

行政院所屬各機關因公出國人員出國報告書
(出國類別：國際會議)

2014 年亞太地區汞監測夥伴會議

服務機關：行政院環境保護署

姓名職稱：張順欽副處長、王嶽斌專門委員、
徐宏博技士

派赴國家：越南

出國時間：103 年 9 月 9 至 13 日

報告日期：103 年 12 月

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摘要

為具體落實環保署今年4月份與美國環保署共同成立「國際環境夥伴計畫」，我國、美國環保署及越南環境資源部三方首次共同合作，於越南河內舉辦亞太地區汞監測夥伴會議 (Asia-Pacific Mercury Monitoring Network Workshop)，邀請去年成立的專家諮詢會 Scientific Advisory Group (SAG) 專家與各國政府員工共計30餘位一同參與。會議中，美國 NADP 資深研究員 Dr. David Gay 除重申監測汞之重要性外，也與 NADP 及 NOAA 的專家詳細介紹汞監測設備與流程，與會國家代表皆參與熱烈討論並表達高度參與意願。

於第二天會議中，與會之夥伴國代表針對汞監測之 SOP 進行詳細討論，對於汞溼沉降與大氣汞採樣之標準方法以及測站選址準則等相關重要文件，都經各國同意後定案，越南甚至同意將於9月30日起，每周二進行採樣並將樣本寄送至中央大學，由許桂榮副教授之研究團隊負責分析，泰國、印尼等國也將後續加入監測。另外，日本基於過去建立東亞監測網之經驗，也率團參加會議並熱烈參與討論，同時也積極表達未來想加入監測網之意願。最後我國與美方也在會議結束前提議，Pilot Study 開始推動後，預計明年（2015年）1月將再次開會，檢討相關執行情形，使東亞地區汞監測網之建立可進行得更加順利，冀望未來能透過區域夥伴關係，進行技術交流以提升東亞地區的汞監測能量，並期許我國可由環保技術輸入國轉型成為環保技術輸出國，促使我國成為亞太地區環境監測技術中心。

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一、 會議背景及目的

近年來由於亞太地區經濟快速發展，且仍大量使用燃煤獲取能源。經研究報告指出，亞太地區為汞排放之重要區域，而人為產生的汞污染物在大氣中存留期長，又可藉由氣流傳輸，或經由降雨進入水體、魚體，對環境影響深遠，逐漸引發各國重視大氣汞污染跨境傳輸的監測課題，故聯合國於 2013 年 10 月 9 日在日本熊本市公開簽署關於汞污染防治的全球性公約：「水俣汞公約(Minamata Convention on Mercury)」，正式開始約束汞之排放。

我國有鑑於汞對環境會帶來嚴重影響，在 2007 年始建立鹿林山高山背景測站同時，就開始架構大氣汞自動連續監測儀器，由於臺灣位於亞洲氣流系統之下風處，高山背景測站之監測數據就極具代表性。透過臺美環保技術合作協助，鹿林山測站目前已分別加入全球大氣汞監測網 (AMNet) 及美國國家大氣沉降監測網 (NADP)，監測技術與世界先進國家同步並獲得認可。在 2012 與 2013 年舉辦兩場亞太地區大氣汞監測夥伴合作會議後，亞太地區與會國都認為，有必要共同合作監測大氣汞，藉以瞭解其環境濃度分布情形，進而訂定管制策略與控制人為排放量。且 2013 年美國環保署捐贈兩套汞監測儀器給越南及印尼後，兩國參與共同監測之意願也大幅提高，今年越南甚至大力配合，與臺灣及美國共同籌辦 2014 年亞太地區汞監測夥伴會議。

本次會議在我國與美國環保署共同成立之「國際環境夥伴計畫」推動下，首次與美國及越南環境資源部三方共同合作主辦「亞太地區汞監測網夥伴會議 (APMMNW, Asia-Pacific Mercury Monitoring Network Workshop)」，邀請來自泰國、印尼、美國、日本及菲律賓等共 8 國的環保部門及學術研究人員代表與會，就區域性汞監測進行成果及技術交流，並提升我國在國際上之能見度。

會議中，與會之夥伴國代表針對汞監測之 SOP 進行詳細討論，對於汞溼沉降、大氣汞採樣之標準方法以及測站選址準則等擬定草案，越南甚至同意將於 9 月底起，每周進行採樣並將樣本寄送至中央大學進行分析，正式啟動先驅採樣監測網 (Pilot Study Network) 之工作，泰國、印尼等國也將後續加入監測。參與 Pilot Study 的夥伴國成員也同意，預計明年 (2015 年) 1 月再次召開會議，檢討汞監測之執行情形。

二、 會議過程及內容重點整理

本次「亞太地區汞監測夥伴會議」首次由本署、美國環保署與越南環境資源部於越南河內共同舉辦，共有來自我國、美國、日本、泰國、越南、印尼、印度及菲律賓等國政府及學術研究部門 30 餘位專家代表與會，延續去年 (2013 年) 於美國華盛頓特區舉辦之「亞太地區汞監測夥伴合作會議」的決議，以參與 Science Advisory Group (SAG) 的核心國代表為主，共同討論亞太地區汞監測網之推動。相關議程如附件 1，主要行程及內容簡如下表：

日期	行 程 內 容
9 月 9 日	啟程，參加越南河內汞監測研討會。
9 月 10 日	1. 進行汞監測夥伴會議之開幕致詞及現場來賓問題答覆 2. 進行區域性汞監測成果及技術交流，討論亞太地區汞監測網建構方式
9 月 11 日	1. 協助外交部駐越南代表辦事處公使之蒞臨會場致詞 2. 討論大氣汞技術發展及濕沈降的汞監測採樣及分析標準作業程序
9 月 12 日	1. 參訪越南環境資源部之空氣品質監測站，瞭解該部環境監測技術及儀器維護運轉 2. 美國大氣沈降計畫實驗室主任 David Gay 對於越南濕沈降之汞監測採樣及分析方式進行討論
9 月 13 日	返程。

第 1 天（9 月 10 日）上午會議由越南環境資源部自然資源與環境總局副局長 Dr. Bui Cach Tuyen 先行致詞。越南環境總局以地主身分，歡迎與會人員，並感謝臺灣環保署與美國環保署大力推動東亞地區汞監測網之建立，還捐贈採樣儀器與提供監測技術等，深表感謝，另期許亞太地區汞監測網建立後，透過多方技術交流，提升區域汞監測實力，亦冀望藉由多邊合作關係，為世界環境保護領域提供更多貢獻。

