出國報告(出國類別：其他　)

#12 鍋爐、發電機汰舊換新計畫方法流程及設計規範研討與查核

服務機關：中油公司石化事業部
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壹、 緣起

石化事業部林園石化廠#12 高壓鍋爐與發電機組於民國 68 年啟用至今已逾 26 年, 近年來因效率顯著降低、操作及維修費用大幅增加，為提升該廠蒸汽及電力等公用系統之供應能力與可靠度，確保煉製工場維持正常生產，減少停爐損失，降低跳電風險，提昇經濟效益並改善環境品質，自 93 年起分四年編列新台幣 13.7 億元預算辦理汰舊換新計畫。本計畫主要內容包括：新建 300t/Hr 鍋爐一套、30MW 汽渦輪發電機組一套、脫硫設備、脫硝設備及相關之土木、儀控、消防、管線、電氣等系統。主體包工程經公告招標由建成機械公司得標，契約金額為新台幣 12.74 億元，全案於 93 年 12 月 31 日動工，工期 1000 日曆天，預定完工日期為 96 年 9 月 26 日。

本工程為一包含工程設計(Engineering)、材料採購(Procurement)、裝建及性能測試(Construction & Commissioning)之 EPC 統包工程，主要設備如鍋爐、汽渦輪發電機組、脫硫、脫硝系統及空氣預熱器等重大設備皆由以建成公司為主承包商之技術合作廠家日本 Babcock Hitachi K.K.、Fuji Electric Systems Co., Ltd、Fujikasui Engineering Co., Ltd.、Alstom K.K.等公司負責設計、主要購件供料或製作，本(94)年度之工作重點在執行鍋爐、汽渦輪發電機組、脫硫、脫硝系統及空氣預熱器等主要設備之流程規劃與基本設計與材料訂購工作，本次出國主要任務乃在拜訪上述各項主要設備之設計或製作廠家與其技術人員進行期中工作檢討，針對相關之流程規範、基本設計、材料選用、製造及品管作業等相關議題進行研討，並實地查核其執行情況，俾確保該等設備之性能、品質能符合合約規範之要求，如期交貨，使本工程能按預定計畫期限順利完工。

貳、目的

本次出國赴日本 Alstom K.K.、Fuji Electric Systems Co., Ltd、Babcock Hitachi K.K.、Fujikasui Engineering Co., Ltd.等公司進行工作研討與查核主要目的如下：

(一) 研討本計畫之鍋爐、汽渦輪發電機組、脫硫、脫硝系統及空氣預熱器等設備之流程及設計規範，確認其皆符合本案需求及合約規定。

(二) 實地查核相關工作之施作品質，確認符合規範要求，提升整體工程品質。

(三) 掌握各項主要設備之規劃、設計、採購及製造進度，確保整體工程能如期完工。

(四) 收集相關設備廠家之技術資料，為操作及維修預作準備。

(五) 學習相關之規劃及設計專業能力，增進本公司工程、技術相關人員之專業技能。

參、出國行程

91.10.13　啟程(高雄 – 大阪)

91.10.14　拜訪 Alstom K.K 公司，研討 Air-preheater (空氣預熱器)設計規範，並查核主要元件之製造與品質管理執行情況。

91.10.17~20　(大阪 – 東京)

拜訪 Fuji Electric Systems Co., Ltd 公司，研討汽輪發電機系統設計及材料規範，並查核其執行進度及品管作業。

拜訪 Babcock Hitachi K.K.公司，研討鍋爐及脫硝設備流程規劃、設計及材料選用規範。

拜訪 Fujikasui Engineering Co., Ltd.公司，研討脫硫系統流程規劃、設計及材料選用規範。

91.10.21　返程(東京 – 高雄)

肆、拜訪內容及洽談結果

一、 Alstom K.K 公司

Alstom 集團為世界著名的能源供應及鐵路運輸設備製造廠商，其機電系統及相關附屬設備在全球市場的佔有率超過 25%，其日本分公司 Alstom K.K.負責本案空氣預熱器(Air-preheater)之設計與主要構件之供應，在亞太區經理 Mr. Koichi Sakuma 引領下會見了總經理 Mr. Hiroki Hyoguchi 及部門經理 Mr. Ryuhel Sugita 聽取有關公司組織及業務情況的簡報，隨後並與其技術經理 Mr. Toshihiko Matsumoto 及 Mr. Yoshihiko Fujisaki 進行了有關空氣預熱器之設計規範、材料選用、製造品管及執行進度方面的研討，研討內容如下：

(一) 設備型式及材料規範

1. Type of Air-preheater：本案空氣預熱器乃選用 H-type(水平式)取代以往常用的 V-type(垂直式)，其主要特性是可減少重力之影響，運轉起來 H-type 較 V-type 更為平順，可增加操作之穩定性，減少故障頻率，也可大幅降低維修費用與停爐損失。(H-type 空氣預熱器外型圖詳**附件一**)

2. Type of Heat transfer Surface：本案 Hot end(熱端)及 Cold end(冷端)之 Heat transfer Surface 皆採用 Double Undulated Notched (DUN) type 之傳熱片(外型圖詳**附件二**)，其為 Double Undulated(DU) type 之改良型，母材為與 A588 同等級之 Carbon Steel，Hot end(熱端)傳熱片之長度為 1150mm，厚度為 0.6mm，Cold end(冷端)傳熱片長度為 1000mm，厚度為 1.0mm，相較於其他 Notched Flat(NF)、Flat Notched Cross(FNC)與 Corrugated Undulated(CU)等型式之 Heat transfer Surface，其有相對較佳之傳熱效果及較低之壓力損失，可提升空氣預熱器之熱回收效率；另，Cold end(冷端)之傳熱片乃依據合約規定採用 Porcelain Enameled Coating，其抗腐蝕性是一般 Corrosion-resistant Low Alloy Steel Heating Element 的 3 倍，可有效減緩冷端腐蝕現象發生。(性能比較表詳**附件二**)

3. Prevention of Clogging：空氣預熱器冷端的結垢及阻塞問題經常導致傳熱效率降低、壓降提高，本案在 Hot end(熱端)及 Cold end(冷端)兩部分皆裝設有 Retractable Power Soot Blower，可在設備操作中，利用過熱蒸汽來吹除附著在傳熱片上的飛灰，有效地提昇傳熱效率，減少壓降。

4. On-Stream Washing Device(OSW)：除了前述 Retractable Power Soot Blower 經常性的吹除外，本案空氣預熱器依據合約規定另行裝設有 On-Stream Washing Device(線上清洗系統)，其乃利用高壓水柱及化學藥劑來清除 Soot Blower 無法清除的傳熱片上的結垢，有了本套線上清洗系統，除了可提昇傳熱效率、減少壓降之外，其不需停爐即可進行線上清洗之特性，亦可增加工場操作之穩定性，大幅減少非計畫性停爐的次數。(On-Stream Washing Device 外型圖詳**附件三**)

(二) 品管與檢查計畫

本案空氣預熱器其品管及檢查作業分為設計及實體兩大部分，設計部分之圖件，主承包商建成公司皆有配合工程進度將日本 Alstom K.K.公司完成設計之圖件陸續送審，並據以執行製造工作；實體部分則包含傳熱構件之 30° compartment inspection、現場安裝之 Connecting duct and center section 檢查及傳動系統運轉測試等三大項，各項檢查及測試工作將配合後續之製造及現場安裝進度逐一進行，各部分之主要檢查項目詳如**附件四**。

(三) 執行進度：

本案空氣預熱器製作流程分為設計、採購、製造與安裝等四個階段，設計部分包括 Engineering 圖件、Shop 圖件之繪製及認可，採購部分包括熱傳構件、設備框架、傳動系統等材料之採購，製造部分包括熱端製作、冷端製作、鋼架結構製作、清洗設施及傳動系統之製作等，安裝部分包括空氣預熱器本體組裝、清洗設施組裝、傳動系統組裝及相關運轉測試等工作；整套設備於 94 年 6 月 6 日下訂單，開始進行設計及採購作業，預定於 95 年 6 月 6 日完成製造工作後，將各項構件及設備運抵工地進行現場組裝；目前設計工作及製造圖繪製工作進度已接近 100%，購料工作陸續進行中，製造工作亦將依序展開，皆能符合預定進度。(詳細製造排程及進度詳**附件五**)

二、 Fuji Electric Systems Co., Ltd 公司

Fuji Electric Systems Co., Ltd 公司(以下簡稱 Fuji)為本案汽渦輪發電機組(T-G Set)供應廠家，負責整體汽渦輪發電機組及相關附屬設備、控制系統之設計、供料及製造工作，其在台灣已有超過 4,855,413KW/43UNITS 以上的實績(詳**附件六**)，容量從 21,175KW 到 125,900KW 不等，市場佔有率超過 70%。本案中所使用的蒸汽渦輪機及發電機均由 Fuji 公司川崎製作所負責製作，本次拜訪會見了川崎製作所的 Mr. Takeshi Kawamura(General Manager, Sales Dept. I, International Sales)、Mr. Shugoro Suzuki(General Manager, Plant Engineering Department, Power Plant Group) 、Mr. Yasuo Ueno(Assistant Manager - Plant Engineering, Power Plant Group)等行銷及技術部門人員，聽取了公司簡報並對本案汽渦輪機及發電機之設計規範、製造進度及品質管理等執行情況進行檢討，隨後並實地參觀其生產線與試驗設施，研討內容如下：

(一) 設計規範

1. 機組型式：

- 汽輪機(Steam Turbine)：本案汽輪機採用 Fuji 公司 20-200MW FET 系列抽汽冷凝式汽輪機組，其主要構件包括 Casing(外殼)、Rotor(轉子)、Blade(葉片)、Governing System(導引系統)、Protective System(保護系統)、Lubrication and Control Oil System(滑油及控制系統)、Gland Steam Condensing Unit(蒸汽冷凝系統)及 Condensate System(冷卻水系統)，設計規範依合約規定之 API612、614 為主，以 JIS 為輔。
- 發電機組(Generator)：本案發電機設計容量為 41,000KW，採用 Fuji 公司 10-200MVA GTLRI 系列之發電機組，為全密氣冷式三相同步發電機組(Total Enclosed Inner Air Cooled 3-phase Synchronous Generator)，其主要結構包括 Rotor(轉子)、Stator(定子)、Exciter(激磁器)、Cooling System(冷卻系統)、Bearing & Shield(軸承及軸封)、Main Terminal Box(接線箱)、本體結構及附件等，設計規範依合約規定採最新版 IEC60034-3，其冷卻系統依合約規定為全密氣冷式，空氣分別經由風扇送至定子及轉子內，以冷卻其 Windings，之後熱空氣經由冷卻器與冷卻水作熱交換後，再將冷空氣送回風扇入口，形成一密閉循環冷卻系統。

2. 熱平衡圖研討：本案根據操作需求，汽輪發電機組之熱平衡模式分為 Case1、

Case2、Case3 三種，各種式之操作條件如下：

- Case1：鍋爐產汽量 300t/Hr，外送高壓 58.77t/Hr，中壓抽汽 192.43t/Hr，低壓抽汽 18.65t/Hr，冷凝量 30.09t/Hr，發電機出力 30.0MW。(熱平衡圖詳**附件七之一**)
- Case2：鍋爐產汽量 300t/Hr，外送高壓 126.80t/Hr，中壓抽汽 63.8+22.0t/Hr，低壓抽汽 27.33t/Hr，冷凝量 60.04t/Hr，發電機出力 30.0MW。(熱平衡圖詳**附件七之二**)
- Case3：鍋爐產汽量 300t/Hr，外送高壓 27.45t/Hr，中壓抽汽 162.3+22.1t/Hr，低壓抽汽 28.08t/Hr，冷凝量 60.01t/Hr，發電機出力 42.6MW。(熱平衡圖詳**附件七之三**)

Fuji 公司乃依據前述三種操作模式來設計其汽渦輪發電機組，使合乎本廠在不同操作狀況下之需求，並根據合約規定以最有利於本公司之第三種操作模式作為驗收時性能測試之標準。

3. Turbine Trip Logic System 之選用：Turbine Trip Logic System 主要有 Hard Wired Type 與 Digital Type 兩類，本案採用 Hard Wired Type，其 Mean Time Between Failure(MTBF)可達 77.93 年，Availability Factor 可達 99.999%，而 Digital Type 之 Mean Time Between Failure(MTBF)為 47.22 年，Availability Factor 為 99.997%，相較之下 Hard Wired Type 之性能略優於 Digital Type，造價及維護成本亦較為經濟，相關性能比較及計算資料**詳表一**：

表一 Hard Wired 與 Digital Protection 比較表

Item	Hard Wired	Digital Protection
Reilability	Base	Equivalent, when triplicate system is applied
System Configuration	Simple and flexible design can be achievable.	Configuration of hardware can be standardized. Triplicate system shall be applied for maintain same level of reliability.
Price Difference	Base	US$35,000~higher than that of hard-wire(Depending on number of logic to be handled)
Note: The reiliabilitr is the most important factor, so the triplicate-redundant digital protection system is applied for comparison.		

□ Calculation of MTBF for Hard Relay System

$$MTBF(h) = \frac{1}{\left(\sum FIT\right) \times 10^{-9}} = 682687h = 77.93 years$$

MTBF: Mean Time Between Failure
FIT: Failure in Time

$$AvailiabilityFactor = \frac{MTBF}{MTBF + MTTR(12hours)} = 99.999\%$$

MTTR: Mean Time to Repair

		System	FIT/Unit	Tot. FIT	MTBF(h)	MTBF(y)	S.F.*	FIT
1	Main Steam Temp. LL	2 out of 3	11918.4	35755.2	83903	9.58	0.02	715.104
2	EXH. Steam Press. HH	2 out of 3	12251.8	36755.4	81620	9.32	0.02	735.108
3	Over Speed	2 out of 3	1.19	3.57	840336134	95928.78	0.02	0.0714
4	Shaft Position	2 out of 3	1.19	9.52	840336134	95928.78	0.02	0.0714
5	Shaft Vibration	single	1.19	3.57	105042390	11991.14	1.00	9.52
6	Control Oil Press. LL	2 out of 3	1.19	3.57	840336134	95928.78	0.02	0.0714
7	Lube Oil Press. LL	2 out of 3	1.19	3.57	840336134	95928.78	0.02	0.0714
8	TGR/EHG Heavy Fault	single	1.19	1.19	840336134	95928.78	1.00	1.19
9	Boiler Trip	single	1.19	1.19	840336134	95928.78	1.00	1.19
10	Remote Emergency Trip	single	1.19	1.19	840336134	95928.78	1.00	1.19
11	Emergency Trip	single	1.19	1.19	840336134	95928.78	1.00	1.19
	Σ FIT							1464.7778

*System Factor：Single：1
Double： 0.1
2 out of 3：0.02

□ Calculation of MTBF for Microprocessor System

$$MTBF\ (h) = \frac{1}{\left(\sum FIT\right) \times 10^{-9}} = 413657\ h = 47.22\ years$$

MTBF: Mean Time Between Failure
FIT: Failure in Time

$$Availiabil\ ityFactor\ = \frac{MTBF}{MTBF\ +\ MTTR\ (12\,hours\ )} = 99.997\,\%$$

MTTR: Mean Time to Repair

		System	FIT/Unit	Tot. FIT	MTBF(h)	MTBF(y)	S.F.*	FIT
1	Power Supply Unit	2 out of 3	2100	4200	476190	54.36	0.02	84.00
2	MICREX-SX System (CPU,AI,DI,DO)	2 out of 3	826	2478	1210653	138.20	0.02	49.56
3	DISTRIBUTER	2 out of 3	17180	51540	58207	6.64	0.02	1030.80
4	TRANSDUCER	2 out of 3	20885	62655	47881	5.47	0.02	1253.10
5	SWITCHER	double	2130	4260	469483	53.59	0.10	426.00
	Σ FIT							2417.46

*System Factor：Single：1
Double： 0.1
2 out of 3：0.02

(二) 製造進度：本案汽渦輪發電機製造構件分為 Loosely Supply CT、Subsole Plate、Steam Turbine、Generator 及 Electrical and I&C Equipment 等五大區塊，整套 T-G Set 發電設備於 93 年 12 月 10 日下訂單，預定於 95 年 7 月 10 日前完成各項設備之製造後交運，進行後續之現場安裝及測試作業，根據 Fuji 公司的排程，其實際作業上是以 95 年 6 月 26 日交運作為努力目標，較原定日期提前 14 日，如此可增加後續現場安裝及測試作業之彈性調度時間。本年度的工作重點是在工程設計及材料採購工作，目前 PFD、P&ID 等圖件皆已完成認可，其他設計及製造圖

繪製工作亦已陸續完成，設計進度已接近 100%，購料工作則陸續在進行中，主要構件用料如蒸汽渦輪機轉子等已交貨待製中，各項工作皆能符合預定進度，分項進度如下：(詳細製造排程及進度詳**附件八**)

1. Loosely Supply CT：分為 Engineering、Material Procurement & Assembling、Packing、FOR 四個階段，目前已完成 Engineering 工作、Material Procurement & Assembling 正待展開中。
2. Subsole Plate：分為 Engineering、Material Procurement & Assembling、Packing、FOR 四個階段，本項工作需配合其他工作之進行來展開，預定 95 年 1 月開始。
3. Steam Turbine：包含 Outer Casing、Inner Casing、Rotor 三項主要構件，目前已按進度完成大部份 Material Procurement 工作，預定於 11 月初陸續進廠。
4. Generator：Stator 及 Rotor 為最重要之二項構件，目前已按進度完成 Material Procurement 工作，其中 Rotor 用料已進廠待製中。
5. Electrical and I&C Equipment：分為 Engineering & Designing、Material Procurement、Manufacture、Assembling、Test、Packing、FOR 等六個階段，目前 Engineering & Designing 仍在進行中，預定於 11 月完成，Material Procurement 自本月中旬起展開。

(三) 品管作業：

本案汽渦輪發電機其品管作業分為設計及實體兩大部分，設計部分之圖件須配合工程進度送審，現正依合約規定執行中；實體部分則包含汽渦輪機及發電機二大部份，主要檢查項目包括汽渦輪機本體(Steam Turbine)、控制及保護系統(Control and Protection)、滑油系統(Lube Oil System)、控制油系統(Control Oil System)、冷卻系統(Condensing)、發電機本體(Generator)、激磁系統(Exciter and P.M.G.)、發電機組立(Generator Assembly)、控制盤(Panel and Cubicle)等測試，各項檢查及測試工作將配合後續之製造及現場安裝進度逐一進行，各部分之主要檢查項目詳如**附件九**。目前已完成 Shaft 原形之初步動態平衡測試及材質查驗，測試紀錄如下：

1. Shaft 動態平衡測試：(詳**附件十**材料試驗報告)

(1) 測試標準：Lateral Analysis：Critical Speed ≧4320 rpm(120%) or Critical Speed ≦3060 rpm(85%)。

(2) 試驗結果：

- Unbalanced Model 1 Lateral Analysis：Critical Speed ＝2602 rpm(72.3%), Acceptable。
- Unbalanced Model 2 Lateral Analysis：Critical Speed ＝5677 rpm(157.7%), Acceptable。

2. Shaft 品質查驗紀錄：

材質：26NiCrMoV 145 合金鋼

尺寸：803^{Φ}x 245^{Φ}x 6708^{1}(mm)

試片：21758-101T2、21758-101AX

爐號：F217083、F217084、F217085、F217149

(1) 物理試驗結果：(詳**附件十一之一**材料試驗報告)

- 降伏點強度：試驗結果 80.1~76.7kgf/mm^2, 合乎 JIS 強度標準 84.6~74.4 kgf/mm^2。
- 抗張強度：試驗結果 90.2~88.2kgf/mm^2, 合乎 JIS 強度標準 102 kgf/mm^2 Max.。
- 伸長率：試驗結果 21%~18%, 合乎 JIS 伸長率標準 15% Min.。
- 面積縮減率：試驗結果 72%~68%, 合乎 JIS 面積縮減率標準 50% Min。
- 硬度試驗：試驗結果 14.4~11.8, 合乎 JIS 硬度標準 10.2 Max.。

(2) 化學成分分析：(詳**附件十一之一**材料試驗報告)

- C 成分：分析結果 0.26%~ 0.25%, 合乎 JIS 成分標準 0.28% Max.。
- Si 成分：分析結果 0.09%, 合乎 JIS 成分標準 0.15% Max.。
- Mn 成分：分析結果 0.32%~ 0.31%, 合乎 JIS 成分標準 0.40% Max.。
- P 成分：分析結果 0.004%, 合乎 JIS 成分標準 0.010% Max.。
- S 成分：分析結果 0.004%, 合乎 JIS 成分標準 0.010% Max.。
- Ni 成分：分析結果 3.43%~3.42%, 合乎 JIS 成分標準 3.80%~3.40%。
- Cr 成分：分析結果 1.64%~1.63%, 合乎 JIS 成分標準 1.80%~1.40%。
- Mo 成分：分析結果 0.34%~0.33%, 合乎 JIS 成分標準 0.45%~0.30%。

- V 成分：分析結果 0.12%，合乎 JIS 成分標準 0.15% Max.。
- Al 成分：分析結果 0.007%，合乎 JIS 成分標準 0.015% Max.。

(3) 熱處理紀錄(詳**附件十一之一**材料試驗報告)

- Q. 855°C x 19 h WSPC：加熱至 855°C後，以 Water Spray Cooling 方式淬火處理，熱處理時間 19 小時。
- T. 605°C x 34 h F.C.：加熱至 605°C後，以 Furnace Cooling 方式回火處理，熱處理時間 34 小時。

(4) 超音波探傷試驗報告：採用 Normal Beam Technique(垂直法)，進行 10 個位置的超音波探傷試驗，試驗結果 acceptable。(詳**附件十一之二**超音波探傷試驗報告)

(四) Steam Turbine 生產線參觀：Fuji 公司川崎製作所創立逾 70 年，佔地 212,875 平方公尺(約 7,000 坪)，僱用人數達 1,500 員，為 Fuji 公司最主要之汽渦輪發電設備製造工廠，在參觀其生產線時，共有大大小小十數套發電機組正在線上趕工製作，可說是工作滿檔，可見近年來發電設備市場確實是處於供不應求之狀態。其生產流程大致如下：

(1) Steam Turbine 製作流程：

- 葉片(Blade)製作：原材料為方型條塊，材質為鎳鉻合金鋼，經機械加工，成品如**圖-1**，其車削加工，約需車掉原材料的三分之二，由於葉片型狀為機翼型，在完成一片後其它同樣 SIZE 之葉片則可使用 CNC CONTROL 的 COPY MILLING M/C(靠模銑床)來銑出其它同一形狀的葉片。

圖-1 Blade(From Fuji Electric Systems Co., Ltd)

- Shaft 製作與動平衡測試：如**圖-2**。

圖-2 Shaft 製作(From Fuji Electric Systems Co., Ltd)

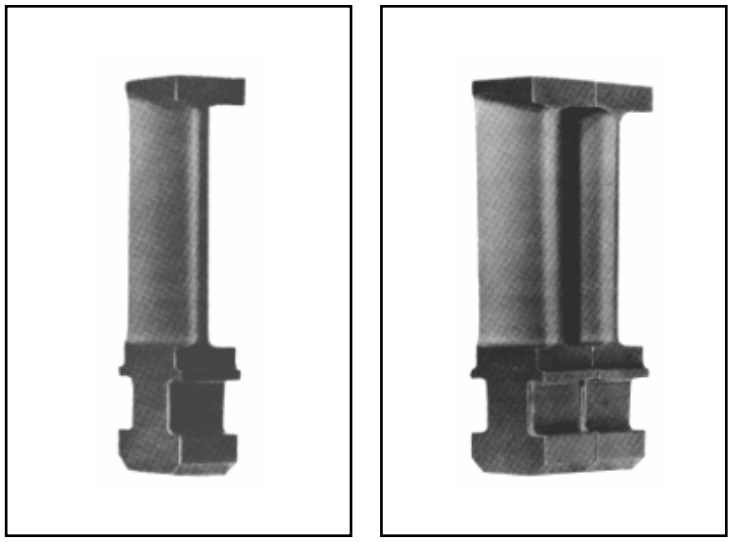
- 葉片之組裝：各葉片由開槽缺口逐一崁入凹槽內，最後再以 KEY 堵住其缺口，組合後如**圖-3** 及**-4**，上有 1. 2. 3. 4 等標記，其乃表示葉片崁入之順序，葉片之外緣做成為一梯型條塊，使各葉片間之外緣一塊塊緊密接著成環狀。

圖-3 葉片組裝(From Fuji Electric Systems Co., Ltd)

圖-4 葉片組裝(From Fuji Electric Systems Co., Ltd)

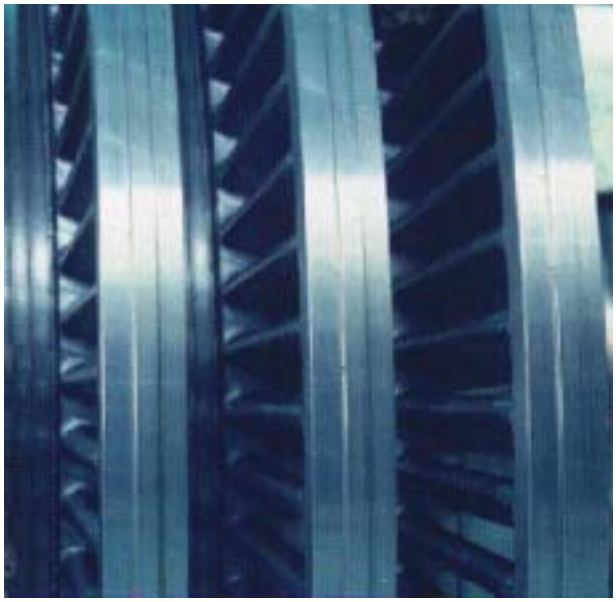
- 導葉片之製作：以銑床銑出後組裝如**圖-5**，其中座上之開孔型狀亦如機翼型，係用雷射切割完成。

圖-5 導葉片(From Fuji Electric Systems Co., Ltd)



□ 加工後之側板護罩：詳如**圖-6**

圖-6 側板護罩(From Fuji Electric Systems Co., Ltd)



□ CASING 組立：如**圖-7**。

圖-7 CASING 組立(From Fuji Electric Systems Co., Ltd)

(2) GENERATOR 製作流程：

□ STATOR 線圈繞組製作：Winding 是用 3-D 的自動化機器來完成，如**圖-8**。

圖-8 Stator Winding Forming Facility(From Fuji Electric Systems Co., Ltd)

□ STATOR 線圈繞組之絕緣及 Coating：線圈經絕緣處理後，在加熱狀況下壓成長條狀，Epoxy Coating。如**圖-9** 及**-10**。

圖-9 Facility for Insulation Taping of Stator Winding (From Fuji Electric Systems Co., Ltd)

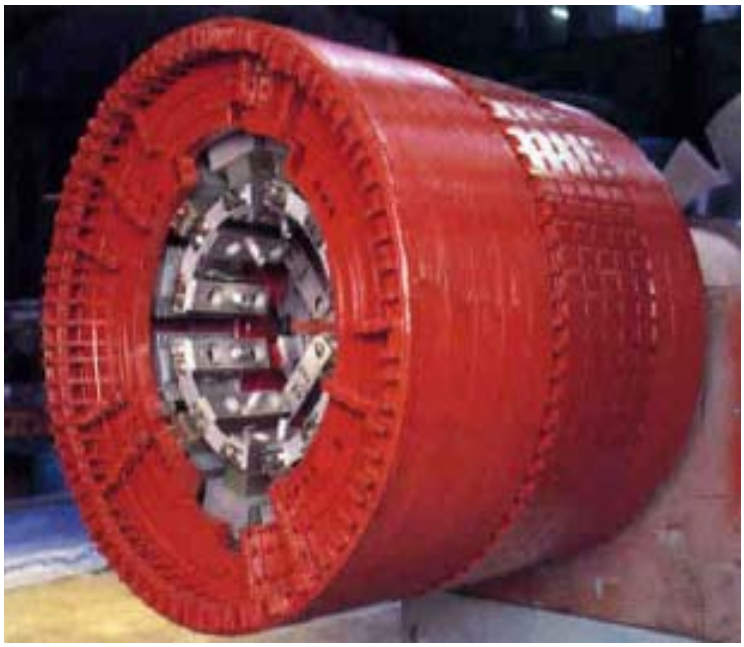
圖-10 Stator Conductors before Insert into Stator Core(From Fuji Electric Systems Co., Ltd)

- STATOR 之組立：如**圖-11**。

圖-11 Stator Assembly after Insulated with Global VPI Process (From Fuji Electric Systems Co., Ltd)

