

TOSHIBA

**RENOVATION OF
HYDROELECTRIC POWER
EQUIPMENT**





*From Planning to Execution,
Toshiba is always with you*



Introduction

The role of the hydroelectric power plant is increasing in importance because water power is a clean energy source amply available in nature; furthermore, requirements for hydroelectric generation have been raised as a means of generating energy quickly in response to demands of electricity systems.

It is very important to utilize existing old hydroelectric power plants effectively and efficiently, as well as to build new hydroelectric power plants.

TOSHIBA has been playing a leading role in the field of hydroelectric generating equipment, supplying over 1900 units of water turbines with a total capacity of over 36 million kW, and over 1300 units of hydro-generators with a total capacity of over 37 million kVA.

Today highly sophisticated computers are utilized in automatic designing and manufacturing processes, and in various kinds of analyses. Materials of high quality and with excellent characteristics are now obtainable on the market. Also, great progress has been made in N.D.E. (Nondestructive Examination) technology and in its evaluation techniques. Under these conditions, TOSHIBA has adopted such modern technology in the field of hydroelectric generating equipment.

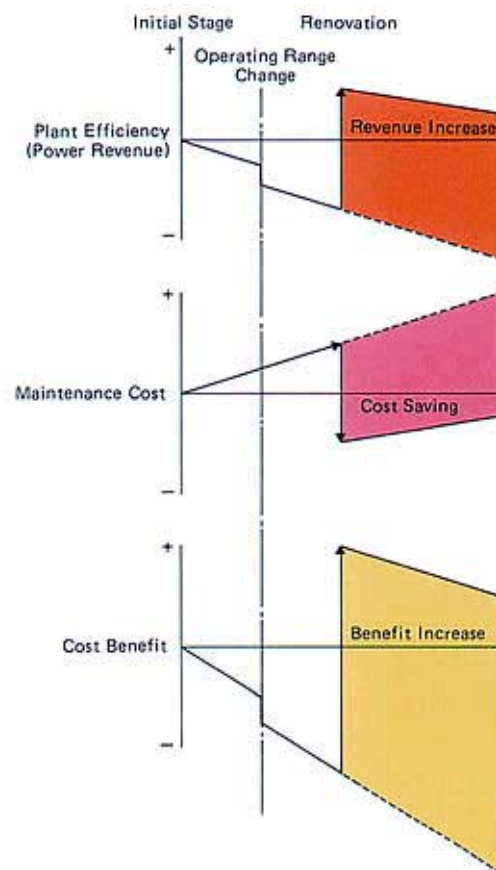
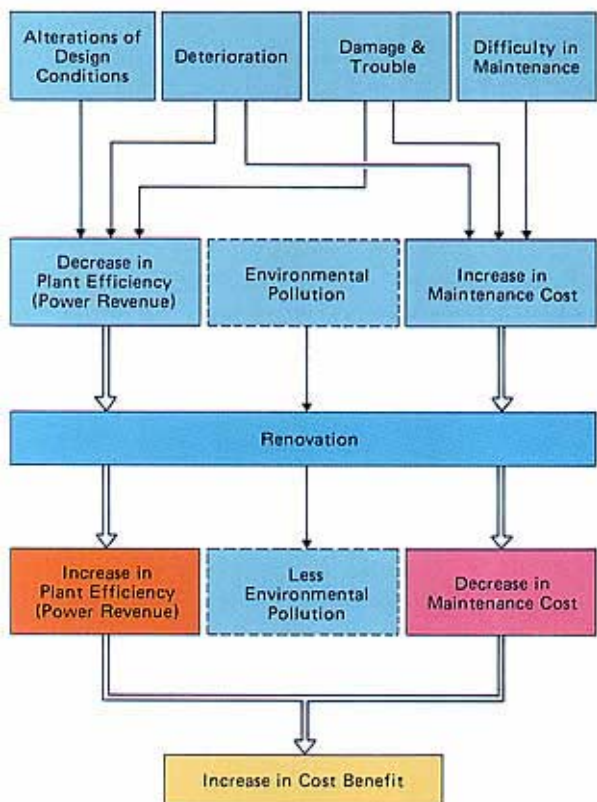
TOSHIBA is eager to collaborate with clients in renovation schemes of old hydroelectric power plants presently existing, based on our rich accumulation of experience and using our developed highly innovative technology, as well as designing and installing newly constructed hydroelectric power plants to conform to customer's individual requirements.

