

HITACHI PUMPS



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HITACHI Experiences in Large Scale Pumps

- 1. Total 13,132 units (As of 2006)
(11,580 units in Japan, 1552 units in other countries / area)**
- 2. More than 90 years experiences in manufacturing pumps**

HITACHI Solutions

- 1. All kinds of engineering on pumping station**
 - System planning**
 - Advanced simulation technology (CFD, FEM, WH analysis)**
 - Hitachi owns exclusive testing facilities for hydro model test**
- 2. Highly engineered and custom-made pumps to optimize customer's needs**
- 3. Wide pump applications**
- 4. High reliability and maintainability**
- 5. Pump testing facilities (up to 10,000 kW input)**

2 . SUPPLY RECORD IN THE WORLD

Hitachi Large Scale Pumps in the World (Except Japan)

Total

1,552

**Asia and
Middle East**

832

Europe

22

**North
America**

295

**South
America**

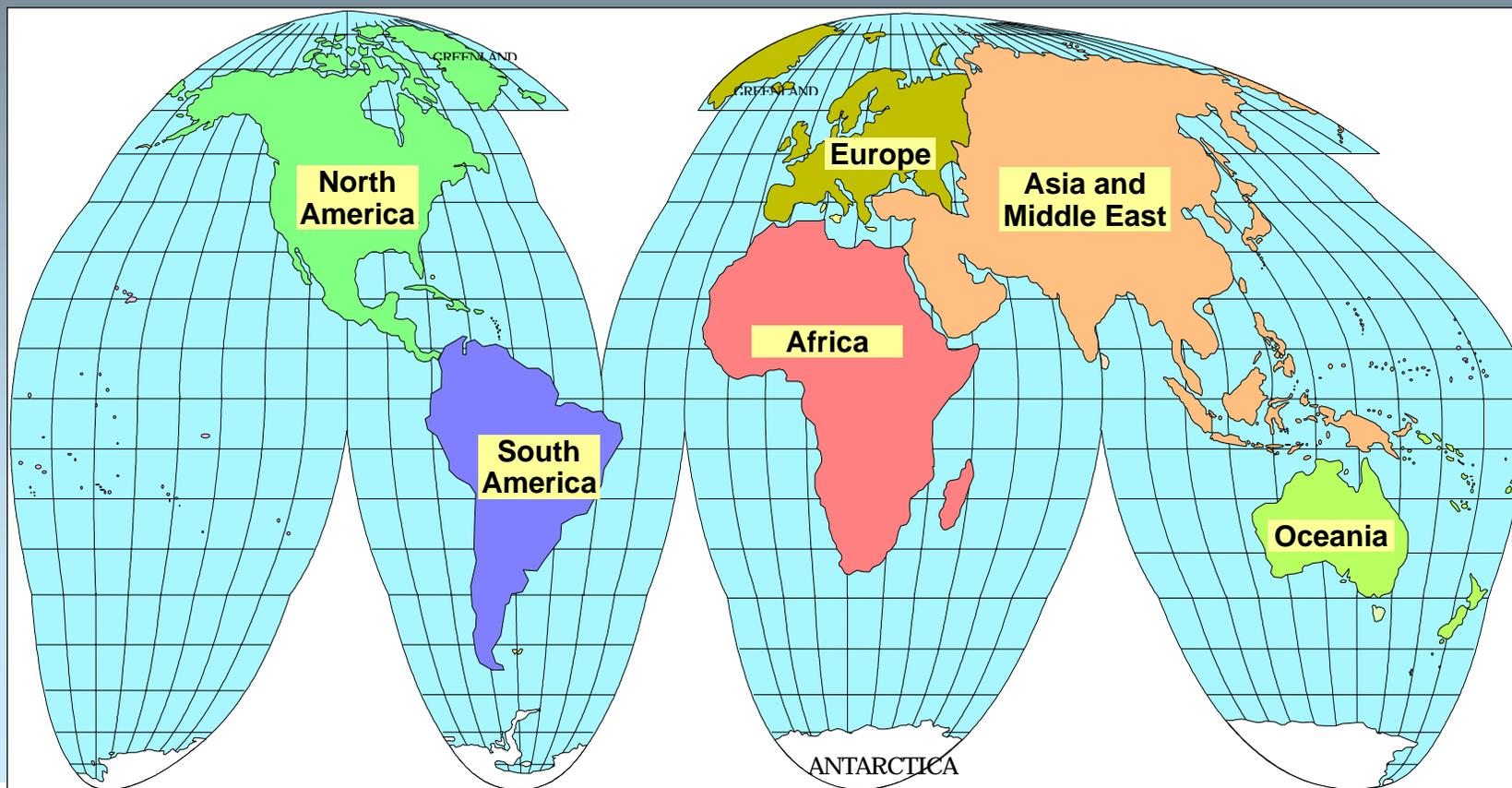
73

Africa

197

Oceania

133



3 . MANUFACTURING LOCATION



TSUCHIURA WORKS

Site area :380,000m²:94acres

Floor area :130,000m²:32acres

Employees:1000

Sales:US\$400,000,000/year

MAJOR PRODUCTS

Pump

Compressor

Fan

Test Facility

4. TYPES AND APPLICATIONS

Axial Flow	Mixed Flow	Mixed Flow Volute
Type AP, KP*	Type SP, KSP*	Type SPS, KSPS*
<p>Vertical</p>  <p><i>Applications</i> -Drainage -Irrigation</p>	<p>Vertical</p>  <p><i>Applications</i> -Drainage -Irrigation -Water Supply -Sea Water -CWP</p>	<p>Vertical</p>  <p><i>Applications</i> -Drainage -Sewage -Irrigation -Sea Water</p>
<p>Horizontal</p> 	<p>Horizontal</p> 	