本署監資處張順欽副處長隨後以會議貴賓身份致詞，提及此次會議是臺灣 4 月份成立的「國際環境夥伴計畫」所推動的工作之一。在這個新計畫下，臺灣將繼續主動分享環境保護的成功經驗、提供大氣汞監測樣品分析技術以及積極擴展夥伴計畫參與國家，一同致力改善全球環境（副處長致詞稿如附件 2）。隨後，由美國 NADP 計畫主持人 Dr. David Gay 博士以及 Mr. David Schmeltz 先生就大氣汞監測之現況及未來發展藍圖簡報。

其後議程分別由與會人員報告各國在汞監測工作現況（各國簡報資料如附件 5），我國由本署環境監測及資訊處代表介紹鹿林山背景測站，由中央大學許桂榮副教授介紹我國汞監測流程與相關數據分析結果。其中以我國和日本在此領域已有相當成果，本次會議原先亦有邀請具有溼沉降監測經驗的韓國參與，然其有其他因素不克前來，稍感遺憾，但仍在通訊之電子郵件內容中表示積極參與監測網之意願，而其它東南亞地區國家則尚屬起步階段。本日會議後，本署於越南傳送資料回國，發布新聞如附件 3。

第 2 天（9 月 11 日）會議主要由美國 NADP 與 NOAA 的專家講解於美國監測汞沉降與大氣汞的採樣標準方法與流程，中央大學許桂榮副教授與日本 Mr.Kohji Marumoto 教授亦分別介紹臺灣與日本的監測方法，以供與會夥伴國成員參考。NADP 的專家 Dr. David Gay 也講解選站的相關準則並與各參與國代表進行討論，按國情狀況不同進行調整與修正。經過多方討論之後已提出修訂草案（溼沉降採樣 SOP 如附件 4）。

經過熱烈討論並修訂汞溼沉降監測標準流程草案後，越南同意首先加入先驅採樣監測網 (Pilot Study Network)，允諾九月底開始，每週進行採樣，並將樣品寄送至臺灣，泰國與印尼等夥伴國代表亦同意後續儘快建立測站並開始進行採樣，而我國中央大學許桂榮副教授也同意提供分析經驗與能力，協助分析三國提供之樣本，進而協助本署成為東亞地區汞監測分析之樞紐。日本此次率團參與，也於會後向我方及美方表達積極想參與先驅採樣監測網之意願，後續將再討論如何整合其監測網之資源與應用。第 3 天 (9 月 12 日) 參訪越南環境資源部的空氣品質監測站，瞭解該部環境監測技術及儀器維護運轉，並進行技術交流與經驗分享，會議期間相關紀錄照片如附件 5。

三、參加會議心得及建議

自 102 年 10 月聯合國已於日本熊本市進行水俣公約之簽署，國際間對於汞監測的議題也逐漸受到重視，在研究中，亞洲地區因經濟快速的發展，但能源結構相對仍多有以燃煤獲取能源的情況，預估之汞排放量應相當可觀，實需儘速進行監測以為後續訂定管制標準之依據。

日本、韓國是屬於東北亞監測網發展較早的國家，而臺灣於此領域投入的努力較東南亞國家較早也較多，在美國與我國的支持下，去年泰國與印尼受贈汞溼沈降採樣儀器，今年的夥伴會議中該國也展現強烈參與監測的意願。同時，美方 NADP 專家在會議中也仔細地說明採樣標準流程與相關的方法，本署委託之中央大學許桂榮副教授團隊亦允諾提供分析能力，協助分析夥伴國採樣之樣品，種種條件促成先驅採樣監測網 (Pilot Study Network) 的成立，以下將針對參與此次會議之心得與建議進行重點整理：

- (一) 會議中越南同意進行先驅採樣 (Pilot Study)，我國支援樣品分析，並自今年 9 月底起每週採集樣品，委託送至中央大學進行汞分析，泰國與印尼亦將陸續加入。初期我國雖可協助分析東南亞國家樣品，但以我國現有之技術水準，未來建議可提高支援層次，訓練東南亞國家分析人員，打造臺灣成為亞洲地區的汞監測技術支援中心。
- (二) 美國環保署及 NADP 預計於 104 年 1 月舉辦汞監測執行情形及檢討會議，並建議會議地點在我國，後續由美方規劃 104 年「亞太地區汞監測夥伴合作會議」時程及提出與會人員名單。
- (三) 日本汞監測係由環境省環境保健部負責，本次會議由化學物質情報課長金子元郎率團與會，基於過去該國已在東南亞各國建立酸沈降監測網經驗，會議中除分享汞監測經驗，也展現積極加入亞太地區汞監測網合作意願，未來可持續討論如何整合相關資源與應用。
- (四) 越南空氣品質監測站由環境總局設置，維護由省級環境部門負責，越南缺乏儀器維護、維修及管理等相关技術，且對於監測數據之研判及解析經驗不足，該國希望與我國進一步合作，已建議該國透過我國駐越南代表辦事處提出

附件1、亞太地區汞監測夥伴會議議程

Asia-Pacific Mercury Monitoring Network Workshop

September 10-12, 2014

Pullman Hotel Hanoi, Vietnam

Objectives: Meeting of the Science Advisory Group (SAG) and interested stakeholders to expand coordinated mercury monitoring capacity in the Asia-Pacific region, in light of the Minamata Convention on Mercury: 1) share information on mercury monitoring plans for the region, with updates from partners on their progress; 2) Further develop plans for the Asia-Pacific Mercury Monitoring Network pilot; finalize modifications to the APMMN standard operating procedures; and decide on a wet deposition sampling start date; 3) provide training and demonstration of mercury wet deposition sampling operations and manual methods for gaseous and particulate atmospheric mercury sampling, including review of SOPs and best practices.

