2015 ANNUAL REPORT

IWHR

China Institute of
Water Resources and
Hydropower Research

中国水利水电科学研究院

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WELCOME MESSAGE

Kuang Shangfu, Ph.D.
President of IWHR

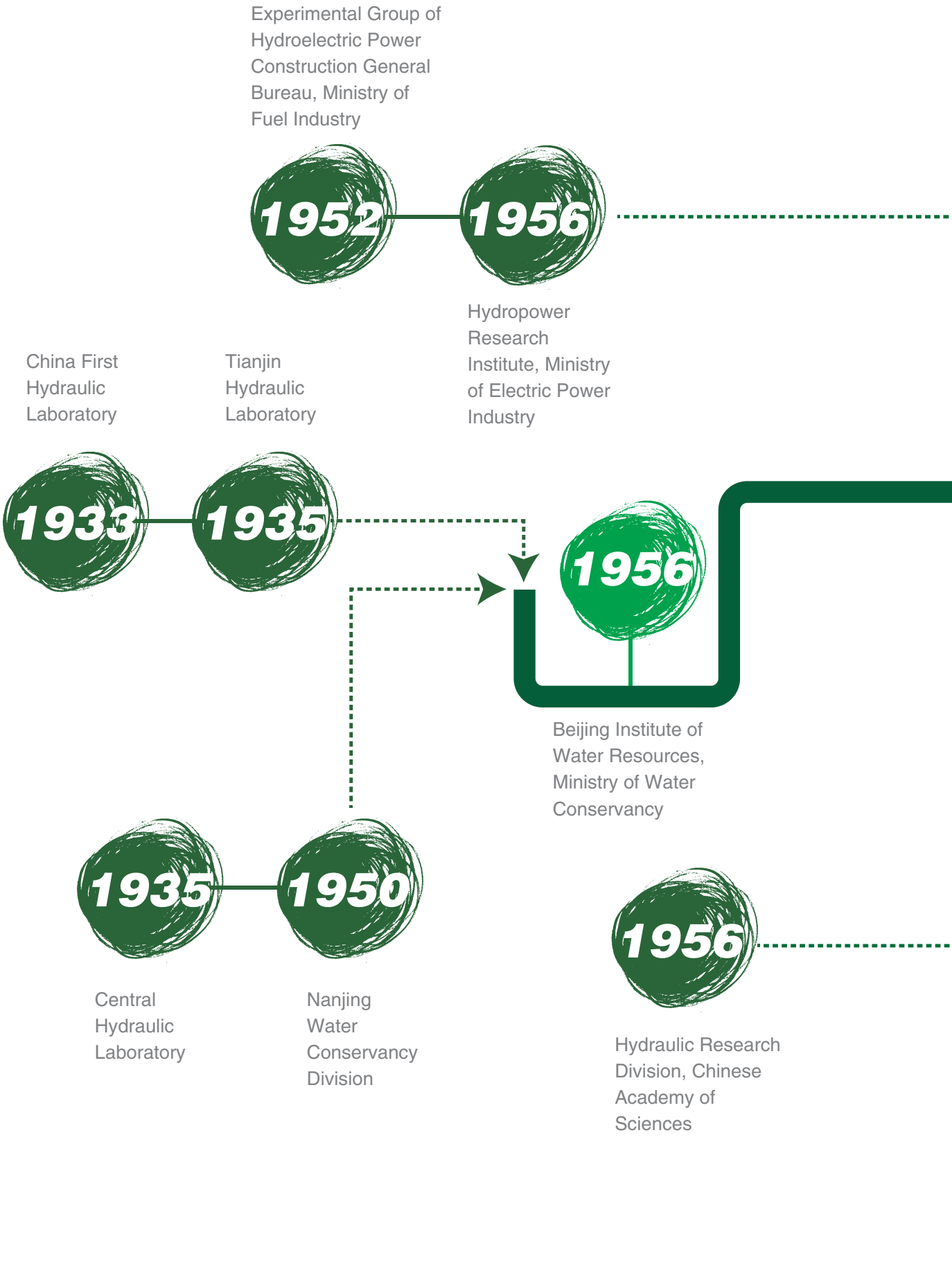
China Institute of Water Resources and Hydropower Research (IWHR) is a national research institution under the Ministry of Water Resources of China, and is engaged in almost all the disciplines related to water resources and hydropower research. With over 50 years of development, IWHR has grown into an indispensable think tank of the Chinese government for decision making and a backbone technical consultant in water related areas. It is at the same time the host of multiple international organizations or their Chinese branches, including WASER, WASWAC, ICOLD, ICID, IAHR, GWP, IHA, ARRN, etc.

In 2015, IWHR received 200 foreign visitors and dispatched experts to 14 countries and regions in order to boost knowledge sharing as well as technical exchange and cooperation. Leading the Chinese expert team of water resources, we participated in the 7th World Water Forum in Daegu and Gyeongbak, Republic of Korea, organized the China Session (T.1.4.1 Strategies and Planning for Sustainable Water Infrastructure Development), and contributed to 34 forum events. With China Three Gorges Corporation and other two partners, we jointly organized the 2015 World Hydropower Congress in Beijing. We also held the 12th IWHR-

KICT Joint Seminar, the IAHR Beijing Office Launching Ceremony and High-Level Forum on Water Security, International Youth Forum on Soil and Water Conservation (in Nanchang), the 7th International Symposium on Roller Compacted Concrete Dams (in Chengdu), etc.

In 2015, IWHR accomplished great breakthroughs in R&D, attaining overall progress in flood control and disaster mitigation, water resources management and eco-environment improvement, efficient irrigation, drinking water safety, intelligent water technology, as well as the construction, operation and management of key water projects. Newly-signed contracts in 2015 totaled to CNY 1.159 billion, among which about 9% are overseas research projects in electromechanical hydropower equipment, rubber and hinge dams, impounding safety of dam projects, flood control planning and policy consulting. Throughout the year, IWHR accomplished 566 papers, 52 monographs, 116 patents and 18 standards in addition to 25 main awards (including 4 national prizes).

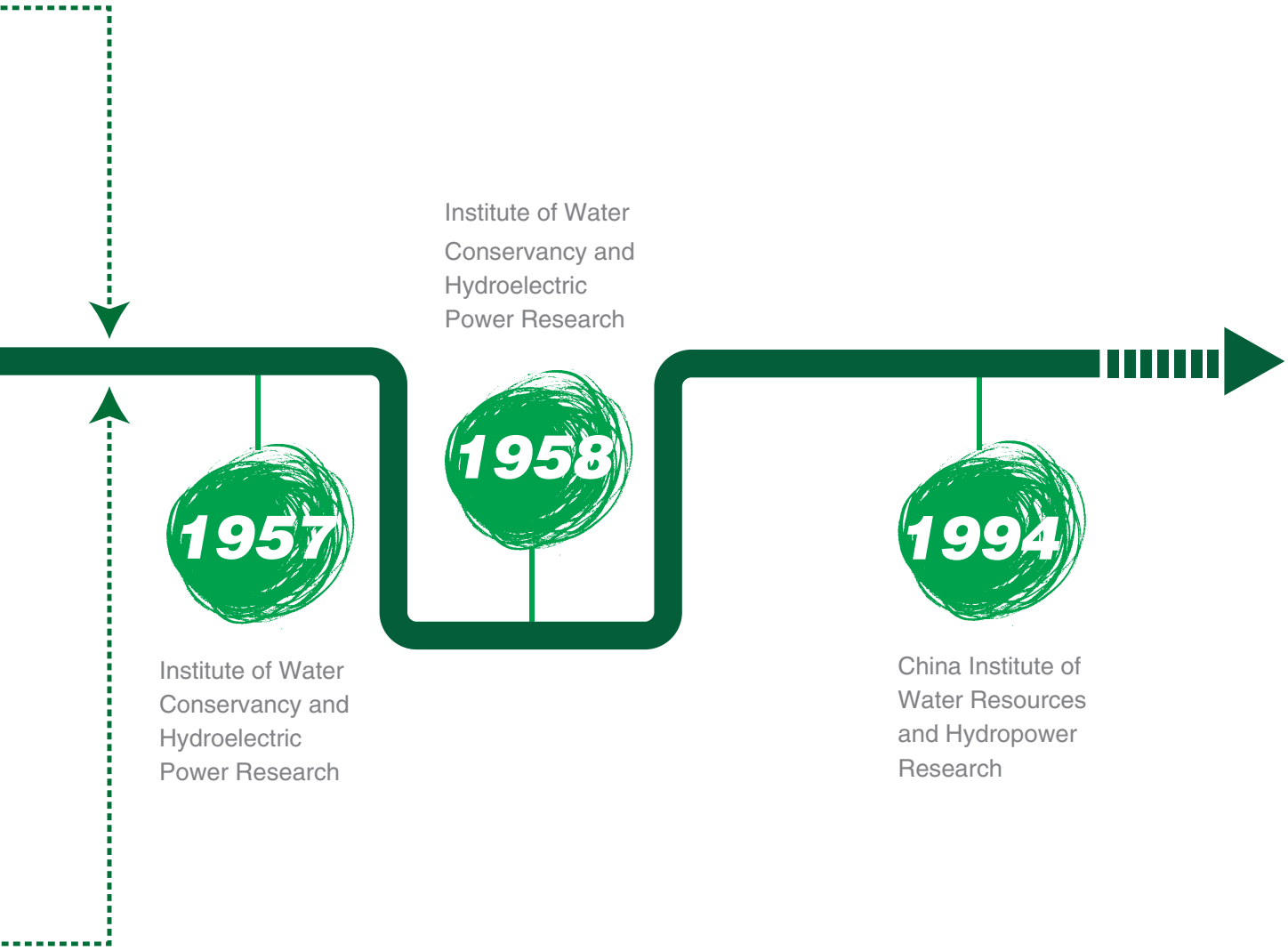
Looking ahead into the year 2016, we will build on our existing efforts and hold the hands of our international partners more firmly on the joint adventure to the future. The ship of IWHR can never sail without the support and driving of all its international friends, to whom we would like to extend our heartfelt appreciation. Hope we could do more to better the future of water in China and the whole world!


Experimental Group of Hydroelectric Power Construction General Bureau, Ministry of Fuel Industry
1952
1956
Hydropower Research Institute, Ministry of Electric Power Industry
China First Hydraulic Laboratory
Tianjin Hydraulic Laboratory
1933
1935
1956
Beijing Institute of Water Resources, Ministry of Water Conservancy
1935
1950
Central Hydraulic Laboratory
Nanjing Water Conservancy Division
1956
Hydraulic Research Division, Chinese Academy of Sciences

HISTORY

Annual Report
2015

CHINA INSTITUTE OF WATER RESOURCES AND HYDROPOWER RESEARCH



CHINA INSTITUTE OF WATER RESOURCES AND HYDROPOWER RESEARCH

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Vision and Strategy

Mission Achievement

中国水科院

CHINA INSTITUTE OF WATER RESOURCES AND HYDROPOWER RESEARCH

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Annual Report

2015

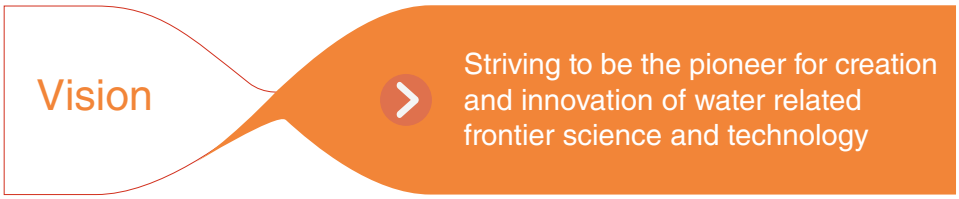
CHINA INSTITUTE OF WATER RESOURCES AND HYDROPOWER RESEARCH