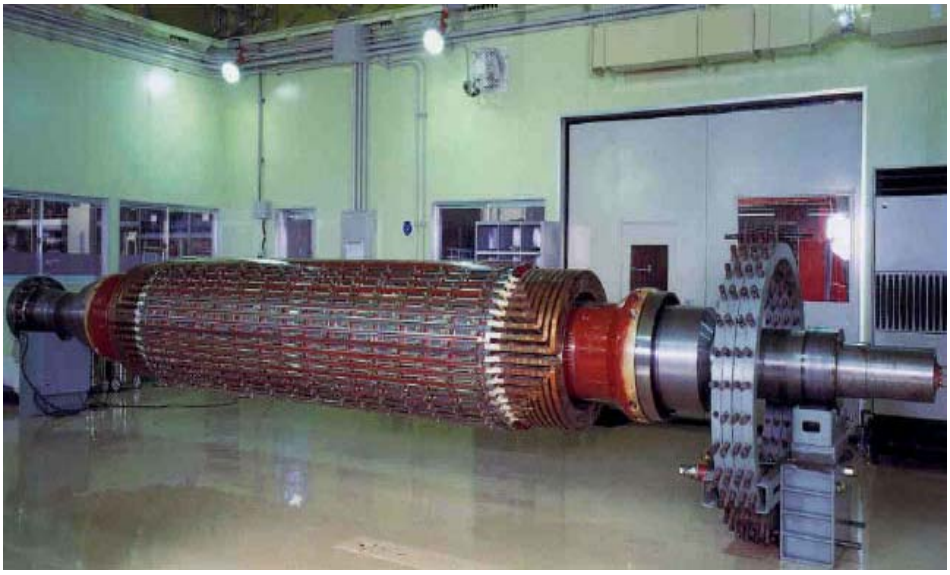
- 激磁器製作、組立：其係針對激磁系統所進行的一連串機械、導電、高壓負荷等測試, 目的在確認其系統功能是否符合規範要求(有關測試報告詳附件七)。詳如**圖-12**。

圖-12 Brushless Exciter Assembly (From Fuji Electric Systems Co., Ltd)



- ROTOR 之製作、組立：如**圖-13**。

圖-13 Rotor Assembly (From Fuji Electric Systems Co., Ltd)



- 測試：包括線圈繞組絕緣測試、轉子動態平衡測試、激磁系統性能測試、發電機組立完成後之 Routine Test。

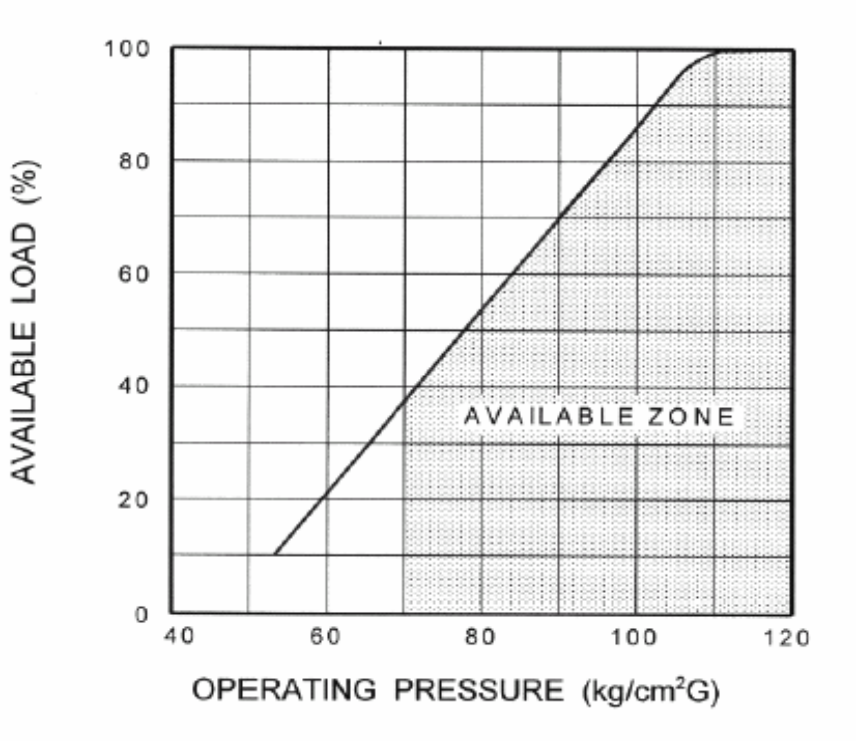
三、 Babcock Hitachi K.K.公司

Babcock Hitachi K.K. Co.(以下簡稱 BHK)為本案承攬商建成公司之技術母廠，亦為世界知名的鍋爐及環保設備製造廠家，其在台灣有相當多的實績(詳**附件十二**)，容量從 60t/h 到 500t/h 以上不等，本案中所使用的高壓鍋爐及脫硝系統之設計技術乃來自於該公司，本次拜訪會見了 Mr. Yoshiaki Honda(Manager, Nuclear & Thermal Power Dept. International Operations Division)、Mr. Kazuhiko Saito(Senior Engineer, Project Development, International Marketing & Sales Operations, Energy Systems)、Ms. Ryoko Gokan(Power & Environmental Systems, nternational Marketing & Sales Operations, Energy Systems)等行銷及技術部門人員，聽取了公司簡報並對本案高壓鍋爐及脫硝設備相關之燃燒技術、脫硝技術、設計規範及操作維護建議事項進行研討，內容如下：

(一) 有關高壓鍋爐的操作壓力建議：

1. 操作壓力對鍋爐的影響：操作壓力的下降，會因鍋爐本體(含汽鼓)內的蒸汽溫度降低、蒸汽比容積增加，對於鍋爐操作有下列的影響：
   - 鍋爐汽水分離器(cyclone)負荷增加；
   - Economizer 出口水溫愈趨近器鼓飽和溫度，甚至產生 steaming 現象；
   - 循環比增加；
   - Steam Purity 降低。
2. 本案鍋爐操作參考模式：
   - 當壓力下降時，其可操作之負荷應隨之減低，否則將嚴重影響水循環，導致鍋爐損壞。
   - 由**圖-14** 鍋爐壓力變動與鍋爐容許負荷關係曲線觀察，本案鍋爐額定操作壓力為 120kg/cm^{2}G，若需降壓操作時，其負荷應同步降低以保護鍋爐水循環之正常運轉，同時也應量避免在額定操作壓力的 60%以下做長時間的運轉。

圖-14 鍋爐壓力變動與鍋爐容許負荷關係曲線圖



(二) 有關高效率低氮氧化物(Nox)燃燒技術的研討：

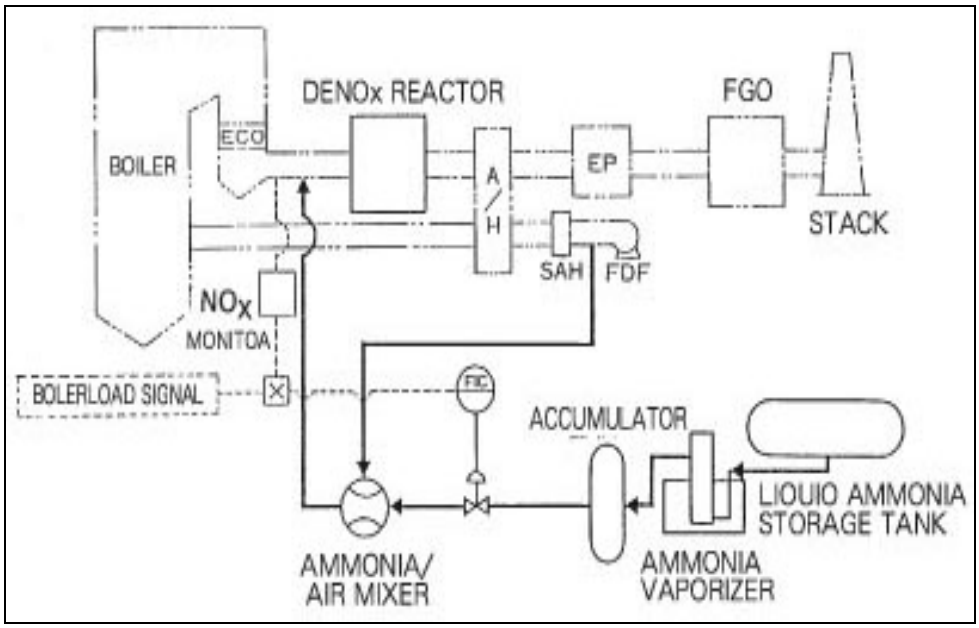
本案採用 HT-SJ 型燃燒器，為 BHK 公司近年針對燃油及燃氣鍋爐，所研發之高效率低氮氧化物(Nox)燃燒器(詳**附件十三**)，其可適用在單獨燃油或燃氣鍋爐，也可適用在兩者混燒之情況下，其主要是利用二次空氣螺旋導風片(Secondary Vane & Swirlers)及三次空氣調節設備(Tertiary Register)來改變其燃燒模式、及燃燒熱區分佈，顯著效益有三：

1. 改善鍋爐之熱效率
2. 降低鍋爐府績系統之能耗
3. 改善環保：
   - □ 使燃燒更完全，降低粒狀物之排放量。
   - □ 降低氮氧化物之產生。

(三) 脫硝技術及流程規劃：本案脫硝系統乃由 BHK 公司負責基本設計及反應器觸媒之供應，設備及鋼架結構則由主承包商建成公司製作完成後載運至工地進行整合及組裝。

1. 脫硝系統基本流程：(詳**圖-15**)

圖-15 Flow Diagram of DeNOx System(from BHK combustion Technology)



(1) 氮氧化物(NOx)移除原理：

本案採用乾式 SCR 脫硝系統(Dry Selective Catalytic Reduction System with Ammonia)乃是利用氨水(NH3)作為抑制劑來分解煙道氣中有害的氮氧化物(NOx)使反應成無害的氮氣(N2)和水分子(H2O)，其做法是將稀釋過的氨水(NH3)均勻的注射入脫硝反應器的上游煙道氣中，使得煙道氣通過反應器觸媒床時，在觸媒表面，將大多數的氮氧化物(NOx)產生分解反應形成無害的氮氣(N2)和水分子(H2O)後，再排放到大氣中，其反應方程式如下：

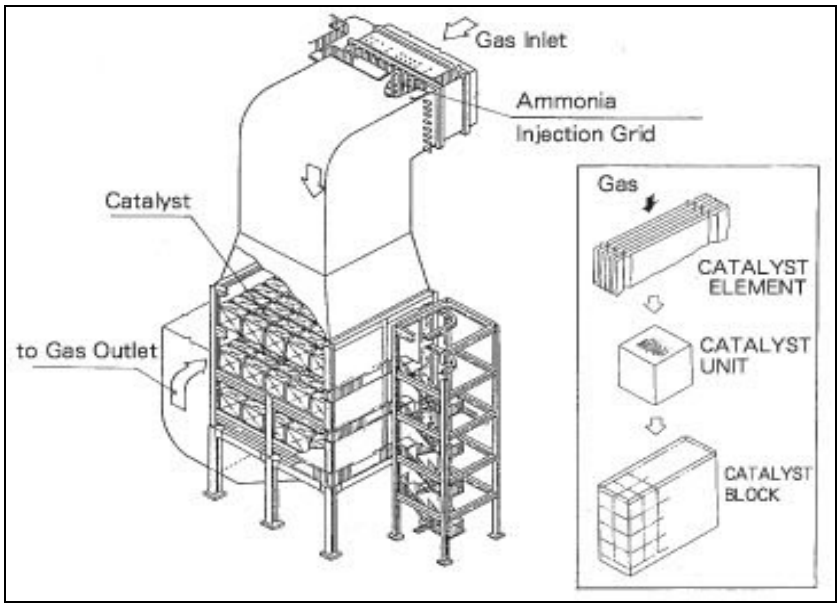
$$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$$
$$6NO_2 + 8NH_3 \rightarrow 7N_2 + 12H_2O$$

(2) 氮氧化物(NOx)移除效率：本案 SCR 脫硝系統之移除效率將隨著煙道氣之流速及反應溫度而變動，當 Space Velocity 在 6,400 1/h、反應溫度在 320°C以上時，其效率可達 80%以上。(氮氧化物移除性能曲線詳**附件十四**)

(3) 系統特性：

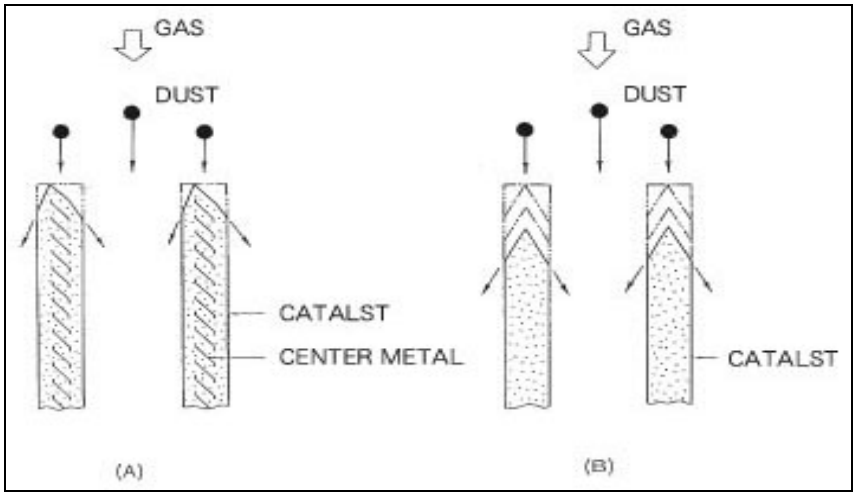
□ 選用板式觸媒，可有效降低壓力損失，可符合設計規範在 100%MCR 的操作條件下，差壓小於 80mmH_2O 之規定。(詳**圖-16**)

圖-16 Construction of Reactor(from BHK combustion Technology)



- 採用板式觸媒，如**圖-17** 左圖所示，有 center metal 嵌埋其中，較右邊無嵌埋者有更加之抗腐/侵蝕性，特別適用於含塵量高之煙道氣。

圖-17 High Erosion Resistance on Dust Particle with Catalyst Edge (from BHK combustion Technology)



- 反應後之產物為氮氣(N_2)和水(H_2O)，無廢水或其他須再做處理之副產品，可避免二次污染之問題。
- 運轉操作單純，與煙氣發生源容易均勻混合，採用高活性之觸媒使得在較低的 mole ratio (NH_3/NOx)下仍可維持高的 NOx 去除效率，並

可降低反應器出口的 NH_3 濃度，減低二次污染之發生。

2. 觸媒更換時機及模式研討：觸媒之活性及壽命對脫硝系統之去除效率有相當大的影響，本次拜訪也藉機與 BHK 的專業人員就觸媒更換最佳模式進行研討，為確保本案脫硝設備能符合合約中經脫硝後之煙道氣 NOx 含量為 30 ppmv, Max.，且觸媒活性需保證在三年內不得低於 60%之規定，雙方根據本案使用燃料、觸媒之特性及以往實際案例，規劃出如下之更換觸媒模式(詳附件六)供本案爾後操作與維護之參考。(詳**附件十五**)

   - Initial Catalyst：4 layers, 總體積 157.3 m^3
   - 第 3 年初：加裝 1 layer, 體積增加 22.5 m^3
   - 第 5 年初：更換 3、4 兩層, 更換體積為 67.4 m^3
   - 第 7 年初：更換 1、2 兩層, 更換體積為 89.9 m^3
   - 第 10 年初：同第 3 年初

     ……

四、 Fujikasui Engineering Co., Ltd.公司

Fujikasui Engineering Co., Ltd.(以下簡稱 Fujikasui)負責本案脫硫設備(FGD)之規劃設計與主要構件之供應, 本次拜訪會見了 Mr. Takumi Okanda(Deputy Director & Group Leader, FGD Project Headquarters, Sales & System Engineering Group)、Mr. Katsuo Oikawa(Director, FGD Project Headquarters)、Mr. Chaturong Yongsiri, Ph.D.(Chief Engineer, FGD Project Headquarters, Sales & System Engineering Group)、Mr. Hiroyuki Ibe(Chief Engineer, FGD Project Headquarters, Sales & System Engineering Group)等行銷及技術部門人員，聽取了公司簡報並對本案硫設備相關之脫硫技術、製造進度及品質管理等執行情況進行研討，內容如下：

(一) 脫硫技術及流程規劃：本案脫硫系統乃由 Fujikasui 公司負責流程及基本設計工作，設備及鋼架結構則由主承包商建成公司製作完成後載運至工地進行整合及組裝。

1. 脫硫系統基本規範及流程：

本案 Fujikasui 採用以氫氧化鈉(NaOH)作為吸收劑之 Moretana Plate Tower 濕式脫硫系統(Wet Flue Gas Desulfurization System with NaOH)，其主要規範及操作條件如下：

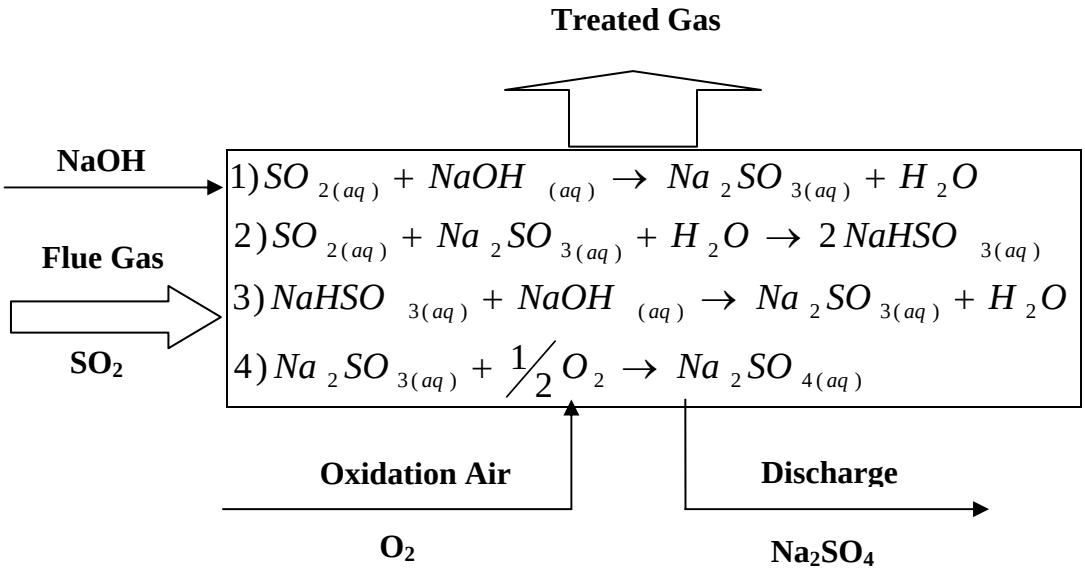
- 脫硫效率：＞95.7%
- 煙道氣流量及 SO_x 含量：338490 Nm3/Hr，693 ppmV@6%O2
- 處理後之 SO_x 含量：＜30 ppmV@6%O_2
- 廢水排放量：25 m3/Hr
- NaOH 補充量：0.85 t/Hr
- 差壓損失：240 mmAq
- TSP：＜29 mg/Nm^3

鍋爐煙道氣在上述操作條件下由 inlet duct 進入 Absorber，inlet duct 設有分配式洒水裝置來預冷並增加鍋爐煙道氣之溼度, 其目的在平衡煙道氣的蒸發損失並減少廢水之產生量，煙道氣在 Absorber 中與由下往上流動，與藉由循環泵來驅動由上往下流動的吸附劑相互交錯接觸產生吸附反應，而脫硫及除塵就在此區完成，反應後之廢液將排放至廢水處理系統，經排煙脫硫設備洗滌程序後之乾淨煙氣，則經除霧後直接排至大氣。(詳細 FGD 流程圖詳附

件十六)

2. 硫氧化物(SOx)移除原理

本案採用的濕式 FGD 脫硫系統乃是利用氫氧化鈉(NaOH)作為吸收劑來吸收煙道氣中之 SO_2，即利用硫氧化物易溶於水的特性，濕式排煙脫硫設備係提供洗滌機制，先以水吸收煙氣中的硫氧化物成酸性水溶液，系統中再添加鹼性吸收劑予以酸鹼中和，而達到脫硫及除塵之目的，其反應過程及生成物如下：



Absorption：1),2),3)
Oxidation： 4)

3. 硫氧化物(SOx)移除效率：本案 FGD 脫硫系統乃是利用氫氧化鈉(NaOH)作為吸收劑來吸收煙道氣中之 SO_2，其移除效率將隨著煙道氣中 SO_2濃度之降低而減小，SO_2 濃度在 700ppmV 以上時，其效率可達 96%以上，濃度在 200~700ppmV 之間，其平均效率約為 93%，濃度在 200ppmV 以下時，其平均效率約為 87%。(硫氧化物移除性能曲線詳**附件十七**)

4. 煙灰(Dust)移除效率：本案濕式脫硫系統，除了利用氫氧化鈉作為吸收劑來吸收煙道氣中之 SO_2外，其 Moretana Plate Tower 上具有相當良好的煙灰(Dust)移除效率，其對直徑 15μ以上之 dust 移除效率可達 80%以上，在一般狀況下其可將煙道氣之含塵量由 0.5~1.0 g/Nm^{3}處理至 0.03~0.05 g/Nm^3，在有特殊

需求時，可經由加長 Moretana Plate Tower 之縱深，增加反應區域之方式，進一部提高其移除效率，使出口煙道氣之含塵量達到合約規範之 TSP：＜29 mg/Nm^3。(煙灰移除性能曲線及 Moretana Plate 詳**附件十八**)

5. 系統特性：

- □ 和傳統的 lime-gypsm method 相比，本案系統架構較為簡單且操作、維修成本較低。
- □ NaOH Method 所採用的 absorbent 可在溶解狀態下包含脫硫劑不同於傳統的 lime-gypsm method 所採用的 slurry type absorbent，而懸浮粒子則主要來自於煙道氣中的 dust，反應後之生成物之處理較為簡單，可節省後續廢棄物處理成本。
- □ 本案採用 Moretana Plate Tower，其 Hole Area Ratio 達 25~60%，遠較傳統之 10%為優，由於其具備較高的 Hole Area Ratio，亦即在相同的其 Pressure Drop 下，其流量可達傳統型之 2 倍或以上。
- □ 本案採用 Moretana Plate Tower，其具有 Self-cleaning phenomena 之特點，是液氣分離容易。
- □ 本濕式脫硫系統對不同的負荷變化皆有相當高且穩定的去除效率。

(二) 執行進度：

本案脫硫系統製作流程分為基本設計、細部設計、製造與安裝等四個階段，設計部分及 Absorber 主要構件 Moretana Plate 由 Fujikasui 負責供應，其他製造與安裝則由建成公司負責，全部工作於本年 7 月開始展開，至 10 月止，Fujikasui 所負責之基本及細部設計工作皆已接近完成，並依進度送審及認可，部份須與建成配合之工作則將於本年 12 月至明年 2 月間同步來進行；有關製造進度方面，其中 Spray Nozzle、Moretana Plate、Misteliminator 等三項由 Fujikasui 負責供應之主要構件，目前皆已完成購料，正進行製造工作中，該等構件預定將於 94 年 12 月底前陸續完成製造並交運，隨後於建成公司進行組裝工作。目前各項工作皆能符合預定進度。(詳細製造排程詳**附件十九**)

伍、結論與建議

一、 本案以統包方式辦理鍋爐汰舊換新工程，工期為 1000 日曆天，工程內容涵蓋流程規劃、基本設計、購料、製造與裝建，由於前期之規劃、設計工作是否完備、周詳對後續之製造及建廠工程能否順利展開、如期完工有莫大之影響，因此，此行赴日本拜訪 Babcock Hitachi K.K.等本工程各項主要設備之設計及供應廠家，進行相關工作之研討與查核，對本案工程之順利進行有極為正面之意義。

二、 本次出國分別拜訪了 Babcock Hitachi K.K.、Fuji Electric Systems Co., Ltd、Fujikasui Engineering Co., Ltd.、Alstom K.K.等本案鍋爐、汽渦輪發電機組、脫硫、脫硝及空氣預熱系統等廠家，與其專案及技術人員針對相關之流程規劃、設計規範、材料供應、製造進度與品管作業等議題進行面對面之工作會談與實地查核，整體而言，上述各廠家其專案及技術人員無論是在工程設計、採購、裝建與品管作業等各個領域皆具有相當之專業水準。查核的結果，各項主要設備之設計規範、製造進度與施工品質皆能符合合約之規定與進度要求。另外，在研討過程中，雙方也針對現階段最新之汽電共生工程實務、設計規範、操作與施工技術進行意見交換與討論，對提升公司及個人之專業技術能力，可說是獲益良多。

三、 汽電共生之發展已有相當時日，其技術也已臻成熟階段，各廠家目前皆致力於如何能更加提升其系統之能源產生效率、降低耗熱率及減少伴隨污染之產生上，BHK 公司其鍋爐熱效率據稱可達到 94%以上，而其新研發之燃燒器其 NOx 含量在燃油的情況下亦可低於 50 PPM，目前本案招標書所規定之鍋爐效率最低標準為 93%，煙道氣 NOx 含量之保證值為 150 PPM(BURNER)，衡諸未來的發展趨勢，鑑於燃燒技術的日益精進，建議爾後類似工程之鍋爐效率與 NOx 含量之保證標準可酌予提昇，以增加整廠能源產生效率，減省操作支出並收環保之效。

陸、附件

附件一 H-type 空氣預熱器外型圖 (1 頁)

附件二 Double Undulated Notched (DUN) type 等傳熱片外型圖及性能比較表 (1 頁)

附件三 On-Stream Washing Device 外型圖 (1 頁)

附件四 空氣預熱器品管作業檢查項目及程序 (4 頁)

附件五 空氣預熱器製造排程及進度 (1 頁)

附件六 Fuji 汽渦輪發電機組台灣市場實績 (2 頁)

附件七 汽渦輪發電機組熱平衡圖 (3 頁)

附件八 汽渦輪發電機組製造排程及進度 (2 頁)

附件九 汽渦輪發電機組檢查及測試計畫 (19 頁)

附件十 汽渦輪發電機 Shaft 動態平衡測試 (5 頁)

附件十一 汽渦輪發電機 Shaft 材料試驗、熱處理紀錄及超音波探傷試驗報告 (2 頁)

附件十二 BHK 鍋爐及環保設備台灣市場實績 (1 頁)

附件十三 BHK 高效率低氮氧化物燃燒器 (1 頁)

附件十四 BHK 脫硝系統氮氧化物(NOx)移除性能曲線 (3 頁)

附件十五 BHK 脫硝系統觸媒更換時機及模式 (1 頁)

附件十六 Fujikasui FGD 系統流程圖 (2 頁)

附件十七 Fujikasui 脫硫系統硫氧化物(So_2)移除性能曲線 (1 頁)

附件十八 Fujikasui 脫硫系統 Dust 移除性能曲線及 Moretana Plate 安裝圖 (5 頁)

附件十九 排煙脫硫工程進度排程 (1 頁)

附件一　空氣預熱器外型圖

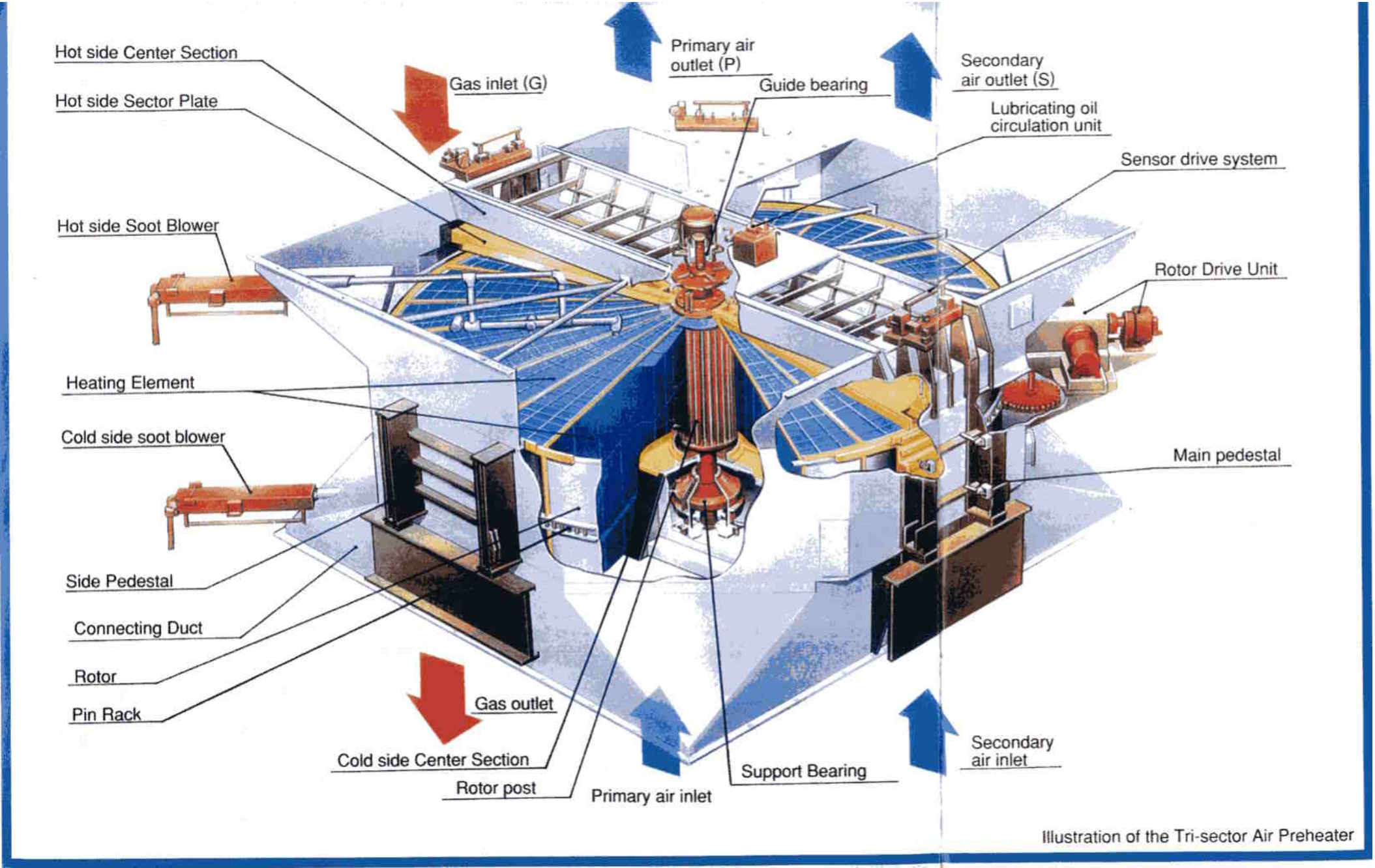


Illustration of the Tri-sector Air Preheater

附件二

Types of Heat transfer Surface

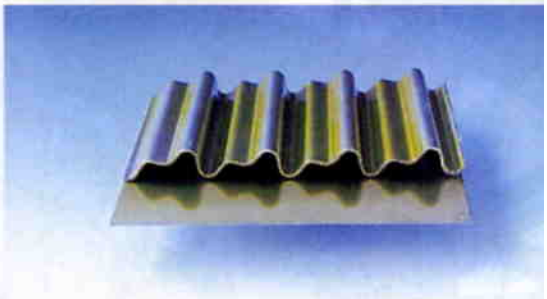
DU *Double Undulated*

The DU type can be used in the hot, intermediate and cold layers. The materials are carbon steels, corrosion-resistant steels or porcelain enamel coated steel.