Date		Day 1 Wednesday, September 10, 2014	
Start	End	Topic	Speaker/Session Host
09:00	09:15	Welcoming Remarks <i>(3 minutes each)</i>	Assoc. Prof. Dr Bui Cach Tuyen, Vietnam Environment Administration, General Director, Deputy Minister of Natural Resources and Environment Dr. Hoang Duong Tung, Vietnam Environment Administration, Deputy General Director Dr. Shuenn-Chin Chang, EPA Taiwan Deputy Director of Department of Environmental Monitoring and Information Management Mr. David Schmeltz, US EPA Office of Atmospheric Programs Dr. David Gay, US National Atmospheric Deposition Program

09:15	9:45	Group Introductions and Photo Workshop Overview	(Moderator: Nguyen Van Thuy, VEA Center for Environmental Monitoring)
9:45	10:45	Session I Overview of the Mercury Problem	Mercury Overview: Sources and Impacts <i>David Schmeltz, US EPA</i> Mercury in East and Southeast Asia <i>Guey-Rong Sheu, National Central University, Taiwan</i> Update on the Minamata Convention <i>David Schmeltz, US EPA</i> Why is Mercury Monitoring Important? <i>David Gay, NADP</i>
10:45	11:00	Coffee Break	
11:00	12:00	Session II Update on Recent Monitoring Activities from Science Advisory Group Members <i>(15 minutes for each speaker)</i> (Moderator: David Schmeltz, US EPA)	Vietnam <i>Nguyen Van Thuy, VEA/CEM</i> Thailand <i>Hathairatana Garivait, Thailand MONRE</i> Preparation for monitoring mercury in ambient air in Indonesia <i>Esrom Hamonangan, Indonesia MOE</i> Japan <i>Mr. Motoo Kaneko, MOEJ</i> <i>Kohji Marumoto, NIMD</i>
12:00	13:30	Lunch (Buffet)	
13:30	14:30	Science Advisory Group Updates <i>(continued)</i>	Atmospheric Background Station in Taiwan <i>Hong-Po Hsu/Shuenn-Chin Chang, EPAT</i> Update on Taiwan's Mercury Monitoring Program <i>Guey-Rong Sheu, NCU</i>

			<p>United States <i>David Gay, NADP</i> <i>Winston Luke, NOAA</i></p>
14:30	15:15	<p>Invited Updates from Other Southeast/East Asian Stakeholders on Mercury and Atmospheric Monitoring</p> <p>Q&A and Discussion</p>	<p>Philippines <i>Teresita Peralta, Environmental Management Bureau, Department of Environment and Natural Resources, Philippines</i></p> <p>Hong Kong <i>Eric Ho, Environmental Protection Department, Hong Kong</i></p> <p>India <i>Asif Qureshi, Indian Institute of Technology, Hyderabad, India</i></p>
15:15	15:30	CoffeeBreak	
15:30	17:30	<p>Session III</p> <p>Asia Pacific Mercury Monitoring Network</p> <p>(Moderator: David Schmeltz, US EPA)</p>	<ul style="list-style-type: none"> • Vision • Operations • How to Get Involved <p>Round table discussion: specifics of network operations</p> <p><i>Guey-Rong Sheu, NCU</i> <i>David Gay, NADP</i></p>
17:30	Adjourn		
18:30	Welcome Dinner (TBD)		

Date		Day 2 Thursday, September 11, 2014	
Start	End	Topic	Speaker/Session Host
08:30	10:00	Training Session 1 Introduction of Wet Deposition Standard Operating Procedures	<ul style="list-style-type: none"> • Local Siting Criteria • Supporting Site Information • Sampling Start Date and Next Steps <p>Questions and Discussion</p>
10:00	10:30	Coffee Break	
10:30	12:00	Training Session 1 (continued) Review of Wet Deposition Standard Operating Procedures	<ul style="list-style-type: none"> • Installation • Sampler • Sample change out • Field sheet review • Maintenance • Sample storage and shipment
12:00	13:30	Lunch (Buffet)	
13:30	14:30	Training Session 1 (continued) Review of Wet Deposition Standard Operating Procedures	<ul style="list-style-type: none"> • Acid cleaning procedure • Emphasis on clean hands/dirty hands procedure • Quality assurance of sample train blanks • Overview of laboratory procedures • Data reporting (values provided) <p><i>** to be videotaped for display on web, download, etc.</i></p> <p><i>David Gay and Mark Olson, NADP</i></p>
14:30	15:00	Demonstration and Practice of Sample Change-outs	<p><i>Mark Olson, NADP</i> <i>Guey-Rong Sheu, NCU</i></p>

15:00	15:20	CoffeeBreak	
15:20	16:50	<p>Training Session 2</p> <p>Atmospheric Mercury Introduction to Manual Systems for Monitoring Gaseous and Particulate Mercury</p>	<ul style="list-style-type: none"> • Review equipment set-up • Operation and Maintenance • Data generated • Suppliers of equipment <p><i>Guey-Rong Sheu, NCU</i> <i>Kohji Marumoto, NIMD</i></p>
16:50	17:50	<p>Training Session 3</p> <p>Atmospheric Mercury Automated System for Monitoring Gaseous and Particulate Mercury</p>	<ul style="list-style-type: none"> • Review equipment set-up • Operation specifics • Data generated • Suppliers of equipment <p><i>Mark Olson, NADP</i></p>
17:50	Adjourn		

Date		Day 3 Friday, September 12, 2014	
Start	End	Topic	Speaker/Session Host
07:00	19:00	Leaving for Ha Long Bay Air Quality Monitoring Station	VEA and participants

附件2、亞太地區汞監測夥伴會議張順欽副處長開幕致詞

Special Remarks by Deputy Director Shuenn-Chin Chang

Asia-Pacific Mercury Monitoring Workshop

Director General Tuyen, Vice Director General Tung, Program Coordinator David, Senior Environmental Analyst David, Deputy Director Chang, Participants from Thailand, Indonesia, Lao, Hong Kong, India, Japan, Phillipines and representatives from EPA of the United States, Vietnam and Taiwan:

It is my pleasure to be here to share the fruitful results of this meeting with you, and to witness that we work together in 3 days intensive meeting to establish a strong foundation for future progress.

This meeting is part of the International Environment Partnership Program launched by Taiwan in April. In this new program, we continue to share Taiwan's experiences and technologies in the field of environmental protection with world countries, and actively engaged in technical exchanges with environmental protection officials from world countries. Here in Vietnam, we have seen a very successful example.

I hope this meeting also give you a message that, Taiwan's participation can make a difference in global environmental work along the way. We are looking forward to your continuously support to Taiwan to take part in future international environmental collaborations and activities.

Finally, thank you for your participation, we welcome all of you to visit Taiwan to experience the achievements of Taiwan's environmental protection work!