Benefits Obtainable through Renovation

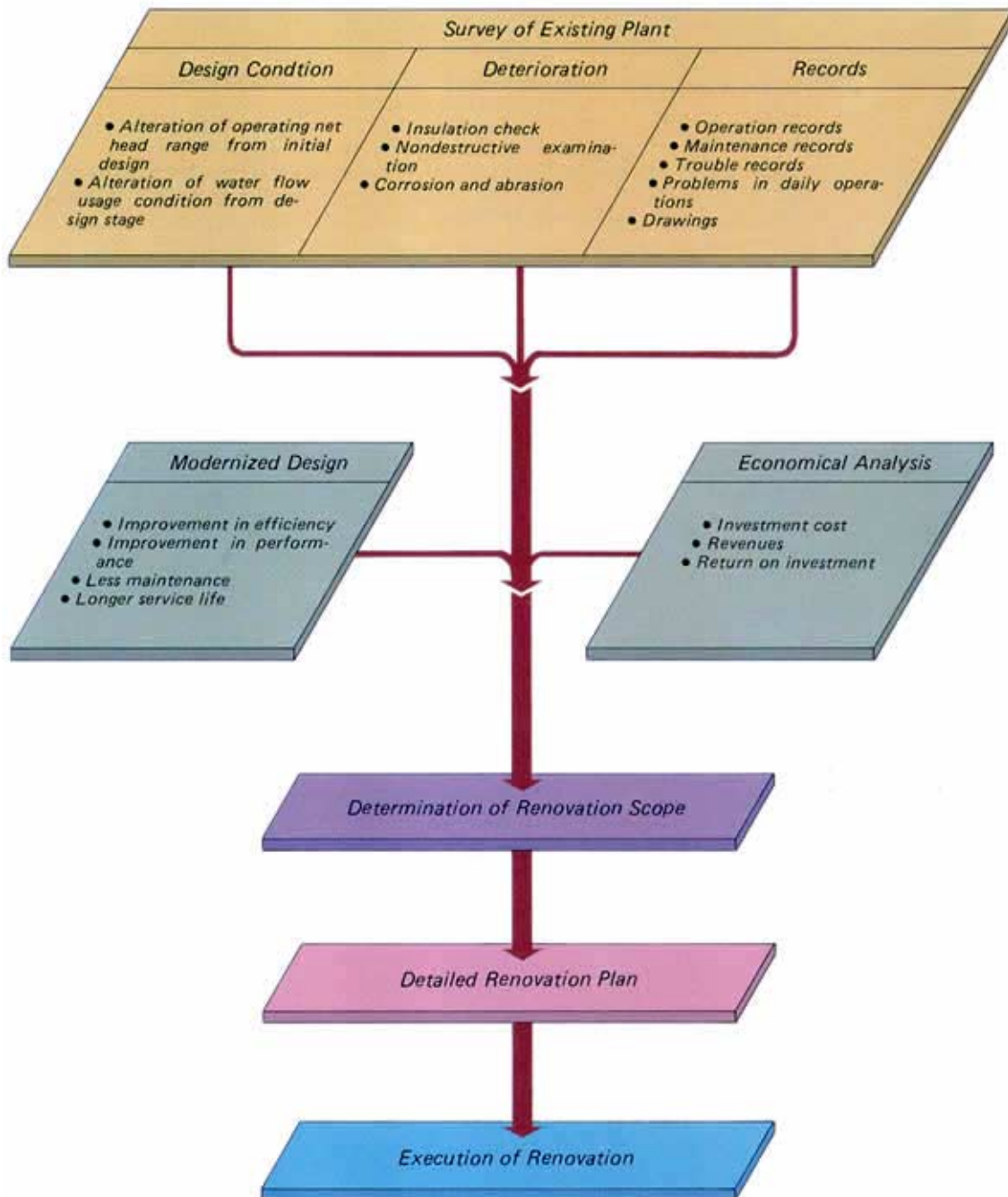
In old hydroelectric power plants still operating, there occurs deterioration, damage to or trouble with the equipment, alterations of conditions from the initial design stage, difficulty in maintenance, increasing maintenance costs and/or environmental pollution with the passage of time. These adverse circumstances result in a decrease in power revenue and an increase in maintenance costs.

