

公務出國報告

(出國類別：會議)

一〇五年度經濟部台灣自來水公司

「參加 2016 IWA 國際水質安全會議」

出國報告書

服務機關：台灣自來水公司

出國人員：姓名：何承嶧

職稱：組長

出國地區：菲律賓

出國期間：105.04.24~105.04.29

報告日期：105.6.21

系統識別號：C10501219

公務出國報告提要

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報告名稱：一〇五年度經濟部台灣自來水公司「參加 2016 IWA 國際水質安全會議」出國報告書

主辦機關：經濟部台灣自來水公司

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台灣自來水公司

出國類別：會議

出國地區：菲律賓

出國期間：105 年 04 月 24 日至 105 年 04 月 29 日

報告日期：105 年 6 月 21 日

分類號/目：770 環境保護

關鍵詞：水安全計畫、水質研究

內容摘要：參加 2016 國際水安全研討會(Global Water Safety Conference, GWSC)是本公司近年參加 WSP（水質安全計畫）相關國際會議的濫觴，具有重視水質安全的指標意義。在氣候變遷影響各水源(包括河、湖、井、海水及水庫等)水質變化的此時，藉由與世界多單位多面向交流用以檢視台灣自來水公司有關水源、淨水場、管網系統至用戶端之整體飲用水水質管理架構，並針對水質研究業務進行深入討論。整體而言此行不論在 WSP 汲取新知，以他國之石提供本公司參考，及結識各國執行 WSP 人員，均有助本公司推動 WSP 效能，成果相當豐碩。

摘 要

國際自來水協會 (International Water Association, IWA) 是全球最富盛名輔導自來水永續經營的國際組織，每年均針對不同自來水主題開設各類型的國際研討會，並為平衡五大洲發展及權益，每次舉辦地點均極具特色。以本次舉辦城市：菲律賓巴拉望 (Philippines, Palawan) 為例，其特色即以”世界最後處女地 (The place where the GOD live)”著稱，該地號稱無污染、無天災、人民友善；另外近年來因菲律賓已陸續將自來水發展之成熟經驗，成功輸出至鄰近東協國家，包括泰國、緬甸及印尼等，本次研討會亦成為經驗分享並宣揚國威的絕佳時機。

本次會議另一個協辦單位為世衛組織 (World Health Organization, WHO)，該組織長期關注未開發國家的用水安全，並在本次研討會分享協助不丹、尼泊爾、衣索比亞及賴比瑞亞等國家建置自來水系統的經驗，從一幕幕自來水從無到有的畫面，你看到的就是一次次的感動。讓人直想到供水普及率已達 92.18% 的台灣 (2015, TWC)，我們有多麼的幸福！而本公司持續供應量足、質優、服務好的自來水是多麼義無反顧的社會責任。

本公司近來積極與國際接軌，設置有研究單位持續觀察供水系統的問題種類，及負責引入新技術，朝向兼具專業檢測、科學研究及技術創新之制度化水質單位發展，為推動水安全計畫 (Water Safety Plan, WSP) 奠基。為有效全方位管理水資源，針對經營管理、生態保育、提供誘因促進用水效率、減少水資源運送之漏損、促進省水作為及建立合適管理機制與方法等面向進行全方位研討，期望未來能有效提昇本公司經營績效及用戶服務水準。

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壹、目的

我國是島國型國家，雨量豐沛，但地形坡度大，大部分水流入大海，加上工廠廢水、生活污水對水源的污染，水源之開發是日漸困難，開發成本升高，可用的水資源相形見絀。然工商業持續發展，國民生活水準日益提昇，用水量是逐年提高，而台灣自來水公司(以下簡稱本公司)仍必須肩負政府政策性的要求辦理各項供水任務，財務負擔甚為沉重，以現行每度自來水的平均單位成本為 10.85 元，而平均單位售價為 10.78 元，自來水水價偏低，無法反映成本，使得本公司經營更加困難。

又近期全球氣候異常，更造成水質變動相當大，尤其是濁度，汛期時原水水質高達數千或數萬 NTU，而水庫藻類優養化衍生臭味、總有機碳偏高等，已遠遠超出淨水場之處理負荷，水質管理遭遇相當大挑戰；此外，本公司自民國 63 年合併各地水廠成立公司時，所屬管線均已老舊。而當時為提高供水普及率，其新埋管線亦多採用經濟管種，迄今已逾 40 年，加上我國地震頻繁，致漏水嚴重，較其他已開發國家高。面對這些問題，本公司仍基於「品質、創新、信賴、專業」之經營理念，積極推動水源開發利用多元化規劃、水源聯合調配運及充實供水系統備援備載能量。故本公司近來加強水質管理及水質處理相關研究以提升水質處理技術，並投入相當人力、成本強化防漏及水壓管控工作，以中、小區管網分析評估有高缺水風險及漏水嚴重之區域，積極推動檢漏作業及管線汰換，有效控制供水系統及管線之漏水復原，以達成本公司「提供量足、質優自來水，以提升國民生活水準、促進經濟發展」使命自詡。

近年來因氣候急遽變化，降雨量極不平均，常造成枯水期乾旱缺水或豪雨成災導致原水濁度過高的窘境；枯水期亦因流量短缺造成供水吃緊，本公司為能解決缺水問題，需多方評估擇選最佳方案。因此，

本公司極需培養具水處理全流程(含淨水、廢水及污泥)操作、管理及檢討修正的人才，並需具備外語能力，可適用引進國外最新技術，以因應多變的供水環境。

本次研討會研習內容對本公司刻正發展研究業務、與國際接軌及推動水安全計畫(Water Safety Plan, WSP)，及針對 WHO 制訂(德國)波昂安全飲用水憲章(The Bonn Charter for Safe Drinking Water)，用以強調自來水水源、淨水場、管網系統至用戶端之整體飲用水水質管理架構等發展具正面助益。

貳、研習內容與行程

本案本公司係以 poster presenter 參加 GWSC 進行研究成果發表及參與會議及研討會，藉由與多單位多面向交流，用以檢視本公司有關水源、淨水場、管網系統至用戶端之整體飲用水水質管理架構，並針對水質研究業務進行深入探討，俾利為提供安全、可靠及優質飲用水預做準備。


水安全計畫雖源自德國波昂，自從 2004 年世界衛生組織(WHO)公布第三版飲用水水質準則(WHO Guidelines for Drinking Water Quality)及國際水協會(IWA)公布的波昂安全飲用水憲章(IWA Bonn Charter for Safe Drinking Water) 後， 2011 年第四版的 WHO 飲用水水質準則更強化 WSP 重要地位。

本公司自 2014 起將水安全計畫(Water Safety Plan, WSP)由七區澎湖所七美淨水場開始導入，時值台灣地區自來水事業刻正與國際水質安全概念接軌，此行針對 WSP 主題進行更深入與多國進行實務交流研討獲益良多，相關研討會議行程詳參表 1 所示。又相關大會報到及會場相片如下。

表 1 研習行程與內容

* April, 24: 去程：桃園—>馬尼拉(Melina)—>巴拉望(Palawan)

Monday 25 (Pre-conference Workshop)

13:30-15:00	Workshop: Water Safety Planning for Small Water Supply Systems
	Chair: Oliver Schmoll (WHO)
	 Workshop material

Tuesday 26 Room 1

10:30-12:00	Technical Session: WSP Implementation: Benefits, impacts and Lessons Learned
	Chair: Philip De Souza (Emanti)
	 Impact Assessment Of Water Safety Plans In The Asia Pacific Region , Emily Kumpel (Kenya)
	 Implementation Water Safety Plans In Iran , Ahmad Montazeri (Iran)
	 A Systematic Review Of Outcomes And Lessons Learned From General, Rural, And Country-specific WSP Implementations , Gabrielle String (USA)




 [Ensuring water safety applying sustainable sanitation and hygiene promotion programmes for marginalized communities – Sri Lankan Experience](#), N.I.Wickremasinghe (Sri Lanka)