*Adjustable Blade Type

4. TYPES AND APPLICATIONS

Centrifugal Volute

Centrifugal Turbine

Double Suction Volute

Type

OV

OT

DV

Vertical

Applications

- Drainage
- Sewage
- Irrigation
- Sea Water



Applications

- Drainage
- Sewage
- Irrigation
- Water Supply

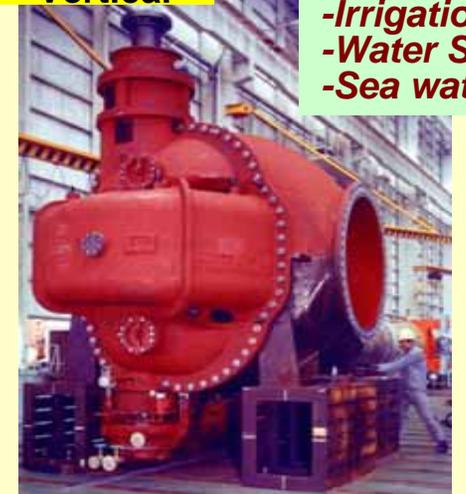
Vertical



Horizontal



Vertical



Applications

- Water Supply
- Irrigation
- Water Supply
- Sea water

4. TYPES AND APPLICATIONS

Multistage Double Suction Volute

Double Suction Turbine

Multistage Turbine

Type

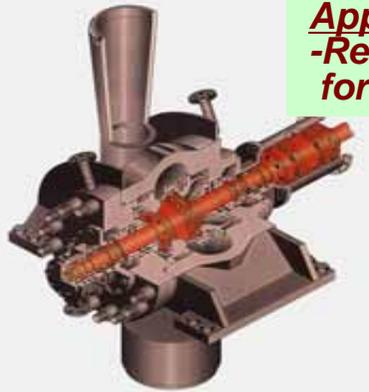
DVM

DT

GM



Applications
-Water Supply
-Irrigation
-Water Supply
-Sea water



Application
-Reactor Feed
for Nuclear



Applications
-Boiler Feed
-Descaling



Barrel Casing Multistage Turbine

Type

BGM



Applications
-Boiler Feed
-Reactor Feed
-High Pressure
drain for Nuclear



Applications
-Send-out and Booster
at LNG Terminal

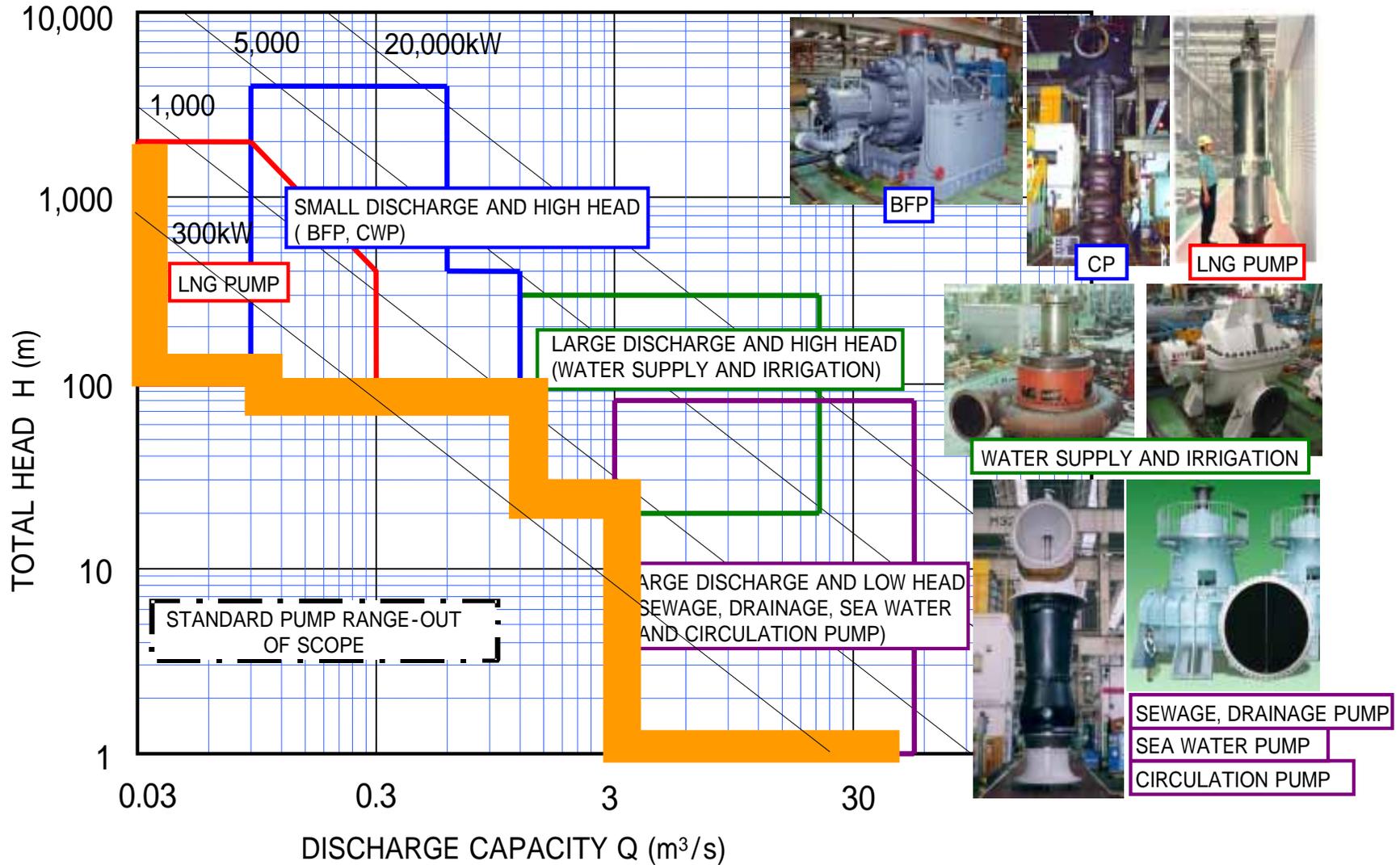


Pot-Type

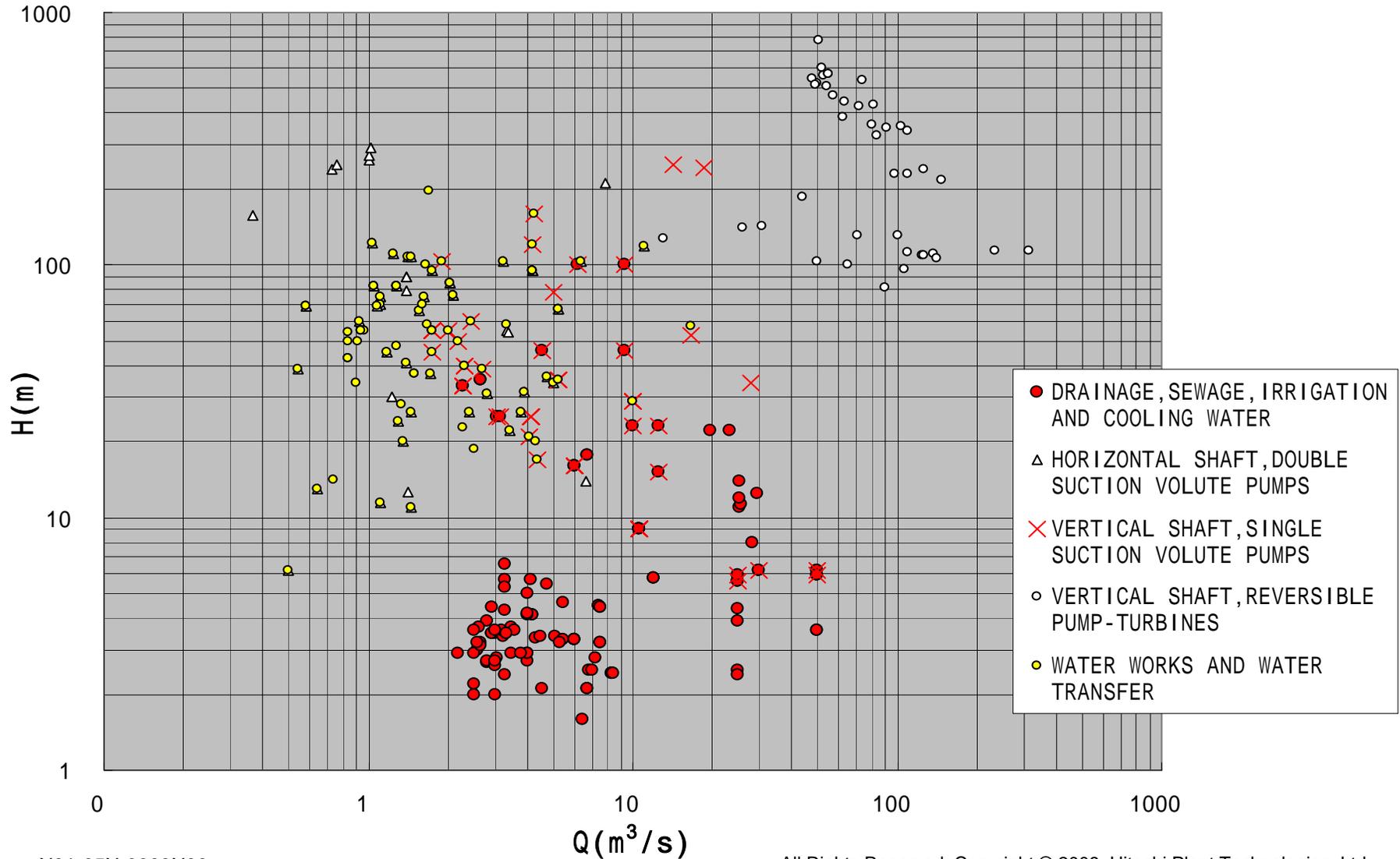
In-Tank Type

4. TYPES AND APPLICATIONS

HITACHI PUMPS - GENERAL APPLICATION CHART



SUPPLY RECORDS OF HITACHI PUMPS



HITACHI PROVIDES ALL KINDS OF ENGINEERING ON PUMPING STATIONS

by utilizing all technologies in Hitachi group, long time experience and systematic design

PLANNING

SEWAGE TREATMENT
BOOSTER
WATER PURIFICATION
WATER INTAKE
WATER SUPPLY
IRRIGATION
DRAINAGE
COOLING WATER
POWER PLANT
LNG PLANT

ANALYSIS

WATER HAMMER
OPEN AND CLOSED CHANNEL FLOW ANALYSIS
TURBULENT ANALYSIS, VORTEX ANALYSIS IN PUMP SUMP
MULTI PHASE FLOW ANALYSIS IN SIPHON
SIMULTANIOUS ANALYSIS OF TRANSIENT PHENOMENA & CONTROL
NOISE ANALYSIS (TRANSFERRED BY AIR, TRANSFERRED BY SOLID)
VIBRATION ANALYSIS
PULSATION ANALYSIS
WATER LEVEL PREDICTION ANALYSIS

TOTAL ENGINEERING

SUPPLY

DIESEL ENGINE
GAS TURBINE
MOTOR
GEAR
TRASH SCREEN
OVERHEAD TRAVELING CRANE
VALVE
PIPE
PANEL, ELECTRICAL EQUIPMENT

DESIGN AND MANUFACTURING

AXIAL PUMP
MIXED FLOW PUMP
MIXED FLOW VOLUTE PUMP
CENTRIFUGAL FLOW VOLUTE PUMP
CENTRIFUGAL FLOW TURBINE PUMP
DOUBLE SUCTION VOLUTE PUMP
DOUBLE SUCTION MULTISTAGE PUMP
DOUBLE SUCTION TURBINE VOLUTE PUMP
BARREL CASING MULTISTAGE TURBINE PUMP

Research and Development



**Power & Industrial Systems
R&D Laboratory**
(Hitachi City)



**Hitachi Research
Laboratory**
(Hitachi City)



**Mechanical Engineering
Research Laboratory**
(Hitachinaka City)

Hitachi pumps are continually in concert with domestic and overseas research organizations as well as the research laboratories of Hitachi Limited for the development of new products and putting the latest technology to practical use.

7.

TYPICAL EXPERIENCES AYASE DRAINAGE PUMPING PLANT

HITACHI
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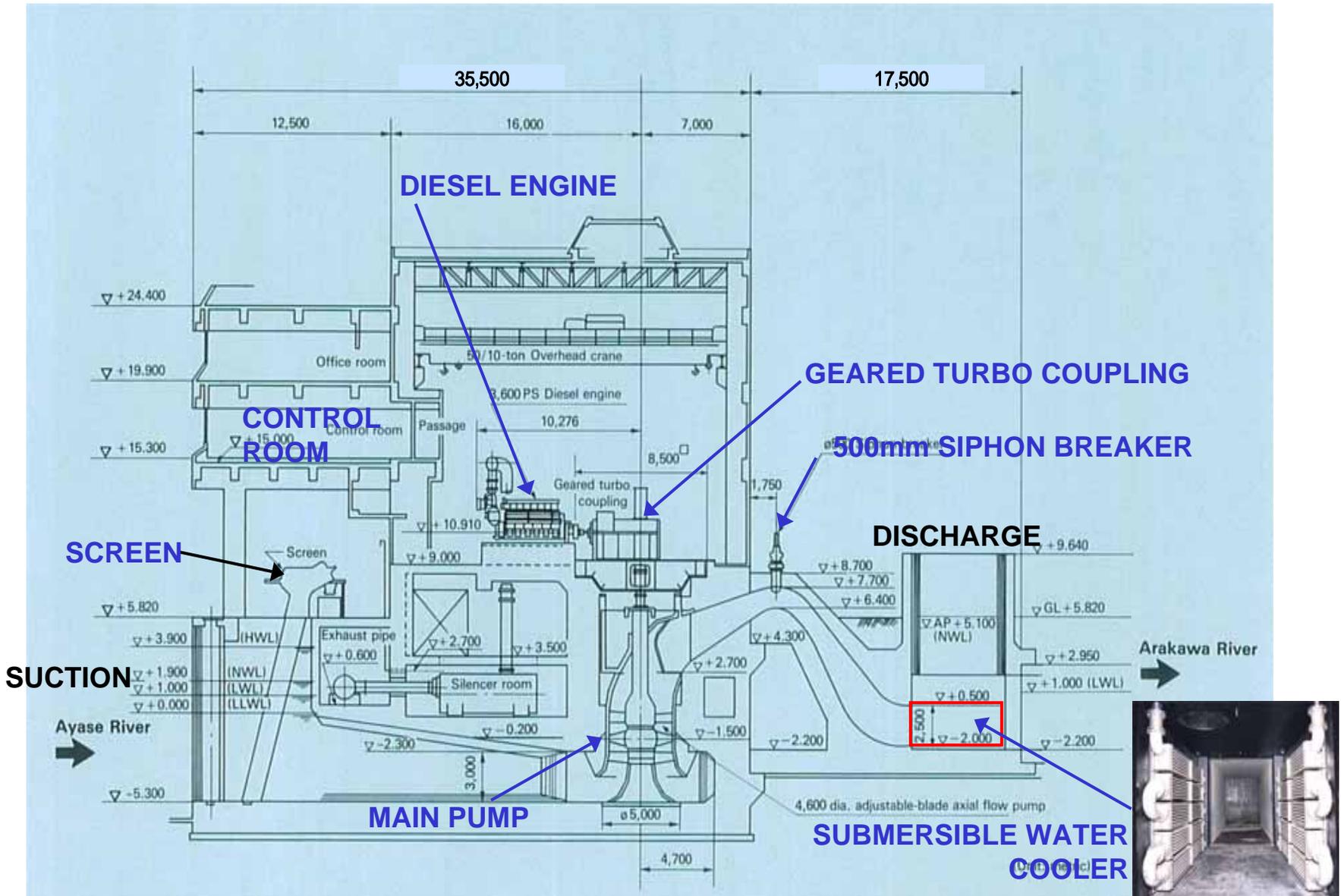
Customer: Ministry of Land, Infrastructure and Transport , Japan
No. of Sets: 2

	Unit No.1	Unit No.2
Bore:	4,600mm (182in)	4,600mm (182in)
Type:	Vertical, Adjustable blade, Axial flow pump	Vertical, Fixed blade, Axial flow pump
Discharge Capacity :	50m ³ /s (1,141mgd)	50m ³ /s (1,141mgd)
Total Head:	3.6m (11.8ft)	3.6m (11.8ft)
Speed (rpm):	82	100
Prime Mover:	2,648kW (3,550HP) (Engine)	2,721kW (3,650HP) (Engine)
Year of Supply:	1984	1993
Service:	Drainage	Drainage
Siphon Formation:	Forced formation	Self formation

Feature: One of the largest drainage capacity in Japan
Liquid to be handled : Brackish water
Valveless system

7.

TYPICAL EXPERIENCES AYASE DRAINAGE PUMPING PLANT



7.

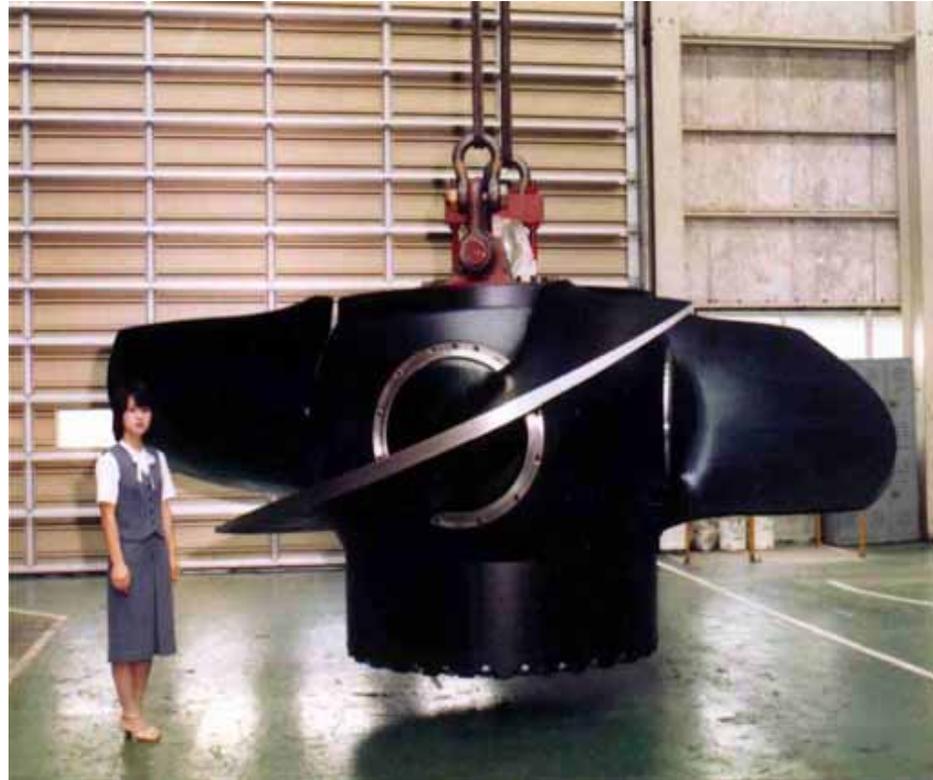
TYPICAL EXPERIENCES AYASE DRAINAGE PUMPING PLANT



Installation of Siphon Discharge Liner



Installation of Discharge Liner



Impeller

TYPICAL EXPERIENCES

SARINAH THAMRIN DRAINAGE PUMPING PLANT



**Customer: Ministry of Public Works,
INDONESIA**

No. of Sets: 6

Bore: 1,650mm (64in)

Type: Vertical, Axial flow pump

Discharge

Capacity : 6.7m³/s (153mgd)

Total Head : 4.2m (13.8ft)

Speed (rpm): 223rpm

Prime Mover: 430kW (576HP) Motor

Year of Supply: 1989

Service: Drainage

Features

1. With a discharge capacity of 40m³/sec. this is the largest drainage pumping plant in Indonesia.
2. Adoption of lubrication-free bearings for the pump has simplified the auxiliary machinery system.
3. Equipped with an intensive remote control system and an in-house power generation unit to enable continuous pump operation during power failure, the plant is highly reliable.

