14 November 2008

By Fax to; 604 660 1102

Total No. of pages, including cover, 9 (nine)

ATTN. Ms. Erica Hamilton,
Commission Secretary
BC Utilities Commission
Sixth Floor 900 Hamilton St.
Vancouver, BC V6Z 2N3

Dear Ms. Hamilton:

RE: BC Hydro Project No. 3698514/ Order G-96-08
Intervenor Evidence for 2008 LTAP

Please find attached evidence supplied in support of our letter of 19 June 2008 (Exhibit No. C5-1).

– The attached article entitled "Nelson's power-selling draws Hydro wrath" is submitted to support our argument that BC Hydro will also continue to do everything in its power to ensure that Vanport never gets an opportunity to get involved in profiting from the export market sale of premium value electricity generated from the bulk transfer and storage of reclaimed municipal water, and/or, seawater, at the JOR Hydroelectric project. The fact that such profits could help finance a new sewage treatment plant for Victoria appears of little interest to those who are also in collusion with BC Hydro to protect and expand their very lucrative interests in obsolete waste-to-energy plants and other so-called 'sustainable' clean energy plants at the expense of Vanport's competing slurry-fueled steam process sterilization, biogas production and wastewater recycling technologies.

- The attached one page summary of the 1963 Rand Development Corp report on the use of coal to filter sewage, as well as the two page report(s) on the use of slurry fuel, are submitted to refute BC Hydro's claim that these technologies are 'speculative". The Rand summary is part of a 500 page study. BC Hydro is also well aware that burning coal slurry fuel in large central power plants is well established and also suited for small, modular plants that are easily equipped to capture all emissions.

- The attached article entitled 'Japanese pumped storage embraces the ocean waves' is submitted to refute BC Hydro's claim that it does not know the meaning of the phrase "ocean pumped hydro plant' (note that the capacity of this plant is very similar to our proposed OPH development of the abandoned high head Forebay reservoir at JOR).

We believe that all of the above further supports our argument of economic negligence demonstrated by the failure to advise the public of the true economic and technical viability of the coal filtration, bulk water transfer and pumped storage development opportunities we have identified at Jordan River, as well as at Britannia Mines and at Fort Nelson.

Thank you for your consideration

Richard Tennant,
President

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Wednesday » October 15 » 2008

Nelson's power-selling draws Hydro wrath

Scott Simpson
Canwest News Service

Wednesday, October 15, 2008

B.C. Hydro wants to shut down a power trading scheme that has the city of Nelson making $50,000 a month exporting Hydro-generated electricity to markets outside the province.

In documents filed with the B.C. Utilities Commission, Hydro says the scheme relies on loopholes in a 15-year-old energy supply agreement and could balloon into a $17 million a year drain on Hydro finances unless the agreement is rewritten.

Hydro says Nelson is effectively "arbitraging" a public resource -- cheap power intended for customers in B.C.

Nelson is buying the power at B.C. Hydro's rock-bottom industrial rate, three cents a kilowatt hour, and selling it on the North American spot-trading market for two, three or more times as much.

Nelson has a rare ability to trade on the North American market due to its ownership of a small run-of-river hydroelectric utility on the Upper Bonington River in the West Kootenays. Nelson is using FortisBC's transmission network to move power to buyers outside B.C.

FortisBC is a utility with 108,000 customers in south-central B.C., and has a standing order with B.C. Hydro to take delivery of Hydro power whenever demand exceeds supply in its customer area, including Nelson.

Hydro's mandate -- to provide all British Columbians with benefits from its roster of hydroelectric facilities around B.C. -- means it cannot refuse calls for power from FortisBC.

Since Nelson began selling power in earnest last June, its monthly exports jumped from two megawatt hours to 151 megawatt hours -- with the bulk of that coming ultimately from Hydro. That's enough electricity for about 150,000 homes. Nelson is home to 5,000.

Hydro worries that unless the Nelson scheme is eliminated, other FortisBC customers with their own generating facilities such as the Celgar Pulp and Paper Mill will join in, costing B.C. Hydro $16.7 million a year in lost power sales opportunities of its own.

"B.C. Hydro and its ratepayers should not be required to incur incremental costs to support the city of Nelson's arbitrage activities and potential arbitrage opportunities of other FortisBC customers with self-generation," Hydro said in a Sept. 16 letter to the BCUC.