LUNCH BREAK

13:30-15:00	Technical Session: Innovative Policies and Regulations for Drinking Water Quality Management
	Chair: Donald Reid (Government of Alberta)
	 Alternate approaches to promotion of Water Safety Plans in two Southeast Asian Countries , Terrence Thompson (Philippines)
	 Exploring The Mandatory Water Safety Planning In Malaysia , Hafizah Hasan (UK)
	 Initiative Water Safety Plan Implementation in Indonesia: Benefits and Lessons Learned , Kristin Darundiyah (Indonesia)

 [Updating The 2007 Philippine National Standards For Drinking-Water](#), Joselito Riego de Dios (Philippines)

COFFEE BREAK

15:30-17:00	Technical Session: Operation and Maintenance of Water Supply Systems
	Chair: Asoka Jayaratne (Yarra Valley Water)
	 Water Safety Plan Implementation To Manage A Drinking-water Contamination From Thallium , Luca Lucentini (Italy)
	 The Practice Of Purification Plant In Response To High Turbidity Raw Water –especially In Extreme Weather , Pei-Ling Hou (Taiwan)
	 A Current Review On Online Detection Of Waterborne Priority And Dangerous Pollutants And Contaminant Warning Systems , Andrea Capodaglio (Italy)





 [Nexus is the new Green. Innovative solution to improve water-energy nexus for the Operation and Maintenance of Water Supply Systems](#), Alejandro de Juanes (Philippines)

 [The Role of Water Safety Plans, Bajo, Bhutan](#), Jigme Phuntsho (Bhutan)





Wednesday 27 Room 1

10:30-12:00	Technical Session: Sanitation Safety Plan Implementation and Integration with WSPs
	Chair: Darryl Jackson (WHO Consultant)
	 Extending Water Safety Plan Concept To Wastewater Treatment Operations , Kris Catang-catang (Philippines)
	 Using the Sanitation Safety Planning tool for improving the sanitation system in peri-urban areas of Iringa, Tanzania , Marta Domini (Italy)
	 Sanitation Safety Plan (SSP) Improves Faecal Sludge Management in Baliwag, the Philippines , Victoria Signo (Philippines)
	 Planning and decisions on management of wastewater systems in River Göta älv – in WWTPs and CSOs – for a safe drinking water supply , Thomas Pettersson (Sweden)

LUNCH BREAK

13:30-15:00	Technical Session: Auditing WSPs
	Chair: Jennifer De France (WHO)
	 Reflections from a WSP Auditor: East African Lessons Learned , Philip de Souza (South Africa)
	 An Index Model For Evaluating Water Safety Plans In The Philippines , Bonifacio Magtibay (Philippines)
	 Using the Water Safety Plan as a tool to investigate Provincial-scale risks to drinking-water in Alberta , Donald Reid (Canada)
	 WSP audit for rural system: Experience of Timor Leste , Nam Raj Khatri (Nepal)

COFFEE BREAK

15:30-17:00	Technical Session: Equitable and Universal Access to Safe Drinking Water & Sanitation: Approaches, Initiatives and Lessons Learned
	Chair: Oliver Schmoll (WHO)
	 A Virtuous Data Cycle: Post-2015 Water And Sanitation Monitoring That Supports Local Service Delivery , Ranjiv Khush (USA)
	 Piloting Water Quality Tests Coupled With A National Socioeconomic Survey In Yogyakarta Province, Indonesia , Kristin Darundiyah (Indonesia)
	 How can Water Safety Plans Help Ensure Equitable Access to Safe Water? , David Sutherland (India)
	 The Equitable Access Score-card: a Tool to Self-Assess Equitable Access to Water and Sanitation , Oliver Schmoll (Germany)

Thursday 28 & Friday 29

	Workshop: WSP Auditing
	Chairs: Darryl Jackson & Angella Rinehold (WHO)
	 Workshop material

* April, 29: 回程：巴拉望(Palawan) ->馬尼拉(Melina)->桃園



參、研習心得

水安全計畫針對「水源管理、配水及用戶，不是僅有淨水場而已」的論述，與本次研討會以規畫整體飲用水水質管理架構完全吻合，在導入研習焦點之前，首先介紹水安全計畫架構(詳圖 1)及製訂流程(詳圖 2)，用以說明 WSP 構架及其重要性。至於完整水安全計畫建置與實施流程則請參看圖 3。

