filtered water and treated water

K-water has supplied water for 22.23 million people all over the country through 48 regional & industrial water supply networks, 41 WTPs, and 5,090 km water networks.

* K-water is responsible for 48% of domestic tap water supply.

Industrial water

K-water has provided industrial water for six major industrial complexes, including Hyundai Steel, and Seosan and Daesan industrial complexes, which is customized for each company's needs for water quality. It has also strived to become the nation's top industrial water supplier by developing high-efficient, low-cost water treatment process technologies and securing optimal operation and management technologies.

* K-water is responsible for 63% of the domestic industrial water market

Seawater desalination for island areas

K-water is commissioned to operate 39 seawater desalination plants (1,800 ㎥/day) in eight provincial areas to ensure better water welfare for those living in the isolated island areas. This shows K-water's efforts to provide healthy water for everyone.

Wastewater treatment

K-water has built 12 WWTPs (wastewater treatment plants) around the country in an effort to improve the quality of river water, improve the public's sanitary conditions and living environment. Also, it has been implementing projects to expand the integrated operation of drainage systems (upstream of dams), along with projects to operate and maintain provincial water supply infrastructure, which is how K-water has improved water management efficiency and benefits.

Improvement of water supply pipes
(at the first phase for the metropolitan areas, Length = 53.9km, Diameter = 800 to 2,800mm)

Removal of the residual painting materials

Surface treatment

Lining of the insides of the pipes

Examining of lining condition

WONDER**FUL**
WORLD

Patrind water power generation
project in Pakistan

With Overseas projects,

K-water will always be there anywhere
someone needs its advanced water
management technologies in the world.

K-water will always be there anywhere you can see water development projects underway in the world.
K-water will always be there as a powerful engine to make the world's dream come true.
K-water will always be there anywhere someone needs its advanced water management technologies
in the world.

Overseas
projects

Change the
world

With water
technologies!
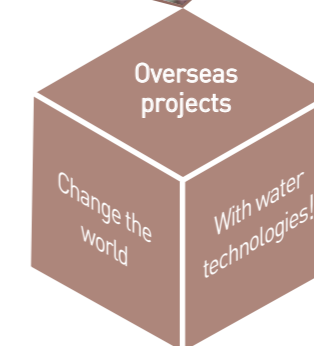
Overseas Projects

Beginning with a survey of the Fenhe River in Shanxi Province in China in 1994, which is the first project ever implemented by K-water in the overseas market, K-water has accumulated its own expertise and technologies, public trusts and global networks in the water industry for the last half century. Based on such achievements and know-how, it has continued its efforts to provide a total water solution over the whole process of water cycle for the world, and ultimately enrich the world with water.

K-water will take a great leap forward the world based on its own so-far achievements in the onshore market.

Currently completed
: 54 projects over 23 countries
 since 1994

Completed projects

Currently underway
: 17 projects over 12 countries

Underway Projects

Status of major overseas projects

K-water's integrated water management projects can be found all over the world it has built dams and HEPPs (hydroelectric power plants), and has proceeded with other many projects around the world for the development & operation of water supply infrastructure for beneficiary countries to improve their people's quality life, which, in turn, will be the driving engine for their respective industrial development.

HEPP (Hydroelectric Power Plant) Projects

Pakistan Patrind HEPP BOT Project
· Installed capacity : 150MW
· Project costs : USD 436 million
· Project period : 34 years
  (December 2012 to January 2047)
 – Four years for construction and 30 years for operation and maintenance
· Location : AJ&K, Pakistan
· January 2017, Commercial operation to be launched

Angat HEPP Project in the Philippines (M&A)
· Installed capacity : 218 MW
· Project costs : 469 mil. USD
· Project period : 50 years
  (November 2014 to October 2064)
· Location: Bulacan, the Philippines
· November 2014, Commercial operation launched

Waterworks Projects

Consulting on NRW Reduction in Water Supply Infrastructure in Yanji
· Installed capacity : 160 thousand ㎥/day
· Project costs : USD 17 million
· Project period : 5 years
  (December 2014 to December 2019)
· Location : Jilin Sheng, China

IWRM projects

· IWRM projects in Cambodia, Peru and Myanmar (currently underway)
· IWRM projects in Thailand and Algeria (relevant negotiation with their respective governments is currently underway)
 ※ K-water was awarded as a preferred bidder for Thailand IWRM Project in June 2013

IWRM projects in Cambodia

IWRM Projects in Algeria

MOU with Peru,technical cooperation in the water resources management

Index of Appendices

RHDAPS

Real-time Hydrological Data Acquisition & Processing System

A-1

Overview

RHDAPS is a customized portal system based on web-DB to acquire, transmit, store and process real-time hydrological data (e.g., precipitation, water level, inflow, etc.), and thereby produce & supply quality data, including basic data for flood analyses and other visual data. This system is also equipped with the function of alarming against any emergency situations (e.g., a sudden rise in water level) via SMS, pop-up window, etc.

Configuration

Features

- Acquires & produces real-time hydrological data
  - Ensures stable operation with wide range satellite communication technologies
  - Collects hydrological data for relevant organizations
- Stores & processes DB about dams & weirs
  - Stores hydrological data into DB
  - Enables the quality management of hydrological data
- Displays & provides hydrological data
  - Displays hydrological data for decision-making support
  - Provides real-time data about the status of dams & weirs, including image data

Functions

Functions to acquire & produce real-time hydrological data

- Calls & processes hydrological data
- Allows interface among different kinds of systems and processes data

Functions to store & process hydrological data

- Collects & processes data at intervals of 1/10/30/60 minutes
- Calculates dam-related data and provide a transmission module

Functions to display & provide hydrological data

- Provides hydrological data about the status of dams & weirs around the country
- Provides a situational alarm along with hydrological images
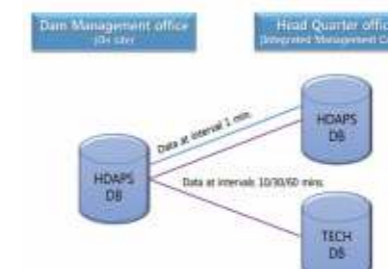
Effects

- Possible to acquire quality data through improving the stability of system operation
- Possible to enhance capacity for disaster management through ensuring the real-time analysis of hydrological data (e.g, water level, precipitation, etc.) and providing efficient decision-making supports

Applications

- 2003 : Applied to the operation of nationwide dams & weirs based on web-DB
- 2010 : Applied to the integration of image data and the improvement of display functions
- 2013 : Applied to the provision of status data about weir gates and the improvement of operator-specific functions
- Applied to the operation of K-water's hydraulic facilities & structures, including 17 multi-purpose dams, 14 dams dedicated to water supply, 16 weirs, etc.

A-2

Riverflow Measurement Technology

RMT

Overview

RMTs, which include multi-depth flowmeters, microwave surface velocity meter and gyro ball, are technologies to acquire reliable basic water resource data, and thereby perform relevant surveys in a timely manner

Configuration

Gyro ball for tracking the behavior of water body

Microwave surface velocity meter   Multi-depth flowmeter

Features

- Gyro ball
  Calculates 3-D flow velocity and travel distance, compare between gyroball flow velocity and measured flow velocity, and determine correlations among depth, temperature and flow velocity
- Microwave surface velocity meter
  Measures flow velocity on water surface from a difference between signals (Doppler frequency) sent and received from flow movement on water surface
- Multi-depth flowmeter
  Measures 3-point flow velocity at any given time through securing equal-ratio water depth based on the pulley principle

Functions
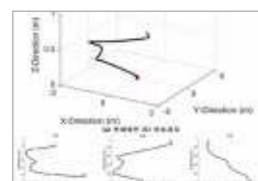
| Gyroball | | Microwave surface velocity meter | | Multi-depth flowmeters |

- Gyro ball : Functions to calculate 3D velocity and relative travel distance by calculating & integrating the accelerations of each axis, and post-process and visualize data with GUI
- Microwave surface velocity meter : Functions to resolve problems (that come from the risk of damages against rotational flowmeters, errors in measuring flow velocity with floats, a need to mobilize multiple personnel, etc.) through non-contact measurement methods, which, in turn, will make it possible to conveniently measure flow velocity even in case of flood
- Multi-depth flowmeter : Functions to save measuring time and reduce uncertainty by applying a simultaneous 3-point flow velocity measurement method

Effects

- Gyroball : Possible to track a river's 3D flow velocity, identify the point of flow stagnation, and thereby predict the point of water pollution
- Microwave surface velocity meter : Possible to regularly monitor flood discharge with an unmanned real-time flood measurement system
- Multi-depth flowmeter : Possible to save measuring time by 33~50%, and reduction uncertainty by up to 54%

Applications

- Applied to the measurement of flow velocity in a river (K-water, university labs, government organizations, etc.)

A-3

M-WAS

Mobile Water Analysis System

Overview

M-WASs are multi-purpose river Hydrological survey vehicles used to conveniently accommodate and transport such river survey equipment or instruments as flowmeters, suspended load samplers, S-boats, etc.

Configuration

Features

- Timely produces outputs by mobilizing mid-to-high speed flowmeters and suspended load samplers with a crane
- Possible to accurately moves & adjusts survey equipment with special devices (e.g., weight sensor, winch, etc.)
- Easy to accommodate relevant survey equipment thanks to a sliding platform
- Equipped with a portable refrigerator to prevent any pollution and alteration in specimen for water quality analysis

Functions

| Relevant equipment & tools |

[Medium-high speed flowmeter]   [Microwave surface velocity meter]   [ADCP]   [suspended load sampler]

| Storage of speciment for water quality analysis | | Status view of surveys performed using a crane |

Effects

- Possible to improve the applicability & safety of survey equipments under various river conditions
- Possible to improve the storage & utilization of various survey equipment
- Possible to save traveling & measuring time
- Convenient to perform surveys at night time thanks to water depth and water surface detection sensors
- Possible to appropriately store samples as per a water pollution process test method.

Applications

- Applied for hydrological surveys required to operate K-water's dams and weir
- Applied to survey the status of salt damages, riverbed variation, etc.

HOPTC

## Hydrological Observation Performance Test Center

A-4

Overview

HOPTC is a proven performance test center with capabilities to perform overall performance tests on hydrological monitoring systems in terms of their performance, compatibility, applicability, reliability, etc.

- Develops a standard verification system through standard guidelines to performance tests
- Conducts the calibration of rainfall gauge and stage meters
- − Builds a world−class scientific facility management system
- − Supports the building of integrated flood disaster management system
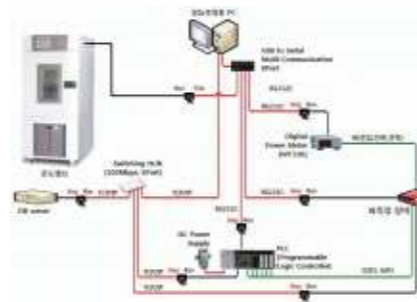
Configuration
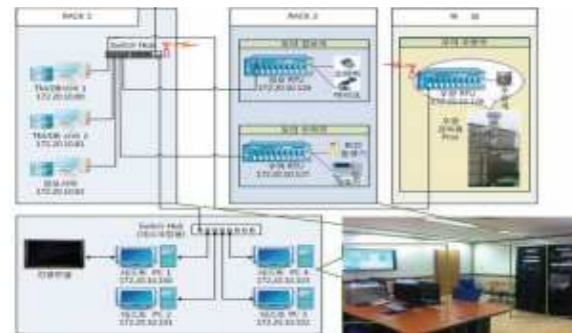
Features

Components	Performance tests
Gauging system	· Determine the measurement uncertainty of rainfall gauges, stage meters, etc.
Communications system	· Satellite, LAN, WiFi, Zigbee, etc.
Warning system	· Sound pressure test, sound collection test, etc.
R T U	· Protocol, applicability of new systems, etc.
Server	· CPU, memory service rate · Compatibility tests with other models
S / W	· Applicability, installment procedure
Miscellaneous	· Solar photovoltaic power, battery charge/discharge tests · Limit tests on facilities (data, environment)

Functions

Functions to monitor performance tests on a real−time basis

- Monitors real−time test data with a performance test program and builds DB

Functions to calibrate rainfall gauges

- Calibrates rainfall gauges in a calibration room or on an onsite basis / issues an onsite calibration certificate

Functions to calibrate stage meters

- Calibrates stage gauges in a calibration room / issues an onsite calibration certificate
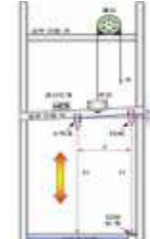
Effects

- Contributes to the improvement of data reliability
- Used for the development of next−generation water management infrastructure markets & role models
- Allows the building of feedback system: Technical supports, training supports, PR activities, etc.

