出國報告（出國類別：洽公）

日本三菱重工(MHI)及荏原製作所(EBARA)備品製作進度及經驗交流

服務機關：台灣電力公司龍門電廠

姓名職稱：巫鴻志 十二等機械工程監

派赴國家：日本

出國期間：99.11.28 至 99.12.4

報告日期：100.1.25

行政院及所屬各機關出國報告提要

出國報告名稱：日本三菱重工(MHI)及荏原製作所(EBARA)備品製作進度及經驗交流

頁數 28 含附件：□是■否

出國計畫主辦機關/聯絡人/電話：台灣電力公司 / 陳德隆 / (02)2366-7685

出國人員姓名/服務機關/單位/職稱/電話

巫鴻志/台灣電力公司/龍門電廠/機械工程監/（02）24903550＃3600

出國類別：□1 考察□2 進修□3 研究□4 實習■5 其他(洽公)

出國期間：99.11.28 至 99.12.04 出國地區：日本

報告日期：100.01.25

分類號/目：

關鍵詞：核能電廠 主汽機 循環水泵

內容摘要：

核能電廠汽機轉子爲主要設備，有其重要性。近年國內核能電廠主汽機，皆因於大修期間發現問題進行更新。龍門電廠建廠主汽機由日本三菱重工製造，一號機已初步完成主汽機慢車，即將進行後續正式試運轉。擬赴三菱公司洽訪主汽機試運轉測試應注意與檢查項目及相關時程。

龍門電廠需準備之備品金額龐大，雖已進行部分採購，仍需與原廠(日本三菱重工)擬定相關不足備品規劃因應策略，及了解已購備品製作進度。

龍門電廠泵室空間較不足，廠用循環水泵進行維護需花費較多時程，相關特性及防蝕即顯重要，實有必要前往原製造廠[荏原製作所(EBARA)]了解其特性擬定相關維護策略，以增加可靠度，及了解已購備品製作進度。

本文電子檔已傳至出國報告資訊網（http://open.nat.gov.tw/reportwork）

目　　錄

壹、國外公務之內容與過程

一、目的

(一) 出國任務

赴日本三菱重工(MHI)及荏原製作所(EBARA)備品製作進度及經驗交流，出國期間自99年11月28日至99年12月04日，共計7天。

(二) 緣起及目標

核能電廠汽機轉子為主要設備，有其重要性。近年國內核能電廠主汽機，皆因於大修期間發現問題進行更新。龍門電廠建廠主汽機由日本三菱重工製造，一號機已初步完成主汽機慢車，即將進行後續正式試運轉。擬赴三菱公司洽訪主汽機試運轉測試應注意與檢查項目及相關時程。

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二、過程

至日本三菱重工(MHI)及荏原製作所(EBARA)備品製作進度及經驗交流，爲期 7 天，詳細過程及工作內容如下表：

起始日	迄止日	地點	工作內容
991128	991128		往程（台北-日本東京-兵庫縣）
991129	991130	兵庫縣	洽訪MHI 討論主汽機試運轉測試及維修策略
991201	991201		轉換工作地點（兵庫縣-東京）
991202	991202	東京	洽訪 MHI 總公司進行備品規劃策略討論
991203	991203	東京	洽訪荏原製作所討論循環水泵特性及防蝕
991204	991204		返程（東京-台北）

貳、執行過程與內容

一、洽訪三菱公司(MHI)兵庫縣高砂製造所 (99.11.29-99.11.30)

核能電廠汽機轉子爲主要設備，有其重要性。近年國內核能電廠主汽機，皆因於大修期間發現問題進行更新低壓汽機轉子。龍門電廠建廠主汽機由日本三菱重工製造，一號機已初步完成主汽機慢車，即將進行後續正式試運轉。本次洽訪洽訪三菱公司(MHI)兵庫縣高砂製造所，針對以下議題進行討論：

- 主汽機及其輔助系統，於起動各階段間需進行查修項目

針對主汽機及其輔助系統主要之設備，於起動測試各個階段需進行檢查清理項目請 MHI 提供規劃與建議(附件一)。(如低壓汽機末級葉片於完成高功率起動測試後進行葉片沖蝕檢驗；主汽機關斷閥內部檢查；冷擬器內部於各功率起動測試後皆需進入檢查清理，等等。)，如此電廠方可事前規劃相關時程與人力。

- 針對本廠規劃起動測試時程之建議與意見

針對本廠規劃起動測試時程， MHI 依其經驗，建議主汽機系統應執行喪失廠外電源汽封消耗測試；此外 STP-61F "Turbine Generator Lube Oil Test"，本廠原規劃於低功率時測試，MHI 建議於在加熱階段執行(於第一次轉汽機即執行確保相關功能)，等等(附件二)；本部份已安排 MHI 派員至電廠與相關組進行進一步詳細討論規劃。

- 扭轉振動測試相關事件澄清

確認汽輪發電機組扭轉振動自然頻率可確實避開運轉倍頻，是非常重要的，現一般電廠於新建、更換或變動汽機輪發電機組重大組件，須進行扭轉振動自然頻率驗證，已是共同之做法。遠從國內核三廠之案例，至近來美國 South Texas Project 2 機組(於 2002 年更新 Generator Rotor)，未行驗證測試，造成汽輪發電機組扭轉振動自然頻率，接近系統倍頻而造成葉片斷裂，皆是實例。

本廠針對此測試,特邀請綜研所蒯博士及振動專家龔博士(原於西屋公司發展此項 TVM 偵測技術之專家)協助審查(附件三)，提出要求請 MHI 提供該量測設備之靈敏度，與發展此技術之必要佐證資料。以確保可偵測出異常訊號及其結果具可靠性。

惟 MHI 因年代久遠，已無法提出相關佐證（附件四)。

針對此項，電廠已先行委託綜研所協助進行扭轉振動模態分析，初步顯示其自然頻率確實避開了 57Hz-63Hz、114Hz-126Hz(附件五)。惟切確臨界轉速需待將來實測確認。此實測部分本廠將續委請綜研所協助審查，並嘗試請振動專家龔博士協助。

- 主汽機之一般問題點

針對日本濱岡電廠 5 號機及志賀電廠 2 號機低壓汽機事故交換意見；MHI 公司表示，使用於龍門電廠之低壓汽機機組已達 15 部(附件六 T6C（惟皆使用於 PWR 電廠))，且設計皆經儀器實測測試相關數據，且其葉片設計爲獨立式葉片，較之濱岡電廠 5 號機及志賀電

廠 2 號低壓汽機採用群組式葉片，其振動承受之應力相差 4-6 倍以上(此部分可接受其論點)，因此不會有類似之情形。

該公司目前已進行 62”及 74”葉片之研發，但囿於全鍛式(Full Integrated)轉子發展與製造之限制，MHI 公司亦開始發展焊接式轉子(Welded Rotor 附件七，另焊接試轉子之特性請參閱本人 87 年度[主蒸汽低壓汽機轉子及組件安裝技術與維修運轉經驗]報告)。

二、洽訪三菱公司(MHI)東京事務所

龍門電廠需準備之備品金額龐大，雖已進行部分採購，因囿於預算有限仍需與原廠(日本三菱重工)擬定以下規劃因應策略：(MHI 已重提建議備品)

1.Priority I

1.無替代性、交貨期長(尚未購買)(Liner、電磁閥、Actuator修理包、Accumulator修理包等)

2.Priority II

1.可於迅速自#2機拆用(螺栓螺帽)，已採購部份備品(非全數)(軸承、動作器)➔一號機商轉後補足

3.Priority III

1.靜件對運轉無影響，可於次年大修更換。(Seal Ring for HP Nozzle Block)

2.國內可製作(O-ring、一般襯墊等)

4.不再生產電子配件

1.振動診斷系統(VDS (Vibration Diagnostic System))與扭轉振動監測系統(TVM (Torsional Vibration Monitor))已不再生產，將以#2機之設備配件爲#1機設備備品；#2機部分再予升級。

三、洽訪荏原公司(EBARA)東京製作所

針對 UNIT 1 汽機所使用的循環水泵(CWP) 之 B 泵[1P28-P-5001B]發生腐蝕現象,EBARA 認爲於長時間停機的期間海洋生物附著後,海水轉變成停滯(Stagnant),海洋生物因海水含氧不足後死亡,脫落而導致孔蝕的現象,並建議泵如浸泡於海水應定期運轉(附件八)。

另荏原公司針對工地於組裝泵組件時除安裝橡膠封環外，應塗以密封劑(Santac Sealer)，方可避免間隙腐蝕(附件九)。

參、心得與感想

本次赴日本三菱重工及荏原公司(EBARA)洽訪，主要在了解設備特性，可提早準備規畫擬定未來測試維修策略。兩公司亦十分歡迎電廠實際擔任維護人員到訪，於交換意見後，有助電廠擬定未來測試維修策略更爲精準。

- 日本三菱重工

日本三菱重工汽機轉子其源自美國西屋公司設計(本公司核一、二廠主汽機皆源自美國西屋公司，近年因缺失已陸續進行更換新轉子)，並經自行研發測試改善，將原西屋公司之缺點進行改進。如原採用群組式葉片設計進步爲爲獨立式葉片，較之濱岡電廠 5 號機及志賀電廠 2 號低壓汽機仍採用群組式葉片，其振動承受之應力相差 4-6 倍以上。

該公司針對全鍛式(Full Integrated)轉子發展與製造之限制，自 1995 年起亦開始發展焊接式轉子(已使用於火力電廠)(核一廠、核三廠改善後轉子即採用 ABB 公司提供之焊接式轉子)，此項亦將改善套縮式轉子及全鍛式轉子應力腐蝕問題(原核二及核一轉子之問題)。該公司相關設計改進並有一 300MW 複循環機組進行驗證，取得各項數據。因此 MHI 轉子有其可靠度。

