RELEVANT OCEAN ENERGY ACTIVITIES IN CHINA

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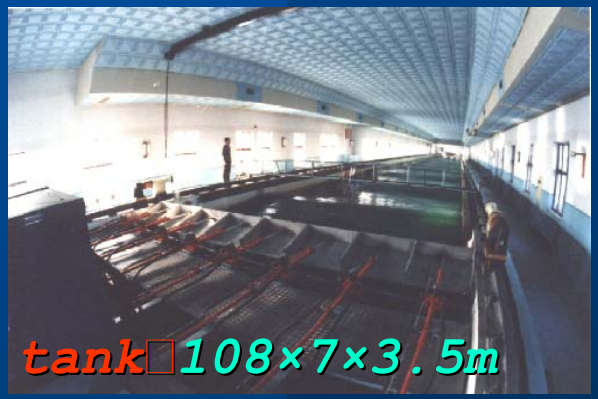
Harbin, Heilongjiang province, PR China

Heilongjiang, located at north most of China and has an area of more than 460,000 km^2. It borders Russia on the northeast. Historically it was one of the main gateways from China to Russian and Europe.

Harbin, capital of HLJ province, is located in the middle reaches of the Songhua River in the south of the province. The whole city covers 1,637 km^2, with a population of 3.23 million.

Habin Engineering University (HEU)



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carriage: 0.1- 6.5m/s

channel：

8×1.7×1.5m

Scheme of presentation

- Brief introduction to The Renewable Energy Law of China
- Resources of ocean RE
- Activities on tidal-current energy exploitation
- Activities on wave energy exploitation

Brief introduction to the RE Law of China

- **Purpose of this law is prepared (Article 1) to**
  - promote the development and utilization of RE
  - improve the energy structure
  - diversify energy supplies
  - safeguard energy security
  - protect the environment
  - realize the sustainable development of the economy and society

- **RE in this law refers to non-fossil energy (Article 2) of**
  - wind energy
  - solar energy
  - water energy
  - biomass energy
  - geothermal energy
  - ocean energy, etc.

- **This Law shall become effective on Jan 1st, 2006 (Article 33)**

Brief introduction to the RE Law of China

- **Main target of the law**
  - **Identify the rules of public responsibility. Buildup the hardship consciousness of public on resource**
  - **Identify the government's essential power, duty and obligation**
  - **Bring forward the definite market directive signal**
  - **Strengthen the confidence of the main market investors**
  - **Accelerate the process of expanding the market scale and commercialization**

Brief introduction to the RE Law of China

- **Feasibility of the legislation**
  - **Plenty of RE resources, excellent technology bases and practical experience;**
  - **New requirement on RE due to the insufficient supply of power and pressure of environment;**
  - **Existed promotional policies and measures for RE**
  - **Planning target of RE development**
  - **Practical experience from other legislation**
  - **Excellent international environment of RE development and successful experience on RE legislation**

Basic framework of The RE Law

---Total eight chapters, and thirty three articles

- **Table of Contents**
  - General (Aticle 1 - 5)
  - Resource Survey and Development Plan (Aticle 6 - 9)
  - Industry Guidance and Technology Support (Aticle 10 - 12)
  - Promotion and Application (Aticle 13 - 18)
  - Price Management and Fee Sharing (Aticle 19 - 23)
  - Economic Incentives and Supervisory Measures (Aticle 24 - 27)
  - Legal Responsibilities (Aticle 28 - 31)
  - Miscellaneous (Aticle 32 - 33)

Important Articles:

Ch. 1 General

- **Article 4**
  - **The Government lists the development and utilization of RE as the preferential area for energy development and promotes the construction and development of the RE market by establishing total volume for the development of RE and taking corresponding measures.**

  The Government encourages economic entities of all ownerships to participate in the development and utilization of RE and protects legal rights and interests of the developers and users of RE on the basis of law.

Ch. 2 Resource Survey and Development Plan

- **Article 8**
  - **Energy authorities of the State Council shall, on the basis of the middle and long-term total volume target of RE throughout the country, prepare national RE development and utilization plan, which is to be implemented after being approved by the State Council.**

    The approved plan shall be released to the public.

Ch. 3 Industry Guidance and Technology Support

- **Article 12**
  - —The government lists scientific and technical research in the development and utilization of, and the industrialized development of, RE, as the preferential area for hi-tech development and hi-tech industrial development in the national program, and allocates funding for the scientific and technical research, application demonstration and industrialized development of the development and utilization of RE so as to promote technical advancement in the development and utilization of RE, reduce the production cost of RE products and improve the quality of products.
  - – Education authorities of the State Council shall incorporate the knowledge and technology on RE into general and occupational education curricula.