Sunrise in mountains © Yang Yaojuan

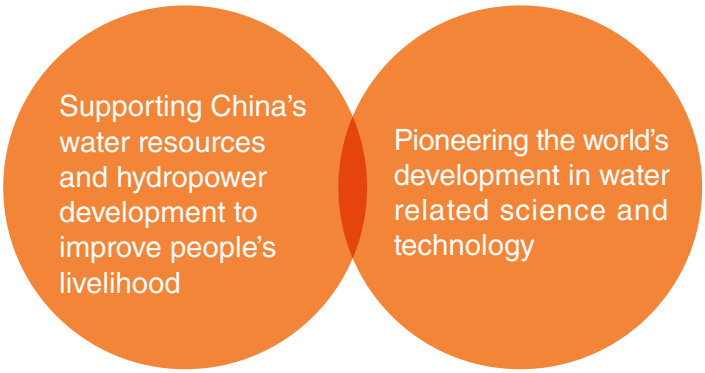
Vision and Strategy

IWHR

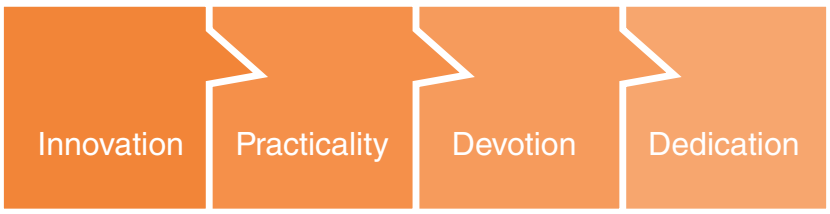
Vision



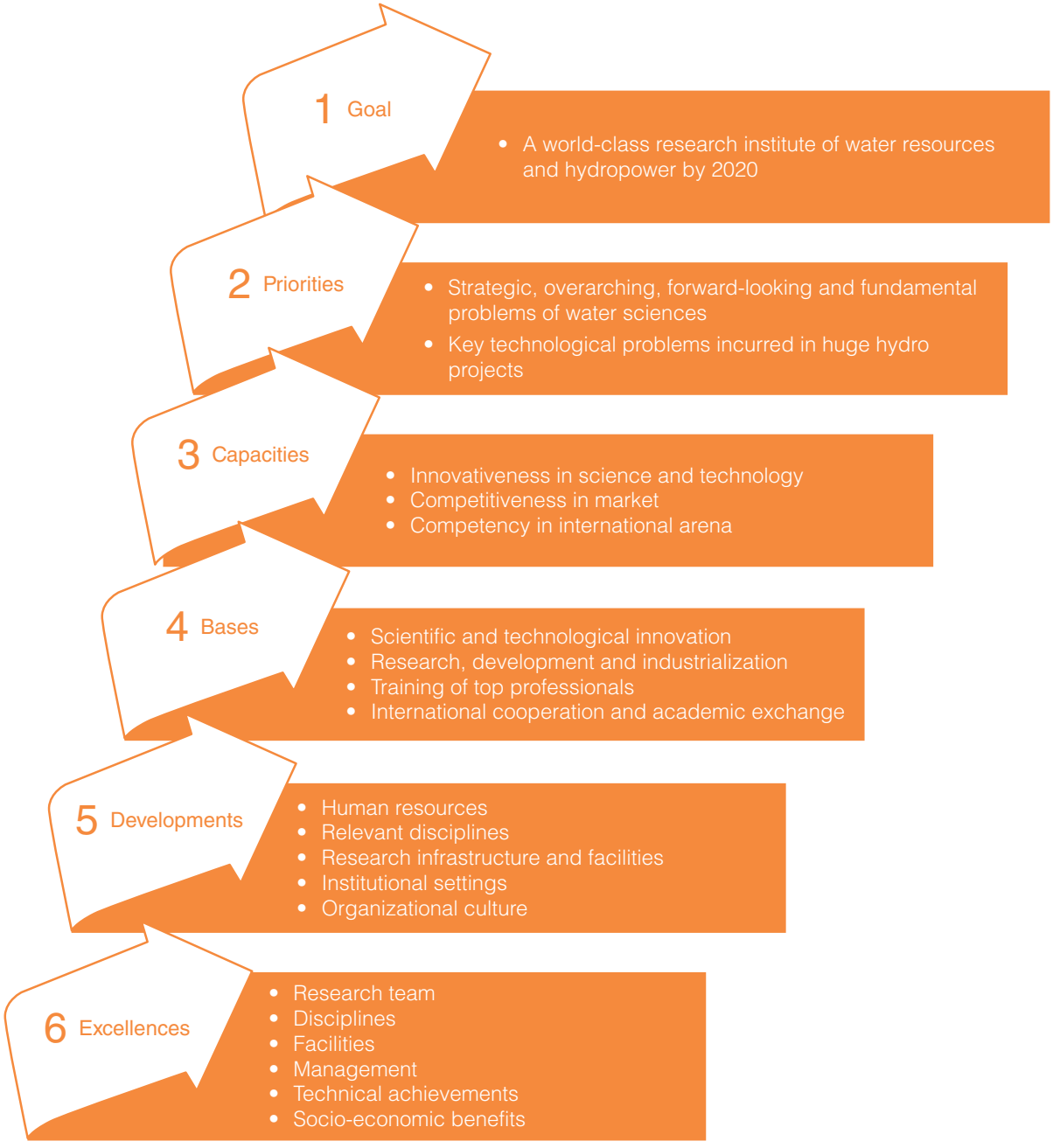
Mission



Spirit



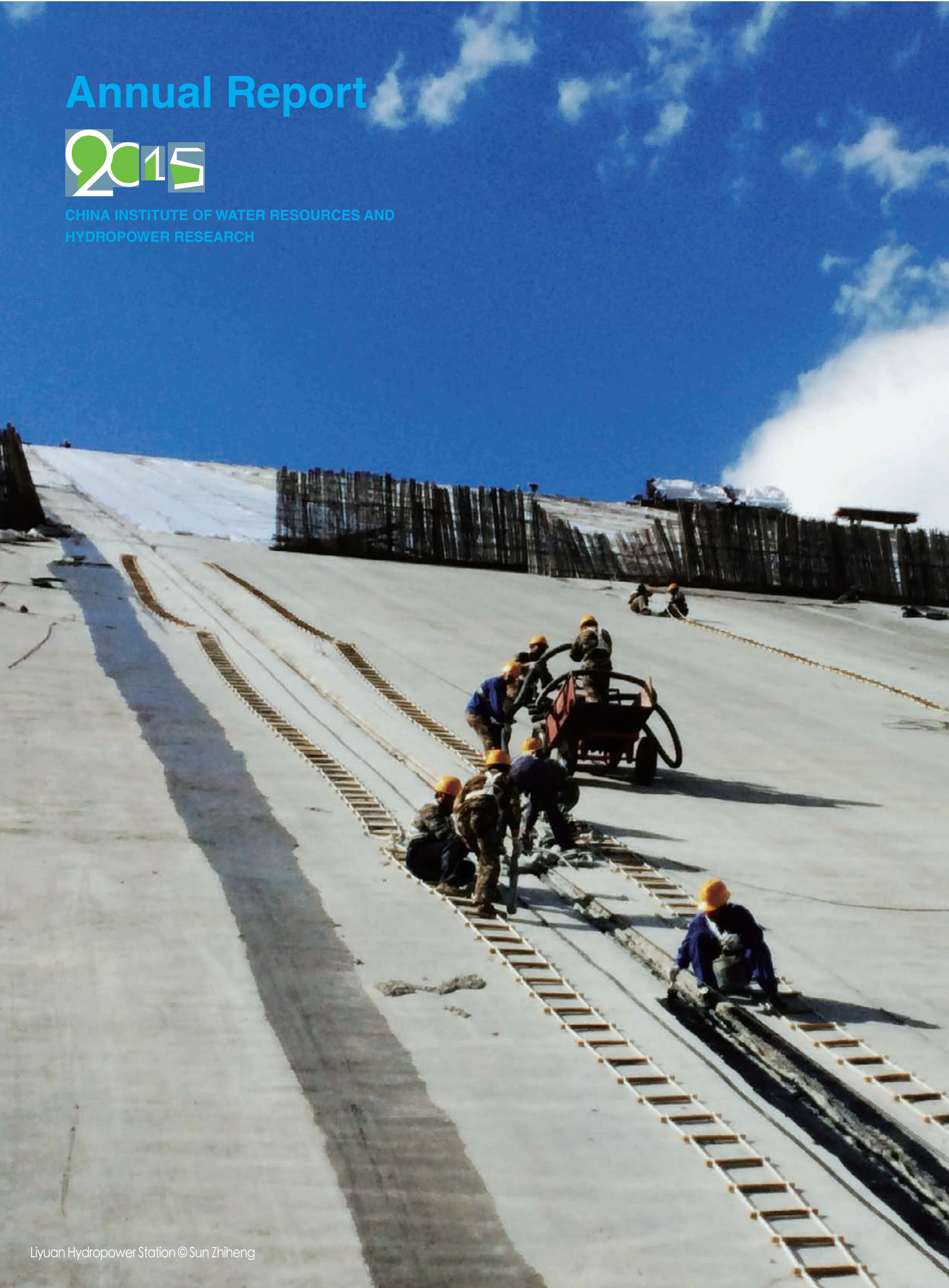
Strategy


1 Goal
• A world-class research institute of water resources and hydropower by 2020
2 Priorities
• Strategic, overarching, forward-looking and fundamental problems of water sciences
• Key technological problems incurred in huge hydro projects
3 Capacities
• Innovativeness in science and technology
• Competitiveness in market
• Competency in international arena
4 Bases
• Scientific and technological innovation
• Research, development and industrialization
• Training of top professionals
• International cooperation and academic exchange
5 Developments
• Human resources
• Relevant disciplines
• Research infrastructure and facilities
• Institutional settings
• Organizational culture
6 Excellences
• Research team
• Disciplines
• Facilities
• Management
• Technical achievements
• Socio-economic benefits

Annual Report

2015

CHINA INSTITUTE OF WATER RESOURCES AND HYDROPOWER RESEARCH



Liyuan Hydropower Station © Sun Zhiheng

Mission Achievement

IWHR

IWHR Innovation

Natural-Artificial Dualistic Water Cycle

By the research team led by Wang Hao

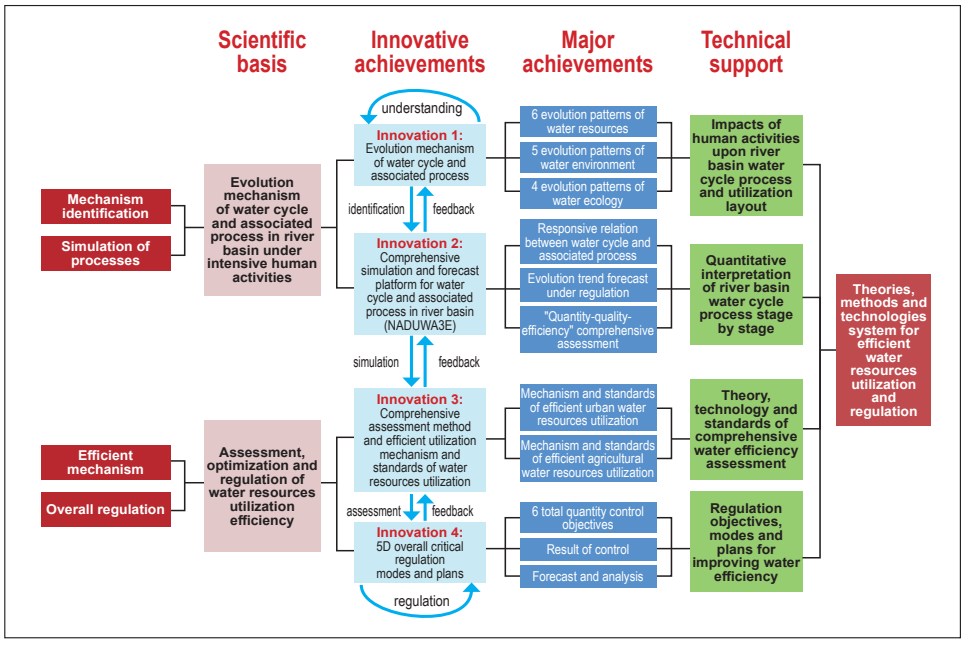
Keywords: natural water cycle, artificial water cycle, natural-artificial dualistic water cycle

Theoretical system

- Natural water cycle: The natural hydrological cycle unaffected by human activities and consisting of atmospheric, overland, soil and underground processes.
- Artificial water cycle: The hydrological cycle created in the social and economic activities, including water withdrawal, diversion, utilization, drain, treatment and recycling. Urban and rural areas are the two fundamental units.
- Natural-artificial dualistic water cycle: The real pattern of hydrological cycle affected by human activities. All river basins with human activities show the characteristics of compound dualistic water cycle.
- The heterogeneous characteristics of dualistic water cycle: Due to the influence of human activities, heterogeneous variations occur in all fundamental links of the water cycle, changing the presumption of hydrological homogeneity.
- Key scientific issues: 1) multi-process coupling feedback mechanism of natural-artificial water cycle, 2) evolution mechanism and pattern of dualistic water cycle and water resources, and 3) quantity-quality-efficiency transformation mechanism of water resources based on the whole process of water cycle.
- Major research contents: 1) interaction and structural coupling of natural-artificial water cycle, 2) multi-process and multi-scale tempo-spatial coupling of dualistic water cycle, 3) evolution pattern of river basin water cycle in changing environment, 4) evolution pattern of river basin water environment in changing environment, 5) evolution pattern of river basin water ecology in changing environment, 6) dynamic assessment of water resources in changing environment, 7) forecasting of future water cycle and uncertainty analysis, and 8) multi-dimensional critical regulation plan of river basin water cycle.

Methodological system

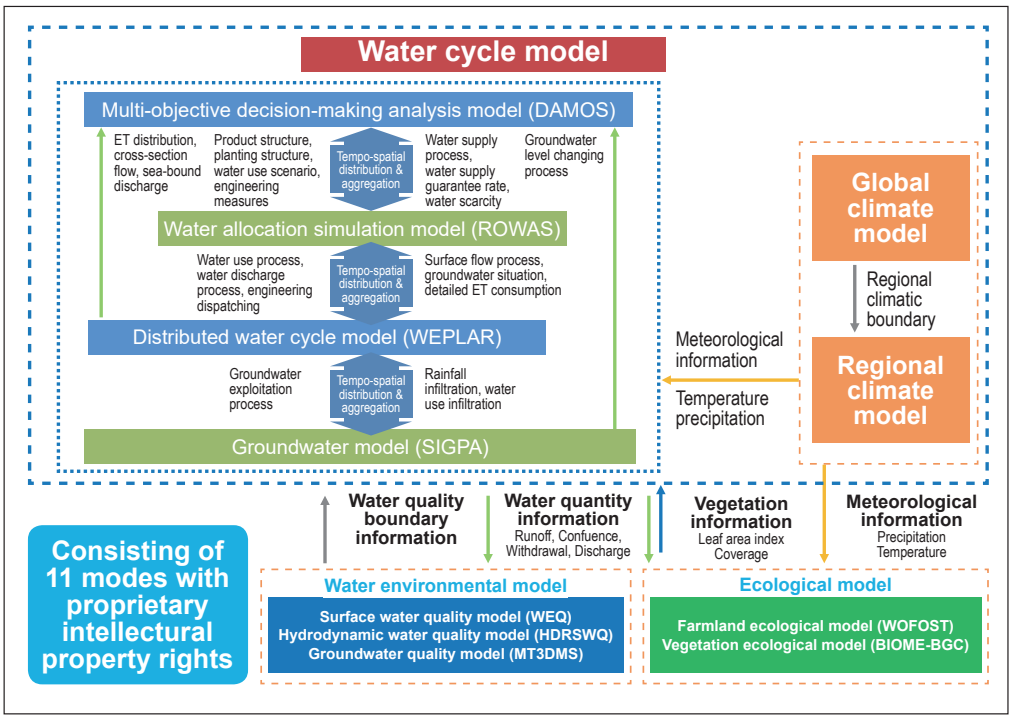
- Based on the dynamic paradigm of natural-artificial dualistic water cycle, the comprehensive simulation model of dualistic water cycle in river basin and the associative processes (NADUWA3E) is developed. Through scaling and coupling integration, the comprehensive coupling simulation is realized of the three major systems (water cycle, water environment, and water ecology) of dualistic water cycle in river basin and the associative processes.
- Comprehensive assessment methods, as well as the mechanism and standards, of full-aperture multi-dimensional efficient water resources utilization are proposed based on the “quantity-quality-efficiency” of water cycle.
- Comprehensive multi-dimensional water cycle regulation model system is established for river basins with intensive human activities and inadequate water resources.