Applications

- Applied to the in−depth examination of the central control center for satellite communications network (HQ, Gunnam) (2013 to 2014)
- Applied to the analysis of RTU electricity consumption and limit temperature tests (2014)
- Applied to the calibration of gauges at 177 lots, including Inje Rainfall Gauging Station in the Soyang R. Dam (once every 3 years)

K−HIT

K-water Hydro Intelligent Toolkit

A-5

Overview

K-HIT is a decision support package converged with advanced ICTs and linked with individual water management technologies, which will ensure flood control & reliable water supply and monitoring of real-time data

- RHDAPS (Real−time Hydrological Data Acquisition and Processing System)
- PFS (Precipitation Forecasting System) : K−PPM (for short−term predictions), CAM (for long−term predictions)
- FAS (Flood Analysis System) : COSFIM (Coordinated dams analysis), K−DRUM (Distributed Rainfall Runoff Model)
- RWSS (Reservoir Water Supply System)
- GIOS (Generation Integrated Operational System)

Configuration
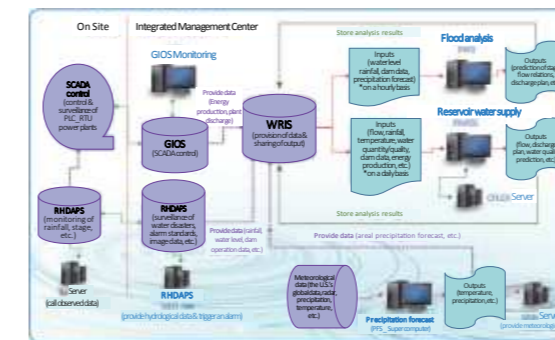
Features

- IWRM (Integrated water resource management) technology based on know−how accumulated by K−water through 40 years of water management development and application practices
- Allows scientific analyses and predictions with ICTs for rainfall prediction, hydrological data management, disaster alarm, flood analysis, water supply, electricity generation, etc.

Functions

- RHDAPS
  Remote call & control of hydrological data, development of DB with real−time hydrological data, web−based monitoring of real−time hydrological data
- PFS
  Long− and short−term weather forecasting for target dam & weir watersheds
- FAS
  Hydrological flood analysis, multi−dimensional rainfall−runoff analysis, integrated hydraulic & hydrological analysis
- RWSS
  Estimation of rainfall & runoff, linked operation of dams & weirs, river flow analysis, river water quality analysis
- GIOS
  Real−time remote surveillance & control

Effects

- Rainfall prediction → data acquisition & management → flood control & water supply → integrated management of hydraulic structures & facilities (e.g., dam, weir, flood control reservoir)
- Contributes to improve the reliability of water supply through minimizing flood and drought damages with scientific water management practices
- Allows the linked operation of dams & weirs
- Allows the production of quality, clean energy

Applications

- Applied to the operation of K−water's hydraulic facilities & structures, including 17 multi−purpose dams, 14 dams dedicated to water supply, 16 weirs, etc.
- Applied to integrated flood disaster management projects for municipal & provincial governments (Namweon, Muju, Gunsan etc.)
- Scheduled to develop & build integrated dam operation system in Algeria

K-PPM

K-water Precipitation Prediction Model

A-6

Overview

K-PPM is a short-term precipitation prediction model to produce long- and short-term quantitative precipitation prediction data optimized for physical environment (e.g., detailed topography of the target dam watershed) by subdividing the nation into lots of grids with a size of 3㎞ × 3㎞, which compared with a long-term precipitation prediction model, CAM

- Produces 5-day (120-hour) prediction data 4 times per day with a 3km x 3km high-resolution model, which is composed of 10 ensembles
- Provides quantitative precipitation prediction data for 58 areas (including dams, weirs, etc.) nationwide
- Provides 10 kinds of real-time input data (including precipitation, temperature, humidity, etc.) required for water quality & hydraulic prediction models

Configuration
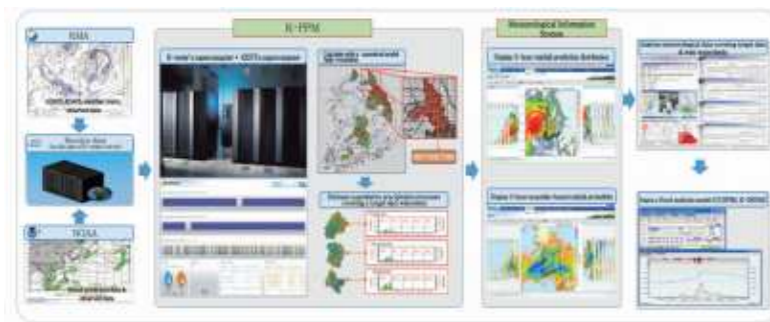
Features

- Improves accuracy considering the complex topography of specific dam watersheds (covering mountains, valleys, etc.) through developing a 3㎞x3㎞ high resolution model
- Timely produces data easy to use through building a supercom-based automation system
- Remedies uncertainty in weather prediction data through simultaneously operating 10 models as per an atmospheric physical equation

Functions

- Functions to query 5-day weather prediction data at different altitudes at intervals of 3 hours
- Functions to produce & analyze GIS-based 5-day precipitation prediction data
- Functions to predict some 60 meteorological variables, including precipitation, temperature, humidity, air pressure, insolation, etc.

Effects

- Contributes to the maximization of power generation revenues &, storage through helping make a decision about the proactive, flexible operation of target dams with 5-day precipitation prediction data
- Minimizes flood damages through helping making a decision about dam discharge in a timely, accurate way
- Improves the accuracy of 5-day precipitation prediction data through installing ultra-short-term & data assimilation modules

Applications

- Applied to the meteorological prediction of 58 basins nationwide, including 17 multi-purpose dams, 14 dams dedicated to water supply, 16 weirs, etc. managed by K-water
- Applied to the "Proposal of Thailand Weather Prediction System in the integrated water management module of Thailand IWRM Project"
- Applied to the real-time production and provision of input data for flood & water quality analysis models

CAM

Community Atmosphere Model

A-7

Overview

CAM is a global weather prediction system to quantitatively predict 1-month precipitation on a daily basis for each of target basins and produce 3-month seasonal weather forecasts required to formulate a reliable water management & supply plan

- Produces & provides 3-month quantitative precipitation prediction data
- Produces & provides 1-month quantitative precipitation prediction data from down-scaled 50㎞x50㎞ data (consisting of 10 ensembles)

Configuration

| GCM | | Down-scaling & statistical analysis |

| Production of monthly daily precipitation at a basin level | | Applied for water management |
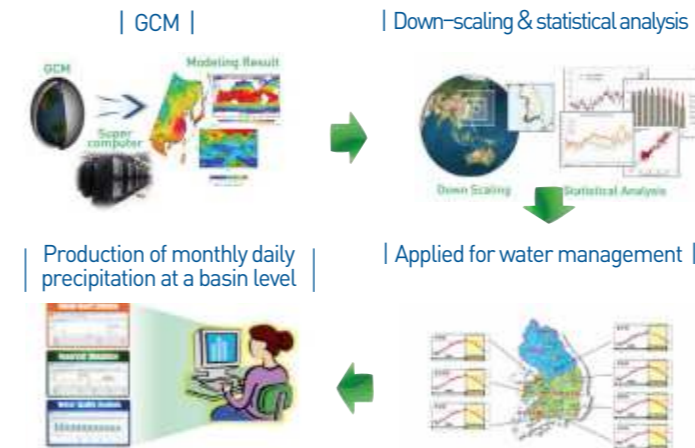
Features

- Produces 3-month prediction data with a horizontal resolution of 50km and 30 stories in vertical level using CAM as developed by the U.S. NCAR
- Produces 1-month daily precipitation data using SSM (Slice Step Method), which is a combination of the down-scaling and statistical methods
- Reduces uncertainty in meteorological predictions by applying mean values as estimated from trying a model 10 times based on a time difference

Functions

Upper and Lower Level Fields   Temperature and Precipitation
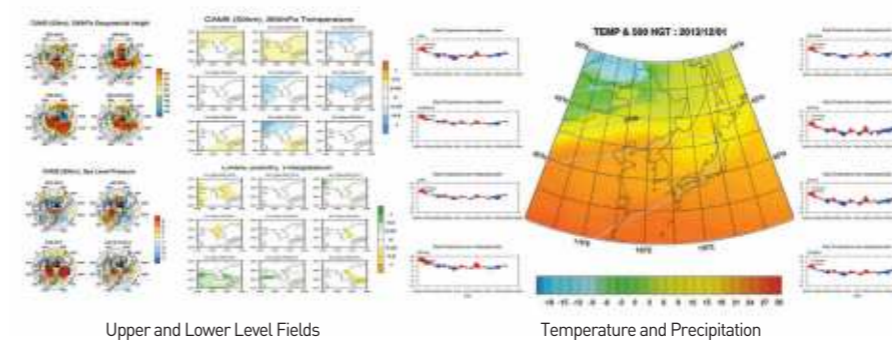
- Functions to produce a deviation degree of monthly, quarterly upper-level circulation, precipitation and temperature
- Functions to produce monthly precipitation and temperature estimates for multipurpose dams
- Functions to produce 3-month weather forecast charts covering East Asia
- Functions to produce 36 global meteorological variables, including precipitation, temperature, etc.

Effects

- Contributes to the prevention of damages from algal bloom, flood and drought through providing quantitative precipitation prediction data by basin
- Maximizes power generation and water supply using long-term precipitation prediction data
- Secures infrastructure to develop offshore projects through verifying outputs and advancing the system

Applications

- Applied to the production of quantitative precipitation prediction data by basin to formulate a reliable water management & supply plan
- Applied to the production of seasonal precipitation prediction data (Korea Meteorological Administration's Long-term Prediction Experts Conference)
- Applied to the production of summer weather prediction data (Korea, China and Japan Long-term Prediction Experts Conference)

COSFIM

Coordinated Operation System for Flood control In Multi-reservoirs

A-8

Overview

COSFIM is a basin-wide integrated flood analysis & decision support system to track hydrological status and predict precipitation on a real-time basis, which is compared K-DRUM is a distributed basin-wide runoff analysis model

- Timely produces basic data through ensuring real-time linkage to DB
- Helpful in improving accuracy and applicability   • Helpful in saving time required for decision-making by intuitively displaying analysis results
- Intellectual properties : COSFIM

Configuration

| COSFIM(Coordinated Operation System for Flood control In Multi-reservoirs) |

Features

- Equipped with functions to perform a hydrological flood analysis with a storage function method and a simulated operation of dams and weirs
- Equipped with functions for a hydraulic analysis of river and reservoir surface shape through automating linkage with hydrological analysis results
- Helps make a decision about discharge through evaluating impacts on the upper and lower river on a real-time basis (real-time linkage to DB)

Functions

| Hydrological flood analysis |
- Estimates floods & reviews reservoir operation
- Analyzes the effects of linkage among flood, dams and weirs in terms of flood control

| Hydraulic flood analysis |
- Analyzes the impacts of flood on the lower river in case of dam discharge
- Performs a flood routing analysis considering tidal level at an estuary

| Simulated flood analysis |
- Performs a flood analysis of virtual meteorological data
- Make an objective evaluation of flood analysis results

Control point 3   Control point 1
Control point 2
Control point 4

Dam 1
Dam 2

Hydrograph at control point in case of zero discharge

Simulated operation & optimization

Calculation of conveyance at the target control point
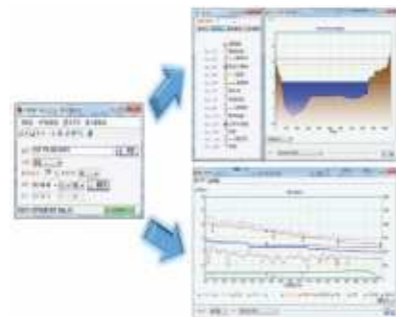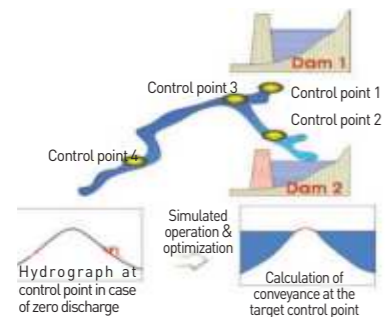
Effects

- Contributes to reduce social, economic flood damages by lowering FWL through the linked operation of dams and weirs
- Contributes to the minimization of flood damages in the upper & lower river through ensuring the efficient linked operation of dams and weirs within a river system

Applications

- Applied to the development of an analysis model for target dams, weirs and basins and flood management practices
- Applied to the provision of technical supports for Algeria, the Philippines, etc. (as through building a flood analysis model and a simulation system)
- Applied to the provision of technical supports for municipal and provincial governments' integrated flood disaster management projects (as through developing a flood analysis model and monitoring standards)

K-DRUM

K-water Distributed Rainfall Runoff Model

A-9

Overview

K-DRUM is a distributed runoff model based on physically subdivided grids to survey and analyze basin runoff, suspended sediments and other water quality parameters

- Divides a specific basin into multiple grids, apply various physical characteristics (e.g., topography, soil, vegetation, etc.), and then calculate infiltration (from rainfall and other basin circumstances), surface flow, groundwater flow, evapotranspiration, snow-melt, sediments, water quality, etc. with a numerical analysis method
- Estimates normal runoff with an automated system to use meteorological prediction data