The city is arguing that that the economic benefits to the city should be considered as part of any decision.

Alex Love, general manager of Nelson Power, said the city undertook a thorough

examination of Hydro's power supply contracts with FortisBC before moving ahead.

The city does not begrudge Hydro's objections, he added.

"The question is, does the benefit to Nelson outweigh any detrimental effects to B.C. Hydro, or vice versa?"

Hydro thinks the scheme is bad news for its customers.

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I SUMMARY

In 1963 the Rand Development Corporation of Cleveland, Ohio began a laboratory study to determine whether coal could be used advantageously in the treatment of sewage and industrial wastewaters. The work was supported by the Office of Coal Research, U. S. Department of the Interior, under Contract No. 14-01-0001-348, and was summarized in OCR Research and Development Contract No. 12, "Investigation of the Use of Coal for Treatment of Sewage and Wastewaters," issued in March, 1966.

Coal was found to be useful as a filter medium and settling aid, and as an agent for the partial removal of certain soluble pollutants by physical and chemical surface reactions. A single-step "coal-sewage process" evolved during this investigation, for which U. S. Patent No. 3,401,114 was issued; and in a continuing pilot plant program under a second OCR Contract, No. 14-01-0001-483, the process was refined and demonstrated to be feasible on a commercial scale. All of the pertinent material from both contract programs is included in this second and final report.

In its basic form the coal-sewage process is a deep-bed, gravity flow, consumable coal precoat filter which may be used in the treatment of wastewaters of nearly any type. Near-perfect removal of suspended solids is attained and variable proportions of dissolved organic matter and phosphates are removed as a function of the type of coal which is used. Process performance does not degrade with time, and there is no significant contamination of the water containing the sewage by the coal. Any type of coal which does not soften in water may be used, with consequent exclusion of only the lignites and some of the lower-rank sub-bituminous coals.

The process is a batch method, with long term continuity attained by alternation among filters at intervals of between one and three months as a function of the type of waste being treated. Continuity of flow rate during a filter run is achieved by the periodic removal of a thin layer of the filter surface by a traveling doctor blade, or scraper, which is the only item of special equipment required. The spent coal and sewage solids are discharged as a slurry which is de-watered by simple mechanical means and incinerated. Approximately ninety percent of the original heating value of the coal is recoverable as usable heat.

The coal-sewage process is the first practical large-scale sewage filter available to the industry: Quantities as high as ten million gallons per day can be treated in a single unit. In this respect the value of coal, as opposed to sand or other permanent media, is especially evident.

Prog. Energy Combust. Sci. 1992, Vol. 18, pp. 409–427
Printed in Great Britain.

0360-1285/92 $15.00

SLURRY FUELS

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Department of Mechanical Engineering, University of Southern California, Los Angeles, CA 90089-1453, U.S.A.

Received 11 February 1992

Abstract—The current state of our knowledge of the burning characteristics of carbon, aluminum and boron slurries is discussed. Particle agglomeration, and in many cases the formation of semiporous shells increase the overall combustion time, thereby requiring a burner of longer characteristic length. Current thoughts about the probable causes of particle agglomeration, in a slurry fuel, are reviewed and the techniques of drop fragmentation as a means of eliminating large agglomerates are discussed. Large agglomerates burn slowly and are responsible for lower combustion efficiency, unacceptable combustion chamber deposits and an increased particulate emission in the exhaust. Possible applications of coal/water and coal oil/slurry fuels are discussed briefly in a separate section. Details of reaction kinetics of either metal or coal combustion are beyond the scope of this paper.