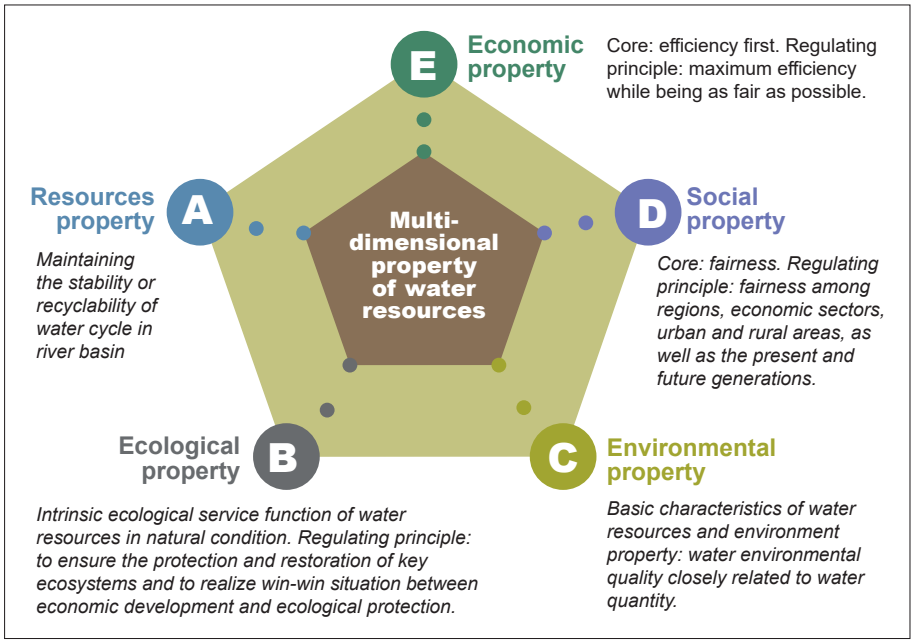
Core technical innovation

Application

- Based on the dualistic water cycle model, simulation and forecasting is conducted for the past, current and future water cycles of Haihe River Basin, quantitatively revealing the six rules of water resources evolution in the river basin and the changing patterns of the associative processes of water cycle. The attribution analysis is also conducted.
- In 2013, International Hydrologic Decade (IHD) decided that the changing “natural-artificial” water cycle be the only direction of development for the next ten years.
- Dualistic water cycle theory, as well as the quantitative tools, has provided decision-making support for the implementation of the most stringent water resources management in China, the building of water ecological civilization, and the development of sponge river basins (cities).
- The research has won the first grade of China’s National Science and Technology Progress Award in 2014.



Comprehensive simulation and prediction platform of water cycle and associated processes in river basins (NADUWA3E)



Theory and mode of multi-dimensional critical overall regulation

Certificate of the National Science and Technology Progress Award (First Grade)

IWHR

Representative Researches

Key techniques of multi-process coupling simulation and ensemble forecast of water cycle under changing environment

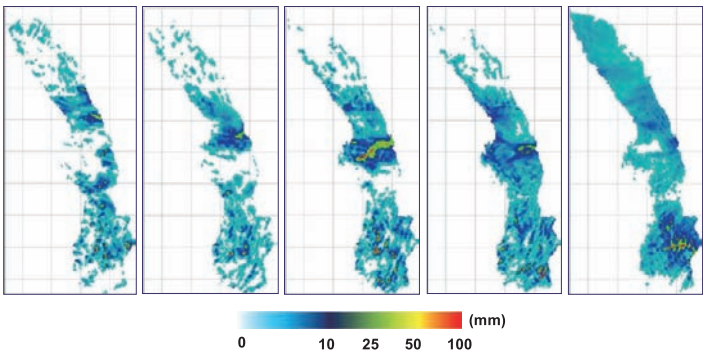
WANG Hao, LEI Xiaohui, JIANG Yunzhong, et al.

Background

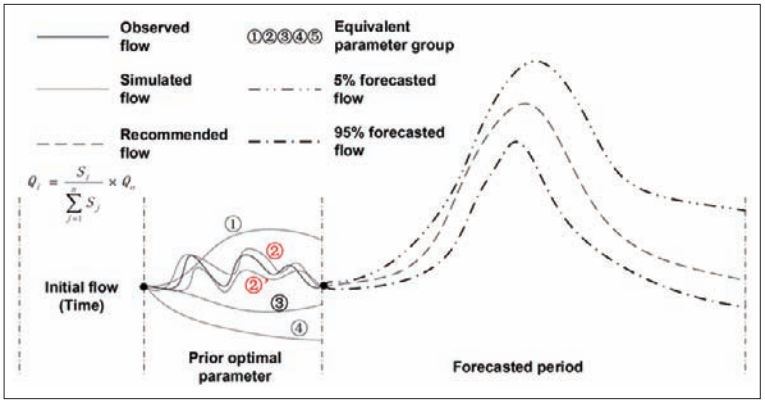
Water cycle simulation and hydrological forecast provide important technical support to flood control and emergency relief, water resources regulation as well as water supply security. However, due to the complicacy of water cycle system in river basin, whether it is in the acquisition, analysis and processing of hydrologic monitor data, or in the development and application of hydrological models, inherent or human-induced uncertainties exist. These uncertainties include subjective hypothesis in hydrological modelling, model structure selection, parameter calibration, methods optimization, and determination of objective function, etc. Study on the uncertainties of hydrological forecast is of great theoretical and practical significance to improving description of hydrological system and accuracy of hydrological forecast.

Contents

- Analyzing error distribution of water cycle simulation/forecast and time-contingent change pattern, so as to further analyze the effects of errors on forecast lead time and water resources regulation.
- Constructing a distributed water cycle simulation model in consideration of human activities, weather system and the uncertainties of modeling tools, thus building 3D visual platform of water cycle simulation and forecast.
- Conducting applied research on model and system in typical river basins, with an emphasis on the uncertainties in the process of water cycle simulation and forecast and their impact.



Precision numerical precipitation forecast based on WRF model



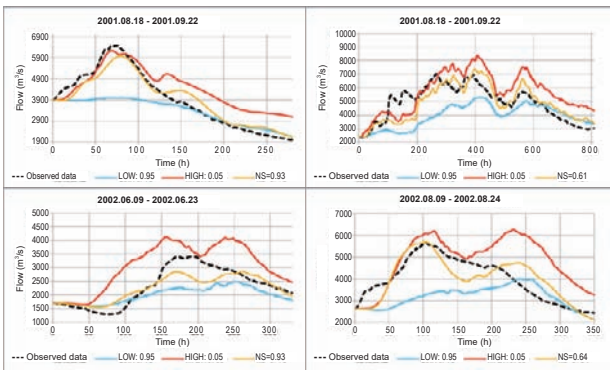
Similar ensemble forecast strategy

Achievements

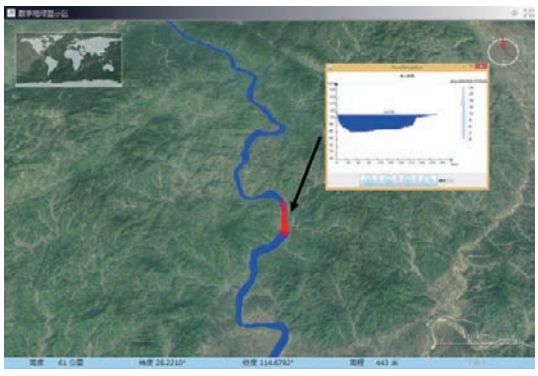
- Using Martingale model, the error uncertainties of hydrological models are described, and the impact of forecast uncertainties on water resources regulation are quantitatively identified.
- The runoff yield and concentration mechanism of the model is improved, and a distributed hydrological model with consideration of the uncertainties of human activities is developed.
- In a bid to control systemic errors and minimize random errors of the model, a collective forecast of runoffs is realized through the combined use of GLUE and similar forecast theories.
- A common hydrological forecast platform is established, combining modeling, parameter adjustment, forecast and evaluation into one 3D visual system.

Application

The research achievements of this project have been applied and verified in several river basins in China such as the Second Songhua river basin, Zhangwei river basin, the Three Gorges reservoir area, Yalong river basin, Shule river basin, etc. and have been utilized in hydrological simulation and flood forecast of Hanjiang river basin, Miyun reservoir area, mountainous region of Taihu Lake basin, Wan'an reservoir basin.



Validation of ensemble runoff forecast



Demonstration of flood peak evolution based on digital globe

Integrated remote control system for giant generator units of cascade hydropower stations in the lower reach of Jinsha River

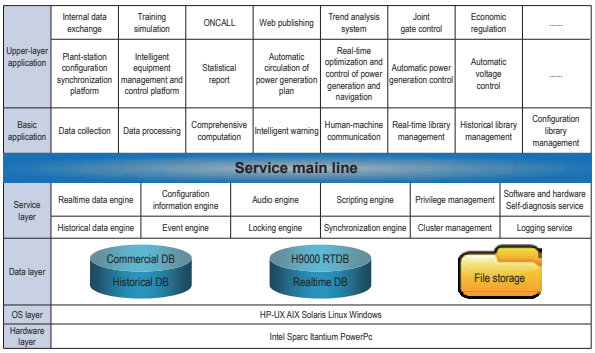
WANG Dekuan,WANG Zhengying, WANG Guiping, et al.

Background

The lower reach of Jinsha River, featured with large water volume and concentrated fall, currently has a cascade of four large-scale hydropower projects under planning and construction, namely Wudongde, Baihetan, Xiluodu and Xiangjiaba from upstream to downstream. It is an important component of the national energy resources base. This research program focuses on the development of remote centralized control and regulation system for the two giant power stations of Xiluodu and Xiangjiaba, so that the control center in Chengdu City will be capable of automatic regulation and control of the cascade hydropower stations in the lower reach of Jinsha River.

Contents

- Designing and implementing a reliable system platform of software and hardware based on multi-redundancy and seamless switching.
- Researching on transmission, processing, storage of mass data and application of reliability technologies.
- Researching on smart warning of mass information and application of visualization technologies.
- Researching on safety control strategies for remote control system and application of technologies against incorrect operation.
- Researching on the application of AGC/AVC and optimized operation technologies for giant cascade hydropower stations under complicated superior regulation environment.
- Researching on grouped remote control technology of gates and application of safety strategies for giant hydropower stations.
- Researching on application of synchronization technology of configuration data for control system of multiple plants and stations.
- Researching on application of smart diagnosis and maintenance technologies for the control system of multiple-type software and hardware.



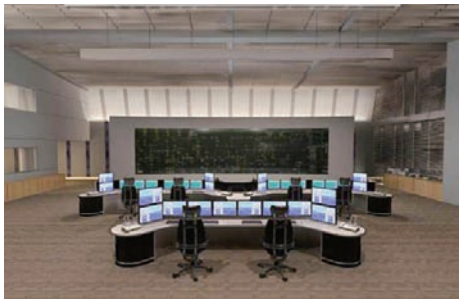
System structure diagram

Achievements

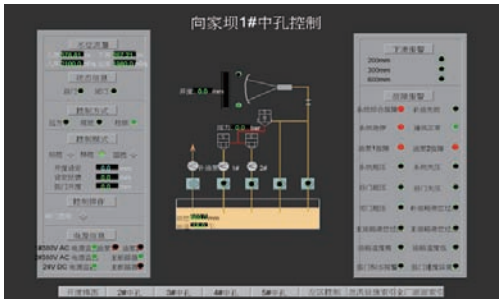
- Remote regulation and control integration is realized in one of the world largest cascade hydropower stations.
- Remote control technology is successfully developed for power generation and navigation safety real-time optimization gate control of large hydropower projects.
- Highly reliable M-SPC multi-stipulation and multi-channel communication technology based on multi-redundancy server cluster is developed.
- Double buffering asynchronous processing communication technology is successfully developed, which can accelerate the current communication speed by tenfold.
- The international standard design in communication field is improved by developing unilateral point table, which greatly improves the safety and maintainability of the system.
- Multi-site online synchronization of configuration data is realized to solve the difficulty of configuration data synchronization among multiple large-scale control systems in a wide area.
- Installment and site commission of cascade centralized control center and power station are conducted at the same time, enabling synchronous automatic control on both sides.
- Equipment-oriented and intelligent real-time alarm technology based on analysis of correlative quantity is developed.

Application

Since its online operation in September, 2012, the newly developed regulation and control system has synchronizly connected and commissioned 26 giant generator units and 44 sets of LCU with the hydropower stations of Xiangjiaba and Xiluodu, and fulfilled its role of remote automatic regulation and control. The system can provide technical referrence for similar projects and has a broad application prospect. Currently, this regulation and control integrated monitoring system has been successfully applied in other projects.



Chengdu control center for Three Gorges Project



Middle outlet control of Xiangjiaba Hydropower Station

Key technologies of satellite remote sensing quantitative monitoring in cross-regional river basins

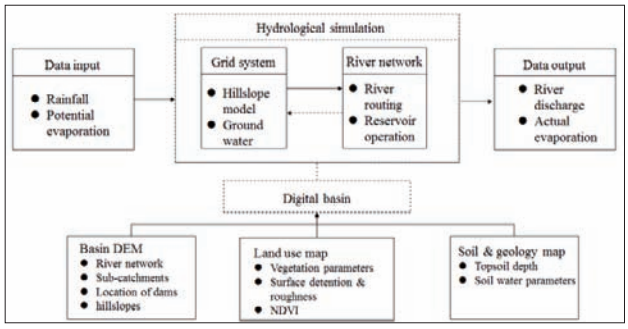
LU Jingxuan, PANG Zhiguo, FU June, et al.

Background

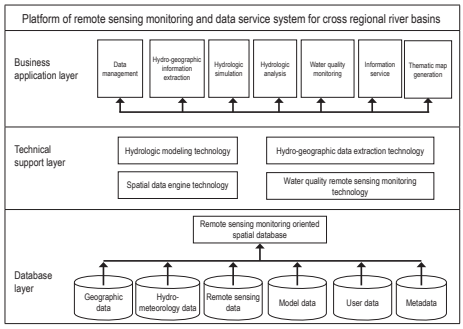
Cross-regional river basins are widely distributed in China, where basic data is scarce and hard to acquire. Therefore, satellite remote sensing technology becomes a necessity to acquire basic data in those river basins. This project aims at key techniques in major aspects regarding quantitative remote sensing applications in such data short river basins.

Contents

- Remote sensing data acquisition and processing, remote sensing based hydrologic parameters inversion, remote sensing based surface land cover data interpretation, topographic data acquisition, and geographic elements extraction in cross-regional river basins.
- Remote sensing based quantitative monitoring of river basin eco-environment, river channel evolution regimes, water resources utilization in cross-regional river basins.
- Applications of remote sensing driven hydrological simulation and quantitative analysis in Yili River, Yalu River and Lancang-Mekong River.
- System platform construction of quantitative remote sensing monitoring and data service for cross-regional river basins.