TYPICAL EXPERIENCES GANGES KOBADAK IRRIGATION PROJECT

Customer : Bangladesh Water Development Board (BWDB) , BANGLADESH

No. of Sets : 3

Bore : 2,800mm (110in)

**Type : Vertical, Adjustable-blade,
Axial flow pump**

Discharge

Capacity : Unit capacity : 28.3m³/s (646mgd)

Total capacity : 84.9m³/s (1,938mgd)

Total Head : 8.25m (27.1ft)

Speed (rpm) : 200

Prime Mover : 2,800kW (3,753HP)

Synchronous motor

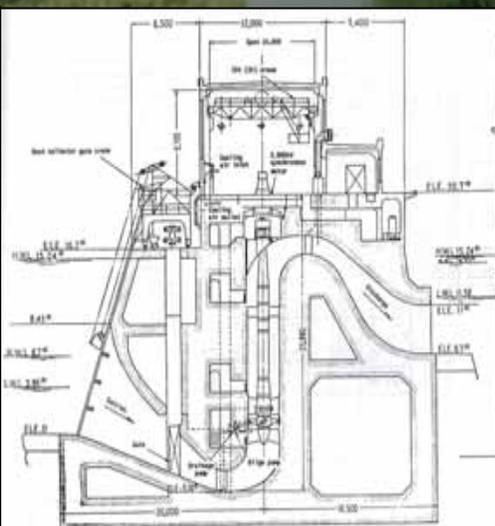
Year of Supply : 1958

Service : Irrigation

Feature : Big size adjustable-blade pump

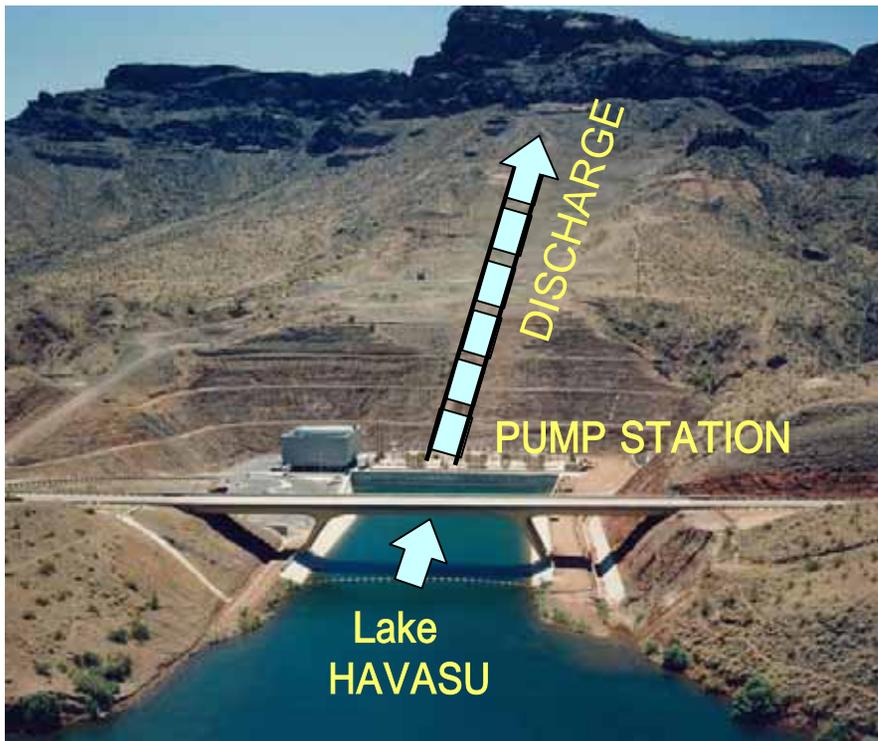
Valve less system

Forced siphon formation



7.

TYPICAL EXPERIENCES HAVASU PUMPING PLANT, USA



Customer : Department of the Interior Bureau of Reclamation, Central Arizona Project , USA

No. of Sets : 6

Bore : 2,400 × 1,350mm (94 × 54in)

Type : Vertical, Single suction, Diffuser type, Volute pump

Discharge

Capacity : 14.2m³/s (500cfs)

Total Head : 251m (824ft)

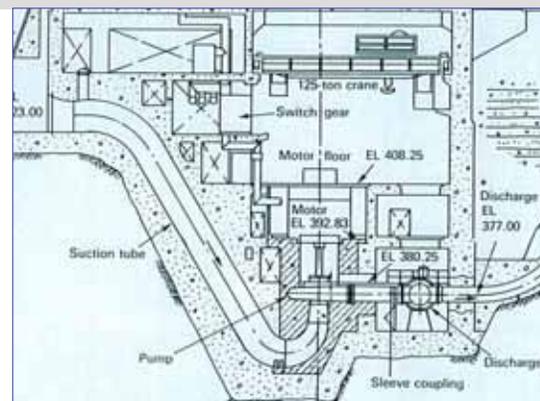
Speed (rpm) : 514

Prime Mover: 44,800kW (60,000HP)
Synchronous motor

Year of Supply : 1982

Service : Multipurpose

Feature : Large capacity, high head single stage
High efficiency(90.5%)

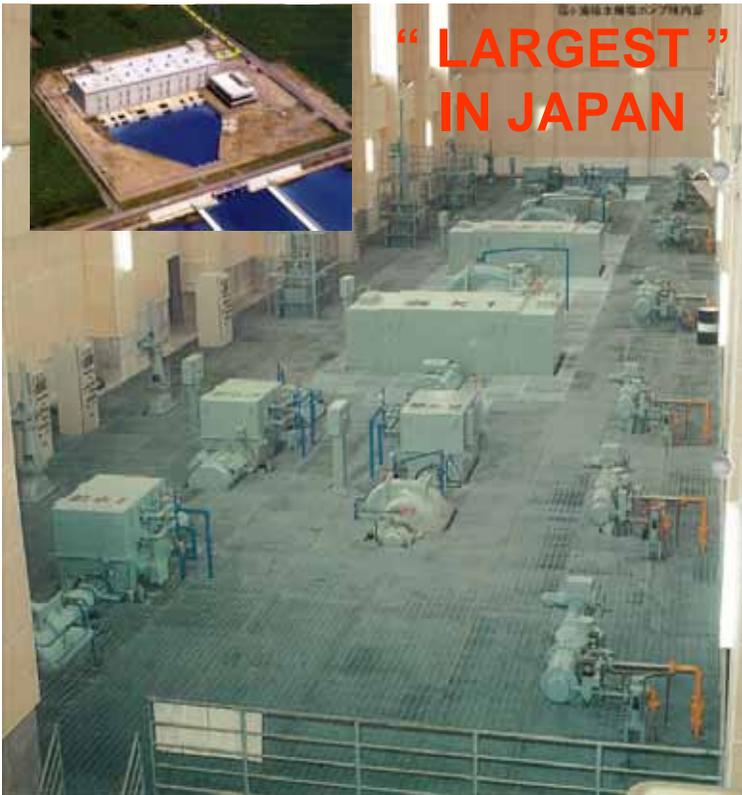


7.

TYPICAL EXPERIENCES KASUMIGAURA CANAL PROJECT, JAPAN



**“LARGEST”
IN JAPAN**



Customer : Water Resource Development Public Cooperation, JAPAN

**No. of Sets : Irrigation 1,650mm × 1,000mm (66in × 40in) 2Sets
Irrigation 1,200mm × 700mm (48in × 28in) 1Sets
Irrigation 600mm × 350mm (24in × 14in) 2Sets
Waterworks 600mm × 350mm (24in × 14in) 3Sets**

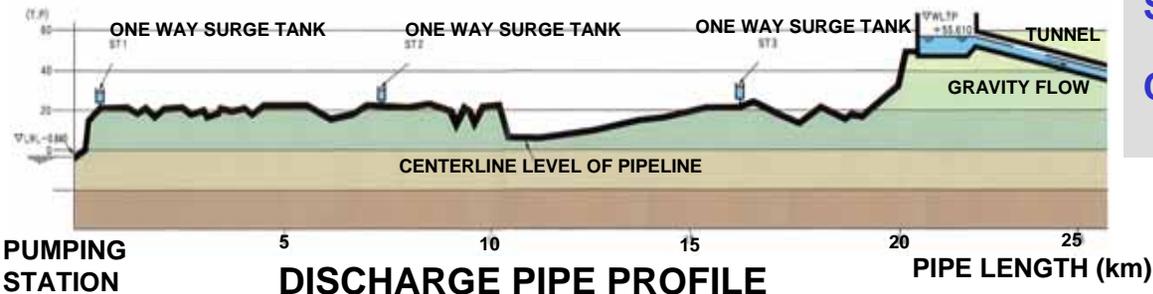
Type : Horizontal shaft, Double suction, Volute pump

Type	Bore (Suction×Discharge)	No.of Sets	Capacity	Total Head	Motor Power
Horizontal shaft, Double suction, Volute pump	1650×1000mm (66in×40in)	2	6.4m ³ /s (146mgd)	103m (338ft)	8000kW (10720HP)
	1200× 700mm (48in×28in)	1	3.255m ³ /s (74mgd)	103m (338ft)	4100kW (5500HP)
	600 × 350mm (24in×14in)	2	0.85m ³ /s (19mgd)	103m (338ft)	1100kW (1470HP)
	600 × 350mm (24in×14in)	3	0.818m ³ /s (19mgd)	103m (338ft)	1100kW (1470HP)

Year of Supply : 1994

Service : Irrigation, Water works

ALTITUDE

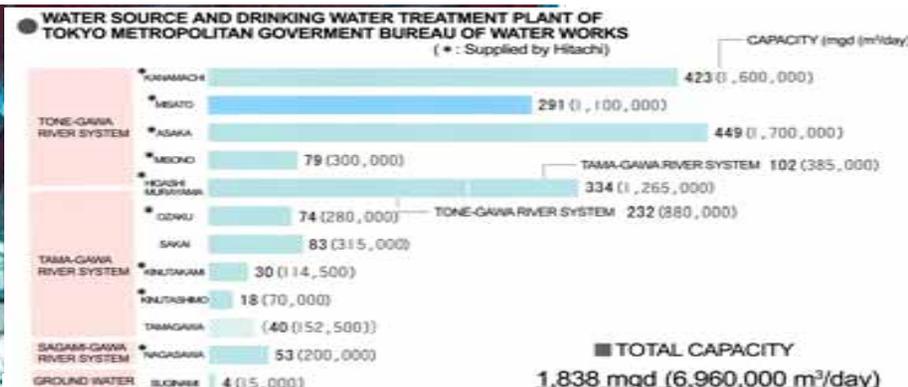
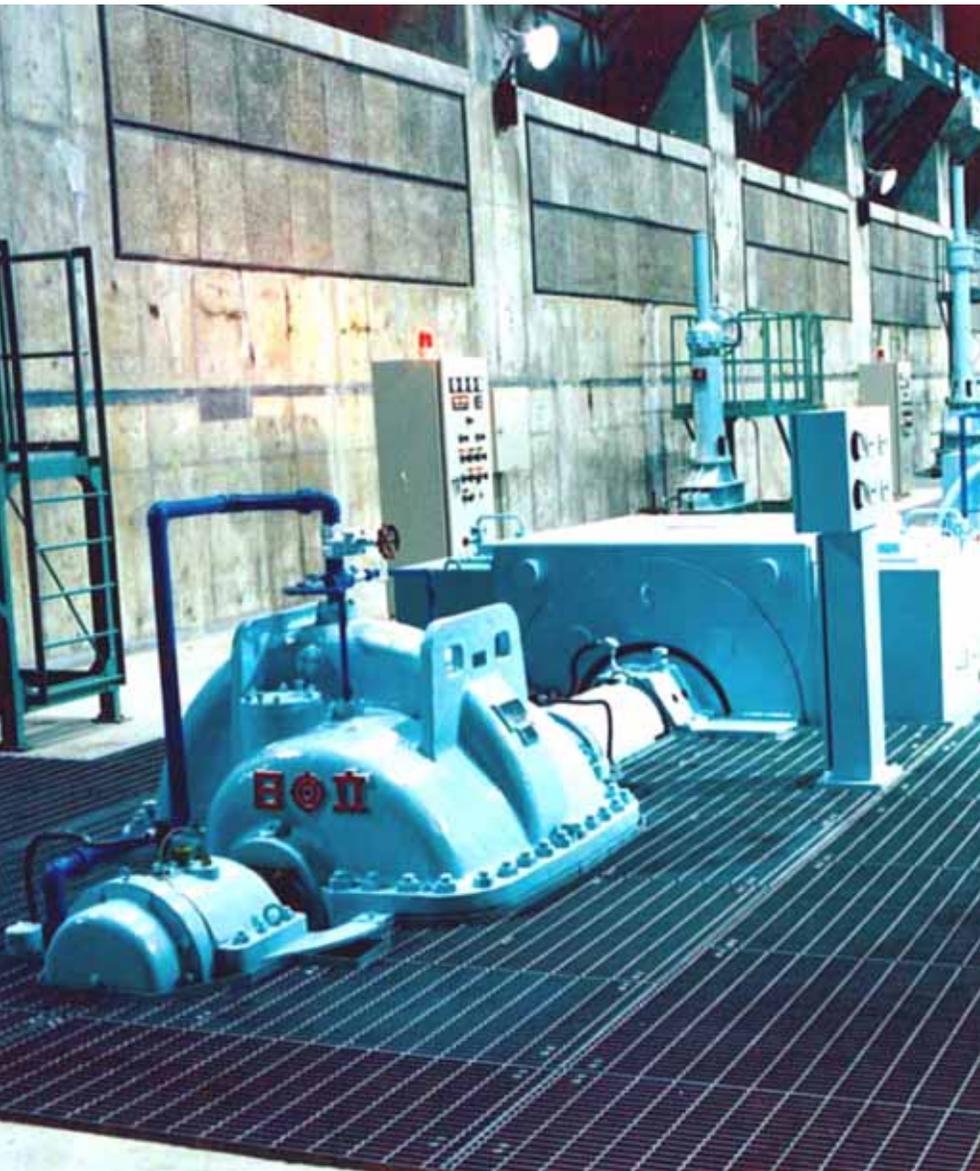


**Starting : Secondary Resistance
Control by Liquid Resistance
Control : Static Scherbius & Liquid
Resistance**

7.