CONTENTS

NOMENCLATURE

A_s	surface area of droplet
A_{sp}	surface area of a single particle
c_{mix}	mixture specific heat, liquid + solids not irradiated
c_{pv}	specific heat of fuel vapor
c_s	specific heat of solid material
D	droplet diameter
D_B	quartz bead diameter
D_o	initial droplet diameter
D_p	mean particle diameter
E_A	activation energy for decomposition
h_c	heat transfer coefficient for spherical droplet
h_{fg}	enthalpy of vaporization of the fuel
h_l	heat transfer coefficient for particle to liquid
h_m	mass transfer coefficient
M	molecular weight of the fuel
$\dot{m}$	mass evaporation rate, $h_m A_s X_{vs}$
m_{mix}	mass of mixture, liquid + solids not irradiated
m_s	mass of a solid particle
n_{fo}	initial number of moles of liquid fuel
n_r	moles of product/initial moles of fuel
N_r	number of solid particles receiving radiation
R	gas constant
t	time
T_f	$(T_l + T_p)/2$
T_g	ambient temperature, adiabatic flame temperature
T_l	liquid temperature
T_m	mean mixture temperature using the one third rule, $T_l + (T_g - T_l)/3$
T_p	particle temperature
$\bar{V}$	mean molecular speed in a liquid medium
X_{vs}	concentration (mass/vol) of fuel vapor at the drop surface
ε	emissivity
ρ_l	mass density of liquid fuel
σ	Stefan–Boltzmann constant

1. INTRODUCTION

Slurry fuels consist of fine particles of solid fuel (e.g. carbon, aluminum or other metals) suspended in a liquid hydrocarbon carrier. In some cases, such as coal/water slurry fuels, the liquid carrier is water. The size of the particles of solid fuel in the slurry depends upon the particular application and may range form submicron size to hundreds of microns. In addition to the particles, chemical stabilizers and viscosity controlling additives (e.g. surfactants, dispersants, gellants etc.) are also used for preserving the fluidity, and preventing stratification and settling of the particles.

The biggest advantage of a slurry fuel is its high energy density (i.e. volumetric heating value, kJ/m^3). A carbon/octane slurry with 50% solid mass loading, for example, has approximately a 55% higher volumetric enthalpy of reaction compared to that of liquid octane alone.[1] As a consequence, slurry fuels show great potential as attractive candidates for advanced high performance air-breathing propulsion

Coal-Fueled Diesel Engine Development Update at GE Transportation Systems

B. D. Hsu
neral Electric Transportation Systems,
Erie, PA 16531

The U.S. Department of Energy is sponsoring a General Electric Company development program for using coal–water slurry (CWS) to power a diesel engine and to test it in a locomotive. The first locomotive system test was successfully completed in 1991 on GE/TS test track. The first-phase coal-fueled 12-cylinder diesel engine used in the locomotive test employed a modified positive displacement fuel injection system and developed 2500 hp in the engine laboratory. The final phase all electric controlled fuel injection equipment (FIE) diesel engine has completed individual component development phases. Combustion research evaluated a broad range of CWS fuels with different source coals, particle sizes, and ash contents. The electronic controlled FIE single cylinder test engine yielded 99.5 percent combustion efficiency. Envelop filters and copper oxide sorbent have been chosen to clean up the engine emissions after extensive evaluation of various hot gas cleaning methods. The projected removal rate of particulate is 99.5 percent and that of SO_2 is 90 percent. Over ten diamond insert injector nozzles performed well on the test engines. A bench test of one nozzle has been run for over 500 engine equivalent hours without significant wear. Tungsten carbide (WC) coated piston rings and cylinder liners were identified to be effective in overcoming power assembly wear. A matrix of WC spray parameters were investigated, and the best process was used to apply coatings onto full scale rings and liners. These and other test parts are currently running in two coal fuel operated cylinders on a converted eight-cylinder endurance test engine. All of these developed technologies will be applied onto the second phase engine and be used in the final phase locomotive test. An economic analysis was also completed on a concept locomotive design. Additional equipment cost and the level of diesel fuel price to repay the investment were analyzed. Thus the economic environment for the commercialization of the modern coal fueled locomotive is defined.