The Lancang-Mekong River basin hydrological model



Technical architecture of the quantitative remote sensing monitoring and data service system for cross-regional river basins

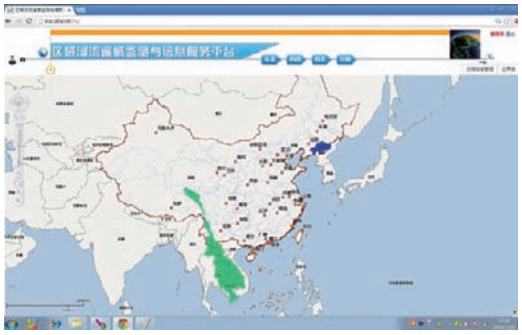
Interface of basic hydro-geographical elements analysis system

Achievements

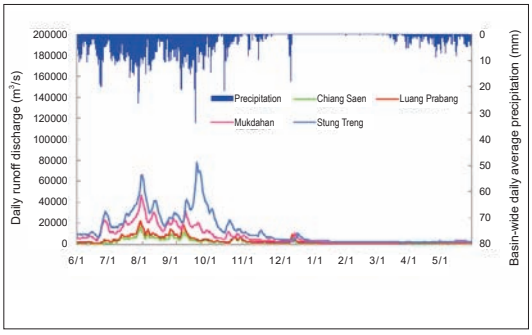
- Complete methodology and relevant key quantitative techniques for remote sensing data acquisition and processing are developed for cross-regional river basins.
- A set of key techniques are developed including remote sensing based hydrologic parametric inversion, land surface interpretation, geographic elements extraction, and remote sensing data products generation for cross-regional river basins.
- A series of quantitative remote sensing applications are conducted with several practical techniques and methods developed.
- Hydrological process models are coupled with remote sensing obtained data, with several fully remote sensing data driven hydrological models established in cross-regional basins.
- A system platform of quantitative remote sensing monitoring and data service for cross-regional river basins is constructed, with techniques of active data service and multi-dimensional visualization applied.

Application

Over 20 times of specific data services have been provided in remote sensing monitoring of landslides, glacier lakes, floods, etc. in cross-regional river basins. The methodology has also been applied in the remote sensing monitoring of water resources conditions in South East Asia, results of which have been compiled into the 2014 Annual Report of Remote Sensing Monitored Global Eco-environment (China-ASEAN Eco-environment Conditions).



Interface of the quantitative remote sensing monitoring and data service system for cross-regional river basins



Simulation result in the Lancang-Mekong River basin

Research on flow resistance characteristics and water transfer capacity of the middle route of South-to-North Water Diversion Project

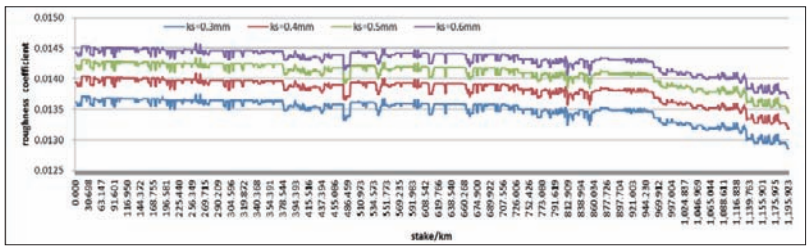
LIU Zhiping, CHEN Wenxue, MU Xiangpeng, et al.

Background

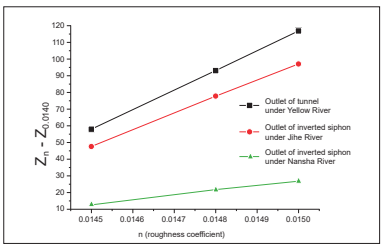
Precisely determining the head loss of water transfer structure and making a reasonable channel water-surface curve are two major issues in engineering design and operation maintenance. Compared with that of the feasibility study stage, there have been several changes during the construction process of the middle route of South-to-North Water Diversion Project, such as adding bridges along the route, change of flow cross-section in some channel sections, adjustment of diversion intakes position, etc. As these changes will bring certain effects to the water-surface curve and water transfer capacity of the middle route project, the practical water transfer capacity and canal freeboard should be rechecked and verified. This research project conducts a comprehensive and systematic research and analysis on water resistance characteristics of various kinds of water transfer structures, water-surface curves and the water transfer capacity of the whole route, and has played a key role in guaranteeing the acceptance and commissioning of the project, and is of great importance to the project operation and regulation and the improvement in canal hydraulic.

Contents

- Comprehensively analyzing the water resistance impacts of various kinds of water transfer structures, conducting research on the calculation methods of main canal roughness coefficient and local head loss coefficient of the South-to-North Water Diversion Project.
- Conducting research on impacts of bridge pier backwater in the middle route of South-to-North Water Diversion Project.
- Analyzing the major factors influencing the water-surface curve and the water transfer capacity of the middle route of South-to-North Water Diversion Project.
- Developing computer platform of data management and water transfer capacity calculation of open-channel water transfer project.



Distribution of roughness coefficients corresponding to roughness of different equivalents along the main channel of South-to-North Water Diversion Project



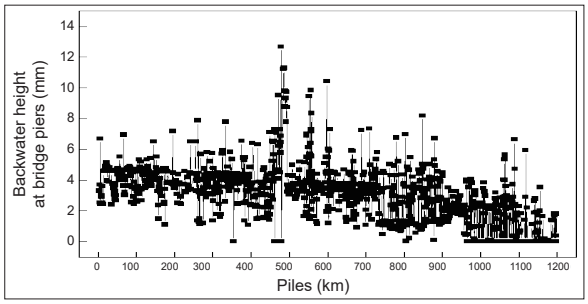
Sensitivity analysis of pool water level to roughness

Achievements

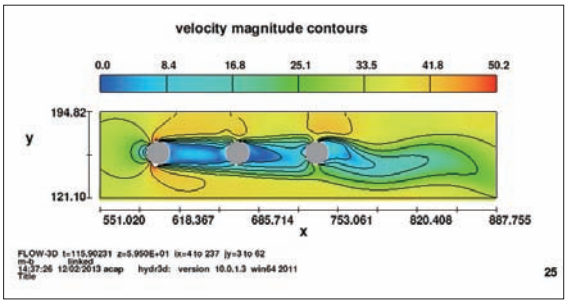
- According to the uncertainty theory, prototype measurement uncertainty calculation formula and prototype measurement method of long-distance water transfer channel roughness coefficient are put forward and the value range and distribution pattern of the roughness coefficient is determined, which are of great significance to accuracy improvement of roughness coefficient observation and frictional head loss calculation of the middle route of South-to-North Water Diversion Project.
- Backwater characteristics of single bridge and multi-successive bridges are reveal and application conditions of different types of bridge pier backwater formulas are obtained, and then the calculation method of bridge pier backwater in main channel of middle route is established.
- According to the uncertainty theory, rules of value choosing of local head loss coefficient and uncertainty calculation formula of prototype observation are put forward to guide the prototype observation and local head loss assessment of the main channel of middle route.

Application

- The research results are directly applied to the demonstration of water transfer capacity, canal freeboard, and design of water diversion gates and check gates, providing technical support to the follow-up construction and water supply.
- The research results provide scientific basis to the planning of water supply and regulation and hydraulic parameter selection of the regulating models, and are of great importance to the operation and management of the project.
- The research results are of reference value to the planning, design, construction and assessment of other long-distance water transfer projects.



Backwater condition of bridge piers along the project under design flow



Velocity distribution of cross sections near multi-row piers

Study on brush-coated flexible cover waterstop structure of CFRD joints and its application

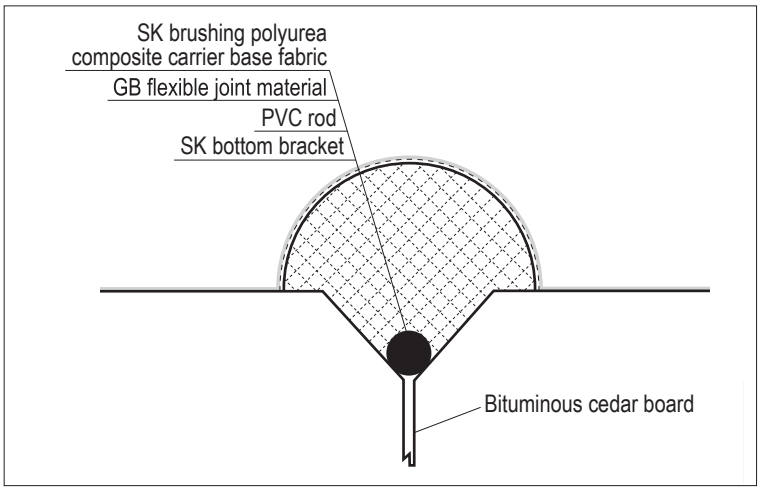
SUN Zhiheng, XIA Shifa, XU Yao, et al.

Background

The cover waterstop of joints is an important part in the seepage-proofing system of a CFRD. In view of the existing problems of disengagement between the protective cover and concrete face and frost heaving and fall-off of exposed fixed bolt, this study puts forward brush-coated flexible cover waterstop structure of CFRD joints, and has conducted systematic in-door and field tests, and has established a complete set of CFRD cover waterstop technologies from material and structural design to construction technique and quality control. The new type of waterstop structure has been successfully applied at Liyuan CFRD of 155m high. It is reliable in surface protection, seepage-proofing and durability, and is easy to be constructed, and can be used for reference by similar projects.

Contents

- Studying the physico-mechanical properties of SK monocomponent polyuria, and putting forward the major technical indicators to satisfy the seepage-proofing requirement of CFRD joint waterstop.
- Studying the seepage-proof reliability and durability of the new-type structure in a systematic way by taking pump-in tests at both downstream face and upstream face, and three-dimensional simulation model test, etc.
- Carrying out study on construction technique of brush-coated flexible cover waterstop structure of CFRD joints based on practical engineering and putting forward a set of quality control and examination methods.



Brush-coated flexible cover waterstop structure

Achievements

- The new brush-coated flexible cover waterstop structure of CFRD joints is brought forward and applied to practical engineering, greatly improving the reliability and safety of waterstop of CFRD joints.
- Moist concrete interfacial agents are developed to match with the SK monocomponent polyuria, ensuring the bonding strength between the coating of SK monocomponent polyuria and the concrete.
- Construction technique and quality control method of brush-coated flexible cover waterstop structure are put forward and applied in practice.

Application

The research results have been successfully adopted by Liyuan CFRD in Yunan Province, Pushihe CFRD in Liaoning Province and Buxi CFRD in Sichuan Province, greatly improving the seepage-proof reliability at CFRD joints. With good economic and social benefits, the new-type structure will have a broad prospect in newly-built and reinforcement projects. Based on the study results and the engineering practice, the research team has compiled related technical regulations, laying a good basis for promoting the new technology.

Application in Liyuan CFRD

Liyuan CFRD after impoundment

Study on prevention and control technology of soil and water erosion on hillslope lands in water erosion areas

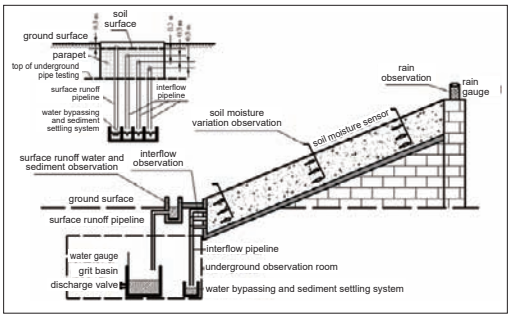
ZUO Changqing, QIN Wei, FANG Shaowen, et al.

Background

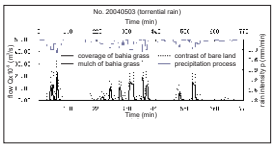
In China, nearly 70 percent of the land area is mountainous region, upon which 40 percent of the total population depends for living and production. Sloping fields have become important carrier and support to socio-economic development and land ecological security. Due to the poor natural conditions, intensely human-conducted exploitation and dramatic climate change, water and soil erosion in sloping land has been a bottleneck constraint in national socio-economic sustainable development. This research focused on prevention and control mechanism and technology, forecasting model, and management effects, sloping lands soil and water resources conservation and efficient utilization was taken as the core point, the red soil area in South Chin where water erosion is severe, but with little research was taken as the study area, multi-scale and applicable water and sand prediction model was established, and water erosion prevention and control technology with integrated effects and in favor of both ecology and economy was developed. The results have provided technical support to a series of national soil and water conservation projects including comprehensive management of sloping farmland soil and water erosion projects etc., and it has great significance for the enhancing of ecological environment and people's livelihood in red soil areas in South China.

Contents

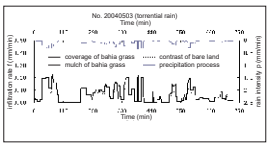
- The spatial-temporal evolution of water erosion agent across the country was assessed by combined statistics and GIS technology .
- Water erosion prevention and control mechanism in red soil sloping areas was illustrated based on water quantity balance test facility on original sloping surface.
- A multi-scale water and sediment forecasting model system in red soil sloping areas was conducted through the physical description of integrated runoff generation process and statistical analysis of sediment yield rule.
- Water erosion prevention technology in red soil areas was studied based on comprehensive effectiveness assessment of treatment measures.



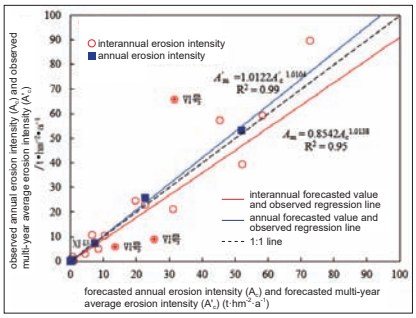
Water and sediment observation device based on water balance experimental facility of original sloping areas



(a) surface runoff;



(b) sediment;



(c)soil infiltration

Comparison between simulation and measurement

Achievements

- GIS database of nation-wide precipitation erosion agent with the longest time sequence and the largest number of monitoring stations is established, the temporal evolution process and spatial variation pattern of precipitation erosion agents in different types of water erosion areas in the recent 60 years are overall analyzed.
- Moisture transport and distribution pattern under the influence of soil and water conservation in sloping fields is revealed, and the capability and functional mechanism of vegetating and mulching in water conservation, flood detention and peak clipping capability are determined.
- Individual rainfall capacity and raininess threshold value, classification standard, simple formula for erosion agent caculation are put forward, and a multi-scale flow and sediment forecasting model system is established, including physical model of individual-rainfall-induced surface runoff, interflow statistical model, multi-year and inter-annual soil erosion equation, etc.
- Vegetation engineering mode of furrow inside and ridge outside plus bench terrace with grass planting on terrace wall, and ecological vegetation mode of banded integration of crops, forests and grass plus cross slope planting are developed, water erosion prevention technologies in favor of ecology and economy are chosen for red soil sloping area.