Sample sheets of Heating Element (DU)

NF *Notched Flat*

The NF type has a simple shape. Due to these characteristics in the profile, deposit formation on this heating surface is held down to the minimum. It is mainly used in the cold end layer. This type is frequently used in the temperature range close to the sulfuric acid dew point. The materials are corrosion-resistant steels or porcelain enamel coated steel.



Sample sheets of Heating Element (NF)

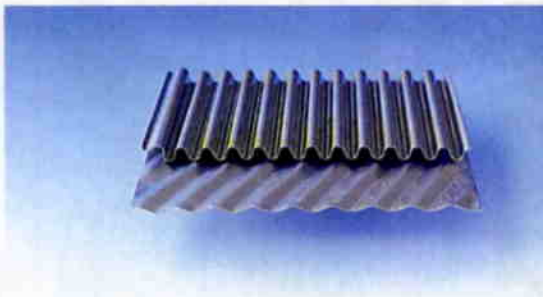
FNC *Flat Notched Cross*

This is more efficient than the DU type heating element. The materials are carbon steels or corrosion-resistant steels depending on the operating temperature range.

Sample sheets of Heating Element (FNC)

CU *Corrugated Undulate*

This is for clean exhaust gases. The materials are carbon steels or corrosion resistant steels depending on the operating temperature range.

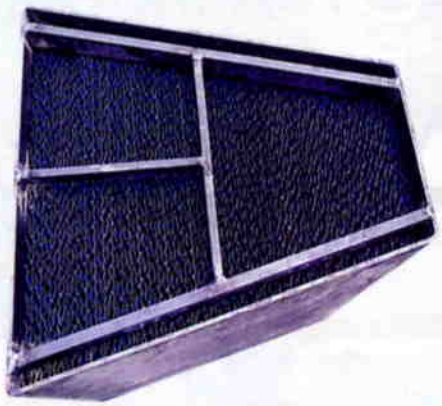


Sample sheets of Heating Element (CU)

Comparison of Characteristics

	DU	NF	FNC	CU
Temperature efficiency	100	40	106	108
Pressure loss	100	28	98	138

Note 1: Comparison of plate thickness of 0.6 mm for DU, CU and FNC and 1.2 mm for NF.
Note 2: Pressure loss is compared for Heating Element length of 1000 mm.

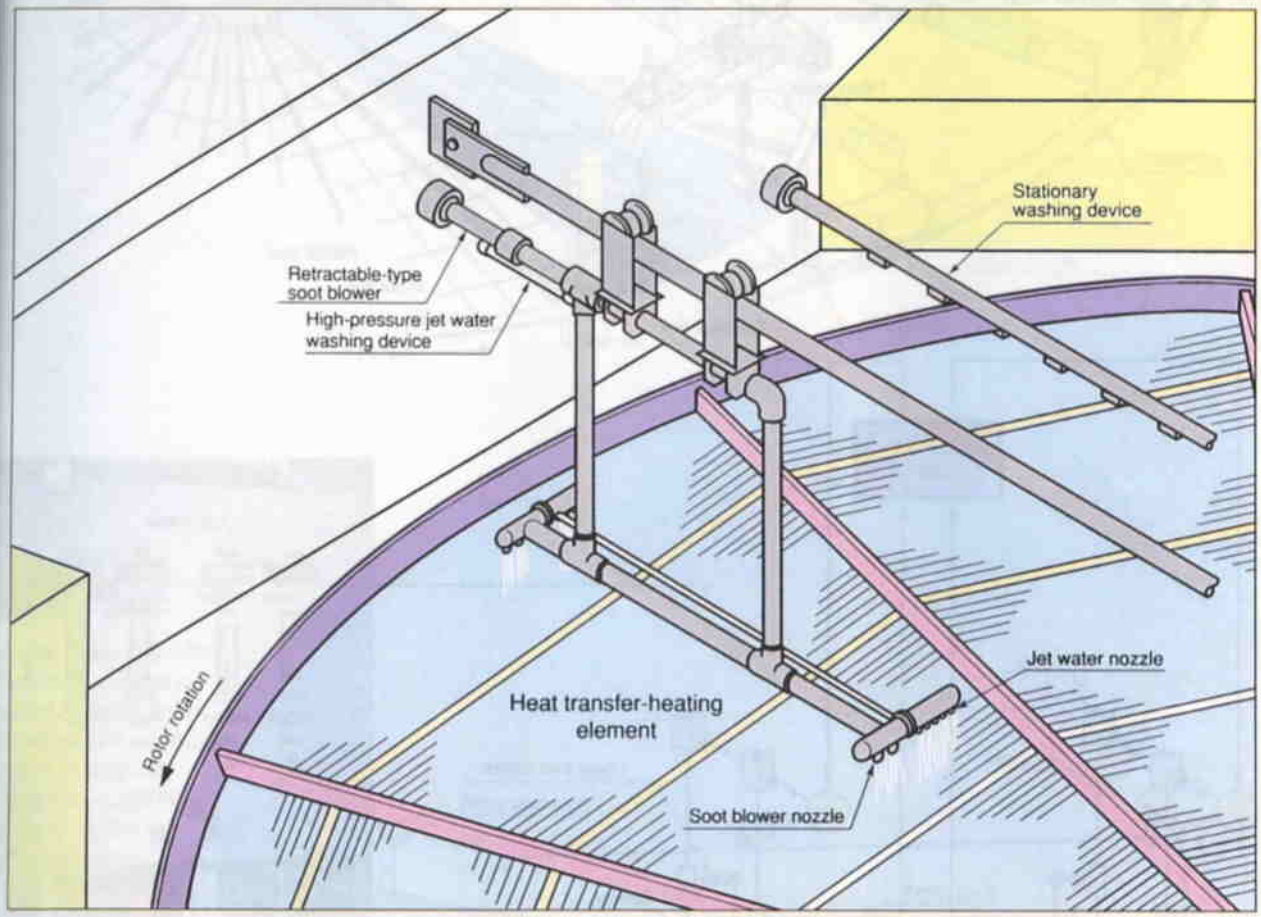


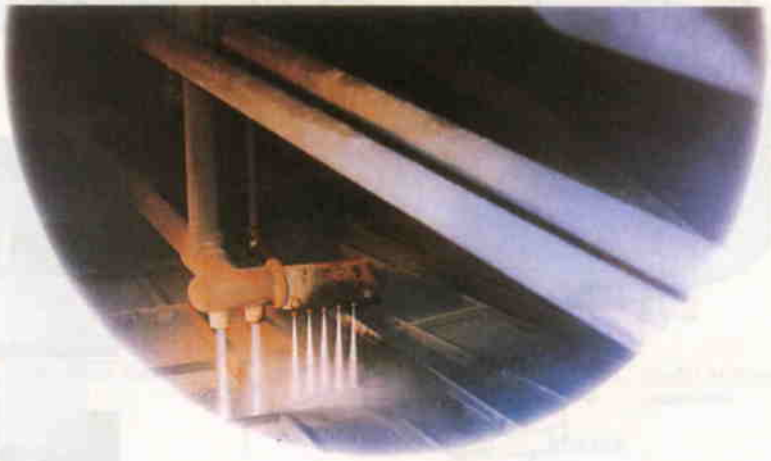
Basket of Heating Element (closed type)

On-Stream Washing Device (OSW)

The dust can be fully removed from the heating surfaces of an air preheater with an ordinary soot blower. Depending on operation conditions, however, water washing is performed by stopping the boiler operation. The OSW is a system to recover pressure loss by washing the air preheater with high-pressure jet water in operation. The OSW performs two operations simultaneously, high-pressure jet water cleaning and soot blow with steam (air). It is installed on both inlet and outlet of the gas side of an air preheater. The washed section is drip-dried by the succeeding soot blowing. The features of the OSW include:

1) Dust can almost perfectly be removed from the air preheater.
2) Operation of the boiler and the downstream units is little affected because a small quantity of high-pressure water is used.
3) The time required for washing the unit in a scheduled shutdown can be reduced by operating the OSW just before the shutdown.





OSW in operation

ALSTOM

附件四

ERS - LHR - DEG -
Order No.:
Mfg. No. :

Inspection Procedure

of

Ljungstrom ® Air Preheater

No. Req'd : 1 set / 1 boiler

Manufacturer : ALSTOM K.K.

REFERENCE

Distri.	
CUS	9
PM	1
DE	1
PG	2
CG	1
QC	1
TW	1
Total	16

Rev	Date	Description	By	Check	Appr.
E					
D					
C					
B					
A					

Ljungstrom® Product Department Energy Recovery Systems Division		
By	Check	Approve
Date : April 4, 2005		
ALSTOM K.K.		

附件四

Inspection Procedure for Ljungstrom® Air Preheater (Type : VI)

1.Outline of Inspection

The shop inspection is performed as following procedure.

No finishing assembly is made at shop.

A. Explanation of drawings and inspection report.

B. Inspection
1. 30° compartment
2. Connecting duct and center section

C. Discussion on the result of inspection, etc.

Remarks :

1. Application for inspection (including inspection date and inspection place) to be submitted later.

2. Temporary assembly and trial operation of air preheater are not carried out.

2. List of Inspection Items

Inspection Items	Record submit	Witness by client
1. 30℃ compartment (refer to page 2)		
1) Element space	○	–
2) Pitch of bolt holes for seal plate	○	–
3) Pitch of bolt for basket cover	○	–
4) Visual check	–	○
2. Connecting duct and center section (refer to page 3)		
1) Duct connecting dimension	○	–
2) Setting position of seal angle	○	–
3) Position of bolt holes for panel setting	○	–
4) Visual check	–	○

3. List of Maker's Test Report

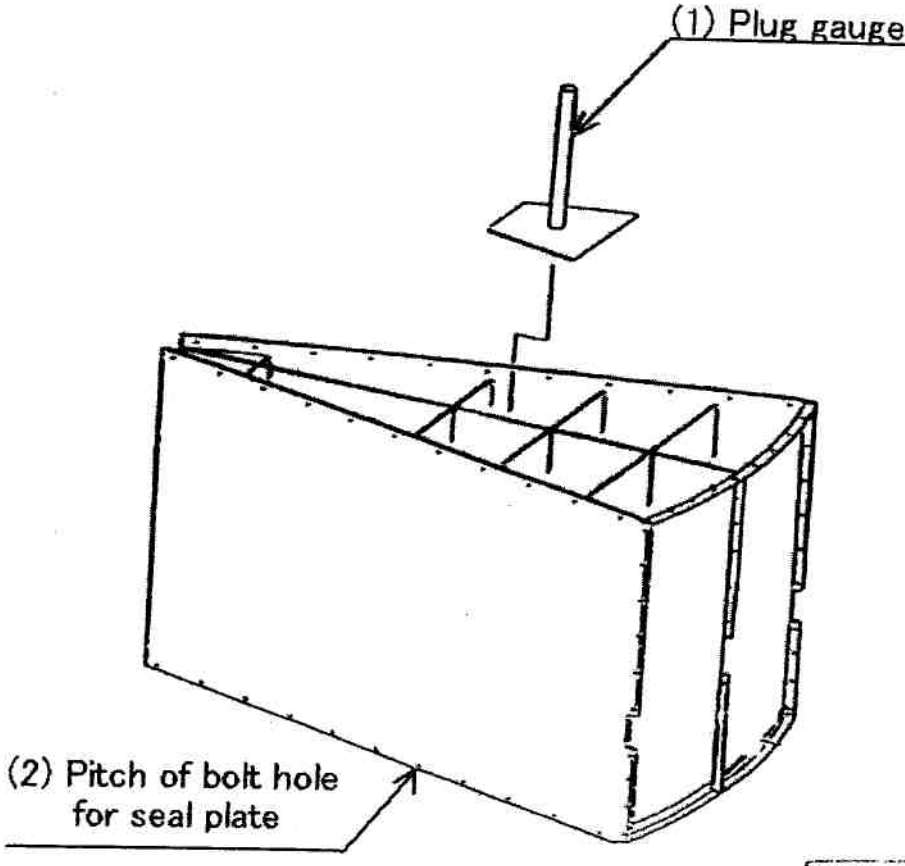
We will submit maker's test report listed as below

1) Electric motor for rotor drive unit
2) Air motor for rotor drive unit
3) Electric motor for lubricating oil circulation unit
4) Electric motor for cleaning device
5) Speed reducer for rotor drive unit
6) Pump for lubricating oil circulation unit

附件四

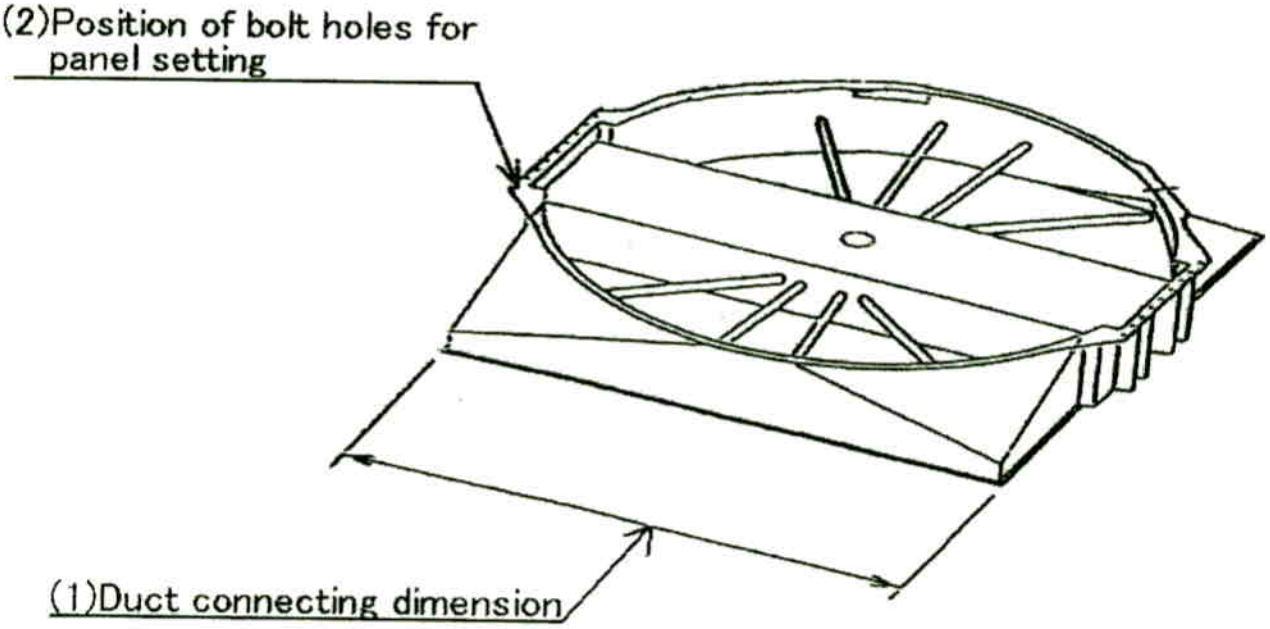
4.Inspection Procedure

	Items	Measurement	Allowable value
1. 30° compartment	1) Element space The plug gauges are same dimension as basket elements.	Plug gauge	
	2) Pitch of bolt hole for seal plate.	Tape measure	Tolerance : ±2mm
	3)Visual check Beads shall have no detrimental defects, such as bead crack, slag inclusion, under cut (depth > 0.5mm), overlap and etc. Surface finishing and cleaning shall be sufficient.		



附件四

	Items	Measurement	Allowable value
2. Connecting duct and center section	1) Duct connecting dimension	Tape measure	Pitch of bolt holes : ±2mm Duct opening : ±6mm
	2) Position of bolt holes for panel setting	Tape measure	Tolerance : ±3mm
	3)Visual check Same as item No.1-4)		

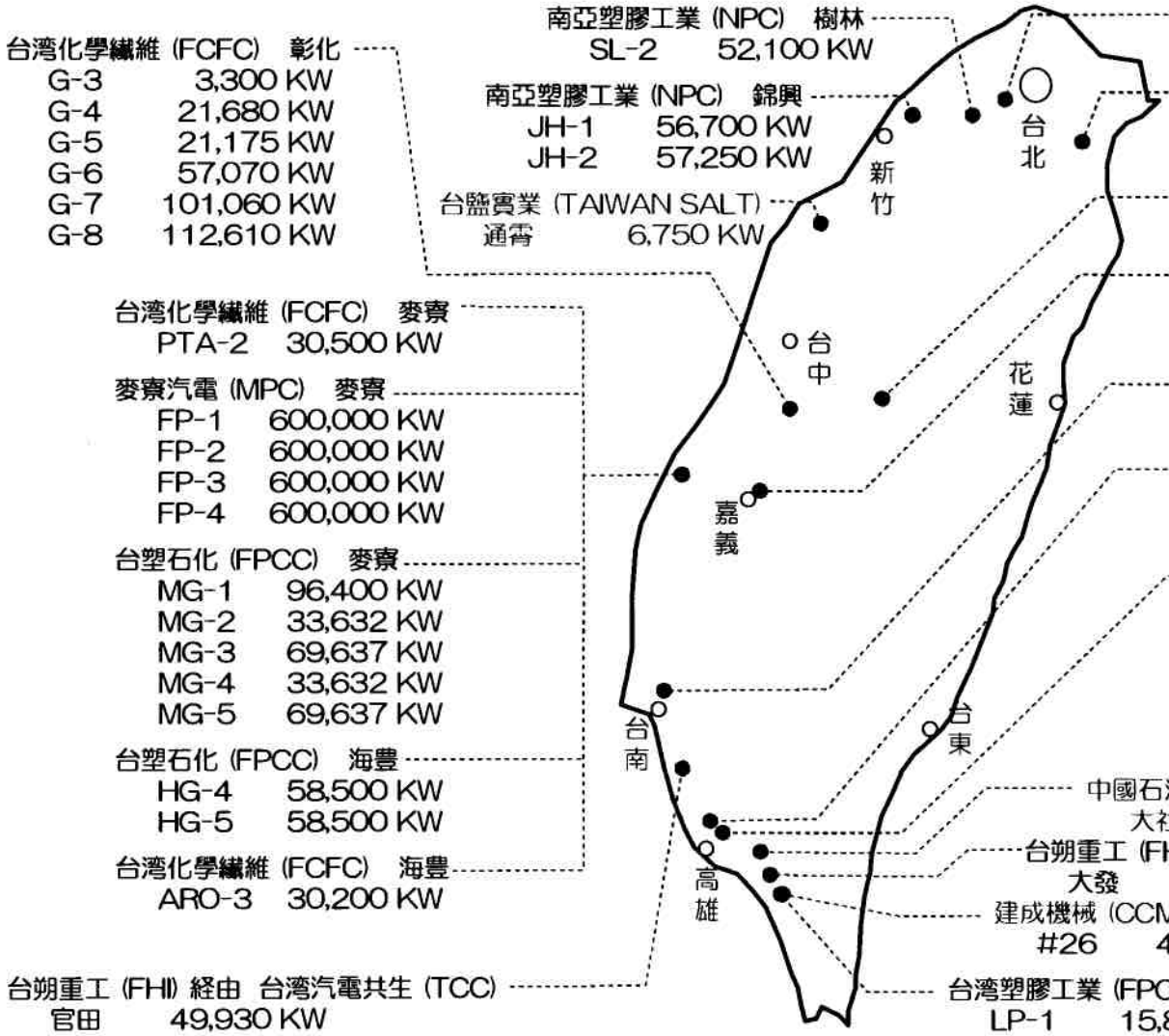


CCMC/CPC Lin-Yuang 1x27-VIX-2150

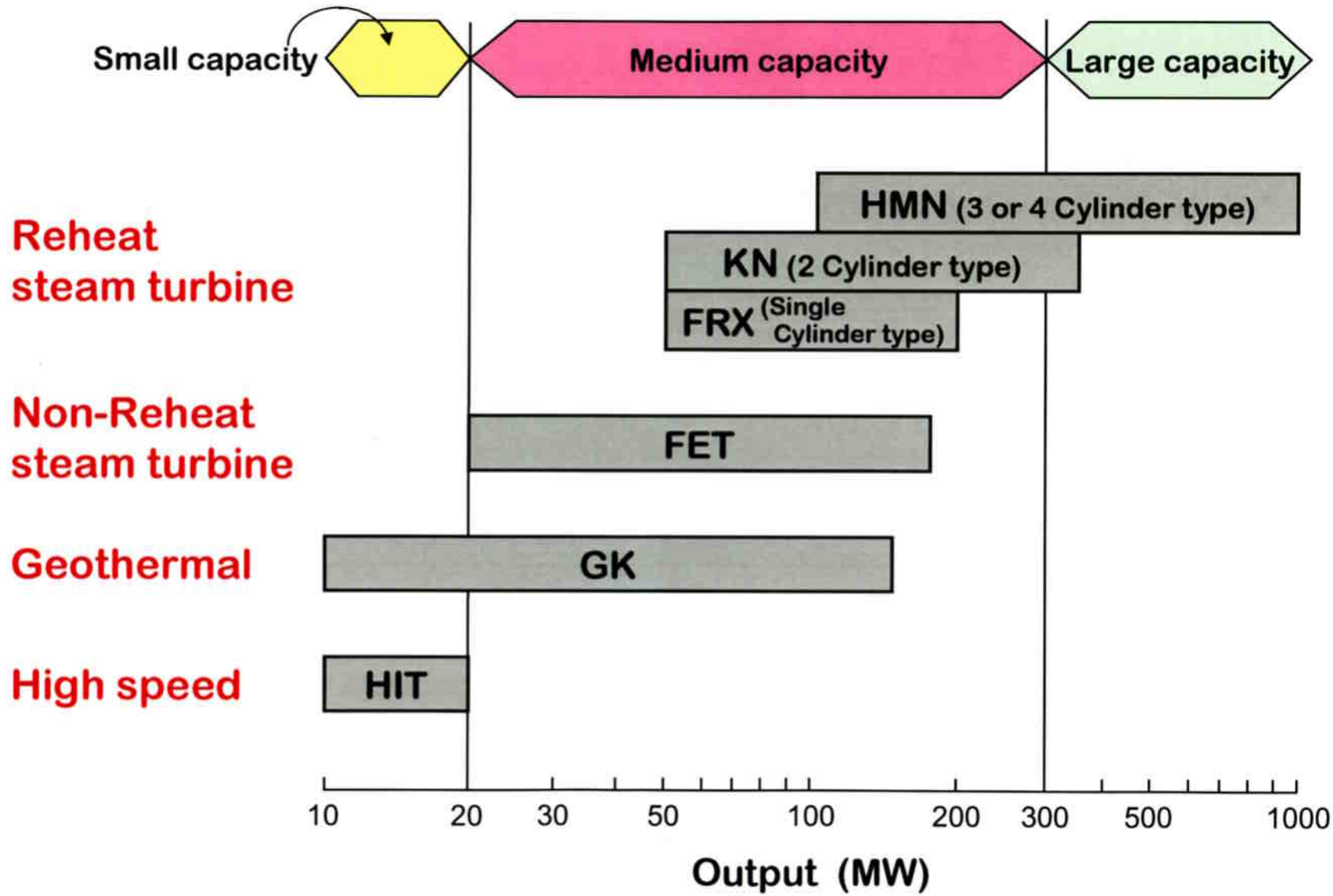
ID	タスク名	05/05	05/06	05/07	05/08	05/09	05/10	05/11	05/12	06/01	06/02	06/03	06/04	06/05	06/06	06/07
		05								06						
1	Start of project		06/20													
2	Receipt of Order Sheet		06/06													
3	Document & Drawing for Client															
4	GAD, P&I		06/20	06/28												
5	Mfg Specification		06/20	07/19												
6	Loading Data		06/20	07/19												
7	Maintenance Floor Planning Drawing			08/10	09/06											
8	Insulation Drawing of Air Preheater			08/10	09/06											
9	Performance Test Procedure		06/20	07/13												
10	Supply List													05/22	05/30	
11	Erection Procedure and Drawing incl. Check list										03/01	03/31				
12	Operation and Maintenance Manual										03/01	03/31				
13	Manufacturing Drawing List (for CCMC portion)		07/04	07/13												
14	Manufacturing Drawing of Main components (for CCMC portio			08/10	10/31											
15	Manufacturing Drawing of Accessories, Piping, etc. (for CCMC			08/10	10/31											
16	Manufacturing Drawing (for AKK portion)															
17	Completion of Mfg Drawing			08/10	12/12											
18	Requision of Main Purchasing Goods															
19	Electric Motor			08/10	03/27											
20	Speed Reducer			08/10	03/27											
21	Sootblower			08/10	03/27											
22	Local panel			08/10	03/27											
23	Guide/Support Bearing		06/27												05/19	
24	Manufacturing															
25	Rotor Post						11/15								04/28	
26	Rotor						11/15								04/28	
27	Hot End Center Section						11/15								04/28	
28	Cold End Center Section						11/15								04/28	
29	Housing panel						11/15								04/28	
30	Heating Element (Japan)									01/16					05/19	
31	Delivery Taiwan Portion- FCA														06/06	
32	Delivery Japan Portion- FOB														06/06	