oduction

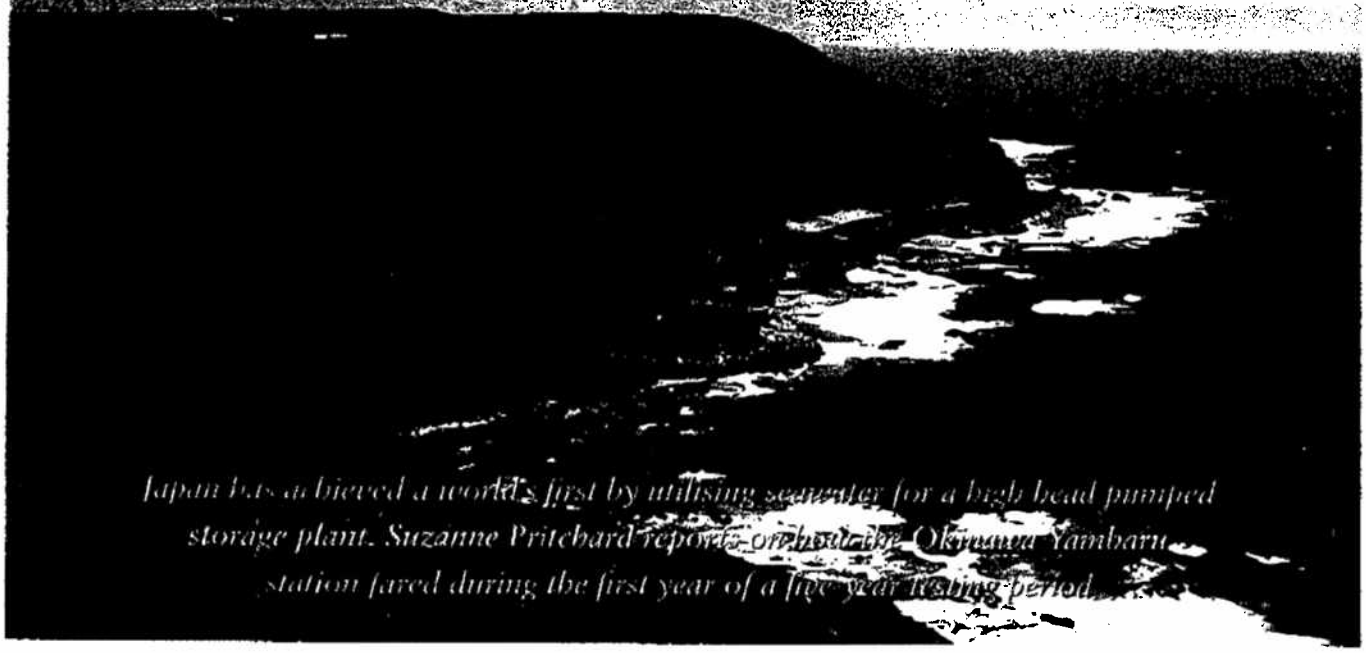
ider the sponsorship of the U.S. Department of Energy E), Morgantown Energy Technology Center (METC), the ral Electric Company Transportation Systems is conng a proof of concept program using coal–water slurry S) fuel to power a locomotive. Some results of this study already been reported in a previous paper (Flynn et al.,). In recent years, significant progresses were made in the letion of the first-phase multicylinder engine laboratory nd the first-stage coal-fueled diesel locomotive track test. fuel, for the first time, was used successfully in powering sel engine at 1050 rpm and developed 2500 hp (16 MPa P) in a GE-7FDL 12 cylinder engine (McDowell et al., . This engine was transferred to a GE Dash 8 locomotive ompleted preliminary system test on GE corporate test .

GE program is planned, in which four phases, "Technology R&D," "Engine Component Development," "Locomotive Integrated Systems Test," and "Conceptual Locomotive Design and Economic Analysis," are performed in parallel. At the core of the tasks, there are two phases of full-size 12-cylinder engine tests as well as two stages of locomotive systems tests. The highlights of the project are shown in Fig. 1. Briefly, the four phases are described as follows.

Technology R&D. The major technical areas, combustion, fuels, emissions, and durability, are to be investigated in bench-scale tests and on the single-cylinder research engine. The first task of the combustion R&D is to burn the coal–water slurry fuel with minimal modifications to the existing mechanical diesel fuel injection equipment (FIE) in order to gain the operating experience of a full-size multicylinder engine as quickly as possible. This experience is going to be used to guide the second task of developing an improved electronic controlled fuel injection system to be able to optimize the combustion of coal fuel in a diesel engine. The fuels R&D task is intended to identify some of the intrinsic CWS fuel parameters that influence engine combustion, as well as to broaden the engine ac-

tributed by the Internal Combustion Engine Division and presented at ergy-Sources Technology Conference and Exhibition, Houston, Texas, y 26–30, 1992. Manuscript received by the Internal Combustion Engine n August 5, 1991. Associate Technical Editor: J. A. Caton.