TYPICAL EXPERIENCES MISATO PURIFICATION PLANT, JAPAN

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**Customer : Tokyo Metropolitan Government
Bureau of Waterworks/Misato, JAPAN**

No. of Sets : 3

Bore : 1,350 x 900mm (54 x 36in)

**Type : Horizontal shaft, Double suction, Volute
pump**

Discharge

Capacity : 4.4m³/s (95mgd)

Total Head : 95m (312ft)

Speed (rpm) : 576- 346

Prime Mover : 5,000kW (6,702HP)

Induction motor

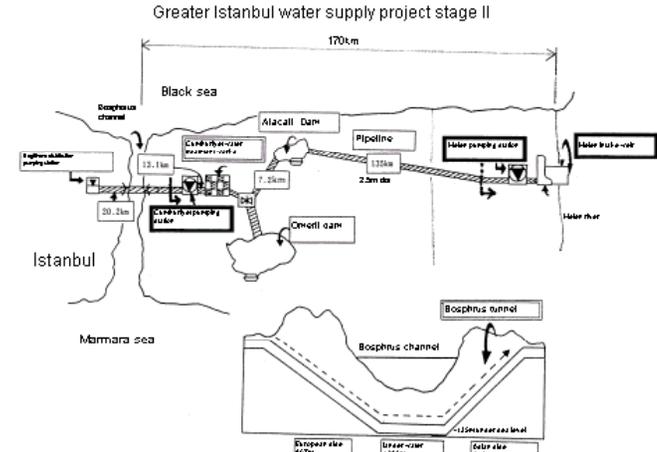
Year of Supply : 1978,1987,1992

Service : Waterworks

Starting : Secondary Resistance Control

Control : Static Scerbius

TYPICAL EXPERIENCES MELEN PUMPING STATION, TURKEY



**Customer : Ministry of Energy and Natural Resources,
Department of Water Supply and Sewage,
TURKEY**

No. of Sets : 6

Bore : 700 × 450mm (28 × 18in)

**Type : Horizontal shaft, Double suction, Volute pump
Discharge**

Capacity : 1.7m³/s (39mgd)

Total Head : 196m (643ft)

Speed (rpm) : 992

**Prime Mover : 4,500kW (6,032HP) Wound-rotor
Induction motor**

Year of Supply : 2003

Service : Waterworks

Starting : Secondary Resistance Control



TYPICAL EXPERIENCES MAINSTREAM PUMPING STATION, USA



Customer : Metropolitan Water Reclamation District of Greater Chicago, USA

No. of Sets : 8

Bore : 2200 × 1500mm (84 × 60in) × 5sets

1800 × 1200mm (72 × 48in) × 2sets

1500 × 1100mm (60 × 42in) × 1sets

Type : Vertical shaft, Single suction, Turbine pump
Discharge

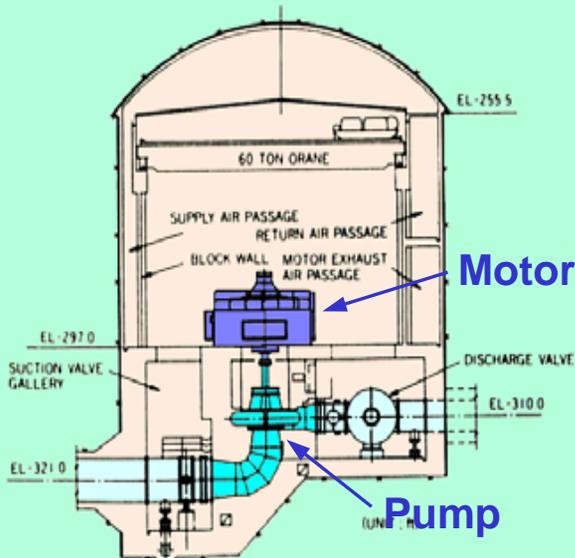
Year of Supply : 1983, 2003

Service : Sewage

Features : World largest sewage pumping plant

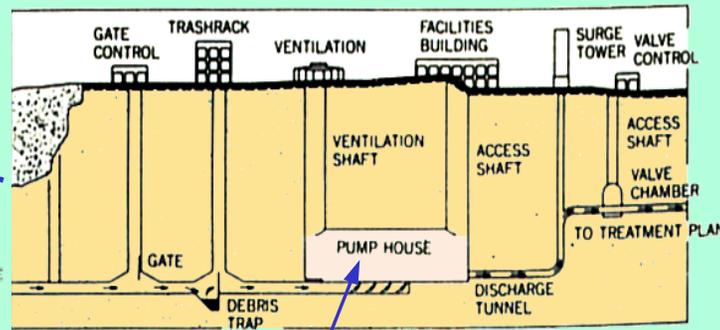
Located in deep underground

Wide operation range



Motor

Pump



Mainstream Pumping Station

Representative Specifications

Discharge

Capacity : 9.3m³/s (330cfs)

Total Head : 100m (330ft)

Speed (rpm) : 360

Prime Mover :

13,054kW (17,500HP)

Synchronous motor

7.

TYPICAL EXPERIENCES

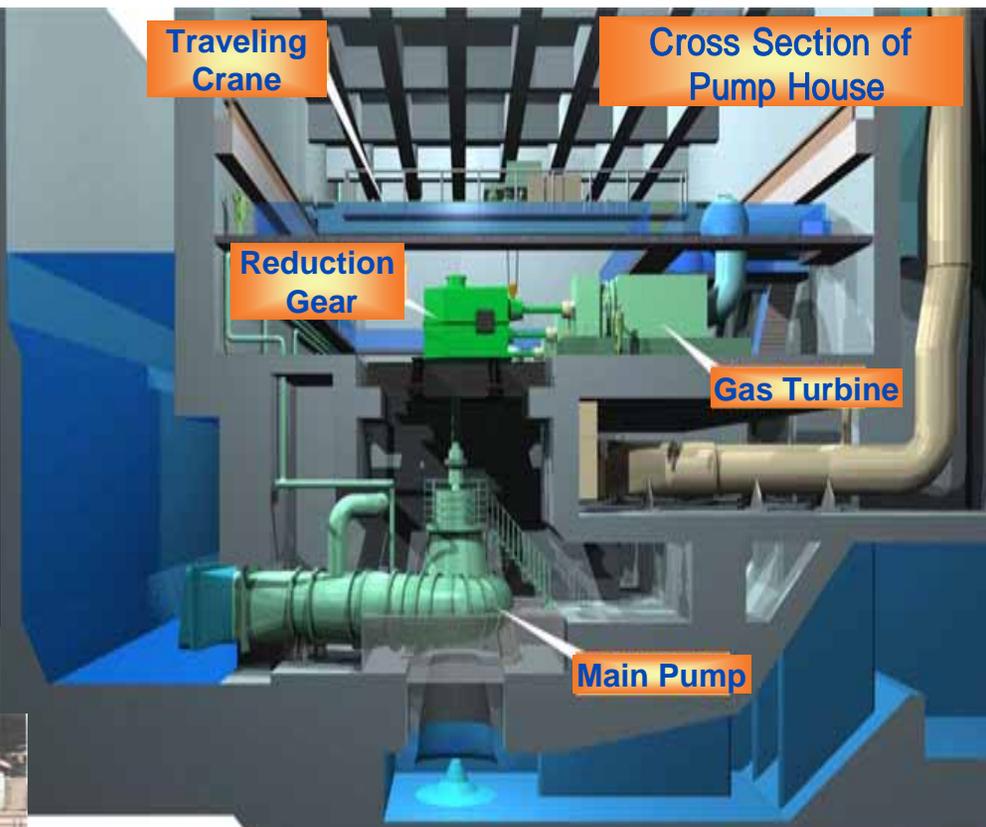
TSUMORI RECLAMATION PLANT, OSAKA JAPAN

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Drainage Pump

102in Vertical Shaft Mixed Flow Volute Pump
 $23.7\text{m}^3/\text{s}$ (837cfs) x 22m (72ft) x 223min^{-1} x
 7100kW (9,157HP)



Gas Turbine

Free Turbine : 7,100kW (9,157HP)
 Out Put Shaft Speed : $4,016\text{min}^{-1}$



Reduction Gear

3-Stage Locked Train Type
 Speed : $4,016\text{min}^{-1}$ / 223min^{-1}

Customer : Department of Sewage, Osaka City,
 JAPAN

No. of Sets : 4

Year of Supply : 1999

Prime Mover : 7,100kW (9,157HP)

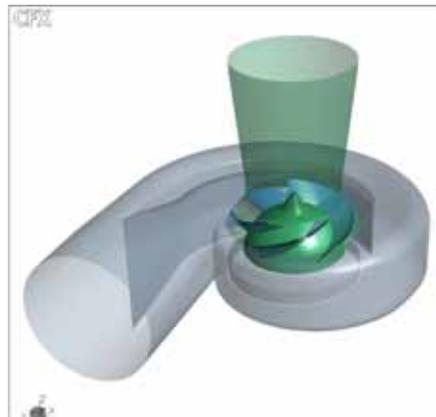
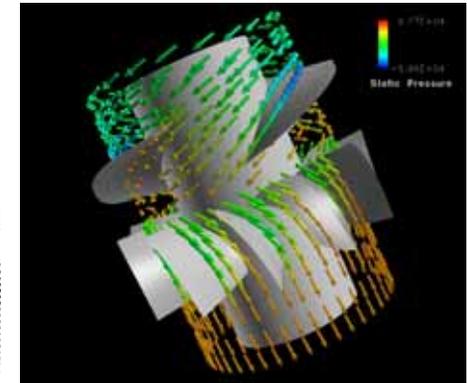
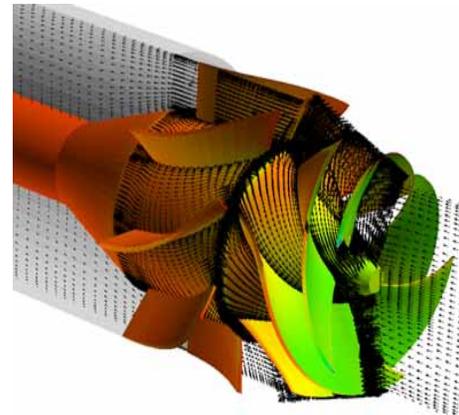
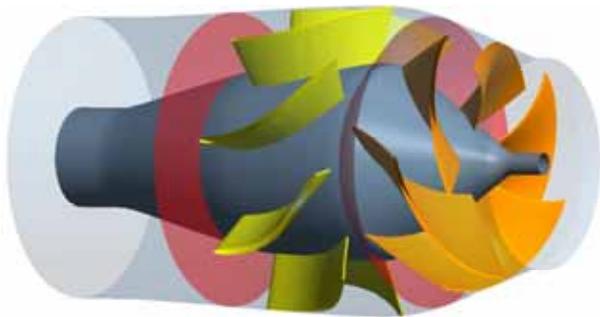
Gas Turbine

Service : Rain Water Drainage

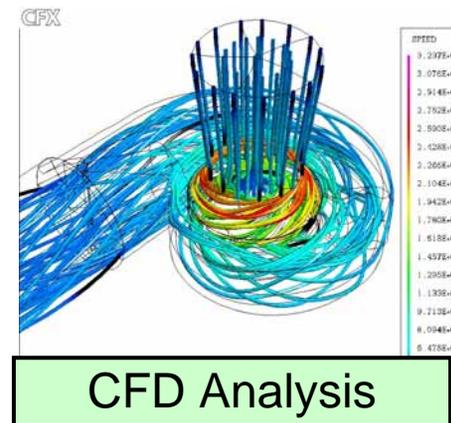
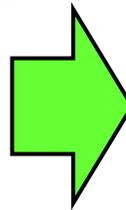
Simulation Technology