Configuration

Grid Based Rainfall Runoff Model   GIS   Radar

Analysis each Grid
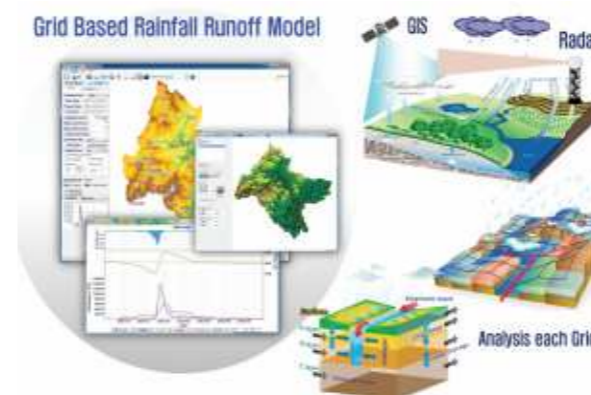
Features

- Possible to build a completely automated system with the application of physical parameters and the initial soil moisture auto-calibration method
- Possible to perform a run-off analysis on an unmeasured basin with high accuracy
- Possible to perform a long-term runoff analysis on a large-scale basin with application of the MPI-based parallel computing method
- Possible to consider localized stormwater through inputting point rainfall data and high-resolution spatial distribution rainfall data
- Possible to analyze the behavior of sediments considering rainfall and flow energy

Functions

- Auto-calibration method (automation, systemization), PC-based analysis method (user-friendly GUI), server-specific system (normal runoff prediction system)
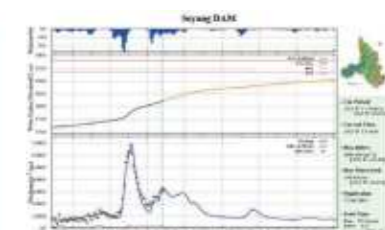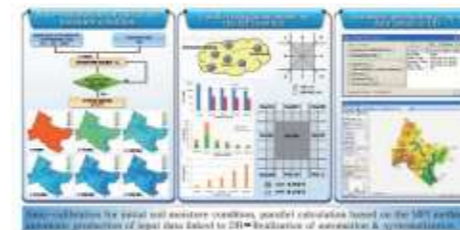
Effects

- Possible to perform short- and long-term rainfall-runoff & sediment analyses and save simulation time with a parallel computing technique
- Leads integrated basin analysis & prediction automation technologies
- Possible to acquire quality runoff data with high accuracy through improving a basinwide rainfall processing method
- User-friendly thanks to linkage to K-water's DB
- Equipped with evaluation technologies for unmeasured basins and newly developed basins

Applications

- Applied to the operation of a normal runoff prediction system linked to K-PPM (17 multi-purpose dams and 14 dams dedicated to water supply)
- Applied to the estimation of runoff and sediments required to survey dam sediments
- Applied to the development of one-stop water management system linked with KMA's LDAPS
- Introduced into the Pakistan Patrind HPP Project (long-term runoff pattern analysis); and applied to the estimation of evapotranspiration and soil moisture content (2014) in the target sub-basins of the Yongdam Dam watershed

RWSS
Reservoir Water Supply System

A-10

Overview

RWSS is an integrated water resource management system to estimate optimal discharge for ensuring linkage among target rivers, dams and weirs considering expected flow into each of them and water demand within the same water system, and thereafter apply the optimal discharge estimates to a water budget analysis model and a water quality analysis model for estimating discharge availability at the event of water pollution and analyzing the effects of water quality improvement.

Configuration

Features

- Serves as an integrated solution in which various water supply analysis models are combined
  - Consists of rainfall-runoff model, irrigation reservoir-linked module, water budget analysis model, water quality analysis model, etc.
- Controls inputs and outputs through developing a user-friendly phased GUI by each model
- Allows real-time linkage among meteorological data, river discharge data, dam or weir operation data, water quality data, etc.

System Connection

| Procedure for the integrated, linked simulation of water supply system |
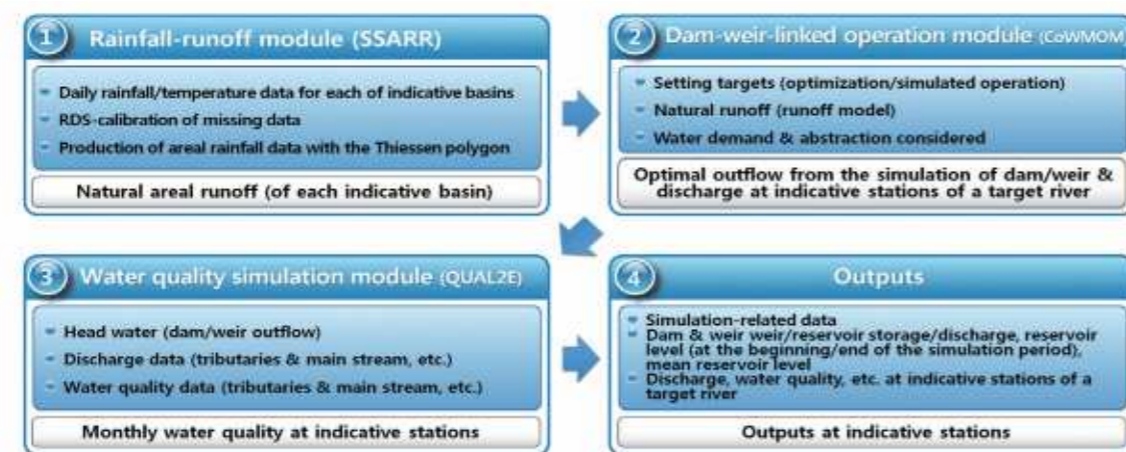
Functions

| Integrated simulation environment |
- Provides user-friendly integrated simulation environment

| Rainfall-runoff model |
- Estimates runoff for each of typical basins with a long-term runoff analysis

| Dam-weir-linked operation mode |
- Performs a simulated dam-weir operation and an optimization analysis

| River water quality analysis |
- Simulates river water quality with the presence of dams or weirs

Applications

- Applied to the development of a dam-weir-linked operation plan for each water system considering expected flow into hydraulic structures and irrigation reservoirs in target river systems and water demand
- Applied to the estimation of available discharge capacity in case of water quality threats and algal bloom and the analysis of the effects of water quality improvement

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GIOS
Generation Integrated Operation System

A-11

Overview

GIOS is an integrated operation system used for the real-time remote supervisory control of dam & weir generation, transmission and distribution systems and gates, and the production & provision of relevant data covering overall operation status and other statistical analysis data

- Ensures efficient water management decision making supports through providing data about the status of power generation and other statistical data
- Multiplexes major servers and networks to improve system reliability
- Manages malfunction logs for each of target facilities & structures, allows real-time alarm monitoring, and ensures data linkage among systems

Configuration

| Powerhouse |
- Surveillance & control of onsite facilities
- Configuration of RTU for control & data acquisition

Surveillance & control system

9 multipurpose dams & 16 weirs (HPPs)

| Water Resources Operations Center |
- Integrated operation, surveillance and control of target facilities & structures
- Data monitoring & analysis

Features

- Dualizes surveillance control and data storage
  - Minimizes data loss and maintain surveillance & control functions through automatic switchover at the event of any failure or malfunction
- Develops a multiplexed communications network
  - Multiplexes WAN zones (2 wired/1 wireless)
  - Dualizes LAN zones (dualized structure of router & switch)
- Applies a standard connection method
  - Select major information communications infrastructure
  - Periodically inspect & address system weaknesses
  - Develops a cyber attack response system
- Certificed as GS (Good Software) by TTA

Functions

| Real-time surveillance & control |
- Integrated remote surveillance & control of generation & substation facilities and gates in 9 multipurpose dams nationwide and generation & substation facilities in 16 multifunctional weirs

| Malfunction monitoring |
- Triggers an audio visual alarm when an alarm is needed
- Transmits an SMS message by level and manages alarm history

| System security |
- Prevents virus & cyber intrusion with Anti-Virus, IP(AMC), firewall, resource management system, one-way transmission device, integrated log-in management system, etc.

Effects

- Helpful in improving productivity through the optimal control of energy generation
- Helpful in saving production costs through ensuring unmanned remote generation surveillance & control
- Possible to improve the reliability of facilities thanks to a remote surveillance & control system

Applications

- Applied to the development of integrated operation system for 9 multipurpose dams (large hydropower) (April 2012)
- Applied to the remote integrated operation of 16 weirs (small hydropower) (May 2012)
- Applied to the remote integrated operation of Sihwa Tidal Power Plant (January 2013)
- Applied to linkage between the integrated mid- and small-scale dam operation system to HQ (December 2014)

K-FAT

K-water Frequency Analysis Tool

A-12

Overview

K-FAT is a tool with which it's possible to acquire & preprocess hydrological data online and make frequency analyses of flood and drought through estimating 14 types of probability distributions, perform a goodness-of-fit test and determining an optimal probability distribution.

Configuration

Features

- Capable for the batch processing of hydrological data at various points
- Pre-processes raw data of various types
- Provides GIS-based visualization functions at multiple analysis points

Functions

Functions to pre-process raw data

- Functions to pre-process K-water's own DB, Excel data, text data, KMA's raw data, etc.
- Functions to visually display outputs before and after preprocessing (e.g., graph or chart)
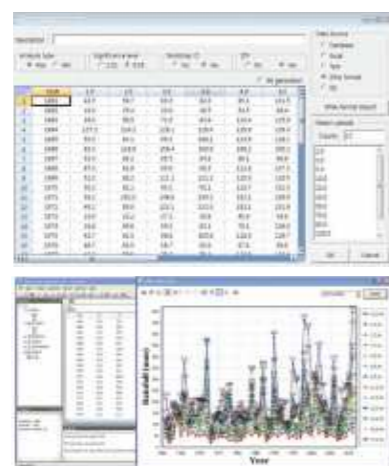
Functions to perform a flood & drought frequency analysis

- Functions to perform calculations with a frequency analysis module
- 14 probability distribution models; estimation of 3 parameters; 5 goodness-of-fit tests; calculation of uncertainty, etc.

Functions to display various analysis results

- Functions to select an optimal probability distribution model with MRD, LMRD, etc.
- Functions to produce histogram, IDF curve, etc.
- Functions to display multi-point analysis results on GIS
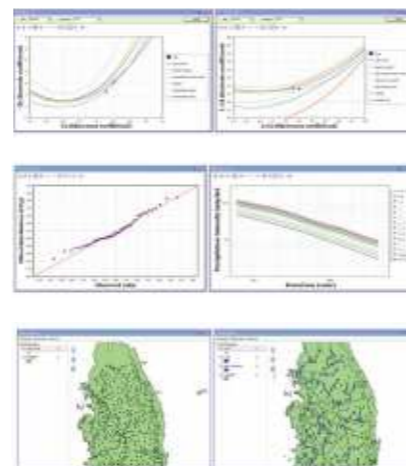
Effects

- Possible to use 14 types of probability distribution models and a frequency analysis timely and accurately
- Possible to perform a simultaneous analysis of hydrological data at multiple points with high efficiency

Applications

- Applied to the development of design & operation standards for various kinds of hydraulic infrastructure assets (e.g., dams, river banks, storm sewers, etc.)

WRIS

Water Resource Integration System

A-13

Overview

WRIS is a system to support & ensure the integrated operation & maintenance of dams and weirs using 6 kinds of data, including meteorological data, hydrological data, water quality data, dam water management data, dam safety management data, and power generation data.

Configuration

Features

- Provides relevant services (e.g., rainfall prediction, weather chart covering specific dam watersheds, etc.) with K-water's own meteorological prediction models
- Supports the integrated management of water resource operation information about target dams & weirs
- Shares operational status data through linking among real-time measured data about target dams & weirs & supports decision-making
- Shares data among relevant organizations (e.g., MOLIT, MOE, KPX, etc.)

Functions

| Meteorological information |

- Provides 『meteorological information』 (e.g., weather chart, rainfall prediction, etc.)

| Hydrological information |

- Supports overall decision-making through collecting 『hydrological information』 (e.g., inflow, discharge, energy production, storage, water level, rainfall, etc.)

| Water quality information |

- Manages pollutants and other environmental factors that affects 『water quality』

| Dam safety |

- Ensures the 『safety management』 of various hydraulic infrastructure assets

| Dam water sales |

- Manages 『dam water sales』 for water supply plan, contract management, monthly reading, billing,, etc.

| Overall management of power generation |

- Supports the overall management of 『power generation practices』 related to power generation plan, bidding process (KPX), power operation, etc.