In considering the solution of this kind of trouble or inconvenience, it is very important for clients to conduct renovation that will offer the benefits listed on the right, comparing them with the investment in cost.

- 1 Increase in generating electricity by applying a higher efficiency turbine and/or generator, or by modification of a turbine and/or generator design to meet the present perating range that differs from the initial design stage.
- 2 Increase in annual generating electricity by applying a highly reliable design that requires less maintenance.
- 3 Cost saving in maintenance by applying minimized maintenance design.
- 4 Countermeasures against environmental pollution. As a result of such renovation, cost benefits obtained from the plant will remarkably increase.



Steps for Renovation

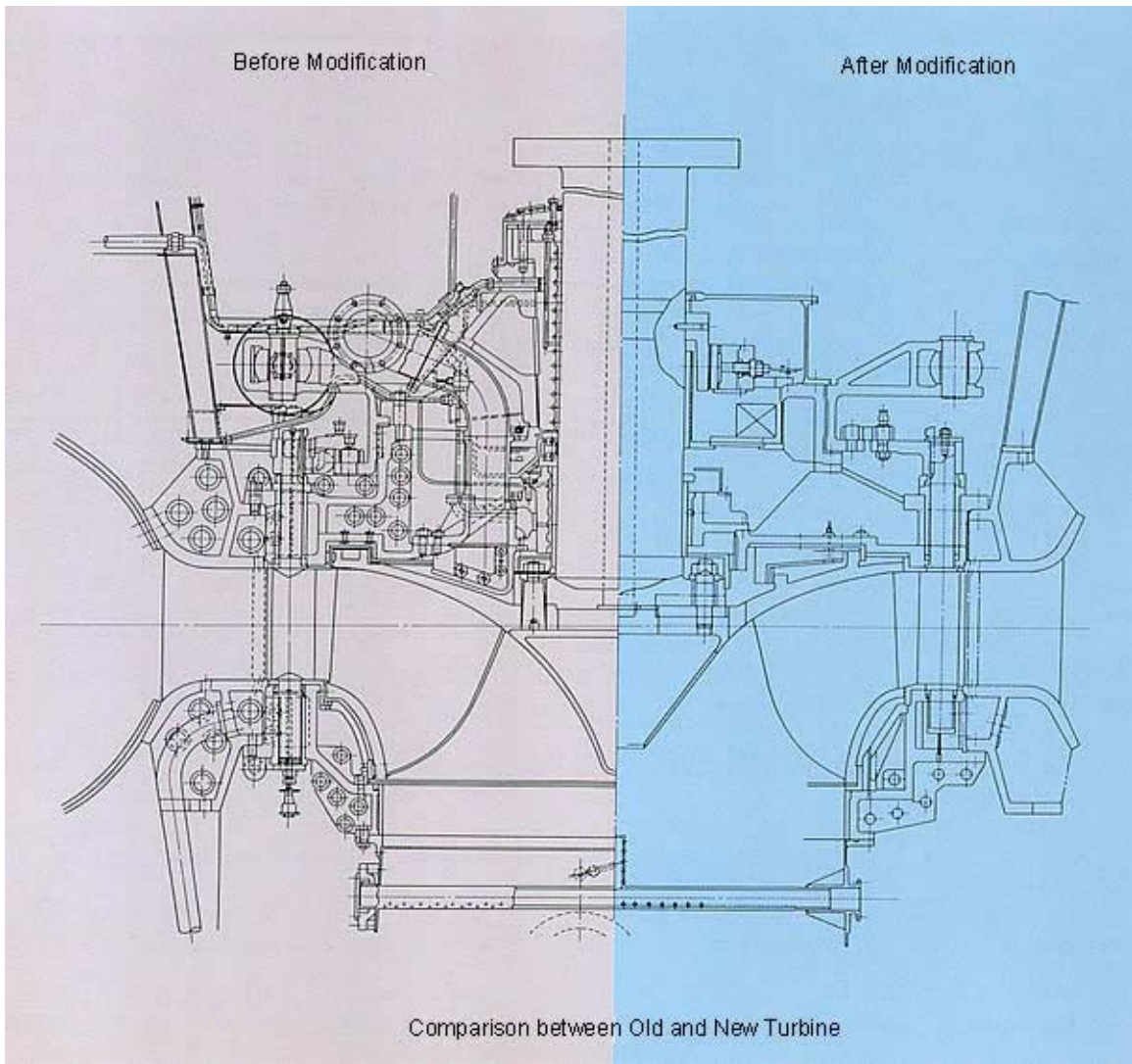


Renovation Plan

Turbine, Governor, and Inlet Valve

Components	Purpose and Time for Renovation	Toshiba Reference Catalog
Water Turbine	<ul style="list-style-type: none"> • Occurrence of excessive corrosion and/or wear on spiral case, guide vane, head cover, bottom ring and so on • Replacement of turbines from multiple turbines to single turbine of different rating and/or type to obtain higher performance • Improvement of turbine efficiency by applying optimum design to water turbine to conform to alterations of design conditions such as net head and water flow 	
Runner	<ul style="list-style-type: none"> • Occurrence of excessive corrosion and/or wear on runner • Improvement of turbine efficiency by applying optimum design to runner to conform to alterations of design conditions such as net head and water flow • Application of high-resistance material to cavitations pitting <p>[Material] SC46 with stainless steel overlay JIS 65101 SCS1 (13Cr stainless steel casting) JIS 65121 SCS5 (13Cr-4Ni stainless steel casting) JIS G5121</p>	QC-63021