附件3、發布新聞「亞太地區汞監測夥伴會議，促進多邊區域交流合作」



亞太地區汞監測夥伴會議，促進多邊區域交流合作

提供單位：行政院環境保護署監資處
發布日期：2014.09.12

[留言](#) | [引用](#) | [轉寄](#) | [友善列印](#) | [A](#) [字體](#) [中](#) [大](#)



為具體落實環保署今年4月份與美國環保署共同成立「國際環境夥伴計畫」，我國、美國環保署及越南環境資源部三方首次共同合作，103年9月10日至12日在越南河內共同舉辦「亞太地區汞監測夥伴會議」，並邀請來自泰國、印尼、美國、日本及菲律賓等共8國的環保部門及學術研究人員代表與會，就區域性汞監測進行成果及技術交流，並提升我國在國際上之能見度。

環保署表示：因應空氣污染物跨境傳輸議題，該署自西元2006年在海拔2,862公尺的鹿林山，設置鹿林山大氣背景監測站，長期觀測跨境污染傳輸，其中也包括大氣汞監測，藉由此次汞監測夥伴會議，進行相關技術交流，以逐步建立亞太地區汞監測網。

環保署指出，為期3天的會議以亞太地區汞監測合作為主軸，分別就大氣汞及濕沉降之汞監測技術發展、監測數據品保品管、資料解析及分享等課題廣泛討論。與會人員也將參訪越南環保署之空氣

品質監測站，並就未來具體之合作方式交換意見。

環保署同時說明，今年在越南舉行的會議，期望臺美雙邊合作經驗，擴大推展亞太地區汞監測夥伴關係的多邊區域合作模式，促進國際環境保護工作之交流合作。

附件4、汞溼沉降監測 SOP

setup

1. Assemble several of the sample train sets
2. Hand out in the room
3. Have the sampler up and running

Siting

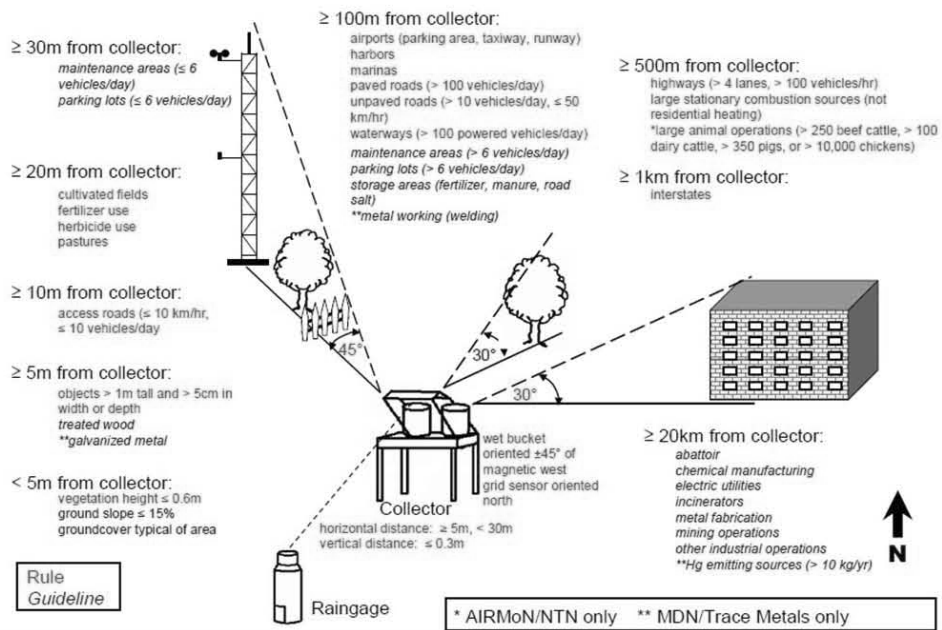
The Asia Pacific Mercury Monitoring Network

Introduction of the
Mercury Wet Deposition Standard
Operating Procedures
Draft Version #1

Site Location & Goals

1. Where data is needed
2. Site where the scientific validity of the sample is assured
3. Where power is available
4. Convenient for the operation of the site

NADP Siting Criteria – Wet Deposition



Installation

Installation: Aerochem-style





Installation: NCON-style

Optical Precipitation Sensor

Top of collector

Sample Train

Drip Pan

Thermoelectric Chiller

collar

pipe

FRONT VIEW OPENED



Start of Sampling for the APMMN

Pilot Network is ready to begin

1. Thailand
 - Collector is sited
 - Ready to begin
2. Vietnam
 - Collector will be sited in the next week or so
 - Will then be ready
3. Indonesia
 - Collector is in-country
 - Site chosen?
 - Estimated time of sampling start?

Date for Beginning of sampling?

September __, 2014

Draft SOP Review

- You received a digital copy
- There are 30 printed copies here

- Based upon the NADP SOP, with adjustments for the needs of the APMMN

SOP

- Presented for your approval here...

Asia – Pacific Mercury Monitoring Network

**Mercury Wet Deposition Network Field Standard
Operating Procedures**

Version 1.0, August 2014

- If you have questions, please ask them
- If you would like changes, please ask

also

- If you notice something that needs changing, note it on you SOP
- After this session, we will combine the changes into one document, and make them...
- Does anyone want to be the recorder of change?

SOP, Page 1.

What is this Document for?

- The following Standard Operating Procedure (SOP) is designed to give the new site operator the detail necessary to perform sample retrieval and sample glassware deployment for the Asia – Pacific Mercury Monitoring Network (APMMN). This SOP provides step-by-step instructions on how to:
 - Retrieve the previous weeks Hg (Mercury) wet deposition sample
 - Complete the Observer Form for the previous weeks sample
 - Deploy the next week's sample glassware
 - Start the next weeks Observer Form
 - Report the Precipitation data from a collocated rain gauge.
-

SOP, Page 1.

Question: Do all have rain gages on their sites?

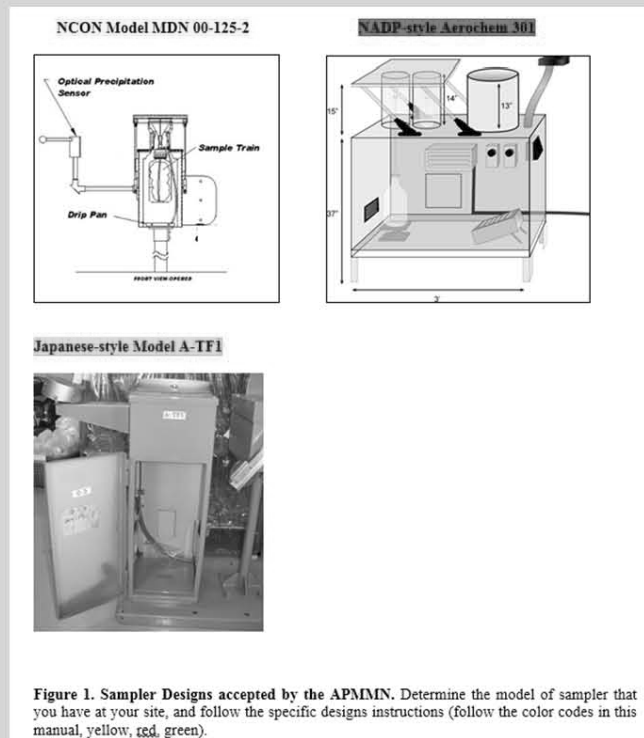
- It is best to have an onsite gage to record precipitation independently
- Do we all have one?
- Do we want to require one?

