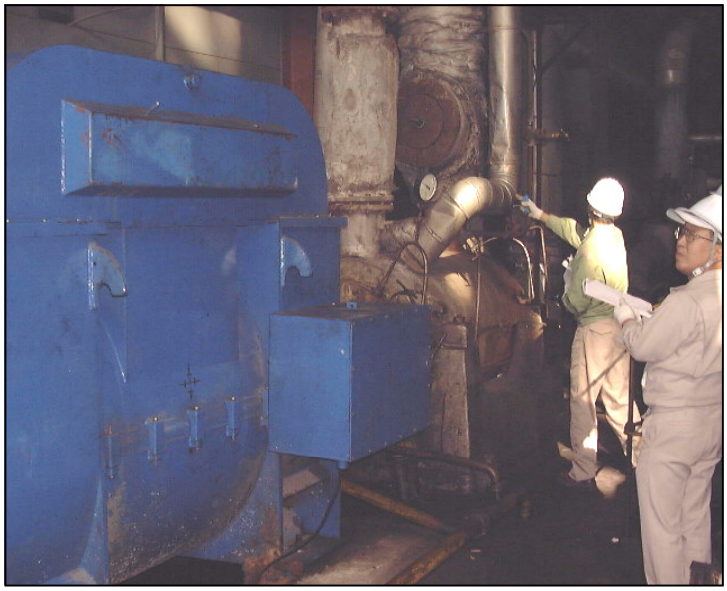
Rehabilitation Equipment	Feed Water Pumps

Fig.5.1-5



Current status

(1) The pumps and motors of feed water pump equipment have a high failure frequency because of being superannuated, and TES4 has difficulty in maintenance and repair work.

(2) Feed water flow control is done by the FW control valves. At start-up of FW pump, a large shock is given to the FW system.

Improvement plan

Feed water pump equipment is replaced by new equipment with variable speed inverter type motors. The feed water rate depends on the motor variable speed or rotation. By this rehabilitation, a reduction of the failure rate of FW control valves etc, and a large saving of auxiliary power consumption are expected.

Rehabilitation Equipment	Condenser Pumps

Fig.5.1-6

Current status

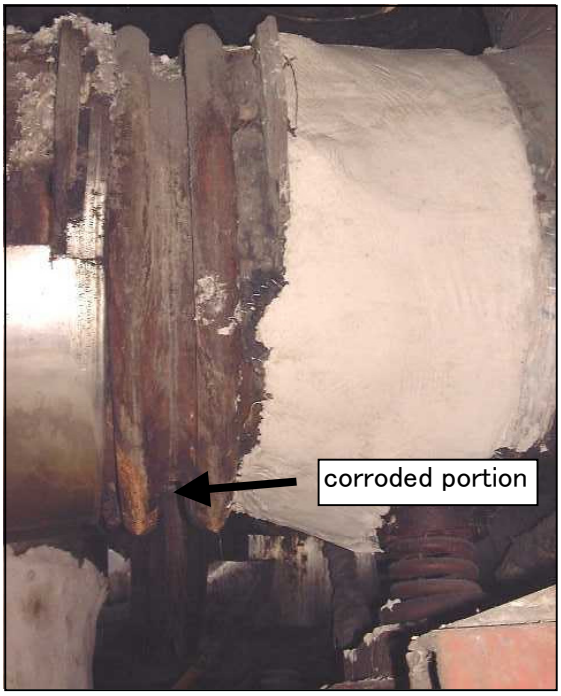
Condenser pumps were replaced several years ago. The number of pumps was changed from 3 sets to 2 sets (from horizontal axis type to vertical axis type) per each turbine. Since then, although pump capacity is rated, response to load change became important. As a result, the impeller has been damaged by cabitation and the pump shaft has broken.

Improvement plan

Replacement with a condenser pump and motors is required and, at the same time, review for control system is being implemented to include control valve for condenser level control to correspond to pump capacity.

Rehabilitation Equipment	Expansion Joint of Condenser and Extraction Pipes

Fig.5.1-7



Current status

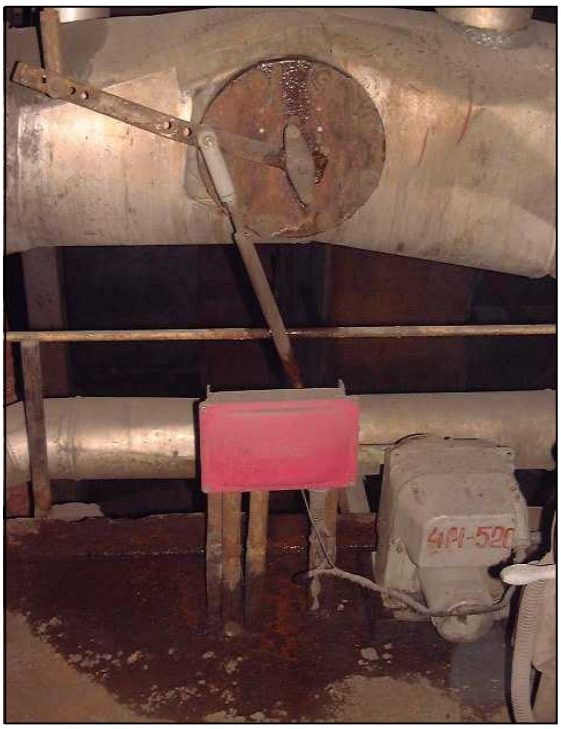
For drain tube clogging, drain pipes had been removed from expansion joints in condenser and extraction lines. In the consequently drained portion, there has been considerable corrosion. Leakage from those corroded portions is one of the factors of the decline of the condenser vacuum.