Application

Seven experimental and demonstration bases are established, the technology is popularized over 300,000 mu land, The research results provide scientific evidence to the comprehensive management of sloping cropland in Jiangxi Province, Fujian Province and Sichuan Province in South China, and have been compiled into the 12th Five Year Plan of Science and Technology Extension in Water Conservancy Industry, and has given great support to water and sediment variation research of the Yellow River, enriching the theoretical and technological system of soil and water conservation in South China.

a. Bench terrace with furry inside and ridge outside plus grass planting at terrace wall

b.Banded integration of crops, forests and grass plus cross slop planting

Vegetation engineering mode and ecological planting pattern optimization and development

Research and application on high accuracy standard facilities and the key technology of large water flow measurement

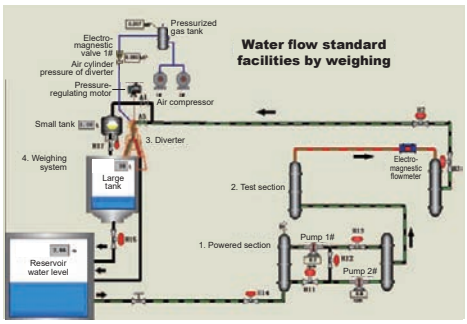
DENG Xianghan, LU Li, WANG Li, et al.

Background

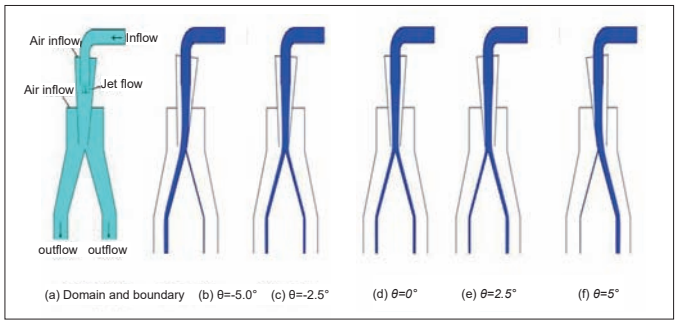
Measurement of water flow is fundamental for water resources and other related sectors. Currently there is still room for improvement in water flow standard facilities with high accuracy, large water flow, large diameter and high velocity of pipe flow. To further enhance and standardize the value traceability system, ensure the reliability and accuracy, and improve the management of water flow measurement, research is conducted on the key technologies of high-accuracy large water flow measurement, and the achievements can be widely applied to the sectors of water resources, power, agriculture and environmental protection, as well as to people's daily life, promising a brighter prospect of application in future.

Contents

- Researching and developing the key technologies of high-accuracy large water flow measurement, including the technology of high-accuracy diverter and timer.
- Researching and developing the onsite calibration technologies for flowmeters in closed conducts, including the electromagnetic flowmeter, and the ultrasonic flowmeter.
- Researching the technical standard system of water flow measurement and the verification and calibration standard system of water flow measuring instruments.



Overall layout for high-accuracy water flow standard facilities by weighing



CFD numerical simulation calculation of two-phase flow of diverter

Achievements

- Technical traceability platform of large water flow measurement is established with static weight method as the core, and the water flow standard facilities of high-accuracy large water flow measurement is developed (the expanded uncertainty 0.0356%, maximum flow rate 7200 m^3/h, maximum diameter 800 mm, and maximum velocity 45.0 m/s for the diameter of 100 mm).
- New online calibration method is proposed for pipe flowmeters of different diameters, while the index system (with relative indication error, repeatability and measure deviation as the three major calibration indicators) is established.
- Technical standard system for water flow measurement, and verification and calibration standard system for water flow measuring instruments are established.

Application

- The research achievement of high-accuracy large-flow measurement standard facilities has been applied to eighteen large water and hydropower projects in China, including the generating unit with maximum installed capacity (1000 MW) in Baihetan Hydropower Station, and the testing nuclear unit (1000 MW) for the full-flow experimental platform of nuclear main pump developed by Harbin Electric Power Equipment Co., Ltd.
- The research achievement of onsite calibration technology for pipe flowmeter has been applied to online flowmeter calibration for 7 companies, including Wuhan Pinghumen Water Plant and Wuhan Geo-Eng Yangtze Australia Co., Ltd.
- The Standard System for Water Flow Measurement Technology and the Standard System for Verification and Calibration of Water Flow Measuring Instruments have been developed. Twelve proposed standards and six pieces of suggestions on standard merging and optimization from these two systems have been accepted in the Standard System for Water Technology issued in 2014 by the Ministry of Water Resources.
- The Verification Regulation on Large Water Flow Measurement (draft) and the Technical Requirements for Online Real Flow Calibration of Pipe Flowmeter (draft) have been developed, providing technical references for the formulation and amendment of related standards.

Onsite real flow calibration of large-diameter pipe flowmeter using Z method

Calibration of clamp-on (externally mounted) ultrasonic flowmeter by using the water flow standard facilities (DN500mm)

Technical System and Standard for Comprehensive Water Conservation in Modernized Agriculture

LIU Qunchang, MU Jianxin, ZHANG Shaohui, et al.

Background

The dramatic regional variation due to restriction by meteorological and geographical et al natural conditions, together with the participation from many sectors, have led to the lack of consistent and standardized index system in construction standard and quality control, as well as the low benefits of irrigation and drainage schemes. Based on the current situation of water saving schemes for China's modern agriculture, and focusing on the three aspects of technical needs in modernization, technical modes and construction standards and quality assessment of irrigation and drainage schemes, this project studied and established the technical index system of standardized water-saving schemess for modern agriculture, and the project results can provide technical supports to the sustainable development of modern water-saving agriculture in China.

Contents

- Study on the connotation and assessment methods of irrigation and drainage modernization of irrigation districts.
- Technical study and demonstration on construction standardization of modernized irrigation and drainage schemes.
- Study on quality control and assessment methods of irrigation and drainage schemes.
- Construction standardization of end canal schemes in irrigation districts of north of China.
- Technical system and standards of pipeline irrigation and drainage schemes in farmlands of south of China.

Management center for the demonstration of pump station in south of China

Automatic control and management office in demonstration area in south of China

Achievements

- Presented the connotation and assessment methods of irrigation and drainage modernization, and established the assessment indicator system of irrigation and drainage modernization.
- Established the indicator system of high-standard irrigation and drainage schemes, presented the construction standards and project layout modes of high-standard irrigation and drainage schemes.
- Presented the quality assessment indicators and grading standards of canal lining and seepage prevention, low-pressure pipeline water conveyance irrigation, and small-scale irrigation water source et al irrigation and drainage schemes.
- Built the cCoupled model of water flow movement for the continuous system among end irrigation canal system, furrowed fields and soil.
- Presented the layout modes and indicator system of construction standardization of end canal schemes in irrigation districts of north of China, established the assessment system for technical suitability of piped irrigation and drainage schemes in south of China.
- Developed the technologies and indicators of efficient water management regulation and control for irrigation and drainage schemes with pipelines, established the indicator system for quality assessment of irrigation and drainage schemes, developed the comprehensive assessment system for quality of irrigation and drainage schemes.

Application

Demonstration areas of high-standard irrigation and drainage schemes have been constructed in Changshu of Jiangsu Province and Guangrao of Shandong Province with a radiating area of 15,000 mu (1,000 ha). Some of the research results have been incorporated ito the “Standard for Check and Acceptance of Water-Saving Irrigation Schemes” (GB/T 50769-2012) et al six standards, compiled the “Design Atlas of High-Standard Irrigation and Drainage Schemes”, as well as the book titled “Technical Manual of Canal Seepage Prevention Schemes”.

Demonstration area of well irrigation

Demonstration area of canal irrigation

Reconstruction of hydrological characteristics of historical droughts and typical drought disasters

LYU Juan, WAN Jinhong, LIU Jiangang, et al.

Background

In a bid to enhance drought relief strategy and prevent extreme drought disasters, it is imperative that the formation of a drought disaster be understood and a management system of drought risks be established. Against the backdrop that research on drought lacks data of long time sequence and systemic base materials, this research collects the original files of historical floods and droughts, and digitally records the files of historical hydraulic droughts, hence lengthening the time sequence of data on drought and drought disasters, and providing important reference for relevant research.

Contents

- Sorting out the files of memorials to the emperor on drought in the Palace Museum, and establishing a drought database.
- Analyzing the patterns of temporal-spatial changes of droughts in various localities.
- Studying on methods to reconstruct hydrological characteristics of typical drought disasters.
- Reconstructing the hydrological environment of mega drought disasters in the history.

Sorting out the original files

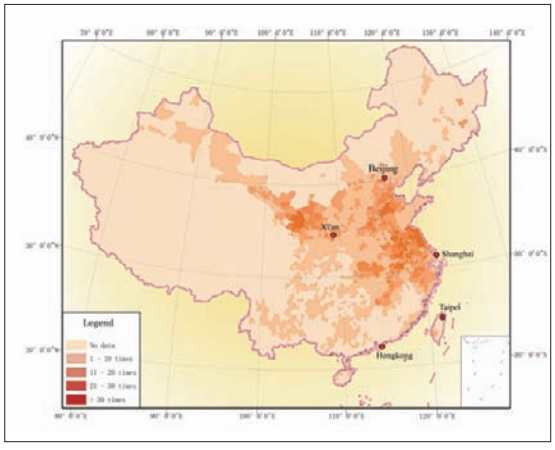
Historical files on drought in Qing Dynasty, China Book Press, 2013

Achievements

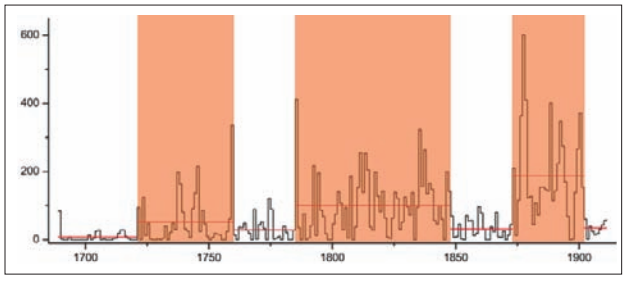
- Using files of memorials to the emperor on drought in the Palace Museum as original materials, a sequence of drought records from 1689 to 1911 is compiled, and the book Historical Files of Droughts in the Qing Dynasty is published.
- The surface hydrological conditions during the sustained drought period in the reign of Guangxu Emperor (1871-1908), Qing Dynasty are reconstructed, including cases of river and well dry-up, etc.
- The year-to-year geological distribution pattern of droughts throughout over 200 years in Qing Dynasty is reconstructed, and change characteristics in varied temporal-spatial scales are analyzed.

Application

Results from this research provide theoretical basis for compiling the national drought relief plan; particularly, the hydrological reconstruction method of typical drought disasters enables the translation from qualitative scripts to quantitative measurements, making possible doing research on drought through drought disasters, and guiding the compiling of regional drought relief plans. Drought data of long time sequence provide key support to relevant research on climate change.



Geological distribution of drought disasters in Qing Dynasty



Change pattern of drought frequency in Qing Dynasty

Supporting techniques of environmental impact post-assessment of reservoir projects

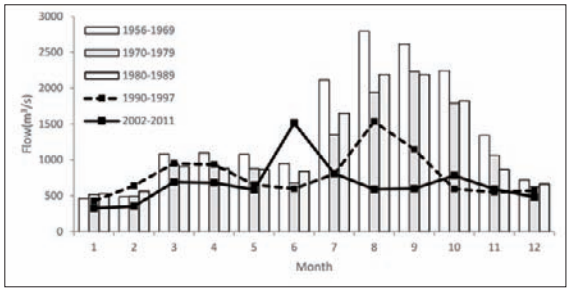
WANG Dongsheng, SUI Xin, GE Huaifeng, et al.

Background

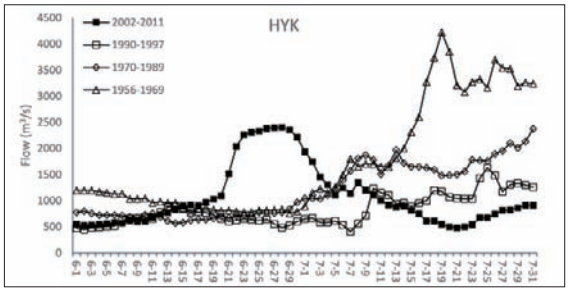
As environmental impact post-project assessment is an indispensable part of environment management, the development of techniques to conduct reservoir environmental impact post-assessment could help lay the foundation for full implementation of post-assessment in the water and hydro-engineering sector. This project sheds light on the long-term eco-environmental impact of reservoir projects in operation period, by conducting post-assessment of reservoir environmental impact, and proposes the basic theoretical and technical systems of reservoir environmental impact post-assessment. Case study on the Xiaolangdi project is conducted in a bid to enhance the technical methods. A technical guideline on reservoir environmental impact post-assessment is complied, providing reference for compiling technical standards.

Contents

- Theories of environmental impact post-assessment on reservoir ecological system.
- Techniques of environmental impact post-assessment on reservoir projects.
- Techniques of environmental impact post-assessment on river corridors downstream the reservoirs.
- Assessment techniques of ecological benefit and loss induced by reservoirs.
- Assessment techniques of the efficacy of environmental protection measures.
- Assessment techniques of ecological adaptive management of reservoir projects.



Monthly average flow variation of Xiaolangdi station from 1956 to 2011



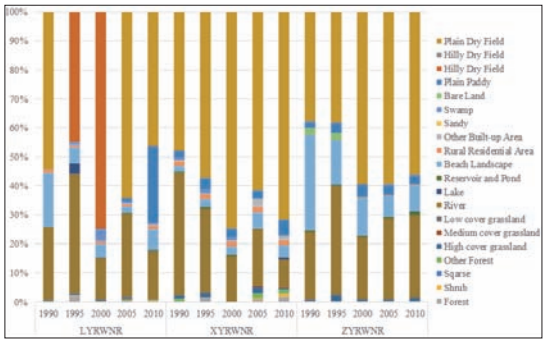
Daily flow variation in water and sediment regulation period

Achievements

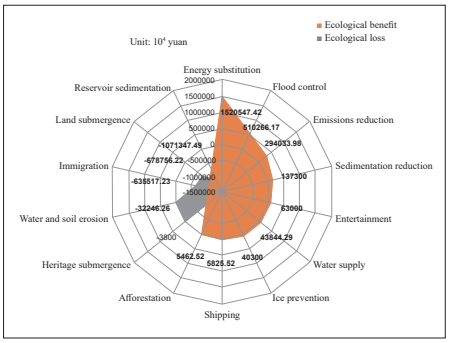
- A theoretical and technical framework of environmental impact post-assessment on reservoir ecological systems are established, and post-assessment procedures are put forward.
- Spatial coupling techniques based on hydrological regime and eco-sensitive targets are proposed.
- The assessment on how reservoir operation impacts biological habitats, targeting the habitats of important fauna (fish and birds) is conducted, and the relationship between river estuary wetland changes and hydrological processes is highlighted.
- A concept of ecological adaptive management is suggested in response to ecological and hydrological processes analyses and demands of protecting key ecological targets, and the methodology of efficacy assessment on environmental protection measures is established.
- The Framework of Technical Guideline on Reservoir Environmental Impact Post-Assessment is formulated.
- A case study on Xiaolangdi project is conducted, and a reservoir management and regulation plan is proposed.