惟使用於龍門電廠 T6C 之葉片,其使用之經驗皆於 PWR 電廠,因其環境與 ABWR 不同(原核一廠低壓汽機葉片斷裂，原西屋公司稱其美國公司機組(多爲 PWR 機組)皆無類似情形，後檢討爲 BWR 機組水中溶氧較高，降低該葉片疲勞破斷強度，因此龍門電廠於大修時之維修檢查工作仍不得輕忽。

此外於要求提供扭轉振動可靠佐證，MHI 以年代久遠，已無法提出相關佐證爲由，針對此項，電廠已先行委託綜研所協助進行扭轉振動模態分析，初步顯示其自然頻率確實避開了 57Hz-63Hz、114Hz-126Hz(附件五)。惟切確臨界轉速需待將來實測確認。此實測部分本廠將續委請綜研所協助審查，並嘗試請振動專家龔博士協助。

起動測試方面 MHI 公司依其經驗提出頗多建議，此部分電廠已安排負責單位與該公司進行討論。

備品方面，與 MHI 皆有共識，未來維修將採 Rotate 方式進行，以節省大修或搶修之時程；惟目前預算考量，暫採無替代性設備優先採購，未來#1 商轉及#2 號機組開始進行測試時，自是續備齊相關備品之時機。

- 荏原公司

荏原公司爲頗具規模大型迴轉機廠家，設備運用於海水及化工環境極具經驗；龍門電廠因時程因素，廠用循環水泵設備長期靜置海水環境，已發現有孔蝕的現象；相關接合面會否因密封劑(Santac Sealer)，塗抹未完全造成間隙腐蝕(附件九)，仍待進一步檢查。

此外龍門電廠泵室空間及吊掛設備較不足，廠用循環水泵進行維護需花費較多時程。

針對上述電廠初步規劃將先行採購一組備品，並擇期拆檢，以確保商轉後該設備運轉之可靠度。

肆、建議

針對重要設備，由電廠實際擔任維護人員定期前往原製造廠家，於交換意見後，有助電廠擬定未來測試維修策略更爲精準。

日本三菱重工葉片設計已有改善，且該公司相關設計改進並有一 300MW 複循環機組進行驗證，取得各項數據，因此 MHI 轉子有其可靠度。惟使用於龍門電廠 T6C 之葉片，其使用之經驗皆於 PWR 電廠，因其環境與 ABWR 不同，因此龍門電廠於大修時之維修檢查工作仍不得輕忽。

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龍門電廠因時程因素，廠用循環水泵設備長期靜置海水環境，已發現有孔蝕的現象；相關接合面會否產生間隙腐蝕，仍待進一步檢查。此外龍門電廠泵室空間及吊掛設備較不足，廠用循環水泵進行維護需花費較多時程。針對此點電廠已初步規劃將先行採購一組備品，並擇期拆檢，以確保商轉後該設備運轉之可靠度。

伍、附件

- 附件一 起動各階段間需進行查修項目

Lungmen / Inspection List during LP_MP_HP Outage

	檢查設備	檢查內容	執行週期			備　註
			LP	MP	HP	
1	主汽機	①LP final blade:L-0 Visual inspection低壓汽機末級葉片:L-0目視檢查 ②Bearing overhaul軸承檢修	-	-	○	Blade : Erosion check葉片:沖蝕檢查 Bearing for inspection is decided based on the bearing metal temperature at the time of operation.由軸承檢查以決定操作時的軸承金屬溫度
2	主蒸汽閥	①Appearance visual inspection外觀目視檢查 (Leakage marks check)洩漏處標示檢	○	○	○	
		②Inside part appearance inspection內部組件外觀檢查	-	-	○	GV inside appearance inspection is performed from the open area of MSV. RSV/ICV are carried out. Caulking visual inspection.藉由MSV/RSV/ICV檢查決定GV內部是否檢查，以及間隙檢查
		③Temporary strainer removal臨時過濾器移除	-	-	○	Only MSV 只有MSV
3	主冷凝器	①Internal part appearance inspection內部組件外觀檢查 ②Hotwell Inspection and Cleaning熱井檢查及清理	○	○	○	Foreign material inspection after hotwell blow.異物檢查 Condenser tube appearance inspection鈦管外觀檢查 Visual inspection of structures, such as Shocked board / small piping結構目視檢查，例如震動板/小管等
4	輔助設備 1. 過濾器 VACCUM PUMP CP, CBP TBCWP	①Permanent strainer cleaning 正式過濾器清潔	○	△	○	LO strainer, Seal water/make-up water strainer, Mechanical seal flushing water strainer, etc... △ means it is judged necessary or not depend on inspection result at LP outage.各系統過濾器清潔其意思為為在LP outage階段判斷真正需要安裝或是不需要依賴檢查結果
		②Temporary strainer cleaning or Removal or Change to Permanent one 臨時過濾器清潔或移除或更改為正式設備	○	○	○	(1)Temporary strainer removal or change to permanent one at HP outage.臨時過濾器移除或在HP outage更換為永久設備 (2)Number of pump inlet temporary strainer cleaning is decided by the result of operation condition or differential pressure.各式PUMP進口臨時濾網清潔決定操作結果或差壓
5	2. Pump/Fan JOP, EH Pump EH Plishing Pump TOP , EOP , AOP Oil conditioner circulation P MFPT-MOP,EOP,Fan MFPT-Oil conditioner In/Out P MFPT-Oil conditioner Fum	①Appearance visual inspection外觀目視檢查 Leakage check洩漏處檢查	○	○	○	
		②Inspection of a coupling part聯軸器組件檢查	-	-	○	Grease replace : Equipment of gear coupling adoption潤滑劑替換:齒輪聯軸器
		④Lubrication exchange潤滑油更換	-	-	○	Based on lubricant specification (Grease injection, it is carried out also during operation for equipment including motor.)依據潤滑油規範(潤滑油注入,它需被執行在有馬達設備運轉)
		⑤Permanent strainer cleaning正式過濾器清潔	○	△	○	LO strainer △ means it is judged necessary or not depend on inspection result at LP outage.N34系統過濾器清潔其意思為在LP outage階段判斷真正需要安裝或是不需要
6	MFPT	HP/LP-SV Temporary strainer removal高壓/低壓-關斷閥臨時過濾器移除	-	-	○	
7	3. Oil Tank Main Oil Tank MFPT Oil Tank Oil conditioner(MT/MFPT) CBP oil unit MD-FWP oil unit CWP oil unit	①LO return strainer cleaning潤滑油回油濾網清潔 Oil conditioner air filter(breather) cleaning油處理器空氣過濾器清潔	○	○	○	Inspection of the bag filter and cartridge filter of oil conditioner are carried out only in HP outage. (However, when oil level is going up, carry out properly.) ※Renew a cartridge filter. Although bag filter is cleanable, check beforehand whether possible or not at local.油處理器內部過濾器檢查只在HP outage階段執行(無論如何,當油位已到頂部,需適時執行)*更換新的匣式過濾器,雖然袋式過濾器已乾淨,但仍需事先檢查不論是可行或不在現場施作
		②Oil Removal and Visual inspection of tank inside parts 移除舊油以及油槽內部組件目視檢查	-	-	○	Looseness check of a piping flange. Foreign material check of a tank bottom. Oil transfer is required.管路法蘭面鎖緊檢查，油槽低部異物檢查,視需要換油
8	4. Heat-exchanger tank MS Drain Tank MSR Drain Tank	①Inside part appearance inspection內部組件目視檢查 ②Inside cleaning內部清潔	-	△	○	△ : depend on operation condition依據運轉狀況
9	MSR(Shell side)	①Inside part appearance inspection內部組件目視檢查 ②Inside cleaning內部清潔	-	-	○	

