Contents

1. Introduction of NARI
2. Overview of China’s Hydropower and Water Conservancy
3. Construction trends of Hydropower in China
4. Operation & Management Trends of Hydropower in China
Introduction of NARI

State Grid Corporation of China (SGCC)

Largest Company in China
100% State Owned
No. 2 in the world (FORTUNE 500)

Assets: 560 billion USD
Employees: 1.63 million
Business Revenue: 341.7 billion USD
Annual Benefit: 90.1 billion USD
Power Supply Scale: Capability: 38745 TWh, serve for 1.1 billion population, 88% territory of China

(2017)
NARI is the largest whole set supplier of electric power equipment in China and is an active player in the global power industry.

NARI is dedicated to providing technologies, products, services and total solutions for customers in other fields like industrial control, energy saving, railway transportation, etc.

**Introduction of NARI**

**NARI GROUP CORPORATION**

Assets: 9 billion USD

Employees: 17,000

Business Revenue: 4.83 billion USD

Contract Value: 8.8 billion USD

Marketing: about 90 countries

(2017)
Introduction of NARI

NARI is the Innovation Base for International Network on Small Hydropower (IN-SHP). Mr. Ban Ki-Moon, the former Secretary General of United Nation gave high appraisal to NARI’s performance in hydropower.

- Supplier of total package solution for safety, efficiency and economic benefits of hydropower operation
- Proposer of an IEC/IEEE dual logo standard on Smart Hydropower
- Hydropower Market cover 50+ countries, 6 continents
- Project experience in the hydropower sector of 10 countries in Africa
- Products with CE, KEMA, TUV etc. certificates
Introduction of NARI

**Dam Safety Monitoring**

- **Objects**
  - Dams, hydraulic structures, water diversion structures, high slopes, water conservancy projects, bridges, subways, ports

- **Items**
  - Displacement, joint opening, deformation,
  - seepage,
  - strain, stress, temperature
  - ambient environment condition

- **Functions**
  - Structural safety monitoring
  - Safety evaluation and early-warning
  - Decision-making support: construction and operation period

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**Introduction of NARI**

NARI GROUP CORPORATION

[Image: Various engineering structures and environments]
Introduction of NARI

Dam Safety Monitoring

Instrumentation supply, installation
Consultation: monitoring scheme design, data mining and analysis

- Carlson sensor
- Vibrating sensor
- Capacitance sensor
- Other instruments

Automation system integration

- over 30 series of transducers
- over 800 Successful projects
- 70% Domestic market share
- Since 2003 UN Supplier
- 305m Jinping-I dam

Domestic market share over 30%
Series of transducers 305m
• Accurate inflow forecast,
• Flood prevention and generation optimization dispatch scheme - safety, 5% benefits promotion
• Market share in China:
  For HPP: 60%
  For remote control center: 80%
  For Dispatching center: 90%
• Applied in: Three Gorges,
  National Dispatch Center of Laos and Sudan
Introduction of NARI

Hydrology Telemetry and Reservoir Dispatch

Object

Cascade HPP in one river basin or HPP group cross river basins

Purpose

Water—electricity: Maximum generation and firm output, maximum revenue

Electricity—water: Minimum water usage, maximum energy storage

Constraint

Water balance, multiple utilization, firm output, stage plant collaboration in the river basin, etc.
Introduction of NARI

Computerized Supervisory & Control

Objects

- Hydropower plants
- Pumped storage
- Remote control centers
- Renewable energy plants

Functions

- Automatic monitoring
- Sequence control
- Safe & economical operation

Applications

- New installations
- Expansions
- Refurbishment/rehabilitation
- Modernization

Centralized Control Room

Local Control Unit
Introduction of NARI

Computerized Supervisory & Control (SCADA)

- 70% China Domestic
- Over 850 Successful projects around the world
- 700MW maximum unit capacity
- 300MW pumped storage unit
- CE Certificate
- Self-developed PLC and control software
- Maximum unit capacity
Governor