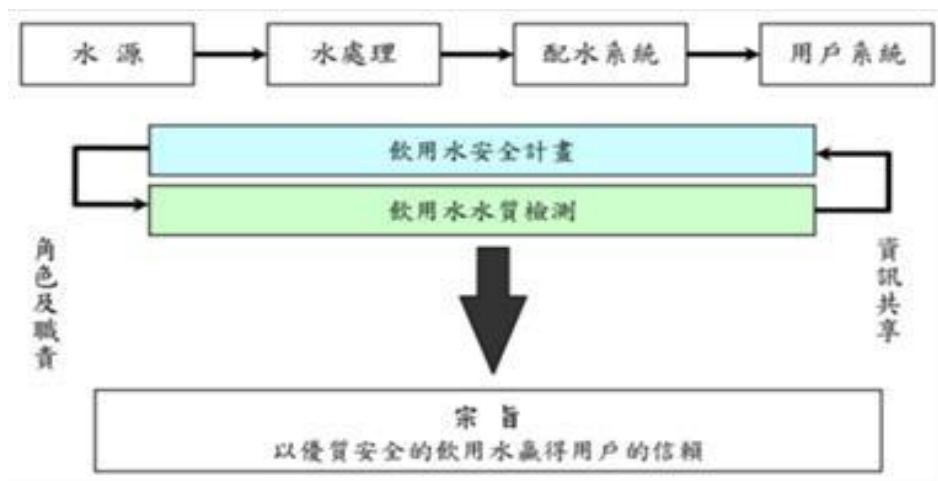


圖 1 水安全計畫架構圖

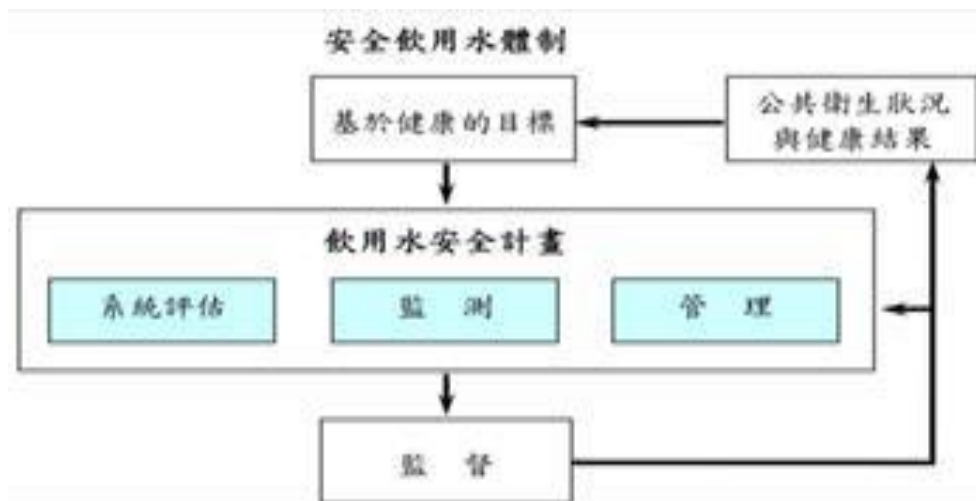


圖 2 飲用水水質標準製訂及驗證流程圖

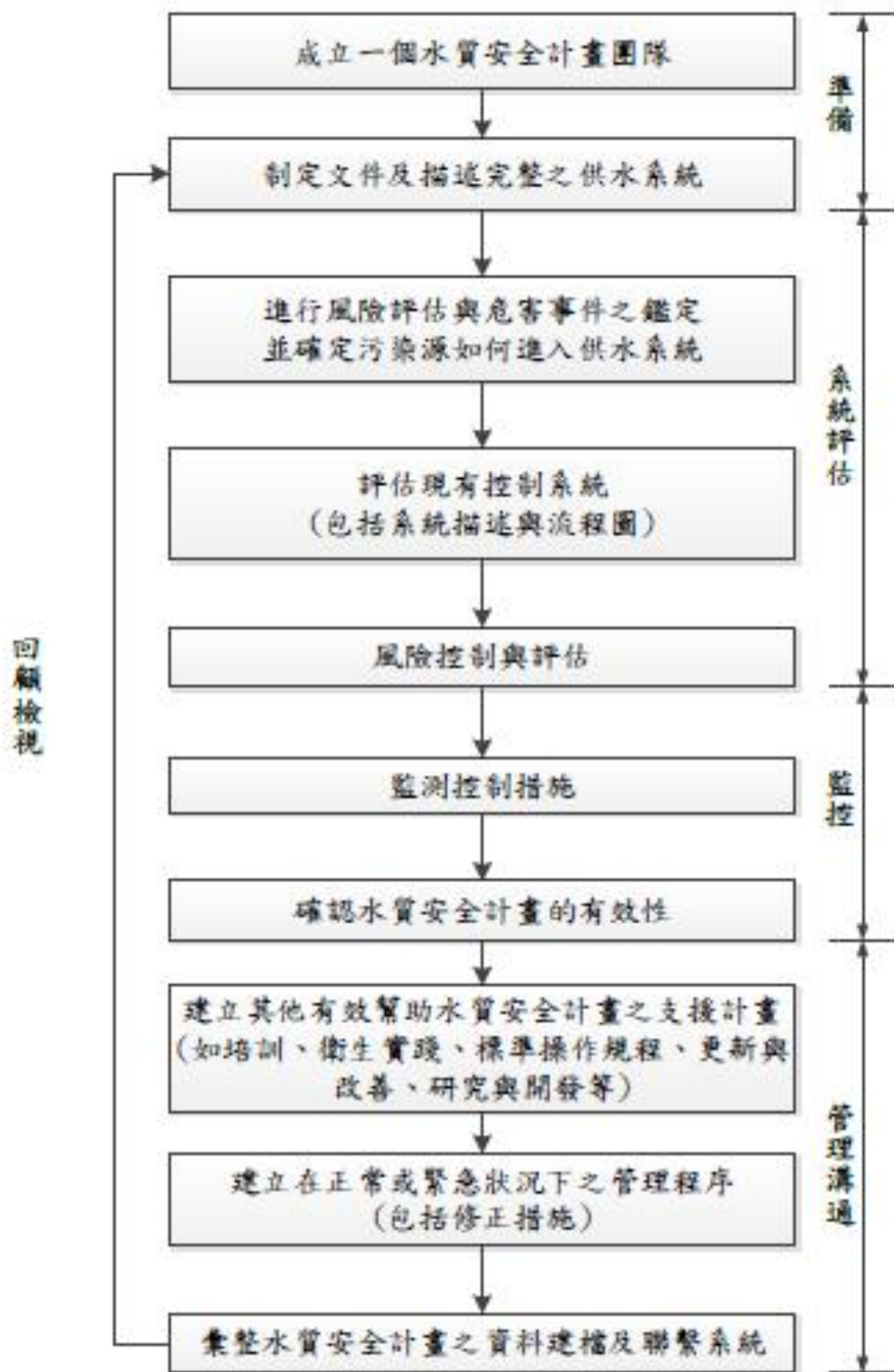


圖 3 水安全計畫建置與實施流程圖

一、GWSC Technique & Workshop

(一) 大會邀請及展示海報

Announcement and Invitation

Global Water Safety Conference and Exhibition

April 25-27, 2016
Aziza Paradise Hotel
Puerto Princesa City, Palawan, Philippines

THEME: A Pathway to Universal Access to Safe and Improved Water Service Delivery

THE VENUE

Puerto Princesa City, a tropical paradise with bustling urban center perfect for business with lush hills, lush rainforests and white sand beaches are easily accessible from the city proper making the water knowledgeable.

Puerto Princesa, which forms part of the Philippines last frontier, was the site of the 11th Water Safety Plan Conference & Exhibition in a City with a natural beauty. The one of the country's largest City with a historic site of 250,000 residents. A shaded resort at the edge of the city through the mountains of the City, directly from the central area - the East and the West Coast. The eastern side, which is being the Sea Side is characterized by the shaded area bordered by mountains, following a series of hills from the center. The West Coast has a view of the sea with mountains and a view of the Ocean, thus giving the City a unique and scenic view.

Historically, the place was named after Princess Anaethon, born in 1664 to Queen Isabella II and her consort, Francisco de Caceres. When the prince arrived in the city, the Queen changed the name to Puerto de la Princesa. Eventually, the name was reduced to Puerto Princesa as it is known today.


Puerto Princesa City was also known for its Subterranean River system to be the natural biological underground river. On January 28, 2015, Puerto Princesa Underground River was declared a World Heritage Site.

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TECHNICAL PAPERS

Interesting topics in the following subject areas are expected to be discussed during the event:

- Water Safety Plan Implementation
- Innovative Policies and Regulations for Drinking Water Quality Management
- Risk-based Investment Planning for Water Supply System
- Auditing Water Safety Plans
- Creating Water Quality Plans
- Improving Resilience to Climate Impacts from Customer to Consumer
- Sanitation Safety Plans Implementation

Interested practitioners may sign up to:

http://www.prwa.org.ph/sign-up-for-water-safety-conference

REGISTRATION

The Conference Secretariat will have registration desk at the City of Palawan starting from July 25 from 8:00 AM to 6:00 PM and on August 25 from 7:00 AM to 6:00 PM.

Registration fees (cash, non-refundable) for attendees are as follows:

Registration Fee	Early Bird (January 28, 2016)	Regular (after Feb 28, 2016)
Local (Philippines)	US\$1000 (USD)	US\$1500 (USD)
International	US\$1500 (USD)	US\$2000 (USD)

Registration Fee covers the following:

- Continental Breakfast
- Luncheon & Lunches on April 26-27
- Dinner on April 26-27
- Conference Kit

ACCOMMODATION

Reservations for hotel accommodations is February 28, 2016. Please check the details on the website. All hotel accommodations are subject to availability. All rooms are on a first-come, first-served basis.

Admission for Hotel Accommodations:
Puerto Princesa City, Palawan, Philippines
Tel. No. (810) 634-3623

Room Type	Room Rate
Single Room (Single occupancy)	PHP 6,000.00 (USD 120.00)
Double Room (Double occupancy)	PHP 10,000.00 (USD 200.00)
Triple Room (Triple occupancy)	PHP 12,000.00 (USD 240.00)
Quad Room (Quad occupancy)	PHP 14,000.00 (USD 280.00)
Executive Suite (Single occupancy)	PHP 18,000.00 (USD 360.00)
Executive Suite (Double occupancy)	PHP 22,000.00 (USD 440.00)
Executive Suite (Triple occupancy)	PHP 26,000.00 (USD 520.00)
Executive Suite (Quad occupancy)	PHP 30,000.00 (USD 600.00)

AA Plaza Hotel
National Highway 11, Palawan Road,
Puerto Princesa City, Palawan, Philippines
Tel. No. (810) 2014-4010 to 11
Email: reservations@aa.com.ph
Website: www.aa.com.ph

Room Type	Room Rate
Single Room	USD 120.00
Double Room	USD 200.00
Triple Room	USD 240.00
Quad Room	USD 280.00
Executive Suite (Single occupancy)	USD 360.00
Executive Suite (Double occupancy)	USD 440.00

Princess Garden Island Resort & Spa
Caraga Bay, Purok 7, Palawan, Palawan, Philippines
Tel. No. (810) 234-2200 to 05
Email: info@princessgarden.com