Lungmen / Inspection List during LP_MP_HP Outage

	檢查設備	檢查內容	執行週期			備　註
			LP	MP	HP	
10	Heat-exchanger TBCW Cooler LP Heater HP Heater	①Appearance visual inspection目視檢查 Leakage check洩漏處檢查 ②Corrosive protection zinc plate exchange腐蝕防護鋅板更換 (Electrolytic Corrosion check)(電解腐蝕檢查) ③Foreign material (Shellfish) Adhesion and Rubber lining visual inspection異物黏著以及橡膠內襯目視檢查	-	-	○	②③ : Cooling water cooler only只用於冷卻水冷卻器 (※Anode replacement is judged by its life.)(依陽極防護使用壽命判斷是否更換) When dirt is noticeable, level gauge glass cleaning is planned.當污物可見,液位鏡玻璃需更換
11	EH oil system(MT/MFPT) 1. EH oil filter	①Used filter washing and exchange使用過過濾器清洗及更換	-	-	○	Cleaning: suction filter, Line filter, Micro separator 進口濾網,出口濾網需清潔 Replacement: Return filter, Fuller earth filter, Back-up filter, Air breather 回油濾網,攀土過濾器,後備過濾器,呼吸器需更換 ※Be consider that the life of Fuller earth filter and Back-up filter is half year. (Possibility to be required to renew them before HP outage.)需考慮攀土過濾器,後備過濾器使用壽命為半年(在HP之前使可能更換新品)
12	2. EH oil Unit Accumulator	Leak check and N_2 pressure check洩漏檢查及氮氣壓力檢查	○	○	○	
13	Sea water piping Condenser water box Sea water piping Condenser water box priming pump	①Rubber lining visual inspection橡膠內內襯目視檢查 ②Foreign material (Shellfish) Adhesion check異物附著檢查 ③Sea water strainer cleaning and anode inspection海水過濾器及陽極保護檢查	-	-	○	Dose lining have any swelling or penetration? Since jet washing damages lining, don't carry it out. A pinhole test etc. is considered when damage is suspected. 橡膠內襯是否有腫起或破裂?不可由jet washing破壞內襯,pinhole測試等需考量是否有可能損壞
14	Main Piping Main steam system Aux. steam system Extraction steam system Make-up water system Condensate water system Gland steam system Main feed water system Heater drain system MS&MSR drain system	①Flange leakage trace inspection法蘭面洩漏痕跡檢查 ②Target plate inspection目標板檢查 ③Grand steam strainer cleaning/removal格蘭汽封過濾器清潔/移除 ④Strainer before oval flow meter cleaning ⑤Vacuum-break valve strainer cleaning真空破壞閥過濾器清潔 ⑥LP gland steam cooling water strainer cleaning低壓汽機格蘭汽封冷卻水過濾器清潔	-	-	○	Only when the target plate is adopted.只用於當目標板被接受狀況 ④:Only oval flow meter adoption unit只用於oval flow meter adoption系統 The drain trap a malfunction is suspected should be planning disassembling inspection. It is judged by the inspection result under operation. (: Steam system) 洩水管路却水器故障需計畫拆解檢查,它可經由在運轉下由檢查結果判斷.
15	Main Piping Support Main steam system Aux. steam system Extraction steam system Make-up water system Condensate water system Gland steam system Main feed water system Heater drain system MS&MSR drain system The following facility in the above-mentioned system (1)Oil Snubber (2)Spring hanger (3)Spring vibrationproofing machine	Oil Snubber油壓式減震器 ①Oil leak appearance inspection油洩漏外觀檢查	○	○	○	② : The amount of movements and load condition are checked not during Outage but during load operation. 減震器位置量以及負荷狀況不必於大修時檢查但需於機組升載時檢查. a) Bolt inspection 螺栓檢查 b) Inspection of the amount of movements of slide support and an oil-pressure vibrationproofing machine 滑動支撐架以及油壓防震設備的位移量檢查 c) Fixed condition check 固定狀況檢查
		Spring hanger彈簧吊架 Spring vibrationproofing machine彈簧防震設備 ①Appearance visual inspection外觀目視檢查 ②Weight condition check荷重狀態檢查	○	○	○	
16	Instrumentation 1. Main setting check Limit switch MFPT control oil pressure	①Inside part inspection內部組件檢查 ②Oil-pressure establishment inspection油壓確認檢查	○	○	○	Limit switch : MT-MSV,GV,RSV,ICV MFPT-HPSV,HPCV,LPSV,LPCV 主汽機及飼水泵汽機各蒸汽閥極限開關檢查
17	2. EH oil system LVDT & Servo valve	①Insulation abnormal due to contact of inside cable (Short circuit) Inspection絕緣檢查(短路)	-	-	○	Including MFPT 此項包含MFPT
18	3. Main Control Valves Condensate water recirculation valve RFP min-flow valve	①Valve disassemble inspection閥拆解檢查 Visual inspection of inside parts, such as a valve body and seat內部組件目視檢查,例如閥體或閥座 ②Pressure reducing valve filter inspection減壓閥過濾器檢查	-	-	○	Existence of erosion or Existence of sheet scratch by foreign material should be checked. 因異物入侵造成的侵蝕或刮痕需檢查

Lungmen / Inspection List during LP_MP_HP Outage

	檢查設備	檢查內容	執行週期			備　註
			LP	MP	HP	
19	4. Main transmitter Turbine inlet(1st) pressure MSV inlet steam pressure LTR steam pressure LP inlet steam pressure 2nd-MSR heat steam press .etc	①Zero point check under the condition of non-pressure在無壓力情況下零點檢查	-	-	○	※Gauge : Check item & period are decided based on a calibration period. (There is a possibility that it is necessary to carry out before HP outage if the period of validity is one year.) 錶:檢查項目以及週期將經由分類週期來決定.(假如其有效週期為一年,儘可於HP outage之前再檢查一次) Especially the instrument used with a performance test and a continuation load test 特別是用於永久測試以及
20	If necessary	①Turbine/Generator balance adjustment 主汽機/發電機平衡調整 ②On-Off valve/Motor valve/Control valve/Manual valve Maintenance開關閥/電動閥/控制閥/手動閥維護 ③Piping Support additional work管支撐架增加工作 ④Each bearing jacking oil pressure gauge removal and cap seal welding各軸承頂升油壓錶移除及管帽seal銲接 ⑤LP#6,8Brg gland pressure gauge removal and cap seal welding低壓汽機#6 & #8軸承格蘭壓力錶移除及管帽seal銲接 ⑥Each bearing box manometer removal 軸承箱壓力計移除 ⑦Logic change and down loading .....etc.邏輯變更以及下載...其它	-	-	○	Commissioning requirement (Not decided)

附件二規劃起動測試時程之建議

Lungmen Nuclear Power Plant / MHI Comments about Commissioning Schedule after Fuel Loading

	Comment	Reply		Comment	Reply
1	MHI intends to perform the "Gland steam consumption Test" during HU stage. Procedure is not still submitted to TPC, but MHI wants to discuss with TPC/GE at site. This test is recognized as pre-test of LOOP. Gland steam pressure remaining time under LOOP condition is measured. Trip Reactor (or Close MSIV fully) during HU, and remaining main steam continue to generate auxiliary steam by Gland steam Evaporator, gland steam pressure keeping time should be more than 40minutes that is the estimation time from turbine trip to 800rpm to condenser 7kPaA.		10	STP-77 "Steam/Power Conversion System Performance" should be performed after HP Outage (Temporary strainer removal). (1) When is the performance test of Reactor performed? Was the procedure already submitted by GE? (2) Pre-measurement is planed to do at LP/MP/HP stage, but TPC schedule shows 30%power at MP stage. It should be change to 50 or 75%Power. This issue is still discussing. (3) Is there no tests after HP-Outage?	
2	STP-61F "Turbine Generator Lube Oil Test" should be performed during HU stage. MHI wants to do this test before initial synchronization.		11	Contract between TPC and MHI does not mention about "Warranty Run", is there in contract of GE? Contract 3.16.4 "Issue of Acceptance Certificates" mentions that it should be issued with satisfaction of ①Pre-Ope ②Start-up ③Torsional Vibration ④Sound Level⑤Performance. Can MHI understand that "Acceptance Certificates" can be issued before completion of the Warranty Run?	
3	STP-61A "Main Turbine Steam Admission Test" includes Rotor Balance Adjustment. In case of balance performing, MHI requests maximum 3 times of turbine start and stop.		12	Outage of HU/LP/MP is planed about 14days, can we do hotwell blow, inspection and cleaning during this period? MHI recommends to perform them. Is this period including Clean-up of condenser and feedwater line?	
4	STP-61B "Turbine No Load and Overspeed Trip Test" includes 2 times M-OST test which is required at least 8 hours operation with more than 10% power. If the result is not satisfied with criteria, once Turbine stop and Notch adjustment is required. Notes : If the duration of turbine stop is less than 12 hours, 8 hours re-heating is not required.		13	HP-Outage is planed about 40days. (1) How many days after turbine stop can we usually start to work at BWR plant? (2) Do you plan to inspect TBV? (3) If you perform it, MHI worries 40 days are not enough.	
5	STP-61C "Load Operation Test" is performed at 10,25,50,75,100% power. Please add in LP stage 10% power in TPC schedule. Also, about the timing of 75% power stage, please change to immediate after the attainment of 75% power.		14	In GE procedure, STP-20 "Guarantee Plant Performance Warranty Run" is performed for 100hours with 100% power. On the other hand, TPC schedule says Warranty Run is planed for 20days. Is this decided from Taiwan local regulation?	
6	STP-61D "Steam inlet valves stem free test" and STP-23 "Turbine Valve Performance" are performed at the same time. STP-61D says this test is performed at 30,50,75,95% power. But TPC schedule shows 65%,75% and Max power. MHI wants to request to add 30% power for confirmation.		15	In TPC schedule, STP-24 "MSIV Performance" is planed at the same timing of STP-23 "Turbine Valve Performance" at HP stage, is it right? Can we close MSIV at this period?	
7	STP-31 "Turbine Trip and Load Rejection" and STP-61G "Load Rejection Test Procedure(MP/HP)" are performed at the same time. STP-61G says Load rejected by 52G open, but STP-31 says by Main Switchyard Breaker open which means house load operation. Also STP-31 says Trip test is performed by Turbine trip button in MCR after Load Rejection Test(LRT). (1) Dose STP-31-01(Turbine Trip <40% PWR) mean Turbine trip without LRT? (2) Which is performed first STP-31-02(Turbine Trip Hi Flow @MP) or STP-31-03(Load Rejection)? (3) Also STP-31-1,2 at HP stage, which first Trip or LRT? (4) STP-31-3(Fast Load Winddown) is a runback test? from 100% to 5% power in 40sec? (5) STP-31-3 is performed after STP-31-2, re-synchro, load-up? (6) What is the trigger of Fast Load Winddown? "Loss of Stator Cooling Runback" is not included in MHI logic. Is it included in Fast Load Winddown signal?		16	About STP-26 "Loss of Feedwater Heating(80-90%Load)", let MHI know the concrete isolation line. (1) One out of three LP heater isolation ? (2) One out of two HP heater isolation? Or HP heater bypass line open? (3) It may be performed at less than 90% power, so runback function must not be worked. Is it correct?	
8	STP-62 is planed to perform at HU/LP/MP/HP stage, please suit the timing of it to STP-13. For confirmation, let MHI know about the RFP operation plan. MHI understands as follows ; (1) Vacuum-up with CP/CBP, then Clean-up with RFP-bypass and HP heater bypass, then start MD-RFP and feed water to Reactor. Heat-up the Reactor-temp by using TBV after Critical with MD-RFP. After main steam establishment, start one TD-RFP and stop MD-RFP. About 30%power 2nd TD-RFP in-service. At this time MSR is still under Temp-control condition, so MFPT is driven by main steam.		17	STP-27 "Feedwater Pump Trip" is (1) one out of three TD-RFP Trip ? Or two out of two TD-RFP Trip? (2) How much % power is the Runback target power ?	
9	STP-60 "MSR Performance Test" is performed at 30,75,100% power. TPC schedule shows 50,100% power. Please change.		18	STP-29 "Shutdown From Outside the Main Control Room(10-25%Load)" is (1) from how much % power is Reactor stopped? (2) Can MHI understand that this test causes Turbine and Generator Trip from load operation condition?	