Guide Bearing	<ul style="list-style-type: none"> • Replacement of turbine guide bearing from forced circulation type to self-lubricating type to eliminate maintenance of the lubricating oil circulation system 	QC-63024
Sliding Portion of Water Turbine and Inlet Valve	<ul style="list-style-type: none"> • Replacement of bearing in sliding portion* from grease-lubricating type to self-lubricating type to eliminate maintenance of the grease lubrication system <p>*Portion of guide vane bushed bearing, guide strips in the operating mechanisms, inlet valve trunnion bushed bearing and so on</p>	QC-63023
Inlet Valve	<ul style="list-style-type: none"> • Occurrence of excessive wear of inlet valve • Modification of inlet valve from butterfly valve to through-flow valve to obtain higher hydraulic performance • Replacement of seals, packing of valve disc and valve trunnion, and so on as countermeasure against water leakage • Repair or manufacture of valve body, valve trunnion caused by excessive corrosion and/or wear • Replacement of packing and bushes • Adoption of self-lubricating bearing 	QC-63022
Pressure Oil Supply System	<ul style="list-style-type: none"> • Reconstruction of pressure oil supply system for inlet valve and/or governor to obtain higher operating pressure • Replacement of all unit or timeworn parts • Replacement of pumping system from central type to unit type • Replacement of pumping system from "motor and auxiliary water turbine (MT)" driving method to "motor and motor (M-T)" driving method 	
Governor	<ul style="list-style-type: none"> • Replacement of governor from mechanical type to electro-hydraulic type to obtain higher performance and easy maintenance • Upgrading the governor to the latest type for enhancing performance • Replacement of worn parts 	