Improvement plan

All expansion joints are to be replaced with new ones and drain pipes which had been removed are to be re-installed.

Rehabilitation Equipment	Valves for Vacuum System

Fig.5.1-8



Current status

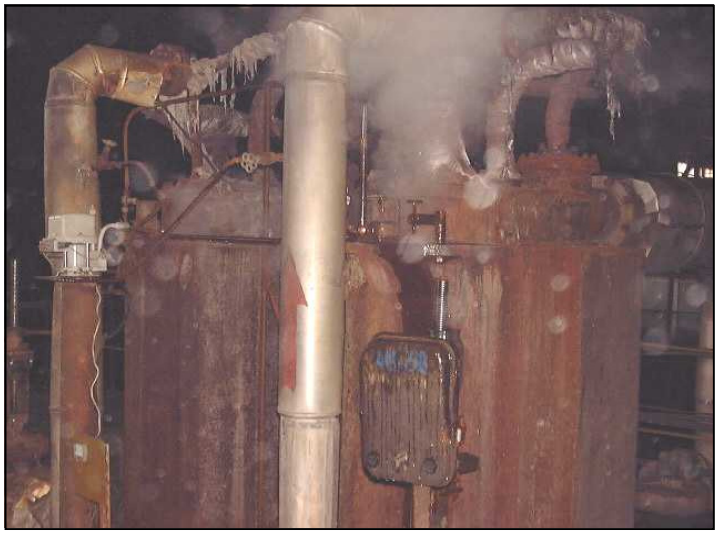
Although the valves in vacuum lines were of water-sealing type originally, these valves were changed to grand packing type during later repair work. This change caused vacuum leakage and is one of the factors of the decline of the condenser vacuum.

Improvement plan

All valves in the vacuum lines are to be replaced with water-sealing type.

Rehabilitation Equipment	Ejectors

Fig.5.1-9



Current status

Ejectors have overhaul and repair work once every 4 years. Various portions including 3 stages type nozzle, however, have been worn-out and leak and have become one of the factors of the decline of the condenser vacuum.

Improvement plan

Since recovery of ejector performance by repair work is expected to be impossible because various portions are worn-out and leaking, ejectors are to be replaced.

Rehabilitation Equipment	HP/LP Feed Water Heaters

Fig.5.1-10

Current status

Since many failures of HP/LP feed water heaters occurred, such as deterioration of thermal insulation and leaks from valves/vent valves, plant efficiency has bacome lower and also these failures relate to causes of failure of surrounding devices/equipment.

Improvement plan

HP/LP feed water heaters are important devices to keep rated turbine efficiency. HP/LP feed water heaters are to be replaced.

Rehabilitation Equipment	Mechanical Filters at Cooling Tower Outlet

Fig.5.1-11

Current status

(1) Mechanical filter equipment is being used in repairing at No.1 and No.2 cooling towers. There is, however, no mechanical filter provided for No.3 cooling tower.
(2) Since mechanical filters are installed at the bottom of the cooling tower, cleaning is carried out only when it is shut down.

Improvement plan

(1) Because of the removal of foreign substances and performance improvement of No.1 and 2 cooling towers, TES4 has a plan to change the filter mesh size from 50mm to 10mm.
(2) TES4 has a plan to manufacture and install a mechanical filter for No. 3.
(3) TES4 has a plan to install dust removal equipment featuring an automatic washing function which can be cleaned during

Rehabilitation Equipment	Cooling Tower

Fig.5.1-12

Current status

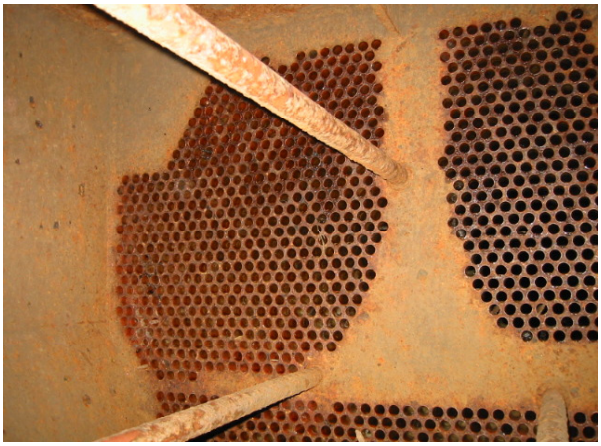
(1) An icicle formed inside the cooling tower in winter fell, and the nozzles and eliminators in the lower portion of the cooling tower were broken by it. This decreased plant efficiency, and increased vaporized spray water. These also become factors which enlarge icicles of the upper portion of the cooling tower.
(2) Garbage, such as sand and plastic, has entered from the lower opening portion of the cooling tower, has blocked condenser tubes, and has accumulated on the lower pit portions of the cooling tower.

Improvement plan

(1) In winter, icicles shall be removed periodically.
(2) Repair the eliminators and nozzles periodically.
(3) Clean lower pit portions of the cooling towers periodically.
(4) The possibility of a radiator type was studied. The study result is shown in Ex 5.1-1.

Rehabilitation Equipment	Condenser Tube Cleaning Devices

Fig.5.1-13



Current status

Groundwater is used for condenser cooling water. Problems, such as clogging by ground dust and foreign substances from the cooling tower, and a decrease of cooling water because of discharging bearing cooling water, have occurred.

Improvement plan

(1) Maintenance of dust collecting equipment.
(2) Keep cleaning condenser tube periodically.
(3) Restoration of bearing cooling water return piping.
(4) The possibility of condenser tube washing equipment was studied. The study result is shown in Ex 5.1-2.