SOP, Page 1.

- Each site operator should carry out these instructions as they cover critical steps for trace metals clean sample handling. It is equally critical to follow these instructions consistently each week in order to standardize the sample and glassware handling for each sample.
- Note to Operator: There are a number of different collector designs used in this network, and care by the site operator should be used in interpreting this manual, which is written to be used with all collector designs. Notes appear in this manual when different conditions/steps are necessary for individual designs. The collectors being used in this network are shown in Figure 1.

SOP, Figure 1

Note the color
Associated with each
sampler



SOP, Page 4.

- When to change the sample....

When to Change your sample: All network samples are changed together on Tuesday mornings, between 8 and 10 AM local time. Please note the exact time on the Network Observer Form (NOF).

SOP, Page 4.

Sample Collection from Previous 7 day sample:

1. **Approach collector from downwind.** Upon arrival at site, before approaching collector, determine which way the wind is blowing. Rule of thumb is to always approach the collector facing into the wind.



Recording observations of the site.

From downwind
As to not contaminate the sample

SOP, Page 4.

2. **NOF Section 10: Remarks** - Make observations as to the condition of the collection site and equipment. Record observations in Section 10: Remarks on Network Observer Form (NOF). Generally, observations should include the following:
- Is the lid in the correct position?
 - Is the lid seal in good condition (no gaps, dirt etc)?
 - Is rain sensor free of debris?
 - Is the equipment generally in good condition?
 - Are there any unusual conditions near the site (fire near by, construction, heavy snow, etc.)? and
 - Does the collector have debris on it (bird feces, dirt, etc)?

First record your obs on the NOF

SOP, Page 4.

3. **NOF Section 9: Enclosure Temp** - Open the enclosure door on the ACM collector and record the Max/Min temperature in Section 9: Enclosure Temperature of NOF.

If the Max/Min temperature within the collector is out of range (outside of 40-100F), adjust the thermostat to obtain the proper temperature range (increase temp on thermostat if below 40F –decrease cooling fan temperature if above 100F).

4. After recording Enclosure Temperature on the NOF, **reset the Max/Min thermometer** by turning the button on bottom of thermometer clockwise (or appropriate). The max and min indicator needles should both arrest to the same position.

Potential problems with temperatures <32F (0C)
and 100 F (4x C)

Question: does everyone have a min max thermometer?

SOP, Page 4.

5. **While wearing a new set of gloves, unscrew the nut connecting the funnel to the sample bottle cap** until the bottom of the bottle and cap are free from the funnel.



Lowering jack to gain access to sample bottle.

SOP, Page 4.

6. **Retrieve the sample bottle cap from zip lock bag, and screw cap onto sample collection bottle.** Ensure the cap is firmly in place. Once cap is in place, remove the sample bottle from bottle jack.

Differences here with different samplers

1. AEROChem has a labjack
2. NCON has a wheel "lazy Susan"

SOP, Page 4.

7. **NOF Section 5: Sample Condition** - Make observations of wet deposition (rain) in sample bottle. Identify any debris in sample and check the appropriate box in Section 5: Sample Condition of NOF. If any of the following debris is present in the sample, check yes next to the appropriate category in section 5.

- Bird droppings
- Cloudy or discolored
- Soot/Ash/Dirt Particles
- Insects/Animal matter
- Leaves/Twigs/Pollen/Plant Matter

After checking the appropriate box in section 5, identify the debris further in Section 10: Remarks, in as much detail as possible. For example: 4 misquotes, 2 large black particles...looks like soot particles; 1 piece of plant matter...looks like a pine needle; etc. If debris is present but does not fit any of the categories above, describe the debris in your own words and record this in section 10. If there is no debris present, check the NO box for each category of Section 5: Sample Condition.

Record on the NOF



Completing the Network Observer Form.

SOP, Page 4.

8. Once all observations of sample are complete, **place sample bottle in its original sample bottle bag, and zip lock the bag closed.** Place the sample bottle bag in the back of enclosure.

This is an important step as the Ziplock bag protects the outside of the sample bottle from collecting dirt and particles. Dirt and other particles typically have mercury adsorbed onto their surfaces. If this material was to accidentally get into the sample bottle, it could contaminate the sample.

Although the bottles are wiped clean when they leave the laboratory, our goal is also to minimize bringing outside sources of particles into the laboratory clean rooms.

important

SOP, Page 6.

9. **NOF Section 3: Bottle** – Record the sample Off Date and Off Time. For time please use twenty four hour time (example: 2pm = 1400hrs), and your standard time zone (i.e. Local Standard Time).
10. **NOF Section 8: Overflow** - Check the overflow container on sample bottle jack for overflow. If no overflow is present, check the No box in Section 8: Overflow.

If overflow is present, DO NOT ADD OVERFLOW TO THE SAMPLE, and check the Yes box in Section 8: Overflow. Pour the water from the overflow container into a plastic graduated cylinder. Measure the overflow and note the volume in milliliters and record this in the appropriate place in section 8.

Very important

SOP, Page 6.

Water found in the Overflow Dish should coincide with a full sample bottle:

If overflow is present, the sample bottle should be full to the top. Note if sample bottle is full in Section 10: Remarks. This will help those processing the sample to see if in fact this was an overflow from the sample bottle.

Cases where there is water in the overflow dish but the sample bottle is not full:

In some cases, the overflow dish could have some water in it but this water is not considered to be overflow. If the sample bottle is not full to the rim, it is likely that precipitation has leaked out of the sample bottle connection assembly. Check to ensure that the sample train was connected and that there were not cracks in the glassware where water could have

APMMN Field SOP Version 1

Page 6 of 19

escaped. Document all of your observations in Section 10: Remarks. Try to determine why this has occurred and be aware and avoid these conditions with the next sample.

SOP, Page 6.

Why Discard the overflow found in the dish?

The water in the overflow dish is contaminated from contact with the dish and is not part of the sample. **This precipitation will contaminate and disqualify your sample.** Once you have measured and recorded the volume of the overflow, pour it out and dry the inside of the overflow container with a paper towel.

Very important

SOP, Page 7.

11. Close enclosure door. Remove old dry side bag from dry side bucket. Observe the condition of the dry side bag (dirt, bird droppings etc). Record any observations in Section 10: Remarks



a. Removing old dry-side bag and
b. Securing new dry-side bag.

12. While wearing a new set of clean gloves, retrieve the new dry side bag from supplies. Open the bag and place into bucket. Pull top of bag over edges of bucket and pull bag down so it is firmly in place

AEROCHem Sampler Only (RED)

SOP, Page 7.