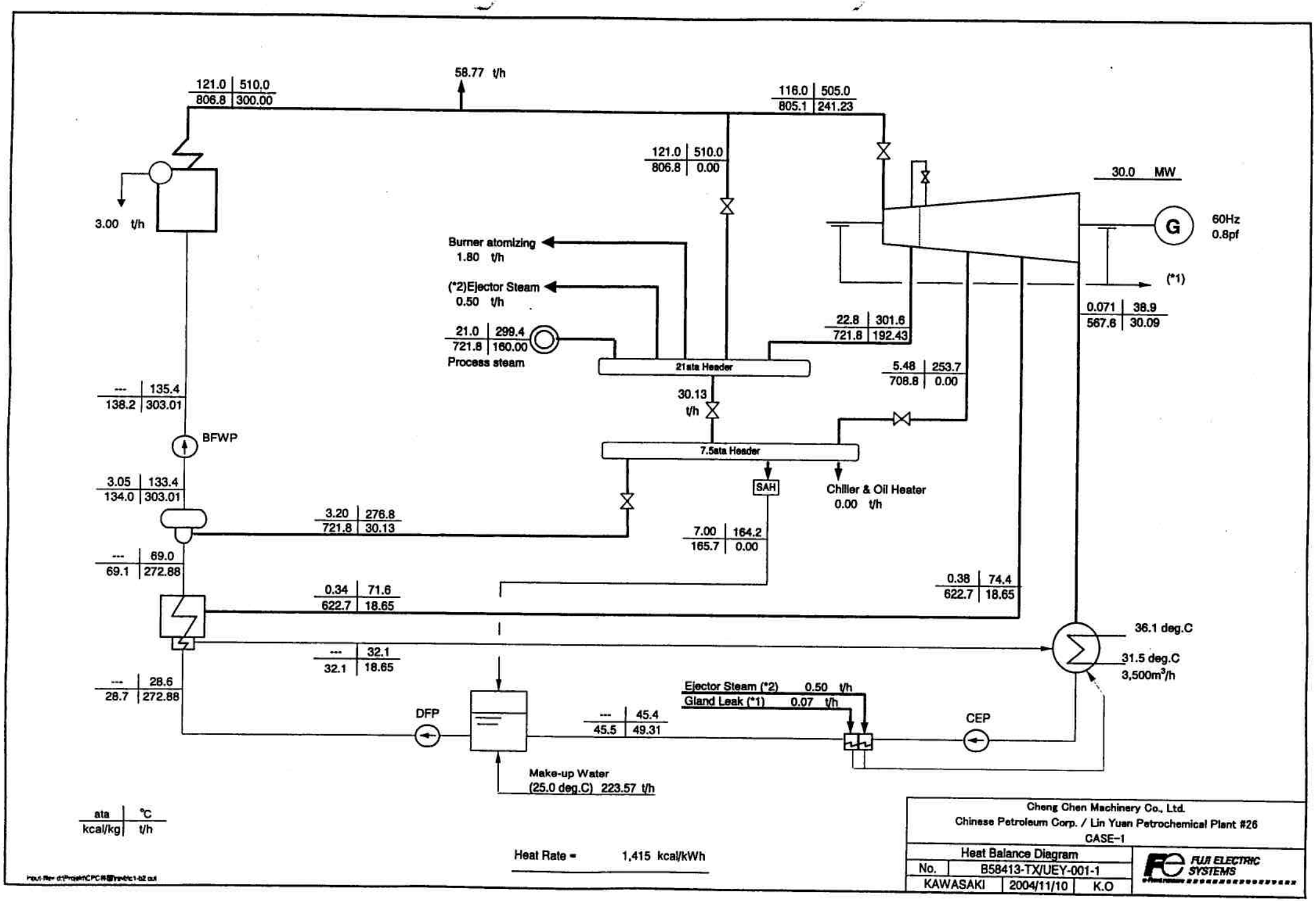
附件五

FUJI'S EXPERIENCE OF STEAM TURBINE PLANTS IN TAIWAN （TOTAL 4,855,413 KW / 43 UNITS）

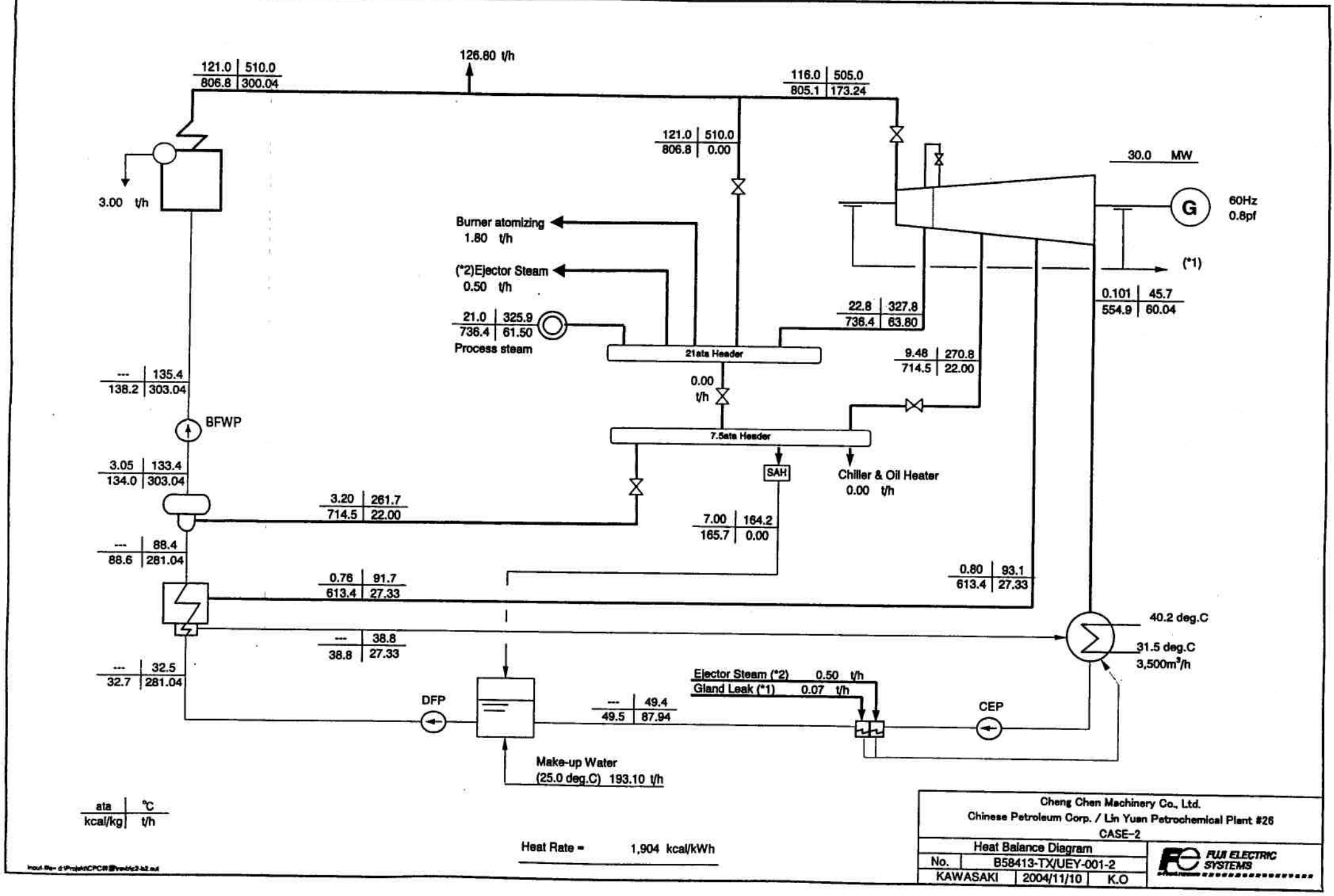


FUJI steam turbine model series

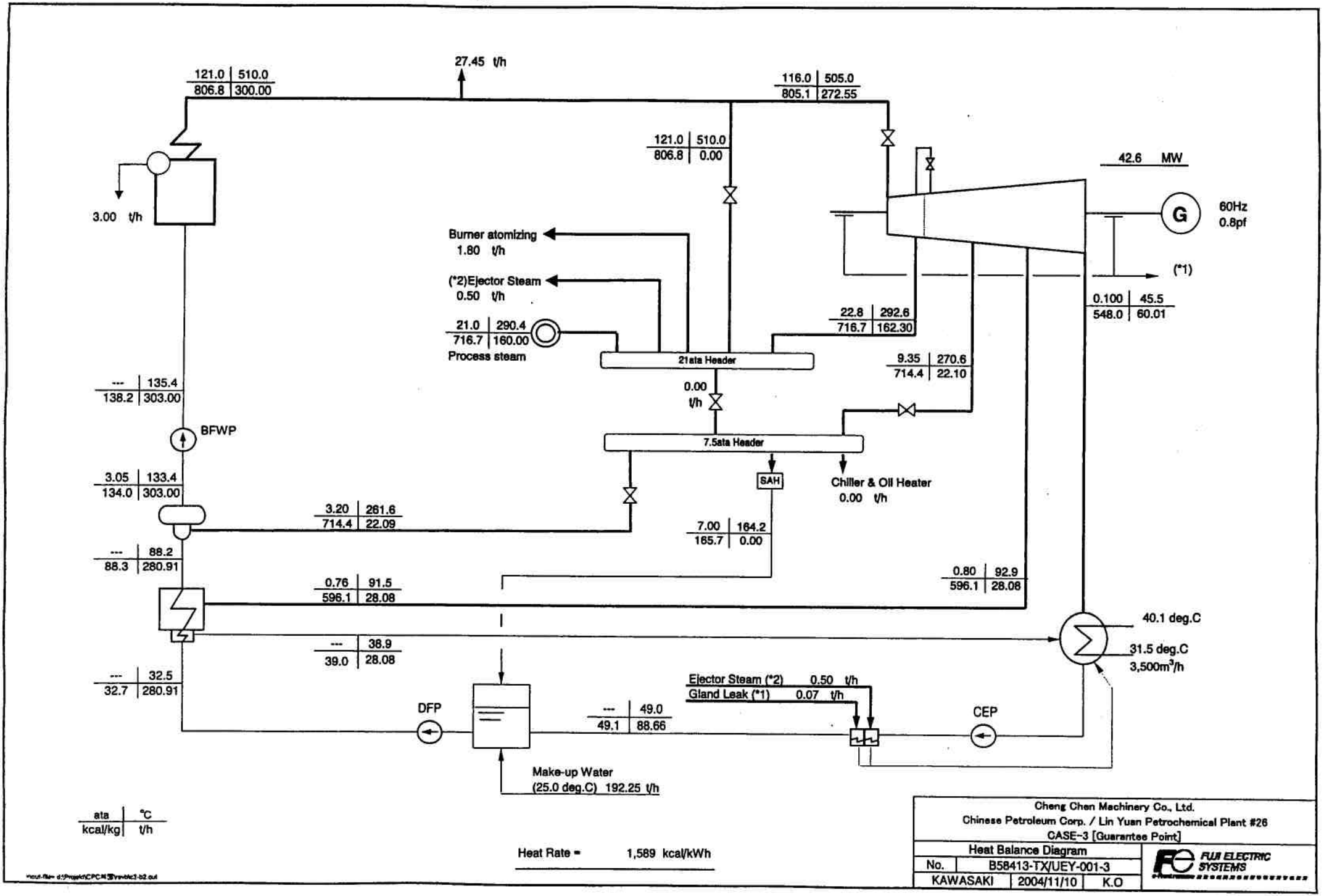



121.0 | 510.0
806.8 | 300.00
58.77 t/h
116.0 | 505.0
805.1 | 241.23
121.0 | 510.0
806.8 | 0.00
30.0 MW
G
60Hz
0.8pf
(*1)
3.00 t/h
Burner atomizing
1.80 t/h
(*2)Ejector Steam
0.50 t/h
21.0 | 299.4
721.8 | 160.00
Process steam
22.8 | 301.6
721.8 | 192.43
0.071 | 38.9
567.6 | 30.09
21ata Header
5.48 | 253.7
708.8 | 0.00
--- | 135.4
138.2 | 303.01
30.13
t/h
BFWP
7.5ata Header
SAH
Chiller & Oil Heater
0.00 t/h
3.05 | 133.4
134.0 | 303.01
3.20 | 276.8
721.8 | 30.13
7.00 | 164.2
165.7 | 0.00
--- | 69.0
69.1 | 272.88
0.38 | 74.4
622.7 | 18.65
0.34 | 71.6
622.7 | 18.65
36.1 deg.C
31.5 deg.C
3,500m³/h
--- | 32.1
32.1 | 18.65
--- | 28.6
28.7 | 272.88
Ejector Steam (*2) 0.50 t/h
Gland Leak (*1) 0.07 t/h
DFP
--- | 45.4
45.5 | 49.31
CEP
Make-up Water
(25.0 deg.C) 223.57 t/h
ata | °C
kcal/kg | t/h
Heat Rate = 1,415 kcal/kWh
Cheng Chen Machinery Co., Ltd.
Chinese Petroleum Corp. / Lin Yuan Petrochemical Plant #26
CASE-1
Heat Balance Diagram
No. B58413-TX/UEY-001-1
KAWASAKI 2004/11/10 K.O
FUJI ELECTRIC SYSTEMS

附件七


121.0 | 510.0
806.8 | 300.04
126.80 t/h
116.0 | 505.0
805.1 | 173.24
121.0 | 510.0
806.8 | 0.00
30.0 MW
G
60Hz
0.8pf
(*1)
3.00 t/h
Burner atomizing
1.80 t/h
(*2)Ejector Steam
0.50 t/h
21.0 | 325.9
736.4 | 61.50
Process steam
22.8 | 327.8
736.4 | 63.80
0.101 | 45.7
554.9 | 60.04
21ata Header
9.48 | 270.8
714.5 | 22.00
--- | 135.4
138.2 | 303.04
0.00
t/h
BFWP
7.5ata Header
SAH
Chiller & Oil Heater
0.00 t/h
3.05 | 133.4
134.0 | 303.04
3.20 | 261.7
714.5 | 22.00
7.00 | 164.2
165.7 | 0.00
--- | 88.4
88.6 | 281.04
0.80 | 93.1
613.4 | 27.33
0.76 | 91.7
613.4 | 27.33
40.2 deg.C
31.5 deg.C
3,500m³/h
--- | 38.8
38.8 | 27.33
--- | 32.5
32.7 | 281.04
Ejector Steam (*2) 0.50 t/h
Gland Leak (*1) 0.07 t/h
DFP
--- | 49.4
49.5 | 87.94
CEP
Make-up Water
(25.0 deg.C) 193.10 t/h
ata | ℃
kcal/kg | t/h
Heat Rate = 1,904 kcal/kWh
Cheng Chen Machinery Co., Ltd.
Chinese Petroleum Corp. / Lin Yuan Petrochemical Plant #26
CASE-2
Heat Balance Diagram
No. B58413-TX/UEY-001-2
KAWASAKI 2004/11/10 K.O
FUJI ELECTRIC SYSTEMS

附件七


121.0 | 510.0
806.8 | 300.00
27.45 t/h
116.0 | 505.0
805.1 | 272.55
121.0 | 510.0
806.8 | 0.00
42.6 MW
G
60Hz
0.8pf
(*1)
3.00 t/h
Burner atomizing
1.80 t/h
(*2)Ejector Steam
0.50 t/h
21.0 | 290.4
716.7 | 160.00
Process steam
22.8 | 292.6
716.7 | 162.30
0.100 | 45.5
548.0 | 60.01
21ata Header
9.35 | 270.6
714.4 | 22.10
--- | 135.4
138.2 | 303.00
0.00
t/h
BFWP
7.5ata Header
SAH
Chiller & Oil Heater
0.00 t/h
3.05 | 133.4
134.0 | 303.00
3.20 | 261.6
714.4 | 22.09
7.00 | 164.2
165.7 | 0.00
--- | 88.2
88.3 | 280.91
0.80 | 92.9
596.1 | 28.08
0.76 | 91.5
596.1 | 28.08
40.1 deg.C
31.5 deg.C
3,500m3/h
--- | 38.9
39.0 | 28.08
--- | 32.5
32.7 | 280.91
Elector Steam (*2) 0.50 t/h
Gland Leak (*1) 0.07 t/h
DFP
--- | 49.0
49.1 | 88.66
CEP
Make-up Water
(25.0 deg.C) 192.25 t/h
ata | °C
kcal/kg | t/h
Heat Rate = 1,589 kcal/kWh
Cheng Chen Machinery Co., Ltd.
Chinese Petroleum Corp. / Lin Yuan Petrochemical Plant #26
CASE-3 [Guarantee Point]
Heat Balance Diagram
No. B58413-TX/UEY-001-3
KAWASAKI 2004/11/10 K.O
FUJI ELECTRIC SYSTEMS

附件七

附件八

MANUFACTURING SCHEDULE

CHENG CHEN MACHINERY CO., LTD.
CPC #26 CO-GENERATION PROJECT

For Information

O/S No. B58413

Internal Distribution	Copy to	Revision	Date and Remarks	Drawn	Checked	Approved

Plant Design Department
Thermal Power Division
Fuji Electric Systems Co.,Ltd.

Drawn	N. NAKASHIMA	2005-2-28
Checked		
Approved		2005-3-1

Control No.
S-30-0001

Drawing No.
B58413-DKS/P001

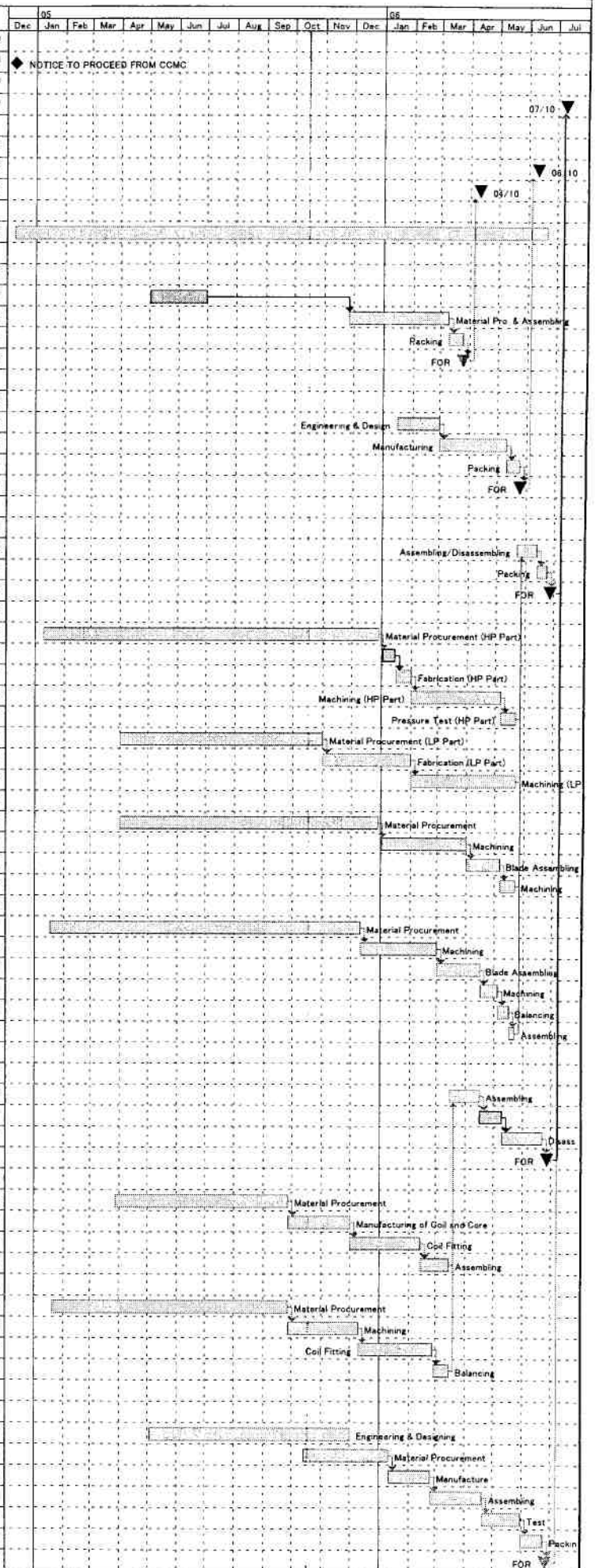
CHENG CHEN MACHINERY CO., LTD.
CPC #26

MANUFACTURING SCHEDULE

FUJI ELECTRIC SYSTEMS CO., LTD.

附件八

ID	WBS	Task	Period	Start	Finish
1	1	**KEY DATE**	577d	2004/12/10	2006/07/10
2	1.1	NOTICE TO PROCEED FROM CCMC	0d	2004/12/10	2004/12/10
3	1.2	CONTRACT FOB	0d	2006/07/10	2006/07/10
4	1.2.1	FOB-Steam Turbine/Generator	0d	2006/07/10	2006/07/10
5					
6	1.3	TARGET FOB	61d	2006/04/10	2006/06/10
7	1.3.1	FOB-Subsole Plate for STG	0d	2006/06/10	2006/06/10
8	1.3.2	FOB-LOOSELY SUPPLY CT	0d	2006/04/10	2006/04/10
9					
10	2	**OVERALL ENGINEERING & DESIGN**	558d	2004/12/10	2006/06/20
11					
12	3	**LOOSELY SUPPLY CT**	328d	2005/05/02	2006/03/25
13	3.1	Engineering	60d	2005/05/02	2005/06/30
14	3.2	Material Pro. & Assembling	104d	2005/11/26	2006/03/09
15	3.3	Packing	15d	2006/03/10	2006/03/24
16	3.4	FOR	1d	2006/03/25	2006/03/25
17					
18	4	**SUBSOLE PLATE**	130d	2006/01/16	2006/05/25
19	4.1	Engineering & Design	44d	2006/01/16	2006/02/28
20	4.2	Manufacturing	71d	2006/03/01	2006/05/10
21	4.3	Packing	14d	2006/05/11	2006/05/24
22	4.4	FOR	1d	2006/05/25	2006/05/25
23					
24	5	**STEAM TURBINE**	533d	2005/01/10	2006/06/26
25	5.1	Assembling/Disassembling	21d	2006/05/23	2006/06/12
26	5.2	Packing	11d	2006/06/13	2006/06/23
27	5.3	FOR	0d	2006/06/26	2006/06/26
28	5.4	Outer Casing	498d	2005/01/10	2006/05/22
29	5.4.1	Material Procurement (HP Part)	353d	2005/01/10	2005/12/28
30	5.4.2	Machining (HP Part)	13d	2006/01/02	2006/01/14
31	5.4.3	Fabrication (HP Part)	16d	2006/01/16	2006/01/31
32	5.4.4	Machining (HP Part)	95d	2006/02/01	2006/05/06
33	5.4.5	Pressure Test (HP Part)	16d	2006/05/07	2006/05/22
34	5.4.6	Material Procurement (LP Part)	214d	2005/04/01	2005/10/31
35	5.4.7	Fabrication (LP Part)	92d	2005/11/01	2006/01/31
36	5.4.8	Machining (LP Part)	111d	2006/02/01	2006/05/22
37	5.5	Inner Casing	417d	2005/04/01	2006/05/22
38	5.5.1	Material Procurement	272d	2005/04/01	2005/12/28
39	5.5.2	Machining	89d	2006/01/02	2006/03/31
40	5.5.3	Blade Assembling	35d	2006/04/01	2006/05/06
41	5.5.4	Machining	16d	2006/05/07	2006/05/22
42	5.6	Rotor	491d	2005/01/17	2006/05/22
43	5.6.1	Material Procurement	328d	2005/01/17	2005/12/10
44	5.6.2	Machining	80d	2005/12/11	2006/02/28
45	5.6.3	Blade Assembling	46d	2006/03/01	2006/04/15
46	5.6.4	Machining	19d	2006/04/16	2006/05/04
47	5.6.5	Balancing	12d	2006/05/05	2006/05/16
48	5.6.6	Assembling	6d	2006/05/17	2006/05/22
49					
50	6	**GENERATOR**	523d	2005/01/20	2006/06/26
51	6.1	Assembling	32d	2006/03/15	2006/04/15
52	6.2	Test	24d	2006/04/16	2006/05/09
53	6.3	Disassembling/Packing	43d	2006/05/10	2006/06/21
54	6.4	FOR	0d	2006/06/26	2006/06/26
55	6.5	Stator	352d	2005/03/28	2006/03/14
56	6.5.1	Material Procurement	183d	2005/03/28	2005/09/26
57	6.5.2	Manufacturing of Coil and Core	65d	2005/09/27	2005/11/30
58	6.5.3	Coil Fitting	74d	2005/12/01	2006/02/12
59	6.5.4	Assembling	30d	2006/02/13	2006/03/14
60	6.6	Rotor	419d	2005/01/20	2006/03/14
61	6.6.1	Material Procurement	250d	2005/01/20	2005/09/26
62	6.6.2	Machining	74d	2005/09/27	2005/12/09
63	6.6.3	Coil Fitting	78d	2005/12/10	2006/02/25
64	6.6.4	Balancing	16d	2006/02/27	2006/03/14
65					
66	7	**ELECTRICAL and I & C EQUIPMENT**	420d	2005/05/03	2006/06/26
67	7.1	Engineering & Designing	212d	2005/05/03	2005/11/30
68	7.2	Material Procurement	90d	2005/10/13	2006/01/10
69	7.3	Manufacture	44d	2006/01/11	2006/02/23
70	7.4	Assembling	55d	2006/02/24	2006/04/19
71	7.5	Test	41d	2006/04/20	2006/05/30
72	7.6	Packing	24d	2006/05/31	2006/06/23
73	7.7	FOR	1d	2006/06/26	2006/06/26



Original Issue : Planed by N.Nakashima, Checked by C.Kan, Approved by S.Suzuki
Revised A(2005/10/14) : N.Nakashima, Checked by C. Kan, Approved by S.Suzuki

Orinigal w/w Issue Date : 2005-02-28
Dwg No. : B58413-DKS/P001 rev.A

附件九

SHOP INSPECTION AND TEST PLAN

CHENG CHEN MACHINERY CO., LTD.
CPC #26 CO-GENERATION PROJECT

For Approval

O/S No. B58413

Internal Distribution	
Copy to	
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(火技工)	1
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(火設 1)	1
(火設 2)	
[火プ建]	
(火計設)	1
(火構設)	4
(回設火)	1
(回電設)	1
[品]	3

Revision	Date and Remarks	Drawn	Checked	Approved

Plant Quality Assurance Department
Thermal Power Division
Fuji Electric Systems Co.,Ltd.

Drawn	Haruki Matsuda	May 30, 2005
Checked		May 30, 2005
Approved		May 31, 2005

Control No.
Q-40-0001

Drawing No.
B58413-DEQ/7000

0	

Total 19 sheets

1. General

附件九

This list covers workshop inspection and test for the equipment supplied by Fuji Electric Systems Co., Ltd., and describes witness point, test place, test procedure and document.

2. Test item type (Column of PARTICIPATION BY)

CLE.	: Client and/or Owner's engineer
ENG.	: Engineering company's engineer
FUJI	: Fuji Electric Systems Co., Ltd. (referred to as Fuji)
SUB.	: Fuji's Sub-contractor
REP.	: Report
○	: Item of apply.

"○" marks which are in FUJI and/or SUB. column mean that Fuji and/or his sub-contractor perform the test/inspection at their factory.

"○" marks which are in CLE and/or ENG column mean that Client and/or Engineering company attend jointly on the test/inspection at Fuji or his sub-contractor's factory.

"○" marks which are in REP column mean that test report or certificate will be issued and sent to the client for reference.

3. Applicable Specification and Procedure

附件九

Applicable Specification and Procedure for test and inspection are shown with following abbreviation.

AFBMA	:	ANTIFRICTION BEARING MANUFACTURE'S ASSOCIATION
AGMA	:	AMERICAN GEAR MANUFACTURE'S ASSOCIATION
AISC	:	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AISI	:	AMERICAN IRON AND STEEL INSTITUTE
ANSI	:	AMERICAN NATIONAL STANDARDS INSTITUTE
ANST	:	AMERICAN SOCIETY FOR NON-DESTRUCTIVE TESTING
API	:	AMERICAN PETROLEUM INSTITUTE
ASME	:	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTM	:	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWS	:	AMERICAN WELDING SOCIETY
DIN	:	DEUTSCHES INSTITUT FUER NORMUNG
DWG	:	MANUFACTURER'S DRAWING
HI	:	HYDRAULIC INSTITUTE
IEC	:	INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEEE	:	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS
ISA	:	INSTRUMENT SOCIETY OF AMERICAN
ISO	:	INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
JEC	:	JAPANESE ELECTROTECHNICAL COMMITTEE
JEM	:	JAPAN ELECTRICAL MANUFACTURER'S ASSOCIATION
JIS	:	JAPANESE INDUSTRIAL STANDARD
KWU	:	KRAFTWERK UNION
MS	:	MANUFACTURER'S STANDARD
NEMA	:	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NIST	:	NATIONAL INSTITUTE OF STANDARDS AND TESTING
SPEC	:	CUSTOMER'S SPECIFICATION
SSPC	:	STEEL STRUCTURES PAINTING COUNCIL
VDI	:	VEREIN DEUTSCHER INGENIEURE, GERMANY
FEM	:	FEDERATION EUROPEENNE DE LA MANNTENTION

4. Others

○ : Column of PRO.
Test procedure will be submitted to the CLE/ENG before the inspection/test.

Column of REV.
Identification of revised status.

Contents

附件九

TSC Steam Turbine ---------- Page 1 - 4

- TSC 01 Outer Casing (Front)
- TSC 02 Outer Casing (Rear)
- TSC 03 Inner Casing (1)
- TSC 04 Inner Casing (2)
- TSC 05 Stationary Blade Holder (1)
- TSC 06 Stationary Blade Holder (2)
- TSC 07 Rotor
- TSC 08 Stationary Blade (Machined)
- TSC 09 Moving Blade (Machined)
- TSC 10 Labyrinth Ring and Gland Packing Ring (Front and Rear)
- TSC 11 Bearing Pedestal (Front)
- TSC 12 Journal and Thrust Bearing
- TSC 99 Assembly of Turbine

TCA Control and Protection ---------- Page 5

- TCA 01 Main Steam Stop Valve
- TCA 02 Main Steam Control Valve
- TCA 03 Extraction Control Valve

TPC Lube Oil System ---------- Page 6 - 7

- TPC 01 Main Oil Pump
- TPC 02 Emergency Oil Pump
- TPC 03 Main Oil Tank
- TPC 04 Lube Oil Cooler
- TPC 05 Lube Oil Accumulator
- TPC 06 Lube Oil filter
- TPC 99 Lube Oil Console

TCC Control Oil System ---------- Page 8

- TCC 01 Control Oil Pump
- TCC 02 Control Oil Tank
- TCC 03 Control Oil Radiator
- TCC 04 Control Oil Accumulator
- TCC 99 Control Oil Console

CSA Condensing Unit ---------- Page 9
CSA 01 Steam Jet Air Ejector

GAA Air Cooled Generator ---------- Page 10 - 11
GAA01 Stator
GAA02 Stator Core
GAA03 Stator Coil
GAA04 Rotor
GAA05 Rotor Coil
GAA06 Rotor Slot Wedge
GAA07 Retaining Ring
GAA08 Fan
GAA09 Bearing Pedestal
GAA10 Journal Bearing
GAA30 Air Cooler

GEA Exciter and P.M.G. ---------- Page 12
GEA01 Exciter and P.M.G. Stator
GEA02 Exciter Rotor
GEA03 P.M.G. Rotor

GEN Assembly of Generator ---------- Page 13
GEN99 Assembly of Generator

EPA Panel and Cubicle ---------- Page 14
EPA01 TG Regulator Cubicle (TGR)
EPA02 MIMIC Control Panel
EPA03 DC Motor Starting Panel
EPA04 PT/SA Cubicle
EPA05 NGR Cubicle

SHOP INSPECTION AND TEST PLAN

Chinese Petroleum Corporation #26 Co-Generation Project

Date: May 30, 2005

附件九

No.	DESCRIPTION OF INSPECTION	PARTICIPATION BY [CLE	[ENG	[FUJI	[SUB	[REP	PLACE / PROCEDURE	[PRO	[REV
TSC	**STEAM TURBINE**								
TSC01	**OUTER CASING (FRONT)**								
	A)CASTING								
	01)Control of Heat treatment	[	[	[	[O	[O	MS.	[	[
	02)Chemical analysis	[	[	[	[O	[O	DWG.	[	[
	03)Mechanical properties	[	[	[	[O	[O	DWG.	[	[
	04)Dimensional check	[	[	[	[O	[	DWG.	[	[
	05)Visual inspection	[	[	[	[O	[	DWG.	[	[
	06)Ultrasonic inspection	[	[	[	[O	[O	JIS Z2344	[	[
	07)Magnetic particle inspection and/or Dye penetrant inspection	[	[	[	[O	[O	JIS G0565 and/or JIS Z2343	[	[
	B)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	03)Hydraulic pressure test for Steam chest (HP Valve)	[	[	[O	[	[O	1.5XMax.working press., 30min	[	[
TSC02	**OUTER CASING (REAR)**								
	A)ROLLING OF STEEL PLATE								
	01)Chemical analysis	[	[	[	[O	[	DWG.	[	[
	02)Mechanical properties	[	[	[	[O	[	DWG.	[	[
	B)WELDING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	MS.	[	[
	02)Magnetic particle inspection	[	[	[O	[	[O	JIS G0565	[	[
	03)Control of Stress relief condition	[	[	[O	[	[	MS.	[	[
	C)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
TSC03	**INNER CASING (1)**								
	A)CASTING								
	01)Control of Heat treatment	[	[	[	[O	[O	MS.	[	[
	02)Chemical analysis	[	[	[	[O	[O	DWG.	[	[
	03)Mechanical properties	[	[	[	[O	[O	DWG.	[	[
	04)Dimensional check	[	[	[	[O	[	DWG.	[	[
	05)Visual inspection	[	[	[	[O	[	DWG.	[	[
	06)Ultrasonic inspection	[	[	[	[O	[O	JIS Z2344	[	[
	07)Magnetic particle inspection and/or Dye penetrant inspection	[	[	[	[O	[O	JIS G0565 and/or JIS Z2343	[	[
	B)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	C)BLADE FITTING & MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
TSC04	**INNER CASING (2)**								
	A)CASTING								
	01)Control of Heat treatment	[	[	[	[O	[O	MS.	[	[
	02)Chemical analysis	[	[	[	[O	[O	DWG.	[	[
	03)Mechanical properties	[	[	[	[O	[O	DWG.	[	[
	04)Dimensional check	[	[	[	[O	[	DWG.	[	[

SHOP INSPECTION AND TEST PLAN

Chinese Petroleum Corporation #26 Co-Generation Project

Date: May 30, 2005
Page: 2

附件九

No.	DESCRIPTION OF INSPECTION	PARTICIPATION BY [CLE	[ENG	[FUJI	[SUB	[REP	PLACE / PROCEDURE	[PRO	[REV
	05)Visual inspection	[	[	[	[O	[	DWG.	[	[
	06)Ultrasonic inspection	[	[	[	[O	[O	JIS Z2344	[	[
	07)Magnetic particle inspection and/or Dye penetrant inspection	[	[	[	[O	[O	JIS G0565 and/or JIS Z2343	[	[
	B)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	C)BLADE FITTING & MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	TSC05 STATIONARY BLADE HOLDER (1)								
	A)CASTING								
	01)Control of Heat treatment	[	[	[	[O	[	MS.	[	[
	02)Chemical analysis	[	[	[	[O	[O	DWG.	[	[
	03)Mechanical properties	[	[	[	[O	[O	DWG.	[	[
	04)Dimensional check	[	[	[	[O	[	DWG.	[	[
	05)Visual inspection	[	[	[	[O	[	DWG.	[	[
	06)Ultrasonic inspection	[	[	[	[O	[	JIS Z2344	[	[
	07)Magnetic particle inspection and/or Dye penetrant inspection	[	[	[	[O	[	JIS G0565 and/or JIS Z2343	[	[
	B)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	C)BLADE FITTING & MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	TSC06 STATIONARY BLADE HOLDER (2)								
	A)ROLLING OF STEEL PLATE								
	01)Material check	[	[	[	[O	[	JIS	[	[
	B)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	C)BLADE FITTING & MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	TSC07 ROTOR								
	A)FORGING								
	01)Forging ratio check	[	[	[	[O	[	DWG.	[	[
	02)Control of Heat treatment	[	[	[	[O	[O	MS.	[	[
	03)Chemical analysis	[	[	[	[O	[O	DWG.	[	[
	04)Mechanical properties	[	[	[	[O	[O	DWG.	[	[
	05)Dimensional check	[	[	[	[O	[	DWG.	[	[
	06)Visual inspection	[	[	[	[O	[	DWG.	[	[
	07)Ultrasonic inspection	[	[	[	[O	[O	JIS Z2344	[	[
	08)Heat stability test	[	[	[	[O	[O	MS.	[	[
	B)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[

SHOP INSPECTION AND TEST PLAN

Chinese Petroleum Corporation #26 Co-Generation Project

Date: May 30, 2005
Page: 3

附件九

No.	DESCRIPTION OF INSPECTION	PARTICIPATION BY [CLE	[ENG	[FUJI	[SUB	[REP	PLACE / PROCEDURE	[PRO	[REV
	C)BLADE & FIN FITTING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Runout check (Deflection check)	[	[	[O	[	[		[	[
	03)Over speed test	[	[	[O*1	[	[O	*1:120% of rated speed, 2min	[O	[
	04)Dynamic balancing test	[	[	[O	[	[O	MS.	[O	[
	05)Runout check (Deflection check)	[	[	[O	[	[		[	[
	06)Visual inspection	[	[	[O	[	[	DWG.	[	[
	TSC08 STATIONARY BLADE (MACHINED)								
	A)ROLLING								
	01)Control of Heat treatment	[	[	[	[O	[O	MS.	[	[
	02)Chemical analysis	[	[	[	[O	[O	JIS G1201	[	[
	03)Mechanical properties	[	[	[	[O	[O	JIS Z2202, Z2241, Z2242	[	[
	04)Dimensional check	[	[	[	[O	[	DWG.	[	[
	05)Ultrasonic inspection	[	[	[	[O	[	JIS Z2344	[	[
	B)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Magnetic particle inspection	[	[	[O	[	[	JIS G0565	[	[
	03)Visual inspection	[	[	[O	[	[	DWG.	[	[
	TSC09 MOVING BLADE (MACHINED)								
	A)ROLLING								
	01)Control of Heat treatment	[	[	[	[O	[O	MS.	[	[
	02)Chemical analysis	[	[	[	[O	[O	JIS G1201	[	[
	03)Mechanical properties	[	[	[	[O	[O	JIS Z2202, Z2241, Z2242	[	[
	04)Dimensional check	[	[	[	[O	[	DWG.	[	[
	05)Ultrasonic inspection	[	[	[	[O	[	JIS G0565	[	[
	B)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Magnetic particle inspection	[	[	[O	[	[	JIS G0565	[	[
	03)Visual inspection	[	[	[O	[	[	DWG.	[	[
	TSC10 LABYRINTH RING AND GLAND PACKING RING (FRONT AND REAR)								
	A)RAW MATERIAL								
	01)Material check	[	[	[	[O	[	JIS	[	[
	02)Dimensional check	[	[	[	[O	[	DWG.	[	[
	B)MACHINING								
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	TSC11 BEARING PEDESTAL (FRONT AND REAR)								
	A)STOCK MATERIAL								
	01)Material check	[	[	[	[O	[	JIS	[	[
	B)WELDING								
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Magnetic particle inspection	[	[	[O	[	[	JIS G0565	[	[
	03)Control of Stress relief condition	[	[	[O	[	[	MS.	[	[
	C)MACHINING								
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[

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No.	DESCRIPTION OF INSPECTION	PARTICIPATION BY [CLE	[ENG	[FUJI	[SUB	[REP	PLACE / PROCEDURE	[PRO	[REV
TSC12	**JOURNAL AND THRUST BEARING**								
	A)MACHINING								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Separation check of White metal (Ultrasonic inspection)	[	[	[	[O	[	JIS Z2344	[	[
	03)Dye Penetrant Inspection	[	[	[	[O	[	JIS Z2343	[	[
	04)Visual Inspection	[	[	[	[O	[	DWG.	[	[
TSC99	**ASSEMBLY OF TURBINE**								
	A)FINAL ASSEMBLY						Fuji/Kawasaki, Japan		
	01)Alignment Check	[	[	[O	[	[O	DWG.	[	[
	02)Clearance Check	[	[	[O	[	[O	DWG.	[	[
	03)Visual inspection	[	[	[O	[	[	DWG. MS.	[	[
	B)PAINTING						Fuji/Kawasaki, Japan		
	01)Painting inspection	[	[	[O	[	[	DWG. MS.	[	[
	C)PACKING						Fuji/Kawasaki, Japan		
	01)Packing inspection	[	[	[O	[	[	MS.	[	[

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No.	DESCRIPTION OF INSPECTION	PARTICIPATION BY [CLE	[ENG	[FUJI	[SUB	[REP	PLACE / PROCEDURE	[PRO	[REV
TCA	**CONTROL & PROTECTION**								
TCA01	**MAIN STEAM STOP VALVE**								
	A)CASTING OF VALVE COVER								
	01)Chemical analysis	[	[	[	[O	[O	JIS G1201	[	[
	02)Mechanical Properties	[	[	[	[O	[O	JIS Z2202, Z2241, Z2242	[	[
	03)Magnetic particle inspection	[	[	[	[O	[O	JIS G0565	[	[
	B)RAW MATERIAL OF MINOR PARTS								
	01)Chemical analysis	[	[	[	[O	[	JIS G1201	[	[
	02)Mechanical properties	[	[	[	[O	[	JIS Z2202, Z2241, Z2242	[	[
	C)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	D)ASSEMBLING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	03)Clearance check	[	[	[O	[	[	DWG.	[	[
	04)Function test for Actuator	[	[	[	[O	[O	MS.	[	[
TCA02	**MAIN STEAM CONTROL VALVE**								
	A)CASTING OF VALVE COVER								
	01)Chemical analysis	[	[	[	[O	[O	JIS G1201	[	[
	02)Mechanical properties	[	[	[	[O	[O	JIS Z2202, Z2241, Z2242	[	[
	03)Magnetic particle inspection	[	[	[	[O	[O	JIS G0565	[	[
	B)RAW MATERIAL OF MINOR PARTS								
	01)Chemical analysis	[	[	[	[O	[	JIS G1201	[	[
	02)Mechanical properties	[	[	[	[O	[	JIS Z2202, Z2241, Z2242	[	[
	C)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	D)ASSEMBLING OF CONTROL VALVE						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	03)Clearance check	[	[	[O	[	[	DWG.	[	[
	04)Function test for Actuator	[	[	[	[O	[O	MS.	[	[
TCA03	**EXTRACTION CONTROL VALVE**								
	A)CASTING OF VALVE COVER								
	01)Chemical Analysis	[	[	[	[O	[O	JIS G1201	[	[
	02)Mechanical Properties	[	[	[	[O	[O	JIS Z2202, Z2241, Z2242	[	[
	03)Magnetic Particle Inspection	[	[	[	[O	[O	JIS G0565	[	[
	B)RAW MATERIAL OF MINOR PARTS								
	01)Chemical Analysis	[	[	[	[O	[	JIS G1201	[	[
	02)Mechanical Properties	[	[	[	[O	[	JIS Z2202, Z2241, Z2242	[	[
	C)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional Check	[	[	[O	[	[	DWG.	[	[
	02)Visual Inspection	[	[	[O	[	[	DWG.	[	[
	D)ASSEMBLING OF CONTROL VALVE						Fuji/Kawasaki, Japan		
	01)Dimensional Check	[	[	[O	[	[	DWG.	[	[
	02)Visual Inspection	[	[	[O	[	[	DWG.	[	[
	03)Clearance Check	[	[	[O	[	[	DWG.	[	[
	04)Function Test for Actuator	[	[	[	[O	[O	MS.	[	[

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No.	DESCRIPTION OF INSPECTION	PARTICIPATION BY [CLE	[ENG	[FUJI	[SUB	[REP	PLACE / PROCEDURE	[PRO	[REV
TPC	**LUBE OIL SYSTEM**								
TPC01	**MAIN OIL PUMP**								
	A)TOTAL ASSEMBLING								
	01)Visual inspection	[	[	[	[O	[	DWG.	[	[
	02)Dimensional check	[	[	[	[O	[	DWG.	[	[
	03)Mechanical running test	[	[	[	[O	[O	MS.	[	[
	04)Performance test	[	[	[	[O	[O	MS.	[	[
	05)Vibration measurement	[	[	[	[O	[O	MS.	[	[
	06)Noise measurement	[	[	[	[O	[O	MS.	[	[
	07)Painting check	[	[	[	[O	[	DWG.	[	[
TPC02	**EMERGENCY OIL PUMP**								
	A)TOTAL ASSEMBLING								
	01)Visual inspection	[	[	[	[O	[	DWG.	[	[
	02)Dimensional check	[	[	[	[O	[	DWG.	[	[
	03)Mechanical running test	[	[	[	[O	[O	MS.	[	[
	04)Performance test	[	[	[	[O	[O	MS.	[	[
	05)Vibration measurement	[	[	[	[O	[O	MS.	[	[
	06)Noise measurement	[	[	[	[O	[O	MS.	[	[
	07)Painting check	[	[	[	[O	[	DWG.	[	[
TPC03	**MAIN OIL TANK**								
	A)WELDING								
	01)Visual inspection	[	[	[	[O	[	DWG.	[	[
	02)Dimensional check	[	[	[	[O	[	DWG.	[	[
	03)Dye penetrant inspection	[	[	[	[O	[	JIS Z 2343/ASME SecⅢ	[	[
	04)Water filling test	[	[	[	[O	[	at Atmospheric press., 24hr	[	[
TPC04	**LUBE OIL COOLER**								
	A)MATERIAL(FOR TUBE AND SHELL)								
	01)Chemical analysis	[	[	[	[O	[	JIS,ASME	[	[
	02)Mechanical properties	[	[	[	[O	[	JIS,ASME	[	[
	B)FABRICATING AND MACHINING								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Visual inspection	[	[	[	[O	[	DWG.	[	[
	03)Dye penetrant inspection	[	[	[	[O	[	JIS Z 2343/ASME SecⅢ	[	[
	04)Hydraulic pressure test	[	[	[	[O	[	applicable standard	[	[
	C)ASSEMBLING								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Visual inspection	[	[	[	[O	[	DWG.	[	[
	03)Painting check	[	[	[	[O	[	DWG.	[	[
TPC05	**LUBE OIL ACCUMULATOR**								
	A)COMPLETION								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Visual inspection	[	[	[	[O	[	DWG.	[	[
	03)Hydraulic pressure test	[	[	[	[O	[	applicable standard	[	[
TPC06	**LUBE OIL PURIFIER**								
	A)COMPLETION								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Visual inspection	[	[	[	[O	[	DWG.	[	[
	03)Mechanical running test	[	[	[	[O	[	MS.	[	[

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No.	DESCRIPTION OF INSPECTION	PARTICIPATION BY [CLE	[ENG	[FUJI	[SUB	[REP	PLACE / PROCEDURE	[PRO	[REV
	04)Painting check	[	[	[	[O	[	DWG.	[	[
TPC99	LUBE OIL CONSOLE								
	A)COMPLETION								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Visual inspection	[	[	[	[O	[	DWG.	[	[
	03)Assembling inspection	[	[	[	[O	[	DWG.	[	[
	B)PACKING								
	01)Packing inspection	[	[	[	[O	[	MS.	[	[

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No.	DESCRIPTION OF INSPECTION	PARTICIPATION BY [CLE	[ENG	[FUJI	[SUB	[REP	PLACE / PROCEDURE	[PRO	[RE
TCC	**CONTROL OIL SYSTEM**								
TCC01	**CONTROL OIL PUMP**								
	A)TOTAL ASSEMBLING								
	01)Visual inspection	[	[	[	[O	[	DWG.	[	[
	02)Dimensional check	[	[	[	[O	[	DWG.	[	[
	03)Mechanical running test	[	[	[	[O	[O	MS.	[	[
	04)Performance test	[	[	[	[O	[O	MS.	[	[
	05)Vibration measurement	[	[	[	[O	[O	MS.	[	[
	06)Noise measurement	[	[	[	[O	[O	MS.	[	[
	07)Painting check	[	[	[	[O	[	DWG.	[	[
TCC02	**CONTROL OIL TANK**								
	A)WELDING								
	01)Visual inspection	[	[	[	[O	[	DWG.	[	[
	02)Dimensional check	[	[	[	[O	[	DWG.	[	[
	03)Dye penetrant inspection	[	[	[	[O	[	JIS Z 2343/ASME Sec Ⅲ	[	[
	04)Water filling test	[	[	[	[O	[	at Atmospheric press., 24hr	[	[
TCC03	**CONTROL OIL RADIATOR**								
	A)COMPLETION								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Visual inspection	[	[	[	[O	[	DWG.	[	[
	03)Painting check	[	[	[	[O	[	DWG.	[	[
TCC04	**CONTROL OIL ACCUMULATOR**								
	A)COMPLETION								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Visual inspection	[	[	[	[O	[	DWG.	[	[
	03)Hydraulic pressure test	[	[	[	[O	[	applicable standard	[	[
TCC99	**CONTROL OIL UNIT**								
	A)COMPLETION								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Visual inspection	[	[	[	[O	[	DWG.	[	[
	03)Assembling inspection	[	[	[	[O	[	DWG.	[	[
	04)Unit test run & Function test	[	[	[	[O	[	MS.	[	[
	B)PACKING								
	01)Packing inspection	[	[	[	[O	[	MS.	[	[

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No.	DESCRIPTION OF INSPECTION	PARTICIPATION BY [CLE	[ENG	[FUJI	[SUB	[REP	PLACE / PROCEDURE	[PRO	[REV
CSA	**CONDENSING UNIT**								
CSA01	**STEAM JET AIR EJECTOR**								
	A)PURCHASING OF MATERIAL (FOR TUBE)								
	01)Chemical analysis	[	[	[	[O	[	JIS	[	[
	02)Mechanical properties	[	[	[	[O	[	JIS	[	[
	B)FABRICATING AND MACHINING								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Visual inspection	[	[	[	[O	[	DWG.	[	[
	03)Dye penetrant inspection for Welding seam	[	[	[	[O	[	JIS Z2343	[	[
	04)Hydraulic pressure test	[	[	[	[O	[	1.5XMax.working press., 30min	[	[
	C)FINAL ASSEMBLING								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Visual inspection	[	[	[	[O	[	DWG.	[	[
	D)PAINTING								
	01)Painting inspection	[	[	[	[O	[	DWG. MS.	[	[
	E)PACKING								
	01)Packing inspection	[	[	[	[O	[	MS.	[	[

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No.	DESCRIPTION OF INSPECTION	PARTICIPATION BY [CLE	[ENG	[FUJI	[SUB	[REP	PLACE / PROCEDURE	[PRO	[REV
GAA	**AIR COOLED GENERATOR**								
GAA01	**STATOR**								
	A)CORE STACKING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	B)COIL CONNECTION						Fuji/Kawasaki, Japan		
	01)Insulation resistance measurement	[	[	[O	[	[	MS.	[	[
	02)Withstand voltage test (Dielectric test) of Stator winding	[	[	[O	[	[	IEC 60034	[	[
	03)Winding resistance measurement	[	[	[O	[	[	MS.	[	[
GAA02	**STATOR CORE**								
	A)RAW MATERIALS								
	01)Magnetic characteristics	[	[	[	[O	[	JIS	[	[
GAA03	**STATOR COIL**								
	A)RAW MATERIALS								
	01)Electrical conductivity	[	[	[	[O	[	MS.	[	[
GAA04	**ROTOR**								
	A)FORGING								
	01)Control of Heat treatment	[	[	[	[O	[	MS.	[	[
	B)ROUGH MACHINING								
	01)Chemical composition	[	[	[	[O	[O	MS.	[	[
	02)Mechanical properties	[	[	[	[O	[O	MS.	[	[
	03)Dimensional check	[	[	[	[O	[	DWG.	[	[
	04)Ultrasonic inspection	[	[	[	[O	[O	MS.	[	[
	C)COIL CONNECTION						Fuji/Kawasaki, Japan		
	01)Insulation resistance measurement	[	[	[O	[	[	MS.	[	[
	02)Withstand voltage test (Dielectric test)	[	[	[O	[	[	IEC 60034	[	[
	03)Winding resistance measurement	[	[	[O	[	[		[	[
	04)Dimensional check	[	[	[O	[	[	DWG.	[	[
	D)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	E)COMPLETION						Fuji/Kawasaki, Japan		
	01)Over speed test	[	[	[O*1	[	[O	*1:120% of rated speed, 2min	[	[
	02)Dynamic balancing test	[	[	[O	[	[O	JIS	[	[
	03)Visual inspection	[	[	[O	[	[	DWG.	[	[
GAA05	**ROTOR COIL**								
	A)RAW MATERIALS								
	01)Chemical composition	[	[	[	[O	[	MS.	[	[
	02)Mechanical properties	[	[	[	[O	[	MS.	[	[
GAA06	**ROTOR SLOT WEDGE**								
	A)RAW MATERIALS								
	01)Chemical composition	[	[	[	[O	[	MS.	[	[
	02)Mechanical properties	[	[	[	[O	[	MS.	[	[
	03)Ultrasonic inspection	[	[	[	[O	[	MS.	[	[

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No.	DESCRIPTION OF INSPECTION	PARTICIPATION BY [CLE	[ENG	[FUJI	[SUB	[REP	PLACE / PROCEDURE	[PRO	[RE
	B)MACHINING								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Dye penetrant inspection	[	[	[	[O	[	MS.	[	[
	GAA07 RETAINING RING								
	A)ROUGH MACHINING								
	01)Chemical composition	[	[	[	[O	[O	MS.	[	[
	02)Mechanical properties	[	[	[	[O	[O	MS.	[	[
	03)Dimensional check	[	[	[	[O	[	DWG.	[	[
	04)Ultrasonic inspection	[	[	[	[O	[O	MS.	[	[
	05)Dye penetrant inspection	[	[	[	[O	[O	MS.	[	[
	B)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	02)Visual inspection	[	[	[O	[	[	DWG.	[	[
	GAA08 FAN								
	A)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	GAA09 BEARING PEDESTAL								
	A)WELDING						Fuji/Kawasaki, Japan		
	01)Visual inspection of Welding	[	[	[O	[	[	DWG.	[	[
	B)MACHINING						Fuji/Kawasaki, Japan		
	01)Dimensional check	[	[	[O	[	[	DWG.	[	[
	GAA10 JOURNAL BEARING								
	A)WHITE METAL CASTING								
	01)Chemical composition of White metal	[	[	[	[O	[	JIS	[	[
	B)MACHINING								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Separation check of White metal (Ultrasonic inspection)	[	[	[	[O	[	MS.	[	[
	03)Dye penetrant inspection	[	[	[	[O	[	MS.	[	[
	GAA30 AIR COOLER								
	A)RAW MATERIALS								
	01)Material test for Tube	[	[	[	[O	[	JIS	[	[
	B)ASSEMBLY OF AIR COOLER								
	01)Dimensional check	[	[	[	[O	[	DWG.	[	[
	02)Hydraulic pressure test	[	[	[	[O	[O	MS.	[	[

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GEA	**EXCITER & P.M.G.**								
GEA01	**EXCITER & P.M.G STATOR**								
	A)COIL CONNECTION						Fuji/Kawasaki, Japan		
	01)Insulation resistance measurement	[	[	[O	[	[	MS.	[	[
	02)Withstand voltage test (Dielectric Test)	[	[	[O	[	[	IEC 60034	[	[
	03)Visual inspection	[	[	[O	[	[	DWG.	[	[
GEA02	**EXCITER ROTOR**								
	A)COIL CONNECTION								
	01)Insulation resistance measurement	[	[	[O	[	[	MS	[	[
	02)Withstand voltage test (Dielectric Test)	[	[	[O	[	[	IEC 60034	[	[
	03)Winding resistance measurement	[	[	[O	[	[		[	[
	04)Dimensional check	[	[	[O	[	[		[	[
	B)ASSEMBLY OF ROTATING RECTIFIER								
	01)Visual check	[	[	[O	[	[	DWG.	[	[
	02)Insulation resistance measurement	[	[	[O	[	[		[	[
	03)Withstand voltage test (Dielectric Test)	[	[	[O	[	[	IEC 60034	[	[
GEA03	**P.M.G. ROTOR**								
	A)POLE ASSEMBLY								
	01)Visual inspection	[	[	[O	[	[	DWG.	[	[
	02)Polarity check	[	[	[O	[	[	DWG.	[	[

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GEN	**ASSEMBLY OF GENERATOR**								
GEN99	**ASSEMBLY OF GENERATOR**								
	A)ASSEMBLY OF GENERATOR WITHOUT EXCITER & P.M.G.								
	01)Winding resistance measurement	[	[	[O	[	[O	IEC 60034-4	[	[
	02)No load characteristics (Generator only)	[	[	[O	[	[O	IEC 60034-4	[	[
	03)Short circuit characteristics (Generator only)	[	[	[O	[	[O	IEC 60034-4	[	[
	04)Losses measurement	[	[	[O	[	[O	IEC 60034-2	[	[
	05)Calculation of Excitation current	[	[	[O	[	[O	IEC 60034-4	[	[
	06)Temperature rise test (Zero excitation circuit)	[	[	[O	[	[O	IEC 60034-1	[	[
	07)Temperature rise test (Open circuit loading)	[	[	[O	[	[O	IEC 60034-1	[	[
	08)Temperature rise test (Short circuit loading)	[	[	[O	[	[O	IEC 60034-1	[	[
	09)Calculation of Derived value at Rated load	[	[	[O	[	[O	IEC 60034-1	[	[
	B)ASSEMBLY OF GENERATOR WITH EXCITER & P.M.G.								
	01)Visual Inspection	[	[	[O	[	[	DWG.	[	[
	02)Dimensional check	[	[	[O	[	[O	DWG.	[	[
	03)Winding resistance measurement	[	[	[O	[	[O	IEC 60034-4	[	[
	04)No load characteristics (Generator with Exciter)	[	[	[O	[	[O	IEC 60034-4	[	[
	05)Short circuit characteristics (Generator with Exciter)	[	[	[O	[	[O	IEC 60034-4	[	[
	06)Phase sequence check	[	[	[O	[	[O	IEC 60034-8, DWG.	[	[
	07)Vibration measurement	[	[	[O	[	[O	VDI 2056 and 2059	[	[
	08)No load voltage wave form (Line to line)	[	[	[O	[	[O	Spec. IEEE 115	[	[
	09)Total harmonic distortion (THD) Measurement	[	[	[O	[	[O	IEC 60034-1	[	[
	10)Calculation of Efficiency	[	[	[O	[	[O	IEC 60034-2	[	[
	11)Insulation resistance measurement	[	[	[O	[	[O	MS.	[	[
	12)Withstand voltage test (Dielectric Test)	[	[	[O	[	[O	IEC 60034-1	[	[
	C)PAINTING						Fuji/Kawasaki, Japan		
	01)Painting Inspection	[	[	[O	[	[	DWG. MS.	[	[
	D)PACKING						Fuji/Kawasaki, Japan		
	01)Packing Inspection	[	[	[O	[	[	MS.	[	[

SHOP INSPECTION AND TEST PLAN

附件九

No.	DESCRIPTION OF INSPECTION	PARTICIPATION BY [CLE	[ENG	[FUJI	[SUB	[REP	PLACE / PROCEDURE	[PRO	[RE
EPA	**PANEL & CUBICLE**								
EPA01	**TG REGULATOR CUBICLE (TGR)**								
	A)COMPLETION						Fuji/Kobe, Japan		
	01)Construction check	[	[	[O	[	[	DWG.	[	[
	02)Insulation resistance	[	[	[O	[	[O	≧1MΩ/1Panel.	[	[
	03)Dielectric test	[	[	[O	[	[O	IEC or JEM	[	[
	04)Sequence test	[	[	[O	[	[O	DWG.	[	[
	05)Control unit characteristics test	[	[	[O	[	[O	DWG.	[	[
	06)Packing check	[	[	[O	[	[	MS.	[	[
EPA02	**MIMIC CONTROL PANEL**								
	A)COMPLETION								
	01)Construction check	[	[	[O	[	[	DWG.	[	[
	02)Insulation resistance	[	[	[O	[	[O	≧1MΩ/1Panel.	[	[
	03)Dielectric test	[	[	[O	[	[O	IEC or JEM	[	[
	04)Sequence test	[	[	[O	[	[O	DWG.	[	[
	05)Packing check	[	[	[O	[	[	MS.	[	[
EPA03	**DC MOTOR STARTING PANEL**								
	A)COMPLETION								
	01)Construction check	[	[	[O	[	[	DWG.	[	[
	02)Insulation resistance	[	[	[O	[	[O	≧1MΩ/1Panel.	[	[
	03)Dielectric test	[	[	[O	[	[O	IEC or JEM	[	[
	04)Sequence test	[	[	[O	[	[O	DWG.	[	[
	05)Packing check	[	[	[O	[	[	MS.	[	[
EPA04	**PT/SA CUBICLE**								
	A)COMPLETION						Fuji/Kawasaki, Japan		
	01)Construction check	[	[	[O	[	[	DWG.	[	[
	02)Insulation resistance	[	[	[O	[	[O	>600V:≧10MΩ/1Panel., ≦600V:≧1MΩ/1Panel.	[	[
	03)Dielectric test	[	[	[O	[	[O	IEC or JEM	[	[
	04)Sequence test	[	[	[O	[	[O	DWG.	[	[
	05)Packing check	[	[	[O	[	[	MS.	[	[
EPA05	**NGR CUBICLE**								
	A)COMPLETION						Fuji/Kawasaki, Japan		
	01)Construction check	[	[	[O	[	[	DWG.	[	[
	02)Insulation resistance	[	[	[O	[	[O	>600V:≧10MΩ/1Panel., ≦600V:≧1MΩ/1Panel.	[	[
	03)Dielectric test	[	[	[O	[	[O	IEC or JEM	[	[
	04)Sequence test	[	[	[O	[	[O	DWG.	[	[
	05)Packing check	[	[	[O	[	[	MS.	[	[

e-Front runners

附件十

To : CHENG CHEN MACHINERY CO., LTD.
No.1, Chung - Hwa Rd., Hsin - Chu Industrial District
Hu -Kou Hsiang, Hsin - Chu Hsien, TAIWAN
(TEL NO.010-886-3-5981611 ex. 234 or 235)
(FAX NO.010-886-3-5981149)

ATTN: Mr. H. K. Chang / Vice President
Mr. F. J. Tseng / Project Manager

Fuji Electric Systems Co.,Ltd.
1-1 Tanabeshinden, Kawasaki-ku
Kawasaki-shi 210-9530, Japan
FAX No. : 81-44-329-2429
Phone No. : 81-44-329-2121

Ref. CPC-FE-CCMC-TG-D 066
Date : 2005/8/2

CPC #26

RE: Chinese Petroleum Corporation #26 - Lin Yuan Plant

Dear Sir,

We are pleased to submit the following drawings and documents.

Yours faithfully,

Y. Ueno
Project Manager
Plant Engineering Dept.
Thermal Power Division
Power Plant Group
Fuji Electric Systems Co.,Ltd.

CC;

Internal Distribution
A (火技)上野(康)PM経由 顧客 (図面6部+送状1部を送付のこと。)
B

B58413

1 FES 三番町)海外営業)第一統括)営業一部長殿 経由 庄司殿 (送状のみ1部)
2 (火計設)長殿
3 (火構設)長殿
4 (火構設)K長殿
5 (火構設)P長殿
6 (火構設)R長殿
7 (火構設)H長殿
8 (発設火)長殿
9 (発電設)長殿
10 (火設1) 長殿
11 (火設2) 長殿
12 [火プ建]長殿
13 (火プ品)長殿
14 (火技運)長殿
15 (火技工)長殿
16 (火制技)長殿
17 [火電気]長殿
18 [火技]長殿
19 PM殿
20 [火プ建]電工Gr長殿
21 (火製)長殿
22 鹿D)
23
24
25

REV ; for Review PR ; Preliminary Drawing RE ; for Reference
AF ; as Final AB ; as Build IF ; for Information
AP ; for Approval FC ; for Construction RA ; Revised Approval

Drawn ; T. Yamauchi Checked; K. Kato

発行部署 : KK

No.	CONTROL No. / DRAWING NUMBER	REV	DESCRIPTION/TITLE	PUR.	copies	Internal Distribution 合計 A~E	1~25	配布部数(送 : 送状のみ) A	B	C	D	E	1	2	3	4	5	6	7	8	9	10
								11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	T-KK-0006	0	LATERAL ANALYSIS REPORT	IF	6	6		6					送									
	ST7B6595					2				1					1							
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
11																						
12																						

附件十

LATERAL ANALYSIS REPORT

1.Analysis procedure of turbine shaft vibration

··· page 2

2.Results of Lateral analysis

- 1st critical speed analysis
  (Unbalanced mode 1) ··· page 3
- 2nd critical speed analysis
  (Unbalanced mode 2) ··· page 4

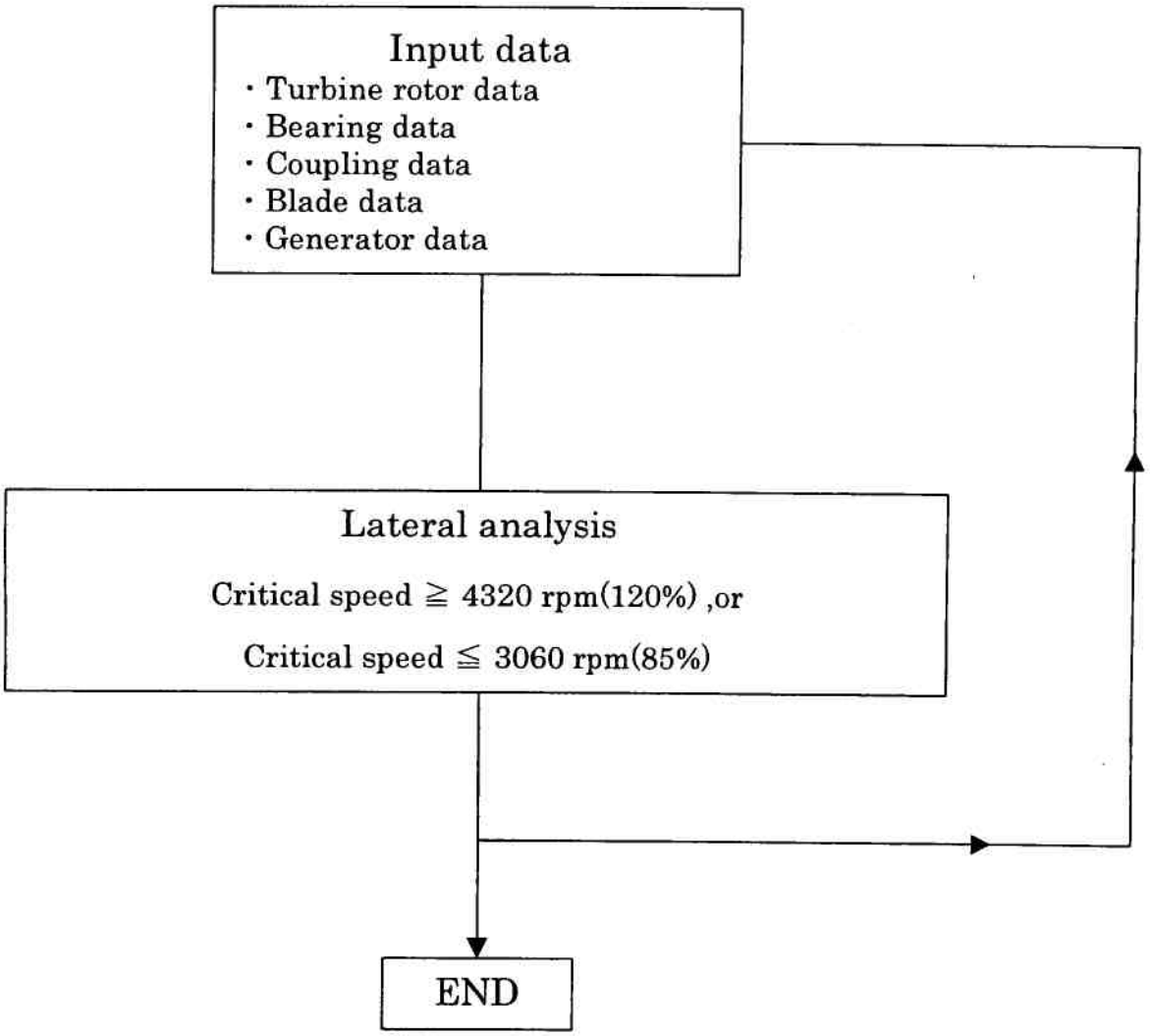
Control No. : T-KK-0006

DRAWN	CHECKED	APPROVED
Jul.30.2005 T.Yamauchi	July 30'2005 K.Kato	Aug.1,2005 S.Tsuru

CHENG CHEN MACHINERY CO., LTD.

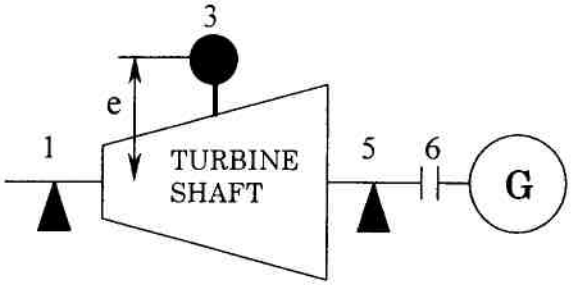
CPC #26 CO-GENERATION PROJECT

Analysis procedure of turbine shaft vibration

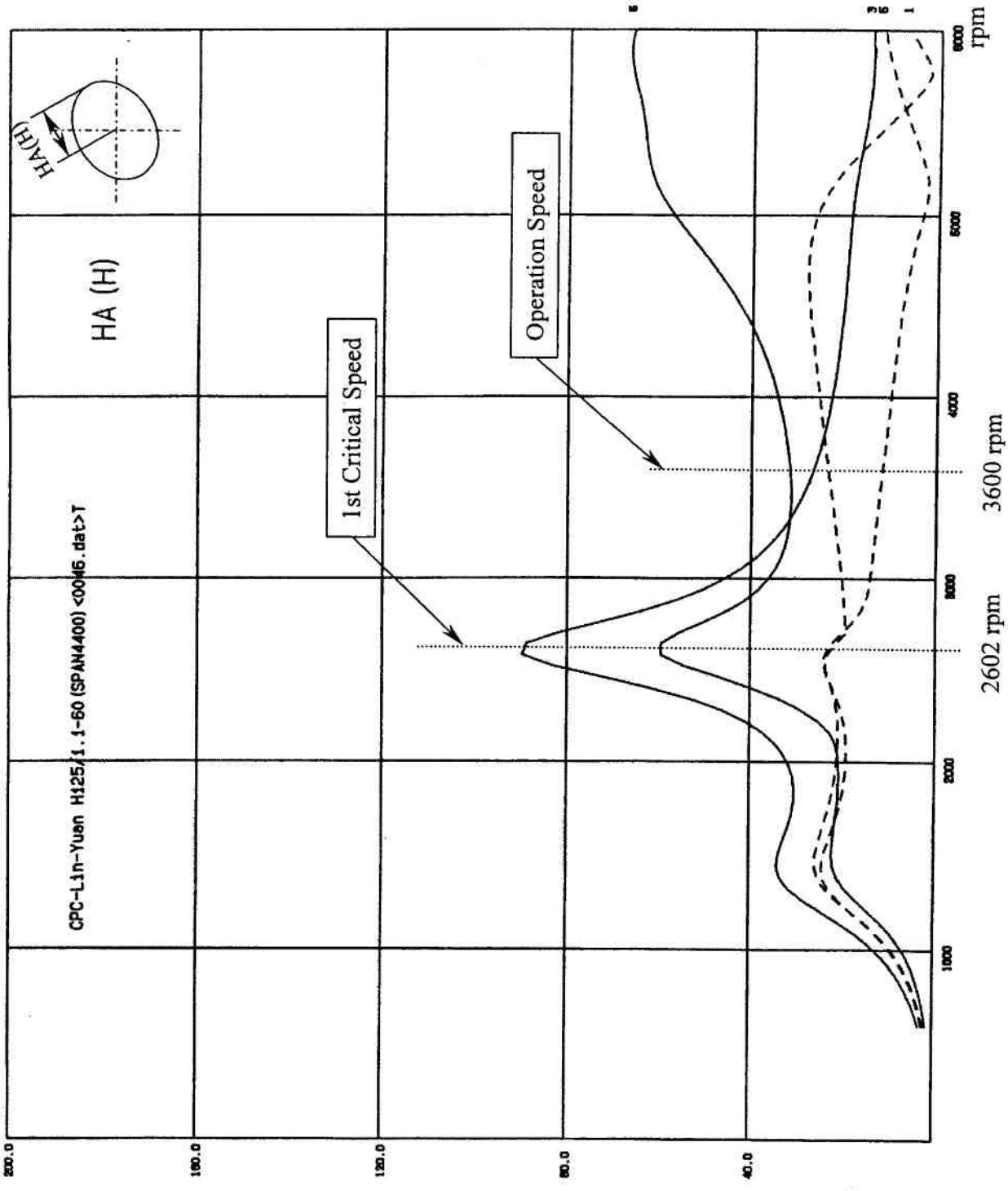


Unbalanced mode 1

1 : No.1 bearing
3 : center of gravity
5 : No.2 bearing
6 : coupling
e : mass eccentricity

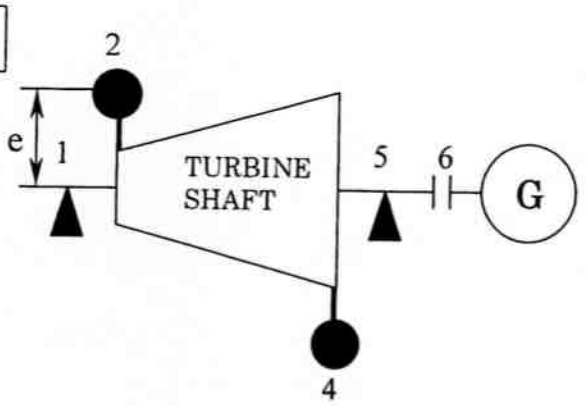


Bearing (1,5)
Others (3,6)
Critical speed :
2602 rpm (72.3%)

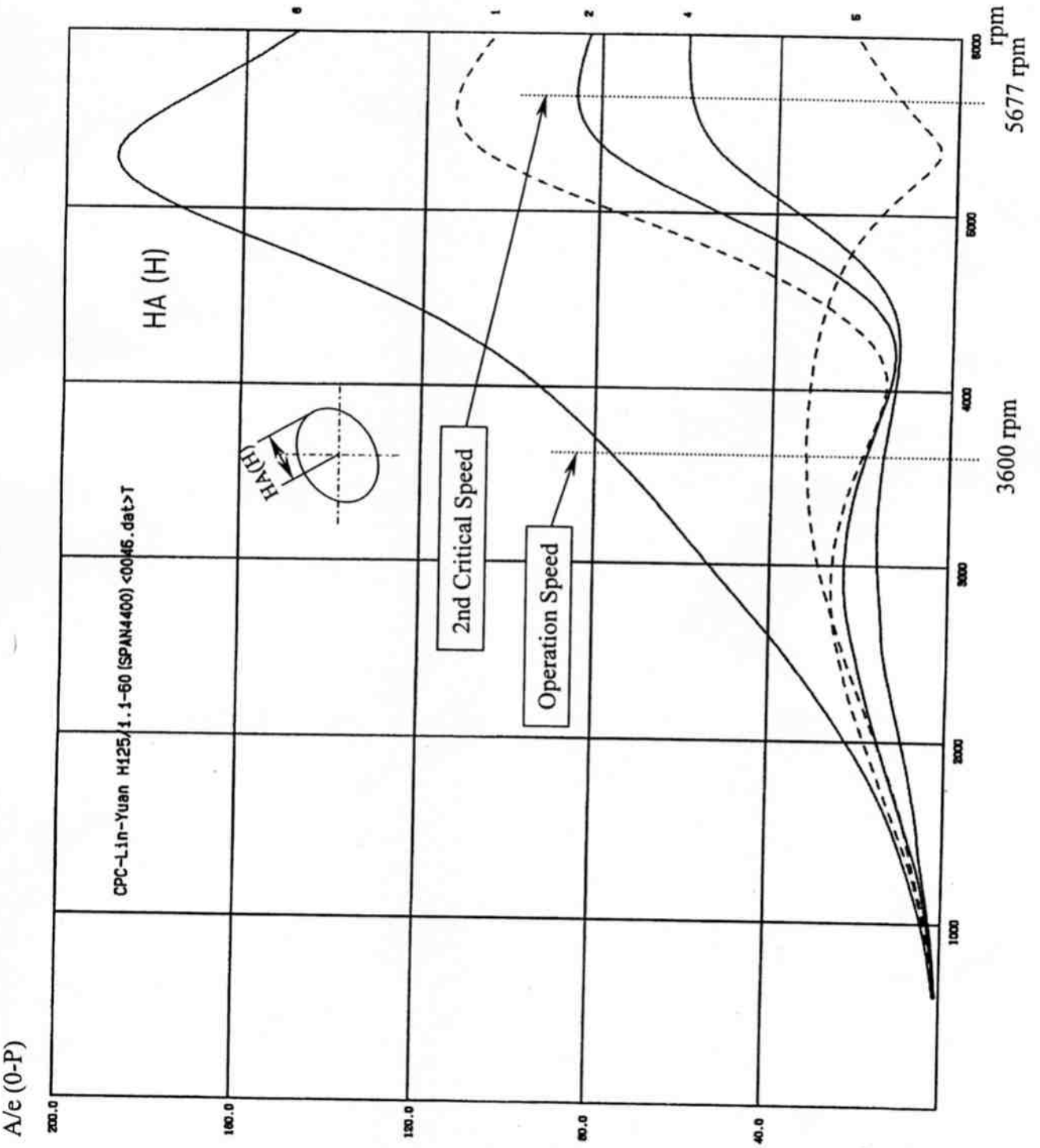


Unbalanced mode 2

1 : No.1 bearing
2,4 : balance plane
5 : No.2 bearing
6 : coupling
e : mass eccentricity



Bearing (1,5)
Others (2,4,6)
Critical speed :
5677 rpm (157.7%)



ST7B6595 4/4

附件十

MATERIAL TEST REPORT
材料試験成績表

ITP No. GAA 04, B, 01 & 02

Date 9 SEPT. 2005 Report No. 051000

Manufacturer's Order No. M05-04-030

Purchaser 御注文主 Fuji Electric Systems Co., Ltd.

Name of Article 品名 ROTOR SHAFT

Material 材質 26NiCrMoV 145

Purchaser's Order No. 注文主番号 K1B58413L1

Specification No.(仕様書No.) KRS71-402a

Drawing No. 図番 M402.3B0202 REV.0

Plant/Project

WITNESSED, REVIEWED BY
H. Nakagawa
Witness DATE: Sep. 8. 2005
立会者 Fuji Electric Systems Co.,Ltd.

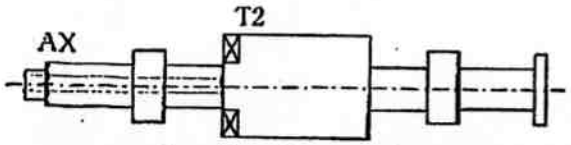
S. Seo
Chief of Quality Control Section

Testing Machine No. : T-70 NG28,1-76 NG7,920,H-93 NG2

F.R. 1/1.6U 4.5S
Mass 12733 kg

Piece No. 製品番号	Size of Test Specimen Diameter Gauge Length 12 mm × 60 mm	Yield Strength $\sigma_{0.2}$ kgf/mm² (N/mm²)	Tensile Strength kgf/mm² (N/mm²)	Elongation %	Reduction of Area %	Impact Test Notch 2mmV Charpy Test temp. 20 ℃ kgf·m (J)	Hardness Brinell
	Test piece No. 試験片番号 Min.	74.4 (730)		15	50	Average Min. 10.2 (100)	Min.
	Max.	84.6 (830)	102 (1000)				Max.
21758-101	21758-101T2	80.1 (785)	90.2 (885)	21	72	14.4 [14.3 14.8 14.0] (140.8 [140.3 144.6 137.4])	269
	Diameter Gauge Length 5 mm × 25 mm Min.	74.4 (730)				Average Min. 10.2 (100)	Min.
	Max.						Max.
QUANTITY 1	21758-101AX	76.7 (752)	88.2 (865)	18	68	11.8 [11.8 11.4 12.3] (115.9 [115.8 111.6 120.2])	262

Heat Treatment
Q. 855 ℃ × 19 h WSPC
T. 605 ℃ × 34 h F.C.



Location of test specimens

Heat No. 溶解番号	Chemical Composition 化学成分 % C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	Al
Min.							3.40	1.40	0.30		
Max.	0.28	0.15	0.40	0.010	0.010		3.80	1.80	0.45	0.15	0.015
21758 Ladle	0.25	0.09	0.32	0.004	0.004		3.43	1.64	0.34	0.12	0.007
Product	0.26	0.09	0.31	0.004	0.004		3.42	1.63	0.33	0.12	0.007

Heat treatment
N. Normalizing
Q. Quenching
S.T. Solution Treatment
A. Annealing
T. Tempering
S.R. Stress Relieving
A.C. Air Cooling
O.C. Oil Cooling
F.C. Furnace Cooling
W.C. Water Cooling
P.H. Precipitation Hardening
B.C. Blast Cooling
W.S.P.C. Water Spray Cooling
Ac.C. Accelerated Cooling

Other
L. Longitudinal
Ta. Tangential
R. Radius
T.S. Top Side
M. Middle
B.S Bottom Side
$\sigma_{0.2}$ 0.2% offset
$\sigma_{0.02}$ 0.02% offset
F.R. Forging Ratio
H.T. Heat Treatment
Ceq. Carbon equivalent
R.T. Room Temperature

PACIFIC STEEL MFG. CO., LTD. TOYAMA WORKS
大平洋製鋼株式会社 富山製造所

附件十一

ULTRASONIC INSPECTION REPORT
超音波探傷試験成績表

ITP No. GAA04, B, 04

Date 9 SEPT. 2005 Report No. 051000

Manufacturer's Order No. M05-04-030

Purchaser 御注文主 Fuji Electric Systems Co., Ltd.

Name of Article 品名 ROTOR SHAFT

Purchaser's Order No. 注文主番号 K1B58413L1

Drawing No. 図番 M402.3B0202 REV.0

Material 材質 26NiCrMoV 145

Specification No.(仕様書No.) KRS71-402a

Plant/Project

WITNESSED, REVIEWED BY

Witness 立会者 T. Uchiyama

DATE: Sep. 8, 2005

Fuji Electric Systems Co.,Ltd.

Examined 検査者 S. Sakai

SNT-TC-1A LEVEL II

Approved 承認者 K. Shimada

SNT-TC-1A LEVEL III

Piece No. 製品番号: 21758-101

QUANTITY 1

Conditions of Ultrasonic Inspection 探傷条件

Defect Detector 探傷器: Kraut Krämer USM 3S

Couplant 接触媒質: Machine oil マシン油

Procedure No. 要領書No.: MIP-T7-05-03B

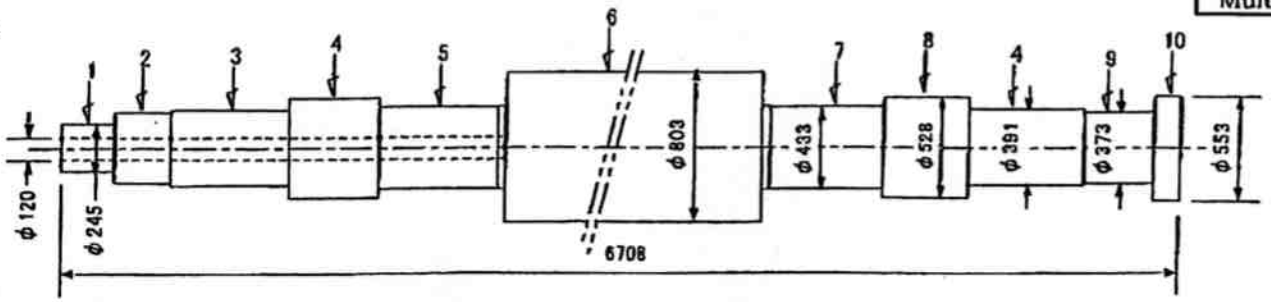
Applied Code 適用規格: KIS S 2001 h

Test Method 試験方法	Search Unit 探触子	Specified Sensitivity 探傷感度
Normal Beam Technique 垂直法	24 φmm / 2 MHz	Height of B_1 echo BG : 100 % + Sensitivity Multiplication
Angle Beam Technique 斜角法	— mm / MHz	—
Double crystal Technique 分割形探触子法	— φmm / MHz	—

Acceptance: 判定: Acceptable

Figure & Inspected Area 形状および探傷範囲

Shown by



Position	1	2	3	4
Sensitivity Multiplication	10	14	15	18
	5	6	7	8
	16	24	19	20
	9	10	–	–
	17	21	–	–

(dB)

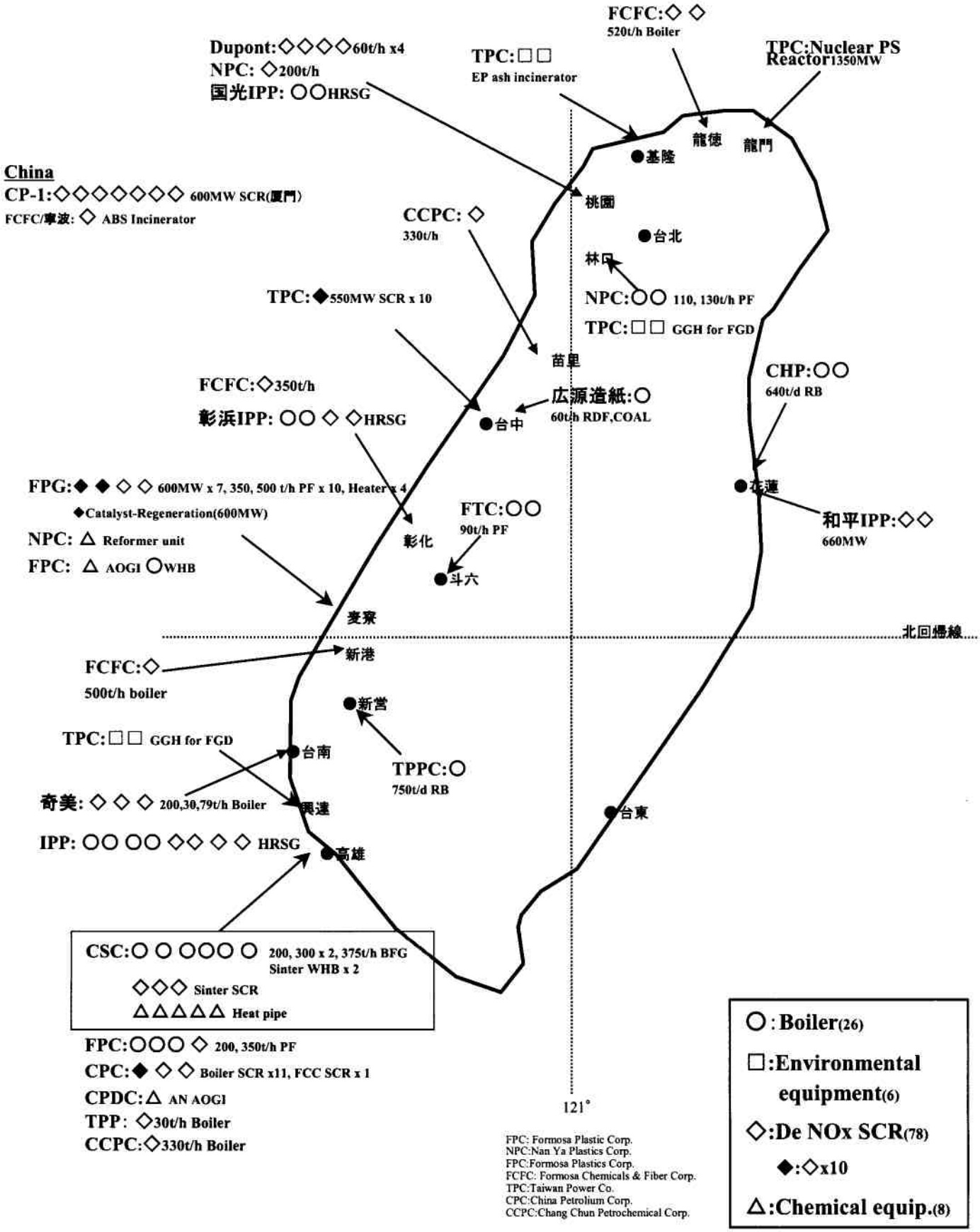
PACIFIC STEEL MFG. CO., LTD. TOYAMA WORKS
大平洋製鋼株式会社 富山製造所

附件十一

Babcock-Hitachi K.K.

附件十二

BHK's Experience in Taiwan



B1 IMPROVEMENT OF BOILER EFFICIENCY

OUTLINE

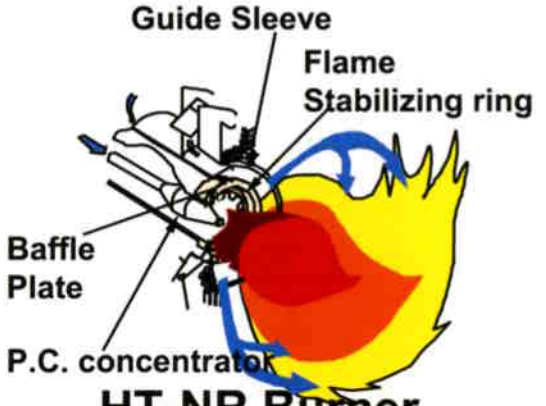
- Application of New Burner System with Latest Combustion Technology

EFFECT

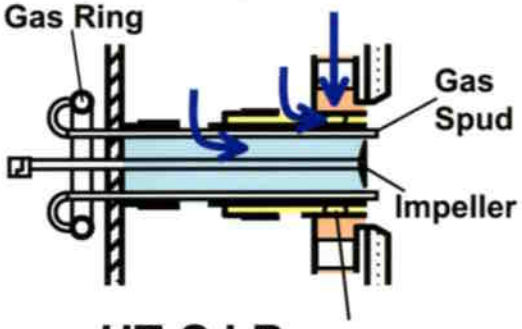
- Improvement of boiler efficiency
- Reduction of auxiliary power consumption
- Environmental improvement
  - -Less particulate matter emission
  - -Less NOx emission

LATEST COMBUSTION TECHNOLOGY

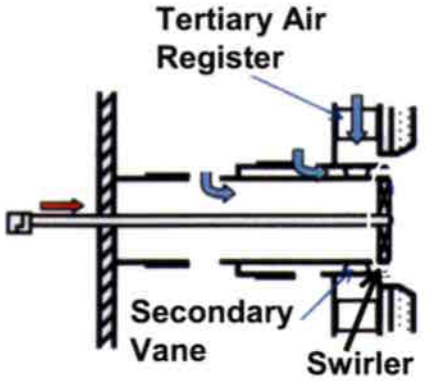
	HT-NR burner	HT-SJ burner	HT-PS burner
Application	Coal firing	Gas and oil firing	Oil firing
Effect	- Reduction of unburned carbon in fly ash and NOx emission	- Reduction NOx emission - Capability of dual fuel firing	- Reduction of particulate matter and NOx emission



HT-NR Burner



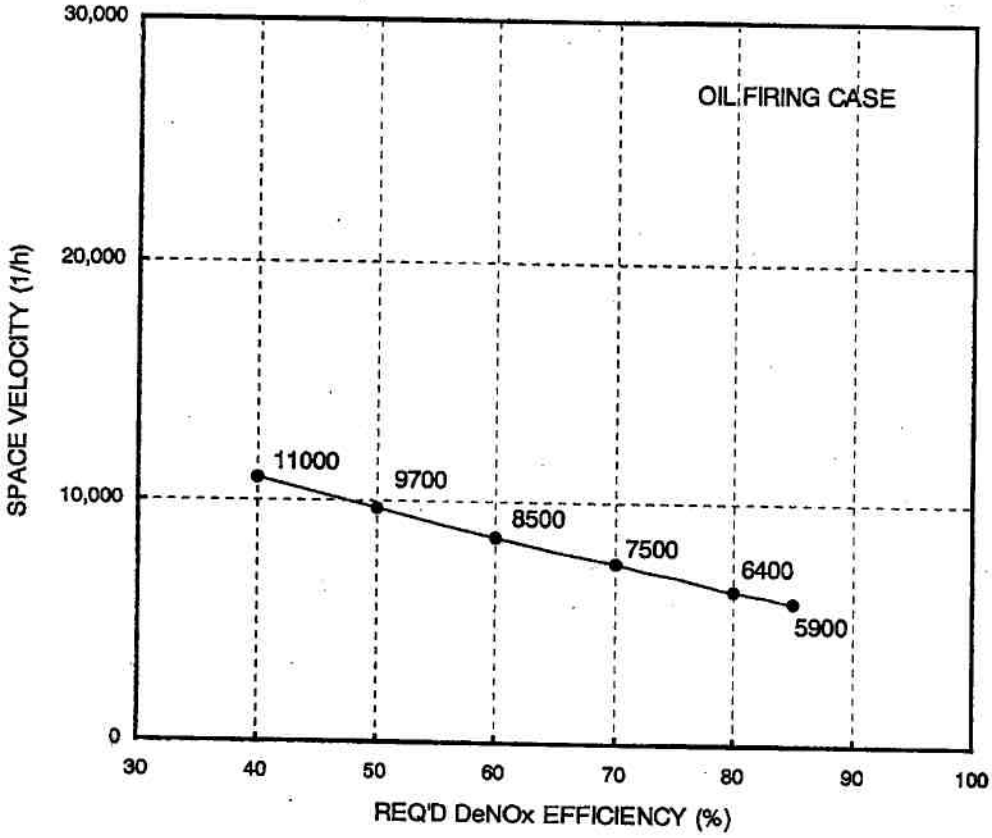
HT-SJ Burner



HT-PS Burner

BABCOCK-HITACHI K.K.

CATALYST VOLUME CALCULATION SHEET



For CCMC's #6 oil firing case:

NOx Reduction Rate	:	200 ppm to 30 ppm
Flue Gas Flow Rate (Nm^3/hr)	:	338,900
NH_3 Slip (ppm)	:	5
Operation Temperature (ºC)	:	404
Catalysts Guarantee Life (Year)	:	3
Estimated Catalyst Volume (m^3)	:	57.4 m^3

$$\text{Catalyst Volume} = \frac{\text{Flue Gas Flow Rate}}{\text{Space Velocity}}$$

$$\text{Catalyst Volume} = \frac{338{,}900}{5{,}900} = 57.4\ m^3$$

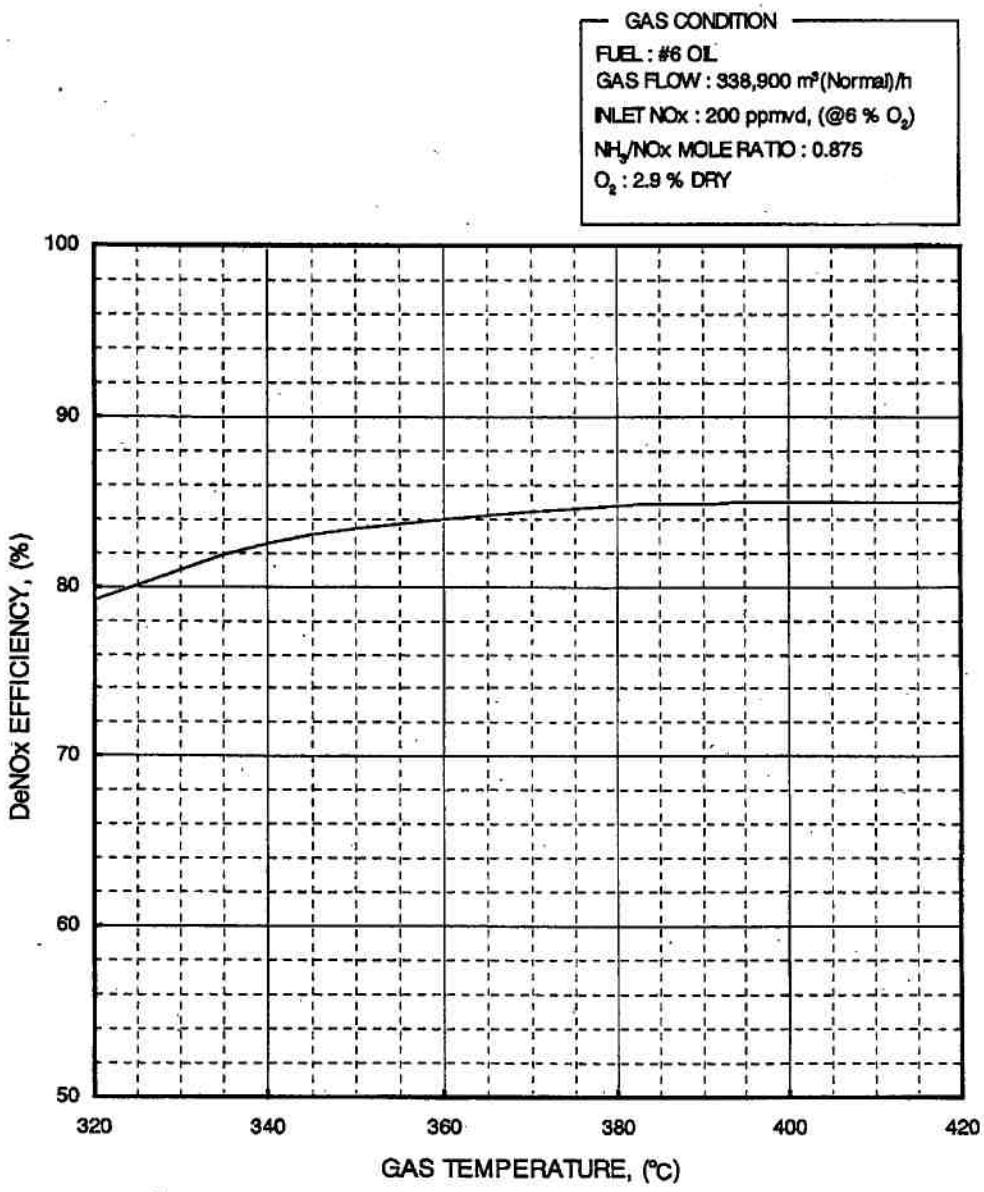


Fig. 1 PERFORMANCE CURVE OF DeNOx EFFICIENCY VS. GAS TEMPERATURE

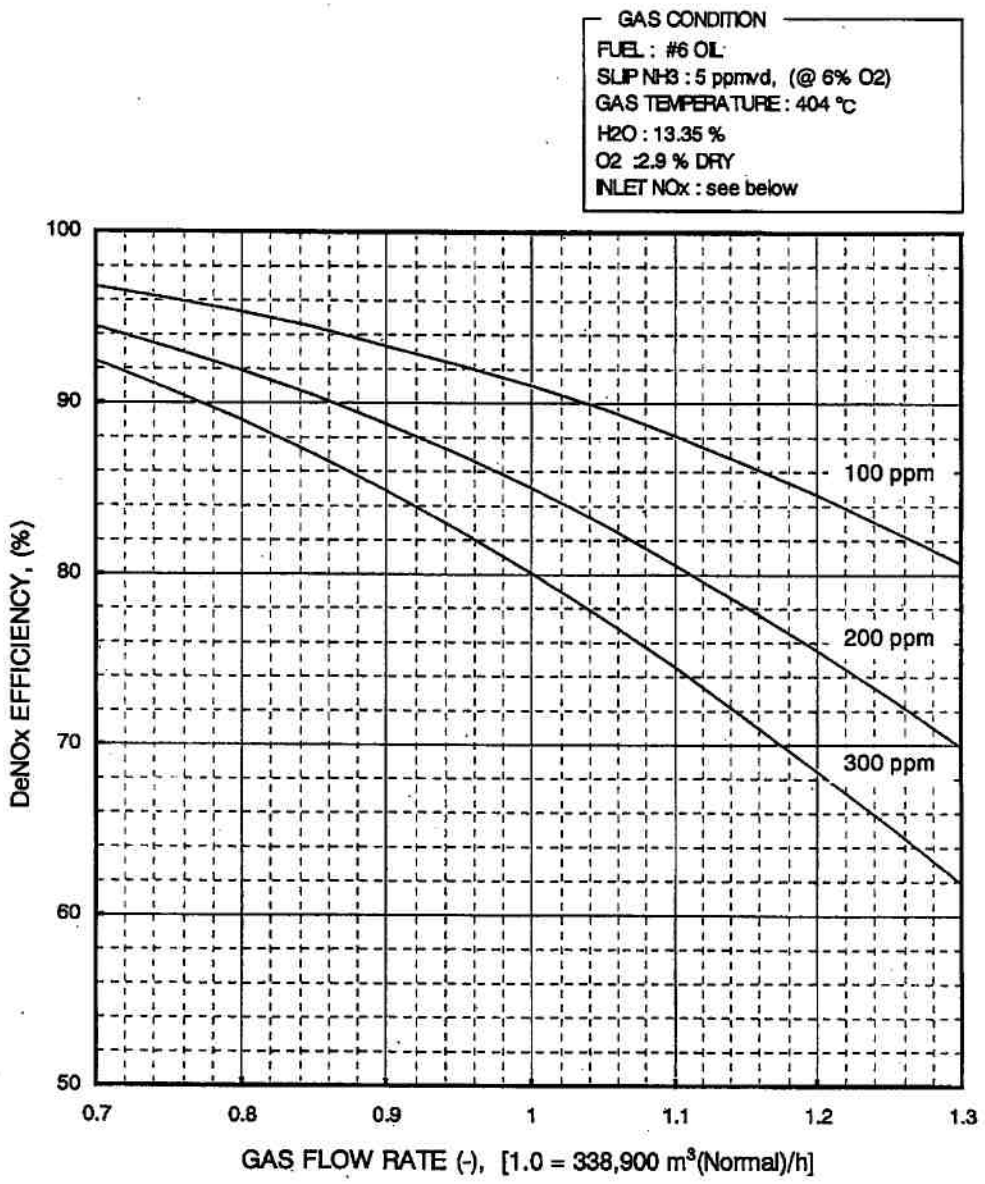
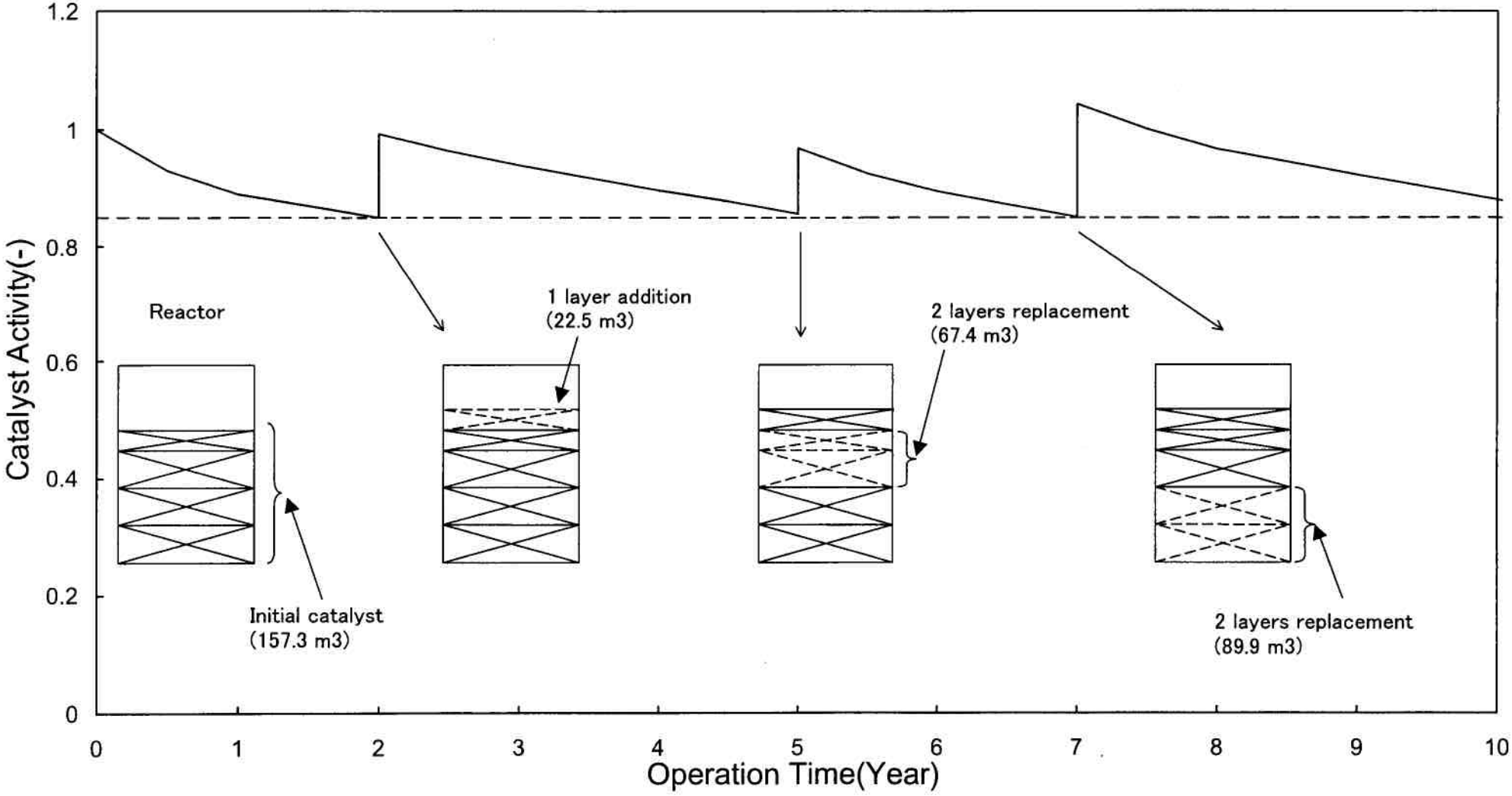
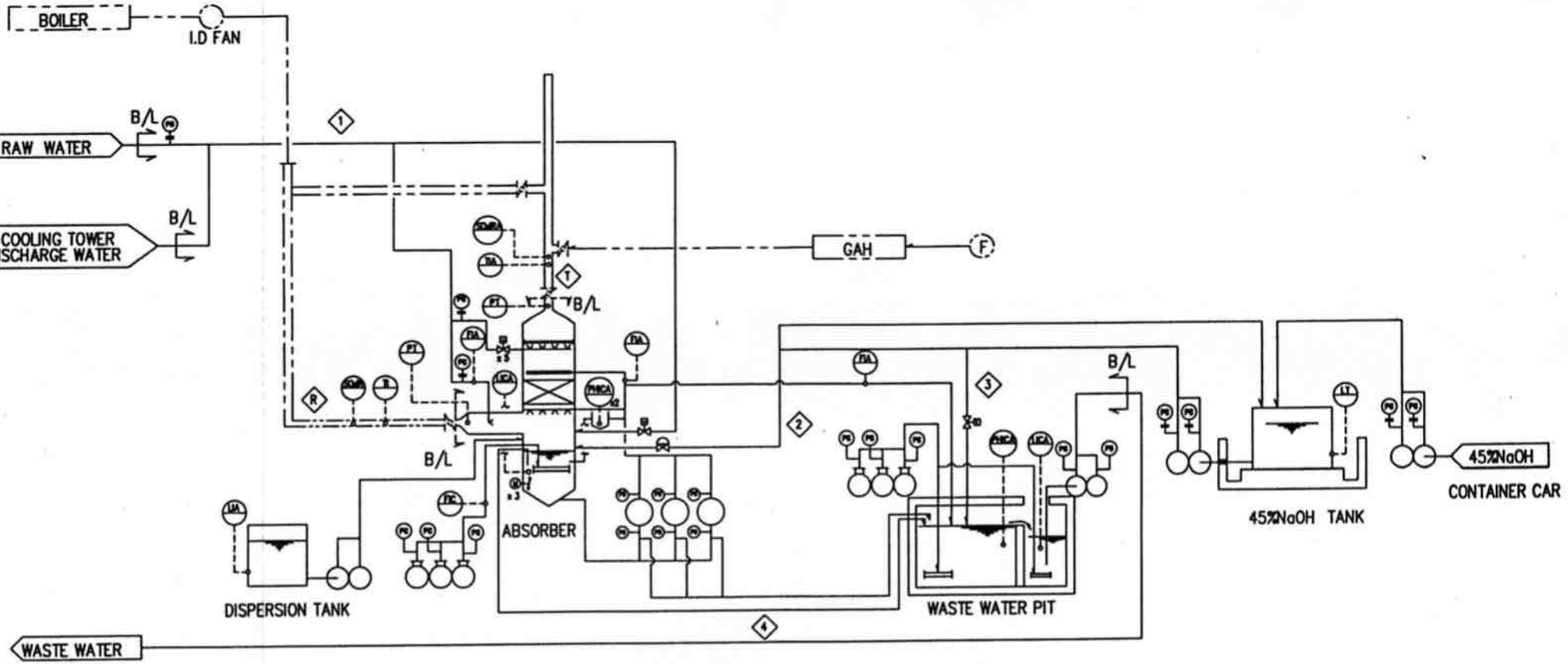


Fig. 2 PERFORMANCE CURVE OF DeNOx EFFICIENCY VS. GAS FLOW RATE

EXPECTED CATALYST MANAGEMENT PLAN FOR CPC No.26 PROJECT



附件十五



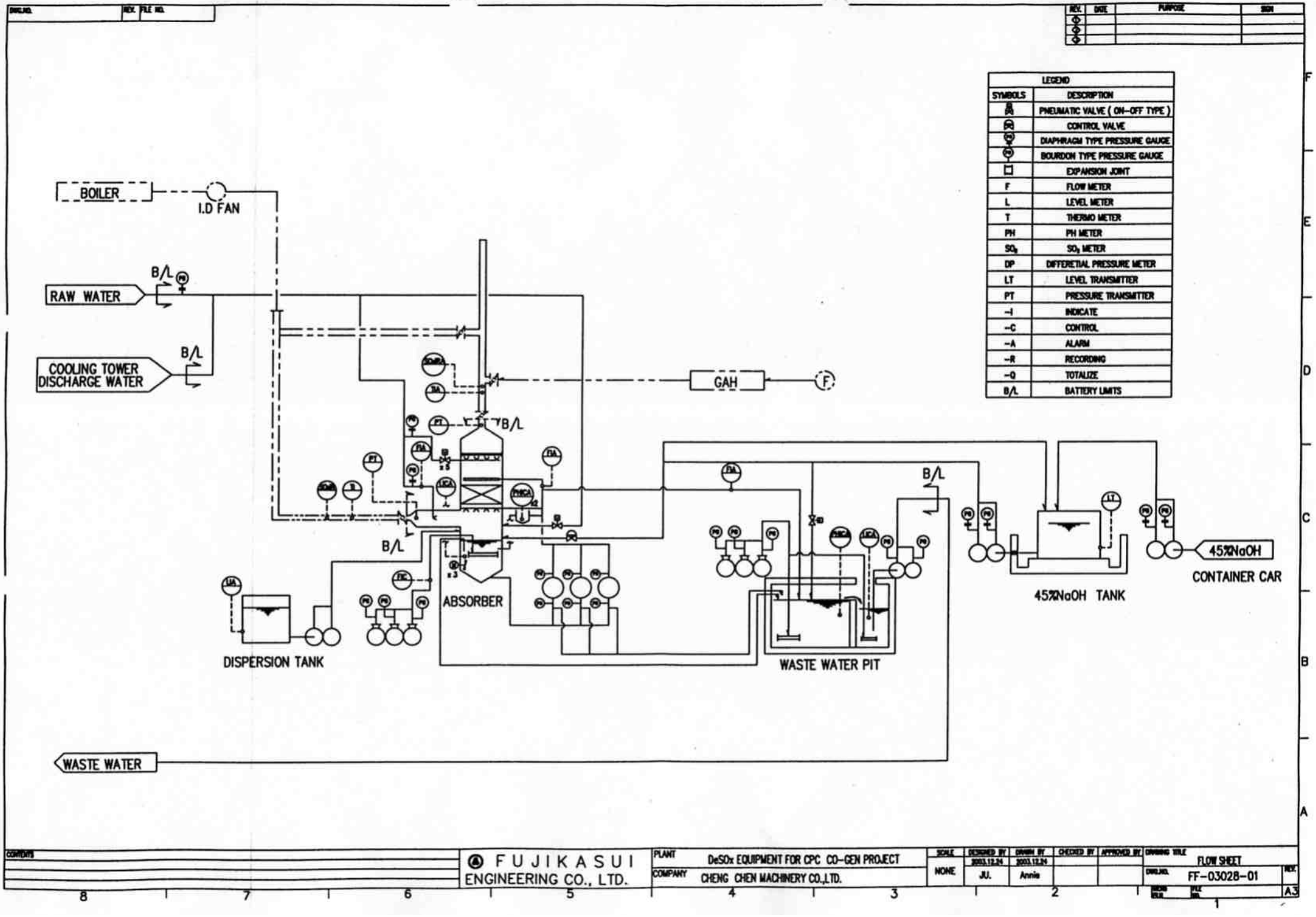
STREAM NO.		ⓡ	ⓣ
H_2O	Vol%	12.3939	16.68
SO_2	Dry ppm	780	30
O_2	Vol%	4.1132	3.92
CO_2	Vol%	10.2587	9.77
N_2	Vol%	73.1660	69.63
Dust	mg/Nm	100	40
WET GAS	Nm^3/H	338490	355846
PRESSURE	mmH_2O	+240	±0
TEMP.	℃	150	56

STREAM NO.		①	②	③	④
H_2O	T/H	38.947	1.010	0.031	23.573
$MgSO_3$	T/H				0.006
$MgSO_4$	T/H				1.403
SS	T/H				0.018
NaOH	T/H		0.827	0.025	
Diatomite	T/H				
FLOW RATE	T/H	38.947	1.837	0.056	25000
Sludge	T/H				
TEMP	℃	5~30			56

FUJIKASUI ENGINEERING CO., LTD.