Integrates

• Electrical cabinet,
  • hydraulic cabinet,
  • oil pressure device,
  • valves

Functions

• Regulation of generation output, speed, guide vane opening, power and water level
• Grid frequency tracking

Results

• Match turbine output with load demand
• Maintain grid frequency
• Emergency shutdown

Introduction of NARI

• Intelligent control algorithm, self-adaptive PID regulation, suitable to different operation modes and turbine types
• Highly accurate proportional servo valve as electrical-hydraulic conversion component, flexible self-recovery function of main distribution valve, promote system reliability
• Performance projects cover 1MW-700MW as unit capacity
Introduction of NARI

Excitation

**Objects**
- Hydropower
- Wind Power
- Thermal Power
- Nuclear Power

**Functions**
- Decrease the three-phase stator voltage through excitation transformer
- Provide DC Voltage to rotor through rectifier
- Create working magnetic field

**Results**
- Maintain unit output voltage
- Distribute reactive power among units
- Improve grid stability

- Suitable for different types of power plants
- Performance projects add up to **420GW, 1000MW** for thermal power unit, **700MW** for hydropower unit (just won the contract for 1000MW hydropower unit)
- CE Certificate, TUV Certificate
Introduction of NARI

Protection (Relay)

- Multi-types of generators
- Transformer
- Feeders
- Busbar & Line

Functions
- Disconnect accident source
- Maintain normal operation of grid
- Protect key equipments

Addresses

Benefits
- New installations
- Refurbishment/rehabilitation
- Modernization

✓ Market share in China for above 220kV, more than 50%
✓ Protection system supplier for 1000kV transmission project
✓ Products exported to 75 countries
✓ KEMA Certificate, TUV Certificate
Introduction of NARI

Water Conservancy Project Integrated Management

Hydro-junctions, reservoirs, water diversion/water supply, irrigation projects.

Featured by:
- Large project scale
- Scattered stations over a long distance
- Need to monitor multiple kinds of data

Geotechnical safety
Hydrology
Water Quality
Meteorology
Gate & pump control
CCTV

Unified software application platform
Unified database management
Unified hardware platform, unified bus
## Typical Reference Projects in Zambia

<table>
<thead>
<tr>
<th>HPP</th>
<th>Capacity (MW)</th>
<th>SCADA</th>
<th>Protection System</th>
<th>Dam Safety Monitoring</th>
<th>Governor</th>
<th>On-line Flow Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Kariba</td>
<td>6×180=1080</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>South Kariba</td>
<td>2×180+5×120=960</td>
<td>√</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Itezhi</td>
<td>2×60=120</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Lower Kafue Gorge</td>
<td>5×150=750</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Adding up to 180MW*6 And Shouldering 54% load nationwide
• Work scope: Control System, Governor, Protection System
• Second largest HPP in Zambia
• Work scope: Control System, Dam Safety Monitoring, Condition-based Monitoring System
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In the past 10 years, China increased 124% total installed Power capacity, from 792GW in 2008 to 1777GW in 2017.
### Power and Energy Current Status

By the end of 2017......

<table>
<thead>
<tr>
<th>Energy</th>
<th>Installed Capacity (GW)</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>343</td>
<td>20%</td>
</tr>
<tr>
<td>Thermal</td>
<td>1,105</td>
<td>62%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>36</td>
<td>2%</td>
</tr>
<tr>
<td>Wind</td>
<td>163</td>
<td>9%</td>
</tr>
<tr>
<td>Solar</td>
<td>130</td>
<td>7%</td>
</tr>
<tr>
<td>Total</td>
<td>1,777</td>
<td></td>
</tr>
</tbody>
</table>

- **Hydro**: 343 GW (20%)
- **Thermal**: 1,105 GW (62%)
- **Nuclear**: 36 GW (2%)
- **Wind**: 163 GW (9%)
- **Solar**: 130 GW (7%)
- **Total**: 1,777 GW
Conventional Hydropower Current Status