Effects

- Improves data reliability through ensuring the integrated management of water resource information & supports timely decision-making
- Shares meteorological data among relevant organizations (e.g., KMA, GFS etc.) and ensure proactive risk response through K-water's own meteorological prediction system
- Ensures efficient water quality management through managing pollutants and ecological environment
- Monitors safety threat factors to hydraulic infrastructure
- Ensures the systematic management of dam water supply

Applications

- Applied to the provision and utilization of hydrological data covering 17 multipurpose dams, 14 dams dedicated to water supply, and 16 weirs
- Applied to the development & operation of real-time surveillance system through linking among embedded gauges in 31 dams and 16 weirs nationwide
- Applied to the testing of 41 kinds of water quality items for each of 109 water quality measurement points and the utilization of the outputs

WRSMS
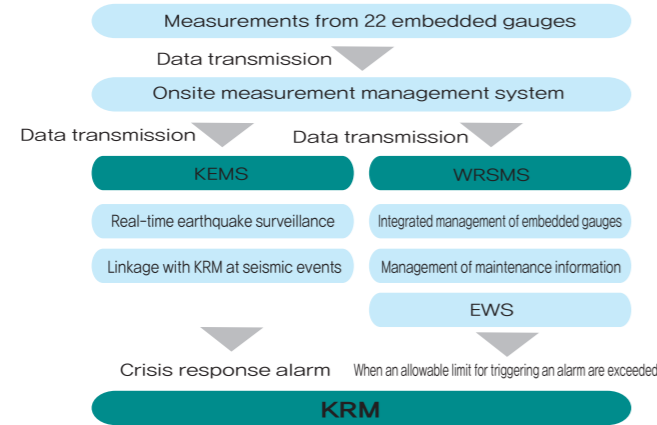## Water Resources Safety Management System

A-14

Overview

WRSMS is a system to trigger an early warning against any emergency situation through monitoring & analyzing information about the maintenance records of hydraulic infrastructure assets (in terms of regular inspection, repair and reinforcement) and nation-wide seismic events, and thereby ensure their safety management

- EWS (Early Warning System)
- WRSMS (Water Resources Safety Management System)
- IESS (Integrated Earthquake Surveillance System)

Configuration

Measurements from 22 embedded gauges

Data transmission ▼

Onsite measurement management system

Data transmission ▼   Data transmission ▼

KEMS	WRSMS
Real-time earthquake surveillance	Integrated management of embedded gauges
Linkage with KRM at seismic events	Management of maintenance information
	EWS

▼

Crisis response alarm   When an allowable limit for triggering an alarm are exceeded

KRM

Features

- WRSMS
  - Manages embedded gauges
  - Manages repair & maintenance plans and results
  - Monitors real-time measured data
- EWS
  - Functions to build a timely onsite inspection system when any abnormal readings are detected
- IESS
  - Allows the real-time monitoring of seismic events

Functions

Water resource safety management system

Management of embedded gauges	Management of inspection	Management of Repair & maintenance
• Measurement &opinformation • Real-time measurement information • Early warning (external displacement, seepage)	• Management of inspection plan • Management of inspection results • ICT-based onsite safety inspection	• Repair & maintenance plan • Repair & maintenance results

Early warning system

Management of embedded gauges		Management of inspection		Management of Repair & maintenance
• External displacement measuring system • Seepage measuring system	Data	• Detection of abnormal readings	SMS	• System & onsite inspection/response

Integrated earthquake surveillance system

Ensures the real-time monitoring of seismic events and the sharing of status data among relevant organizations

Effects

- Used to assess mid- & long-term dam stability through accumulating basic data
- Possible to systematically manage hydraulic structures & facilities through providing space dedicated to safety management
- Contributes to the improvement of the safety management of dam structures with remote monitoring & automation technologies against natural disasters and dam aging

Applications

- Applied to the operation of K-water's various hydraulic structures & facilities, including 17 multipurpose dams, 14 dams dedicated to water supply, 16 weirs, etc.

KEMS
K-water Earthquake Monitoring System

A-15

Overview

KEMS is a system with which it's possible to receive & analyze real-time information about seismic event through ensuring the integrated management of seismometers at hydraulic structures (dams and weirs) and spread & share information about any emergency situation in a timely manner

- Status of installed seismometers
  - Installed in 17 multipurpose dams, 14 dams dedicated to water and 16 weirs, Nakdong R. Estuary Barrage, Gyeongin Ara Waterway, Sihwa Tidal Power Plant, etc., and monitored on a real-time basis
- Supports timely crisis response (Inland M4.0, Ocean M4.5) through automating linkage to K-water's KRM
  - Response procedure : Inform about the outbreak of an earthquake → Emergency inspection (within 3 hours) → Confirmation inspection (within 6 hours) → In-depth inspection (within 24 hours, if required)

Configuration
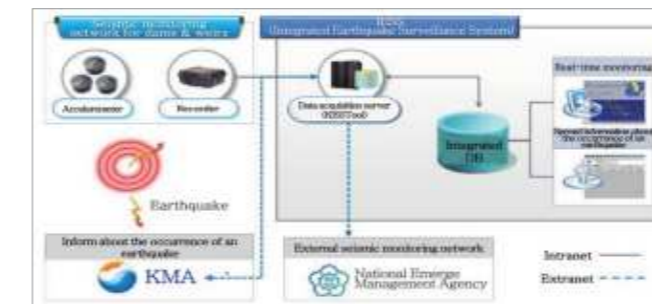
Features

- Ensures the integrated management of seismometers:
  - Integrated management of information from seismometers (location, quantity) installed at all sites
  - Manages inspection history (initial inspection, regular inspection)
  - Transmits SMS messages to POCs automatically when any abnormal readings are detected
- Informs about earthquake information:
  - Timely informs applicable facility managers about the outbreak of an earthquake through ensuring linkage to KMA

Functions

- Automates linkage with KRM
- Creates a damage status report at seismic events
  - Automatic creation of seismic response analysis results
- Surveillance of all relevant sites at seismic events
- Real-time monitoring (seismic wave form, etc.)

Effects

- Possible to identify the status of earthquake damages an early stage of earthquake through enabling the timely detection of its outbreak
- Possible to share earthquake information among relevant organizations through ensuring linkage to the MPSS

Applications

- Applicable to national critical infrastructure (e.g., reservoirs, dams, gas utilities, nuclear utilities (KHNP), express railroads), substations, etc.) and other facilities or structures where seismometers are installed as per Article 5 of the Enforcement Ordinance of the Earthquake Disaster Response Act

D-SMART

Evaluation tool for risk-based dam safety management

A-16

Overview

D-SMART is a DSS (decision support system) to determine risk factors in which the uncertainty of flood, earthquake, aging, etc. are reflected, present the quantitative results of failure probability, and thereby prioritize repair & reinforcement plans for the improvement of dam stability prioritize
- Hydrological, geotechnical analysis module ：Used to calculate the probability of potential failure mode accompanied by flood, earthquake, etc. against hydraulic structures
- Risk assessment tool ： Functions to design a risk analysis model, assess possible risks under different scenarios at a potential failure, and compare the effects of risk mitigation

Configuration

Features

- Risk analysis module
  - Engineering assessment, history management of potential failure mode
  - Hydrological analysis module for climate change
  - Geotechnical analysis module for failure characteristics
- Risk assessment tool
  - Management of central server data & uses
  - Function of risk model wizard
  - Function of analyzing results to compare alternatives

Functions
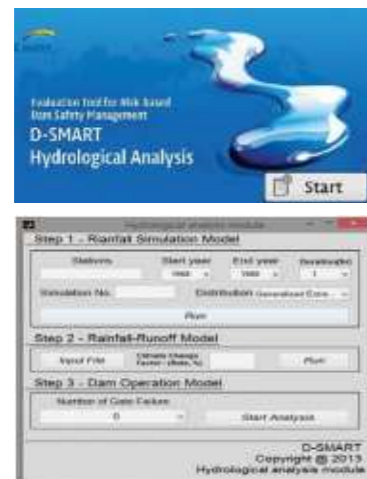
| Hydrological analysis module |　　| Geotechnical analysis module |　　| Risk assessment tool |

Effects

- Manages the history of dam risk factors & monitors inspection results
- Manages dam analysis data & improvement of data reliability thorough their control management
- Enables proactive responses through self-application & competitiveness improvement
- Produces quantitative, scientific results
- Produces optimal alternative by comparing among alternatives

Applications

- Applied to the risk analysis & assessment of target dams
  - Soyang R. Dam, Sueo Dam, Gwangdong Dam, Yeongcheon Dam
- Applicable to projects to stabilize aged reservoirs operated by municipal governments
- Introduced into a R&D project for disaster safety management driven by the MPSS (Ministry of Public Safety & Security)

Large Geotechnical Centrifuge

LGC

A-17

Overview

LGC is the world's largest modeling equipment used for the empirical safety performance evaluation of such critical water resource infrastructure assets as dams, multi-purpose weirs, water works, etc.
- Centrifugal model test
  - CMT (centrifugal model test) is a technique to simulate the behavioral characteristics of structures equivalent to the corresponding ones at an actual site through complementing incompleteness accompanied by scaling in scale model tests on geotechnical structures. With this technique, it's possible to represent similar material & geometrical characteristics and structural behaviors as shown in the structures at the actual site and identify a failure mechanism by applying various load conditions, which is why the technique has commonly been used as one of the most reliable geotechnical tests.`
- Utilization of centrifugal model test
  - Used to evaluate the design appropriateness of large-scale structures and their stability against or their vulnerability to extreme natural events (e.g. flood, earthquake, etc.)
  - Used to identify the damage & failure mechanism of structures and evaluate the viability of any countermeasures

Configuration

Reproduce site material & stress conditions
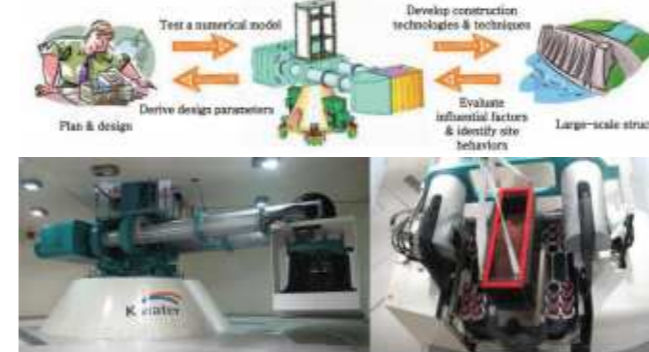
Features

- Reliable safety assessment technique in which the same material & geometrical characteristics as shown in large structure at an actual site are considered
- Used as an empirical validation tool for the safety of large-scale critical hydraulic structures whose design, construction, operation or checkup is underway

Functions
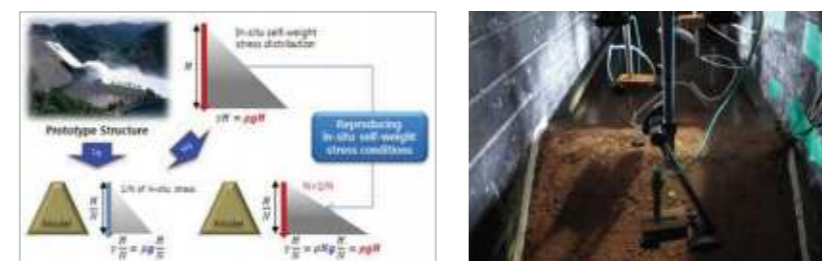
- Utilization of the world's largest centrifugal model tester (radius of gyration：8m, accelerated 150 times as fast as gravity)
- Functions to identify the behavioral characteristics of dams, multi-purpose weirs, conduits, etc.
- Possible to evaluate the seismic performance of large structures using seismic simulation system

Effects

- Advances a process to validate and evaluate the safety performance of hydraulic structures against such extreme events as climate change, earthquake, etc.
- Resolves the constraints of numeric analysis method
  - Realistic modeling of structures & improvement of the geotechnical behaviors of ground materials in terms of reliability

Applications

- Applied to evaluate the appropriateness of long-term settlement estimates and the forced replacement method design for the construction of a guide bank training dyke as par of a project to expand a drainage gate for the Nakdong R. mouth weir (2013)
- Applied to evaluate dam responses to and safety against an extreme earthquake (0.94g) (in the seismic performance tests on the Philippine Angat Dam in 2014)
- Applied to evaluate the safety & behavioral characteristics of aged reservoir levee body at the event of storm water and reservoirs (Kangwon National University) and the seismic response of ocean wind power foundation (Kongju National University)

SMART-TM

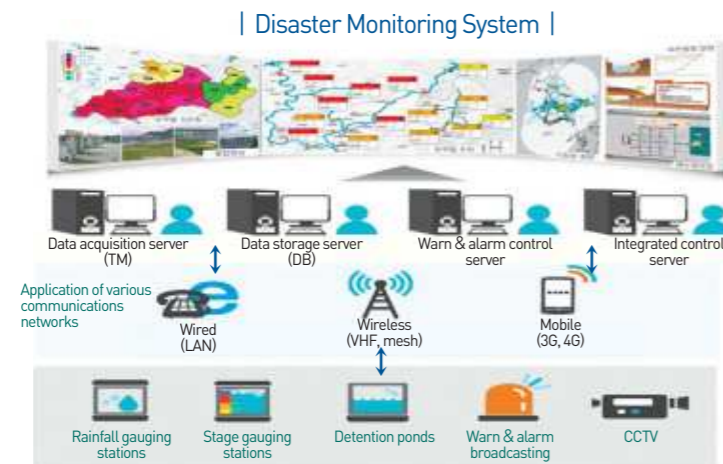## HMI - based integrated package program for disaster management

A-18

Overview

SMART-TM, an HMI-based integrated package program developed by K-water with its own flood disaster prevention technology, is a standard information delivery platform optimized for ensuring the effective acquisition & sharing of relevant data among different disaster management agencies and the remote control of relevant systems & facilities and developing disaster management systems

- With SMART-TM as an integrated package program, it's possible to monitor and control the whole status of a specific disaster (e.g., extreme flood) at a level of a single system.
- Composed of standardized information delivery systems (equipped with the integrated functions of data acquisition & storage, warning and integrated control), SMART-TM has been optimized to effectively share relevant information among different disaster management agencies and develop disaster management systems.