CFD:Computational Fluid Dynamics

- Application of CFD for Hydro-model Development



3D-data creation



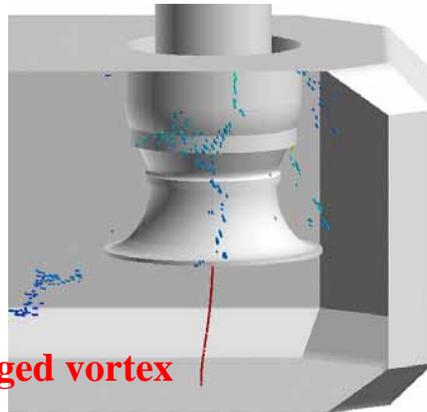
CFD Analysis

Analysis of Flow on pump impeller

Simulation Technology

- Application of CFD for Designing Pump Sump

Submerged vortex



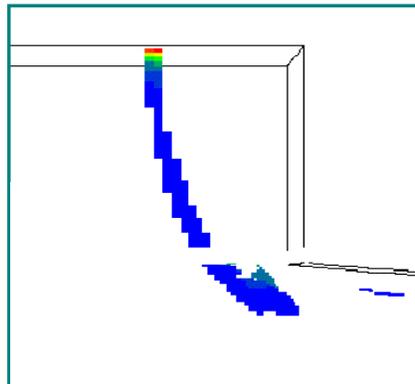
Submerged vortex

Result of analysis

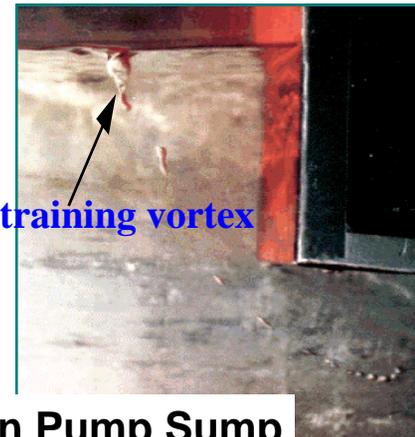


Result of experiment

Air entraining vortex



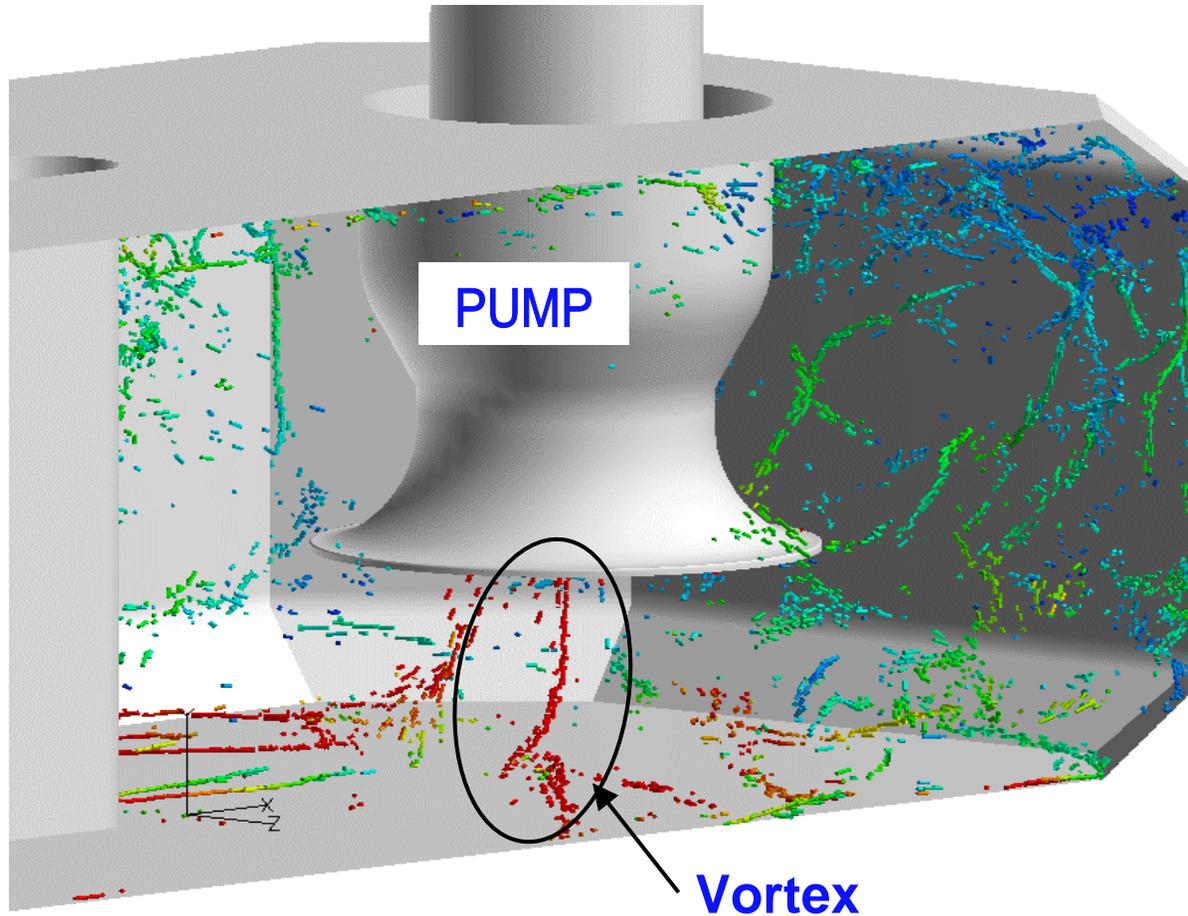
Predictive Analysis of Vortex in Pump Sump



Air entraining vortex

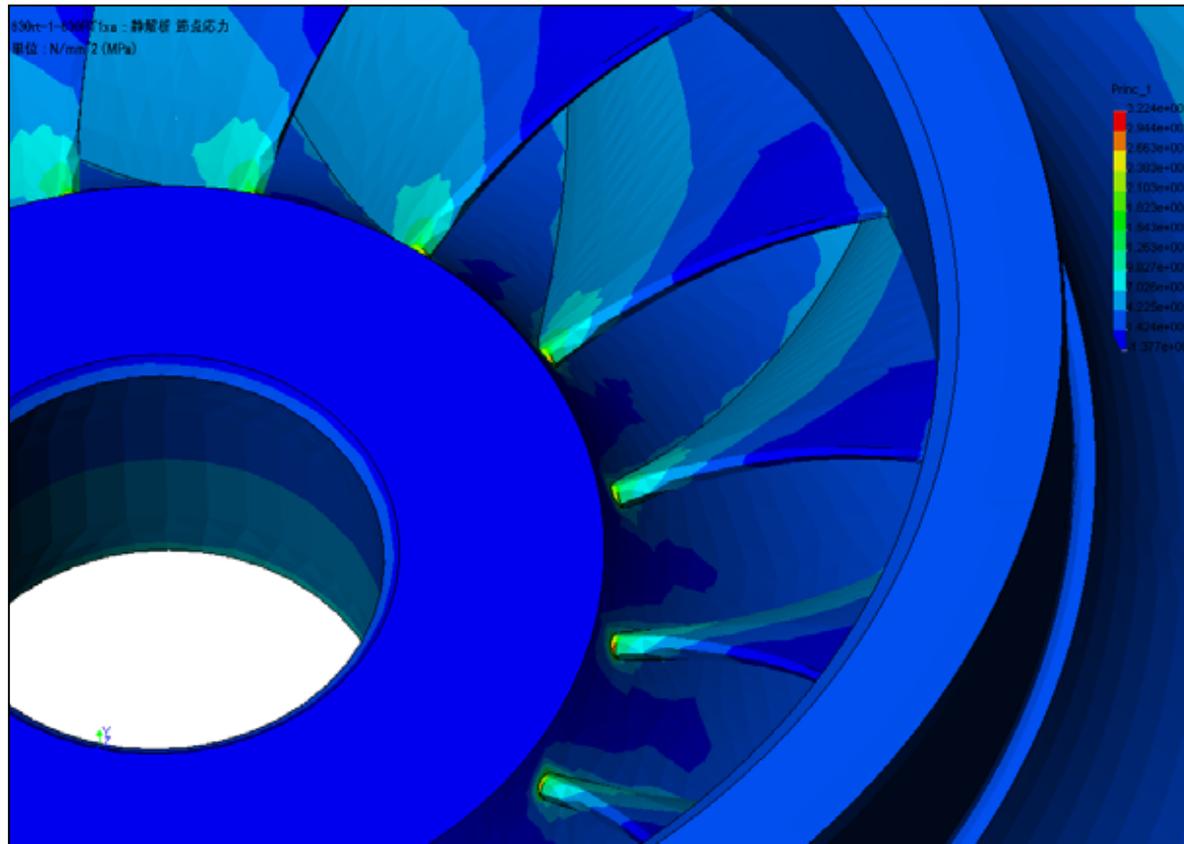
Simulation Technology

• Vortex Dynamic Behavior (with Baffle)



Simulation Technology

- FEM Analysis

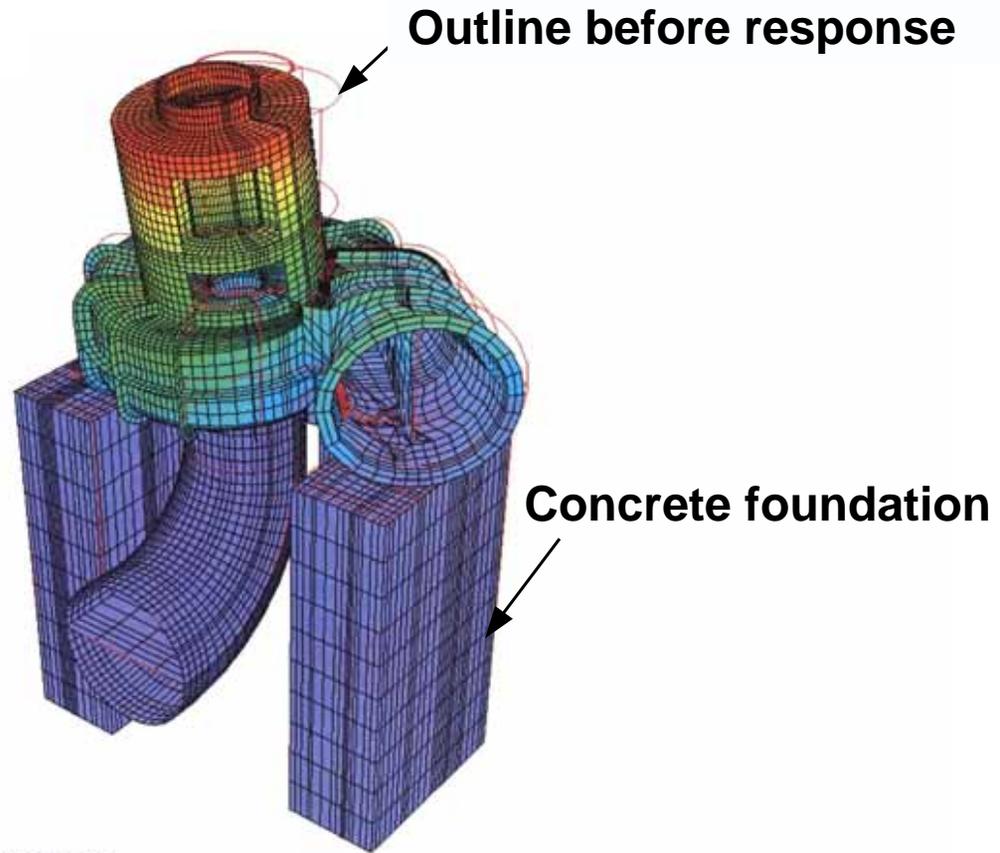
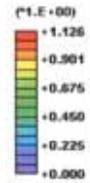


Stress Analysis of Pump Casing and Impeller

Simulation Technology

- FEM Analysis

Relative response (-)



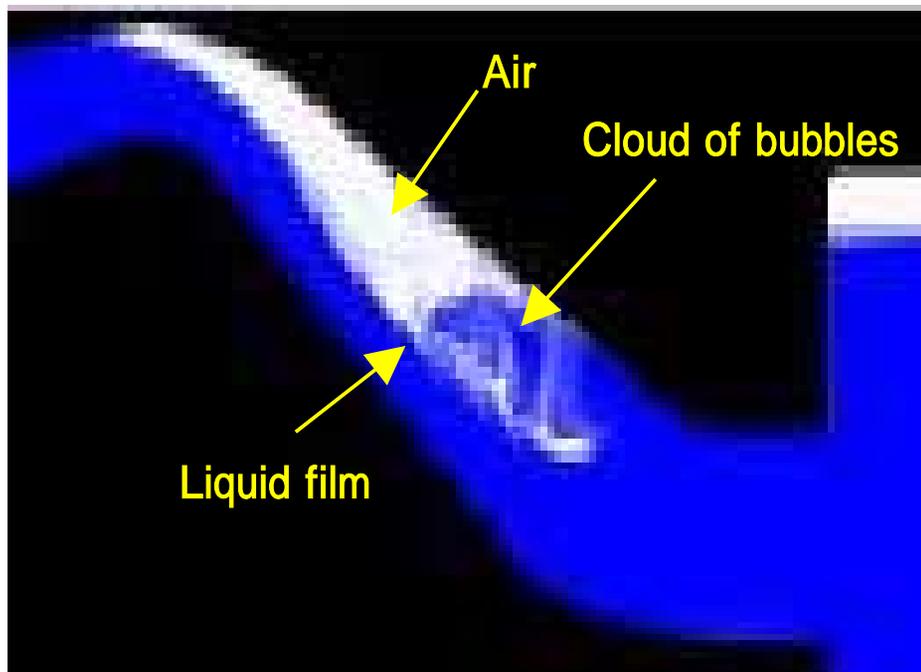
CONTOUR, MODE=1, FREQ= 2.26534E+01
H11B346C SPRING MODEL <FROM H10B076C SPSNEW1.PRE>