Room Type	Room Rate
Princess Garden	PHP 8,000.00
Princess Garden Suite	PHP 12,000.00

Princess Garden Hotel & Casino
Princess Garden Hotel & Casino


CONFERENCE AGENDA

Day	Time	Activity
April 25	8:00 AM - 6:00 PM	Registration
April 26	8:00 AM - 12:00 PM	Continental Breakfast
April 26	12:00 PM - 1:00 PM	Luncheon
April 26	1:00 PM - 5:00 PM	Technical Session 1
April 26	5:00 PM - 6:00 PM	Dinner
April 27	8:00 AM - 12:00 PM	Continental Breakfast
April 27	12:00 PM - 1:00 PM	Luncheon
April 27	1:00 PM - 5:00 PM	Technical Session 2
April 27	5:00 PM - 6:00 PM	Dinner

Eng. Roger E. Borja
 President, PRWA


(二)Poster 海報版及全文

1. Poster 海報



Compared Traditional with Advanced Processes to Determine the Optimal Operation Tactic: Case Study of Chimei Water Treatment Plant

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INTRODUCTION

Chimei Water Treatment Plant (WTP) located in South China Sea, belonged to Taiwan Water Corporation (TWC) 7th branch, and is the only water supply institution of this offshore island. Since always until now, lack of water supply of reservoir and water shortage of wells is the rigorous challenge of Chimei WTP. Owing to the concept of water safety plan, TWC is engaged in the relative research focusing on increasing water demand yield and promoting water quality (e.g. Bromate, Total Dissolved Solid, ...). Compared to the traditional (ex. filtration) and advanced (membrane) processes for determining the optimal operation tactic, the methodology developed is more effective and efficient. Likewise, the methodology can overcome the obstacle of water shortage even in conditions when summer time floods into tourists.

Keywords: Bromate; Membrane; Water Safety Plan; Water Treatment Plant

METHODS

- Because Chimei Reservoir is always lack of rainfall, the water source mainly relies on wells. Figure 1 & 2 shows the relative position of aforementioned data of geographic information in Chimei.




Fig. 1 Location Map of Chimei




Fig. 2 Water Source Distribution of Chimei

- Water Distribution Network (WDN) of Chimei, comprised a total length of 37 km, serving water to an area of nearly 7km². Up to 2018, the WDN served a population of about 3,800, equivalent to 100% of the total population of Chimei. The leakage rate was around 32% recently.
- Among the WDN in Chimei, HWRP (High Impact Water Pipe), ABSP, PVC-P and DIP comprised 24.2km (65.5%), 7.4km (20.5%), 5.4km (13.5%) and 0.2km (0.6%), respectively. Due to the firmness and long life-time characteristics of DIP, it has become the preferred alternative for constructing or substituting pipes of WDN during the recent years. Pipe materials may influence the probability of breaks and the statistics for breaks versus different pipe materials. Notably, most of the breaks occurred in ABSP and PVC-P.
- Traditional and advanced water treatment processes are both applied in this study. We used Jar-test to determine optimal dosages of agents. On the other hand, how to mix capacity of traditional and advanced tap water is another issue. The results can help engineers effectively reduce wastewater produced by advanced process and the items of water quality (ex. TDS, bromate, ... etc.) potentially exceed the regulation can then be overcome. It becomes easier for the engineers to make a decision in operating the water treatment and finally reach the time-saving goal.

DISCUSSION

- The 8 main water quality topics of Water Safety Plan: water source, water purification, water distribution and satisfaction of water supply can hint water company to check the water quality and quantity comprehensively.
- To sum up, this study has improved the practical operation of the Chimei Water Treatment Plant. Through the Jar-test technique, it has successfully help us to timely switch operation condition so as to reduce the laborious and time-consuming cost effectively. Subsequently, the aforementioned results and methodologies would be helpful for the follow-up studies and practical operation strategy.
- The data derived from the TWC LRMS (Taiwan Water Corporation-Leakage Reapment Management System) in this study has fully completed the QA and QC process. The qualified data were so persuasive that they can face the challenge when questioning the accuracy and the representativeness of the data.




Fig. 4 Schematic Diagram of Water Safety Plan

RESULTS

- Adding 5-8ppm potassium permanganate in traditional process is the optimum dosing tactic. And then, blending capacity ratio: traditional/advanced tap water (1:1) can measure up to Drinking Water Quality Standard of Taiwan. The processes of Chimei Water Treatment Plant shows as Figure 3.

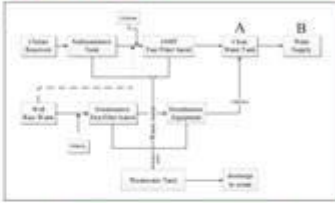


Fig. 3 Processes of Chimei Water Treatment Plant

- Replacing potassium permanganate with 35ppm sodium hypochlorite (effective chlorine concentration 6%) in traditional process is another optimal dosing tactic. And then blending capacity ratio: traditional/advanced tap water (1:1) can also reach to Drinking Water Quality Standard of Taiwan.
- If potassium permanganate and sodium hypochlorite are both used as agents, then the dosage of sodium hypochlorite can decrease to 25ppm (effective chlorine concentration 6%). Besides, the conditions are all the same as above mentioned.
- Recently, we replace ABSP and PVC-P into DIP in order to down percentage of leakage and it's really to up the percentage of water sold from 50% directly to 60%.
- In view of efficiency management, GIS can help to analyze leakage points. As GIS can enhance the visual effects by displaying the distribution of leakage points, it is a supplementary tool to arrange the pipe replacement project. In the fact GIS apparently acts better than the paper graphs in this study.

CONCLUSIONS

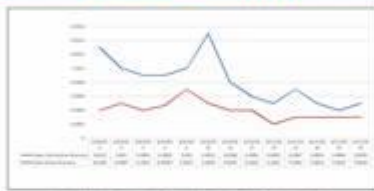


Fig. 5 The Line Graph of Bromate in Chimei Water Treatment Plant

- This study successfully developed an optimal operation model for Chimei Water Treatment Plant. Such operation models of ordinary and rush time in summer period, respectively can overcome the problem of having water shortage which engineers frequently face in practice. Furthermore, they may also help the decision makers more effectively manage increasing revenue problems and plan preventive water leakage strategies.
- Although water supply scales of Chimei is small, Taiwan Water Corporation also obeys the principles of WSP to provide good quality and adequate quantity water to customers under the regularly circumstances of water resource shortage.

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Draak, M., Dixon, M., and Moran, J. (2011). Long term case study of MRE pre-treatment in drinking water: understanding NOM removal. *Water research*, 45, 1539-1548.

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Morgan, M. R., Jefferson, S., Parsons, S. A., and Jarvis, P. (2008). Magnetic ion-exchange resin treatment: Impact of water type and resin use. *Water Research*, 42, 1977-1988.

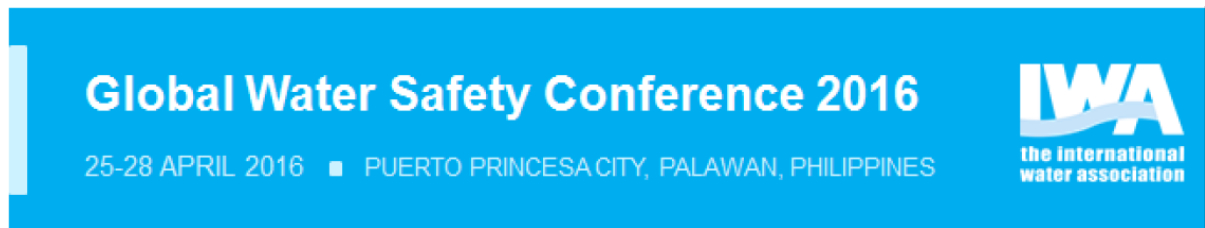
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Acknowledgement

The authors would like to thank the reviewers and editors for their expertise and their invaluable advice. The authors also hope to thank Taiwan Water Corporation and Graduate Institute of Environmental Engineering, National Taiwan University offering the scenario and data.