Configuration

| Disaster Monitoring System |

Data acquisition server (TM)
Data storage server (DB)
Warn & alarm control server
Integrated control server

Application of various communications networks
Wired (LAN)
Wireless (VHF, mesh)
Mobile (3G, 4G)

Rainfall gauging stations
Stage gauging stations
Detention ponds
Warn & alarm broadcasting
CCTV

Features

- Real-time monitoring & hydrological analysis
  - Acquisition of reliable data
  - Provision of real-time video monitoring functions
  - Provision of alarm as monitoring standards
  - Supervisory control of drainage pump station and detention pond
- Standard information delivery system
  - Standard platform for system integration
  - Possible to communicate among different models of systems
  - Sharing of hydrological among relevant agencies
- System integration
  - Equipped with the integrated functions of data acquisition & storage and warning
- Certified as Good Software by TTA

Functions

- Functions of integrated & supervisory control, data analysis, and video monitoring

- Integrated functions of data acquisition & storage, warning, integrated control, etc.
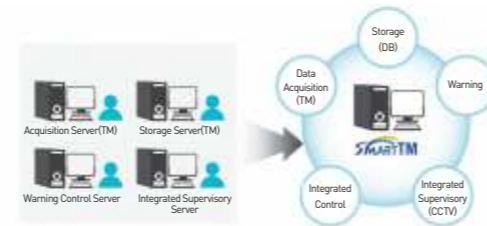
Effects

- Possible to maximize flood damages in small- and mid-scale rivers through building a customized flood disaster management system for flood-prone areas
- Possible to save costs for building & operating a disaster management system for municipal & provincial governments
- Possible to achieve flood-free land through linking to the national disaster response system

Applications

- Applied to the development & building of flood disaster management system for Namweon City (2011), Muju Country(2013), Gunsan City(2014)
- Applied to the development & building of customized flood disaster management system for each of municipal & provincial governments
- Applied to the development of overseas integrated flood disaster management projects

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# SURIAN

Supercom-based River Analysis Network

A-19

Overview

SURIAN is a system to provide more accurate water quality prediction data, improve capabilities to respond to water pollution accidents and facilitate decision-making through linking to K-PPM, HSPF, CE-QUAL-W2, and ELCOM-CAEDYM

- Real-time forecasting system
  - Real-time forecasting system to provide 5-day water quality prediction data every day through mailing and web services (containing temperature, BOD, TN, TP, SS, Chl-a, Geosmin, 2-MIB, etc.)
- Timely forecasting system
  - Timely forecasting system operated at a manual mode to flexibly respond to various water quality prediction scenarios and providing various post-processing functions, including user-friendly automatic modeling system and 3-D visual graphs

Configuration
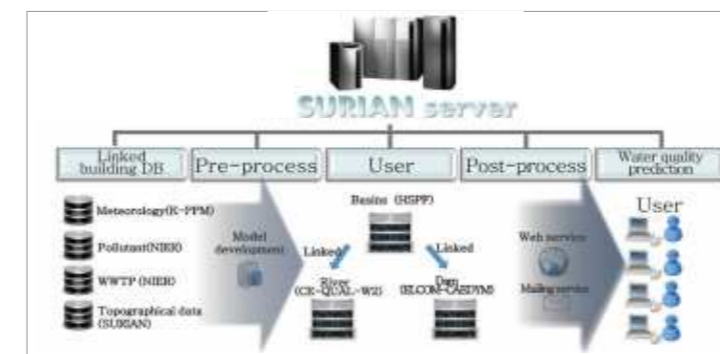
Features

- Improvement of model driving velocity (by some 15 times) through building a server dedicated to model driving and applying parallelization (openMP)
- Provision of various post-processing functions (including automatic modeling system) through developing DB with model input data
- Building & Application of modules for advanced users (as through linking among models and applying PEST and BMPrac)

Functions

- Real-time water quality prediction system
- Automated driving of water quality model & provision of web services
- At-any-time mode (possible to apply different scenarios for different models)
- Maximization of accessibility to water quality model
- Improvement of the velocity of a 3-D reservoir model (ELCOM-CAEDYM)
- Building of a server dedicated to model driving & application of parallelization (openMP)

Effects

- Possible to timely and effectively to respond to water pollution accidents using water quality prediction data
- Improves accuracy through linking among models and applying automated correction program
- Possible to predict water quality based on various water quality scenarios
- Improves model driving velocity through server building & parallelization

Applications

- Applied to the reinforcement & utilization of water treatment process through predicting water quality for 19 rivers and 8 dams
  - Provides water quality prediction information for Daejeon Waterworks Headquarters (2013 to 2014)
- Water turbidity forecasting services covering Imha Dam, Hapcheon Dam, Nam R. Dam, Soyang R. Dam (2012 to 2014)
- Applied to the utilization of real-time water quality prediction data to manage agal bloom (February 2014)
- Applied to the prediction of odoriferous matters through a correlation analysis among Chl-a and Geosmin (2-MIB) (Bukhan River)

K-water GATe Water Combine

K-water Green-Algae-Tide Water Combine to remove algal blooms

A-20

Overview

K-water GATe Water Combine is a technology to timely and directly remove algal blooms present in rivers and reservoirs through coagulating and floating them with physical and chemical methods

- With this technology, it's possible to remove & control agal blooms over wide areas, including a specific river system by coagulating and floating them using an agal remover, and then selectively removing them using an agal removal unit.

Configuration
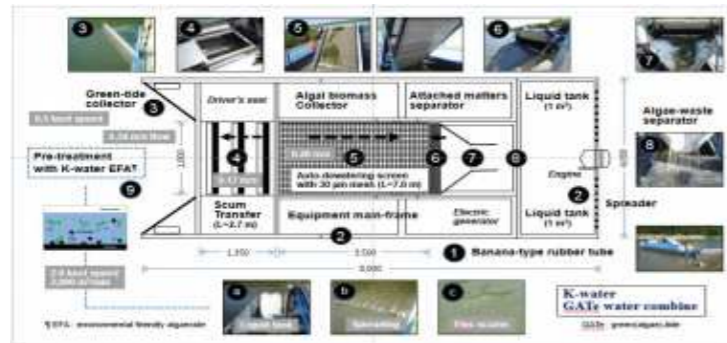
Features

- Highly lightweight assembly type and very good in terms of mobility and applicability (possible to carry this combine with one 5-ton vehicle)
- No separate need for berthing facilities
- Excellent in terms of readiness (possible to carry this combine where agal blooms happen within 3 hours, and then remove them within 4 hours since)
- Possible to control & remove over wider areas and excellent in terms of economic feasibility and environment-friendliness

Functions

| Mobilize & carry | | Assemble | | Spray chemicals | | Remove agal blooms |

- Improvement of mobility (timely mobilization)
- Shortening of disassembly & assembly time to some 2 hours (from 3 hours)
- Spraying of chemicals evenly & improvement of the spraying system and the nozzles
- Improvement of stripping device to separate off collected agal blooms and other impurities

Effects

- Develops onsite practical technologies to proactively respond to agal blooms, and thereby resolve the problem of agal blooms in large rivers and reservoirs
- Develops & provides next-generation pollution purification technologies by changing waters where agal blooms happen to a brand-new concept of resource production base
- Used as a tool to manage water pollution beforehand through onsite practical optimization, and improve the environment of waterfronts (amenities)
- Advances basin & water quality management practices through applying BT and ET convergence technologies
- Development of environment-friendly technologies to control agal blooms → Development of K-water's own source technologies to relevant on-shore & off-shore markets

Applications

- Applied to the removal of agal blooms in the mainstream of Hapcheon & Changnyeong Weirs and its tributaries (some 1.7 tons)
- Applied to the monitoring of where agal blooms occur at Nakdong R. Bonpo Intake Station & removal of pollutants flowing in the tributaries (0.9 ton)
- Applied to the removal of agal blooms in Chuso-ri Waters of Daecheong Dam (2.9 tons)
- Utilized as response technology to agal blooms in large river basins

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# MDSS

MIB Control Decision Support System

B-1

Overview

MDSS is a system to help decision makers optimize water treatment processes considering water quality conditions and design parameters, and thereby control MIB, a main cause of taste and odor in drinking water.

- Allows users to determine optimal water treatment system from the integrated results of the cost analysis and the simulation of seven water treatment processes (PAC, GAC, BF, O_3, UV+H_2O_2, and NF) so as to cost-effectively control the cause of taste and odor (MIB) in drinking water
- Provides information on the design of optimal processes, establishment of water treatment strategies, and achievement of optimal process operation in new and existing water treatment plants.

Configuration
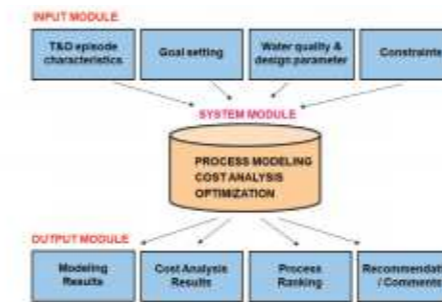
Features

- Consists of three modules
  - Input module : 4 categories
  - System modules : Process modeling, cost analysis, and optimization
  - Output module : Modeling results, cost analysis results, process ranking, and recommendation/comments
- Ranking and Scenario Evaluation : Comparing processes in line with relative O&M, capital, and total cost to determine the priority of processes

Functions

| Main Functions | | Applicable Processes | | Algorism of GAC |
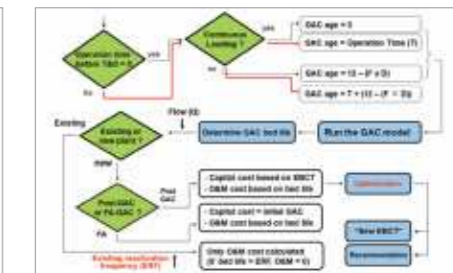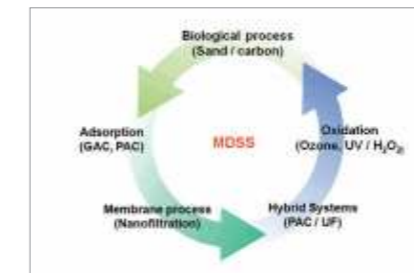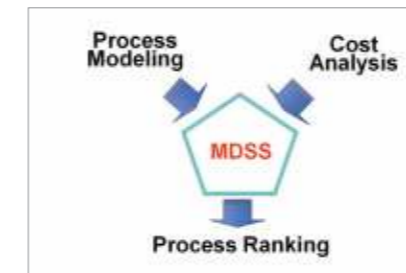
Effects

- Evaluates processes in terms of the ability to control MIB and Geosmin
- Develops algorithm models characterized by processes to control taste and odor in drinking water
- Based on algorithms, developing a decision support system to provide a proper guidance for taste and odor control at water treatment plants in line with raw water quality
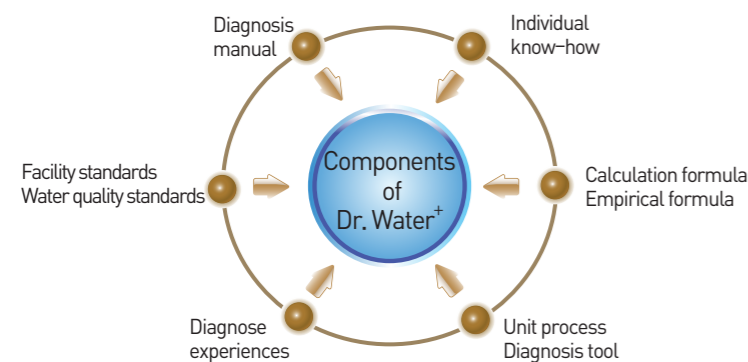
Applications

- 7 advanced WTPs in Metropolitan Area

Dr.Water[+]

Knowledge-Based WTP Diagnosis Program
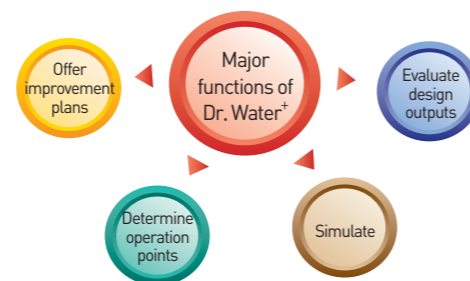
B-2

Overview

Dr. Water[+] is a program dedicated to the technical inspection of WTPs (water treatment plants) and their water treatment processes. This program functions to derive any constraints in the performance of the water treatment processes, and thereby develop an operation & maintenance plan for ensuring efficient water treatment

Configuration

Diagnosis manual
Individual know-how
Facility standards
Water quality standards
Components of Dr. Water[+]
Calculation formula
Empirical formula
Diagnose experiences
Unit process Diagnosis tool

Features

• Evaluates the design & operation and economic feasibility of each process to identify optimal operation points
• Derives optimal process design and operation factors

Offer improvement plans
Major functions of Dr. Water[+]
Evaluate design outputs
Determine operation points
Simulate

Functions

• Contains a list of 51 diagnostic items in 9 water treatment processes.
  – 9 processes : Gauging well, Chemical treatment, Distribution channel, Mixing, Coagulation, Sedimentation, Filtration, Disinfection, and Effluent treatment
  – 51 diagnostic items : Evaluating the appropriateness of hydraulic structure for each process, the characteristics of filter medium, and others
• Includes a Guidebook for the Technical Diagnosis of Water Treatment Plants (e-book)
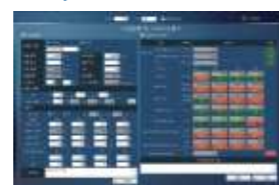• Includes an Ozone Simulator to diagnose ozone process

Main screen | Process analysis Graph drawing | Process analysis Hydraulic evaluation | Guide book for technical diagnoses