CADAT

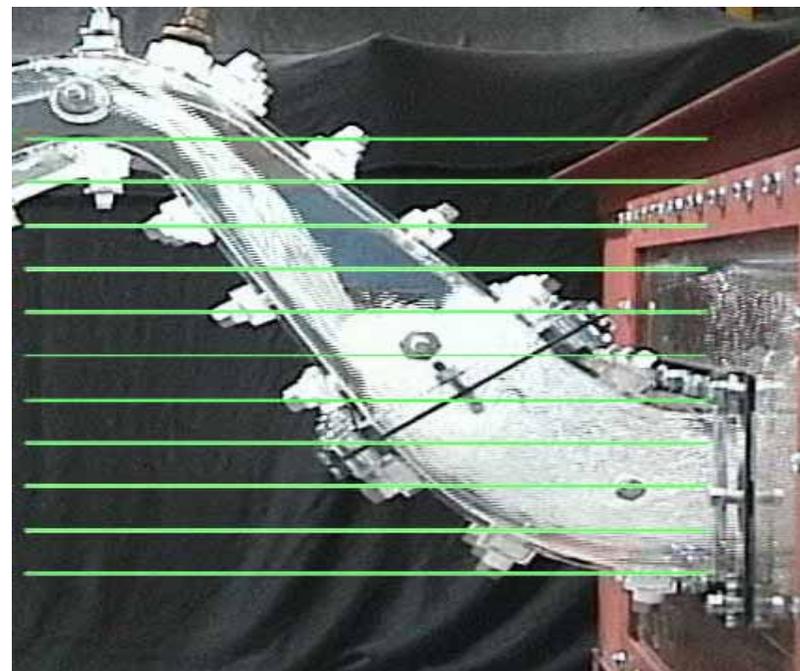
FEM Analysis for Vibration

Simulation Technology

- Multiphase Analysis for Pump Discharge Flow

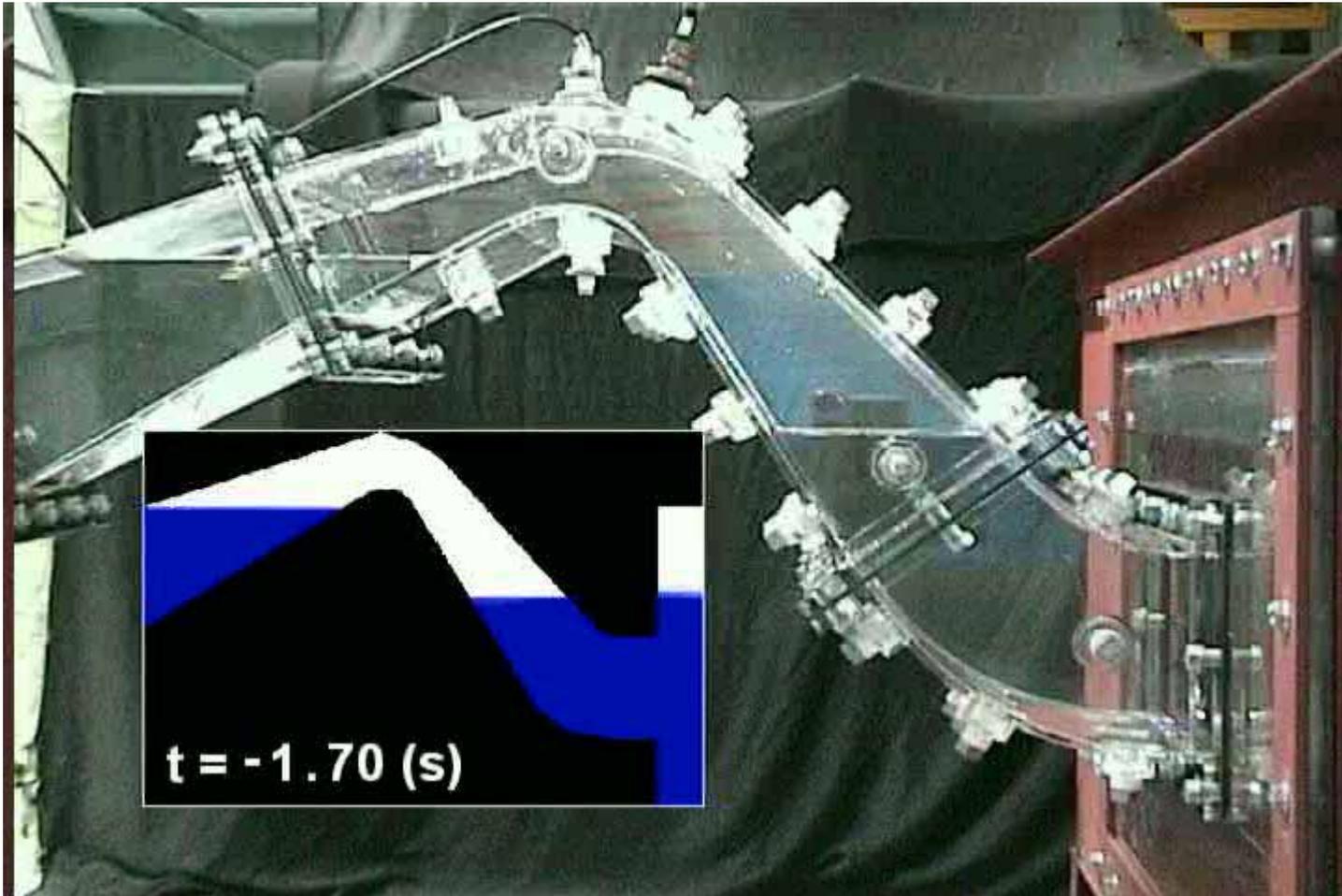


Result of analysis



Result of experiment

8. ADVANCED TECHNOLOGY



Simulation Technology

• Water Hammer Analysis

Comparison of measured value and analysis result

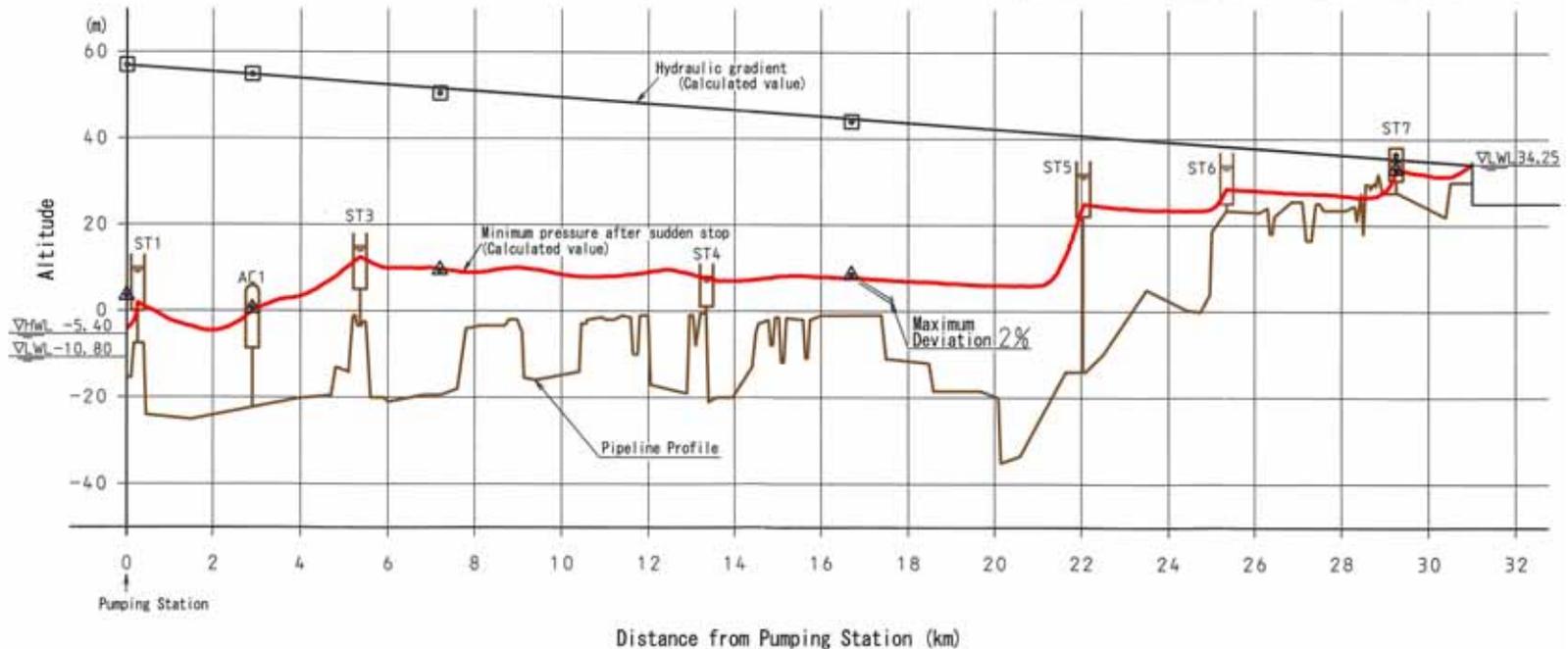
Operating Condition

- Quantity: 710,400 m³/day
- No1 90%N
- No2 90%N
- No5 90%N
- C* : 130
- Coefficient in Hagen William formula

Pressure during operation (Measured value)
 Minimum Pressure (Measured value)

ST : One-way Surge Tank
AC : Air Chamber

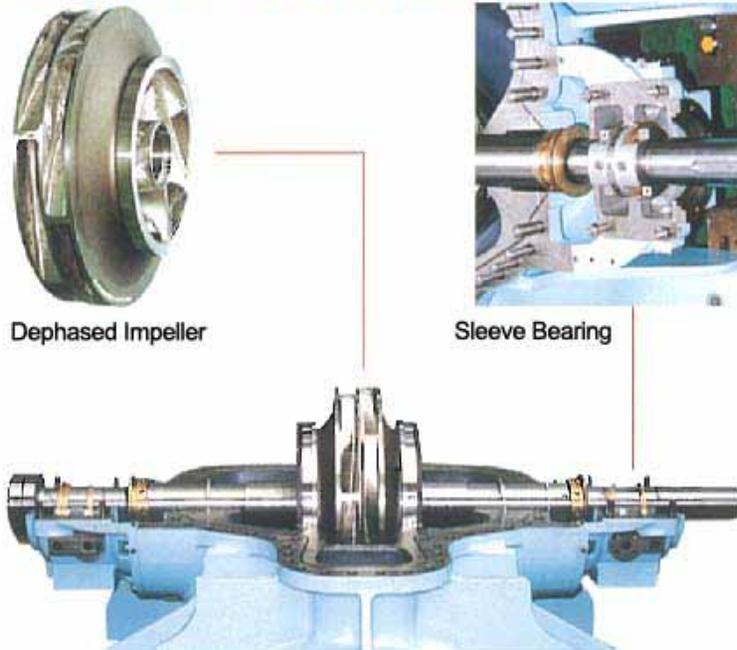
No	Size	Maximum Level	Minimum Level	Connecting Pipe
ST 1	φ14m	TP 10.00	TP 8.97	φ2000×1
AC 1	φ1.4m×2	TP 1.348	—	φ700×2
ST 3	φ9m	TP 15.00	TP 13.47	φ900×2
ST 4	φ5m	TP 8.00	TP 8.00	φ600×2
ST 5	φ8m	TP 32.00	TP 30.03	φ1000×2
ST 6	φ10m	TP 34.00	TP 33.04	φ1350×1
ST 7	□4.5m	TP 34.10	TP 33.77	φ700×2