Japanese pumped storage embraces the ocean waves



Japan has achieved a world's first by utilising seawater for a high head pumped storage plant. Suzanne Pritchard reports on how the Okinawa Yambaru station fared during the first year of a five-year testing period.

In March 1999 construction of the world's first seawater pumped storage power plant was completed in Japan. Called the Okinawa Yambaru station, the plant has a maximum output of 30MW, maximum operating head of 152m and maximum discharge of 26m³/sec.

Prior to construction a six-year study of the plant was started in 1981. Analytical studies, experiments and computer simulations addressed potential problems within a saltwater environment and how they may affect civil structures, electrical equipment and environmental considerations. Work on the seawater pumped storage plant began in 1987, with construction getting under way in 1991.

The unique feature of this scheme is that it is actually a demonstration project which, since commissioning, has entered into a five-year period of testing. So far, the plant has been operating successfully with over 3500hr of generation and pumping in the first year. The main areas under examination are:

- Infiltration and dispersion of land-stored seawater.
- Seawater corrosion of power plant materials.
- Fouling by marine creatures.
- Operation of a pumped storage plant in various sea conditions.

The above subjects were categorised into those which can be dealt with by existing engineering methods, and those for which solutions will have to be provided by new technology. The object of the testing is to verify the application of the new technological solutions to a commercially sized plant through the design, construction and operation of a demonstration plant.

The waste soil site

An example of the innovative solutions applied to the demonstration plant included addressing the problem of storing seawater in a land environment. Remedies included lining the entire surface of the reservoir with a synthetic rubber sheeting to prevent seawater infiltrating the surrounding land strata. In addition fibre reinforced plastic (FRP-M) pipes were used for the penstock which is subjected to a high pressure, high speed flow of seawater, while improved austenitic stainless steel was used for the pump turbine runners and guide vanes to prevent corrosion.

The plant has been in operation almost every day since March 1999 and provides electricity for the power system on Okinawa main island. Operation, inspection and monitoring of the plant during the first year (April 1999 to March 2000) were carried out as follows:

- *Operation:*

Demonstration operations and monitoring of the plant were carried out throughout the year.

- *Maintenance and inspections:*

Periodic inspection and maintenance were carried out on 14-30 June 1999, and on 19 January-14 February 2000. Routine inspections of electrical equipment took place once a week, and civil inspections

twice a week.

•*Environmental monitoring:* Land environment surveys were carried out twice a year. There was observation of plants (June, November-December), animals (June and September), birds (November) and noise levels (June and October).

•*Seawater dispersion/infiltration survey:* Water quality surveys were carried out regularly throughout the year while marine environment surveys were done in August and January.

•*Meteorology/hydrograph monitoring:* Meteorology and hydro-graph observations were done throughout the year.

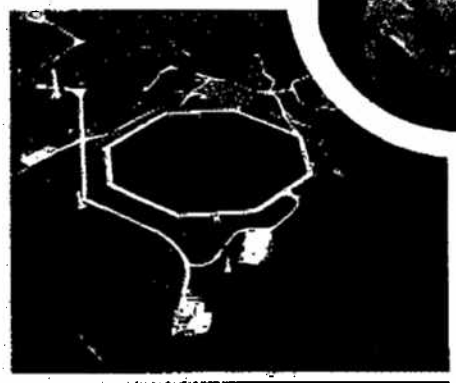
Testing during the five-year period will be carried out through a variety of means:

•Routine inspections during normal operations consist of equipment performance checks, performance checks of sensors and monitoring equipment, and analysis of the data collected by automated sensors and recorders.

•Periodical plant inspections will be performed twice a year during normal operating conditions. In addition detailed inspections will be performed in the second and fifth years of the demonstration plant's life.

•Monitoring will be performed using various types of measuring instrumentation. Environmental monitoring will be carried out annually to determine any environmental impacts of the plant.

•Operating results during typhoons will also be considered.