- Since the construction of Yunnan Shilong Dam in 1910, China started exploitation of hydropower resources.
- The current hydropower development potential is 660GW.
- By the end of 2017, total installed capacity of conventional hydropower amounted to 314.9GW, with development ratio as 47.7%.
- It is estimated that by the end of 2020, total installed capacity of conventional hydropower will increase to 340GW, with the development ratio to 51.51%.
## Typical Conventional Hydropower Projects

<table>
<thead>
<tr>
<th>Distinguishing Features</th>
<th>HPP</th>
<th>Corresponding Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largest total installed capacity</td>
<td>Three Gorges</td>
<td>22,500MW</td>
</tr>
<tr>
<td>Largest unit capacity (in operation)</td>
<td>Xiangjia Ba</td>
<td>8*800MW</td>
</tr>
<tr>
<td>Largest unit capacity (under construction)</td>
<td>Ba Hetan</td>
<td>16*1000MW</td>
</tr>
<tr>
<td>Highest concrete dual-arc dam</td>
<td>Jinping I</td>
<td>305m</td>
</tr>
<tr>
<td>Highest CFRD dam</td>
<td>Shuibuya</td>
<td>233m</td>
</tr>
</tbody>
</table>
● By the end of 2017, pumped storage hydropower in operation was 28GW, less than 2% of the total generation.
● Pumped storage under construction was 8GW

By the end of 2017, pumped storage hydropower in operation was 28GW, less than 2% of the total generation. Pumped storage under construction was 8GW.

- **2017**: Installed Capacity 40GW
- **2020**: Installed Capacity 52GW
- **2030**: Installed Capacity 90GW

+12GW +50GW
Water Conservancy Projects

- Historic Relics including Bai Qiqu, Du Jiangyan, Zheng Guoqu, Jinghang Cannal, Yellow River Dike

- Completed key projects including Huai-Jin Diversion, Huai-Tang Diversion, Huang-Qing Diversion, Huang-Jin Diversion, Jiang-Tai Diversion, Dongshen Water Supply, Da-Qin Diversion, Dahuofang Diversion, National Water Diversion Project from South To North

- During the 13th five-year plan, 172 key projects including Shanxi Han-Wei, Gansu Yin Tao Water Supply Phase 2 Project, Jiang-Huai Diversion, Da-Huang Diversion
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Disadvantages of traditional management means

1. The “dual control” method is not adaptable to large-scale mechanized construction.
   Construction quality of rockfill dam was usually controlled with rolling parameters and testing samples of test pit. The method is not only inadaptable to the current condition of large-scale mechanized construction, but also difficult to meet the requirements of real-time control.

2. Requirements of construction quality control are getting higher and higher.
   For ultra-high rockfill dam, due to great amount of staging and zoning, it requires higher quality in dam filling and rolling. Conventional quality control means, due to the more human interference and extensive management, are difficult to ensure the quality of filling and rolling process. More advanced quality control methods are urgently needed in engineering practice.

3. Owners want to control quality and progress.
   By adopting the traditional construction management method, there is no effective way for the owner to track the quality and progress of the project.
Construction Trends of hydropower in China

3.1 Construction Quality Management Technology

**Function integration**
- Schedule control
- Quality control
- Safety assessment
- Operation management
- ……

**Technology integration**
- GIS Technology
- GNSS Technology
- GPRS Technology
- Internet technology

**Information integration**
- Digitalization of construction schedule
- Digitalization of safety monitoring
- Digitalization of test pit sampling
- Digitalization of Seepage control engineering
- Digitalization of engineering geology and hub layout

**Real time maintenance**
- Digitalization of filling and rolling
- Digitalization of dam materials

**Dynamic update**
- Whole life cycle
3.2 Automation Dam Safety Monitoring in Construction Period

Complicate situation for high dam construction
- Dynamic load variety
- Influence from change of construction conditions
- Sustained action of site environment
  ……

Deformation of dam body
- Deformation of joints and cracks
- Stress and strain of concrete
- Temperature field of dam body
  ……

Safety and schedule simulation of dam construction
based on multiple factors, multiple dimensions and multi-field coupling

Intelligent construction of hydropower dam project
3.2 Automatic Monitoring System Network in Construction Period