13. **Cleaning the Lid Seal:** Take the bottle of distilled water from enclosure and wet a clean paper towel.



Cleaning lid seal as it cycles to cover the dry-side bag.

14. **Clean the lid Seal:** As collector lid cycles to cover dry side, wipe the lid seal with the wet paper towel. Holding the wet paper towel in one hand, signal the sensor to open the sampler (~~apply a few drops of water to rain sensor~~, apply a few drops of water to rain sensor, wave your fingers in the sensor opening to trigger the sampler. As the lid opens, use the on/off switch inside the collector to turn off the motor at a convenient lid position for cleaning). While wiping down the lid seal observe the condition of seal and record any observations in Section 10: Remarks. If lid seal is torn, punctured, or looks discolored, please replace if possible.

SOP, Page 8.

15. **Removing old sample train:** by removing the funnel out of the top of the collector.
16. **Pull the bottle and connector assembly from below.** Observe the condition of assembly and funnel (dirt, debris, etc) and record any observations in section 10: Remarks.



NCON: Removing funnel/sample train from chimney. (Notice how they are being carefully lifted straight up out of the collector.)

Every sampler here

SOP, Page 8.

17. Use the sample bottle cap to secure the sampler by removing the connector assembly, and securing the cap (from the old sample plastic bag. Keep all used sample train components outside of enclosure. Be sure not to mix the used sample train from the previous week with the new sample train for the week to come. Always keep the sample trains separated and closed in their plastic bags.
18. Return the collected sample back to its sample plastic bag. Return the sample to the lab for shipping and analysis.
19. Return sample funnel and collector assembly back to the lab for cleaning.

Every sampler here

SOP, Page 8.

20. Complete Section 6 part 1 “Site Operations” on the NOF.

The questions in this section are designed to ensure that the site operator has checked that the ACM collector is working properly.

If problems are discovered during the weekly check of the equipment, the site operator should check the “No” box adjacent to the piece of equipment they are having problems with. You should note in Section 10: Remarks, the problems you are discovering. **IMPORTANT: Your job**

APMMN Field SOP Version 1

Page 8 of 19

does not end here! You must immediately begin to troubleshoot the problem in order to correct any problems found.

SOP, Page 8.

Precipitation Collectors: If the lid is in the open position, and it is not raining (or it is raining and the lid is not open), this is an indication that something is wrong with the collector.

- The site operator is principally responsible for determining when a piece of equipment is not working properly. Your collector must be assessed each Tuesday to ensure they are working properly.
- If a problem is discovered, the site operator should begin troubleshooting. This means referring to the troubleshooting guides above to help in correcting the problem.
- If the site is down and not working properly, valuable data is lost which is not recoverable.
- The goal for operating the site is to always have a fully operating collector and rain gauge in order to catch each week's sample.
- In order to minimize down time due to collector malfunction etc, the site operator should attempt to diagnose the problem.

This is just to remind the site operator of the importance of reporting a problem.

SOP, Page 9.

21. Cleaning The Equipment:

Special Cleaning Note: At this point in the process, now is the best time to perform routine "house cleaning" of your collector. The previous week's sample is capped and bagged and the new sample train is still in the bag and protected, so you cannot contaminate either one. Use paper towels and water or "409" glass cleaner:

- Wipe down the top of the lid and surrounding sides.
- Wipe down the 4 "arms" of the lid.
- Clean off the rubber boots at the base of each arm.
- Wipe down the top of the collector.
- Check the sides of the enclosure; if needed, wipe down the sides down with DI water.
- Clean any debris off the sensor. Stubborn debris can be removed by using a toothbrush.
- Inside the enclosure, clean the floor of the collector so it is dirt and bug free.
- Clean any other surfaces or areas which are beginning to build up dirt and other debris.



Cleaning the lid.



Cleaning the boots



Wiping down chimneys

SOP, Page 9.

5. Retrieve the new glass funnel and connector assembly. Open the Ziplock bag containing the glass funnel, holding the bag away from your body. Hold the glass funnel through the bag.
6. While **still holding funnel through Ziplock bag**, insert the funnel-assembly down through the chimney of the collector. Be sure to take care and not scrape the bottom of the connector tube down the inside of the chimney.



Bag covering
new funnel.

SOP, Page 9.

7. The funnel should now be resting on the lip of the chimney. Carefully remove the Ziplock bag covering the funnel and connector assembly.
8. Raise the sample bottle on the bottle jack up to just below the connector assembly, remove the sample bottle cap and connect the funnel connector to the sample bottle tube.
9. Put the sample bottle cap into the plastic bag, and seal the Ziplock bag that now contains the sample bottle cap. Store this bag and cap for the next week.

@@

SOP, Page 9.

10. Adjust the height of the sample bottle and funnel to ensure that the laboratory jack or bottle supports are supporting the weight of the bottle and any sample, and that it will not weigh down the funnel and pull the funnel free from the sample connector assembly. This is done by adjusting the bottle jack upwards such that the bottle, being raised, begins to raise the thistle-funnel upwards. You can observe the funnel rising above the rim of the chimney cap or the aluminum chimney. Adjust the funnel height such that it is just barely resting on the chimney cap or the rim of the chimney.

@@

SOP, Page 9.

11. From inside enclosure, look to make sure the sample bottle, thistle tube, and funnel are connected.
12. Stand on the North side of the sampler (remember that each sampler rain sensor is pointed magnetic North). Facing away from the sample chimneys with your back to the open funnel, cup the rain sensor on the right side with one hand and blow off any remaining water. The lid should cycle back and come to rest on top of the funnel. Turn the sample on/off switch back to on, and the lid should cycle back to the closed position. Check to make sure the lid seal makes a good seal with the top of the glass funnel.



Notice he is facing away from the exposed new sample train.

SOP, Page 9.

13. Place the sample from the previous week, used thistle tube and funnel, and NOF from previous week into shipping cooler.

14. Close enclosure door and clean up the site (used gloves, paper towels etc).

@@

SOP, Page 10.

Complete the NOF and Interpret Rain Gauge Chart:

1. **Review the NOF for any missing information**, and add this information at this time. Note anything that you think might be of help interpreting the mercury deposition results. Add any of this information to the notes section.
2. **Remember to collect new supplies** for your next sample change-out, including any Field Forms, Gloves, Lid Seal Pads, DI Water, etc.
3. Place completed NOF with the sample, and return the NOF, sample, and dirty sample train back to your lab.
4. Ship the cooler to the following address within 48 hours of collecting sample. We suggest using 2 day UPS or FedEx service if possible, but longer times (3-4 days are also acceptable):

Dr. Guey-Rong Sheu
APMMN
Department of Atmospheric Sciences
National Central University
300 Jhong-Da Road
Jhong-Li 320, Taiwan

Remember to copy the NOF for your own records and later data interpretation.