附件三 本公司針對 MHI 進行扭轉振動測試審查意見.PDF

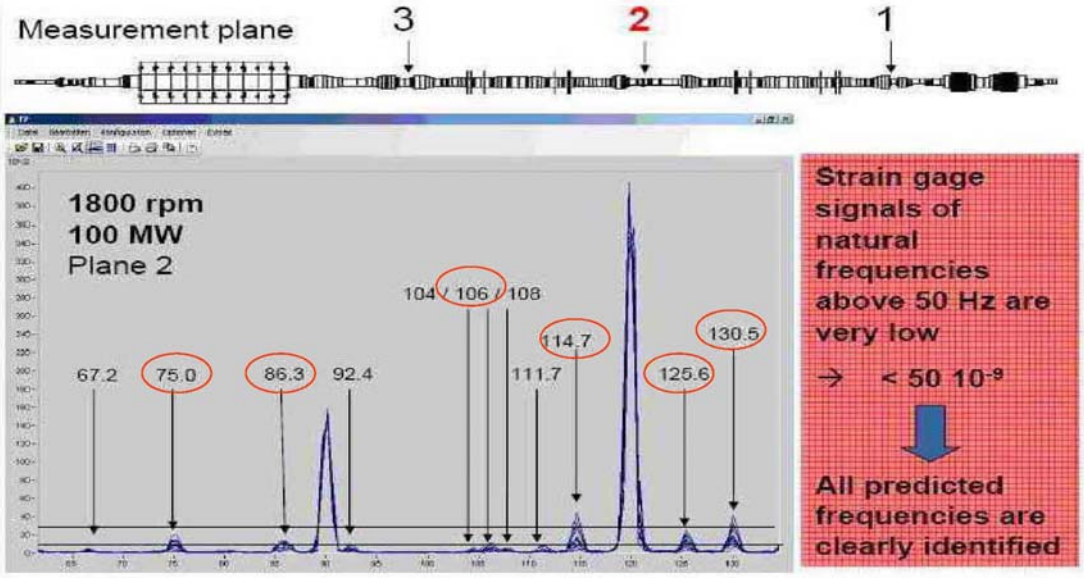
發文MHI

- Additionally, **we expect the strain level on the shaft surface to be at the same level of 0.002 micro M/M as those actually measured at KuoSheng (see the reference 2).** Please clarify if MHI's electromagnetic system can measure a dynamic torsion of this low level, while no artificially applied torque is imposed. If the torsion measurement system can not measure a strain equal or slightly lower than its threshold strain value, then the torsional natural frequencies can not be identified.

- With regard to your technical proposal on the Lungmen field test for checking the torsional natural frequencies, we understand MHI's current method of measurement uses electromagnetic probes (or called torsion meters). Since TPC top management have a serious concern about the adequacy of employing such a method for Lungmen's torsion test, **MHI is hereby requested to provide us with the reports of your past measurement records used both with strain gages and with electromagnetic probes for our review.**
- Please note we have had two successful torsional measurements in 1999 and 2006 for our ChinShan and KuoSheng retrofit projects, which utilized the strain gage measuring systems with a tele-communication technique for transmitting signals from a rotating shaft. Both cases were performed under normal operating condition, i.e. without a requirement of imposing external torque such as short-circuiting the exciter. The system with semi-conductor level strain gages by its own nature can provide very high sensitivity for measuring dynamic strains. We suspect your proposed measurement method can provide the same level of sensitivity and can identify the torsional natural frequencies without an artificially applied torque.

●

解析度之影響



67.2/75.0/86.3/92.4/104/106/108/111.7/114.7/125.6/130.5/...HZ

FIG 1：

threshold value 為 0.03 μ m/m，在 65~135HZ 之間只能看到 114.7 及 130.5 HZ 兩個自然頻率，但若改以 0.01 μ m/m(=10^-8)為 threshold value，則可看到 75.0/86.3/106/114.7/125.6/130.5/...HZ，threshold value 至少至 0.002 μ m/m(=2X10^-9)。

附件飼 MHI 圖法提供扭轉振動計數佐證資料

MITSUBISHI HEAVY INDUSTRIES, LTD.
TAKASAGO MACHINERY WORKS
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HYOGO PREF., JAPAN
Phone : 81-794-45-5339
Facsimile : 81-794-45-6937

	Action Item	Answer
1	MHI will submit the measurement result of torsional test which was used both Magnetic Probe and Telemetry.	As a result of search, it found the measurement data is not stored. The measurement in question was carried out more than 30 years ago. By the successful measurement result, we confirmed reliability of the measurement with electromagnetic probe, we are using the measurement method as our standard since then.
2	MHI will submit the past field measurement result in order to show that the electromagnetic probe method can detect all torsional natural frequencies.	Figure.1 shows the result of the field torsional test measured with electromagnetic probe at one 1200MW class nuclear power plant. The measurement was carried out during no load to rated load in 1986. The measured frequencies have some variation because each frequency was measured at each load and have measuring variation. The measured natural frequencies agree well with calculation, and all natural frequencies are detected by the measurement.

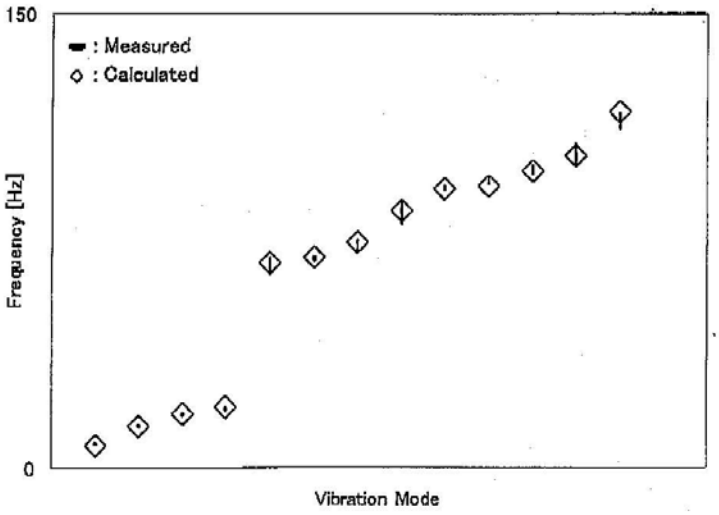


Figure.1 Measurement result of torsional vibration test with Magnetic Probe

附件五 綜研所協助進行扭轉振動模態分析.

大型汽輪發電機轉軸
側向及扭轉共振頻率分析研究

完成報告

研究方式　：自行研究
執行期間　：96 年 1 月 1 日至 98 年 12 月 31 日
計畫主持人　：陳瑞麒
研究人員　：鍾秋峰、唐文元

執行單位　：綜合研究所

四、結論與建議

1、本計畫建立了核四廠#1 機高壓汽機、低壓汽機、發電機連勵磁機各軸段轉子的分析模型及汽機發電機轉子串列的分析模型。

2、本計畫完成了核四廠#1 機高壓汽機、低壓汽機、發電機連勵磁機各軸段轉子的模態分析及汽機發電機轉子串列的模態分析。

3、轉軸的模態可分類成側向振動模態、扭轉振動模態和軸向振動模態三大類，每一類的模態又可分成 0、1、2...節點的模態。

4、0 和 1 節線的葉片模態有可能與轉軸的模態產生耦合現象，此一現象在進行轉軸的模態分析時必須加以注意。

5、根據汽機發電機轉子串列的臨界轉速分析，在所假設的軸承勁度下，汽機發電機轉子串列的側向振動自然頻率確實避開了 30 Hz 的運轉頻率，但由於軸承勁度的不確定性，確切的臨界轉速尚須待將來機組實際運轉時的實測值為準。

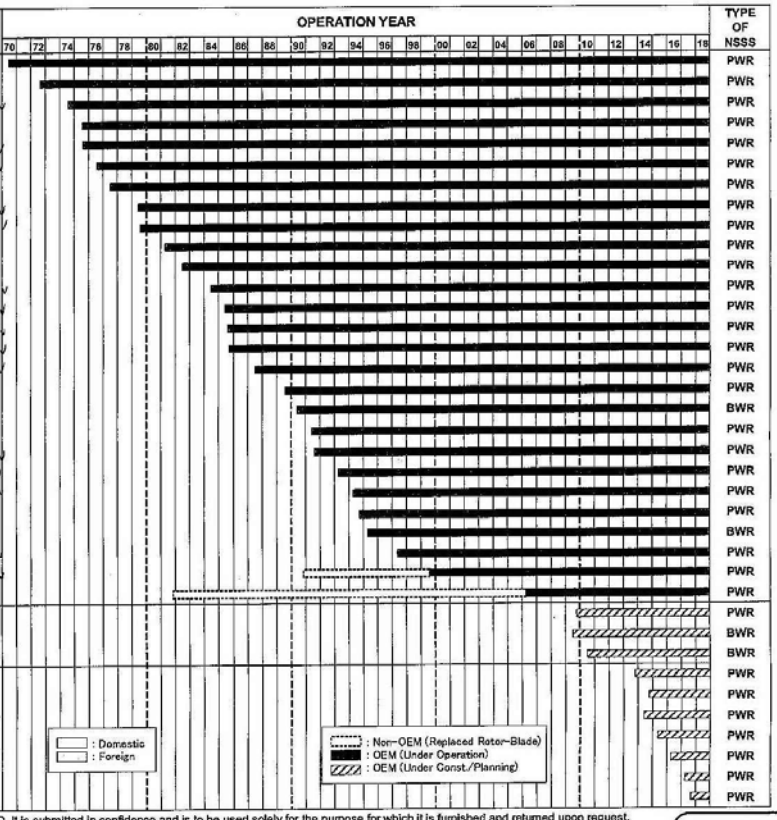
6、在汽機發電機轉子串列的扭轉振動模態分析中，結果顯示扭轉振動自然頻率確實避開了 57 Hz ~ 63 Hz 以及 114 Hz ~ 126 Hz 兩頻率範圍。

附件六 T6C 葉片實績

Experiences of Mitsubishi Nuclear Turbines

MITSUBISHI HEAVY INDUSTRIES, LTD.