Temporary monitoring station in construction area

Fixed monitoring station

Remote scattered monitoring station

Construction Trends of hydropower in China
3.3 Technology for Access Control and Location of Personnel & Vehicles

- Identification of incoming and outgoing personnel
- Violation/overcrowding alarm
- Vehicle license plate recognition
- Tracking/Analysis target information
- Alarm linkage video, access control etc.
- Dynamic playback of target running track
- Statistics of personnel at the designated area
Construction Trends of hydropower in China

3.4 BIM+GIS Display Technology

- Implementation of full life cycle service for the project based on BIM model
- Design information is effectively applied to automation and information system.
- Seamless connection between BIM model and automation and information system.
Construction Trends of hydropower in China

3.5 Fishway Monitoring & Control Technology

- Integrated monitoring and control
- Fish identification analysis
- Statistical analysis & comprehensive display

Integrated management and control platform

Communication network and power supply system

- Fish counting and fish identification system
- Safety monitoring system
- Gate local monitoring system
- Fish lift monitoring system
- CCTV
- Fish luring and expelling lighting system
- Collection of water level, water temperature and flow speed
3.6 Water Quality Monitoring Technology
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At present, the world science and technology innovation presents a new trend that scientific and technological innovations in different fields are under accelerated integration.

The emerging technologies, represented by cloud computing, big data, Internet of things and Artificial Intelligence, are developing rapidly and are beginning to be applied to different industries, which are giving birth to new economy, new industries, new forms of business and new models.

It will bring profound influence to the transformation of hydropower industry pattern and technological innovation, and also bring many opportunities to the development of hydropower automation.

4.1 Application of New Technologies
4.2 New Technologies - Cloud Computing

**Development Background**

**Electrical Power Cost**

**Space Cost**

**Maintenance Cost**

**Definition**

Wikipedia: Information technology that quickly provides preconfigured system resources and more advanced services to minimize administrative costs, and which is usually based on the Internet.

- **Distributed Computing**
- **Parallel Computing**
- **Utility Computing**
- **Network Storage Technologies**
- **Virtualization**
- **Load Balance**
- **High Available**

**Technical Characteristics**

**Software as a Service**

The role of this layer is to provide the application as a service to the customer.

**Platform as a Service**

The role of this layer is to provide a development platform as a service to the user.

**Infrastructure as a Service**

The role of this layer is to provide a virtual machine or other resource as a service to the user.
4.3 New Technologies - Big Data

Development Background

In 2008, Google published a special issue of "Big Data" in Nature magazine.

Definition

It usually refers to data above 100TB!

Wikipedia: Big data is a data set that cannot be acquired, managed and processed in a certain time by using traditional and commonly used software techniques and tools.

Now many hydropower plants in China are promoting R&D effort for big data:

- River basin hydrology features
- Alarm threshold
- Failure rate of different equipment/devices of different vendors
- Primary equipment faults/failure-root causes, evolution trend rules
- Efficiency characteristics of different generation equipments, including evolution trend rules
1999, MIT proposed "Internet of things (IOT)"

2003, The Technology Review of the United States puts forward that the sensor network technology is one of the top ten technologies that will change people's lives in the future.

2009.1, IBM firstly put forward the concept of "Smart Earth", the core of which is to build the Internet of things.

2009.8, During his inspection work in Wuxi, Premier Wen Jiabao put forward the concept of Internet of things (IOT) revolved around "perception of China".

The broad Internet of things includes RFID, sensors, network communications and cloud platforms.
Apart from application of new wireless communication technology for acquisition of data for hydrology telemetry, dam safety monitoring, many hydropower plants are exploring the application of RFID and other technologies for intelligent patrol inspection, assets management and tools management.
Firstly proposed "Artificial Intelligence", "the father of Artificial Intelligence", at the Datt Conference in 1955
Won the Turing prize for contributions to artificial intelligence in 1971

—— John McCarthy
(1927.9.4 – 2011.10.24)

4.5 New Technologies-AI

Development Background

Some hydropower plants in China has applied image recognition technology for function such as:

- detecting whether plant staff is in right uniform,
- making statistics of fish species and quantity, reading of water level meter, etc.