SOP, Page 10.

Precipitation Data

This network requires that data from an accurate precipitation gage also be collected for accurate determination of precipitation depth. Choose a rain gauge that is onsite (best), or as close as possible to the collector (within 5 kilometers).

1. Obtain the precipitation information from your precipitation gage.
2. Add the daily sums of precipitation (in millimeters) to the NOF.

Is this doable for all sites?

Need this value for QA and for calculating deposition

OBSERVER FORM
Send Completed Form With Each Shipping

1. STATION
Name _____
ID [][][]

2. OBSERVER
Print name _____
Initials [][]

3. BOTTLE
Date: [][] [][]
Time: [][] [][]
ON [][][][] [][][][]
OFF [][][][] [][][][]

5. OBSERVATIONS Check yes or no if samples were observed to have any of the following: Describe all observations in Block 10.

YES	NO	1. Bird droppings	YES	NO	4. Insects/animal matter
<input type="checkbox"/>	<input type="checkbox"/>	2. Cloudy or discolored	<input type="checkbox"/>	<input type="checkbox"/>	5. Leaves/leaves/pollen/plant matter
<input type="checkbox"/>	<input type="checkbox"/>	3. Soot/dust/dirt particles	<input type="checkbox"/>	<input type="checkbox"/>	6. Handling contamination

6. SITE OPERATIONS Check yes or no for all samples.

YES	NO	1. Sensor heater and motor box are operating properly. Lid is in correct position.
<input type="checkbox"/>	<input type="checkbox"/>	

7. PRECIPITATION RECORD
R - Rain Only (Excludes Hail) S - Snow Only M - Melted U - Unknown
MON TUES WED THURS FRI SAT SUN MON TUES WED
R S M U R S M U R S M U R S M U R S M U R S M U R S M U
INCHES
Z - Zero T - Trace MM - Missing
Total Precipitation [][][][]

10. REMARKS For example: equipment malfunction, contamination, turning, burning, logging, leakage, etc.

Courier/Tracking # _____

LAB ID

HAL/NADP Use Only

Sample Receipt
Name (print): _____
Date: [][] [][] [][] [][]
Cooler # [][][] Time: [][] [][] [][] [][]
Bag Open? Yes No Leak? Yes No
Full Wt. [][][][] [][][][] [][][][] [][][][]
Empty Wt. [][][][] [][][][] [][][][] [][][][]
Net Wt. [][][][] [][][][] [][][][] [][][][]
Leak Wt. [][][][] [][][][] [][][][] [][][][]
Total Wt. [][][][] [][][][] [][][][] [][][][]

8. OVERFLOW (check one) YES NO
Overflow [][][][] mL

9. ENCLOSURE TEMPERATURE
MAXIMUM [][][] °C
MINIMUM [][][] °C

LABORATORY Use Only

Preservation: HCL [][][][] mL Chill Freeze
BCL [][][][] mL [][][][] mL
Composition: [][][][] mL [][][][] mL
PAC [][][][] mL [][][][] mL
Salt Bottle ID [][][][] Comp. Bottle ID [][][][]

Do we want Daily precipitation?
Design a new form?
Change anything that is obvious
GR: anything new in the lab section?

Glassware Cleaning Procedure

All components of the sample train (funnel, sample bottle, connection apparatus and parts, sample bottle cap), and sample shipping bottles (and caps) should be thoroughly cleaned using the following method, following from Landis et al., 2002 (see below). All cleaning should be in a negative pressure vent hood in good working order.

Use 10% reagent-grade hydrochloric acid as the rinsing solution for all acid-rinsing steps.

Deionized Water (DIW): should have a maximum resistivity of 18.2M/cm. If stored, this water should be stored in acid rinsed glassware using appropriate laboratory practice.

Using powder free nitrile laboratory gloves, eye protection and appropriate laboratory safety clothing.

1. Rinse each component thoroughly three (3) times with fresh rinsing solution.
2. Then rinse thoroughly each component with DIW to ensure no Hydrochloric acid remains.
3. As a final rinse, rinse each component laboratory-grade methanol.
4. Air dry each component briefly in the vent hood, and store in "ziplock" plastic bags until used.
5. For the sample collection bottle, pre-weigh the bottle.
6. put 20 ml of 0.2 N Hydrochloric Acid into the sample collection bottle and cap the bottle.

- Do we want to add anything here about how often to send in cleaned glassware?
- i.e. QA checks on the cleaning procedures?

SOP, Page 10.

Precipitation Data

This network requires that data from an accurate precipitation gage also be collected for accurate determination of precipitation depth. Choose a rain gauge that is onsite (best), or as close as possible to the collector (within 5 kilometers).

1. Obtain the precipitation information from your precipitation gage.
2. Add the daily sums of precipitation (in millimeters) to the NOF.

Is this doable for all sites?

Need this value for QA and for calculating deposition

SOP, Page 13.

Sample Transfer to sample shipping bottles

1. Weigh the sample bottle to the nearest 1/10 gram. Record post-weight on the NOF
2. Put on a new pair of nitrile gloves.
3. Obtain the sample collection bottle, and place in the fume hood.
4. Obtain a acid-cleaned sample shipping bottle, and place in the fume hood.
5. Gently swirl the collection bottle to ensure that all surfaces in the bottle are washed by the sample liquid.
6. Uncap the sample shipping bottle, then the collection bottle. Pour up to 150 ml of sample into the shipping bottle. Cap the shipping bottle. Cap the sample bottle.
7. At this point, the remaining sample in the collection bottle can be used for additional measurement (duplicates, QA samples, etc.).

Any problems here?

Fume hood?

Sampling Supply List and Part Numbers, etc.