Application

- The methodology and technical guideline framework put forward in this study have been applied to the drafting of Technical Guideline of Hydro-Engineering Projects Environmental Impact Post-Assessment.
- The technical methodology and key environmental assessment indexes raised in this study provide operable tools for quantitative assessment, hence providing technical guidance to the design review and environmental impact post-assessment of hydro-engineering projects.



Land use of three wetland natural reserves in 1990, 1995, 2000, 2005 and 2010 as a percent of the total area



Envelope diagram of ecological benefit and ecological loss of Xiaolangdi reservoir

Technical research on conservation and protection of Karez groundwater resources

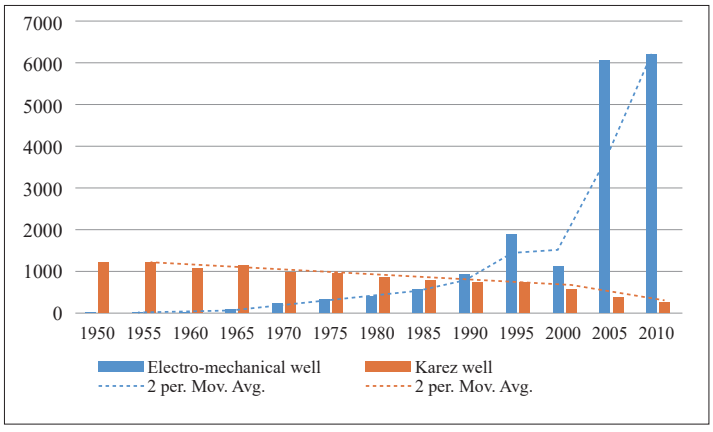
XING Yichuan, ZHANG Aijun, HUANG Qingwen, et al.

Background

Karez located in Xinjiang Uygur Autonomous Region are accomplished and time-honored hydraulic structures created by ancient Chinese, and still provide the main source of water for local drinking and livestock raising, hence acclaimed as the “spring of life” by the local residents. Mainly built in Xinjiang Turpan and Kumul, Karez in recent years decline both in number and water output due to the expansion of cultivated land and the advance of electro-mechanical wells. In an effort to protect Karez and enhance the sustainable development of water resources, this research conducts analysis of water environment evolution, damage mechanism and reinforcement, and water withdrawal control, etc. of Karez.

Contents

- Investigation of water environment evolution and trend analysis in Karez area.
- Technological demonstration of using water stored in the piedmont alluvial fan in Turpan Depression to replenish ground water.
- Research on Karez damage formation and reinforcement technology.
- Research on water quantity control in Karez in non-irrigation period and ground water conservation technology.



Change in numbers of electro-mechanical wells and Karez wells in Turpan region

Achievements

- Analysis of the main factors causing the dry-up of Karez in Turpan Depression over the past three decades is completed, and measures to protect and utilize Karez are suggested.
- The feasibility of replenishing Karez water source with water stored underground in piedmont alluvial fan is demonstrated, and technologies like fish scale-shaped pits and flood detention dams are put forward.
- Damage formation process of Karez culverts and vertical shafts under the impact of dry-wet cycle, freeze-thaw cycle and water seepage is illustrated, and a culvert reinforcement technology—concrete spray(smear) by anchor bolt with geogrid is suggested.
- Technologies of harnessing stored water during agricultural slack season are suggested, including replenishing Karez with the stored water and water quantity control.

Application

The idea that conserving ground water sources should be the first step of protecting Karez resonates well with the local authority, as results from this project have already been applied to the plan of Karez ground water conservation and protection formulated by the local government. Multiple Karez have been successfully reinforced and restored.

Self-revolving anchor bolt and geogrid under installation

Piedmont alluvial fan in Turpan Depresion

Recharge experiment of electro-mechanical wells (recharge inlet)

Method and indexing system for evaluating the reservoir functions

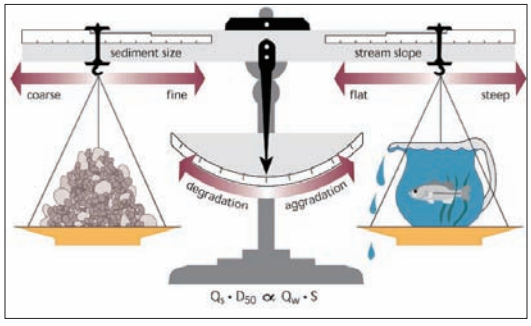
YU Qiyang, LIU Xiaoying, WU Baosheng, et al.

Background

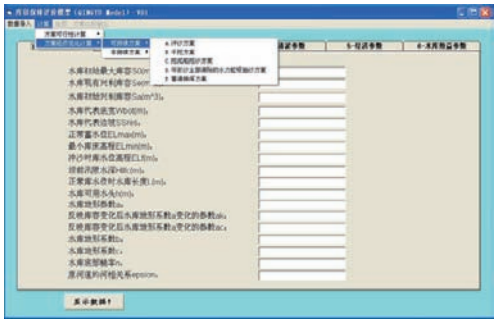
Encumbered by limited resources and conditions at the time of construction, and faults in reservoir design, construction, operation and management, there are operating reservoirs in China experienced significant loss of capacity. The capacity loss resulted in declined functions of flood control and water storage. It is very important to restore these worn-out reservoirs that is an integral part of the solution to address water shortage and flood disasters. This research provides methods to assess the impact of sedimentation on reservoir functions and develops an accordant evaluation model, hence providing sound technical support to effective management and sustainable utilization of reservoirs.

Contents

- Analyzing the impact of sedimentation on reservoir function.
- Establishing an indicator system for evaluation of function attenuation and restoration measures.
- Establishing the evaluation methodology and model of function attenuation and restoration measures.
- Applying the evaluation system to five reservoirs.



Environmental impact of reservoir sedimentation



Economic optimization calculations in the evaluation model of function restoration measures

Achievements

- Analyzed typical reservoir function classification involving the impact scope and degree of sediment deposit, distribution, and other factors, and the existent impact of reservoir sediment on reservoir functions.
- Developed an evaluation indicator system to assess the sedimentation impacts on reservoir functions, including main evaluation standards, factors and indicators.
- Established an evaluation methodology of reservoir function and evaluation modelling are established.
- Designed a visual management decision-support system on WINDOWS platform that focused on reservoir function attenuation and restoration measures.
- Applied research and analysis on 5 typical reservoirs are conducted.

Application

By conducting case studies on 5 reservoirs—Guanting, Xiaolangdi, Danjiangkou, Sanmengxia and Naodehai reservoirs, a series of optimized function measures for restoration are suggested. Management of sedimentation has been adjusted and improved, particularly for the Naodehai Reservoir in Liaoning Province.

Interfaces of data input and result output in the evaluation model of function restoration measures

Low voltage intelligent device units

GUO Jiang, HUANG Yan, LEI Liang, et al.

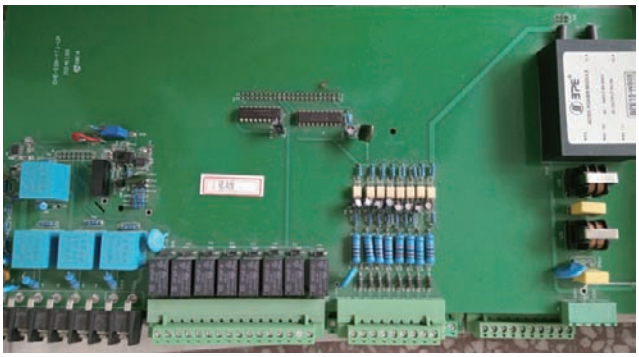
Background

Many old hydropower stations in China are equipped with generator units of quite small capacity, the majority of which work at a low voltage of 0.4kV. These old stations, mostly built in the 1970s or 80s, suffer from the consequence of integrated with antiquated equipments, outdated technologies and insufficient professional staff, hence obstacles are inevitably troubling its units operation or management. This project aims to develop a concise and fully functioned intelligent device for low voltage generator units. When combined with necessary simple peripheral subassemblies, such a device could set up a single control panel to perform functions of speed regulation, excitation, water level monitoring, automatic power adjusting, protecting, synchronization and primary loop stepping. It could be widely applied to small low-voltage hydropower generator units, hence helping improve the productivity and economic state of hydropower stations.

Contents

- Researching on the methods to conduct brief maintenance and operation with the updated auto control system without additional professional staff.
- Realizing the integration of multiple functions like speed regulation, excitation, protection, monitoring into a single control panel. And subsequently realizing of unattended unit operation or with fewer on duty.

The general integrated control device



The power and output integrated circuit

Achievements

A single multi-functional control panel that integrates speed regulation, excitation, water level control, automatic power adjusting, protection, synchronization and primary loop stepping is accomplished. Such a device is tightly integrated, reliable and easily operable, and also enjoys light maintenance and low cost.

Application

In 2014 three low voltage intelligent device units began operation at Shihe Hydropower Station in Qinhuangdao City, Hebei Province, having a capacity of 400KW; up till now running stably, the device contributed to safer, more efficient and more economically viable operation of the station. In 2015 three units began operation at Shuihutong Hydropower Station in Hebei Province and have been running stably. Three units of 200KW at Hairisu station in Nei Mongol, four units of 320KW at Ulanhot in Inner Mongolia, and six units of 320KW at Sanmajia in Inner Mongolia are going through tests.

The cabinet housing the low voltage intelligent device units at Shihe Hydropower Station in Qinhuangdao City

Generation units of Shihe station

Research and realization of combined control of zero capacity cascade hydropower stations

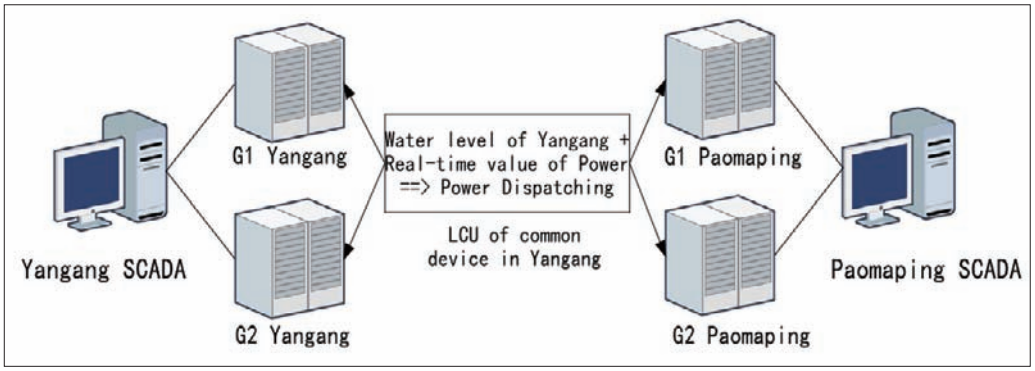
DENG Xiaogang, FENG Xun, HUANG Le, et al.

Background

Yazui River in Sichuan Province has Buxi, Yangang and Paomaping hydropower stations located from its upstream to the downstream. In the bid to produce electricity in an energy-efficient manner and optimize water harnessing by the cascade hydropower stations, it is necessary to do research on combined control of the cascade under the principle of energy-efficient electricity production. This project, centering on the design principle of "zero staff on shift and few staff on attendance", uses computer monitor system to study how to realize combined control of the cascade hydropower, with aim of improving water harnessing ratio, maximizing the comprehensive benefits, and ensuring safe, stable and efficient operation of the grid. This project may contribute to improved electricity production capacity of Sichuan Province.

Contents

- Researching on the monitor system of a centralized control center that can cover Buxi, Yangang and Paomaping.
- Implementing the combined control of Yangang and Paomaping based on the H9004.0 monitor system developed by Beijing IWHR Technology Co., Ltd.



Data sharing and synchronized command forwarding by multiple LCU in Yangang and Paomaping

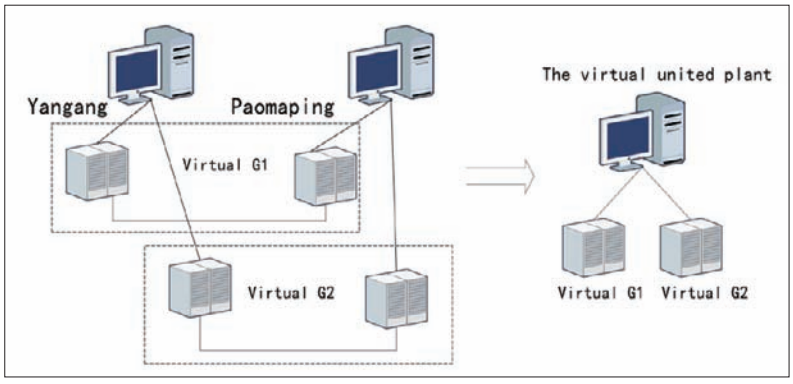
Achievements

- The combined control of the cascade stations of Buxi, Yangang and Paomaping is realized.
- The paired control of generation units of Yangang and Paomaping with zero capacity is realized.
- In response to changes of water level, LCU is enabled to independently render micro-control of paired units of Paomaping and Yangang in order to restore water level equilibrium.

Application

As a result of the realization of combined control of the cascade hydropower stations on Yazui River, the roster of operation staff in Buxi and Yangang can be reduced by four, with saved expenditure up to 400,000 RMB, and monthly electricity output can increase by 300,000 kWh.

Forebay at Paomaping (1,100 m^3)



Paired units operation in Yangang and Paomaping

Best Papers of IWHR's Journal

Reviews of heavy metals pollution in water environment of Three Gorges Reservoir

WANG Jian-kang, ZHOU Huai-dong, LU Jin, GAO Bo

Abstract: Since the impounding completion of the Three Gorges Reservoir (Design water level is 175m), its environmental effect has been concerned widely. Heavy metal pollution is one of the important potential contaminants in water environment of the Three Gorges Reservoir. The concentration, morphology, distribution, accumulation and their transportation behavior of the heavy metals are very important in the research of heavy metal pollution in the Three Gorges reservoir. This paper outlines the pollution situation and pollution characteristics of heavy metals for the different environmental mediums (water, sediments, soils, municipal solid waste and aquatic organism) in the water environment of Three Gorges Reservoir. The paper also provided several useful suggestions for the future research. The paper is beneficial for the protection of water resources in the Three Gorges reservoir.