Ch. 4 Promotion and Application

- **Article 13**
  - **The Government encourages and supports various types of grid-connected renewable power generation.**

    In the construction of renewable power generation projects, if there is more than one applicant for project license, the licensee shall be determined through a tender.

Ch. 4 Promotion and Application

- **Article 14**
  - **Grid enterprises shall enter into grid connection agreement with renewable power generation enterprises that have legally obtained administrative license or for which filing has been made, and buy the grid-connected power produced with RE within the coverage of their power grid, and provide grid-connection service for the generation of power with RE.**

Ch. 6 Economic Incentives and supervisory measures

- **Article 24**
  - **The Government budget establishes RE development fund to support the following:**
    - **Scientific and technological research, standard establishment and pilot project for the development and utilization of RE;**
    - **Construction of RE projects for domestic use in rural and pasturing areas;**
    - **Construction of independent RE systems in remote areas and islands;**
    - **Surveys, assessments of RE resources, and the construction of relevant information systems;**
    - **Localized production of the equipment for the development and utilization of RE.**

Ch. 6 Economic Incentives and supervisory measures

- **Article 25**
  - **Financial institutions may offer preferential loan with financial interest subsidy to RE development and utilization projects that are listed in the national RE industrial development guidance catalogue and conform to the conditions for granting loans.**
- **Article 26**
  - **The Government grants tax benefits to projects listed in the RE industrial development guidance catalogue, and specific methods are to be prepared by the State Council.**

Resources of Ocean RE in China

- shore line: 18,000 km
- islands: 6960

National OE resource

RE	av. power (GW)
tidal	110
tidal stream	14.0
wave	12.9
Salinity E	125

High Tidal current Energy Density Channels

Region / Province	Channel	Region Class	Max. energy density (kW/m²)	Averaged theor. power (MW)
Zhejiang	North Hangzhou Bay	I	28.99	3830
	Jintang channel	I	25.93	3090
	Guishan Channel	I	23.89	
	Xihoumen Channel	I	19.08	

Tidal power station in China

1950 - 1980: built about 76, 5160kW total

Up to 1985: 8 running

Now: 3 running

Haishan plant: 150kW (2,1975)

Baishakou plant: 640kW (6,1978)

Jiangxia plant: 3200kW (6,1980)

Activities on Tidal-current Energy Exploitation in China (HEU)

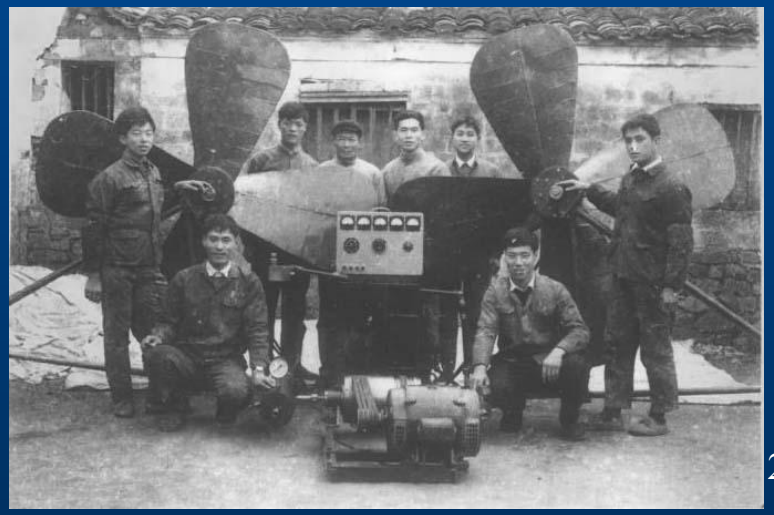
Review of R&D on tidal-current exploitation in China

- 1979: Mr. HE Shijun built a 8kW propeller-type device
- 1984: 60W VAHT model test (Prof. ZHU Dianming)
- 1989: 1kW generator tested in Lalin river
- 1995: scheme design of 10kW tidal-stream power plant
- 1996-2002: built a 70kW floating experimental tidal-stream power plant with a twin-rotors VAHT (cycloidal)
- 2003-2006: build a 40kW submerged experimental device with a twin-rotors VAHT

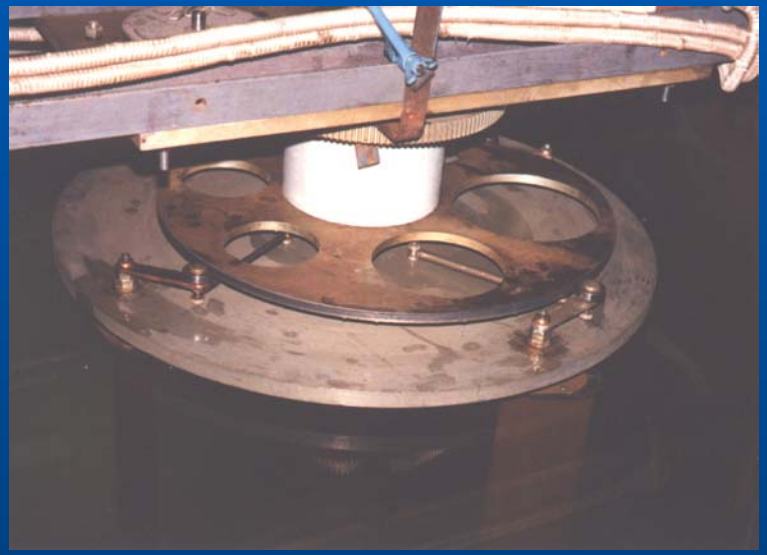
Sea test of a 8kW propeller-type device

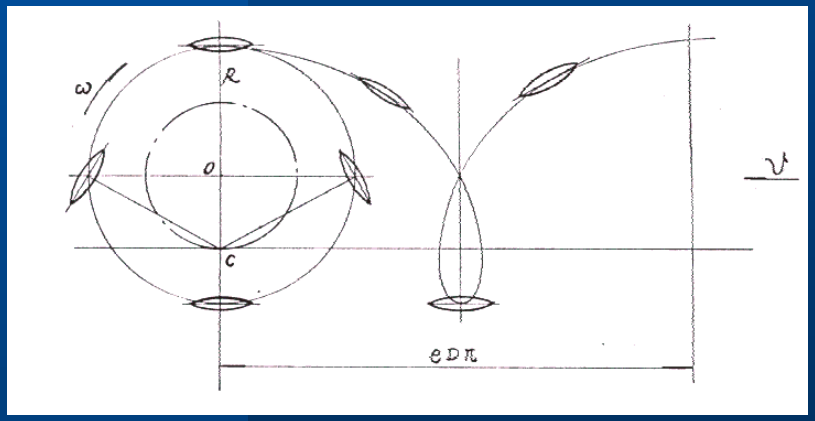
(1979 Mr. HE Shijun)

- two propeller-type rotors were put under the stern of a fishing boat
- performed 27h field test with 5.7kW output power
- tested in Xihoumen strait of Zhoushan, Zhejiang province.



Model test of 60W VAHT in circulation water channel (1982□1984 HEU)

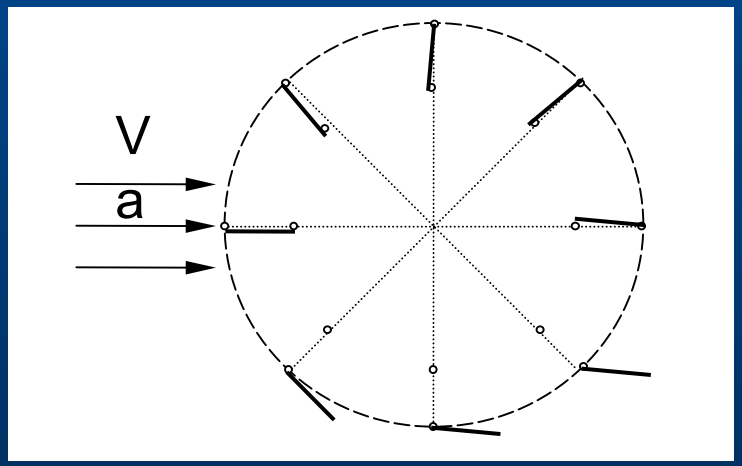




Model test of 60W VAHT with cam and sway bar in the towing tank

1kW power device with VAHT tested in Lalin River near Harbin□1989, HEU□

Model test of turbine "□□"□1999, HEU□



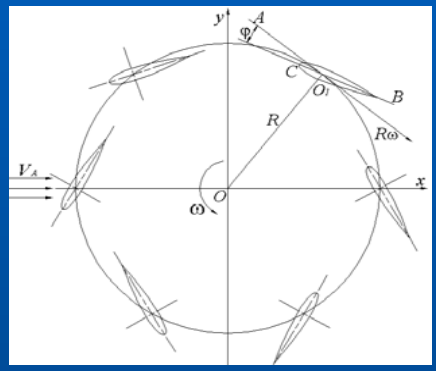
Theoretical aspects for VAHT □ HEU□
——Hydrodynamic performance

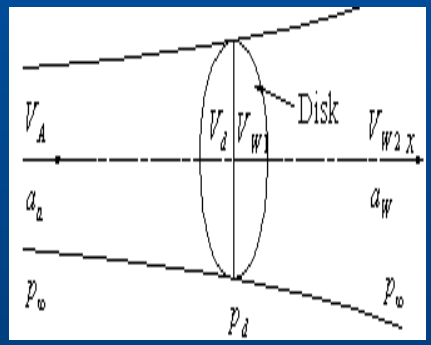
1980□1984:

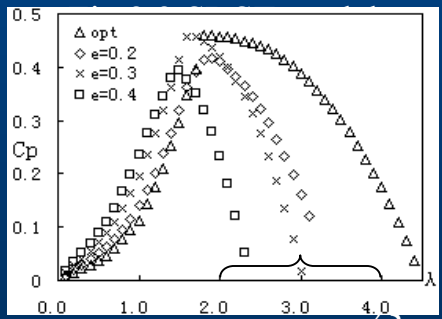
- Stream tube model (SDST)
- Vortex model with Steady wake

1999□2005:

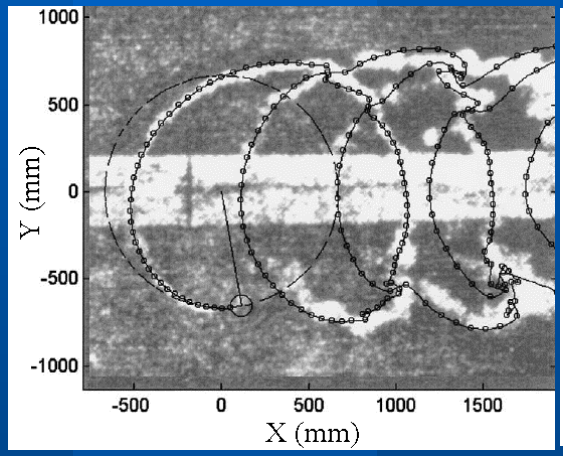
- Stream tube model with modification （C-VAPHT)
- Vortex-panel model for transient loads □BEVAPHT□
- Blade motions and optimization

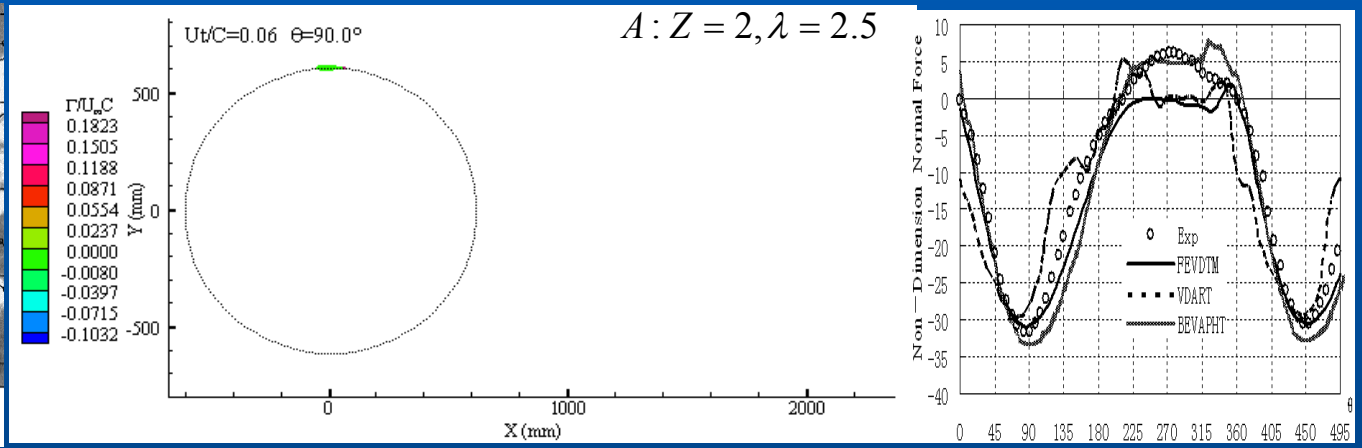


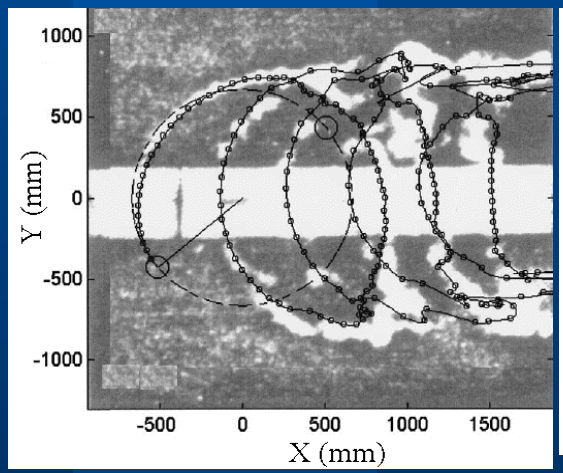


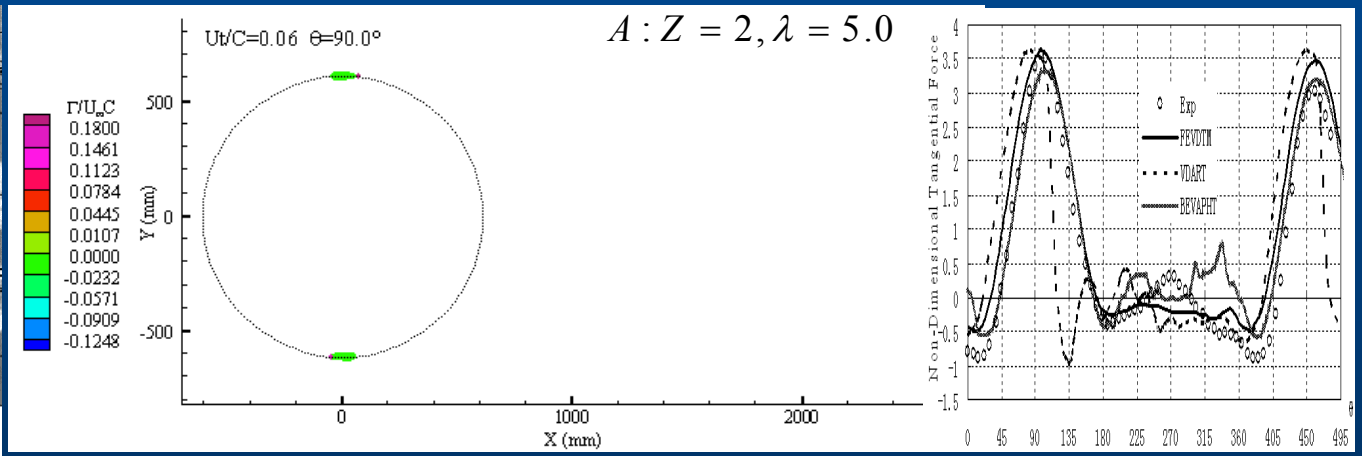


Example: V-DART *by J.H. Stricland*
FEVDTM *by F. L. Ponta*
BEVAPHT *by L. Zhang & LB Wang*



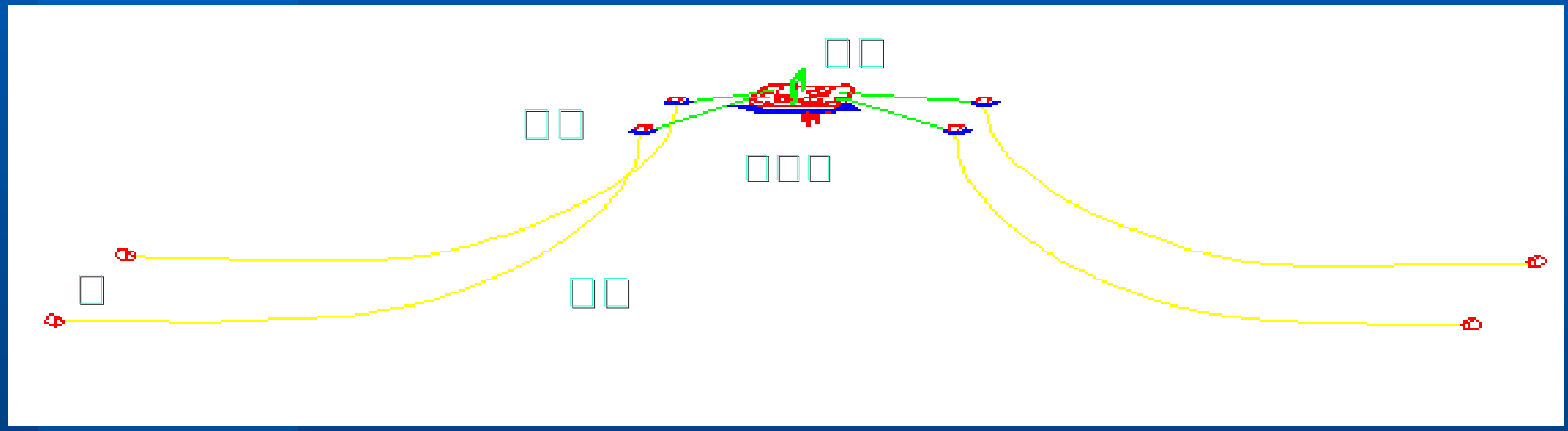


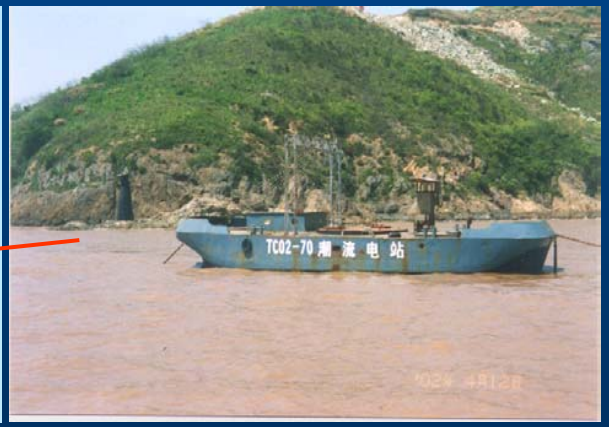




70kW Exp. Power Plant (HEU,China, 2002)

An artist's impression of the China's first real tidal-stream generator designed by HEU. Named as "Wanxiang - I".

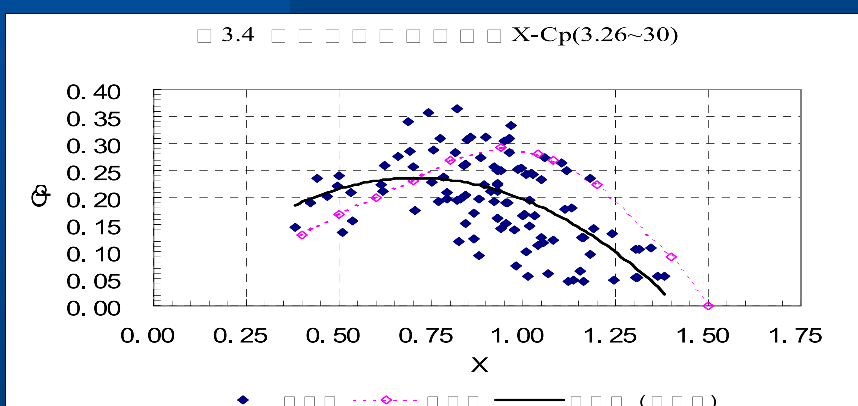




The plant is based on a floating platform and is composed of a pontoon carrier, a turbine with 2 rotors, mooring system, electric generator and control system.

Parameters of the “□□□I”

The Plant is located at Guanshan strait in Daishan, Zhejiang province.



Capacity	70kW
Work velocity	1.6 - 4.0m/s
Sustain wind	10th grade
Sustain wave	3m height
Mooring system	4 blocks of 35t
Speed 2-2.5m/s	output 5-20kW
Pontoon	18*9.0*2.2m
Blades size	0.56*2.5m
Blades number	2×4
Water depth	20-70m

40kW Exp. Power Plant (HEU,China, 2006)

“□□-II”

The plant with two VAHT is under water and seats on sea-bed of a strait of Daishan, Zhejiang Province.

Size: 7.6*7.6*5 m

Weight in air: 60 ton

Activities on Wave Energy Exploitation in China (GIEC)

Marine Energy Lab

Guangzhou Institute of Energy Conversion

1985-90: 10kW, 60kW & 100kW navigation use wave power devices (GIEC)

BD102, 10 W, navigation buoy use, 700 sets are using, export to U.K., Japan and Philippine

BD102 in operation

100 W wave power device used in navigation ship

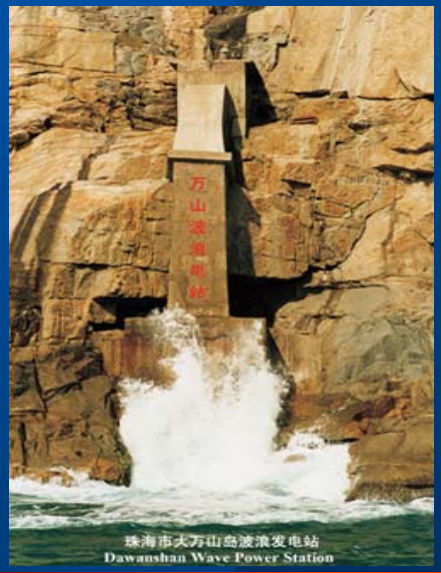
1985-90: 3 kW onshore OWC wave power station