Above from left to right: aerial view from the east side; the guide vane and speed rings; a diver carries out research on the outlet

Infiltration and dispersion

Seawater infiltration and dispersion under normal operations are observed by daily monitoring and inspection. To prevent seawater infiltrating into the surrounding land strata, the entire reservoir surface is lined with rubber sheeting. Assessment of the impervious nature of the sheeting started when reservoir inundation began in August 1998. No water leakage has been detected within the upper reservoir for nearly two years, including the test inundation period. However, if seawater leakage does occur it will be detected and collected in the inspection gallery.

To observe the effect of ozone, ultraviolet rays and seawater on the rubber sheeting, test samples attached to the sheets are collected regularly and their physical changes observed. No substantial change has been observed during routine inspections and at reservoir draining.

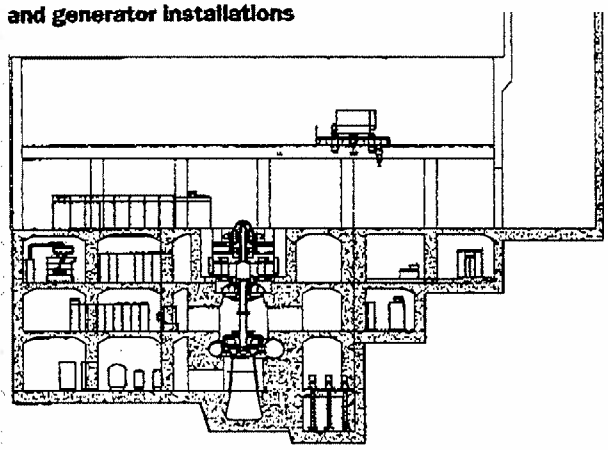
Seawater dispersion is regularly checked by measuring the salt content in the surrounding atmosphere, rainwater and soil. As Okinawa main island is surrounded by the sea the salt content is usually high. So far, there is no sign of an increase caused by the operation of the upper reservoir. To confirm the effect of seawater infiltration and dispersion the flora and fauna in the surrounding environment, and the water quality in nearby streams and ponds, are also being monitored. No substantial changes have been observed so far.

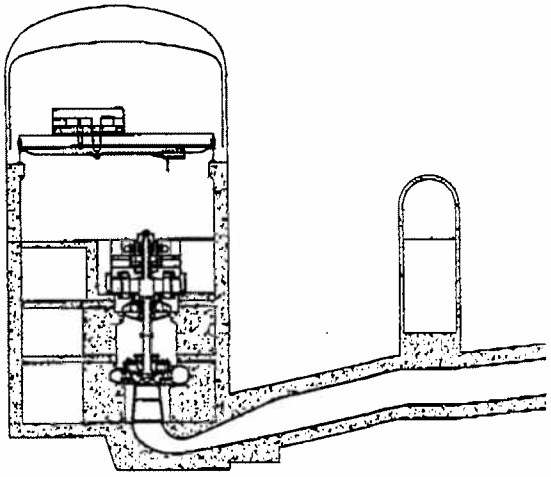
Periodic inspections were performed in June 1999 and January 2000. The pump-turbine was pulled out for the inspection. The level of the upper reservoir was reduced virtually to the low water level. The intake, penstock, discharge tunnel and tailrace were left full of water and could be inspected by divers.