Key words: Three Gorges Reservoir, heavy metals, water environment, overview,

Analytical methods and their comparisons for water and sediment variation trends

WANG Yan-gui, LIU Xi, SHI Hong-ling

Abstract: In order to analyze variation trends of water and sediment in the river effectively, the graphical analysis method and the statistical analysis method were analyzed and compared systematically in this paper, based on the existing research methods and using as case studies on the water and sediment changes in the Datong Station and the Yichang Station of the Yangtze River. It is suggested that the graphic analysis method and statistical analysis method should be combined to analyze the trend in river water and sediment. For the graphic analysis methods such as the process line method, the sliding average line method and the cumulative curve analysis, the first two methods mainly reflect the variation process of water and sediment trend, while the third one can analyze the long-term trend. For the statistical analysis methods such as the Mann-Kendall method, the linear trend regression test, the Spearman rank correlation test and the cumulative filter method, the Mann-Kendall method is used more widely because of its simplicity and effectiveness in the process analyzing the water and sediment status.

Key words: water and sediment amounts in the river, variation trend, graphic analysis method, statistical analysis method

Study on the mountain water extraction method of the space-borne SAR Image

SUN Yayong, LI Xiaotao, YANG Fengjie, HUANG Shifeng

Abstract: The space-borne SAR with all-weather and all-day monitoring ability has been widely used to xtract the surface water information, but because of slant-range imaging, the SAR image has the significant geometric deformation in the mountain areas, which seriously affects the image geometric positioning accuracy and water body extraction. Therefore, the article takes the Envisat ASAR image as an example to iscusses an extraction method of the mountain water, which is utilizing the SAR image simulation technology based on DEM to orthorectify images and to further eliminate the hillshade from the water which is extracted by the bimodal method. Finally, the experiment shows that this method perfectly orthorectified the deformation of the image, reduced the hillshade confused with water and improved the accuracy of the water extraction.

Key words: SAR, DEM, SAR simulation image, hillshade

A GA-WNN time series model for runoff forecasting:taking San Menxia as an example

SONG Yifan, GUO Zhongxiao, LU Yajing, XU Xiaomin

Abstract: The main problems leading to the difficulty in mid-to-long-term hydrological forecasting research re the complexity, uncertainty and high non-liner relationship in hydrological phenomenon. To address these problems, a wavelet neural network time series model optimized by genetic algorithm has been built. In this model, some parameters such as connection weights, scale factors and translation factors were optimized by the genetic algorithm. Through verifying this model in forecasting runoff process of the Sanmenxia Station, analyzing the result in aspects of precision, tendency and stability, it can be concluded that, compared with traditional wavelet network and BP network, this model has a better precision and stability, and can avoid effectively falling into local minimum points in error function which can easily occur in traditional wavelet neural network and BP neural network.

Key Words: genetic algorithm, wavelet neural network, time series, mid-to-long-term hydrological

Orthogonal experiment on removal rate of pollutant in subsurface flow constructed wetland

FU Ling, HU Chunhong

Abstract: The effect of plant, flow and water level on pollutant removal of constructed wetland was investigated through orthogonal experiments. Results show that there are almost similar effects of three indicators on removal rate of BOD 5, COD Mn and TN, and plant has better effects than others, flow is in the second position, and water level is the last one. Pistiastratiotes generally have more effective removal rate than Eichhorniacrassipes, but at the end of September, it may cause secondary pollution, so it is important to harvest in time. Flow is significantly related to removal rate of TN and COD Mn, but it is not for water level. The concentration of BOD 5, COD Mn and TN experienced sharp drop in the front of the constructed wetland bed, and the downward trend slow down gradually and finally went stable. Those processes indicate that almost all the pollutant was removed in the front of wetland bed, and the intercepting pollution capacity of whole wetland system can be improved significantly. Pistiastratiotes are recommended to be planted in north China area, and take full advantage of carrying capacity of wetland systems to deal with water polluted sources.

Key words: subsurface flow constructed wetland, orthogonal experiment, removal rate

Status of numerical simulation research on thermal discharge of coastal power plant

ZHANG Beibei, ZHOU Jing, JI Ping

Abstract: Numerical simulation is an important method to conduct thermal discharge study. This paper reviews the thermal discharge numerical simulation studies at coastal areas, and discusses the selected models' discretization method, mesh generation, spatial dimension, whether the models take the density gradients and baroclinic effect into account, parameters selection and so on. Researchers need conduct studies on real-time forecasting model for the post-assessment and monitoring of thermal discharge, and also try to introduce the data assimilation thoughts into the real-time forecasting model to improve the prediction level.

Key words: thermal discharge, numerical simulation, diffusivity, surface heat exchange, open boundary conditions

Annual Report

2015

CHINA INSTITUTE OF WATER RESOURCES AND HYDROPOWER RESEARCH

Testing of hinge dam © Li Lei

Management Achievement

Highlights of 2015

1

IWHR was granted the title of “Capital Star” for its institutional and cultural building.

2

IWHR won the special prizes of both the 2015 Dayu Water Science Award (with its research on impact of climate change upon flood and drought disasters and the adaptation to the risks) and the 2015 Hydroelectric Science and Technology Award (with its research on key technologies for large pumped-storage power plant development).

3

IWHR launched the overall planning for the 13th Five-Year Plan period to enhance the development of talents, disciplines, laboratories, sci-tech industry, infrastructure, and informatization.

4

IWHR's State Key Laboratory of Simulation and Regulation of Water Cycle in River Basin passed the evaluation of the Ministry of Science and Technology with high marks.

5

Journal of IWHR was included into the list of Chinese core academic journals by the Research Center for Chinese Science Evaluation (RCCSE). The Journal of Hydraulic Engineering (which is edited and published by IWHR) was selected as one of the Top 50 scientific and technological journals by China Association for Science and Technology, and the Top 100 newspapers and journals by the State Administration of Press, Publication, Radio, Film and Television.

6

IWHR was certified as a new and high technology enterprise.

7

IWHR was selected as one of the 89 model bases for training innovative talents.

8

IWHR reformed its pension insurance and logistics management.

9

IWHR became the 43th organizations for investment consulting and assessment commissioned by the National Development and Reform Commission.

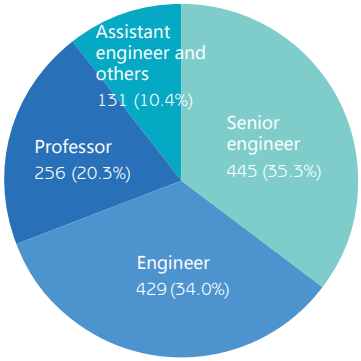
10

IWHR held a special celebration for two centenarian retired employees.

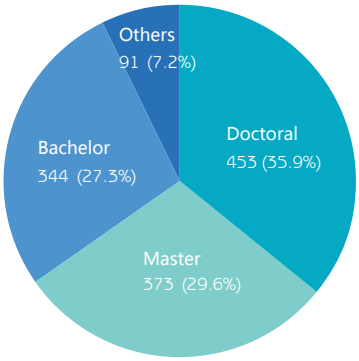
Statistics

Human resources

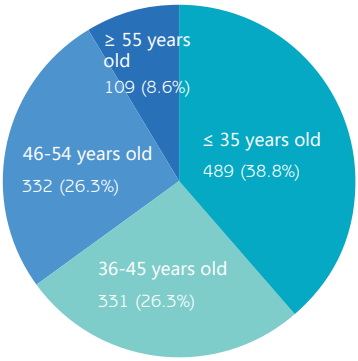
IWHR has 1438 staff members in 2015, including 1261 technical professionals.



By title



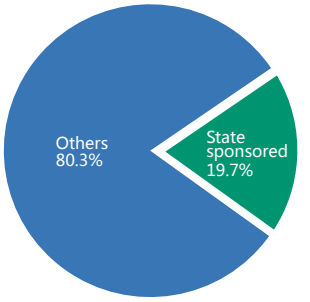
By educational level



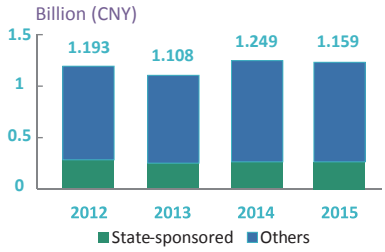
By age

Research Contracts

Research contracts signed in 2015: CNY 1.159 billion in value.



National	33.1%
Ministry of Water Resources	58.3%
Other ministries	4.2%
Local governments	4.4%



Awards

In 2015, 4 completed researches are granted state level prize and 21 on provincial/ministerial level.

Type	Amount	Grade
State level	4	First prize (1)
		Second prize (3)
Provincial (ministerial) level	21	Special prize (3)
		First prize (5)
		Second prize (9)

Some of the prized researches:

- Research and application of key technologies for guaranteeing dam and reservoir safety
- Key technologies for intelligent construction of the 300-meter level Xiluodu Arch Dam
- Key technologies and application of big data-driven multi-factor hydrological monitoring and forecasting
- Key technologies, product research and development and application of precision dripping irrigation
- Impact of climate change upon drought and flood disasters and risk assessment technology
- Key technologies on intelligent temperature control for crack prevention of large-volume concrete
- Research on drought disaster risk assessment and key regulation technologies
- Research on key supporting technologies for water-saving and upgrading of large agricultural irrigation areas
- Research and application of key technologies on flood control model building for Yangtze River
- Optimization deployment and construction technologies of gully improvement project
- Research on carrying capacity and ice control technology for the central route of South-to-North Water Diversion Project
- Key technologies on planning and building of water and sediment regulation system for Yellow River
- Key technologies of parameter identification and safety regulation for large water diversion projects
- Research and demonstration on formation mechanism and key controlling technologies of urban flooding and waterlogging
- Research and monitoring of reservoir-induced earthquake of large hydropower projects
- Research and demonstration on precision dynamic management and 3D monitoring of urban water resources
- Key technologies and application of building lake and reservoir ecological safety guaranteeing system in China
- Research and application of satellite remote sensing technology for monitoring soil moisture
- Research and engineering application of key technologies of dynamic intelligent temperature control for crack prevention of high concrete dams
- Research on cavitating turbulent flow mechanism and its application and promotion in hydraulic machinery
- Research and application of high-precision multi-clock unified satellite time synchronization system

Intellectual Properties

IWHR obtains 116 patents in 2015 (including 54 inventions and 62 utility models), participates in the editing of 17 technical codes, and also publishes 52 books and 566 papers.

	Patents		Technical codes		Books	Papers
	Inventions	Utility models	Chief edited	Co-edited		
Amount	54	62	10	7	52	566

Journals

journal of hydralic engineering

Journal of China Institute of Water Resources and Hydropower Research

International Journal of Sediment Research

nternational soil and water conservation research

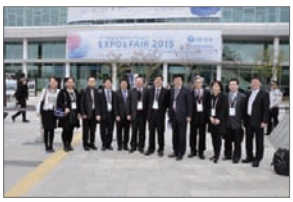
china flood & drought management

International cooperation

International exchange

Working meeting of China-German joint research on small hydro substituting fuel

IWHR signing a cooperation agreement with IAHR to become the host of IAHR Beijing Office



IWHR leading Chinese expert team to the 7th World Water Forum (Daegu and Gyeongbuk)

IWHR experts at the 35th World Conference on Environmental Impact (Florence)

IWHR held joint seminar with KICT to promote exchange and cooperation

Delegates from Finland Ministry of Agriculture and Forestry visiting IWHR's Daxing Experimental Base

Technical tour on fish lift of Alqueva Dam (Portugal) under the China-EU Water Platform

Visiting key hydrological stations in Mekong River Basin

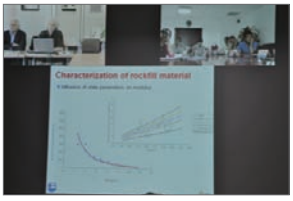
Visiting Albuquerque, US on the Bear Valley water distribution system

Delegates from Bangladeshi Ministry of Agriculture visiting IWHR's Daxing Experimental Base

EDF delegates visiting IWHR's lab of automation

IWHR co-sponsored 2015 World Hydropower Congress (Beijing)

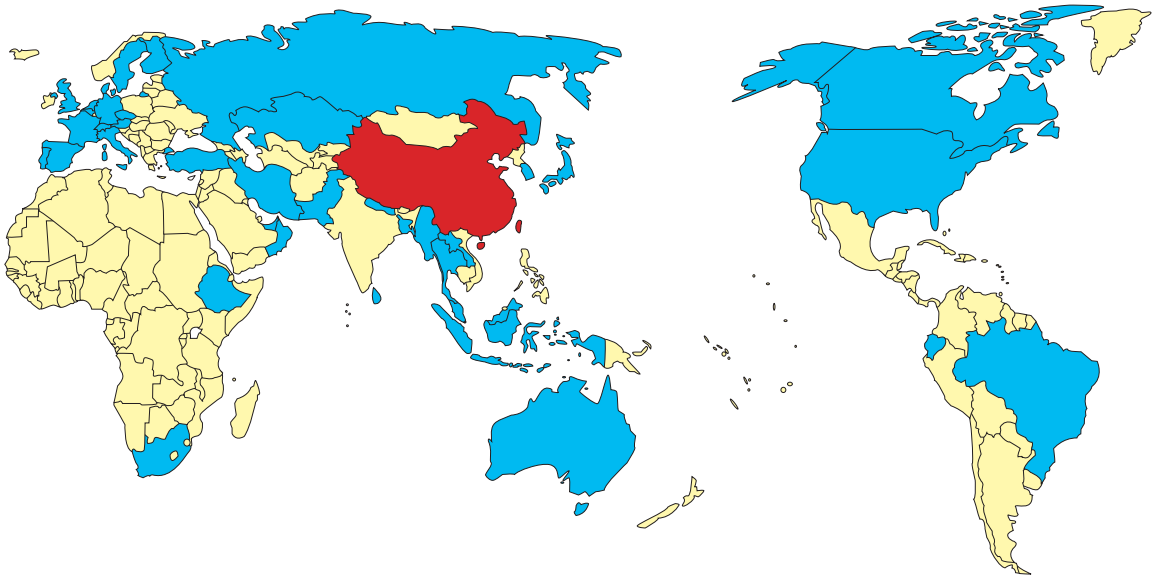
IWHR Vice President Jia Jinsheng chairing a session on sustainable water infrastructure development during the 7th World Water Forum (Daegu and Gyeongbuk)



IWHR held video conference with EDF to launch joint researchs

Partnership with cooperative agreements

2015 IWHR global footprints



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CHINA INSTITUTE OF WATER RESOURCES AND HYDROPOWER RESEARCH

Nuozhadu Hydropower Station © Yu Lang

APPENDIX

Organization

President and Vice Presidents

Commissions

- Academic Commission
- Board of Professional Title Assessment
- Board of Academic Degree Assessment

Administration Divisions

- General Office
- Division of Personnel, Labor and Education
- Division of Research, Management and Planning
- Division of International Cooperation
- Division of Finance and Assets Administration
- Division of Supervision and Audit

Research Departments

- Department of Water Resources
- Research Center on Flood and Drought Disaster Reduction (*incl. the Remote Sensing Technology Application Research Center and the Department of Water Resources History*)
- Department of Water Environment
- Department of Irrigation and Drainage
- Earthquake Engineering Research Center
- Department of Geotechnical Engineering
- Department of Structures and Materials
- Department of Sediment Research
- Department of Hydraulics
- Research Center for Sustainable Hydropower Development
- Department of Water Resources for Pastoral Areas

Key Laboratories

- State Key Laboratory of Simulation and Regulation of Water Cycle in River Basin
- Key Laboratory for Hydraulics and Sedimentation Science and RiverTraining (*of the Ministry of Water Resources of China*)
- Key Laboratory for Construction and Safety of Water Project (*of the Ministry of Water Resources of China*)

Division of Comprehensive Business

- General Office
- Section of Postgraduate Education
- Standardization Research Center
- Section of Academic Journals and Library

Enterprises

- Beijing IWHR Corporation
- Beijing IWHR Technology Co., Ltd.
- Beijing IWHR-KHL Co., Ltd.
- Beijing Zhongshui Runke Certification Co., Ltd.
- Tianjin Institute of Hydroelectric and Power Research

Secretariats of Organizations

- World Association for Sedimentation and Erosion Research
- World Association of Soil and Water Conservation
- Chinese National Committee on Large Dams
- Chinese National Committee on Irrigation and Drainage
- Beijing Office of International Association for Hydro-Environment Engineering and Research
- Global Water Partnership China
- China Office of International Hydropower Association

Research Divisions

Department of Water Resources

Fundamental and applied research on the theories and applications in hydrology and water resources, including the fundamental theories and simulative technologies of water cycle, the assessment, planning, allocation, saving, regulation, management, protection and macro-strategy research of water resources, and the consulting and international cooperation in related fields.