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2. 海報內容全文



COMPARED TRADITIONAL WITH ADVANCED PROCESSES TO DETERMINE THE
OPTIMAL OPERATION TACTIC: CASE STUDY OF CHIMEI WATER TREATMENT PLANT

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Introduction

Chimei Water Treatment Plant (WTP) located in South China Sea, belonged to Taiwan Water Corporation (TWC) 7th branch, and is the only water supply institution of this offshore island. Since always until now, lack of water supply of reservoir and water shortage of wells is the rigorous challenge of Chimei WTP. Owing to the concept of water safety plan, TWC is engaged in the relative research focusing on increasing water demand yield and promoting water quality (e.g. Bromate, Total Dissolved Solid,...). Compared to the traditional (ex. filtration) and advanced (membrane) processes for determining the optimal operation tactic, the methodology developed is more effective and efficient. Likewise, the methodology can overcome the obstacle of water shortage even in conditions when summer time floods into tourists.

Keywords : *Bromate; Membrane; Water Safety Plan; Water Treatment Plant*

Method

Because Chimei Reservoir is always lack of rainfall, the water source mainly relies on wells. Figure 1 & 2 shows the relative position of aforementioned data of geographic information in Chimei.



3. Fig. 1 Location Map of Chimei

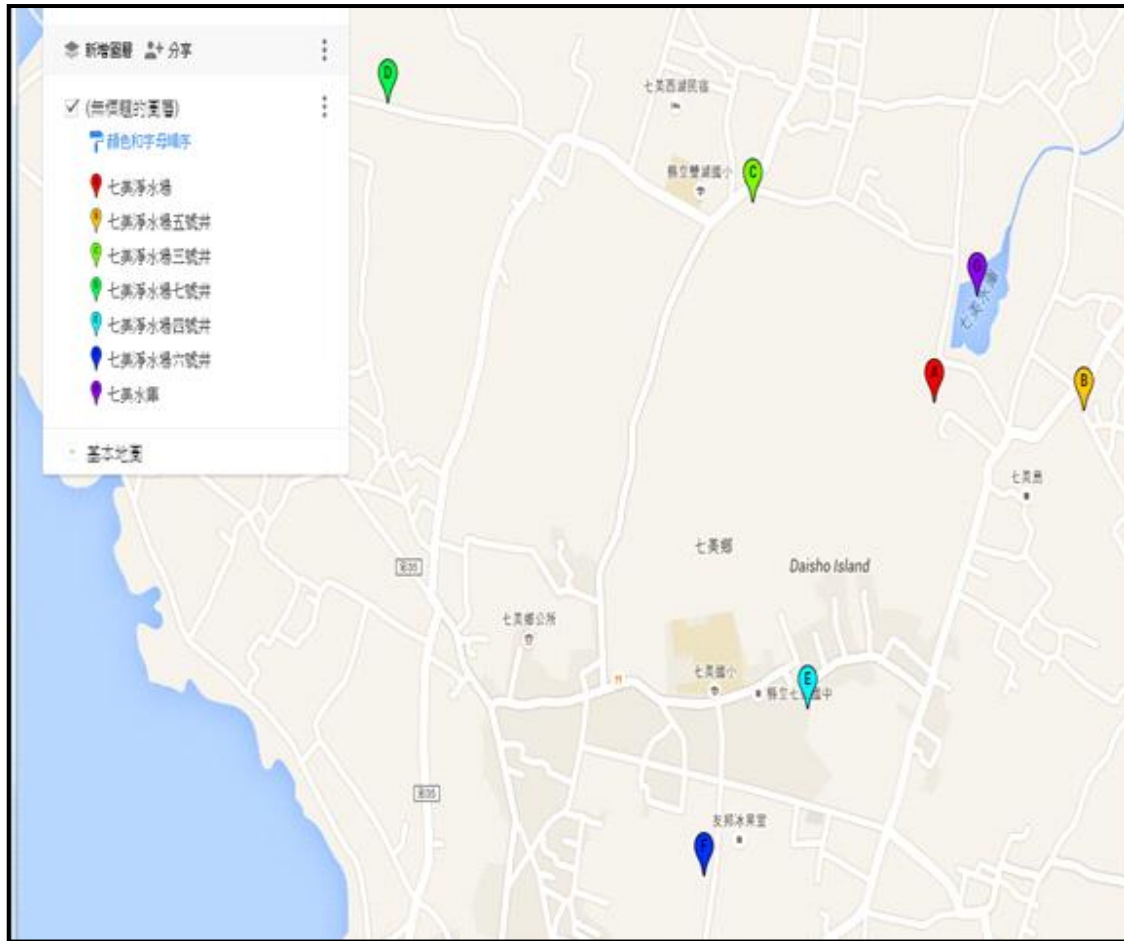


Fig. 2 Water Sources Distribution of Chimei

Water Distribution Network (WDN) of Chime, comprised a total length of 37 km, serving water to an area of nearly 7km². Up to 2016, the WDN served a population of about 3,800, equivalent to 100% of the total population of Chimei. The leakage rate was around 32% recently.

Among the WDN in Chimei, HIWP(High Impact Water Pipe), ABSP, PVCp and DIP comprised 24.2km (65.5%), 7.6km(20.5%), 5km(13.5%) and 0.2km (0.5%), respectively. Due to the firmness and long life-time characteristics of DIP, it has become the preferred alternative for constructing or substituting pipes of WDN during the recent years. Pipe materials may influence the probability of breaks and the statistics for breaks versus different pipe materials. Notably, most of the breaks occurred in ABSP and PVCp.

Traditional and advanced water treatment processes are both applied in this study. We used Jar-test to determine optimal dosages of agents. On the other hand, how to mix capacity of traditional and advanced tap water is another issue. The results can help engineers effectively reduce wastewater produced by advanced process and the items of water quality (ex. TDS, bromate,...etc.) potentially exceed the regulation can then be overcome. It becomes easier for the engineers to make a decision in operating the water treatment and finally reach the time-saving goal.

RESULTS

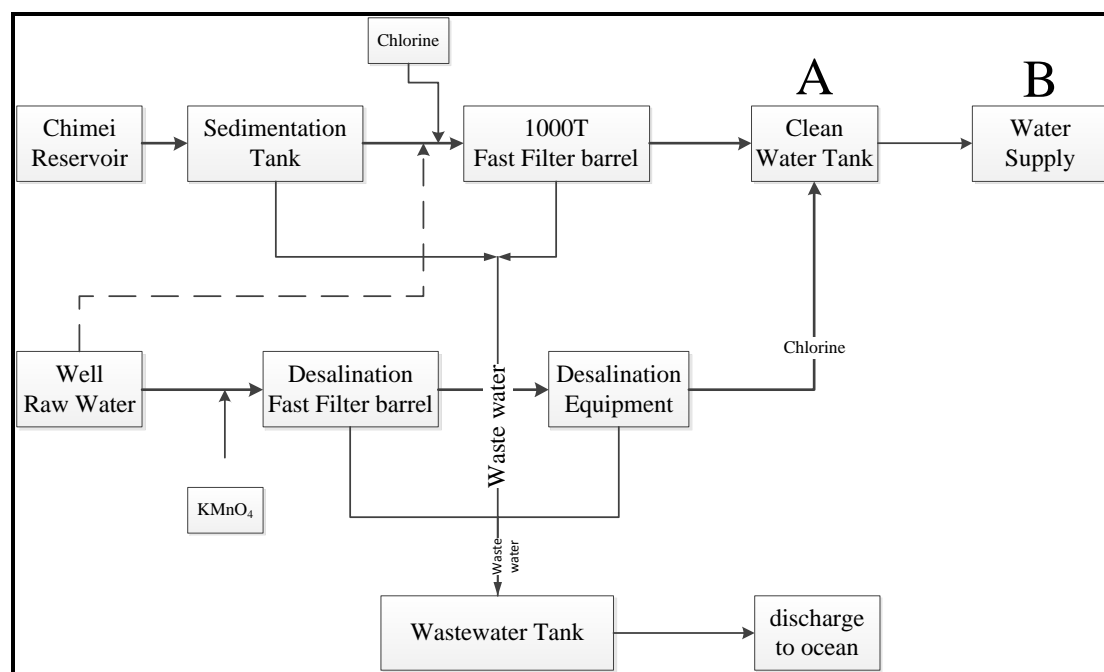


Fig. 3 Processes of Chimei Water Treatment Plant

Adding 0.4ppm potassium permanganate in traditional process is the optimum dosing tactic. And then blending capacity ratio: traditional/advanced tap water (1:1) can measure up to Drinking Water Quality Standard of Taiwan. The processes of Chimei Water Treatment Plant shows as Figure 3.