Application of AI in hydropower

Some hydropower plants in China has applied image recognition technology for function such as:

- Forecast for hydrological,
- Dam safety data analysis, etc.

October 19, 2017

Mastering the game of Go without human knowledge

2017.5.27, AlphaGo beat Cogel at 3:0;
2017.10.18, DeepMind announces AlphaGo Zero, which doesn't need artificial knowledge and can beat AlphaGo. by 100: 0 through three days of machine learning.
The hydropower plants in one river basin are related to each other closely in terms of both hydrology and electricity generation, which requires for integrated, optimized dispatch and control.

Remote control center of one river basin can achieve centralized monitoring, centralized control, centralized dispatch and centralized management for equipments of multiple incorporated power plants, and realize resource optimization and energy efficiency to an extreme.
4.6 Remote Control Center

**Subsystems in remote control center**

- Computerized Supervisory and Control
- Reservoir Dispatch Automation
- Collection and quotation of the power energy
- Management of Production Information
- Communication System
- UPS
- CCTV
- Protection and Fault Recording
- Large Screen Display
- Time Synchronization
- Comprehensive Wiring and Security
Remote control center is an important bond between the power supply end and grid end in the power system.

4.6 Remote Control Center

- Role of remote control center

Remote control center is an important bond between the power supply end and grid end in the power system.
4.6 Remote Control Center

- **Advantages of remote control center**

1. Optimize utilization of water resources in the basin and improve generation efficiency
   - Raise the water head, reduce abandoned water, achieve joint regulation of water and electricity and optimal dispatch scheme for the whole river basin.

2. Integrate multiple resources, realize data sharing and reuse
   - Information sharing and common platform for hydrology, reservoir dispatch, power dispatch, operation of power grid and power station, channel operation, dam safety monitoring, etc.

3. Improve safety and availability, improve working efficiency
   - Comprehensive monitoring, quick response, condition-based monitoring and maintenance, scientific decision-making.

4. Trim staff for greater efficiency, reduce operation costs
## Typical Cases of remote control center

<table>
<thead>
<tr>
<th>Basin Name</th>
<th>Power Utility</th>
<th>Total Installed Capacity (MW)</th>
<th>Operation Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yunnan Lancang River Remote Control Center</td>
<td>Huaneng</td>
<td>25,584</td>
<td>In 2008</td>
</tr>
<tr>
<td>Sichuan Yalong River Remote Control Center</td>
<td>SDIC</td>
<td>26,258</td>
<td>In 2012</td>
</tr>
<tr>
<td>Sichuan Dadu River Remote Control Center</td>
<td>China Guodian Corporation</td>
<td>23,680</td>
<td>In 2007</td>
</tr>
<tr>
<td>Guizou Wujiang River Remote Control Center</td>
<td>China Huadian Corporation</td>
<td>8,085</td>
<td>In 2005</td>
</tr>
<tr>
<td>Hubei Qingjiang River Remote Control Center</td>
<td>Hubei Energy</td>
<td>3,040</td>
<td>In 2002</td>
</tr>
<tr>
<td>Southern Grid Peak-Frequency Regulation Remote Control Center</td>
<td>Southen Grid</td>
<td>6,520</td>
<td>In 2013</td>
</tr>
<tr>
<td>Guangxi Guiguan Remote Control Center</td>
<td>Guiguan</td>
<td>9,976</td>
<td>In 2015</td>
</tr>
</tbody>
</table>
1. Pursuit of optimized economic benefit under the background of continuous increase of staff cost and decrease of electricity price.

