Large Hydropower and Hydraulic Projects in China

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China Three Gorges Corporation
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Cascade Development in Upstream Yangtze River

South-North Water Diversion Project

Reclamation of Tidal Flats in Jiangsu
Cascade Development in Upstream Yangtze River

I. Operation of the Three Gorges Project

II. Hydropower Development in Jinsha River
Cascade Hydropower Development Patterns of China Three Gorges Corporation
I  Operation of the Three Gorges Project

Started: 1993
Completed: 2009
Period: 17 years
Benefits

№. Flood Control

№. Power Generation

№. Navigation

№. Water Supply
Flood Control Benefits

- Effectively intercepts and reduces 40% of flood peak discharge

- Lower downstream water level by 1.0-2.5m during flood peak

- Estimated benefit of flood control reached 26.6 billion RMB in 2010. (equals to 3.022 billion Euros)
<table>
<thead>
<tr>
<th>Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation Power (TWh)</td>
<td>8.61</td>
<td>39.16</td>
<td>48.93</td>
<td>49.25</td>
<td>61.31</td>
<td>80.31</td>
<td>79.47</td>
<td>84.37</td>
<td>451.40</td>
</tr>
<tr>
<td>Saved Standard Coal (Million tons)</td>
<td>3.19</td>
<td>14.49</td>
<td>18.10</td>
<td>18.22</td>
<td>22.68</td>
<td>29.71</td>
<td>29.40</td>
<td>28.26</td>
<td>164.07</td>
</tr>
<tr>
<td>CO2 Emissions Reduction (Million tons)</td>
<td>7.83</td>
<td>35.60</td>
<td>44.48</td>
<td>44.77</td>
<td>55.73</td>
<td>73.01</td>
<td>72.25</td>
<td>69.44</td>
<td>403.11</td>
</tr>
</tbody>
</table>
Navigation Benefits

Average energy consumption decreases from 6.7kg to 2.9kg per thousand ton-kilometer, the unit cost reduces by nearly 37%.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cargo Volume Million tons</th>
<th>Increment compared with 2002 volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Million tons</td>
<td>%</td>
</tr>
<tr>
<td>2002</td>
<td>18.00</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>43.08</td>
<td>25.08</td>
</tr>
<tr>
<td>2005</td>
<td>43.93</td>
<td>25.93</td>
</tr>
<tr>
<td>2006</td>
<td>50.00</td>
<td>32.00</td>
</tr>
<tr>
<td>2007</td>
<td>65.00</td>
<td>47.00</td>
</tr>
<tr>
<td>2008</td>
<td>68.47</td>
<td>50.47</td>
</tr>
<tr>
<td>2009</td>
<td>74.26</td>
<td>56.26</td>
</tr>
<tr>
<td>2010</td>
<td>87.94</td>
<td>69.94</td>
</tr>
</tbody>
</table>
No. Water Supply Benefits

Supply water: 21.2 billion m³.
Raise the water level: 0.6~1.0m.
Monitoring of Structures and Generator Set Performance

- №. Dam Monitoring
- №. Ship Lock Monitoring
- №. Generator Set Monitoring
Monitoring of horizontal and vertical displacement

- The process of horizontal displacement of typical dam block at left

- The process of grouting gallery vertical displacement of typical dam block at left
Monitoring of seepage flow

The process of seepage flow and water level of typical dam block at left
Monitoring of deformation of ship lock

The maximum height of vertical slope is 170m.
Achieved 1233 hours full capacity running at 18.2 million kw in 2010.
Sediment, Earthquake, and Bank stability of Reservoir

No. Sediment

No. Earthquake

No. Bank stability
According to the monitoring data from 2003 to 2010, the real amount of sediments is 210 million tons, only 40% of the designed amount. It is used to store water and flush sedimentation flow to guarantee the long-term use of reservoir.

From water storage period to now, there are no large-scale sliding of mountain slope, rock and soil mass slipping to the river in the reservoir area of Three Gorges.