Status	NAME OF UNIT	RATED OUTPUT (MWe)	TURBINE TYPE	TYPE OF NSSS
In Commercial Operation	MIHAMA #1	340	TC2F	PWR
	MIHAMA #2	500	TC4F	PWR
	TAKAHAMA #1	826	TC6F	PWR
	GENKAI #1	559	TC4F	PWR
	TAKAHAMA #2	826	TC6F	PWR
	MIHAMA #3	826	TC6F	PWR
	IKATA #1	566	TC4F	PWR
	OHI #1	1,175	TC6F	PWR
	OHI #2	1,175	TC6F	PWR
	GENKAI #2	559	TC4F	PWR
	IKATA #2	566	TC4F	PWR
	SENDAI #1	890	TC6F	PWR
	TAKAHAMA #3	870	TC6F	PWR
	TAKAHAMA #4	870	TC6F	PWR
	SENDAI #2	890	TC6F	PWR
	TSURUGA #2	1,160	TC6F	PWR
	TOMARI #1	579	TC4F	PWR
	LAGUNA VERDE #1	675	TC4F	BWR
	TOMARI #2	579	TC4F	PWR
	OHI #3	1,180	TC6F	PWR
	OHI #4	1,180	TC6F	PWR
	GENKAI #3	1,180	TC6F	PWR
	IKATA #3	890	TC4F	PWR
	LAGUNA VERDE #2	675	TC4F	BWR
	GENKAI #4	1,180	TC6F	PWR
	VANDELLOS II	1,004	TC6F	PWR
	KRSKO	704	TC4F	PWR
Under Construction	TOMARI #3	912	TC4F	PWR
	LUNGMEN #1	1,371	TC6F	BWR
	LUNGMEN #2	1,371	TC6F	BWR
Planning Stage	SANMEN #1	1,251	TC6F	PWR
	SANMEN #2	1,251	TC6F	PWR
	HAIYANG #1	1,253	TC6F	PWR
	HAIYANG #2	1,253	TC6F	PWR
	TSURUGA #3	1,538	TC6F	PWR
	TSURUGA #4	1,538	TC6F	PWR
	US-APWR	1,700 class	TC6F	PWR

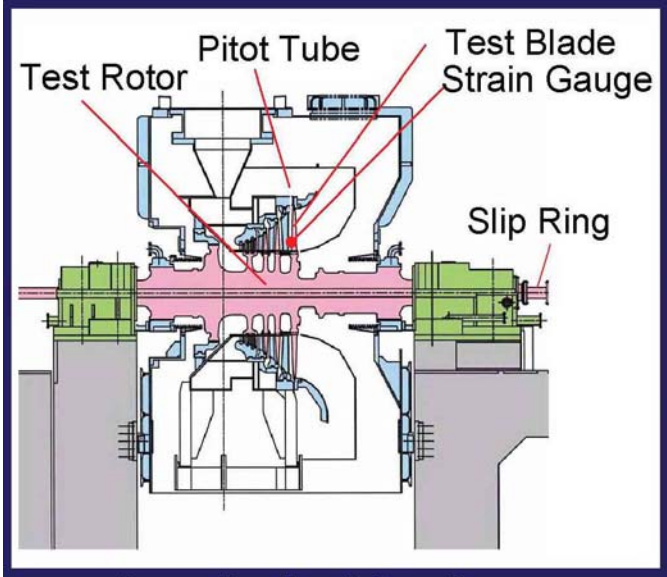


MITSUBISHI HEAVY INDUSTRIES, LTD.
Takasago Machinery Works

附件七 MHI 汽機技術.PDF

LP Turbine Test Rotor

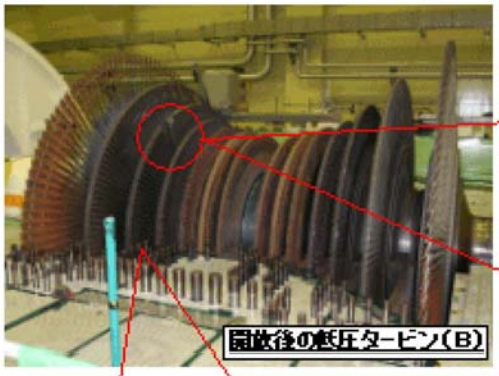
Manufacture New LP Turbine Complete Model (Larger than 50% Scale)
Install in Test Facility with Special Measurement Instrumentation



Longitudinal Section of Test Turbine

54IN Test Rotor

外側算第3段的葉輪片的葉根1支由汽機軸脫落，確認掉落在汽機下部



低圧タービン（B）下部に落下していることが確認された羽根

確認葉片掉落在汽機(B)下部。

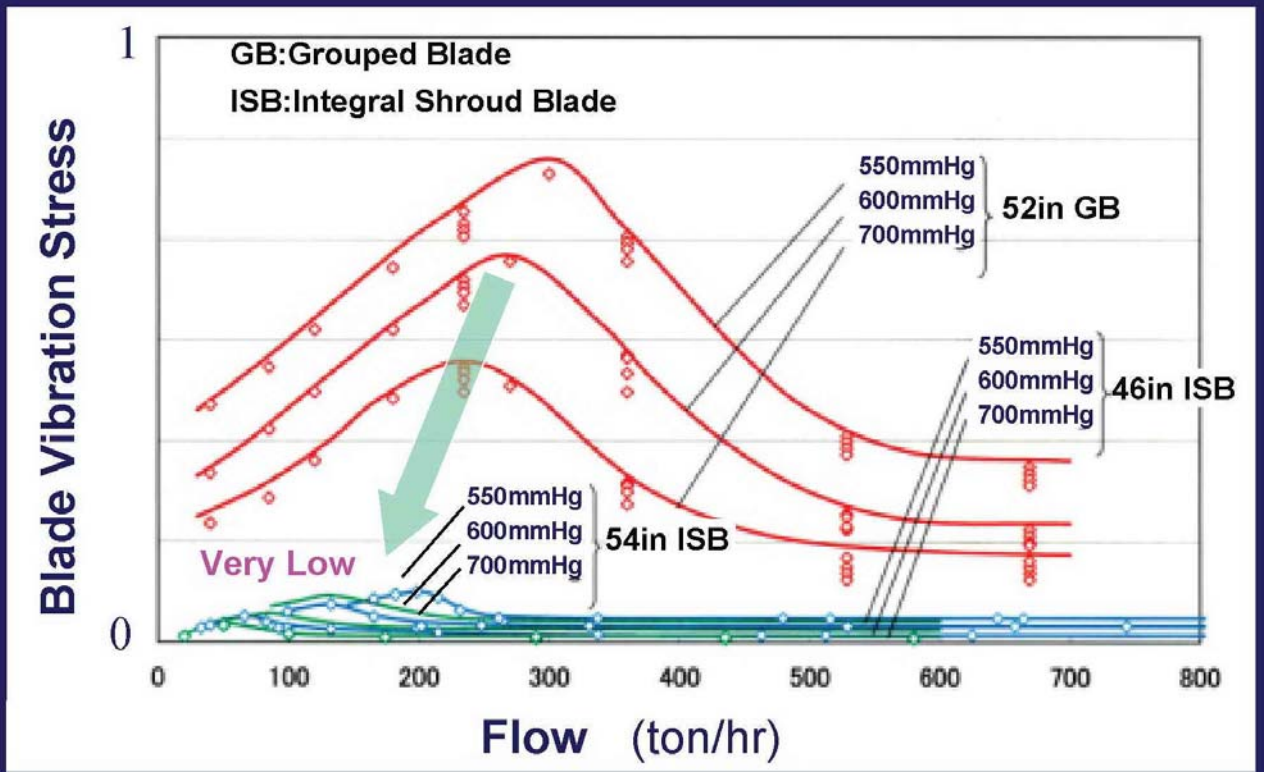
損 傷 箇 所

・外側から３段目にある羽根車の羽根１本がタービン軸から脱落し、タービン下部に落下していることを確認した。
・その周囲の羽根や部材の一部にも、擦り傷やへこみがあることを確認した。