2. Remote area where lack of qualified technicians

3. Automation technology is mature to support remote control

### Solution for Small Hydropower Plant Hosting

1. **Build A remote control center** (supported by one of the **largest power plants** with relatively strong technical HR)

2. Sign hosting contracts with IPPs

3. Organize a team for maintenance & management
4.7 Small Hydropower Plant Hosting Service

- **Advantages**

  - Share the resources of staff, tools, and spare parts, etc.
  - Through **remote monitoring and operation**, lower down **O & M cost**
  - Improving the stability of staff
  - Share the data, skill, etc.
4.8 Small Hydropower Plant Scale Up Development

**Reasons**

1. **Unified planning, save cost** at the project initial stage
2. With small installed capacity and small investment/benefit for a single plant, scale up project development is a great option for resources integration, efficiency promotion and attracting investment.

International Network on Small Hydropower (INSHP) hosted the kick-off meeting for “Scale Up SHP Project”. In the framework of ISID initiated by UN, this meeting aims to launch feasibility study, drafting investment plan and eventually support scale up development of small hydropower plants.
4.9 Optimized Reservoir Dispatch & Management

- Development real-time electricity price bid market, competitiveness pursuit of power utilities
- Improving management level
- Dispatch for ecological concern, apart from power generation and flood prevention
- Coordinated dispatch of hydropower and wind/solar power
- Needs for analysis of optimized reservoir dispatch

Problem encountered

- Need more accurate hydrology forecast based on longer term
- Optimized reservoir dispatch under more constraint conditions and of more purposes
4.9 Optimized Reservoir Dispatch & Management

- **Coupling of numerical weather forecast with hydrology forecast**

- Take the rainfall information from numerical weather forecast as an input to hydrology forecast model, conducting coupling calculation.

- Improve accuracy of hydrology forecast, prolong the forecast term, supporting optimized reservoir dispatch scheme.
Coordinated optimized dispatch scheme for multiple purposes

- Add purposes of ecology, sedimentation control apart from generation and flood prevention, realize multi-purposes coordinated dispatch scheme under more constraint conditions, achieve enhanced social and economic benefits.

- Coordinated dispatch scheme for multiple energy resources can prioritize consumption of new energy, ensure safe & reliable operation of the power grid and maximize power utilities’ economic benefits.
4.10 Smart Hydroelectric Power Plant

What is the context hatched “Smart Hydroelectric Power Plant”?

- Rapid development and wide applications of latest technologies
- Promotion of Smart Grid construction.
- 31.5 GW of new hydroelectric power installed capacity in 2016 (including pumped storage)

Undesirable performance

- Vulnerable anti-interference,
- Information isolation,
- Lack of interoperability, analysis & evaluation & optimized decision-making support,
- Low cost-effectiveness

New perspective

- Interaction,
- Ease of O&M
- Artificial Intelligence
- Financial Benefits

Reality

Expectation
What is the definition of “Smart Hydroelectric Power Plant”?

- Safety, Efficiency, and Interaction
- Information digitalization
- Networked communication
- Standardized integration
- Interactive applications
- Optimized operation and intelligent decision-making

- Intelligent Electronic Devices
- Intelligent Applications
- Integrated Management & Control Platform
What is the preliminary architecture of “Smart Hydroelectric Power Plant”? 

4.10 Smart Hydroelectric Power Plant
What is the financial benefits of “Smart Hydroelectric Power Plant”? 

- Economize automation system investment by 30%
- Cut O & M workload by 20%
- Save water usage for generation by 4%
- Optimize maintenance duration for units and electrical primary equipments by 20%
How is the application of “Smart Hydroelectric Power Plant” solution?

10 Completed projects
- Jilin Baishan (2000MW)
- Jilin Songjiang River (510MW)
- Three gorges Chengdu cascade reservoir (22500MW)
- Yunnan Lancang River remote control center (14370MW)
- Hunan Yuanshui cascade reservoir (4839MW)
- Hubei Gezhouba (2715MW)
- Hubei geological survey academy (~MW)
- Datang Guangxi (8265MW)
- Xinjiang Erqisi River Beitun remote control center (444MW)
- Xinjiang Ili River (593MW)