청수시설 기술진단 가이드북

Effects

• Provides an effective tool for technical diagnosis
• Ensures the objectivity of results from computer-aided diagnosis approach
• Contributes to effective operation and maintenance of water supply system

Applications

• The technical diagnosis of municipal and industrial water supply systems (2011 ~ 2014)


ICLP-WTP

Integrated Control Logic Program for WTP

B-3

Overview

ICLP-WTP is a program for the smart monitoring of water treatment processes using a conventional control method and a data mining technique (to ensure the supervisory control of major water treatments (e.g, chlorination) and effluent treatment processes)
• Integrated Control Logic Program for Water Treatment
  – Up-to-date control method is used to ensure stable water production and standardize water treatment control logic.
  – Contains a core process automation software technique for the control logic of production technology-dependent main water treatment processes.
• Integrated Control Logic Program for Effluent Treatment
  – Implements a continuous integration system of effluent treatment process to increase sludge treatment capacity and to meet the legal effluent quality standards
  – Analyzes realtime material balance to monitor sludge for each section, and control retention time/schedule and change effluent structure/facility to ensure flexibility.
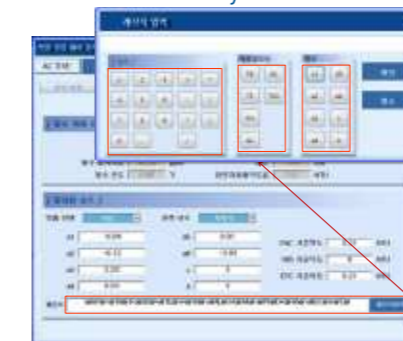
Configuration
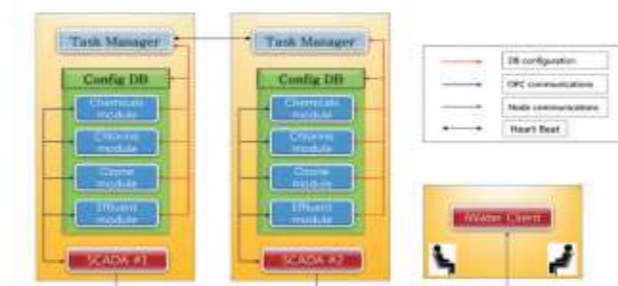
Features

• Application-based control logic
• Determine scientific feed rate on data mining
• Analyzes realtime sludge material balance of effluent process
• Controls retention time to meet legal effluent water quality standards
• OPC communication and tag mapping provide expansibility
• Certified Good Software

Functions

Chemical process control in regression analysis | Realtime material balance analysis of effluent processes

Main Algorithms

• Integrated Control Logic Algorithms for Water Treatment
  – Chemical : Multiple Regression Equation
  – Disinfection : Multiple Loop Control
  – Ozone : Multi-point Operational Formula
• Integrated Control Logic Algorithms for Effluent Treatment
  – Sequence, estimated sludge production, and retention time control

Effects

• Determines scientific feed rate corresponding to a given water treatment condition to enhance the stability of drinking water
• Implements a continuous integration effluent system to increase treatment capacity and to meet the legal effluent quality standards
• Reduces costs related to the extension to application-based program and ensuring versatility
• Secures core software technologies and creating value-added technologies

Applications

• Pilot implementation of an integrated control logic program for water treatment processes (2010-2012)
  – Cheongju WTP (chemical and disinfection), and Seongnam WTP (ozone)
• Expansion of integrated control logic program for water treatment processes (2012-2014)
  – Ilsan WTP, Deokso WTP, Gogryeong WTP, and Bansong WTP
• Pilot implementation of an integrated control logic program for effluent processes (2014-2015)
  – Boryeong WTP

KWMTPs

K-water Mobile Water Treatment Plants

Overview

KMWTP is a relocatable water treatment plant to evaluate and select an optimal water treatment process when there is a change in the quality of raw water accompanied by climate change or small modicums of pollutants flow in (newly)

- Mobile water treatment plants (KMWTPs) allow on-site evaluation of BAT (Best Available Technology Economically Achievable) to timely respond to new trace pollutants in water and changes in raw water quality due to climate change.
- The MWTP is used to identify threshold concentration and operating parameters for the treatment of polluted water on site so as to determine technological solutions ensuring water safety against new pollutants and quickly responding to water pollution incidents

Configuration

- (Unit 1,100㎥/day) Coagulation → DAF → Microfiltration (MF) → AOP → Ozone → Activated Carbon → UV, etc.
- (Unit 2,100㎥/day) Microfiltration (MF) → Nano (NF)

Features

- Implements actual water treatment processes in a mobile plant
- Focuses on quick response to unusual water quality due to new pollutants and water pollution incidents

Functions

| Trailer-mounted MWTP for immediate mobility | | Wing opening truck body for increased work space |

Effects

- Carries out on-site evaluation and optimization of water treatment processes for each intake source
- Identifies parameters for design and operation of new and rehabilitated water treatment plants to appropriately respond to new pollutants and climate change

Applications

- Applied to the evaluation of the efficiency of treating
  - Tate & odor attributable to blue-green algae (anabaena spiroides) in the Han R. system (2013)
  - Clogging of filtration pond attributable to diatom in the Nakdong R. system (2014)
  - Pollutants in Asan Lake (2014)
  - Hardness substances at Danyang WTP (2014)
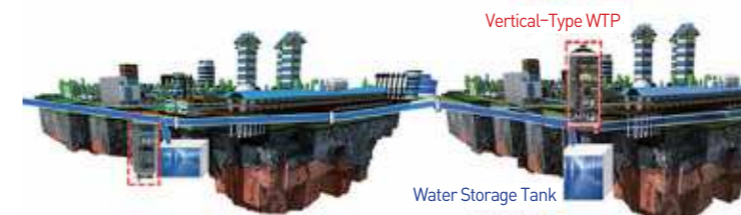
Decentralized Water Supply System

DWSS

Overview

DWSS is a safe, reliable advanced water supply system to ensure the distributed relocation of water treatment plants around customers and secure emergency water using a vertical-type water treatment technology (which is a brand-new concept of compact vertical-structured water treatment design technology)

- Vertical-type Water Treatment Technology
  A tankless water treatment system, including membrane filtration and pressure-type advanced water treatment (ozone and activated carbon), shall be installed in vertical structure to considerably reduce the installation area to 1/3 of that for the existing design technology.
- Decentralized Water Supply System
  A vertical-type water treatment technology shall facilitate a customer-oriented safe and stable water supply system of the future by decentralizing water treatment plants and securing auxiliary water sources and emergency water supply.

Configuration
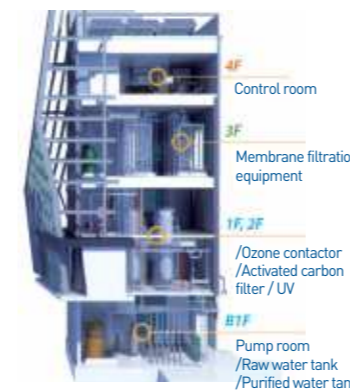
Vertical-Type WTP

Water Storage Tank

Features

- Small-sized vertical water treatment plants facilitate decentralization of water supply system within the city.
- Decentralized water supply system, combined with auxiliary water sources and emergency water supply storage using storage tanks and deep tunnels, ensures a safe and stable water supply.
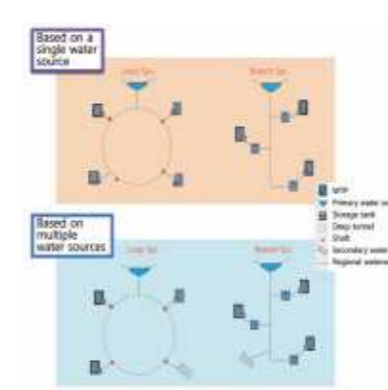
Functions

| Vertical Water Treatment System | | Decentralized Water Supply System | | Clean & Low Energy Technologies |

Control room

Membrane filtration equipment

/Ozone contactor
/Activated carbon
filter / UV

Pump room
/Raw water tank
/Purified water tank

- Pressure-type process package
- A compact tankless system

- Optimal location methodology
- Direct, indirect, and hybrid water supply systems

- Clean energy (small hydropower, water temperature difference and solar power)
- Low energy design

Effects

- Ensures customer-oriented safe and stable water supply in the future
- Aims to make zero cutting-off water supply and increase a direct water supply rate from the current level of 5% to 30%
- Used in other water supply systems, for example, high quality industrial water supply
- Energy saving from clean energy

Applications

- The vertical water treatment demonstration plant in the K-water Cheongju Water Treatment Plant (1,000㎥/day)
- The introduction of the decentralized water supply system in the Saemangeum development project is currently underway.

Water & Sewage Demonstration Plant

WSDP

B-6

Overview

WSDP is a technology to enable the methodical, systematic performance of relevant researches by installing a demonstration plant for validating each of various water treatment processes and capacities, and ensure the timely provision of onsite supports with test beds

- Demonstration plants (Installed Capacity 1,000㎥/day·line × 2 lines)
  - (Line 1) Pre-ozone–Coagulation–Sedimentation–Filtration–Post-ozone–Activated carbon
  - (Line 2) Coagulation–Sedimentation (Inclined plate)–Filtration–Activated carbon
  - 1 unit of each dissolved air flotation (DAF) and non-powered coagulation and sedimentation, and 1 set of effluent water basin
- Pilot Plants (5 processes, 235㎥/day)
  - Optimization of existing processes : Coagulation/sedimentation tank, filtration basin, and underdrains
  - Membrane filtration (UF/MF/NF/RO)　　　– Advanced treatment (ozone and activated carbon) : Ozone generator, and activated carbon column
  - Sewage treatment : Reactor (6 ea), inflow storage tank, and settling basin
  - Pipelines : Corrosion test facilities, storage tank test equipment, and pipe physical properties test facilities
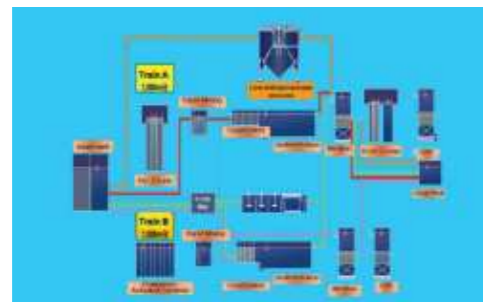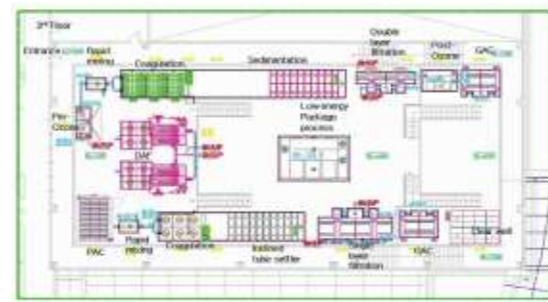
Configuration

Features

- Demonstration plant
  Resolves problems with the demonstrative operation of water treatment processes proposed in the model plant and checks the effects of the treatment processes
- Model plant
  Compares among different unit treatment processes and enables the selection of optimal processes

Functions

| Plant Schematic |

| Lay – out |

Effects

- Provides training programs for local experts and foreigners (ODA/ADB) in water treatment
- Presents rapid solutions to water treatment issues
- Provides membrane module certification and certified flowmeter calibration services
- Implements a test-bed for verification of technologies resulted from small business innovation research projects

Applications

| Education Study Tour |

Year	2010	2011	2012	2013	2014
Event	36	39	28	34	22
Person	696	787	542	587	461

| Membrane Module Certification and Flowmeter Calibration |

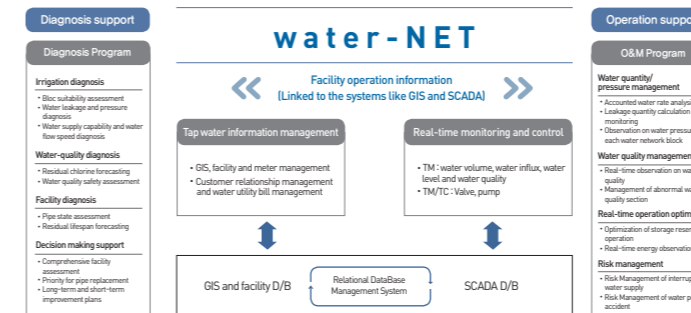| Year		2010	2011	2012	2013	2014
Membrane Module Certification	Event	4	7	6	5	4
	Revenue USD	81,748	123,770	134,000	78,656	37,214
Flowmeter Calibration	Event	2,447	2,929	3,414	2,990	3,373
	Revenue USD	549,872	733,061	725,115	926,021	993,155

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water-NET

Water Network Diagnosis, Operation & Maintenance System

B-7

Overview

water-NET is a water network operation system to support the optimal operation & maintenance of water networks through analyzing, diagnosing and evaluating operational DB with an IT-based work process system covering all works processes (including survey, diagnosis, facility improvement, operational improvement, maintenance, etc.)