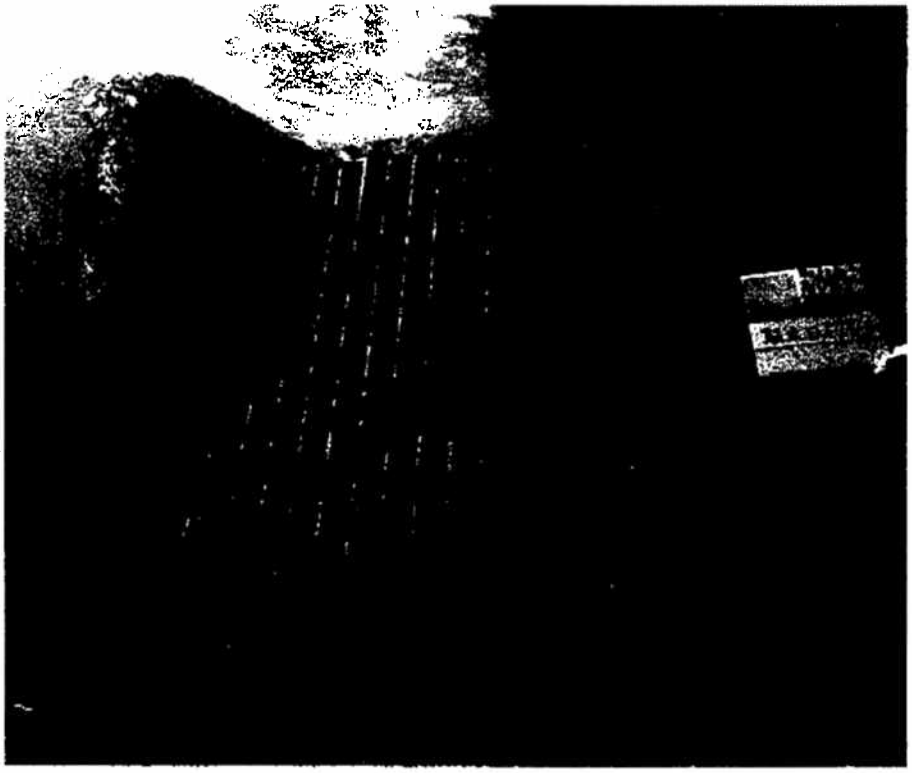
Condition of civil structures

Inspections of civil structures mainly consisted of visual inspections. The condition of the water systems, from the intake at the upper reservoir,

Cross-sections of the turbine and generator installations







Under water view of the screen on the upper pond inlet

through the penstock down to the tailrace opening to the ocean, were observed by video cameras carried by divers and by monitors on land.

The penstock interior was examined to a depth of 50m, the maximum depth for the divers. These observations indicated no marine creature adhesion inside the penstock. However, colonies of calico barnacles that favour water movement were found at some locations on the tailrace. The water-impervious sheet of the upper reservoir had no adhesion within the range where the water level normally changes. However, silt had accumulated below the low water level, where algae grew and some shell adhesion was observed.

A maximum of 20 species of fish and crustaceans were found in this newly created environment, although the variety changes with the seasons. Echinoids with sharp teeth were found among these creatures. Careful observation is required to find these as they may bite into the rubber sheets.

FRP(M) piping and stainless steel were the main materials used at this plant. Where this is not possible and conventional steel has been used, this is protected by coatings and electrolytic anti-corrosion measures.

The penstock, where FRP-M has been used, has not experienced any problems such as excessive erosion, cracks or deformation. Even visual inspections of the intake liner tubes and lower penstock piping, which were protected by coatings and electrolyses, reveal no anomalies. However, crevice corrosion has been found on the nuts and bolts of the inspection doors of the intake screen in the upper reservoir. The cause of this is now being observed.

Inspection requirements applicable to a seawater pumped storage plant have been added to those necessary for a plainwater pumped storage plant. Inspection data were compared to those obtained at the time of construction. The inspection items and equipment conditions are discussed below. No problems which could impede plant operation have occurred so far, and the plant is operating successfully.

Pump-turbine assembly

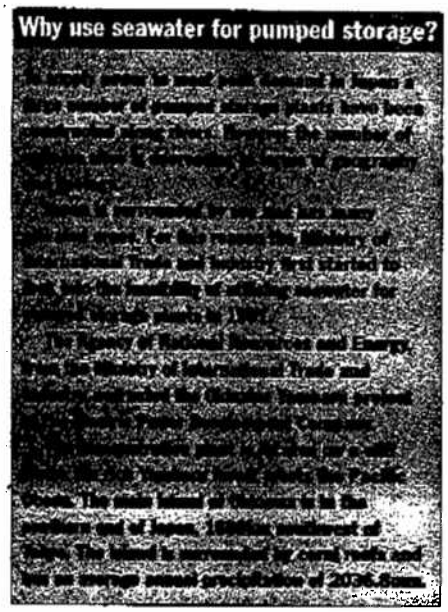
Corrosion checks were made on the stainless steel parts of the pump-turbine. Visual inspections and tissue examinations were conducted on the stainless steel runner and guide vanes. These inspections indicated that material integrity was maintained and there was no deterioration in strength.

The coatings of conventional steel parts were also examined. External visual inspections revealed no fracture, flaking or swelling and conditions were generally normal. Some coat flaking had occurred on parts of the speed ring and lower draft tube near the pump screen for the seawater supply. However, measurements of the coating strength were within an acceptable range. Corrosion was observed near the speed ring where the coat flaking had occurred, but this had not progressed into pitting.