【３段目の羽根の仕様】
長さ：約５３ｃｍ　幅：約１２ｃｍ　厚さ：約３ｃｍ
材質：クロム鋼
重さ：約９ｋｇ／本
全本数：１４０本

其周圍的葉片根部及部份材料有擦傷及凹下現象。

Blade Vibration Stress Results by Steam Loading Tests



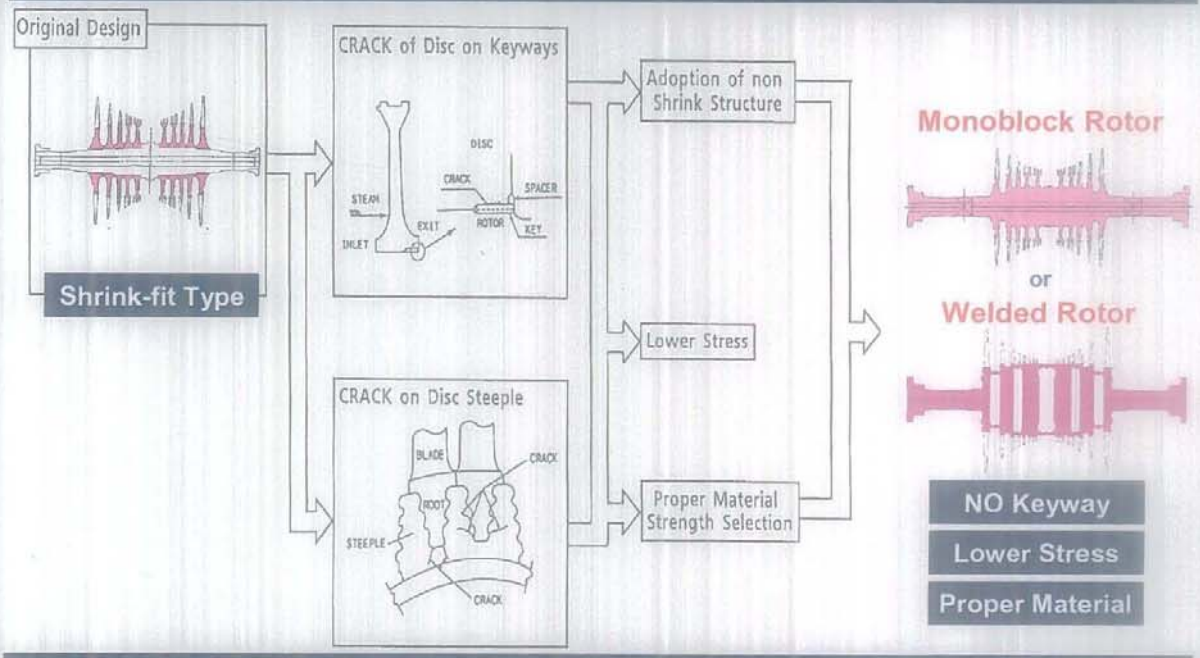
New Technology Verification at In-house Power Plant Steam Turbine

Special Measurement for New Technology in Actual Plant Operation

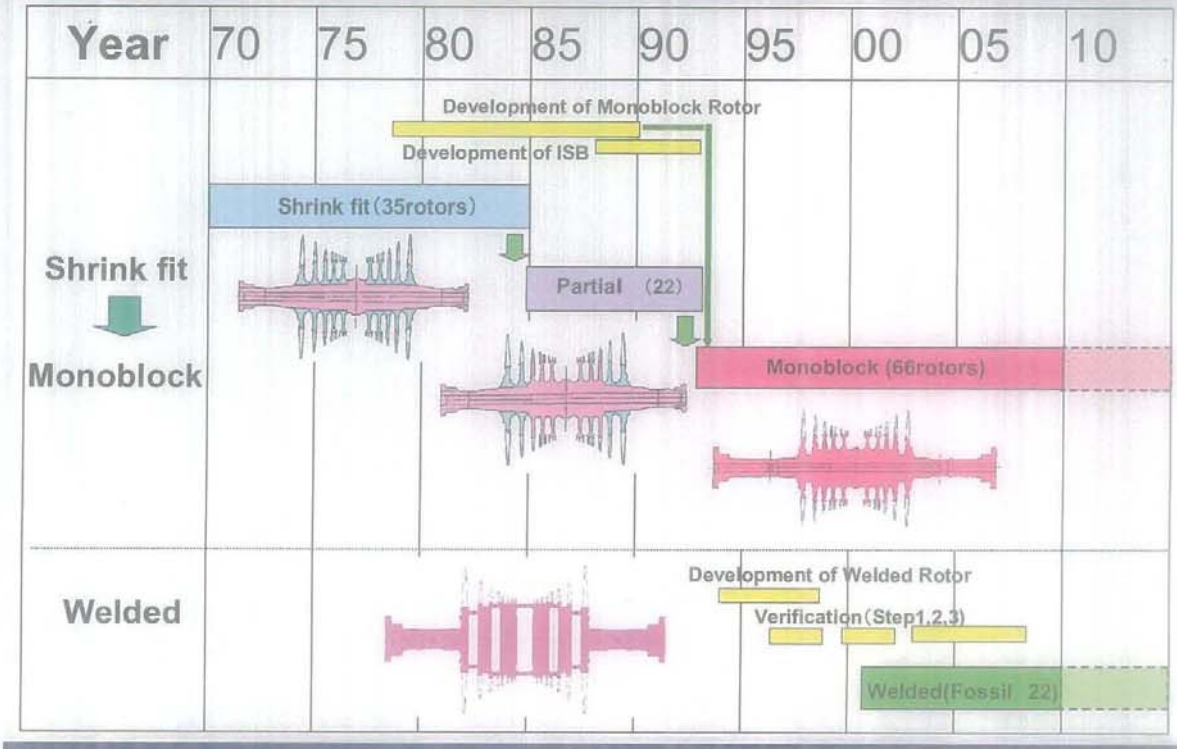
Special Measurement
(LOWER CASING & ROTOR INSTALLATION)

Special Measurement
(UPPER CASING INSTALLATION)

LP Turbine Rotor Improvement against Stress Corrosion Cracking



History of Mitsubishi LP Rotor



附件八 循環海水泵腐蝕.PDF

		DATE	2010.12.03. P. 1
FOR	TAIWAN POWER COMPANY	DOC.No.	5233-J10T151
TITLE	FOR CWP CORROSION		TOTAL 5 SHEETS
		PURPOSE	Reference
PROJECT	LUNGMEN PROJECT FOURTH NUCLEAR POWER PLANT UNIT 1 & 2	SERVICE	CIRCULATING WATER PUMP
CONTRACT No.	8749011M00900	EBARA SER.No	R010014101, R010014102
ITEM No.	1P28-P-5001A～F (UNIT 1) 2P28-P-5001A～F (UNIT 2)	MODEL / EQUIP.	2700VZNM SET 12

有關 貴公司(TPC 龍門核電廠)的既有設備 UNIT 1 汽機所使用的循環水泵(CWP)之 B 泵[1P28-P-5001B]發生腐蝕現象,針對此現象本公司的見解報告如下。

1. 腐蝕狀況

根據 貴公司所提供的照片來判斷,腐蝕的部位呈現下記現象。

(1) Impeller Casing 的內面和 Impeller 之間的摺觸面有摺動痕跡,故表面可看到呈現金屬光澤,但和 Impeller 無摺動的地方,其表面呈現污髒的茶褐色。

(2) Impeller 之翼表面及翼之前端部也無流水痕跡現象且無金屬光澤,並有污髒的茶褐色和海洋生物(例:貝類等)附著的痕跡等現象。

(3) 觀察各腐蝕部之內部都有凹凸劇烈的鋸齒現象。

2. **腐蝕**原因

根據 貴公司所提供的照片判斷,此次所發生的腐蝕現象應是孔蝕所造成的。

本 CWP 於 2008 年 5 月左右裝機,試運轉於 2010 年 9 月左右實施。所以試運轉前約 1 至 2 年泵(Pump)是浸泡於海水中,且處於長時間停機的狀態。

所以,長時間停機的期間海洋生物附著後,海水轉變成 Stagnant,海洋生物因海水含氧不足後死亡・脫落而導致孔蝕的現象。

也就是說,由發生孔蝕的地方為基點慢慢地擴大至內部腐蝕,而最後導致部份腐蝕部位脫落。

配布 TO	数 SET	指示 ACT

A・・ ACTION NECESSARY
B・・ CONTENTS ESSENTIAL
C・・ INFORMATION ONLY

ISSUED BY	APPROVED BY	CHECKED BY
EBARA Corporation Futtsu Plant	Ikeda	Yamamoto (重)

EBARA

EBARA CORPORATION

PM20U

P. 2

3. 對策

(1) 根據 貴公司的照片判斷,其腐蝕範圍和深度皆屬輕微,泵的機能並無影響,故只需清除孔蝕部後可正常操作使用。

(2) 敝公司提供給 貴公司的Installation, Operation and Maintenance Manual (Doc. No. R0100141-1170-0133) 資料中的P.24有記載,如何對應泵需長時間停機時的對策,並請遵照資料中的方式維護及操作。如此的話可將泵因海水的腐蝕減至最低。

P.24

5.2.3 Maintenance During Prolonged Stoppage

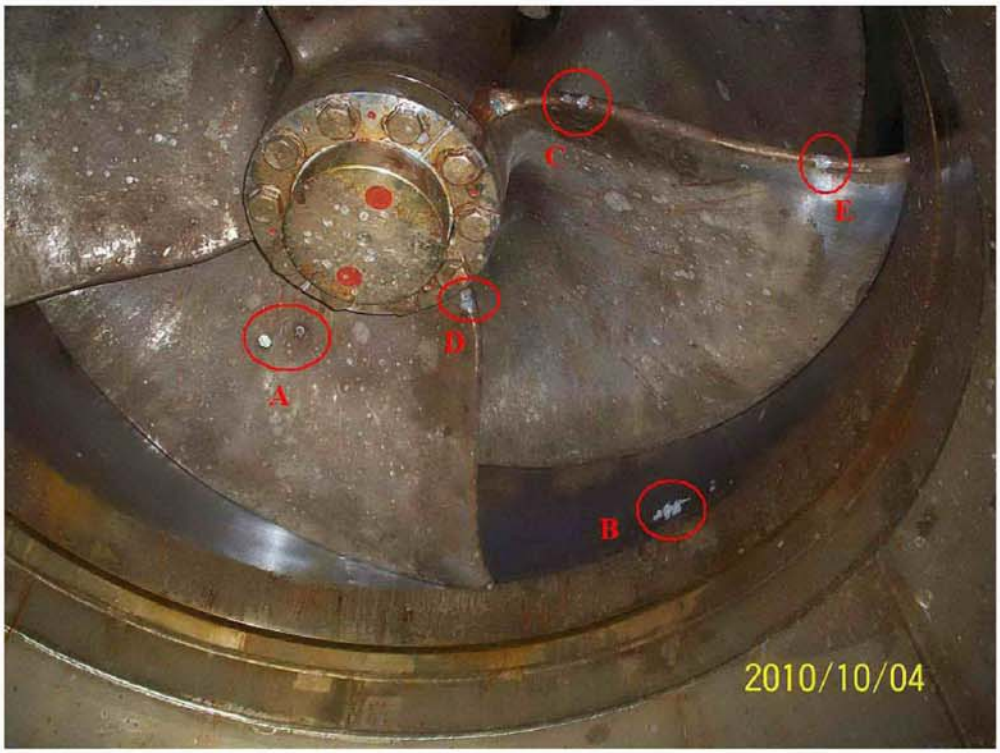
The pump should be maintained so that it may be operated at any time. If possible operate the pump once a month.