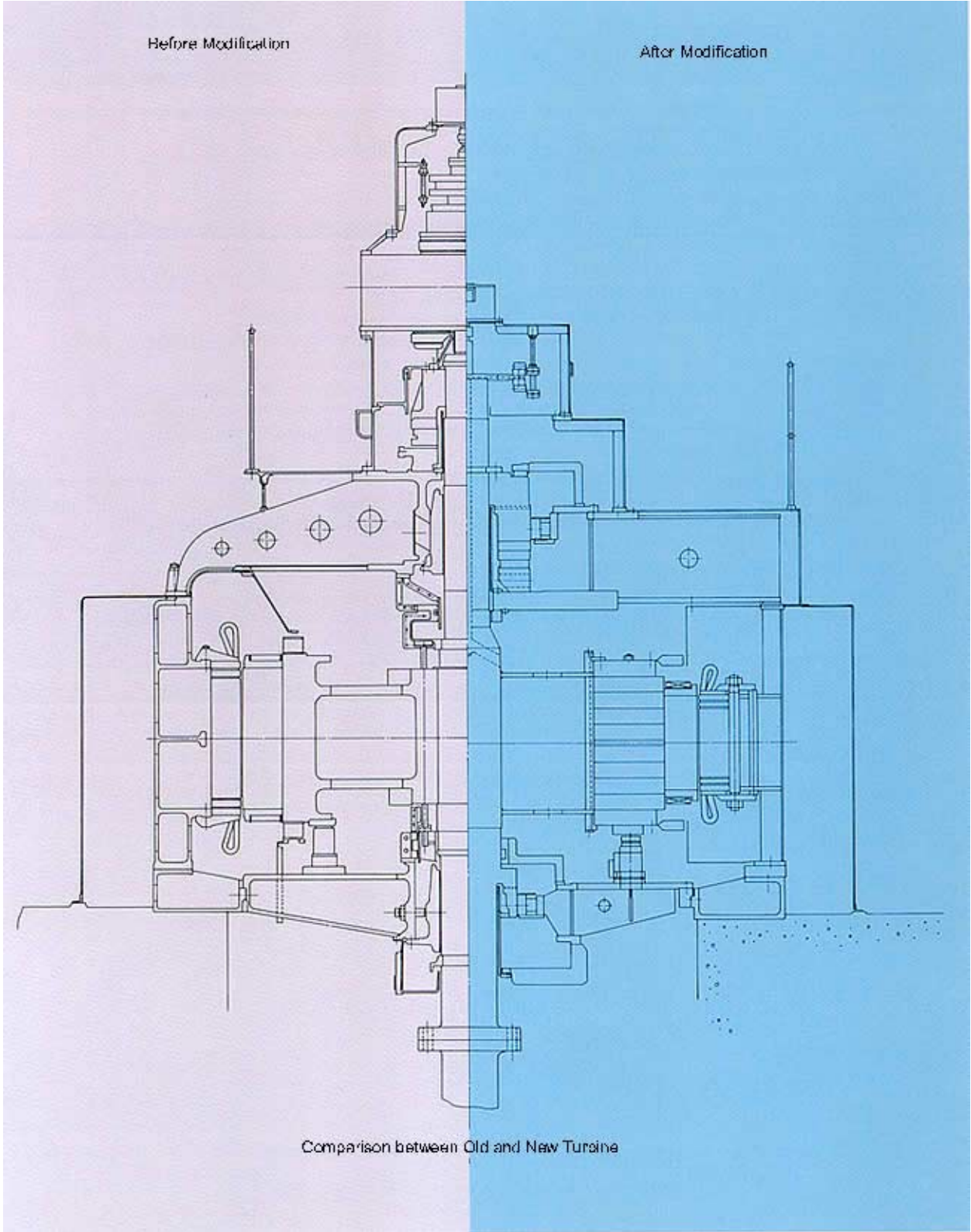
Components	Purpose and Time for Renovation	Toshiba Reference Catalog
Turbine Control Device	<ul style="list-style-type: none"> ● Adoption of latest type solenoid valve because of present timeworn condition or compact arrangement ● Adoption of latest type instruments for improving reliability ● Adoption of latest type electrical parts ● Replacement of existing parts with latest types easily obtainable on the markets ● Adoption of instruments of noncontact type for improving reliability and long service life 	