SILENT PUMPING STATION WHICH CAN HARMONIZE WITH ENVIRONMENTAL CONDITION

PUMP SYSTEM WITH NEW VIBRATION-PROOF TECHNOLOGY

Low pulse · Low noise Pump



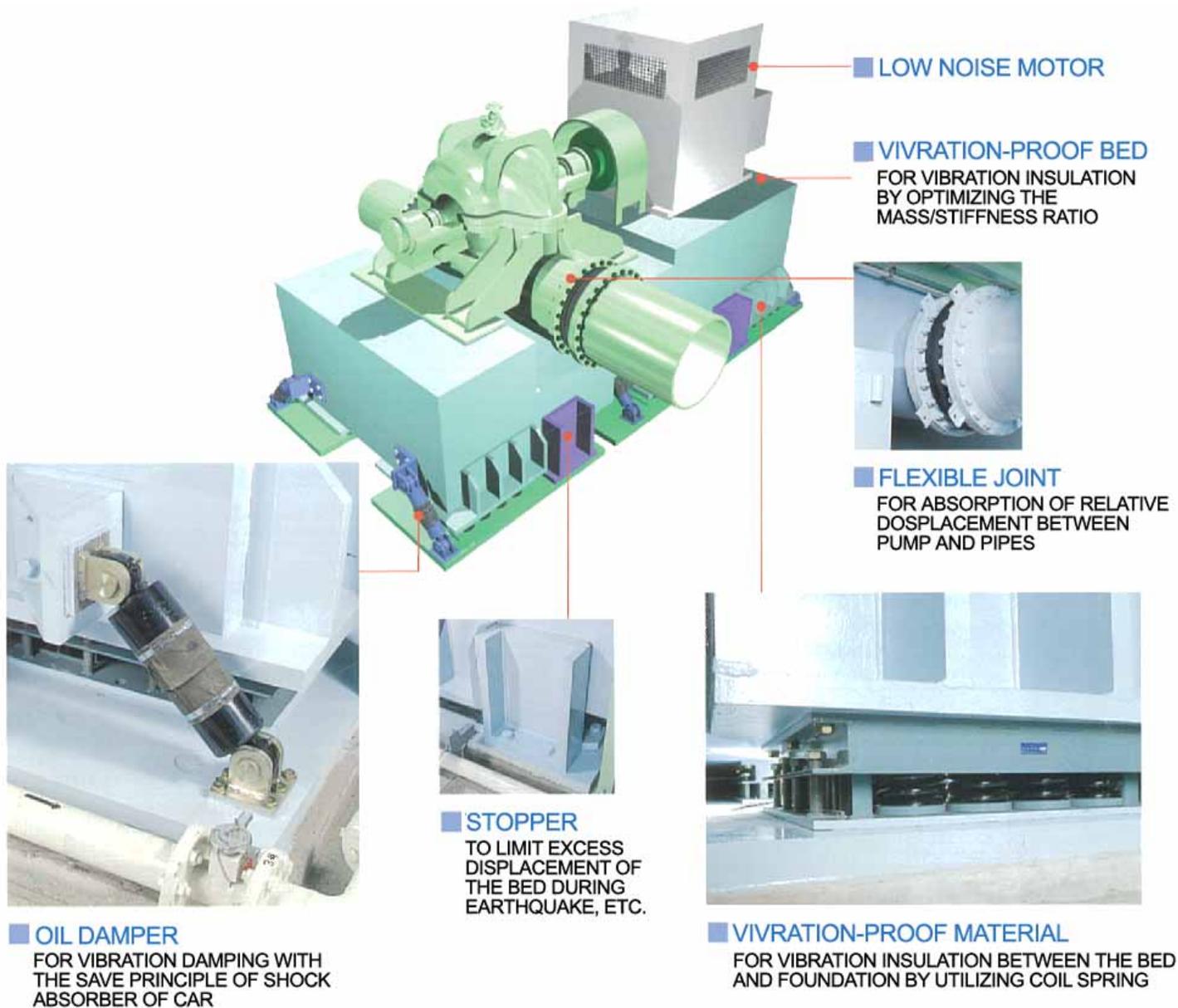
F



PUMP SPECIFICATION

- 800mm VERTICAL SHAFT DOUBLE SUCTION VOLUTE PUMP
77m³/min × 48m × 715min⁻¹ × 800kW × 2units
- 600mm VERTICAL SHAFT DOUBLE SUCTION VOLUTE PUMP
38m³/min × 48m × 953min⁻¹ × 400kW × 2units

8. ADVANCED TECHNOLOGY



9. RECENT WORLDWIDE INSTALLATION



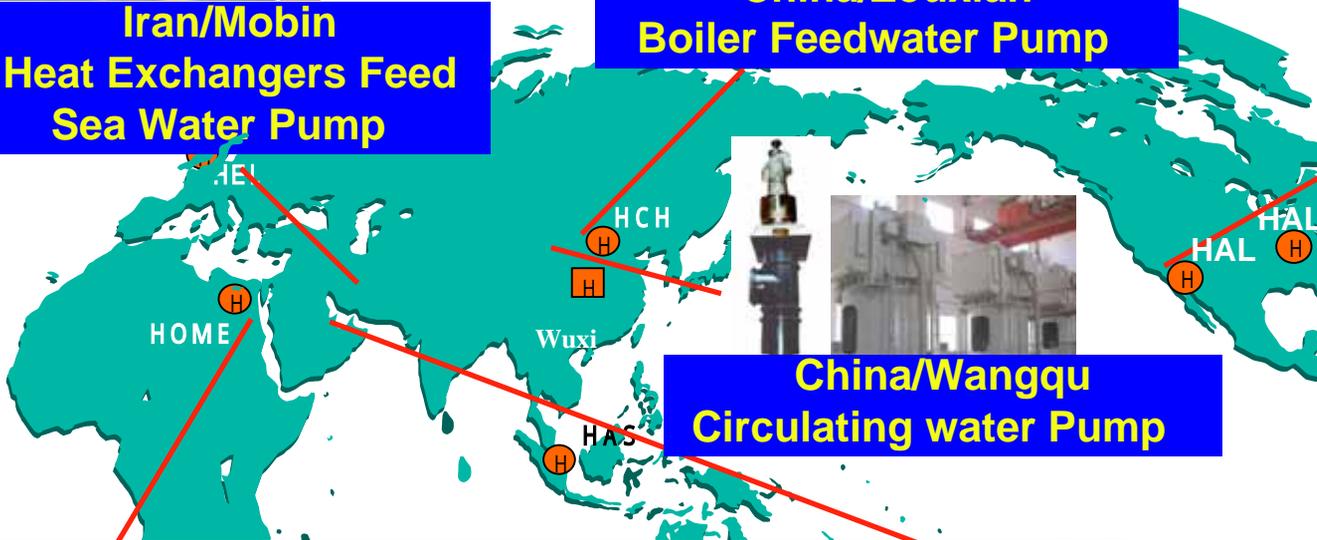
**Iran/Mobin
Heat Exchangers Feed
Sea Water Pump**



**China/Zouxian
Boiler Feedwater Pump**



**USA/California
A. D. Edmonston
Pumping Plant**



**China/Wangqu
Circulating water Pump**



Egypt / Mubarak Pumping Plant



**Qatar/ Ras Laffan
Cooling Sea Water Pump**

9.

RECENT WORLDWIDE INSTALLATION MUBARAK PUMPING STATION, EGYPT



Customer : Ministry of Water Resources and Irrigation, Mechanical and Electrical Department, Arab Republic of Egypt

No. of Sets : 21

Bore : 2,400 x 1,800mm (94 x 70in)

Type : Vertical shaft, Single suction, Turbine volute pump

Discharge Capacity : 16.7m³/s (590cfs)

Total Head : 57.1m (187ft)

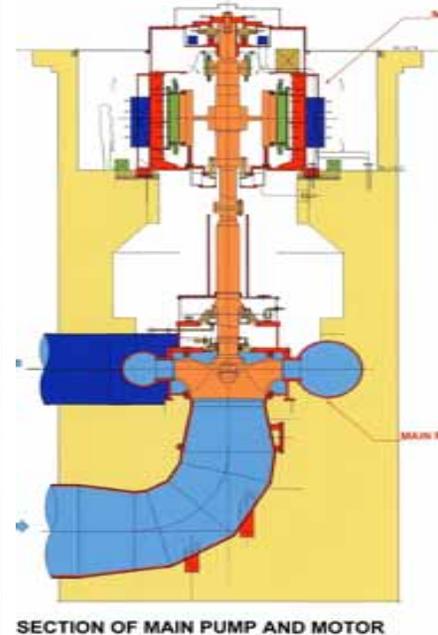
Speed (rpm) : 300- 210

Prime Mover : 12,000kW (16,086HP)
Synchronous motor

Year of Supply : 2002

Service : Multipurpose

Starting : Load commutated inverter system



RECENT WORLDWIDE INSTALLATION

MOBIN PROJECT (Sea Water pump 21sets), IRAN



Casing



Impeller



Reinforcement of Concrete Casing

Volute Casing of Heat Exchanger

Customer : Mobin Petrochemical Company, Iran

No. of Sets : 21

Bore : 2,900mm (114in) etc.

Type : Vertical shaft, Single suction, Volute pump

Discharge

Capacity : 28.3m³/s (590cfs)

Total Head : 34m (112ft)

Speed (rpm) : 228

Prime Mover : 11,800kW (15,812HP)

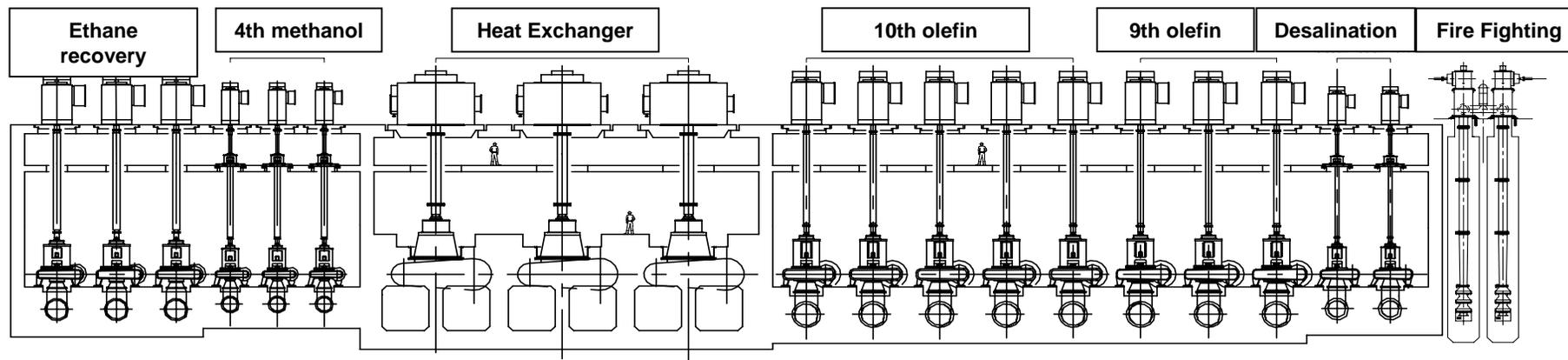
Induction motor

Year of Supply : 2004

Service : Sea Water Intake

Features: Super Duplex Stainless Steel for main parts

Concrete casing borne by reinforcement



CONTRACT : Replacement of the US biggest four pumps (80,000HP) aiming for improving their pump efficiency and cavitation characteristics

SITE : Approx. 90 miles north of Los Angeles

SCHEDULE : Contract:Jun.2003 / Completion:Mar.2011

Oct. 2004 : Completion of Model Test **Completed**

Jun. 2007 : Completion of First Pump **Completed**

Oct. 2009 : Completion of Second Pump

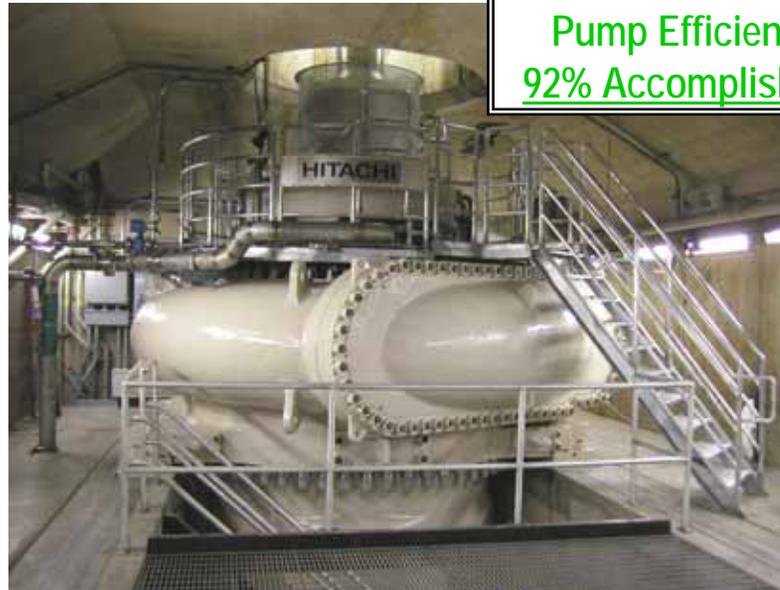
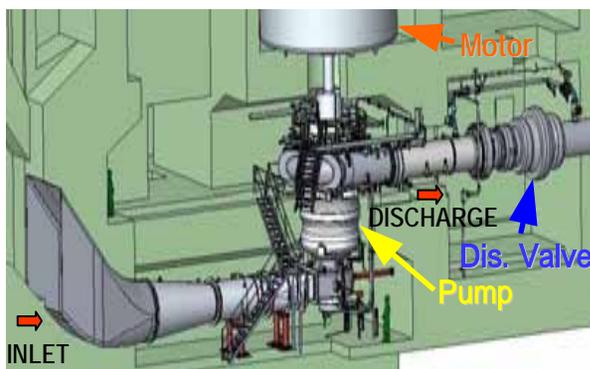
May 2010 : Completion of Third Pump

Jan. 2011 : Completion of Fourth Pump

Specifications

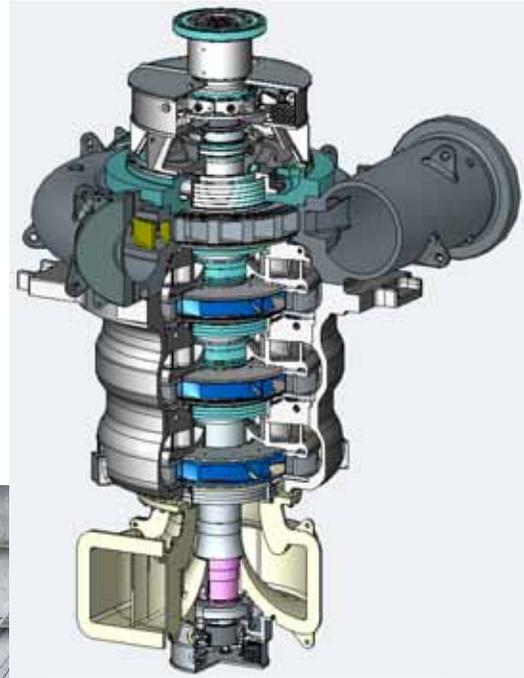
Type:	Vertical Multi-Stage Centrifugal Volute Pump
Bore:	1,200 mm
Capacity:	8.92 m ³ /s
Total Head:	600 m
RPM:	600 min ⁻¹
Motor Power:	59,680kW (80,000HP)
Stage:	4 Stages

**Pump Efficiency
92% Accomplished**



9.