(1) Remove the gland packing and install packing impregnated with grease.

(2) Turn the coupling by hand about once a month.

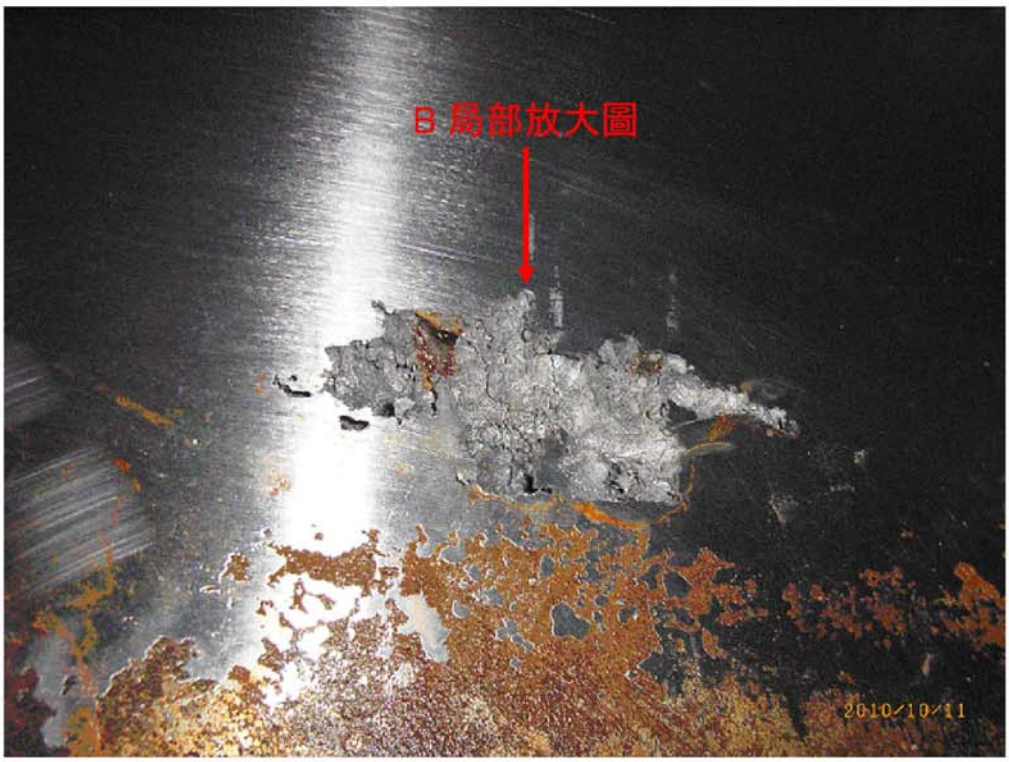
(3) Insulation of the motor will deteriorate when there is high humidity. Take care to keep the motor dry.

(4) Pumps handling sea water or brackish water must be idled for long periods. In such cases operate the pump once every week or two to protect the casing from corrosion caused by stagnant sea water.

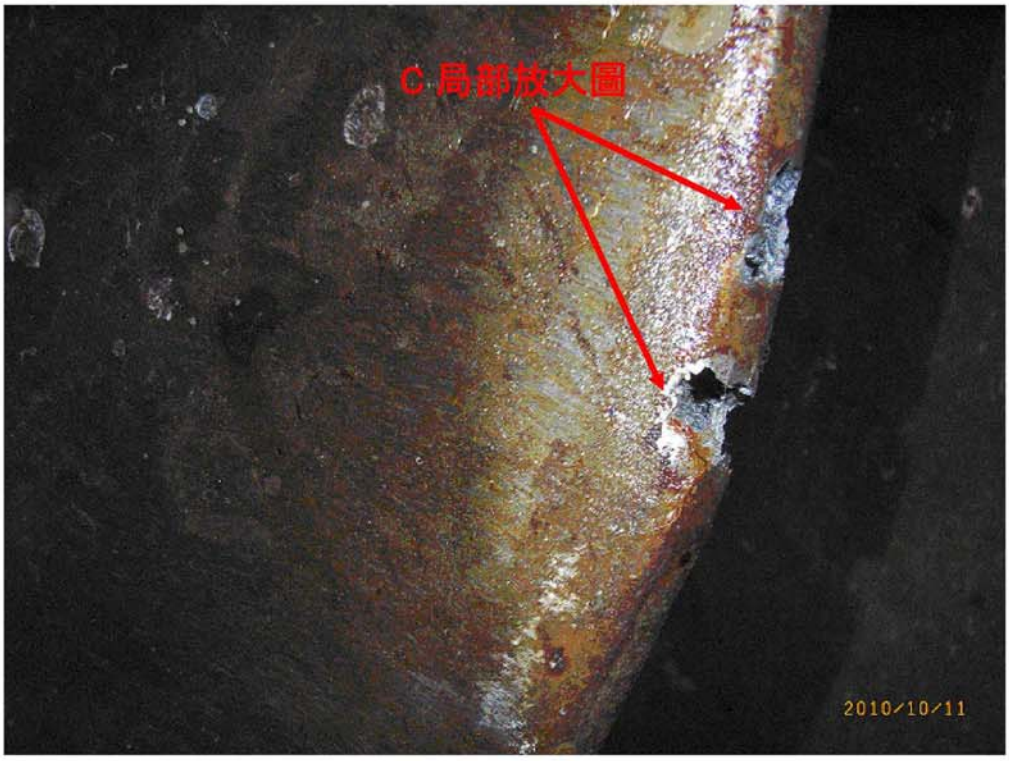


Photo①

Photo②



Photo③



Photo④

7. Assembly

Assemble in the reverse order of disassembly while ensuring the match marks are aligned. In addition, the following instructions must be observed.

(1) When replacing parts, check thoroughly before assembling.

(2) When reassembling each part, remove foreign matter in the tapped holes with compressed air and check for defects or dirt on the flange surfaces and mating surfaces.

(3) Before re-assembly, remove anti-rust agent, check for corrosion and damage.

(4) Generally, replace consumables (such as O rings, rubber rings, gland packing, washers, etc.) with new parts.

(5) The spacer nut is the only one with left hand threads. All other threads are right hand.

(6) The fitted and threaded sections of the bearing casing, shaft and retaining bolts, etc. are to be cleaned thoroughly and a coating of lubricating oil (Never Seez or equivalent) applied to prevent seizing.

⚠***CAUTION*** *: BE CAREFUL NOT TO DAMAGE THE SUBMERGED BEARING ON CORNERS OR THREADED PORTION OF SHAFT.*

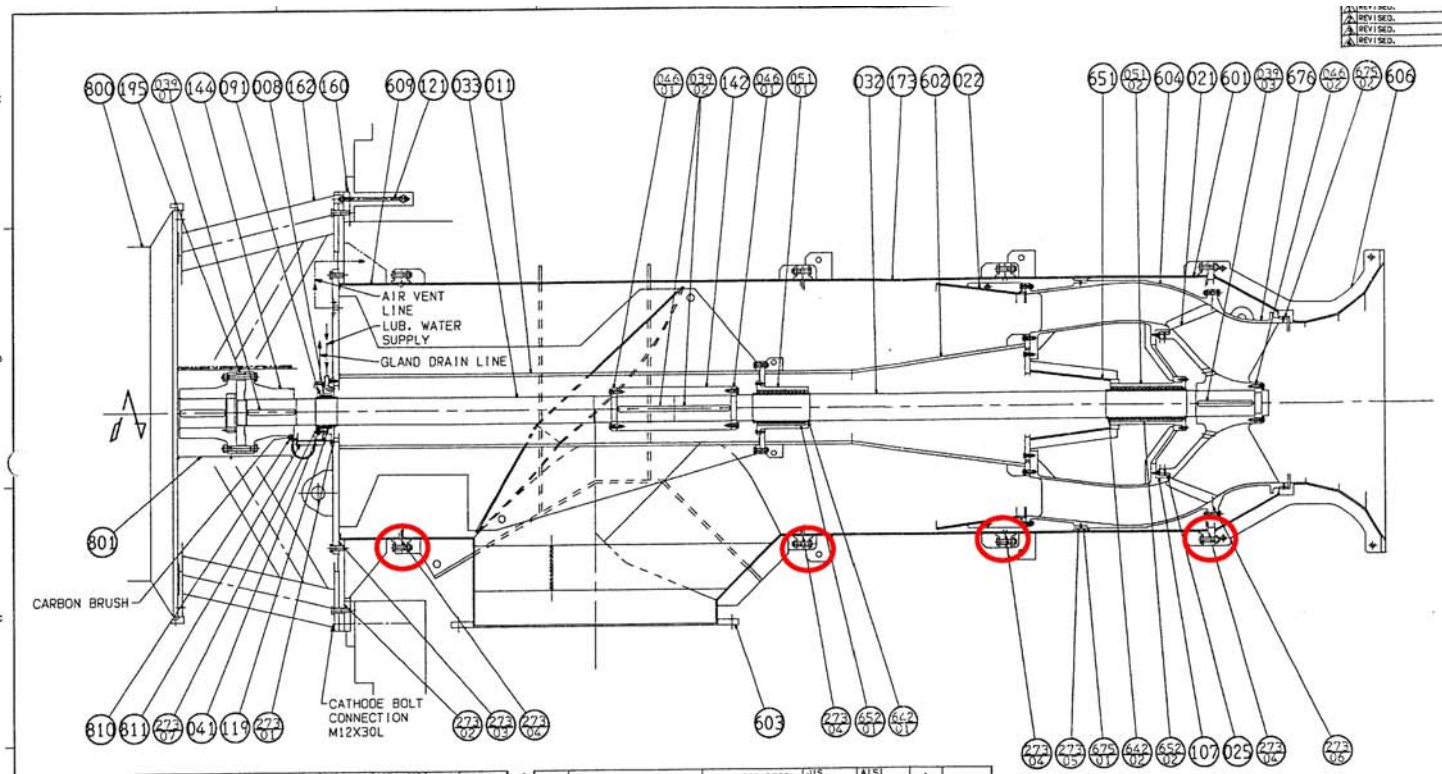
(7) Use impeller nut lock washer and coupling bolt lock washers. Bend the washers into the notch in the nut to prevent turning. Washers shall also be used on lower bearing housing.