Generator and Excitation System

Components	Purpose and Time for Renovation	Toshiba Reference Catalog
Generator	<ul style="list-style-type: none"> • Occurrence of mechanical strength decrease, red rust on main parts of generator, and insulation performance deterioration of coils • Replacement of turbine with one of new rating 	
Stator	<ul style="list-style-type: none"> • Occurrence of mechanical strength decrease and long-term deterioration on stator frame, core, and coils 	QC-62004 QC-62008
Stator Coil and Core	<ul style="list-style-type: none"> • Occurrence of insulation performance deterioration on stator coils, and long-term deterioration and mechanical strength decrease on stator core • Change of stator slot number upon replacement of stator coils 	QC-62004 QC-62008
Stator Coil	<ul style="list-style-type: none"> • Occurrence of insulation performance deterioration on stator coils • Occurrence of external damage on stator coils • Provision of uprating of generator 	QC-62008
Rotor	<ul style="list-style-type: none"> • Occurrence of long-term deterioration or mechanical strength decrease on rotor pole, rim, and shaft • Replacement of turbine with one of new characteristics 	QC-62001
Rotor Pole	<ul style="list-style-type: none"> • Occurrence of long-term deterioration on pole pieces and rotor coils • Provision of damper winding with replacement of rotor coils 	QC-62001
Rotor Coil	<ul style="list-style-type: none"> • Replacement of insulation material • Provision of uprating of generator 	QC-62001
Rotor Coil Insulation	<ul style="list-style-type: none"> • Occurrence of performance deterioration of insulation material for rotor coils 	QC-62001
Rotor Rim	<ul style="list-style-type: none"> • Occurrence of long-term deterioration or mechanical strength decrease of rotor rim • Replacement of turbine with one having new characteristics 	
Rotor Spoke	<ul style="list-style-type: none"> • Occurrence of long-term deterioration or mechanical strength decrease on rotor spoke 	
Shaft	<ul style="list-style-type: none"> • Occurrence of long-term deterioration or mechanical strength decrease on shaft • Provision of one-piece body of shaft with guide sleeve to adopt oil-immersed lubricating system 	
Fan	<ul style="list-style-type: none"> • Occurrence of mechanical strength decrease on fans • Provision of efficiency improvement and temperature rise decrease of coils 	QC-62002
Brake Ring	<ul style="list-style-type: none"> • Occurrence of mechanical or thermal strength deterioration on brake ring 	
Oil Lubrication System	<ul style="list-style-type: none"> • Modification of oil lubrication system from forced oil circulation system to oil-immersed lubrication system 	QC-62005

Components	Purpose and Time for Renovation	Toshiba Reference Catalog
Thrust Bearing	<ul style="list-style-type: none"> ● Modification of bearing from ring type to spring-supported segmental type to improve reliability ● Provision of adopting heat-shrinkage-type thrust collar to prevent damage of mating portion 	QC-62006
Bracket	<ul style="list-style-type: none"> ● Provision of oil lubricating system modification to oil-immersed type 	QC-62005
Brake and Jack	<ul style="list-style-type: none"> ● Occurrence of long-term deterioration ● Provision of adopting braking system to protect bearings ● Provision of adopting jack system for easy assembly and disassembly 	QC-62007
Air Housing	<ul style="list-style-type: none"> ● Provision of air housing for open-type generators to decrease temperature rise ● Provision of air coolers for open-circuit, outlet-duct-circulated-type generators 	
Collector Ring	<ul style="list-style-type: none"> ● Occurrence of deterioration on collector ring ● Provision of excitation system modification from DC exciter to static-type exciter 	QC-62003
Brush Holder	<ul style="list-style-type: none"> ● Occurrence of long-term deterioration on brush holders ● Modification of excitation system from DC exciter to static-type exciter 	QC-62003
Exciter	<ul style="list-style-type: none"> ● Replacement of excitation system from DC exciter to static or brush-less type 	





Example of Generator before Modification (Background)
and after Modification (Foreground)

**Toshiba will be pleased to collaborate with you in renovation work
from planning to execution.**

TOSHIBA

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