1. Plastic Bags large enough for the 2-L sample bottle, and the funnel.
2. Plastic graduated cylinder 100 ml or 250 ml for measuring overflow.
3. Dry-side plastic bags for buckets
4. Deionized Distilled Water (DIW) with a resistivity of 18.2M/cm or lower, made onsite or supplied from a reputable supplier.
5. "Squeeze bottle" for dispensing onsite and for cleaning the sampler. 500 ml per sample change out should be enough.
6. large "Kimwipes" or alternative for cleaning sampler surfaces.
7. Sample Shipping Bottles (3-5, 150 ml) PETG bottles, used at a rate of 1 bottle per week.
8. Sample collection bottles with caps
Nalgene® Square Media Bottles, PETG, Sterile, Graduated; \$166/12 bottles.
9. for the Funnel-to-Bottle connection assembly: Teflon Compression Fitting (must decide on diameter; Stem diameters 3/8" (9.7mm))
10. Five (5) "T" shape ¼ ID Teflon tubing approximately 12 cm (OD to fit compression fitting above).
11. Five (5) borosilicate funnels sized to fit your sampler opening
12. Nitrile powderless gloves.
13. Carrying Case to move equipment to the field and retrieve samples
14. 10% reagent-grade hydrochloric acid purchased from a reliable supplier. Keep 2 liters on hand.
15. laboratory-grade methanol keep 2 liters on hand.
16. "Lab Jack" or other support mechanism to support sample bottle in sampler. Sized appropriately and adjustable for your sampler.
17. 0.2 N Hydrochloric Acid for sample collection bottle pre-charge. Keep 2 liters on hand.
18. overflow container

SOP, Page 17.

List of Analytical Flags for assigning to Data.

Table 2. NADP/MDN Notes Codes			
Code	Description	HAL Database condition	Quality Rating Code
e	extended sample	duration of sample exceeds 194 hours	B
d	debris present	At least one of the six debris checkboxes is positive	B
m	missing information	<u>noEventRecorder</u> = true or <u>precip</u> = null or <u>ignoreRG</u> = true or <u>minTemp</u> = null or <u>maxTemp</u> = null	B
z	site operations problem	<u>HMworks</u> = false or <u>minTemp</u> < 32 or <u>maxTemp</u> > 100 or manual	B

Quality Rating A: no sample problems
 B: some, but sample still valid
 C: invalid sample

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h	sample handling problem	bag = true or leak = true or shipping = true	B
b	bulk sample	(manual) bulk = true	C
v	rain gage/sample volume discrepancy	((RG ≥ 0.03 inches) and (<u>bottlecatch</u> < 1.5 ml)) or (<u>bottlecatch</u> /rg < 0.10)	C
u	undefined	(manual) undefined = true	C
f	serious field problem, data integrity compromised	(manual) field protocol = True	C
l	lab error	(manual) <u>labprotocol</u> = true	C
c	contaminated	(manual) contaminated = true	C
p	no precipitation from rain gauge or sample volume	(<u>rgppt</u> is null or <u>ignoreRG</u> = true) AND (<u>bottlecatch</u> is null or <u>ignoreBC</u>)	C

Yellow here means decisions we need to make

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h	sample handling problem	bag = true or leak = true or shipping = true	B
b	bulk sample	(manual) bulk = true	C
v	rain gage/sample volume discrepancy	((RG ≥ 0.03 inches) and (<u>bottlecatch</u> < 1.5 ml)) or (<u>bottlecatch</u> /rg < 0.10)	C
u	undefined	(manual) undefined = true	C
f	serious field problem, data integrity compromised	(manual) field protocol = True	C
l	lab error	(manual) <u>labprotocol</u> = true	C
c	contaminated	(manual) contaminated = true	C
p	no precipitation from rain gauge or sample volume	(<u>rgppt</u> is null or <u>ignoreRG</u> = true) AND (<u>bottlecatch</u> is null or <u>ignoreBC</u>)	C
n	no sample	<u>fullmass</u> is null or <u>emptymass</u> is null	--

Yellow here means decisions we need to make

Example of Output Data Format

SiteID	Date On	Date Off	RGPT	SVOL	SUBPPT	HgConc.	HgDep.	Sample Type	QR	Notes
			mm	ml	mm	ng/L	ng/m ²			
IN34	10/27/2000 18:00	11/01/2000 14:30	0.00	0.00	0.00	--	0.00	D	B	mzb
IN34	11/01/2000 14:30	11/07/2000 14:30	5.84	66.80	5.84	12.84	75.05	W	B	m
IN34	11/07/2000 14:30	11/14/2000 14:30	--	446.80	37.29	4.67	174.48	W	B	dmh
IN34	11/14/2000 14:30	11/21/2000 14:30	--	1.80	0.15	22.03	3.30	W	B	mi
IN34	11/21/2000 14:30	11/28/2000 14:30	7.62	79.80	7.62	4.48	34.17	W	B	m
IN34	11/28/2000 14:30	12/05/2000 18:34	11.62	138.30	11.62	7.06	82.04	W	B	dm
IN34	12/05/2000 18:34	12/12/2000 18:00	30.23	204.90	30.23	5.33	161.28	W	B	mz
IN34	12/12/2000 18:00	12/19/2000 15:00	17.02	366.00	17.02	4.98	84.74	W	B	mh
IN34	12/19/2000 15:00	12/26/2000 15:00	8.38	48.10	8.38	9.89	82.92	W	B	m
IN34	12/26/2000 19:40	01/03/2001 15:00	17.97	44.10	17.97	8.89	159.87	W	B	dmh
IN34	01/03/2001 15:00	01/09/2001 15:00	1.78	122.40	1.78	--	--	W	C	mz
IN34	01/09/2001 15:00	01/16/2001 14:30	3.11	42.50	3.11	2.44	7.60	W	B	m
IN34	01/16/2001 14:30	01/23/2001 14:30	0.25	0.10	0.25	--	--	W	C	mv
IN34	01/23/2001 14:30	01/30/2001 14:30	16.51	204.90	16.51	9.67	159.68	W	B	dm
IN34	01/30/2001 14:30	02/06/2001 14:00	8.38	38.20	8.38	9.74	81.70	W	B	dmh
IN34	02/06/2001 14:00	02/13/2001 14:00	26.67	323.80	26.67	11.48	306.38	W	B	m
IN34	02/13/2001 14:00	02/20/2001 14:00	3.81	45.80	3.81	10.98	41.84	W	B	m
IN34	02/20/2001 14:00	02/27/2001 14:00	51.31	539.30	51.31	7.04	361.41	W	B	dm

Any changes here?
 More/less?
 Different units?
 Other?

SOP

- That is it
- Problems?
- Additions?
- Subtractions?
- Editorial changes?

附件5、出國期間相關照片



圖 1、本署張順欽副處長於開幕中致詞



圖 2、各國與會來賓合照



圖 3、張順欽副處長致贈鹿林山紀念郵票予越南環境部自然資源與環境總局副局長 Dr. Bui Cach Tuyen



圖 4、亞太地區汞監測夥伴會議開會情形



圖 5、駐越南代表梁光中公使到場致詞並與與會來賓合影



圖 6、NADP 專家 Dr. Mark Olson 講解溼沉降採樣器操作流程



圖 7、協辦本次會議之越南環境部自然資源與環境總局同仁合影



圖 8、參訪下龍灣空品測站

附件 6、會議討論資料