(8) Check the match marks on the casing mating surfaces and the shaft and coupling.

(9) Be sure to install the rubber rings and filler (Santac Sealer) which is used to prevent crevice corrosion by brine or sea water, for the casing joint surfaces. Apply the adhesive filler on the female flange side, and then, extrude it by tightening the bolts. Install O rings for the stuffing box in their proper places.

⚠***CAUTION*** *: CARE SHOULD BE TAKEN NOT TO DAMAGE O RINGS OR RUBBER RINGS WHEN INSTALLING.*

(10) Apply a sufficient amount of Screw-lock (Three-bond 1401B or equivalent) to the bolts fastening the submerged bearing housing cover. Apply liquid gasket (Three-bond 1102 or equivalent) for the joint surfaces of the casing, bearing housing, washer, nut and bolts. Also, apply liquid gasket (Three-bond 1102 or equivalent) to the joint surfaces of the socket type coupling and split ring as shown in



NO.	NAME OF PART	MATERIAL NAME	APPLICABLE CODE	REFERENCE CODE	QUANT. FOR 1 SET	REMARKS
195	ADJUSTING NUT	ROLLED STEEL	JIS SS400	ASTM A283 GR.D	1	
⚠ 173	OUTER COLUMN PIPE	STAINLESS STEEL	JIS SUS316L/ SUS316L	AISI 316L	1	
⚠ 162	DRIVER PEDESTAL	STAINLESS STEEL	JIS SUS316L	AISI 316L	1SET	SPLIT TYPE
160	BASE	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
144	RIGID COUPLING	FORGED STEEL	JIS SF440A	ASTM A668 Cl.D	1SET	
142	SOCKET TYPE COUPLING	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
⚠⚠ 121	FOUNDATION BOLT	STAINLESS STEEL	JIS SUS316L	AISI 316L	1SET	SUPPLIED BY OTHERS
119	GLAND PACKING	CARBONIZED FIBER WITH TEFLON	-	-	4 ▲	
107	CASING RING	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
091	GLAND	STAINLESS STEEL CASTING	JIS SCS16A	ASTM A743 CF3M	1SET	SPLIT TYPE
⚠ 051-02	BEARING HOUSING(2)	STAINLESS STEEL CASTING	JIS SCS16A	ASTM A743 CF3M	1	
⚠ 051-01	BEARING HOUSING(1)	STAINLESS STEEL CASTING	JIS SCS16A	ASTM A743 CF3M	1	
046-02	SPLIT RING(2)	STAINLESS STEEL	JIS SUS316L	AISI 316L	1SET	SPLIT TYPE
046-01	SPLIT RING(1)	STAINLESS STEEL	JIS SUS316L	AISI 316L	2SETS	SPLIT TYPE
⚠ 041	PACKING SLEEVE	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	WITH HARD FACING
039-03	KEY(3)	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
039-02	KEY(2)	STAINLESS STEEL	JIS SUS316L	AISI 316L	2	
039-01	KEY(1)	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
⚠ 033	UPPER SHAFT	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
⚠ 032	LOWER SHAFT	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
025	IMPELLER RING	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
022	DIFFUSER	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
021	IMPELLER	STAINLESS STEEL CASTING	JIS SCS16A	ASTM A743 CF3M	1	
⚠ 011	CASING COVER	STAINLESS STEEL	JIS SUS316L/ SUS316L	AISI 316L	1	
008	STUFFING BOX	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	

NO.	NAME OF PART	MATERIAL NAME	APPLICABLE CODE	REFERENCE CODE	QUANT. FOR 1 SET	REMARKS
⚠ 811	BRUSH STAND (2)	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
⚠ 810	BRUSH STAND (1)	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
⚠ 801	COUPLING GUARD	STAINLESS STEEL	JIS SUS316L	AISI 316L	1SET	SPLIT TYPE
800	MOTOR	-	-	-	1	
676	IMPELLER CASING	STAINLESS STEEL CASTING	JIS SCS16A	ASTM A743 CF3M	1	
675-02	INNER CASING LINER(2)	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
675-01	INNER CASING LINER(1)	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
⚠ 652-02	SUBMERGED BEARING (2)	RUBBER/STAINLESS STEEL CASTING	-/JIS SCS16A	-/ASTM A743 CF3M	1	
⚠ 652-01	SUBMERGED BEARING (1)	RUBBER/STAINLESS STEEL CASTING	-/JIS SCS16A	-/ASTM A743 CF3M	1	
651	BEARING SUPPORT	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	
⚠ 642-02	BEARING SLEEVE(2)	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	WITH HARD FACING
⚠ 642-01	BEARING SLEEVE(1)	STAINLESS STEEL	JIS SUS316L	AISI 316L	1	WITH HARD FACING
⚠ 609	SUPPORT COLUMN	STAINLESS STEEL	JIS SCS316L/ SUS316L	AISI 316L	1	
⚠ 606	SUCTION BELL	STAINLESS STEEL	JIS SCS316L/ SUS316L	AISI 316L	1	
604	DISCHARGE BOWL	STAINLESS STEEL CASTING	JIS SCS16A	ASTM A743 CF3M	1	
⚠ 603	DISCHARGE CASING	STAINLESS STEEL	JIS SCS316L/ SUS316L	AISI 316L	1	
⚠ 602	INNER COLUMN PIPE	STAINLESS STEEL	JIS SCS316L/ SUS316L	AISI 316L	1	
⚠ 601	OUTER CASING	STAINLESS STEEL	JIS SCS316L/ SUS316L	AISI 316L	1	
⚠ 273-07	RUBBER RING(7)	RUBBER	NBR	-	1	
273-06	RUBBER RING(6)	RUBBER	NBR	-	1	
273-05	RUBBER RING(5)	RUBBER	NBR	-	1	
273-04	RUBBER RING(4)	RUBBER	NBR	-	6 ▲	
273-03	RUBBER RING(3)	RUBBER	NBR	-	1	
273-02	RUBBER RING(2)	RUBBER	NBR	-	1	
273-01	RUBBER RING(1)	RUBBER	NBR	-	1	

NO	DATE	DESCRIPTION	REV.	APP.
4	Feb.7 2003	RIVEISED AS PER UPDATING	S.Y.	K.K.
3	Aug.9 2002	RIVEISED AS PEIZ SWT-EC-MS009-000058	S.Y.	K.K.
2	Jun.28 2002	ADDED COUPLING GUARD AND CHANGED MATERIAL OF FOUNDATION BOLT	S.Y.	K.K.
1	Feb.28 2002	REVISED DWG.TITLE	Y.T.	K.K.

REVIEW LEVEL: N P54

TAIPOWER DRAWING REFERENCE NUMBER:

附註 NOTE(S)

台灣電力公司

TAIWAN POWER COMPANY
LUNGMEN PROJECT FOURTH NUCLEAR POWER PLANT UNIT 1 & 2

CONTRACT No. 8749011M00900
CIRCULATING WATER PUMP
SECTIONAL DRAWING

台電職章 TAIPOWER SIG.

PROJECT DRAWING NO. 00141.MS009.0 5-12002
SHEET NO. CAD FILE NAME
SCALE PLOT DATE

THIS DOCUMENT CONTAINS SAFETY RELATED ITEMS ☐ YES ☒ NO

THIS DOCUMENT CONTAINS SEISMIC I(I) ITEMS ☐ YES ☒ NO

營章 SIG.

核准 APP. DEG	日期 DATE
校核 CHK. RJB	審定 REC. MJL/CSY/NG/GRT
繪圖 DWN.	設計 DGN.
工程圖號 DWG. NO.	
張號 SHT. NO.	分類圖號 CLASSIFICATION

EBARA SER.NO. R0100141 | MODEL 2700VZNN | TYPE NO. 1P28-P-5001A-F (UNIT 1)
CAPACITY(CMM) 15.5, 18.3 | HEAD(M) 254 ~ 3700 | SPEED(RPM) 514 | SET 6
SERVICE CIRCULATING WATER PUMP
DRAWN BY K.KASAISHI | CHECKED BY Y. TAKANO | DESIGNED BY | ENGINEERED BY O. HATABAYASHI
TITLE SECTIONAL DRAWING
EBARA CORPORATION
DWG. NO. PR0100141101/911 | REV. 4

MODEL	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL