

出國報告（出國類別：開會）

參加 IERE 2014 TIS-Asia 會議

服務機關：台灣電力公司

姓名職稱：李亦堅 機械工程師

派赴國家：泰國

出國期間：103 年 1 月 13 日至 1 月 17 日

行政院及所屬各機關出國報告提要

出國報告名稱：參加 IERE 2014 TIS-Asia 會議

頁數 37 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/2366-7685

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李亦堅/台灣電力公司/綜合研究所/機械研究專員
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出國類別：1 考察 2 進修 3 研究 4 實習 5 其他(開會)

出國期間：103.1.13~103.1.17

出國地區：泰國

報告日期：102.1.

分類/號目：

關鍵詞：技術問題與方案 (Technological Issues and Solutions)、
氣渦輪機 (Gas Turbine)、燃燒穩定性調校技術 (Combustion
Tuning Technology)、線上監診 (On-line Diagnostics)

內容摘要：(二百至三百字)

一、2014 年 IERE TIS-Asia 會議 (IERE Technological Issues and Solutions - Asia Meeting) 於 2014 年 1 月 13-16 日在泰國芭達雅舉行，本項會議為 IERE 組織主要活動之一。本會議之目的為

- 1、發掘區域性之技術問題。
- 2、經由本活動之專家會議研討交流，尋求技術問題之解決之道。
- 3、藉由提供之演講或訓練課程進行技術轉移。

二、本屆會議研討主題為 “ Technological Issues and Solutions for Asian Power Growth”

三、本項會議由本所研究人員李亦堅參加，並於會議中發表本所在

公司複循環發電機組之氣渦輪機運轉穩定性調校技術發展與研究成果，並參與議題討論，因應公司未來電業自由化之改變，發電業自我提升操作維護技術為一重要工作。其中，減少對原廠製造商不必要之維護工作、自我提升運轉、維護技術為綜研所在氣渦輪機運轉穩定性調校技術發展與研究計畫中推動兩大研究目標。本次藉由此會議與各國會員研討相關議題、經驗之交流，提升運轉維護工程技術，亦可技術輸出，提供各國會員面臨相同問題之技術服務。本次會議專題報告題目為「台電公司在氣渦輪機組燃燒穩定性調校技術之發展 / Gas Turbine Combustion Tuning Technology Development in TPC」。

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

參加 IERE 2014 TIS-Asia 會議

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壹、前言

本次出國目的係參加 2014 年 IERE TIS-Asia 會議 (IERE Technological Issues and Solutions - Asia Meeting) 技術交流會議。為促進本公司與國際電業研究機構之技術交流，以不斷獲取研發新知和提升本公司研發能力。本公司自 2001 年 10 月起正式加入 IERE 之會員，該組織之宗旨在結合全球性合作，利用國際性資料交換及合作活動提昇 R&D 成效，解決電力服務工業的中長程問題。因此，IERE 每年均安排輪流在各會員國舉辦有關電業經營重要議題之研討會，並邀請加入會員之公司派員參加研討會並發表論文，互相交換經驗與心得。其中 TIS 為 IERE 主要活動之一，此技術交流活動起始於 2007 年，本次為第五次會議。

2014 年 IERE TIS-Asia 會議於 2014 年 1 月 13-16 日在泰國芭達雅 SIIT Thammasat 大學會議中心舉行，本項會議為 IERE 組織主要活動之一。本會議之目的為

- 1、發掘區域性之技術問題。
- 2、經由本活動之專家會議研討交流，尋求技術問題之解決之道。
- 3、藉由提供之演講或訓練課程進行技術轉移。

本屆會議研討主題為 “ Technological Issues and Solutions for Asian Power Growth ”，經大會邀請公司發表一篇技術性於大會中與各國會員經驗分享，本項會議經奉派由本所研究人員李亦堅參加，並於會議中發表本所在公司複循環發電機組之氣渦輪機運轉穩定性調校技術發展與研究成果，並參與議題討論。

因應公司未來電業自由化之改變，發電業自我提升操作維護技術為一重要工作。其中，減少對原廠製造商不必要之維護工作、自我提升運轉、維護技術為綜研所在氣渦輪機運轉穩定性調校技術發展與研究計畫中推動兩大研究目標。本次藉由此會議與各國會員研討相關議題、經驗之交流，提升運轉維護工程技術，亦可技術輸出提供各國會員面臨相同問題之技術服務。本次會議專題報告題目為「台電公司在氣渦輪機組燃燒穩定性調校技術之發展 / Gas Turbine Combustion Tuning Technology Development in TPC」

貳、結論與建議

- 一、本次除代表公司專題發表複循環發電機組氣渦輪機運轉維護與事故肇因分析診斷技術論文，並與他國代表就發電技術的實務應用交換彼此經驗和看法外，其他方面也與他國代表有相當多的接觸和交流，對於增進公司同仁國際交流的經驗與能力頗有助益，建議能多參加國際性技術交流的會議，可將成熟之技術推展至其他國家，在公司未來電業自由化後，不失為一國外技術服務之收入。
- 二、本次專題報告題目為「台電公司在氣渦輪機組燃燒穩定性調校技術之發展 / Gas Turbine Combustion Tuning Technology Development in TPC」，主要論述為我們具有氣渦輪機組最常發生的燃燒不穩定之調校技術，並可自行設計開發適合不同機組（SIEMENS，ALSTOM，MHI…等）之客製化及時監診系統，藉由遠端監測技術，可提供客戶即時資訊，避免氣渦輪機組發生燃燒不穩定；若發生時，將可提供調校方法。報告中說明我們的實績，以證明技術成熟度，且技術服務費用將會遠低於原廠報價。
- 三、為因應公司未來電業自由化，公司內具有不少運轉維護技術與專業人員，建議應將有價值可輸出之技術整合成為功能性專職組織，技術服務將不僅只針對公司內部，亦可對國內 IPP，及國外發電同業進行業務推展，此不失為將公司具有實質技術之商品化，可增加技術服務之營收。

參、出國行程及會議內容記要

3-1 出國行程

本計畫出國期間，自民國 103 年 1 月 13 日起至 1 月 17 日止，共計 5 天，行程安排如下：

- 1 月 13 日 去程（台北□泰國芭達雅 SIIT Thammasat 大學會議中心）及註冊報到。

13 January: (Venue: Learning Resort)

18:00- 19:00 Registration

19:00 - 21:00 Dinner

● 1 月 14 日 參加 會議 與 專題 演講

14 January: DAY1 (Venue : Auditorium in Learning Resort)

08:00 - 09:00

Registration

Opening Session			
09:00 - 09:10	O-1	Opening address	Mr. Mongkol Sakulkaio (Deputy Governor, EGAT, Thailand)
09:10 - 09:20	O-2	Welcome address	Prof. Somnuk Tangtermsirikul (Director, SIIT, Thammasat Univ., Thailand)
09:20 - 09:45	O-3	Power Development Plan in Thailand	Dr. Jiraporn Sirikum, (Assistant Director of System Planning Division, EGAT, Thailand)
09:45 - 10:10	O-4	Introduction to TIS-Asia Meeting	Mr. Tetsuo Matsumura (Secretary General, IERE Central Office)
10:10 - 10:30		<i>Coffee Break</i>	
Session 1: Stable Power Supply for Growing Demands <i>Chair: TBD</i>			
10:30 - 10:55	S-1-1	Prolonged Use of PPA-expired Power plants: Societal Benefits and Considerate Issues	Dr. Chira Achayuthakan (EGAT, Thailand)
10:55 - 11:20	S-1-2	TBD	Mr. Hiroki Murata (IHL, Japan)
11:20 - 11:45	S-1-3	TBD	TBD
11:45 - 12:00		<i>Discussion</i>	
12:00 - 13:30		<i>Lunch</i>	
Session 2: Optimized Plant Operation and Maintenance <i>Chair: TBD</i>			
13:30 - 14:00	S-2-1	Enel experiences in advanced diagnostics for power plants	Dr. Giancarlo Benelli (Head of Technology Scouting, Engineering and Research Division, Enel, Italy)
14:00 - 14:30	S-2-2	Gas Turbine Combustion Tuning Technology Development in TPC	Dr. I-Chien, Lee (Taiwan Power Company, Taiwan)
14:30 - 15:00	S-2-3	EGAT O&M Business - An effective solution to the AEC Era	Mr. Supachai Koonsad (Chief of International Sales and Contract Management Department, EGAT, Thailand)
15:00 - 15:30	S-2-4	J-POWER's Activities on keeping performance of aged existing coal-fired power plant	Mr. Taizo Araki (J-POWER, Japan)
15:30 - 16:00		<i>Discussion</i>	
18:00 - 20:00		<i>Dinner</i>	

● 1 月 15 日參加會議與專題演講

15 January: DAY2(Venue : Auditorium in Learning Resort)

08:00 -09:00 Registration

Session 3: Large Scale Introduction of Renewable Energy			
<i>Chair: TBD</i>			
09:00 -09:30	S-3-1	Development of guidance for the purpose of increasing participation connecting of renewable energy generation on power systems	Dr. Agus Yogiarto (Senior Engineer & Researcher, PLN Research and Development, Indonesia)
09:30 -10:00	S-3-2	Active and Reactive Power Control of Wind Power Plant	Dr. Zhu Lingzhi (Deputy chief engineer of Renewable Energy Department, CEPRI,China)
10:00 -10:30	S-3-3	TBD	TBD
10:30 -11:00	S-3-4	TBD	TBD
11:00 -11:30	S-3-5	TBD	TBD
11:30 -12:00		<i>Discussion</i>	
12:00 -13:30		<i>Lunch</i>	
Session 4: Enhancement of wide-area grid connection			
<i>Chair: TBD</i>			
13:30 -14:00	S-4-1	UHV Technologies for Wide-Area Transmission of Large Renewable Generation	Dr. Yao Liangzhong (Vice President, CEPRI,China)
14:00 -14:30	S-4-2	Regional Power Transmission Interconnection in ASEAN Countries	Mr.Tawatchai Sumranwanich (EGAT,Thailand)
14:30 -15:00	S-4-3	TBD	TBD
15:00 -15:30	S-4-4	TBD	TBD
Panel Discussion : R&D in Asia for Solutions to Technological Issues			
<i>Chair: Dr. John W. M. Cheng (CLP, Hong Kong)</i>			
15:30 -17:00		Panelist:Dr. Cheong Kam Hoong (Managing Director, TNB, Malaysia), Dr. Yao Liangzhong (Vice President, CEPRI, China(TBD)), Dr. Agus Yogiarto (Senior Engineer & Researcher, PT PLN, Indonesia(TBD)), EGAT(TBD)	
Closing Session			
<i>Chair: TBD</i>			
17:00 -17:20		Closing Remarks	
18:00 - 20:00		<i>Dinner</i>	

● 1月16日參觀電廠

16 January: DAY3

Technical Tour (Optional)

SIIT Thammasat Univ. organizes Technical Tour to GHECO-One coal-fired power plant on Thu. 16 January 2014.

Schedule(The schedule is subject to change)

09:00 ~ 12:00 Tour
12:00 ~ 13:00 Lunch
14:00 Bus returns to Learning Resort
15:00 Bus departs for Suvarnabhumi International Airport.

GHECO-One is Independent Power Producer (IPP) in Thailand located in Map Ta Phut, Rayong. GHECO-One Company Limited was formed with the objective to produce and supply electricity to EGAT under the IPP program. GHECO-One Power Plant will be operated at international standards, using high quality coals and the state-of-the-art and environmentally friendly technology including the use of Supercritical Pulverized Coal Boiler Technology, a high efficiency boiler system that can reduce consumption of fuel, thus reducing emissions.

GHECO-One coal-fired power plant

http://www.glow.co.th/OurProject/AW_GHECO-ONE_EN.pdf

Tour Fee

US\$ 35 (Including lunch and transportation to airport)

For tour reservation, please check the box on the item "Tour Participation" of the Registration Form (Format1, p.10).

Tour Fee should be paid in advance No later than 20 December 2013 by credit card payment or bank transfer. (with no refund).

1月17日 返程 (泰國芭達雅□台北)

3-2 會議內容記要

- 1月14日參加會議與專題演講

首日上午為大會報告及第一議題：Stable power supply for growing demands。本次 IERE 舉辦會議屬亞洲區域性技術問題提出與交流討論，其定位如圖 2。



圖 1 2014 IERE TIS-Asia 大會

The new directivity of TIS activity

	Regional Activities		TIS Global Activities
Type	Asia Regional Meeting	Africa Regional Meeting/ Activities	Based on a voluntary proposal of an IERE member
Contents	<ul style="list-style-type: none"> ● It holds every year or two years. ● Objectives are: <ul style="list-style-type: none"> ✓ Offering discussion opportunity and place among regional members ✓ Promoting Voluntary scheme of technical solution ● Central Office promotes for the time being, and tries to establish a council of Asia to advance it in the future. 	<ul style="list-style-type: none"> ● It holds every two years. ● Advanced under leadership of PIESA. 	<ul style="list-style-type: none"> ● Specialist meeting ● Lecture meeting <ul style="list-style-type: none"> ✓ Held in a local host's head office or other places. ✓ In the case of a non-open lecture meeting, payment system of actual expenses may be applied. ● Low cost technology transfer (TV/Video) ● Others



圖 2 IERE TIS 活動架構

Opening Session :		
Chair : <i>Tetsuo Matsumura</i> , IERE Central Office, Japan		
O-1 Opening address		
▶ <i>Mongkol Sakulkao</i> , Deputy Governor, EGAT, Thailand		Abstract Presen.
O-2 Welcome address		
▶ <i>Somnuk Tangtermsirikul</i> , Director, SIIT,Thammasat Univ., Thailand		Abstract Presen.
O-3 Introduction to TIS-Asia Meeting		
▶ <i>Tetsuo Matsumura</i> , Secretary General, IERE Central Office		Abstract Presen.

圖 3 2014 IERE TIS-Asia 大會報告流程



圖 4 2014 IERE TIS-Asia 大會報告

● 2014 IERE TIS-Asia Section 1 專題報告議題(3/14 上午)

繼大會報告後，針對 Stable power supply for growing demands 議題進行講演，實際會議歷程如下。

Session 1: Stable Power Supply for Growing Demands

Chair : *Kam Hoong Cheong*, TNB Research, Malaysia

S-1-1 Power Development Plan in Thailand

- ▶ *Jiraporn Sirikum* , Assistant Director of System
Planning Division ,EGAT, Thailand

Abstract Present.

S-1-2 Prolonged Use of PPA-expired Power plants: Societal Benefits and Considerate Issues

- ▶ *Chira Achayuthakan* , Engineer, Power
Purchase Agreement Management, EGAT, Thailand

Abstract Present.

S-1-3 The State-of-the-Art Technology of IHI's USC Boiler and Next Target

- ▶ *Shinji Masaki* , Basic Engineer, Energy & Plant
Operations, IHI, Japan

Abstract Present.

在 3 議題中，EGAT 針對 2012 至 2030 年泰國電力需求預測說明，如圖 5、圖 6 所示。電力需求成長一倍以上，預計增加燃煤電廠 6 座、燃氣電廠 29 座(含複循環機組)、氣渦輪機電廠 3 座、核能電廠 2 座、其他小型發電設備，及夠至鄰國電力。在燃料需求上，天然氣與再生能源為未來需求與發長之主力，如圖 6 所示。

SUMMARY of PDP2010: Revision 3 (During 2012 - 2030)

Unit: MW

Capacity During 2012 - 2030

PDP2010
Rev3

Total Capacity as of December 2011	32,395
Total Added Capacity	55,130
Total Retired Capacity	-16,839
Grand Total Capacity at the End of 2030	70,686

Numbers of Added Power Plants During 2012 - 2030

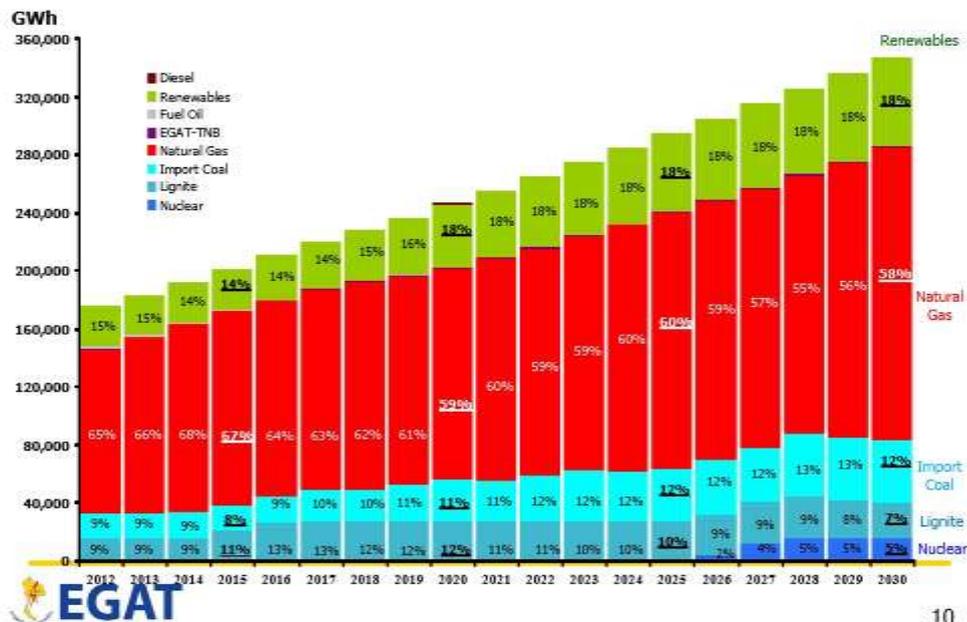
Coal-fired Power Plant (Clean coal Technology)	4,400 (6 Units)
Gas-fired Power Plant	25,451 (29 Units)
Nuclear Power Plant	2,000 (2 Units)
Gas Turbine Power Plant	750 (3 Units)
Cogeneration (SPP / VSPP)	6,374 / 102
Renewable Energy (SPP, VSPP, EGAT)	9,481
Power Purchase from Neighboring Countries	6,572



9

圖 5 2012 至 2030 年泰國電力需求預測

PDP2010 Rev. 3 - Generation Mix



10

圖 6 2012 至 2030 年泰國電力需求預測與燃料需求



圖 7 2014 IERE TIS-Asia S-1-1 by EGAT 專題報告



圖 8 2014 IERE TIS-Asia S-1-2 by EGAT 專題報告



圖 9 2014 IERE TIS-Asia S-1-3 by IHI 專題報告

● 2014 IERE TIS-Asia Section 2 專題報告議題(3/14 下午)

繼大會報告後，針對 Optimized plant operation and maintenance 議題進行講演，實際會議歷程如下。

Session 2: Optimized Plant Operation and Maintenance

Chair : *Yoshiaki Nishimura*, IERE Central Office, Japan

S-2-1 **Enel experiences in advanced diagnostics for power plants:"On-line Diagnostic Tools"**

▶ *Giancarlo Benelli* , Head of Technology Scouting,
Engineering and Research, Enel, Italy

Abstract Present.

S-2-2 **Gas Turbine Combustion Tuning Technology Development in TPC**

▶ *I-Chien, Lee* , Project researcher, Power Research
Institute, Taiwan Power Co, Taiwan

Abstract Present.

S-2-3 **EGAT O&M Business - An effective solution to the AEC Era**

▶ *Supachai Koonsad* , Chief of International Sales
and Contract Management, EGAT
Monton Yingsoong , Supervisor, Sales and
Contact Management, EGAT, Thailand

Abstract Present.

S-2-4 **J-POWER's Activities on keeping performance of aged existing coal-fired power plant**

▶ *Taizo Araki* , Assistant Manager, Thermal Power
Department, Plant R&D, J-POWER, Japan

Abstract Present.

在 4 議題中，第一、二議題為電廠機組性能監測與診斷技術；第三、四議題為電廠機組操作介紹。其中，Enel 公司 Dr. Giancarlo Benelli 介紹其公司發展之氣渦輪機線上監測診斷系統，其功能與本所發展之氣渦輪機線上監測與診斷系統相類似，圖 10 為 Enel 公司氣渦輪機線上監測診斷功能，圖 11 為 Enel 公司氣渦輪機線上監測數據分析。本議題中，本人針對台電公司在氣渦輪機組燃燒穩定性調校技術之發展 (Gas Turbine Combustion Tuning Technology Development in TPC) 報告，主要論述氣渦輪機組最常發生的燃燒不穩定之調校技術，並自行設計開發適合不同機組 (SIEMENS, ALSTOM, MHI...等) 之客製化及時監診系統，藉由遠端監測技術，提供客戶即時資訊，避免氣渦輪機組發生燃燒不穩定；若發生時，將可提供調校方法。報告中說明我們的實績，以證明技術成熟度，報告內容如附件 1。

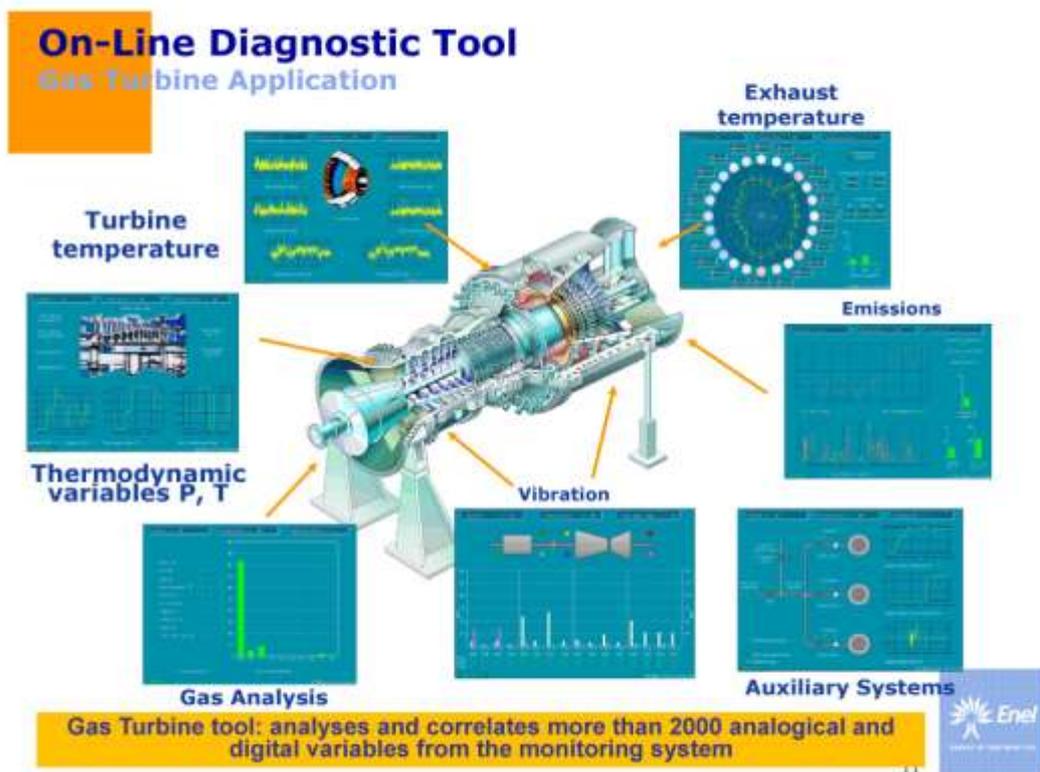


圖 10 Enel 公司氣渦輪機線上監測診斷功能

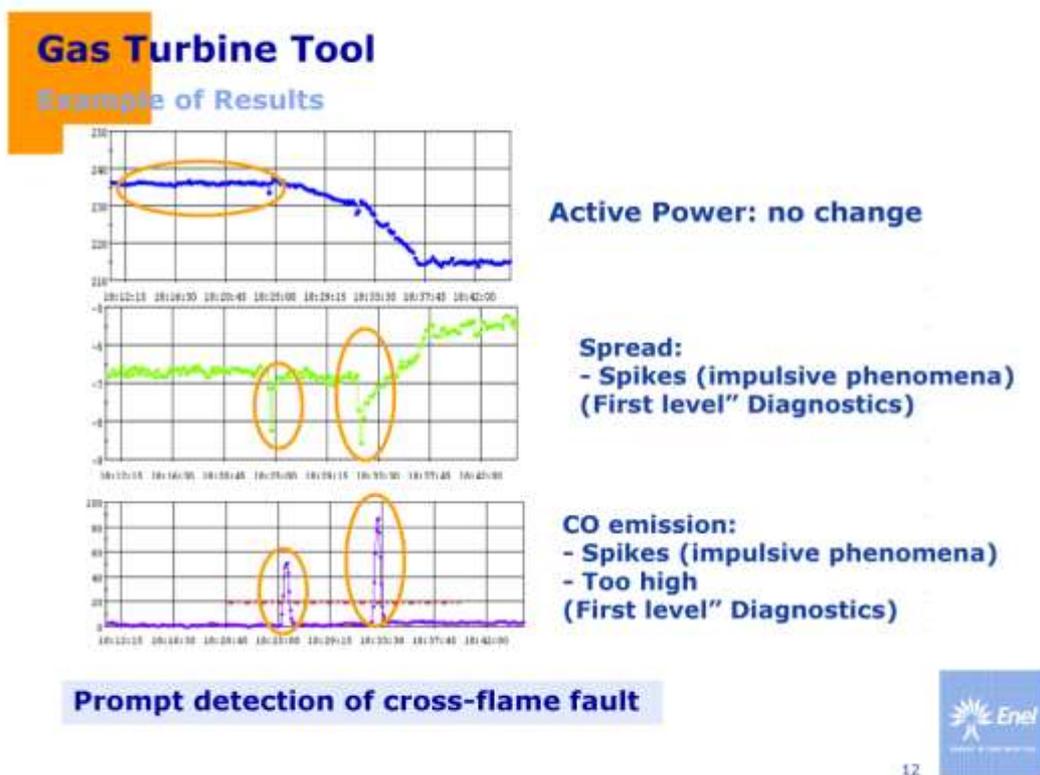


圖 11 Enel 公司氣渦輪機線上監測數據分析



圖 12 2014 IERE TIS-Asia S-2-1 by Enel 專題報告



圖 13 2014 IERE TIS-Asia S-2-2 by TAIPOWER 專題報告



圖 14 2014 IERE TIS-Asia S-2-3 by EGAT 專題報告



圖 15 2014 IERE TIS-Asia S-2-4 by J-Power 專題報告

● 2014 IERE TIS-Asia Section 3 專題報告議題及新會員
報告(3/15 上午)

繼大會首日報告後，3/15 上午針對 Grid connection 議題進行
講演及新加入會員 NHVS 之公司介紹，實際會議歷程如下。

Session 3: Grid Connection	
Chair : <i>Masazumi Yamamoto</i> , Mitsubishi Electric Co., Japan	
S-3-1 Development of guidance for the purpose of increasing participation connecting of renewable energy generation on power systems	
▶ <i>Agus Yogianto</i> , Senior Engineer & Researcher, PLN Research and Development, Indonesia	Abstract Presen.
S-3-2 Regional Power Transmission Interconnection in ASEAN Countries	
▶ <i>Tawatchai Sumranwanich</i> , Chief, Transmission System Planning Department, EGAT,Thailand	Abstract Presen.

Introduction of New IERE member	
A brief Introduction of NHVS	
▶ <i>Shih-chieh Sun</i> , Project Manager, NHVS, China	Abstract Presen.

在第一議題中針對再生能源電廠之規劃介紹，其價更類似國內顧問公司之電廠規劃案。第二議題為 Electrical Generating Authority of Thailand (EGAT)介紹鄰國之間電力互連傳輸系統發展。隨著東盟成員國之間的能源貿易和交換，2015 年東盟經濟共同體 (ASEAN Economic Community ， AEC) 成員國可以共享和使用資源。能源之貿易與交換促使減少新建電廠的最好解決方案。因此鄰國之間電力互連傳輸系統發展有其必要性。



圖 16 2014 IERE TIS-Asia S-3-1 by PLN 專題報告



圖 17 2014 IERE TIS-Asia 新會員報告 by NHVS

- 2014 IERE TIS-Asia Panel Discussion 及閉幕(3/15 下

午)

3/15 下午已研究發展觀點討論亞洲地區會員發電技術問題，如何尋求解決方案。主要為泰國 EGAT、馬來西亞 Tenaga Nasional Berhad (TNB)、印尼 TBD 及日本 IERE 介紹其研究發展工作與方向。

Panel Discussion : R&D in Asia for Solutions to Technological Issues

Chair : Paritud Bhandhubanyong, Panyapiwat Institute of Management, Thailand Presen.

▶ Panelist:

Kam Hoong Cheong, Managing Director, TNB Research, Malaysia

Agus Yogianto, Senior Engineer & Researcher, PT PLN, Indonesia(TBD) Presen1. Presen4.

Taweeep Chaisomphob, Associate Professor, SIIT,Thammasat Univ., Thailand

Yoshiaki Nishimura, Deputy Secretary General, IERE Central Office, Japan



圖 18 2014 IERE TIS-Asia Panel Discussion

Closing Session

Closing Remarks

- ▶ **Taweep Chaisomphob** , Associate Professor,
SIIT,Thammasat Univ., Thailand

Abstract Present.



圖 19 2014 IERE TIS-Asia Panel Discussion 閉幕合影

1 月 16 日參觀電廠

GHECO-ONE 公司為 Glow 能源公用有限公司，屬電力和公用事業工業的泰國最大的私營生產企業。為一獨立電力生產供應商（IPP）提供電力給 EGAT。上午搭專車前往電廠，其燃煤電廠與公司之台中電廠相類似，主要特性說明如下：

1. 使用進口 Bituminous coal
 2. 使用 Low NOx Burner 之粉煤燃燒
 4. 使用 Selective Catalytic Reduction (SCR) 除氮氧化物 NOx；使用靜電集塵器 Electrostatic Precipitator (ESP) 除灰 dust；使用 Flue Gas Desulphurization (FGD) 除硫氧化物 SOx
 6. 使用超臨界鍋爐 Supercritical Pulverized Coal Boiler
- 機組主要特性如下：

Project Description	<ul style="list-style-type: none">◆ Net output of 660 MW.◆ Incorporating state-of-the-art and environmentally friendly technology.◆ The Environmental Impact Assessment (EIA) report of this project has already been approved by the Office of Natural Resources and Environmental Policy and Planning on May 2008◆ Uses high quality, low-sulfur bituminous coal
Project Location	<ul style="list-style-type: none">◆ In the existing power plants' areas of Glow Group, in Map Ta Phut Industrial Port, Map Ta Phut Industrial Estate, Rayong◆ Utilizing existing utilities and infrastructures
Construction Period	<ul style="list-style-type: none">◆ Duration: 40 months◆ Start of construction: Middle of 2008◆ Expected Completion: Approximately October 2011
Project Highlight	<ul style="list-style-type: none">◆ One of the cleanest coal-fired plants in the world.◆ Reduces overall emission resulting in cleaner air for Map Ta Phut.◆ Energy fund support of about 100 MTHB per year◆ Continuous environmental monitoring and controlling program throughout the project lifetime.

	<ul style="list-style-type: none"> ◆ The first private company in Thailand to install an Emission Display Board which is showing real time emissions
Benefits from the Project	<ul style="list-style-type: none"> ◆ Ensure stability of electricity tariff. ◆ Adequate electricity supply for future demand ◆ Cheap electricity tariff (award was based on competitive bidding) ◆ Diversification of fuel risk ◆ Increase competitiveness of Thailand
Project owner	<ul style="list-style-type: none"> ◆ Glow Energy PLC. ◆ www.glow.co.th ◆ Hemaraj Land and Development PLC. ◆ www.hemaraj.com

肆、IERE 之介紹

IERE 之背景及活動

(一) IERE 為一非營利組織，設立於 1968 年，稱為國際電力研究交換，專門服務於負責電力及與能源相關 R&D 工作之高階執行者、高級經理人與研究人員。

他們涵蓋：

- 電力與能源供應工業

- 設備提供者事業

- 學術研究

- 政府機構

(二) 願景：係一個全球性電力研究、發展、示範合作的媒介。

(三) 使命：

- 分享 R&D 策略與執行之最佳實務

- 推動 R&D 與技術移轉

- 促進技術發展、分享與評估

- 持續推展技術的移轉在已開發和正開發中的國家

(四) 主要與辦活動：

- Forum Suite：依據地區性特殊主題而設定之研討會，自 2001~2013 年共舉辦 13 場。

- General Meeting：係會員交互活動之平台，提供每年不同地區之會員與來賓聚會之會議，自 2001~2013 年共舉辦 13 場。

- Workshop：在專家層次上來討論特定的技術與社會／經濟相關議題之會議，自 2002~2013 年共舉辦 14 場。

- Technological Issues & Solution (TIS)：

 - TIS-Asia 係會員交互活動之平台，提供每年不同地區之會員

與來賓聚會之會議，自 2007~2013 年共舉辦 4 場。

TIS-Africa 係會員交互活動之平台，提供每年不同地區之會員與來賓聚會之會議，自 2007~2013 年共舉辦 4 場。。

伍、附件



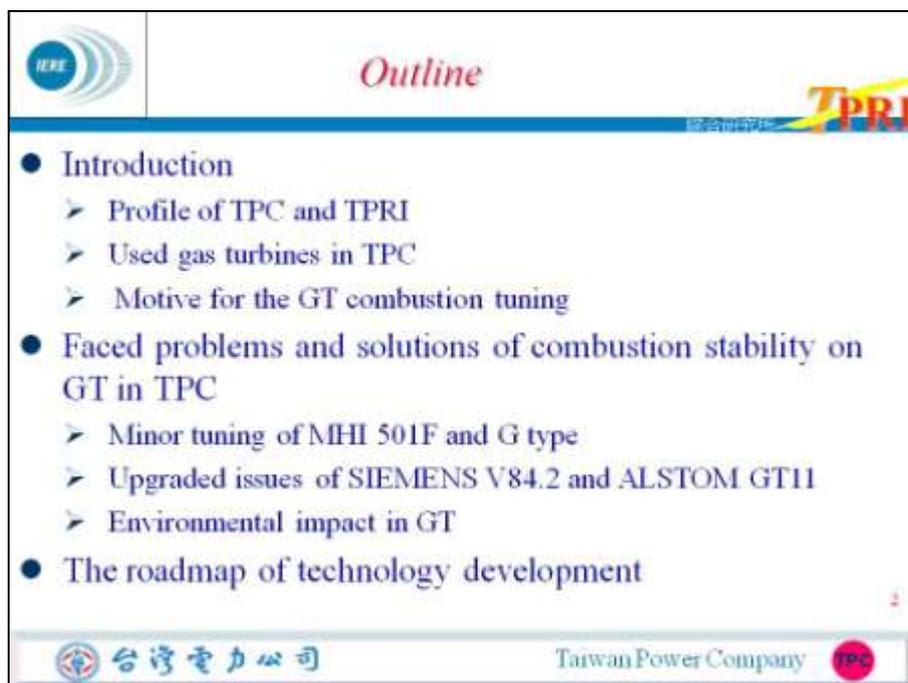
IERE IERETIS-Asia Meeting 2014 TPRI

Gas Turbine Combustion Tuning Technology
Development in TPC

Dr. ICHIEN, LEE
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Taiwan Power Company, Taipei, ROC
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台湾电力公司 Taiwan Power Company TPC



IERE *Outline* TPRI

- Introduction
 - Profile of TPC and TPRI
 - Used gas turbines in TPC
 - Motive for the GT combustion tuning
- Faced problems and solutions of combustion stability on GT in TPC
 - Minor tuning of MHI 501F and G type
 - Upgraded issues of SIEMENS V84.2 and ALSTOM GT11
 - Environmental impact in GT
- The roadmap of technology development

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台湾电力公司 Taiwan Power Company TPC



Introduction

Profile of TPC - TAIWAN POWER COMPANY



Founded: May 1, 1946
 Coverage: Taiwan, Fengshu, Kinmen, Matsu areas
 Capital: NT\$330 billion
 Stock: 96.92% government-owned, 3.08% public-owned
 Total assets: NT\$1,629.7 billion
 Employees: 27,261
 Customers: 12.77 million

Resident	11,398,498 household	Industrial	210,288 household
Commercial	988,827 household	Others	170,431 household

Installed capacity: Taipower System: 41,401 MW,
 (32,508 MW Taipower-owned)
 Power generated and purchased: 213,042 GWh
 Energy sales: 198,637 GWh



Dr. Jung-Chiou Hwang
The Chairman, TPC



Dr. Wen-Chen Chu
The President, TPC



台湾电力公司

Taiwan Power Company





Introduction

Profile of TPC - TAIWAN POWER COMPANY



- TPC is the sole power sales company in Taiwan. The business scope includes:
 - power generation
 - power transmission
 - power distribution
 - power sales
- Independent power producers (IPPs) and cogeneration are sold the electricity in bulk to Taipower

Power Development and Power Grid Map

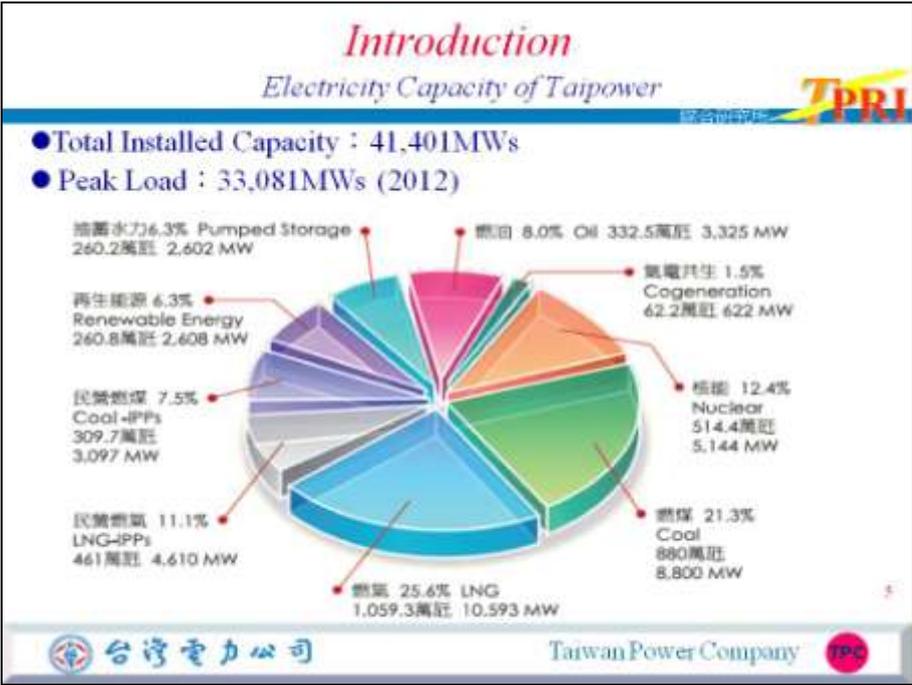




台湾电力公司

Taiwan Power Company





Introduction
TPRI - TAIWAN POWER RESEARCH INSTITUTE



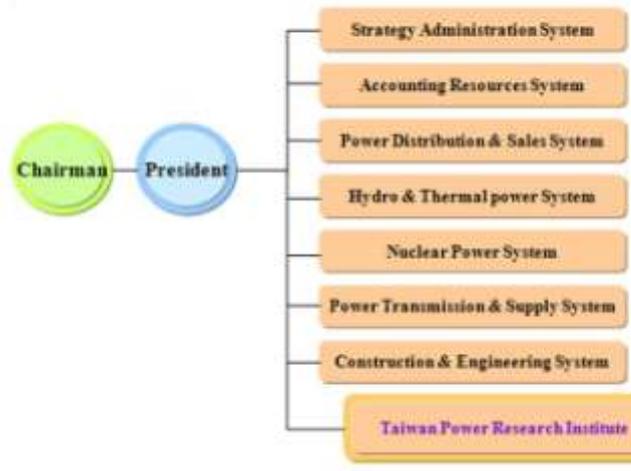
- Taiwan Power Research Institute (TPRI) is one of the departments in TPC. Under the guidance of TPC's short-Middle-long term R&D roadmap, TPRI makes great efforts in research development, technical service and testing business.
- Our objectives:
 - Promote Productivities and Decrease Costs
 - Promote Power Supply Quality and Decrease Outage Events
 - Develop Low Carbon Power Sources and Set Smart Grid Into Action
 - Deeply Cultivate the Core Technologies and Passing Down the Experiences



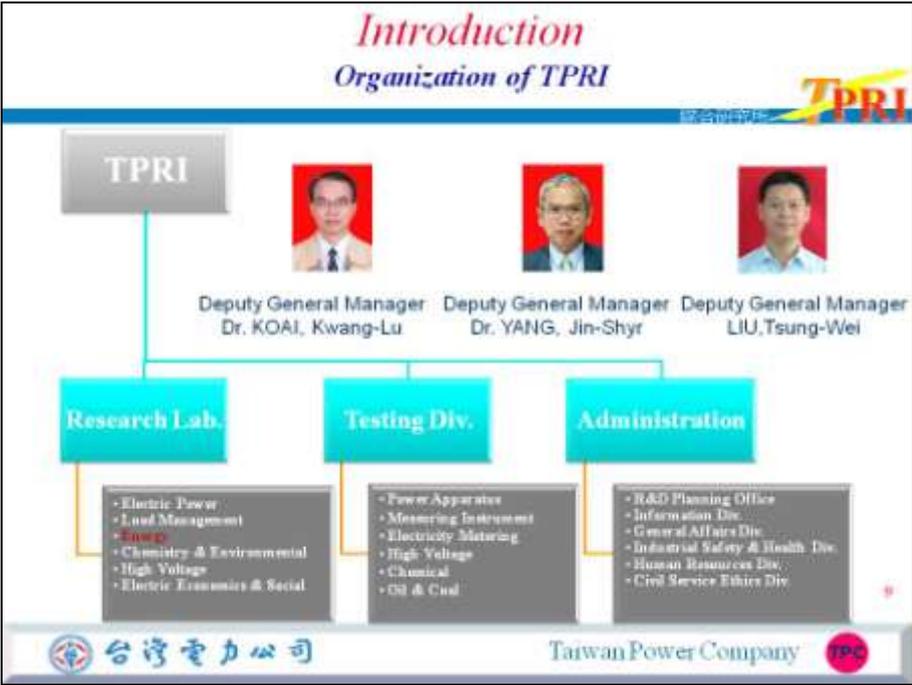
Jen-Ming Hsu
 General Manager,
 TPRI, TPC

 台湾电力公司 Taiwan Power Company 

Introduction
TPRI position in TPC

 台湾电力公司 Taiwan Power Company 



The *GT combustion stability tuning technologies*

Motive

- Relationships between TPC and OEMs : In the recent years, the business relationships between TPC and original equipment manufacturers (OEMs) have shifted toward *longer-term cooperation*. Particularly, it is due to the rapid development of high efficiency components using the most advanced combustion technologies. The more sophisticated a power plant component becomes, the more attention is required during operation to avoid the risk of abnormal behavior, such as combustion unstable .
- The above result has led to develop the combustion stability tuning technologies for GT in TPC.

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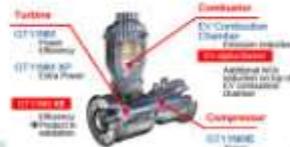
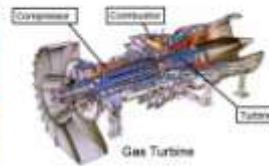

台湾電力公司
Taiwan Power Company




Used Gas Turbines in TPC



OM	GTtype	Power Plant	No. of C.C.	Capacity(MW)
MHI	501F	Tatan	2(3GT+1ST)	742.732
	501F	Nanpu	1(1GT+1ST)	251.431
	501G	Tatan	4(2GT+1ST)	724.734
SIEMENS	V84.2	Nanpu	3(3GT+1ST)	288.833
	V84.2	Hsinta	5(3GT+1ST)	445.1935
ALSTOM	GT11-NM	Tungshiao	2(3GT+1ST)	358.0, 372.0
	GT11-N2	Tungshiao	1(3GT+1ST)	312.531
	1105	Tungshiao	1(3GT+1ST)	246.831
GE(SA)	MS-7001E	Tungshiao	2(3GT+1ST)	258.532
合計				9,534.25 MW



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Taiwan Power Company TPC



Introduction Power Development and Power Grid Map



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Taiwan Power Company TPC



Introduction

Motive- the GT abnormal operation behavior happened in TPC



- Faced problems related to combustion stability on GT in TPC
 - Minor tuning of MHI 501F and G type
 - Upgraded issues of SIEMENS V84.2, ALSTOM GT11N2, NM
 - Environmental impact in GT
 - NOx emission to meet new environmental regulation set
- Usually happened of GT combustion instability in TPC:
 - Environmental influences
 - Performance decay
 - NOx emission problems
 - After periodical inspection (On-scheduled outages)
 - fuel composition variation

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台湾电力公司

Taiwan Power Company



Noticed of Gas Turbines in TPC



	Environmental influences	Performance enhanced	NOx emission	After periodical inspection	fuel composition
	●			● OEM required	○
	●	●	● Near downtown		○
	●	●		●	○
	●				○

○ for the future

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台湾电力公司

Taiwan Power Company

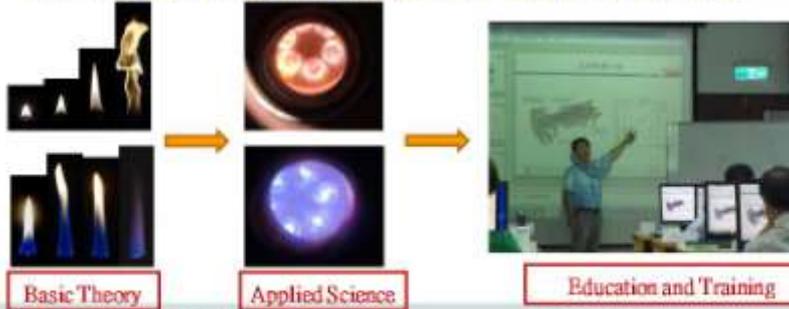




Education and Training



- GT combustion theory belongs to an applied science, combined with fluid mechanics, thermodynamics and combustion science, applied in actual mechanical equipment and control systems.
- Education and training power plant operation, maintenance skills and the establishment of independent analytical techniques.



Basic Theory

Applied Science

Education and Training

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Taiwan Power Company



Combustion tuning after periodical inspection



- Combustion tuning of 501F and 501G suggested by MHI

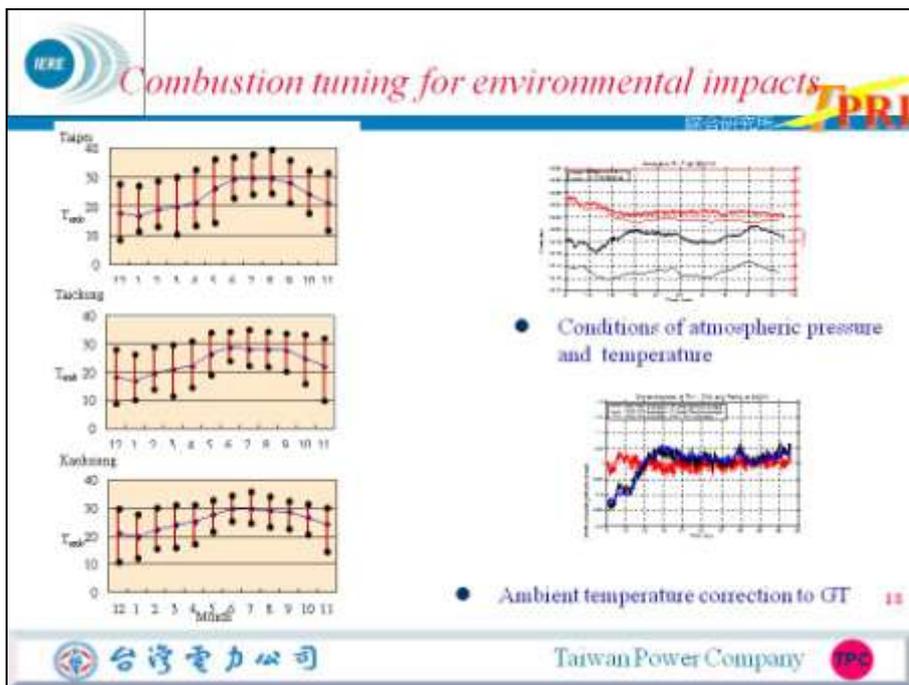
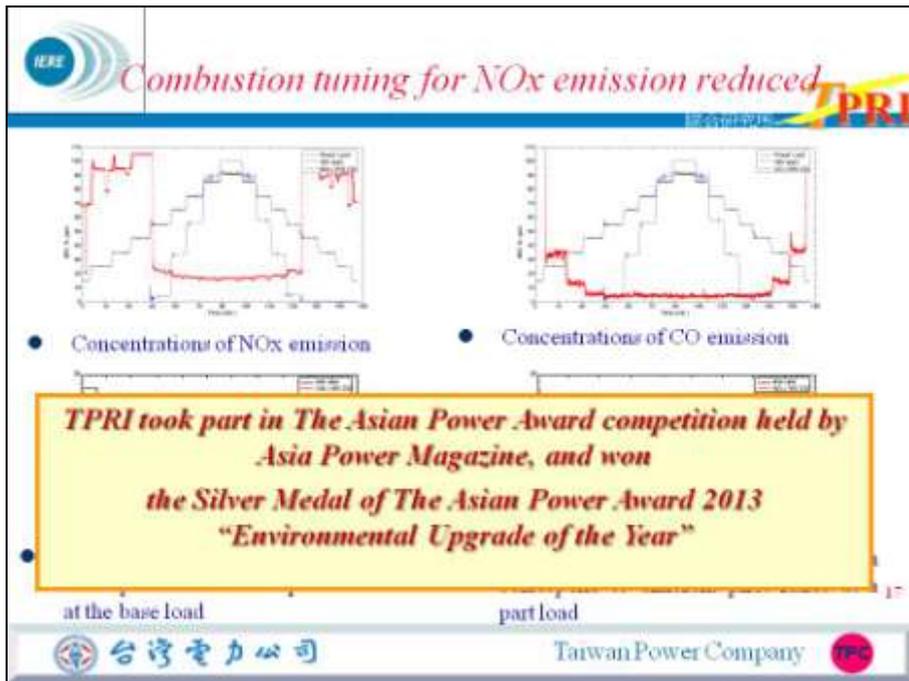
	Tuning	Tuning Item	
Complete Tuning Process (Contact to MHI)	Commissioning period	Gas	Firing & Acceleration
			Load Operation
			Load Rejection
Minor Tuning Process	Commercial operation (After periodical inspection)	Gas	Firing & Acceleration (only check)
			Load Operation
	Commercial operation (CPFM alarm · BPT alarm · NOx high)	Gas	Load Operation

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Taiwan Power Company





IEEE *Combustion Dynamics Monitoring System established by TPRI* TPRI

HD set-up Environmental Anal. Performance Anal.

User-friendly Interface

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台湾电力公司 Taiwan Power Company TPC

IEEE *Measured Techniques of TPRI* TPRI

Sensors A/D DAQ Controller Software

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台湾电力公司 Taiwan Power Company TPC

IEE *The roadmap of technology development in TPC* TPRI

	Environmental influences	Combustion stability tuning	NOx emission	CDMS	Fuel gas impacts
	●	●			○
	●	●	●	●	○
	●	●		●	○
	●	●			

ps. our technology developed follows TPC's GT upgraded projects. 21

台湾电力公司 Taiwan Power Company TPC

IEE *Combustion tuning scope and future of GT in TPC* TPRI

- To continue the roadmap of technology development and cooperated with OEMs of GT. Our research we focus on, is to
 - keep availability high
 - control NOx emission lower
 - decrease environmental impact
 - stabilize combustion stability
 - develop on-line monitoring and diagnostic technology
 - minimize the impact of fuel changed in the future

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台湾电力公司 Taiwan Power Company TPC



*Thank you
for your attention...*