Generally speaking, the activity and frequency of the earthquake at Three Gorges reservoir may not vary greatly after water storage. The characteristics of the earthquake remains low-intensity and high frequency.
Three Gorges Project is proceeding successfully as planned at present.
Jinsha River is located at the upstream of Yangtze River.

It is 3464km long, taking up 55% of Yangtze River total length.

The fall drop reaches 5100m, taking up 95% of Yangtze River total drop.
### Longitudinal Profile of Jin Sha River Cascade Hydropower Plants

<table>
<thead>
<tr>
<th>Jin Sha Watershed</th>
<th>Theoretical Potential</th>
<th>Technological Exploitable Capacity</th>
<th>Economic Exploitable Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed Capacity (MW)</td>
<td>121022.90</td>
<td>119647.50</td>
<td>102982.40</td>
</tr>
<tr>
<td>Output of Plants (hundred million kw·h)</td>
<td>1/6 of China’s gross</td>
<td>5926.78</td>
<td>5130.57</td>
</tr>
</tbody>
</table>

**Key Points**
- **Wu Dongde**
- **Bai Hetan**
- **Xi Luodu**
- **Xiang Jiaba**
# Hydropower Development Scale of Jin Sha River Downstream

<table>
<thead>
<tr>
<th>Project</th>
<th>Wu Dongde</th>
<th>Bai Hetan</th>
<th>Xi Luodu</th>
<th>Xiang Jiaba</th>
<th>Three Gorges</th>
<th>Ge Zhourba</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dam Type</strong></td>
<td>Arch Dam</td>
<td>Arch Dam</td>
<td>Arch Dam</td>
<td>Gravity Dam</td>
<td>Gravity Dam</td>
<td>Gate Dam</td>
<td></td>
</tr>
<tr>
<td><strong>Dam Height (m)</strong></td>
<td>265</td>
<td>289</td>
<td>285.5</td>
<td>162</td>
<td>181</td>
<td>47</td>
<td>-</td>
</tr>
<tr>
<td><strong>Storage Capacity of Normal Pool Level (Billion m³)</strong></td>
<td>5.86</td>
<td>20.60</td>
<td>11.57</td>
<td>4.98</td>
<td>39.30</td>
<td>1.58</td>
<td>83.89</td>
</tr>
<tr>
<td><strong>Flood Control Storage (Billion m³)</strong></td>
<td>1.86</td>
<td>7.50</td>
<td>4.65</td>
<td>0.90</td>
<td>22.15</td>
<td>-</td>
<td>37.06</td>
</tr>
<tr>
<td><strong>Installed Capacity (Million kw)</strong></td>
<td>10.20</td>
<td>14.04</td>
<td>13.86</td>
<td>6.40</td>
<td>22.50</td>
<td>2.74</td>
<td>69.74</td>
</tr>
<tr>
<td><strong>Average Multi-Annual Output of Plant (Billion kw-h)</strong></td>
<td>39.18</td>
<td>60.24</td>
<td>64.06</td>
<td>30.75</td>
<td>100.00</td>
<td>16.24</td>
<td>310.47</td>
</tr>
</tbody>
</table>
Xiangjiaba Hydropower Plant Layout

Underground Water Power Generation System (Right Bank)

Irrigation Water Inlet (Right Bank)

Water Retaining Structure

Irrigation Water Inlet (Left Bank)

Navigation Structure

Water Power Generation System Behind Dam (Left Bank)

Flow Discharge and Energy Dissipation Constructor

preparing in 2004.

eall of the units will start to work in July 2015.
Xiluodu Hydropower Plant Layout
All of the sets will work in December 2014.

- Aerial View of Xiluodu Dam construction
Baihetan Hydropower Plant
Wudongde Hydropower Plant

The feasibility studies and site preparation are in progress. Plan to get into operation in 2020.
Hydropower development is the key solution to carry out emission reduction.