11 under construction projects
- Guangxi Yantan (1810MW)
- Jilin Fengman (1480MW)
- Fujian Shuikou (1400MW)
- Tibet Dagu (660MW)
- Guizhou Dongfeng (570MW)
- Sichuan Shaping (345MW)
- Fujian Gutianxi (276MW)
- Liaoning Taiping Bay (190MW)
- Hubei Huanglong Beach (170MW)
- Xinjiang Kenswat (100MW)
- Xinjiang Jiyan (24MW)

11 under planning projects
- Datang Sichuan (6545MW)
- Datang Yunnan (1435MW)
- Zhejiang Xin'an River (855MW)
- An kang Shanxi (850MW)
- Yingxiu Bay, Sichuan (455MW)
- Zhejiang Shanxi (200MW)
- Zhejiang Jinsuitan (300MW)
- Hunna Zhexi (447MW)
- Mengjiang, Guangxi (330MW)
- Jilintai, Xinjiang (970MW)
- Guangdong Gaobei (100MW)
What is the current standardization development status of “Smart Hydroelectric Power Plant”? 

Up till now, 4 Chinese National Standards for hydroelectric Power Plant have already been published, 6 Chinese National Standards have been submitted for Chinese National Committee’s final approval and will soon be published, 1 International Standard (IEC/IEEE dual logo standard is under drafting).

Standardization Work Milestone-IEC 63198/IEEE 2775

- 2013, submission of the PAR-”Technical Guide on Smart Hydroelectric Power Plant” on Smart Hydro to IEEE
- Nov, 2017, submission of the New Work Item Proposal (NWIP) to IEC
- Feb., 2018, NWIP approval, project falls into IEC/TC4/WG14 (Hydraulic Turbine Technical Committee, Hydropower Plant Automation and Turbine Governor Working Group)

The dual logo standard IEC 63198/IEEE 2775 is scheduled to be released in late 2020.
After “emphasis on engineering and construction” and “emphasis on production control”, now hydropower utilities in China are in the phase of “emphasis on refined and integrated management”, which realizes integrated and smart management support for comprehensive business, through the whole lifecycle of planning and designing, civil works and construction, operation and management of the whole river basin.
4.11 Smart Power Utilities

Technical Research-Business Systems

Display of Full-View Information

- Hydropower engineering
- Power Plant Operation
- River Basin Dispatch
- Equipment Maintenance
- Production management

Supervision for Safety of Network Information

Governmental Agency

Public interaction
4.11 Smart Power Utilities

1. **Intelligent Power Station**
   - Smart sensor
   - Intelligent electronic device
   - Integrated management and control platform
   - Economic operation scheduling
   - Multi-components interaction
   - Intelligent patrol inspection (RFID, robot patrol, UAV, and unmanned boat)
   - Intelligent warning
   - Intelligent lighting and ventilation
   - Positioning of personnel and vehicles
   - Intelligent tools management
   - Monitoring of environment and water quality

2. **Intelligent Scheduling**
   - Prediction of wind and photovoltaic power
   - Complementary scheduling of hydro and PV (similar scenario detection)
   - Ecology scheduling of the basin
   - Trend prediction and self-adjustment (plan revision suggestions)
   - Analysis for scheduling risks (Quantification of risks and sensitivity analysis)
   - Competitive bidding of the electricity market

3. **Wisdom Engineering**
   - Visual design and construction
   - Construction quality
   - Safety monitoring of the engineering
   - Monitoring in the construction period
   - Earthquake monitoring

4. **Wisdom Access**
   - Condition-based monitoring
   - Condition-based maintenance
   - Access simulation
   - Management of spare parts
   - Asset management
   - Management of tools

5. **Wisdom Management**
   - Centralized operation platform
   - Full-view display
   - Big-data analysis
   - Public interaction
   - Regulation for network information security
4.11 Smart Power Utilities

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“Wisdom Dadu River”

关于召开“智能水力发电大坝安全分析系统技术规范（征求意见稿）”等7项技术标准审查会的通知

中国华电集团公司

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Xinyuan “Digital smart power plant, information wisdom enterprise”

Peak-adjustment and frequency – adjustment of Southern Grid
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Dedicated to Hydropower

Win-Win Solution