Replacing potassium permanganate with 35ppm sodium hypochlorite (effective chlorine concentration 6%) in traditional process is another optimal dosing tactic. And then blending capacity ratio: traditional/advanced tap water (1:1) can also reach to Drinking Water Quality Standard of Taiwan.

If potassium permanganate and sodium hypochlorite are both used as agents. Then the dosage of sodium hypochlorite can decrease to 25ppm (effective chlorine concentration 6%). Besides, the conditions are all the same as above mentioned.

Recently, we replace ABSP and PVCP into DIP in order to down percentage of leakage and it's really to up the percentage of water sold from 50% directly to 60%.

In view of efficiency management, GIS can help to analyze leakage points. As GIS can enhance the visual effects by displaying the distribution of leakage points, it is a supplementary tool to arrange the pipe replacement project. In the fact that GIS apparently acts better than the paper graphs in this study.

DISCUSSION

The 4 main water quality topics of Water Safety Plan: water source, water purification, water distribution and satisfaction of water supply can hint water company to check the water quality and quantity comprehensively.

To sum up, this study has improved the practical operation of the Chimei Water Treatment Plant. Through the Jar-test technique, it has successfully help us to timely switch operation condition so as to reduce the laborious and time-consuming cost effectively. Subsequently, the

aforementioned results and methodologies would be helpful for the follow-up studies and practical operation strategy.

The data derived from the TWC-LRMS (Taiwan Water Corporation-Leakage Repairment Management System) in this study has fully completed the QA and QC process. The qualified data were so persuasive that they can face the challenge when questioning the accuracy and the representatives of the data.

CONCLUSIONS

This study successfully developed an optimal operation model for Chimei Water Treatment Plant. Such operation models of ordinary and rush time in summer period, respectively can overcome the problem of having water shortage which engineers frequently face in practice. Furthermore, they may also help the decision makers more effectively manage increasing revenue problems and plan preventive water leakage strategies.

Although water supply scale of Chimei is small, Taiwan Water Corporation also obeys the principles of WSP to provide good quality and adequate quantity water to customers under the regularly circumstances of water resource shortage.

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ACKNOWLEDGEMENT

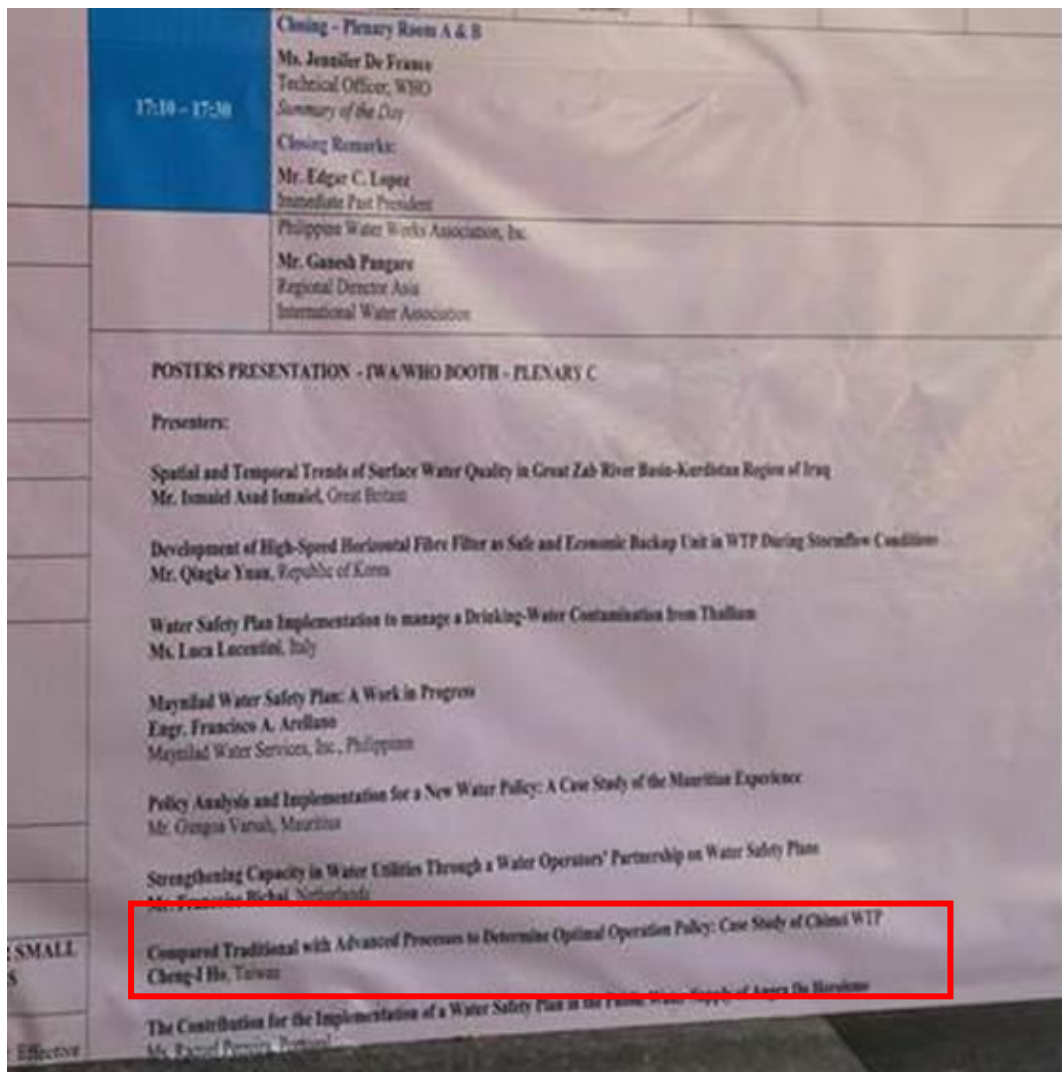
The authors would like to thank the reviewers and editors for their expertise and their invaluable advice. The authors also hope to thank Taiwan Water Corporation and Graduate Institute of Environmental Engineering, National Taiwan University offering the scenario and data.