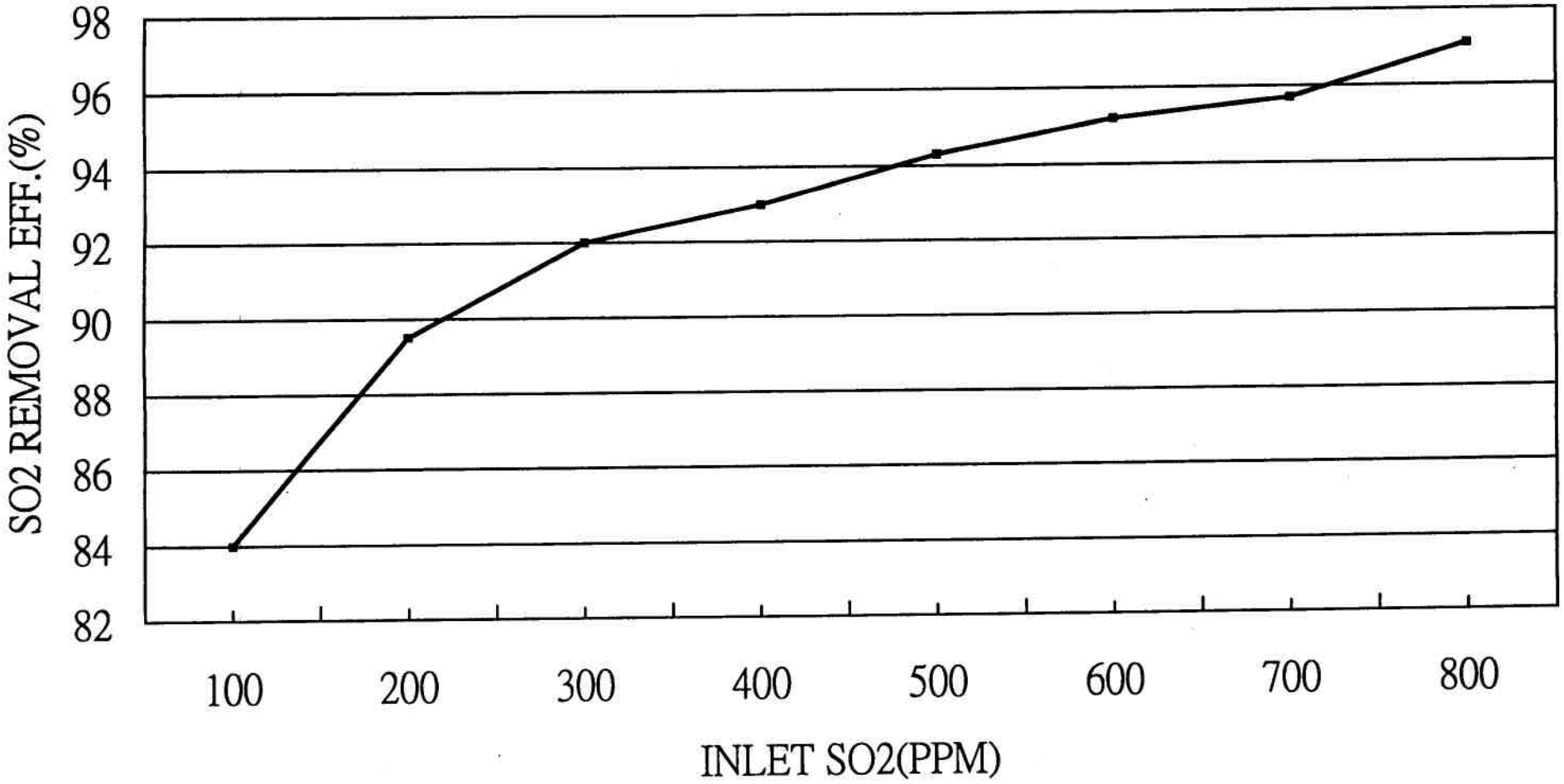
PLANT: DeSOx EQUIPMENT FOR CPC CO-GEN PROJECT
COMPANY: CHENG CHEN MACHINERY CO.,LTD.
SCALE: NONE
DESIGNED BY: JU. 2003.12.24
DRAWN BY: Annie 2003.12.24
CHECKED BY:
APPROVED BY:
DRAWING TITLE: Material Bloance
DWG.NO.: MB-03028-01
REV.
FILE NO.
A3

附件十六

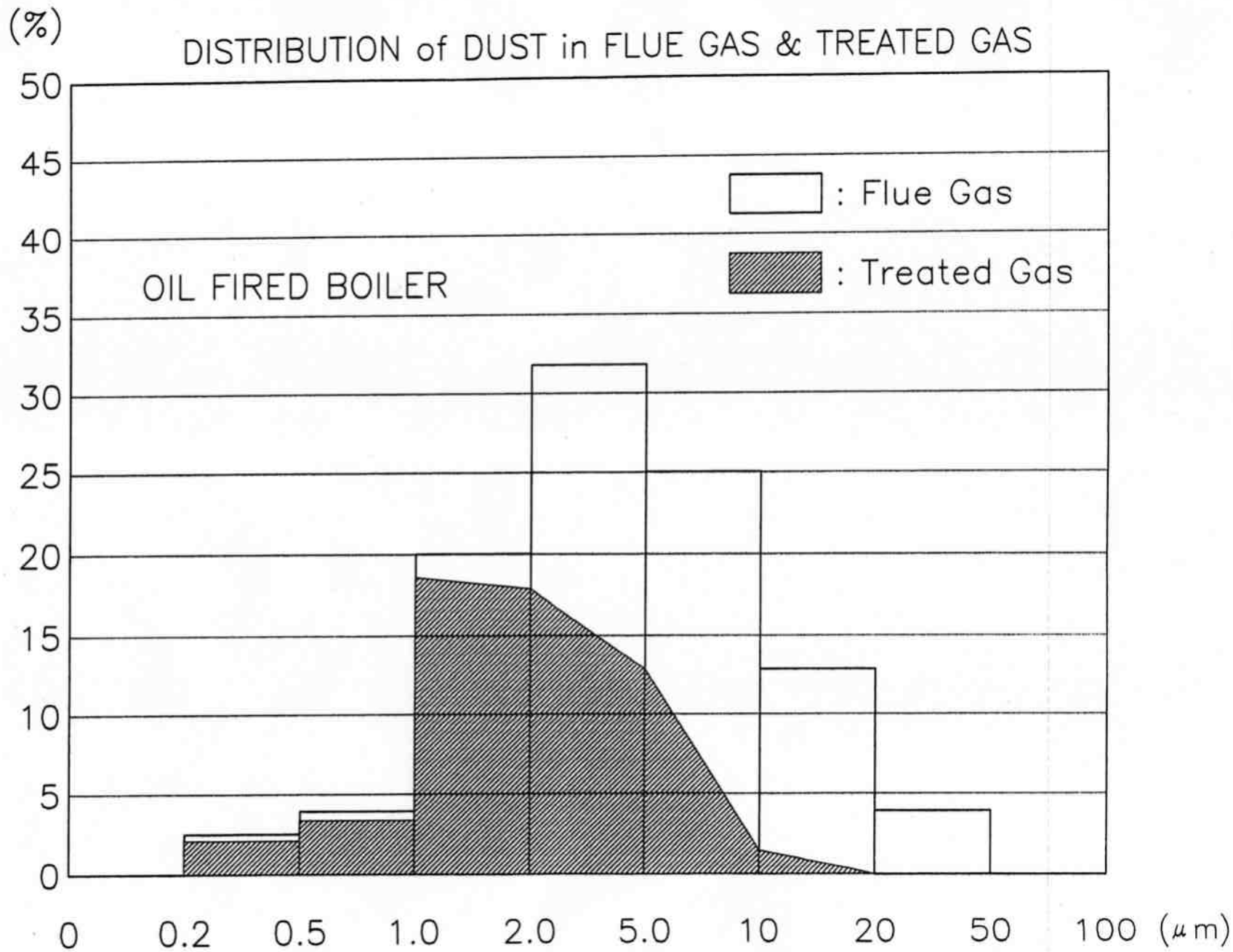

BOILER
I.D FAN
RAW WATER
COOLING TOWER DISCHARGE WATER
B/L
GAH
F
ABSORBER
DISPERSION TANK
WASTE WATER PIT
45%NaOH TANK
45%NaOH
CONTAINER CAR
WASTE WATER
LEGEND
SYMBOLS
DESCRIPTION
PNEUMATIC VALVE (ON-OFF TYPE)
CONTROL VALVE
DIAPHRAGM TYPE PRESSURE GAUGE
BOURDON TYPE PRESSURE GAUGE
EXPANSION JOINT
FLOW METER
LEVEL METER
THERMO METER
PH METER
SO_3 METER
DIFFERETIAL PRESSURE METER
LEVEL TRANSMITTER
PRESSURE TRANSMITTER
INDICATE
CONTROL
ALARM
RECORDING
TOTALIZE
BATTERY LIMITS
REV.
DATE
PURPOSE
SIGN
FUJIKASUI ENGINEERING CO., LTD.
PLANT
DeSOx EQUIPMENT FOR CPC CO-GEN PROJECT
COMPANY
CHENG CHEN MACHINERY CO.,LTD.
SCALE
NONE
DESIGNED BY
2003.12.24
JU.
DRAWN BY
2003.12.24
Annie
CHECKED BY
APPROVED BY
DRAWING TITLE
FLOW SHEET
DWG.NO.
FF-03028-01
REV.
A3

附件十六

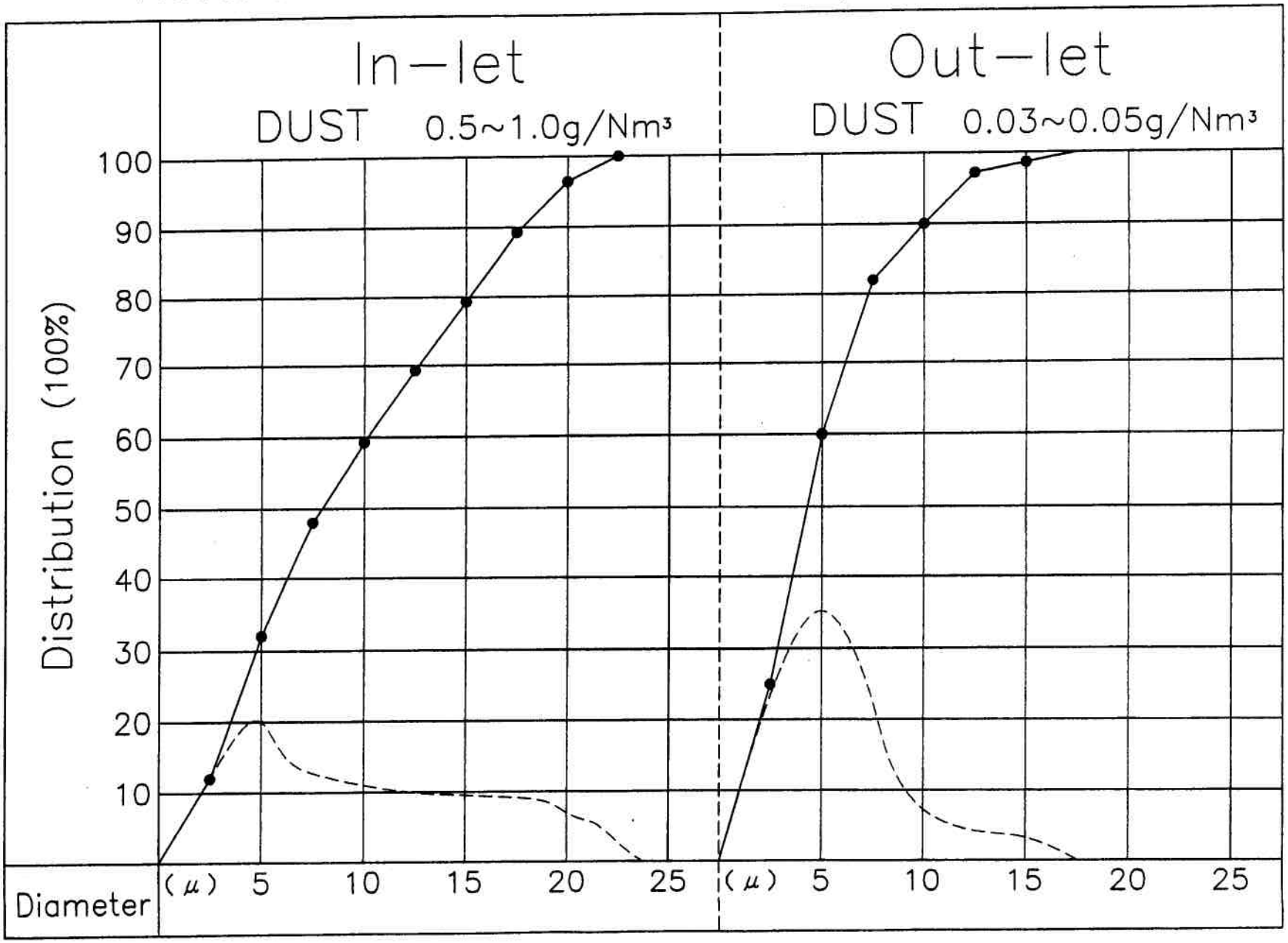
PERFORMANCE CURVE



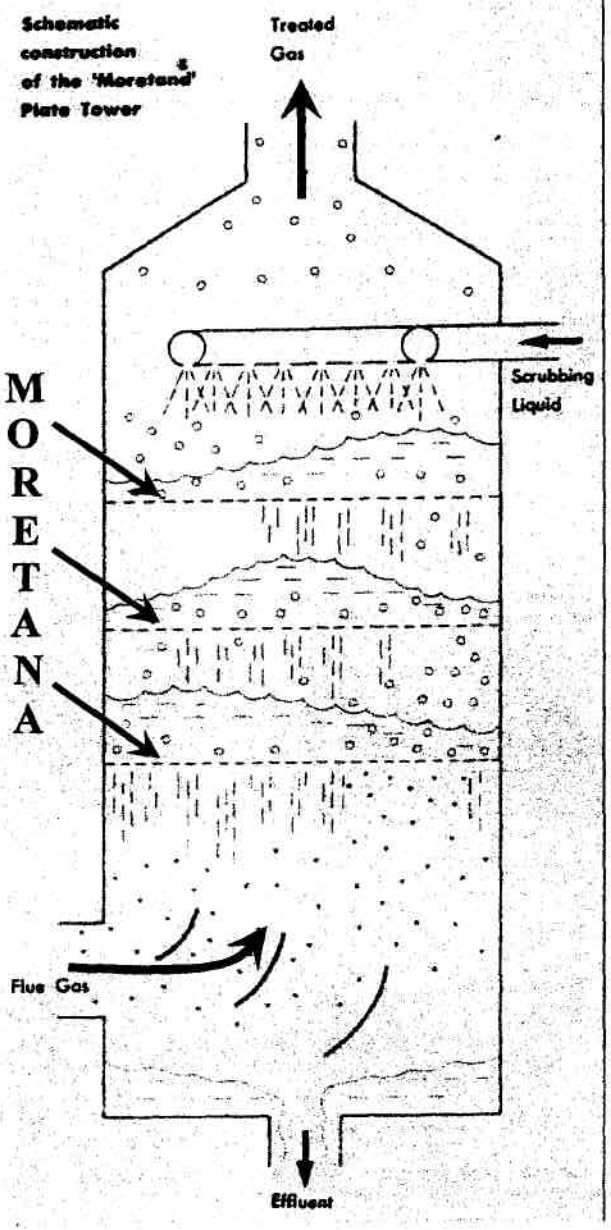
附件十七


(%)
DISTRIBUTION of DUST in FLUE GAS & TREATED GAS
50
45
40
35
30
25
20
15
10
5
0
: Flue Gas
: Treated Gas
OIL FIRED BOILER
0
0.2
0.5
1.0
2.0
5.0
10
20
50
100 (μm)

ACTUAL DATE of DUST REMOVAL by MORETANA FGD



附件十八



Major Charateristics of Moretana Plates

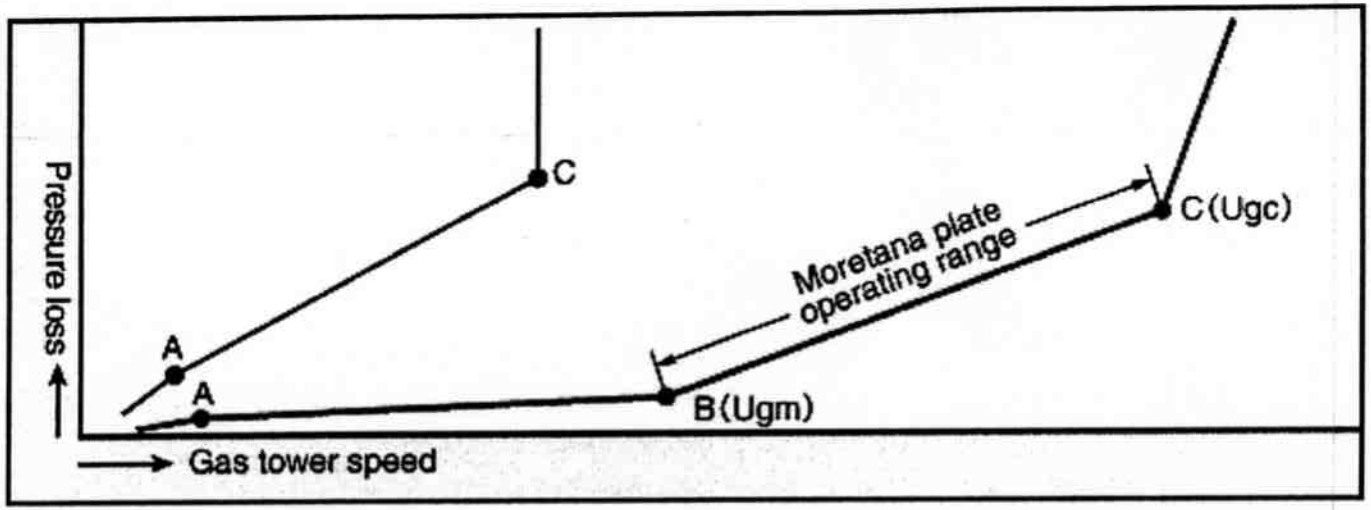
– High & stable SO_2 removal efficiency at varying loading ranges

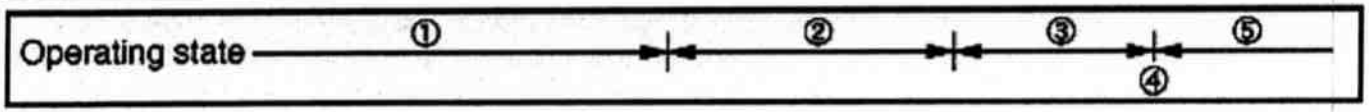
– Compact & simple structure

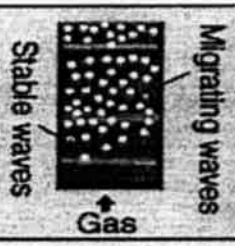
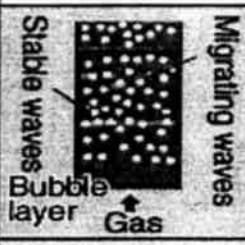
– Self-cleaning phenomena in absorbers

– Low capital & operating costs

FKK

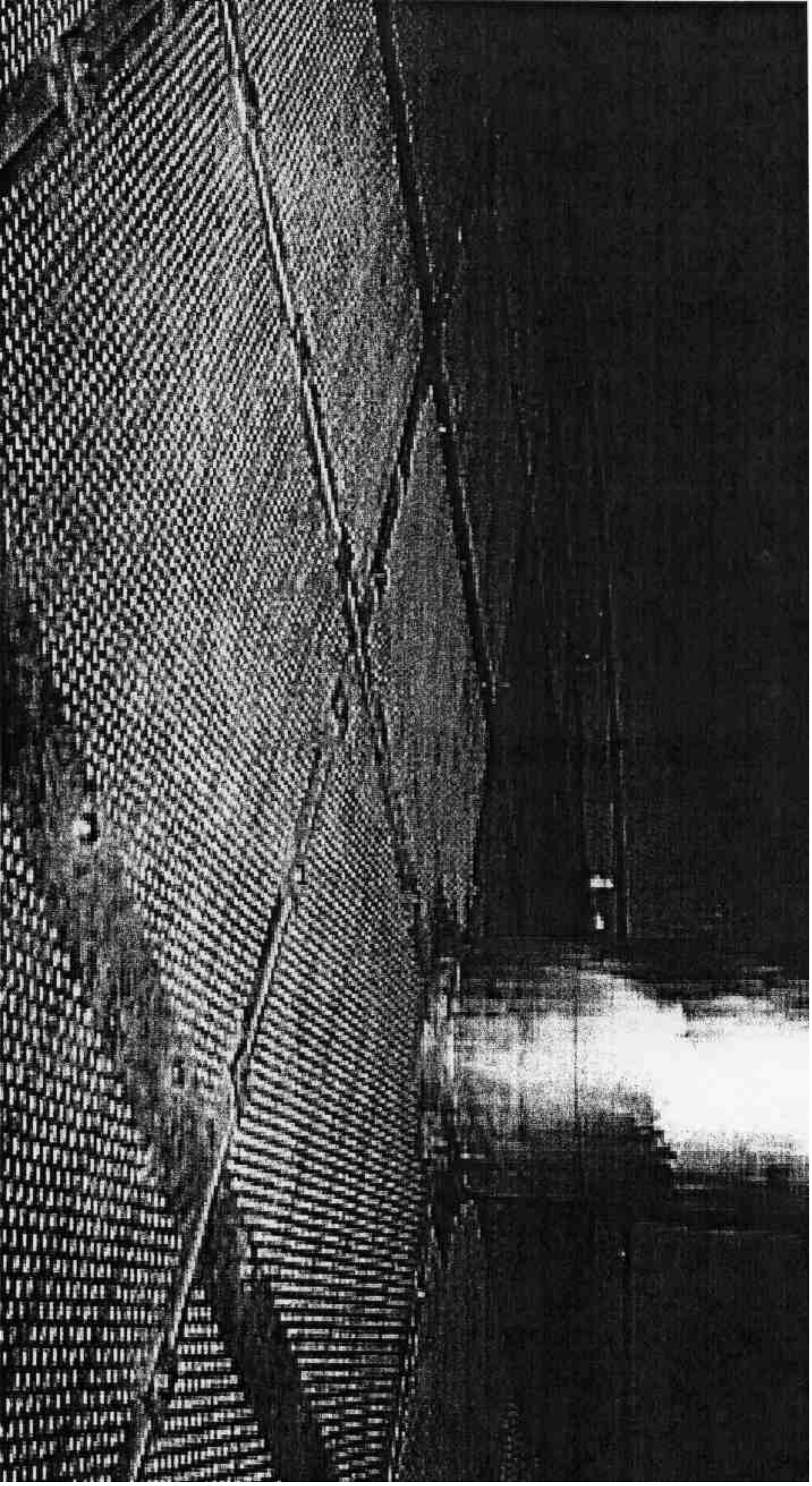




Operating state	①	②	③	④	⑤
	Flowing	Weak wave action	Intensive wave action	Overflow	
View					
Explanation	Stable waves	Migrating waves form high above stable waves.	Liquid density directly above Moretana plate decreases (seen as bubbles). Stable and migrating	Liquid downstream flow rapidly decreases (water content in gas flow increases rapidly). Droplets scatter inside tower.	Liquid downstream flow completely stopped.

FKK

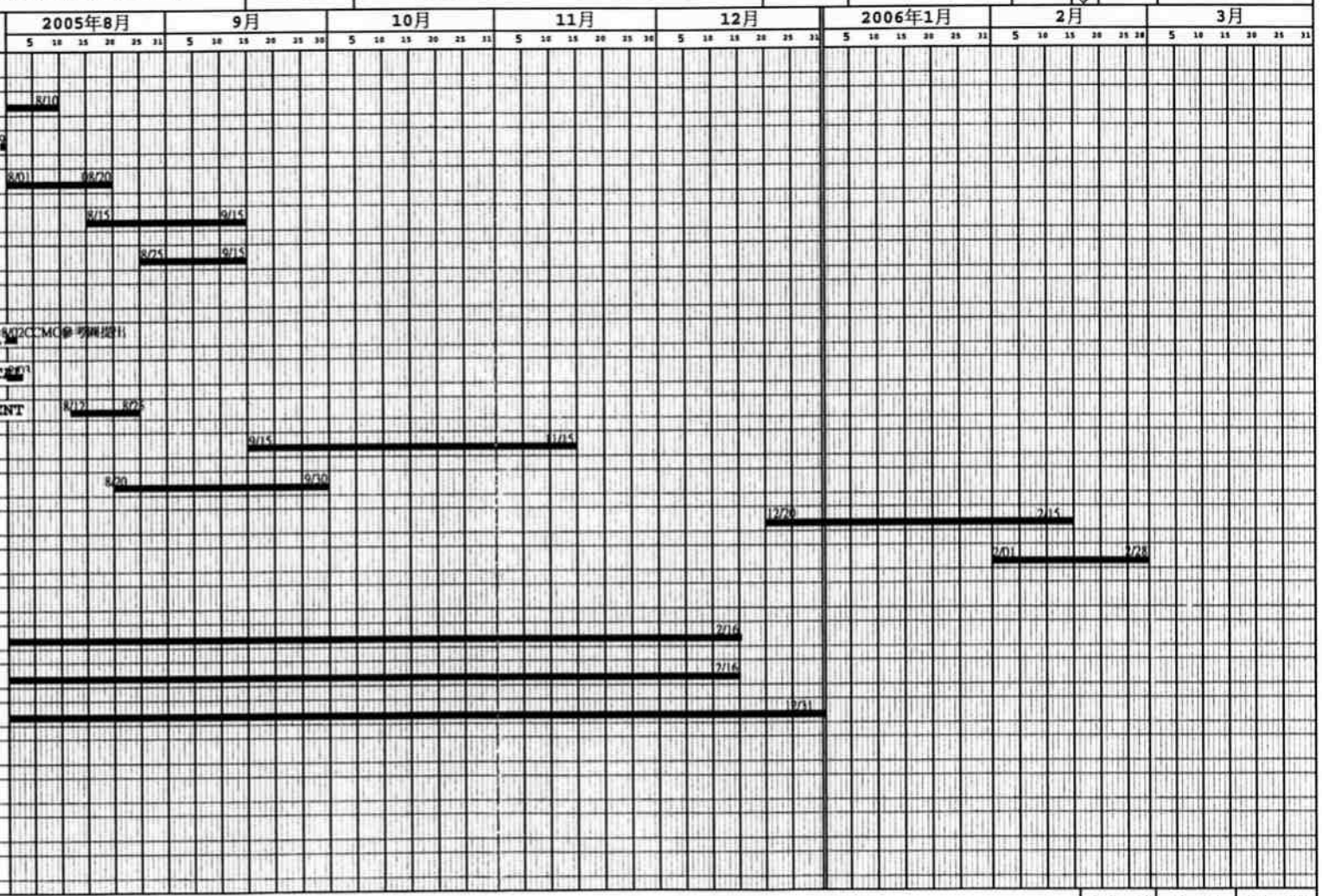
附件十八



排煙脫硫工程表

工號	05050			作成：魏文琦 2005/08/0
業主	建成機械/中油林園廠#26 殿	工程名稱	排煙脫硫(NaOH法)系統工程	完成日 2006年2月28日	修改

項目	內容
1	基本設計 ：
	(1) P & ID 圖
	(2) Layout 圖
	(2) 土木參考圖
	(3) ABSORBER 外型圖
	(4) NaOH TANK 外型圖
2	詳細設計 ：
	(1) 煙囪詳細圖 (CCMC作成)
	(2) B PORTION MECHANIC
	(3) B PORTION INSTRUMENT
	(4) ABSORBER 詳細圖
	(5) 電氣邏輯及儀表接線圖
	(6) 配管平面圖
	(7) DOCUMENT & MANUAL
3	A PORTION 部品製造：
	(1) SPRAY NOZZLE
	(2) MORETANA PLATE
	(3) MISTELIMINATOR



備註	承認	審查	担当
			魏文琦

富士化水工業株式會社
Fujikasui Engineering Co.,Ltd.

附件十九