Dept. of Water Resources /State of California USA A. D. EDMONSTON Pumping Plant Project



Configuration



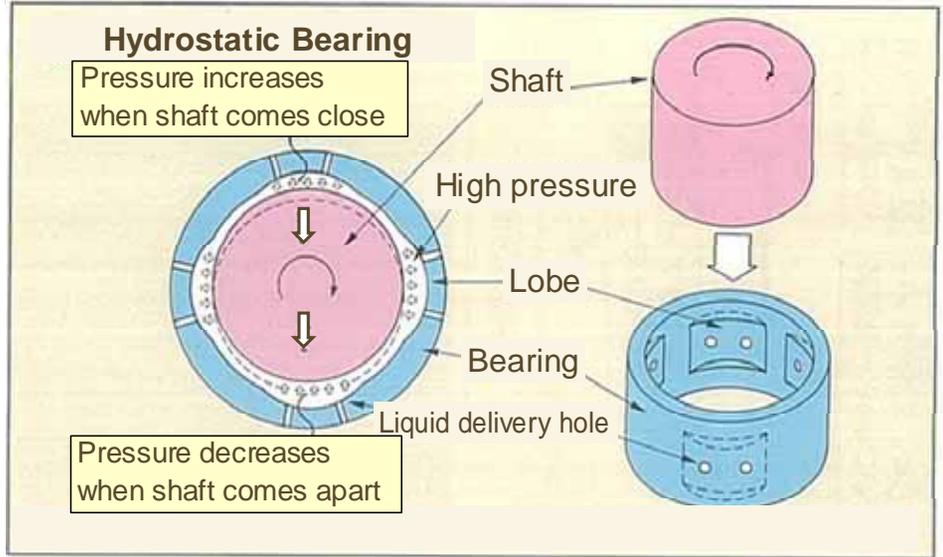
Rotor



Customer : Korea Gas Corporation, the Republic of KOREA, Pyeontaek LNG Terminal
No. of Sets : 4
Type : Vertical shaft, Single suction, 12 stages, Turbine cryogenic submersible pump
Discharge
Capacity : 263m³/hr (2.58cfs)
Total Head : 1689m (5541ft)
Speed (rpm) : 3600
Prime Mover : 900kW (1200HP)
Submersible induction motor
Year of Supply : 2007
Bearing : Hydrostatic bearing (Long Life Type)



Hydrostatic Bearing



9.

RECENT WORLDWIDE INSTALLATION COOLING SEAWATER PUMP, QATAR



Motor

Under Installation at Site



Pump

Customer : Qatar Petroleum, QATAR

Year of Supply : 2007

Service : Cooling Seawater Supply

No. of Sets: 5

Type : Vertical, Mixed - flow pump (VYM2000)

Bore : 2,000mm

Flow : 12.5m³/s

Total Head: 45.5m

Speed : 375rpm

Prime Mover: 7,500kW Induction

Motor, VFD system

Feature:

Duplex stainless steel for main parts

RECENT WORLDWIDE INSTALLATION BENBROOK BOOSTER PUMP STATION, USA



String Test at the Shop

**Customer : Tarrant Regional Water District(TRWD),
Texas, USA**

No. of Sets : 4

**Bore BB1: 610 × 508mm (24 × 20in) × 1set
BB2,3,4: 914 × 914mm (36 × 36in) × 3sets**

**Type : Horizontal shaft, Double suction, Volute
pump**

Discharge

**Capacity BB1: 1.09m³/s (24.8MGD)
BB2,3,4: 3.00m³/s (68.4MGD)**

Total Head : 62.2m (204ft)

Speed (rpm) BB1: 1050

BB2,3,4: 716

Prime Mover BB1: 932.5kW (1250HP)

BB2,3,4: 2536.4kW (3400HP)

Induction motor with VFD

Year of Supply : 2007(Under construction)

Service : Water supply

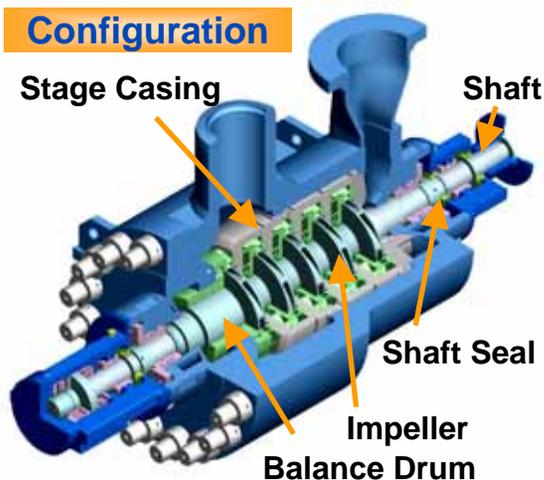
Feature: Rotational speed control by VFD

9. Boiler Feed Pump for Thermal Power Plant

Completed Units at Factory



Configuration



Customer :

***Zouxian Power Plant Phase IV
(China) 2 x 1000 MW***

Year of supply : 2006

No. of sets : 4

**Type : Horizontal, Barrel casing,
Multistage, Turbine pump**

Bore : 400 x 450 mm

No. of stages : 5

Flow : 1592.4 t/h (50%Q)

Total head : 31.25 MPa

Speed : 5203 rpm

Prime mover : 19000 kW , ST

9. Circulating Water Pump for Power Station



Customer : 600MW Thermal Power Station, Japan

Bore : 2,200mm (88in)

Type : Adjustable Blade, Vertical shaft, Mixed-flow pump

Discharge Capacity : 28.3m³/s (458cfs)

Total Head : 23m (75.5ft)

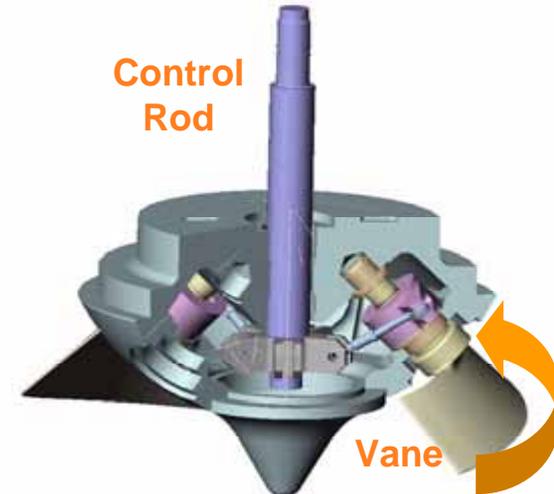
Speed (rpm) : 273

Prime Mover : 3,950kW (5,295HP) Induction motor

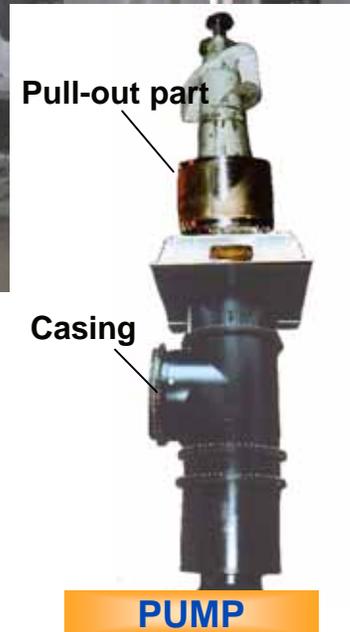
Year of Supply : 2004

Service : Sea Water Intake

Features: Hydraulic Actuator for Adjustable Blade



9. Circulating Water Pump for Power Station



Customer : Wangqu Power Plant Phase I 2 x 600 MW

Year of supply : 2005

No. of sets : 4

Type : Vertical, Pull-out Mixed pump

Bore : 2200 mm

No. of stages : 1

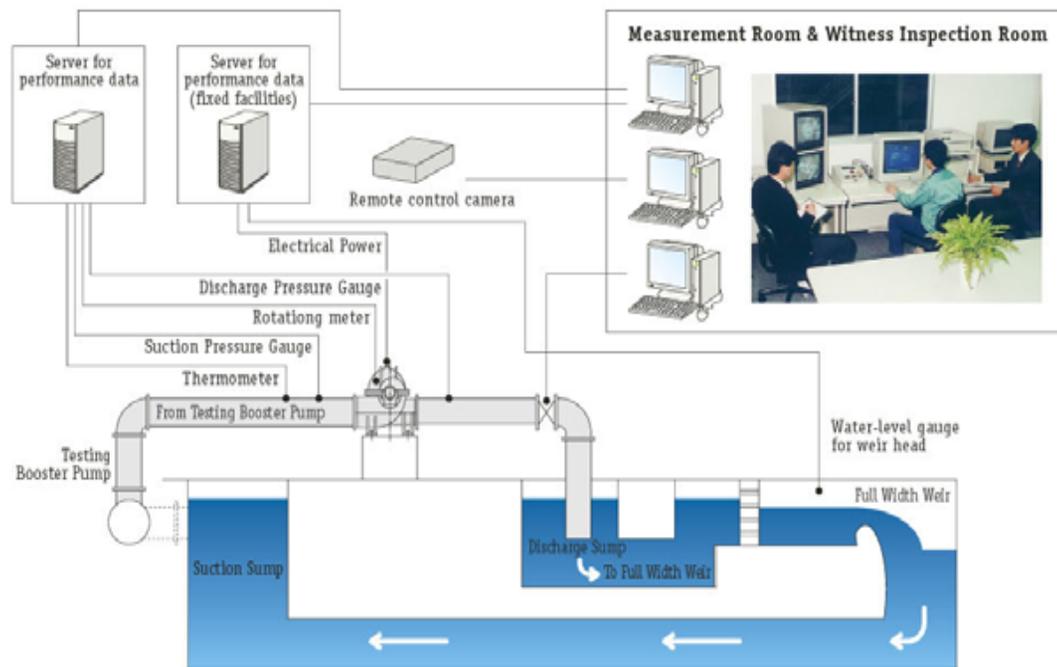
Flow : 9.25m³/s

Total Head : 25m

Speed : 375rpm

Prime mover : 2850 kW, IM

10. PROTOTYPE TEST FACILITY



Outline of Test Loop for Shop Performance Test

Capacity

- Up to 28m³/s (639mgd)

Discharge bore

- Up to 3,200mm (126in)

Flow measuring device

- Weir

- 3 sets - 5m (196in) Full width
- 2 sets - 3m (118in) Full width
- 2 sets - 2m (78in) Full width

Electric Power Supply 電源容量

No.	Power 電源容量			Actual Load 実負荷	
	Capacity (V) 容量	Capacity (Kva) 容量	Frequency (Hz) 周波数	Load (kW/HP)	Frequency (Hz) 周波数
1	6,600	5,000	50 / 60	10,000 / 13,405	50
				2,200 / 2,949	60
2	3,300	5,000	50 / 60	3,400 / 4,558	50
				2,200 / 2,949	60
3	400	500	50 / 60	300 / 402	50 / 60
4	220	500	50 / 60	150 / 201	50 / 60

● For 1000MW Chinese Thermal Power Plants

6 large-scale Boiler Feed Pumps to be shipped in June, 2006

4 large-scale Circulating Water Pumps to be shipped in April, 2007

4 large-scale Circulating Water Pumps to be shipped in May, 2008



Boiler Feed Pumps for Zouxian Power Plant

19000kW 4sets, 12400kW 2 sets

<Zouxian Power Plant>

The very first 1000MW thermal power plant in China

● Hitachi Pump (Wuxi) started manufacturing large scale pumps in July, 2006



Hitachi Pump(Wuxi) in China



New factory

HITACHI
Inspire the Next 