3. 會場海報展示

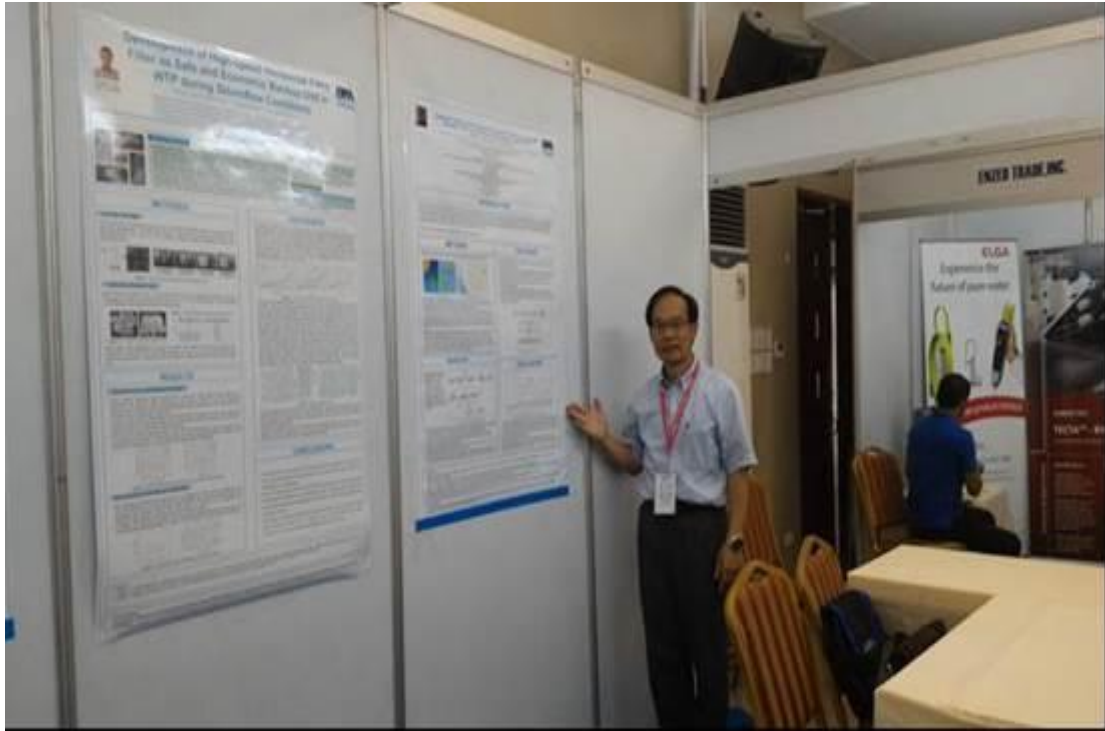
POSTERS

Posters

-  Development Of High-speed Horizontal Fibre Filter As Safe And Economic Backup Unit In WTP During Stormflow Conditions, *Yuan Qingke (Republic of Korea)*
-  Water Safety Plan Implementation To Manage A Drinking-water Contamination From Thallium, *Luca Lucentini (Italy)*
-  Maynild Water Safety Plan: A Work in Progress, *Francisco Arellano (Philippines)*
-  Policy Analysis And Implementation For A New Water Policy: A Case Study Of The Mauritian Experience, *Gungoa Varsah (Mauritius)*
-  Strengthening Capacity In Water Utilities Through A Water Operators' Partnership On Water Safety Plans, *Françoise Bichai (Netherlands)*
-  Compared Traditional With Advanced Processes To Determine Optimal Operation Policy: Case Study Of Chimei WTP, *Cheng-I Ho (Taiwan)*
-  The Contribution For The Implementation Of A Water Safety Plan In The Public Water Supply Of Angra Do Heroismo, *Raquel Pereira (Portugal)*
-  A quantitative structure-activity relationship approach for elimination of contaminants of emerging concern in drinking water treatment processes, *Sung Kyu Maeng (Republic of Korea)*



4.海報展示處現場解說



5.研討會名牌

GLOBAL WATER SAFETY CONFERENCE AND EXHIBITION

**THEME : “A Pathway to Universal Access
to Safe and Improved Water
Service Delivery”**

**April 25-27, 2016
Aziza Paradise Hotel
Puerto Princesa City, Palawan
Philippines**

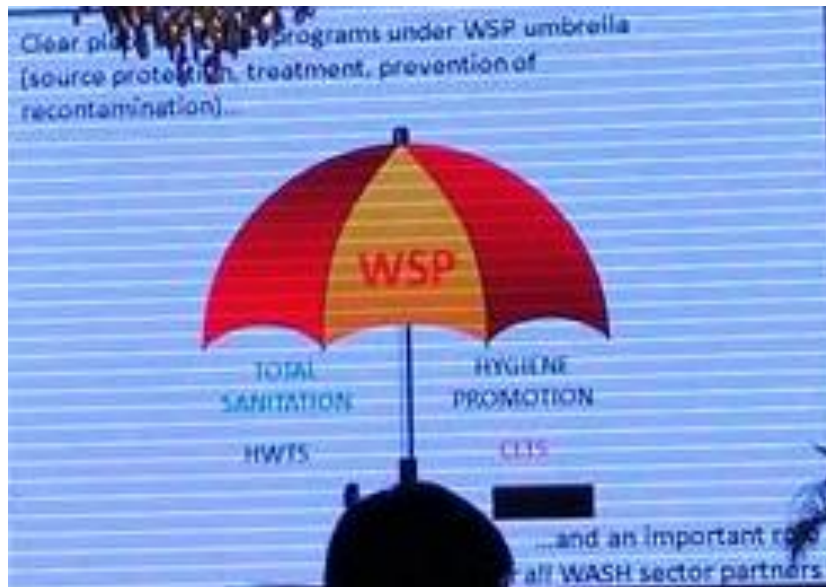
Cheng-I, Ho
**Taiwan Water Corporation, Ministry of
Economic Affairs, (R.O.C.)**

-PRESENTER-



二、Policy & Regulation

水安全計畫(Water Safety Plan, WSP)就像一張大傘，保護全體用水人的飲水安全和身體健康。



目前亞洲地區如緬甸、不丹及尼泊爾等國家針對水質法規的訂定不完善，甚或未針對個別水質項目制訂限值，因此多以經驗法則因應，如簡易設備檢測大腸桿菌群，或點井水源，僅佈設易施工的塑膠明管供應聚落用水，但輸送過程可能遭致外物破壞(如巨石墜落擊破)或動物排遺流入水源或管線造成污染，因此該等國家極需建立相關法規以有效管制。

惟針對此節，台灣地區就水質法規面而言，主管機關行政院環保署已明確訂有水污染防治法、飲用水水源水質標準及飲用水水質標準等，並且針對環境變遷、新興污染物及國際水處理發展技術趨勢進行定期檢討，故本國水質法規面嚴謹程度堪稱國際水準，然而對本公司經營本質而言而言，挑戰及衝擊相對變大，但基於社會責任，本公司責無旁貸，因此持續以 WSP 概念進行審視及檢討實有必要。