Seawater supply system

The seawater supply system was monitored in detail. Corrosion was seen on the valve sheet surface and disc surface of the manually operated butterfly valve at the heat exchanger's seawater inlet in

Above from left to right: the rubber lining inflates as typhoon no 7 passes by; if any infiltration occurs it will be collected and detected through these pipes in the inspection gallery



the seawater supply system. The valve was made of bronze and corrosion was also developing on the disc surface of the seawater strainer inlet valve, formed from a similar material. The valve materials are being re-examined, as are the butterfly valves of other seawater systems.

Gap corrosion and heterogeneous metal corrosion, which had been a subject of concern, were confirmed in the seawater strainer system (although the scale of the corrosion was minor).

No scar, corrosion or rusting had occurred on the pipe linings, including the flange surfaces.

Pipe clogging due to marine creature fouling had been a matter of concern for small diameter piping in the seawater supply system. Inspection up to the present time shows no marine creature fouling inside equipment or piping.

Operating in typhoon conditions

The meteorological features of this region are such that the Okinawa island lies in a typhoon passage, where an average of eight typhoons occur each year. Due to the geographical location of the island, typhoons assault the island during their development stage and change their path nearer land.

As Okinawa experiences severe typhoons the following areas were a concern and verification tests were necessary:

- Seawater dispersion from the upper reservoir due to strong wind.
- Stability of water-impervious sheets under strong wind.
- Pumped storage and power generation operations under high waves during typhoons.

Large typhoons approached and passed Okinawa main island twice in 1999 (August and September).

Typhoon no7 passed through Okinawa main island on 1 August. Although this typhoon was the first to affect the island after the start of operation, the plant operated normally before, during and after the passage of this typhoon.

The waves had little effect on plant operation. Stable generation and pumped storage were continued according to the direction of the automatic load regulator. Vibration and shaft displacement did not differ from normal conditions. The bearing temperature also did not change.

During power generation in the typhoon the effective head of the plant fluctuated by approximately 50cm (a one-minute average), according to variations in the tailrace water level, and the guide vanes acted to maintain a constant output level. The fluctuation of the output level varied by 1-2%. This was a little larger than under normal operating conditions, but the hydraulic piston position that actuated the guide vanes was not required to move excessively to maintain a relatively constant output.

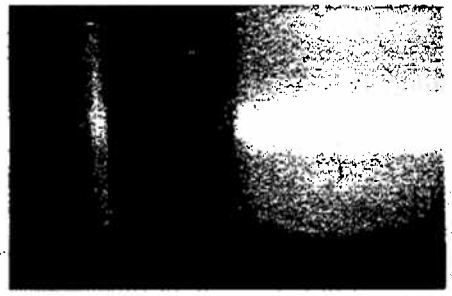
During pumped storage operation in the typhoon, the tailrace level was relatively stable and plant conditions were similar to those in normal plant operation.

The phenomenon of the upper reservoir's water-impervious sheets inflating due to the negative pressure of the typhoon was again observed. The sheets were designed to be problem-free, even when they are inflated to an 8.5m radius (50% of the distance between the fixtures under a maximum wind speed of 43m/sec). In this typhoon, with a maximum wind force of 35m/sec, the swelling due to inflation was only 1m or so.

Typhoon 18 approached Okinawa main island on 22 September and caused substantial damage to the island. Power supplies to 25% of the island's households failed and the water level of the upper reservoir was maintained at the full water level. The maximum wind speed of this typhoon was 45m/sec. The inflation of rubber sheets was similar to the previous typhoon and salt was not dispersed to the neighbouring areas.

Serious equipment faults were not observed during the first year of operation at the demonstration plant. And despite two typhoons hitting the island the plant operated normally. Periodic inspections have not highlighted any major problems, and the first year of the demonstration test is considered to be a success.

The test plant is now operating continuously like a commercial facility. Demonstration testing will continue for the next four years and then engineering tests will be undertaken to commercialise the pumped storage plant system.



Top right: the performance of equipment under sea conditions is assessed regularly; a valve used for the seawater system section

Observation of creatures living in and around a nearby creek