Research Center on Flood and Drought Disaster Reduction (incl. the Remote Sensing Technology Application Research Center and the Department of Water Resources History)

Research on key issues of flood control, drought relief and disaster reduction, including disaster formation mechanism, forecasting and warning, risk assessment, management and rescue technology of risk and emergency, application of remote sensing and other high-technologies, water resources history and water culture.

Department of Water Environment

Evolution mechanisms and simulation technologies of water environment and ecology; methods and standards of assessment and monitoring, as well as protection and recovery technologies of water environment; guarantee technologies of drinking water safety; environmental impact assessment of projects; theories and information technologies of water environment management.

Department of Irrigation and Drainage

Strategies, planning and related standards of water resources development in rural areas; water-efficiency irrigation and management technologies of farmland water and soil environment; research, equipment development, transfer, promotion and application of water supply technologies in rural areas; quality inspection and product certification of equipment.

Earthquake Engineering Research Center

Theories and analysis method of earthquake engineering; the arch dam and gravity dam seismic research; dynamic test of structures and equipment; monitoring and forecasting of reservoir earthquake; anti-earthquake analysis and safety assessment of electrical and nuclear power equipment.

Department of Geotechnical Engineering

Property study of geotechnical materials; behavior simulation, safety assessment and centrifugal testing of geotechnical structures such as embankment dams, high slopes and underground tunnels and chambers.

Department of Structures and Materials

Temperature stress and control of hydraulic structures; numerical, visual and digital simulation of projects; safety monitoring and inspection; anti-seepage, repair and reinforcement of projects.

Department of Sediment Research

River channel evolution and improvement; reservoir sedimentation and regulation; conservation and control of water and soil; sediment issues in estuary, coastal and hydraulic projects; prevention and control of sediment disasters; fundamental theories and simulation technologies of sediment movement.

Department of Hydraulics

Hydraulics of high-velocity flow, flow-induced vibration and project layout; hydraulic control and ice dynamics; cooling water and cooling tower research for thermal and nuclear power projects; river and ecological hydraulics; hydraulic prototype observation and equipment development.

Research Center for Sustainable Hydropower Development

Strategies, policies, planning and key technologies of sustainable hydropower development, including the theories, methods and assessment system of hydropower sustainability (green hydropower); strategic planning of hydropower development; ecological protection and reservoir resettlement policies of hydropower projects.

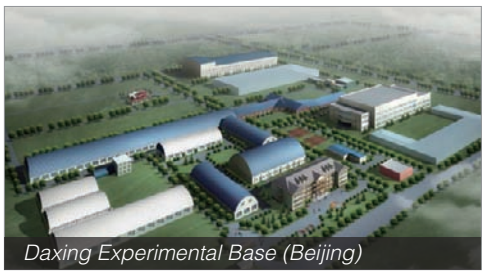
Department of Water Resources for Pastoral Areas

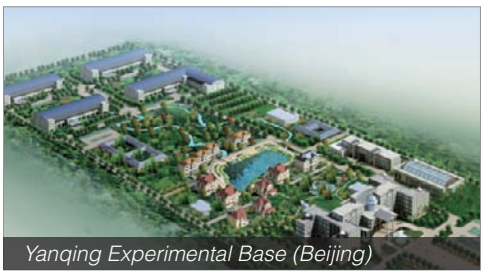
Water resources and water environment for pastoral areas; water-efficiency irrigation and drainage, conservation of water and soil, and ecological recovery of grasslands; clean energy development and utilization, as well as water supply equipment, for pastoral areas.

Scientific Research Bases

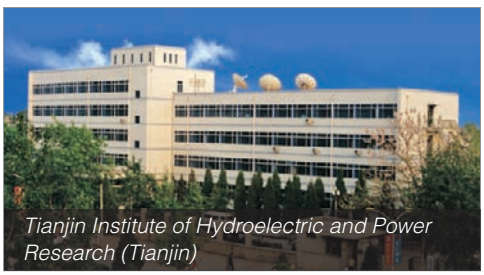

Technology Innovation Base (South, Beijing)


Technology Innovation Base (North, Beijing)


Daxing Experimental Base (Beijing)

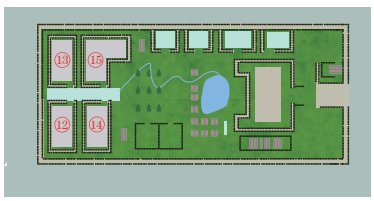

Yanqing Experimental Base (Beijing)


Base of Water Rescources for Pastoral Areas (Inner Mongolia)


Tianjin Institute of Hydroelectric and Power Research (Tianjin)

Laboratories in Daxing and Yanqing bases include:


Daxing Experimental Base


Yanqing Experimental Base

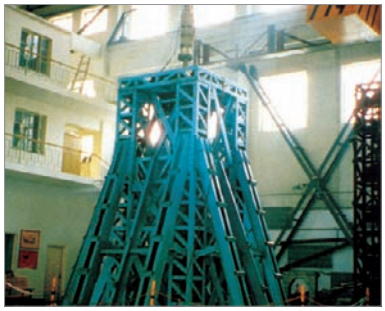
(1) Laboratory of Water Cycle and Deployment
(2) Laboratory of Water-Sediment Regulation and River Training
(3) Laboratory of Soil and Water Conservation
(4) Laboratory of Fundamental Theoretical Research on Sediment Transport
(5) Laboratory of Hydraulics
(6) National Center for Efficient Irrigation Engineering and Technology Research - Beijing
(7) Laboratory of Rural Drinking Water Safety, NCEIR
(8) National Center for Quality Supervision and Test of Agricultural Irrigation and Drainage Equipment
(9) Laboratory of Hydraulic Regulation
(10) Laboratory of River Environment
(11) Hydraulic Machinery Laboratory
(12) Laboratory of Automatic Control and Simulation
(13) Laboratory of Quality Inspection and Simulation for Speed Governing System of Small Hydro
(14) Integrated Laboratory of Engineering Technology on Water Resources and Soil-Water Conservation
(15) Integrated Laboratory of Engineering Mechanics

Large Equipment

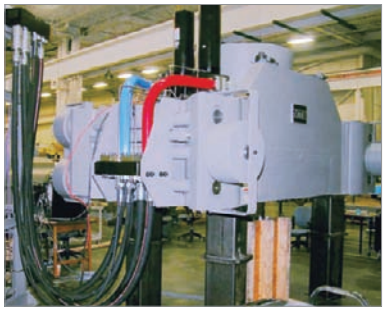
Vacuum tank (vacuum percentage 98.7%; flow discharge 1.0 m)

Universal test stand of advanced hydraulic machinery model

LXJ-4-450g-t geotechnical centrifuge



Tri-axial earthquake simulating shaking table with 6 degrees of freedom



15000 KN universal testing machine

Creep testing system for fully-graded concrete

Hydraulic flume and water tank

Eddy covariance system

Multi-functional GC-MS Machine

2015 Annual Report of IWHR
Published on March 30, 2016

Beijing IWHR Corporation

Scope of business

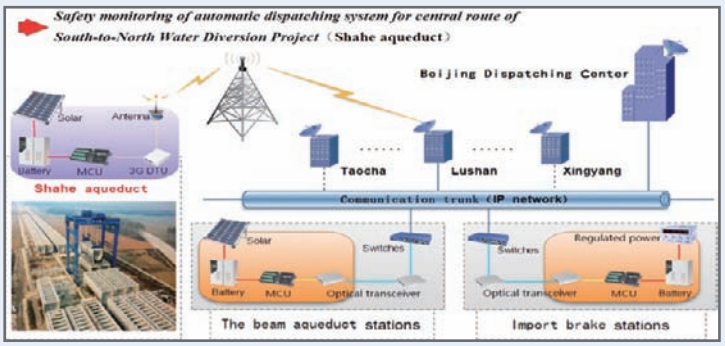
- Consulting, design and equipment development of safety monitoring and automation system
- Foundation anti-seepage, reinforcement and treatment
- Inspection, diagnosis and assessment of project health
- Hydraulic Elevator Dam and Rubber Dam: R & D, manufacturing, installation, engineering contract, technical consulting; Water Sector: irrigation, drinkable water safety, water supply and drainage, and pump station; at the same time, we self-operate and agent the import and export of varied goods and technology, etc.
- General contracting (EPC) of overseas hydropower projects
- Complete set of electromechanical equipment and technical services in hydropower station
- Vibration testing, dynamic response simulation and safety assessment of hydraulic turbine and powerhouse

Representative products/projects

Leakage plugging project for Daping Hydropower Station in Yunnan Province

Hydraulic Elevator Dam in Dunhua, Jilin Province

Rubber Dam in Myanmar



Safety monitoring of automatic dispatching system for central route of South-to-North Water Diversion Project

Beijing IWHR Technology Co., Ltd.

Scope of business

- Study, design, development & turnkey of SCADA&system of simulation for hydropower stations, windfarms, solar power stations,projects of water diversion & irrigation, etc.
- Electro-machinery engineering technology for hydropower stations
- Experimental study of prototype, condition monitoring of hydropower generating units
- Study &integration of automation system of water regime forecasting and dispatching for hydropower stations &river basin
- Study, development & turnkey of management system of information for water utilities
- Design & manufacture of hydro turbine governors& auxiliaries

Representative products/projects

- EPC of electro-machinery equipment for hydropower projects, Bac Binh, Bayramhacili, etc.
- H9000 system of supervision& control for hydropower stations, Three Gorges, Xiluodu, etc.
- OTS2000 3D simulator for operator training for hydropower stations, Xiluodu, etc.
- HR9000 automation system for water regime forecasting&water dispatching, Ertan, etc.
- DVG2000 governors for hydropower stations, Tishrin, Fengtan, Zexi, etc.
- Experimental research of hydro-turbine models, Three Gorges, Xiluodu, Xiangjiaba, etc.
- Diagnostics of hydropower generating units, Three Gorges, etc.

H9000 system of supervision & control, condition monitoring system, experimental study of hydro-turbine model for Three Gorges Project

EPC of generating units for Bac Binh HydropowerStation

Radar water level gauge for Ertanhydropower station

Spillway of Bayramhacili HydropowerStation

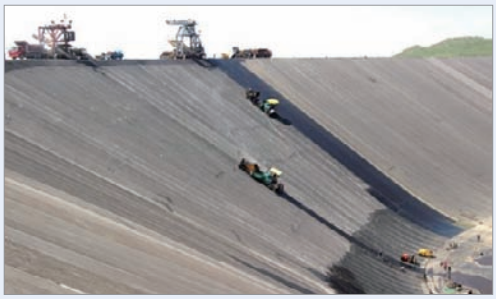
Beijing IWHR-KHL Co., Ltd.

Scope of business

- Research, development, manufacturing and integral construction of waterstop materials
- Research, development and manufacturing of hydraulic concrete and macromolecular materials
- Inspection, safety assessment and technical consulting of hydraulic structures
- Repair and reinforcement of hydraulic structures
- Research, development, manufacturing and construction of hydraulic bituminous concrete materials

Representative products/projects

GB waterstop materials have been applied in more than 100 hydropower stations in and outside China, including Shuibuya Hydropower Station. Our company has conducted optimization of concrete mixing and performance test for over 100 hydropower stations, including the Three Gorges Project. We have also completed the inspection, safety assessment, repair and reinforcement of a large number of hydraulic structures, as well as the construction of bituminous concrete face for the upper reservoirs of many pumped-storage power plants.



Construction of bituminous concrete face for the upper reservoir of Hohhot Pumped-Storage Power Plant in Inner Mongolia

Surface waterstop construction for the concrete face of Liyuan Hydropower Station in Yunnan Province

Inspection and safety assessment for the central route of South-to-North Water Diversion Project

Optimization of concrete mix and performance test for Xiluodu Hydropower Station

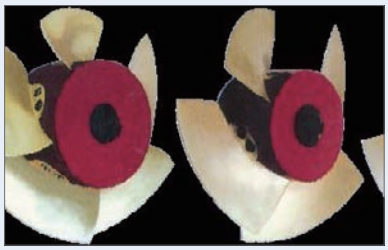
Tianjin Institute of Hydroelectric and Power Research

Scope of business

- Efficient hydraulic-model of hydraulic machinery (pump) technology
- Automatic component (device) manufacturing technology
- Integrated control system technology
- Smart grid device
- Power transmission and distribution equipment
- Debugging and installation guidance and transportation of the products we offered

Sponsor the journal of Electro-Mechanical Technology for Hydropower Station

Representative products/projects



Efficient hydraulic-model of pump

Axial pump

Energy-saving rollover flap valve

Mobile hydraulic driven pump unit

Water circulation pump for high Temperature and Pressure

Salt chemical circulation pump

Double micro-computer (PLC) static excitation system for synchronous generator

Filter reactor

Harmonic control system

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