- Stand-alone, Unstable output
- Width: 4m

  Endurable wave power: 15kW

  Max. average output: 1kW

1990-95: 20 kW onshore OWC



- Co-work with a 14.7kW diesel
- Unstable output

  Width: 4m

  Endurable wave power: 60kW

  Max. average output: 8kW

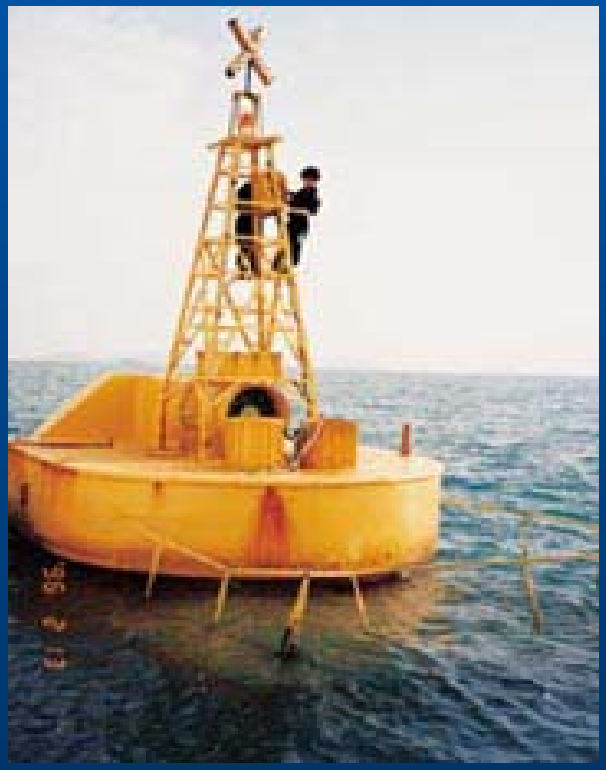
1990-95:

5 kW Backward Bent Duct Wave Generating Ship

- Stand-alone, Unstable output

  Width: 4m

  Max. average output: 1kW



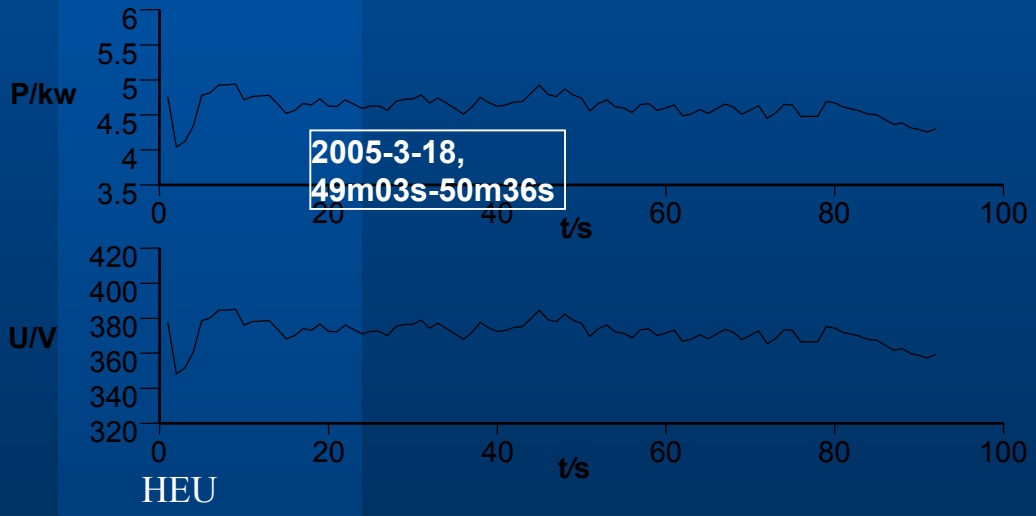
1995-2000:
100 kW onshore OWC Wave Power Station