Configuration

Diagnosis support

Diagnosis Program

Irrigation diagnosis
- Disc suitability assessment
- Water leakage and pressure diagnosis
- Water supply capability and water flow speed diagnosis

Water-quality diagnosis
- Residual chlorine forecasting
- Water quality safety assessment

Facility diagnosis
- Pipe state assessment
- Residual lifespan forecasting

Decision making support
- Comprehensive facility assessment
- Priority for pipe replacement
- Long-term and short-term improvement plans

water-NET

Facility operation information (Linked to the systems like GIS and SCADA)

Tap water information management
- GIS, facility and meter management
- Customer relationship management and water utility bill management

Real-time monitoring and control
- TM : water volume, water influx, water level and water quality
- TM/TC : Valve, pump

GIS and facility D/B　Relational DataBase Management System　SCADA D/B

Operation support

O&M Program

Water quantity/pressure management
- Accounted water rate analysis
- Leakage quantity calculation and monitoring
- Observation on water pressure of each water network block

Water quality management
- Real-time observation on water quality
- Management of abnormal water quality section

Real-time operation optimizing
- Optimization of storage reservoir operation
- Real-time energy observation

Risk management
- Risk Management of interruption in water supply
- Risk Management of water pollution accident

Features

- Dr.Pipe
  - Integrated diagnosis tool for hydraulic integrity, water quality, and physical conditions in WDS
  - Dr.Pipe consist of 4 main modules, including integrity diagnosis, water safety (water quality) assessment, physical condition assessment, and integrated decision support tools for rehabilitating or replace aged water pipes.
- Net.Operation
  - Optimal O&M support system based on a real-time monitoring and control system
  - Net.Operation consist of real-time monitoring system and analysis system to monitor flow, pressure, WQ, energy, etc, in water distribution networks. The monitored data are used for the optimal O&M of water leakage, water quality, energy, etc. with various analysis tools.

Functions

| Dr.Pipe |

Builds a water pipe network model	Inspects hydraulic integrity	Inspects water quality	Inspects the safety of target infrastructure	Supports decision-making
• Build a pipe network analysis model • Functions to automate the calibration & correction of errors in pipe network and the allocation of water demand	• Analyzes water pipe networks considering water pressure, flow velocity, etc. • Assesses hydraulic integrity & block appropriateness • Derive alternatives to the improvement of water supply system	• Assesses WQ variations • Assesses WQ safety • Analyze the damping capacity of residual chlorine	• Assesses the physical conditions of water pipes • Predicts pipes' remaining service life with a physical, economic model	• Analyzes inspection results & makes decisions about each of alternatives • Makes an overall performance assessment • Formulates short- & long-term improvement plans

| Net.Operation |

Functions to analyze water pipe networks	Manages water quantity	Manages energy	Manages water quality (WQ)	Manages water crises	Predicts water demand
• Analyzes pipe networks based on measured data	• Monitors water leakage by block • Analyzes revenue water ratio by block & gross water quantity	• Analyzes pump capacity & energy loss	• Monitors WQ on a real-time basis • Predicts residual chlorine through water pipe network analysis	• Valve operation tool in emergency situation • Predicts expected water supply cut-off areas	• Predicts daily & hourly water demand • Predicts reservoir level through simulating inflow variations

Effects

- Dr.Pipe
  - Enables the saving of inspection & analysis time by 90% and improves reliability of diagnosis
- Net.Operation
  - Enables scientific, efficient operation & maintenance

Applications

- Dr.Pipe
  - Applied to the technical inspection of water pipe networks, along with the transfer of relevant technologies to engineering companies, etc.
- Net.Operation
  - Applied to the building & operation of 16 provincial waterworks and 12 regional waterworks

B-8

iWater 5(SE)

Standard Water Operating System

Overview

iWater 5(SE) is a standardized HMI system for the supervisory control of all relevant facilities (including intake stations, water treatment plants, booster stations, pipelines, distribution reservoirs, water taps, etc.) at a remote integrated center.

① iWater (standard water treatment operating system)
  Serves as K-water's standard HMI to remotely monitor waterworks on a real-time basis
② SiS (smart iWater system)
  Monitors WTPs with mobile units anywhere

③ IWS+ (smart warning management system)
  Functions as an accident prediction & alarm system

④ Optimal pump operating system
  Functions as an automated pump operating system (that functions to monitor pump performance on a real-time basis

⑤ Standard control logic
  Automatically determines chemical/chlorine injection rate in accordance with a specific intelligent algorithm
⑥ Dr.Wastewater (self-diagnosis & management system for WWTP)
  Ensures the real-time monitoring & prediction of inflow & discharge in terms of water quality
⑦ Smart Ozone[+] (smart ozone process program)
  Ensures real-time response & optimal operation depending on changing water quality in ozone processes
⑧ Smart Sludge (smart effluent process program)
  Provides the functions of real-time effluence balance analysis and continuous/automatic operation
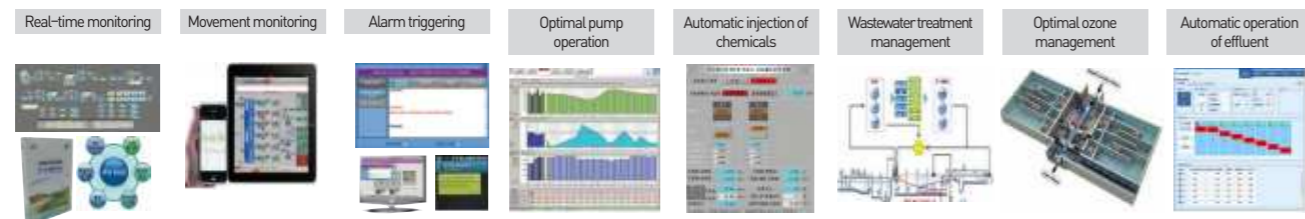
Configuration

Features

• Possible to be equipped with an application software optimized for each water treatment process based on the functions of monitoring & control that are provided by iWater engine software
• Standardizes display structure, components, monitoring control procedure and system application standards, etc.

Functions

| Real-time monitoring | Movement monitoring | Alarm triggering | Optimal pump operation | Automatic injection of chemicals | Wastewater treatment management | Optimal ozone management | Automatic operation of effluent |

Effects

• Reduces work-shift loads on operators through introducing a standardized water treatment system
• Shortens system building period by providing standard displays, water treatment symbols, etc. for building water treatment system
• Leads standards for the development of key water-related S/W's

Applications

• Applied to Chungcheong (1 site), Jeonnam (4 sites), Gyeongbuk (1 site), Gyeongnam (6 sites) in 2014
• Will be applied to Gangweon (2 sites), Gyeongbuk (4 sites) in 2015

B-9

RWIS

## Real - time Water Information System

Overview

RWIS is a system to query & supply real-time operational data about regional and provincial & municipal waterworks, including their business management information, sale operation, facility operation, water quality, annual reports, etc. every one minute.

• Data acquisition & transmission
  Acquires & transmit data about regional and provincial & municipal waterworks, KEPCO's meter readings, including operation data about wastewater works & dams dedicated to water supply, schematic diagrams for water supply, status of pump operation, etc.
• Data calibration & correction
  Calibrates & corrects data every 15 minutes and 1 hour through trending analyses, report configuration, etc.

Configuration

| Acquisition | Operation | Utilization |
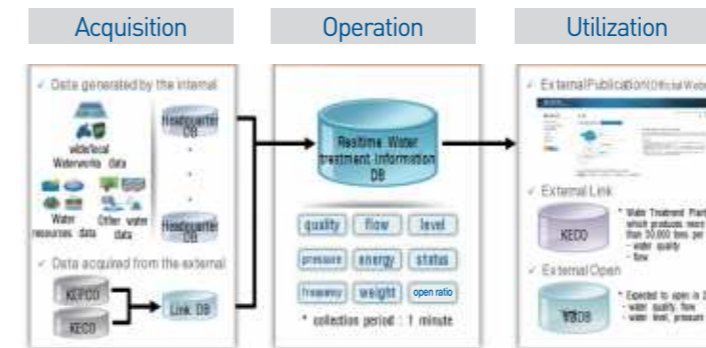
Features

• Acquires data about water quality and volume of water supply over the entire process of water supply ranging from water sources to end users, and links them to an internal system and external entities.
• Acquires & transmits data about the operation of waterworks (water quality, flow, water level, pressure, etc.) per every one minute.

Functions

| Schematic diagrams for water supply | | Water quality information | | Trending analysis |

Effects

• Improves the operation of waterworks & supports decision-making with one-minute real-time data
• Builds a foundation for the analysis & application of data about waterworks

Applications

• Sharing of 18,000 data through 21 internal & external systems
  - Providing water quality information for users on MOE's web-site, application to water resources and supply facilities management

B-10

Water-INFOS

Integrated Waterworks Information System

Overview

Water-INFOS is an integrated waterwork solution for the management of municipal or provincial waterworks, customer management, determination of tariff policy, handling of waterwork-related civil complaints, etc.

Configuration

Features

- The excellence of system quality certified by the Good Software (GS) from the TTA
- Integrated solution for local waterworks
- Provides mobile services for billing check, civil complaints, and billing settlement before moving out

Functions

| Facility Management (Water-Way) |

GIS-based management information on pipeline network and water supply facilities (workplaces and valves)

| Billing Management (Water-Bills) |

Billing procedures, including water meter reading, adjustment, notice, receiving, and late payment

| Customer Management (Water-CRM) |

Customer-based complaints handling and notification services

| Water Quality |

Daily, weekly and monthly water quality at waterworks, and households

| Service Portal (Water-POS) |

e-customer services, such as billing information, on the Internet

| Service Quality (SQI) |

Four SQIs, including water meter reading and visiting complaints handling

| Digital Information Display |

GIS-based realtime statistical information of civil complaints and water quality

Effects

- Integrating information from seven sectors to provide one-stop waterwork services
- Implementing GIS-based effective facility management
- Introducing SQI (Service Quality Index) to improve customer service quality

Applications

- 21 Local Waterworks
  - Metropolitan : Dongducheon, Yangju, Paju, and Gwangju
  - Chungcheong Province : Nonsan, Seosan, Geumsan, and Danyang
  - Jeolla Province : Jeongeup, Naju, Hampyeong, Wando, Jindo, and Jangheung
  - Gyeongsang Province : Yecheon, Goryeong, Bonghwa, Geoje, Sacheon, Tongyeong, and Goseong


FCPTT

## Flowmeter Calibration & Performance Test Technology

B-11

Overview

FCPTT is a world-class technology to help with fluid flow performance tests on watermeters, valves, etc, through the precision correction of flowmeters (CMC : 0.08%)

- Fluid supplied to test pipe from a hydrostatic tank at a stable flow passes through a test flowmeter to enter into a collecting tank
- The mass flow of fluid entered into a collecting tank over a certain period of time is converted into volume flow, which will then be compared with flowmeter reading.
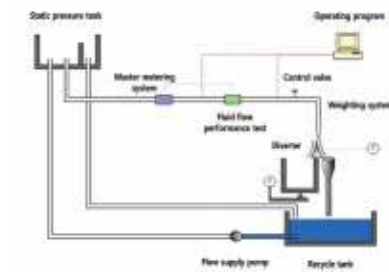
Configuration
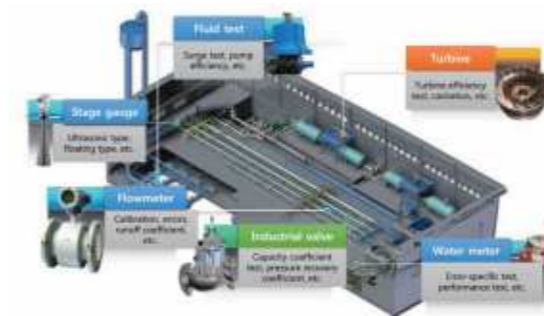
Features

- Introduces double acting hydraulic cylinder and triggering/ photo sensor detection techniques to build a high-precision diverter system
- Air valve, strainer and regulating bypass valve shall be installed in a test pipe to stabilize the test flow rate.
- A high-precision load cell shall be introduced to improve measurement method (compressive → tensile), and in turn to improve weight unbalance.

Functions

| Flowmeter Calibration |

High-precision calibration service ameasurement capability (CMC) of 0.08% at the advanced level

| Water Meter Performance Test |

Water meter performance test corresponding to a given installation setup (15~50mm)

| Valve and Fluid Flow Performance Test |

Precision control value and fluid flow performance test (capacity factor, pressure recovery coefficient, and water hammer)

Effects

- Manages under-registration rate for water meters to improve revenue water ratio in waterworks
- Secures advanced technologies for flow measurement and valve/fluid flow performance test
- Tests the performance of national core products/ exports developed by small business

Applications

- 3,000 units tested annually (revenue of KRW 1 billion)
- Tested the performance of the high-precision control valve for liquid oxygen in the Korea's first carrier rocket Naro
  - Contributing to the localization of core parts, and the market advance to space industry of KRW 210 trillion
- Tested the performance of International Thermonuclear Experimental Reactor (ITER)[1] shield block for cooling
  - Securing technologies for manufacturing core parts of nuclear fusion reactors, equivalent to about KRW 61.8 billion in money terms

1) ITER is the largest international R&D project in history, carried out jointly by the USA, EU, Japan, China, Russia, Japan and Korea to scientifically and technologically demonstrate the commercial feasibility of nuclear fusion energy.