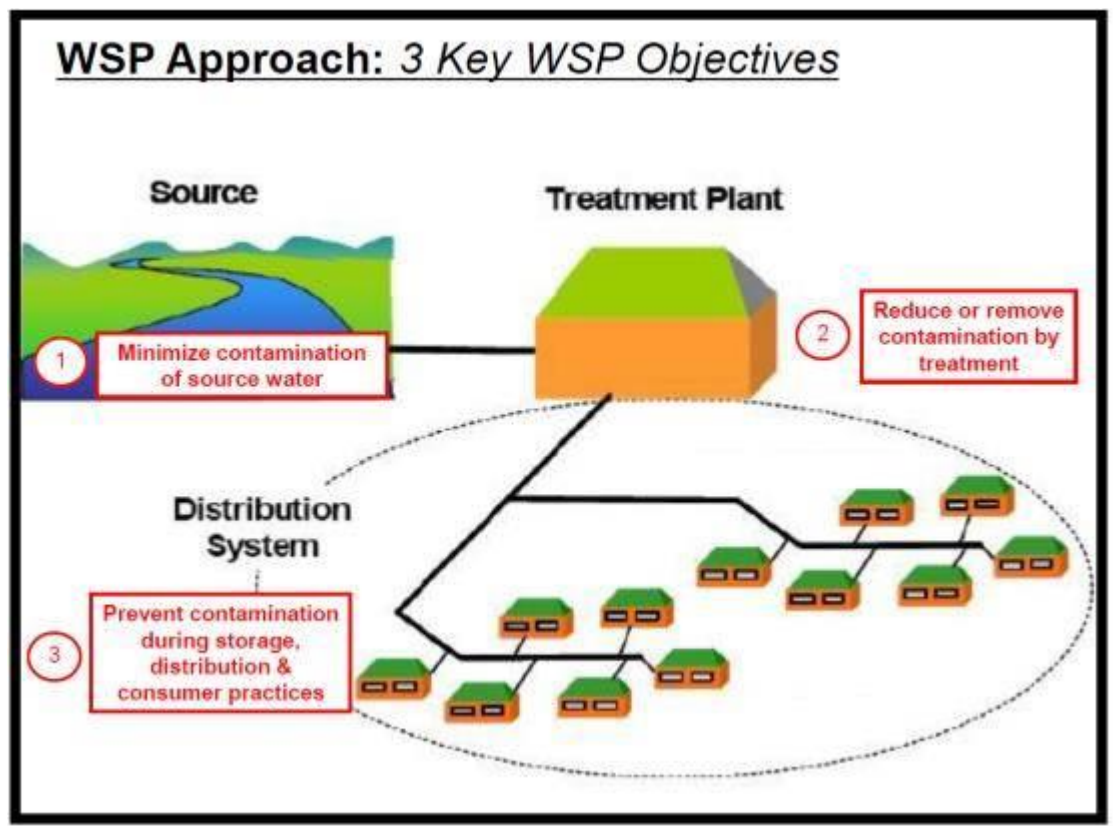
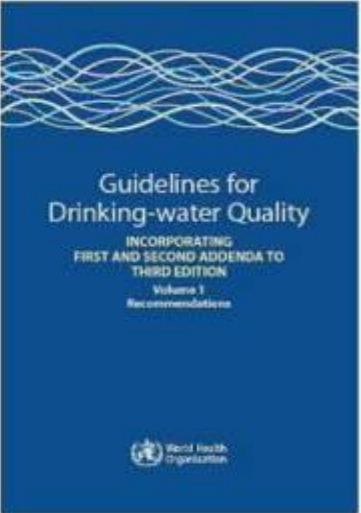
三、 WSP Instruction

以下內容擇要介紹 Water Safety Plan 基本架構及考量因素。

WSP background

Introduced by WHO in GDWQ (3rd Edition, 2004)

“ *The most effective means of consistently ensuring the safety of a drinking water supply.* ”



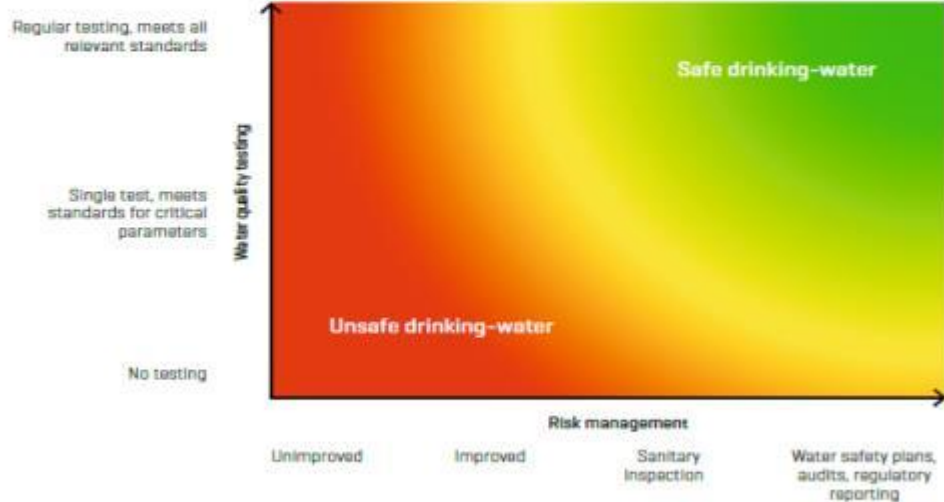
Why do we need WSPs?

Suppliers need a **proactive** approach to ensure water safety through good management of the complete water supply system.

*** WATER SAFETY PLAN ***

Post 2015 monitoring for drinking-water?

Monitoring of water safety should include both water quality testing and risk management



PROPOSED ONLY

Benefits of a WSP



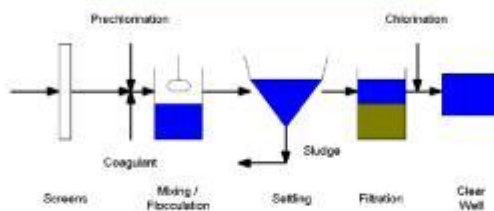
- Clearer understanding of the system and threats to water safety
 - Helps to prioritize use of limited resources
 - Improved relationships with stakeholders
 - Increased compliance with water quality standards
 - Reduced costs and improved cost recovery
 - Tool to justify funding requests to government and donors
-
- Increased confidence in the water supply
 - Safer water
-
- Increased compliance with drinking water quality standards
 - Reduced incidence of water-related illness

Example control measures



Controlling activities in the catchment or source water

Water Treatment Plant processes



Staff training to ensure competency



Treatment chemical quality assurance procedures

Fencing around source water to prevent livestock access



One-way valves to prevent backflow contamination

至於 Water Safety Plan 終極目標則是人人均可平等獲得安全用水的權利，不分國度，世界大同。



肆、心得與建議

1. 建立水質研究架構及與國內外學術界固定溝通平臺：江前宜樺院長提示(103 年行政院第 3405 次院會，行政院秘書長 103 年 7 月 14 日院臺綜字第 1030140940 號函)：「希望所有部會都要設法引進學界的力量，作為政府重要施政之客觀的知識基礎，雖然各部會在政策推動的過程中，會與一些固定的團體進行意見交流，但除了這些與業務直接相關的對象外，各部會也要建立與學術界固定的溝通平臺，由部會首長主動接觸相關政策領域中最值得尊敬、也最能對政府施政提供建言的海內外學者專家，透過餐會、座談會或學術研討各種形式，請他們提供長期所關注議題的意見，讓政策更為周延，並讓整個行政團隊的施政有更堅強的知識基礎，及更長遠的擘劃。」，此論點正是本公司研究業務當即努力的目標與方向。
2. 與世界接軌達成水質安全目標：未來水質問題可能會來的既快又猛，如淨水場遭遇原水低濁度難處理案件(濁度 250 NTU 以下)及新興污染物(Contaminants of Emerging Concerns, CECs)在檢驗技術和適用法規等議題，除建立平時各淨水場對緊急水質事件的應變機制外，常態聯結外部諮詢管道(包括國內外專精水處理之學者及業界)，輔以蒐集先進國家或組織規定、作法或科學性論證資料及方法，並參酌環保主管機關水質標準等法令規定，亦同等重要，因此持續參與國際性與自來水相關會議預期將可提昇本公司從業人員對緊急事件的認知能力進而應變得宜，而持續參與除可提昇本公司的國際能見度，亦對確保民眾用水安全的終極目標得以因持續獲得新知並與國際同步而落實達成。

伍、謝誌

本案目的地巴拉望因屬菲律賓離島，台灣並無直飛班機，因此機位難求，再加上因屬計畫外出國案件，可供聯繫確認行程的時間甚為侷促，此次研習參訪雖然僅短短六日(含前後飛行時間各一日)，但先前撰稿及製作海報均需耗費相當人力及時間，惟因係本公司執行WSP首次案例，對未來落實推動水安全計畫具有指標性意義，然在此過程中仍有您們無私的貢獻與協助，請容一一致謝：

經濟部、台灣大學駱尚廉教授、本公司阮剛猛董事長、胡南澤總經理、水質處洪世政處長、水處理研究組陳威豪工程師、及本案各業管同仁（會計處許永旭帳檢及人力資源處黃柏耀組員）、**WHO, Consultant**, Ms. Angella Rinehold (U.S.A.); **Eawag, Senior Engineer**, Mr. Arnt Diener (Switzerland); United Nations International Children's Emergency Fund (UNICEF), Mr. Khin Aunk Thein (Myanmar).

Thank you so much