- Grid-connected
- Unstable output

  Width: 6m

  Endurable wave power: 500kW

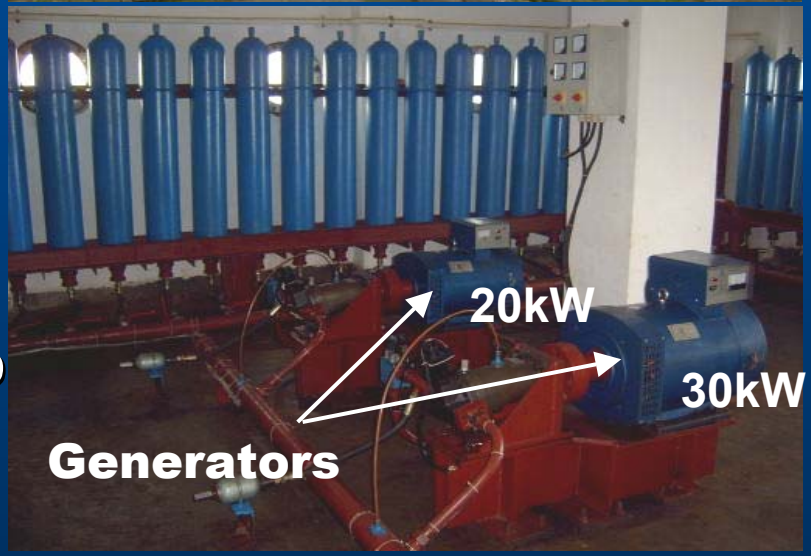
  Max. average output: 15kW



HEU

2000-2005:
50 kW onshore buoy wave power station

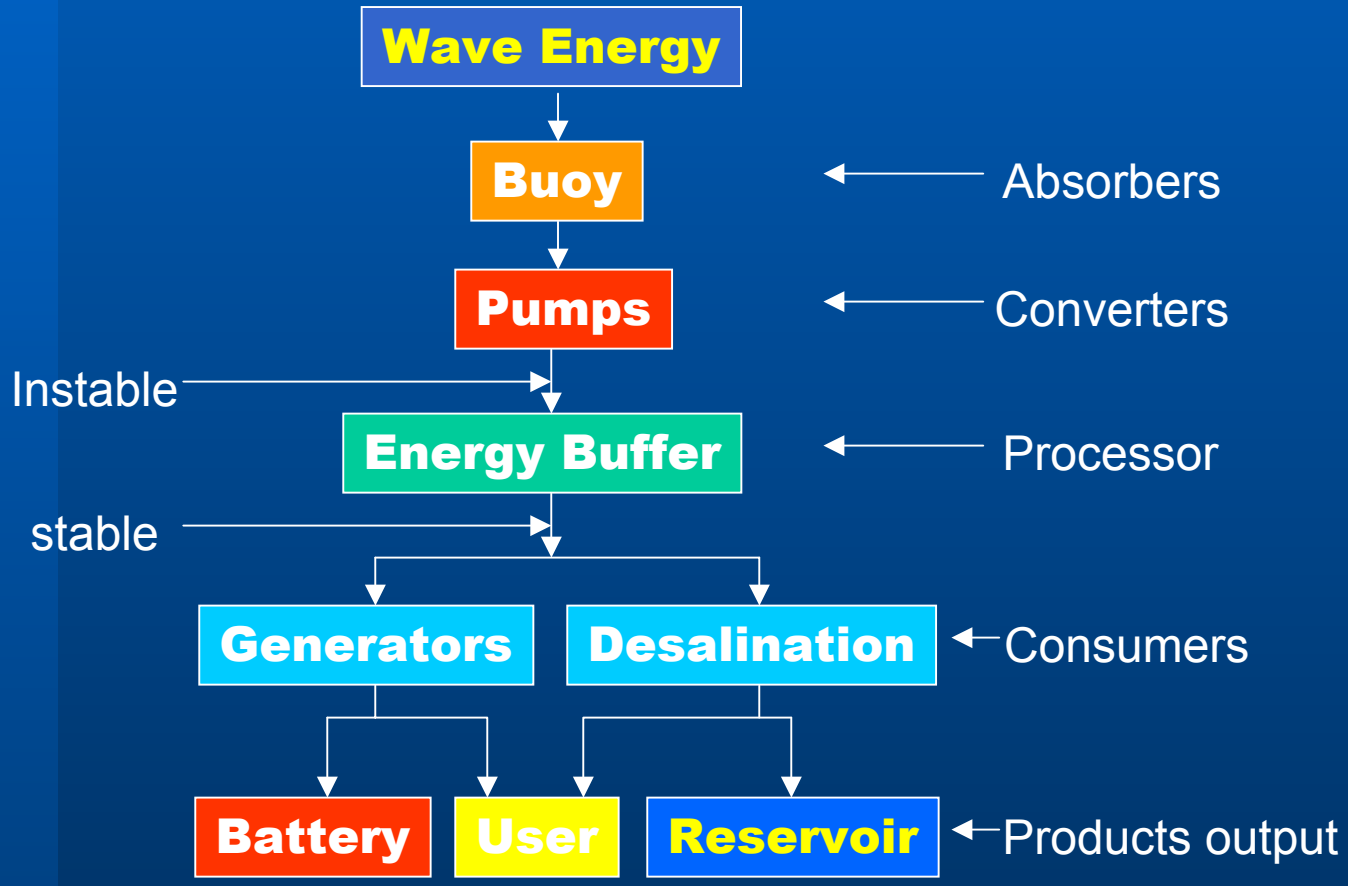
- Stand-alone
- Stable output
  Width: 6m
  Endurable wave power: 400kW
  Max. average output: 50kW



10MJ Energy Buffer

- Efficiency of wave to wire: 50%
- Efficiency of hydraulic energy to portable water: 12 MJ to 1 M^3

Configuration of the Stand-alone WPS



Why Study Stand-alone Wave Power System

In China, wave energy flux is quite low (2~7 kW/m). The cost of the electricity generated by wave power device is much higher than the purchase price of the grid. Thus, in the region with a grid, people are not interested in wave energy.

The people in a remote island without grid are very interested in wave energy utilization.

Thanks for Your Attention !

Welcome to Harbin !