SCSL

Smart Cleaning & Spray-on Lining technology

B-12

Overview

SCSL is a cleaning & spray lining rehabilitation technology for large-diameter water pipes (with D500mm to D1,650mm in diameter) that requires the use of equipment having a structure of polygonal hydraulic cylinder frame
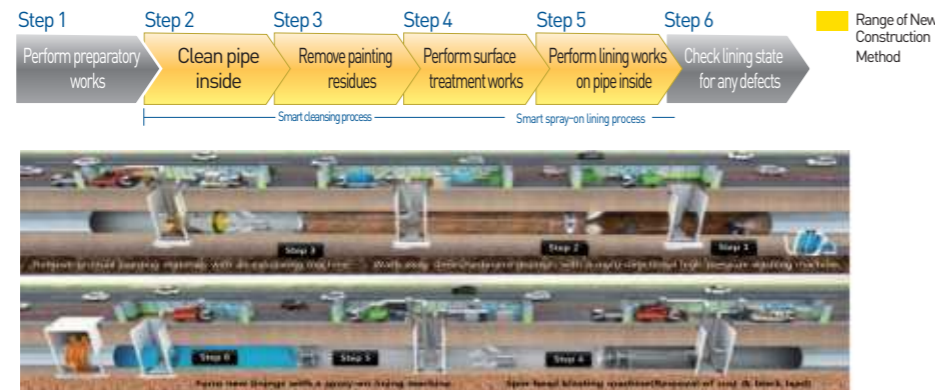
Configuration

Features

- Common features of main apparatuses
  - Structured with multi-joint hydraulic cylinder frame and possible to adhere closely to the pipe inside, bend a pipe spirally, and perform stable construction works
  - Applicable to long-distance construction with the help of high-efficiency batteries (low energy) and through an unmanned remote control (without any separate worker) and possible to monitor construction processes on a real-time basis
- Quality standards for main processes
  - Cleaning : Surface treatment grade SSPC SP-10, surface roughness Over 50 μmRz
  - Lining adhesive strength - Over 10 MPa

Functions

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	
Perform preparatory works	Clean pipe inside	Remove painting residues	Perform surface treatment works	Perform lining works on pipe inside	Check lining state for any defects	Range of New Construction Method

Smart cleansing process — Smart spray-on lining process

Before cleansing

After cleansing

After lining

Effects

- Used to restore the functions of existing aged pipes or extend their service life without any separate excavation or replacement
  - Green technology to reduce CO_2 produced in the process of producing new pipes or from construction wastes, which are accompanied together with non-excavation rehabilitation
- Used to cost-effectively restore hydraulic, water-quality and physical functions and ensure reliable water supply
  - Possible to reduce 40% of construction costs per meter when compared with construction costs for the installation of new pipes (based on D1,500 mm)
- Advances pipe rehabilitation technology and secures quality competitiveness
  - Applicable to oil transportation pipes, gas pipes and other agricultural/industrial water distribution pipes

Applications

- K-water's conveyance pipelines in Changweon
  - Cultural asset protection areas, some sections buried under traffic lane (congested with traffic load at ordinary time)
  - Steel D1,100 mm, L= 1.2 km
- Seoul municipal waterworks
  - Seoun-ro (sections where it's hard to excavate)
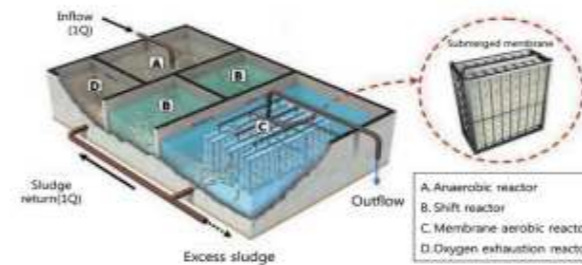 - Steel D900 mm, L= 1.2 km

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KSMBR

K-water Advanced Wastewater Treatment Technology with
Membrane Bio - Reactor

B-13

Overview

KSMBR is an advanced wastewater treatment technology to maximize the utilization efficiency of organic matters with an aeration/non-aeration parallel swing reactor and a microfiltration membrane
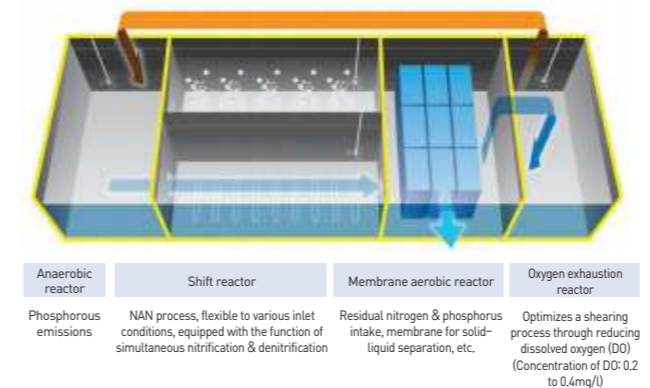
Configuration

Features

- The application of a polyolefin hollow fiber microfiltration membrane module developed by domestic technology contributes to the reduction of initial investment and maintenance cost.
- Facilitates the response to low C/N ratio and the change in organic matters and nitrogen loads in inflow to ensure stable water quality of the recycled water

Functions

Anaerobic reactor	Shift reactor	Membrane aerobic reactor	Oxygen exhaustion reactor
Phosphorous emissions	NAN process, flexible to various inlet conditions, equipped with the function of simultaneous nitrification & denitrification	Residual nitrogen & phosphorus intake, membrane for solid-liquid separation, etc.	Optimizes a shearing process through reducing dissolved oxygen (DO) (Concentration of DO: 0.2 to 0.4mg/l)

- Intermittent aeration process facilitates the reduction of internal recycling energy.
- Minimizes sludge generated with the operation of high-concentration MLSS & long SRT
- Flow analysis is used to minimize under-aeration and to equalize fluid flow.
  - Minimizes membrane pollution and the need for chemical cleaning and cleaning air supply to reduce maintenance cost
- Improved membrane packing density, particulate solids removal capability, and permeability reduce the power cost for suction pump.
  - There are no settling, filtration and disinfection processes needed.
- The short HRT facilitates compact-sized treatment facility, and increases the treatment efficiency in the existing facilities.

Effects

- Uses a hollow fiber microfiltration membrane developed by domestic technology to enhance the cost competitiveness
- Improved membrane packing density and diffuser reduce the area of aerobic tank and air supply rate to less than 40% and 50%, respectively.
- Enables the saving of maintenance costs over the existing MBR process

Applications

- 181 sewage and wastewater treatment plants in Korea (362,000㎥/day)
  - Gongchon STP (65,000㎥/day), and Okchon STP (18,000㎥/day)
- Korea's first project for recycling treated wastewater
  - Treated wastewater reused as industrial water supply in the Daegu Dalseong Industrial Complex (15,000㎥/day)
  - KRW 2.2 billion was saved annually over the existing water supply

B-14

# Dr. Wastewater

Self-Diagnosis & Management System for WWTP

Overview

Dr.Wastewater is a web-based self-diagnosis wastewater operation & maintenance system with which it's possible to predict the water quality of inflow and outflow on a real-time basis, and thereby manage wastewater treatment processes
- Self-diagnosis system built in deductive diagnosis methodology (DDM)
- Web-based management system for sewage treatment plants facilitates the integration with TMS (Tele-Monitoring System)

Configuration

MRA   D-MBM
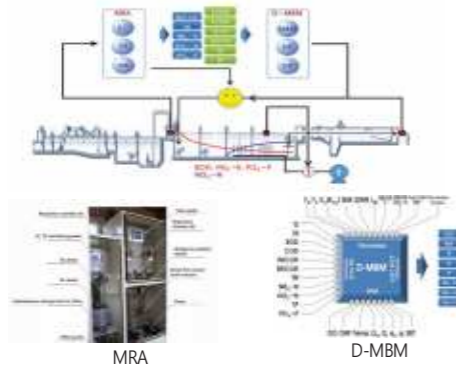
Features

- A Microbial Respiration Analyzer (MRA) is used to collect the realtime pollutant data from inflow (11 items) at 5~10 minutes interval.
- A Dynamic-Mass Balance Model (D-MBM) is used to predict the effluent quality in 8~10 hours based on MRA and monitoring results.
- MRA and D-MBM are used to appropriately control air supply rate in aeration tank for an economic operation.
- DDM is used to identify solutions.

Functions
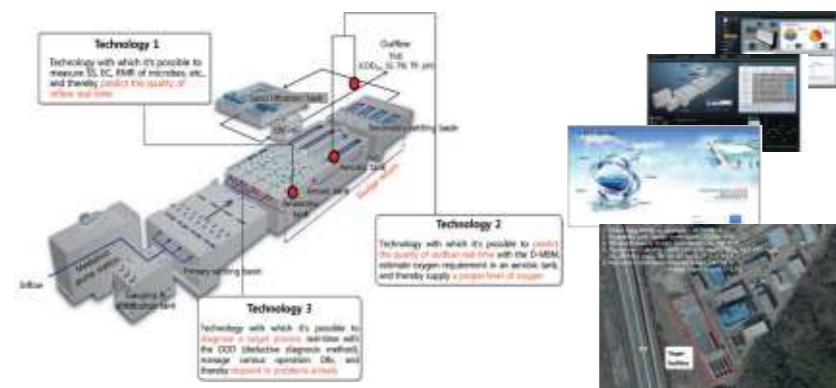
- Realtime inflow prediction module : Realtime inflow analysis (11 items)
- Realtime effluent prediction module : Realtime effluent prediction (8 items)
- Self-diagnosis and realtime optimization module : Diagnostic procedure specialized in main effluent items
- A web-based version facilitates accessibility to and integration with existing systems, and increases security.
- The software allows the customization of core technologies, including prediction, calculation and diagnosis.

Effects

- Routinely monitors effluent quality to meet the criteria in sewage treatment plants
- Increases pollutant removal efficiency (improved by 13.3% for BOD)
- Controls air supply rate for an economic operation : 35% reduction in air supply rate
- Self-diagnosis and process optimization decrease the risk rate.
- Verifies the normal operation of instruments
- Acquires advanced data, including realtime inflow data and behavioral characteristics of pollutants in reactors

Applications

- Oaegwan STP (A₂O, 22,000㎥/day) (2009~2013)

WTPTT

## Water Turbine Performance Testing Technology

C-1

Overview

WTPTT is a technology used to perform turbine generator performance tests (including efficiency test, cavitation test, axial thrust test, pressure fluctuation test, runaway speed test, air injection test, Winter-Kennedy test, flow pattern test, etc.) on a scale model of turbine under preset testing conditions (flow, pressure, rotational speed, etc.) as per generally accepted test standards (e.g., IEC 60193)
- Test capability : Less than 100kW full-sized turbine and reaction turbine model
- Test item : 8 items required by the IEC
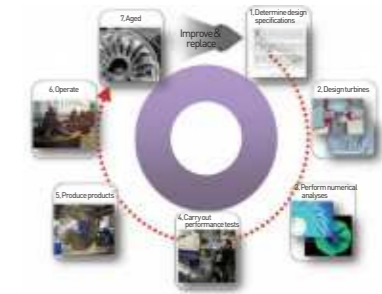

Configuration
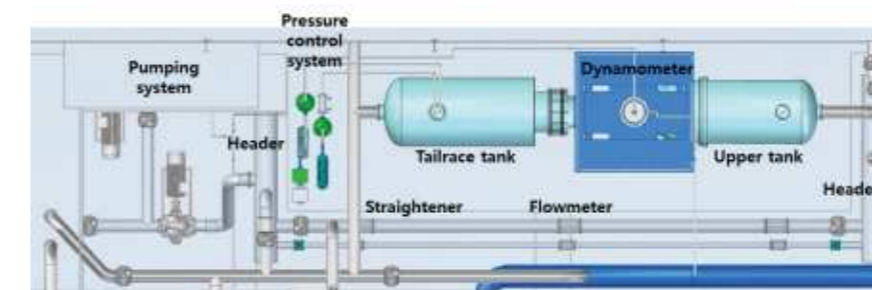
Features

- Installed area : 300 ㎡
- Max. head : 40 m
- Max. flow : 1.0 ㎥/s
- Revolution : 2,500 rpm
- Test item : Efficiency, Pressure pulsation, Runaway, Cavitation, and Axial thrust

Functions

Performance tests on a full-scale turbine and a scaled-down model

| Test items |

- Small-scale model test : Efficiency test, Cavitation test, Runaway speed test, Pressure fluctuation test, Winter-Kennedy test, etc.
- Forces characteristic test : Axial thrust test, Radial thrust test, Guide vane torque test and Runner blade torque test of Kaplan turbine
- Flow pattern observation and inner flow measurement for hydraulic machinery
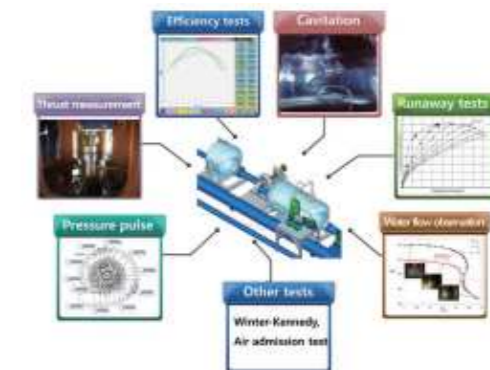
Effects

- Encourages the localization of hydraulic equipment for national strategic projects
- 50 hydraulic equipment were tested

Applications

- Carried out the experimental performance test of turbine developed by the small business for the small hydropower generation system in Yongdam Dam (May 2014)
- Assigned R&D for the standardization of turbine performance testing technologies (←Korea Energy Management Corporation, July 2014)