China will actively and friendly develop and operate the hydropower projects to benefit people’s livelihood and protect our homeland.
Contents

Cascade Development in Upstream Yangtze River

South-North Water Diversion Project

Reclamation of Tidal Flats in Jiangsu
The water resources of China are unevenly distributed. South is rich in water, however the North is poor.
Plan Objective and Transfer Scale

- **Plan Objective:**
  Water supply is mainly for public and industry use, giving consideration to agriculture and ecology purpose.

- **Transfer Scale:**
  Total scale is 44.8 billion m$^3$ water per year.
No. Overall Arrangement

Western Route

Middle Route

Eastern Route
Eastern Route Project

Starting Point: Downstream Yangtze River close to Yangzhou
Destination: North China
Approach: Jinghang Canal
Length: 1156km

Construction has three phases.

Eastern route delivery annual scale is 14.8 billion m³ Water.
Eastern Route

South of Yellow River: Adopt 13 steps, 22 Pumping Stations,
North of Yellow River: Natural flowing to Tianjin
- **Middle Route**

Starting Point: Dan Jiang Kou reservoir

Destination: Beijing and Tianjin

- Length: 1427km.
- The construction has two phases.
- Middle route delivery scale is 13.0 billion m³ Water per year
● Longitudinal Profile of Middle Route

- Ground Line
- Canal Bottom Designed
- Water Line Designed

Length (km): 0, 466, 1267

Altitude (Huang Hai) m: 50, 100, 150, 200

Beijing
Tianjin
Sha River
Yellow River
Canal Head

Altitude Differences:
- 147.38 m
- 98.81 m
- 48.57 m

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West Route

Transfer water from Yangtze River upstream, including Dadu River, Yalong River, and Tongtian River, to Yellow River upstream.

West route delivery scale is 17.0 billion m$^3$ water per year.
No. Investment and Progress

- South- North water diversion project was planned to complete within 40-50 years by phases.
- According to the feasibility study, the first phase comes up to 254.6 billion RMB (28.93 billion EURO).
- In December 2002, the first phase of eastern route and middle route was started to construct and will be put into operation in 2013 and 2014, respectively.
- Some of the projects were qualified for water diversion and some has been got into operation.
Controlled Pumping Station Project
Channel
Tunnel

The project of middle route's general canal – two tunnels through Yellow River
Pipeline
Aqueduct
Danjiangkou Reservoir was built in 1973.
The dam is located in Hubei Province.
Danjianagkou Dam Heightening Project
Contents

Cascade Development of Three Gorges Hydropower

South-to-North Water Diversion Project

Reclamation of Tidal Flats in Jiangsu
№ The location Advantage of Jiangsu Coastal Region

- Blend in Yangtze River Delta in South
- Located beside BoHai Bay in North
- Connect with mid-west continent in west
- Face to Northeast Asia in east
No. Tidal Flats Resources in Jiangsu Province

- Jiangsu has 954km coastline.

- New Tidal Flats Area 687.3 thousand hectares
The plan for overall scale of tidal flats is 180 thousand hectares, including 21 regions, 3 phases in 2010-2020.

<table>
<thead>
<tr>
<th>Phases</th>
<th>Year</th>
<th>Area</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2010~2012</td>
<td>40 thousand</td>
<td>Build 8 provincial experimental plot</td>
</tr>
<tr>
<td>2</td>
<td>2013~2015</td>
<td>46.7 thousand</td>
<td>Integrated development</td>
</tr>
<tr>
<td>3</td>
<td>2016~2020</td>
<td>93.3 thousand</td>
<td>Build a new harbor industrial zone</td>
</tr>
</tbody>
</table>

Allocation of the tidal flats: Agriculture 60%; Ecology 20%; Industry 20%
The reclamation of tidal flats in Jiangsu Province needs to consult with those who have successful experiences.

The Netherlands is an excellent example at this case. China are looking forward to the beneficial directions.
Thanks