Audit of Ambient Air Monitoring Stations
for the Sistema de Monitoreo Atmosférico de la Ciudad de México




Submitted to:

J. Víctor Hugo Páramo Figueroa
Director General de Gestión de la Calidad del Aire
Secretaría del Medio Ambiente
Ciudad de México

Submitted by:
Eric Anderson
EPA Systems, LLC
Austin, Texas

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EXECUTIVE SUMMARY

Compañía Bettel Ecologica and EPA Systems, LLC were contracted by the Environmental Secretariat of the Government of the Federal District (*Secretaría del Medio Ambiente del Gobierno del Distrito Federal* (GDF)) to support the GDF in conducting Technical Systems and Performance (TS&P) audits of selected stations within the Mexico City ambient air monitoring network. Previously these audits were performed in 2003 and 2005 by the USEPA Office of Air Quality Planning and Standards (OAQPS) with follow-up audits conducted by GDF auditors. Prior to this, audits were performed as an adjunct to a research program in Mexico City by the USEPA Office of Research and Development (ORD).

This report details the results of the TS&P audits conducted between 20 and 24 August 2012 on nine of the GDF ambient systems plus the main laboratory's reference analyzers. The audits were performed using an independent Protocol 1 calibration standard and new Environics Model 6103 calibrator and API Model 701 clean air source. The performance audit consisted of challenging each nitrogen oxides (NO_x), sulphur dioxide (SO_2), carbon monoxide (CO) and ozone (O_3) analyzer at four to five upscale data values plus zero. In addition, the nitrogen dioxide (NO_2) convertor efficiency for each NO_x analyzer was tested using a gas-phase titration approach using three different NO concentrations and three different ozone concentrations. Finally, for those stations equipped with continuous PM analyzers the flow rate through the analyzer was checked using a BGI deltaCal® calibrator to ensure that the flow rate though the analyzer was sufficient to maintain the cut-point of the sampling head.

The systems audit showed that GDF has an effective system for station operation and calibration. These operational protocols include:

- Each operator carries a PDA to record site information that is downloaded and archived each day;
- The instrument diagnostic information collected during each multipoint calibration is checked during each site visit;
- Control charts of all zero and span data from each instrument calibration is kept and reviewed during each site visit;
- A master list of maintenance and calibration activities (along with frequency and dates of activities) is posted in each shelter so that the operators know what activities are needed during each site visit; and
- Individual Standard Operating Procedures (SOPs) are available for each instrument make and model.

A review of the site log books showed the logs were signed and dated and that all activities during each site visit were recorded. The only room for improvement is some inconsistency

with the notation of arrival and departure times. Almost all logs showed arrival times, but a few operators didn't always record departure times. It should be noted that during each site visit the operator phones the main laboratory and prior to starting instrument work and phones again when they leave the site. This is the only potential element the auditor found for system improvement for the nine field sites audited.

The sites were all very clean and well kept and the site instrumentation was neatly plumbed and wired making maintenance and servicing of the instrumentation much easier. The operators that the auditor had the opportunity to meet and interact with demonstrated a strong commitment to performing quality work and expressed a lot of pride with the jobs they did.

Overall, the performance audit demonstrated that the sites were well run and were collecting valid and defensible data. Of the 40 instruments audited, none of the analyzers had responses that were greater than ± 7% easily meeting the audit objective of ±15%. During the 2009 audit three analyzers had responses slightly outside of the audit objective of ±15%.

Figures ES-1 to ES-4 show the average audit responses at the ten sites for each of the four criteria pollutant analyzers.

The continuous PM analyzers (both PM_{10} and $PM_{2.5}$) were evaluated to determine if the flow rates through the system were adequate to ensure that a proper cut-point was achieved through the sample inlets. The total flow rate should be 16.67 lpm ± 10%. All of the PM analyzers were within this limit.

Based on the 10 sites audited, the audit demonstrated that the GDF monitoring network has a good QA/QC system in place to operate the network and that performance-wise, the instrumentation is operating well within acceptable limits.

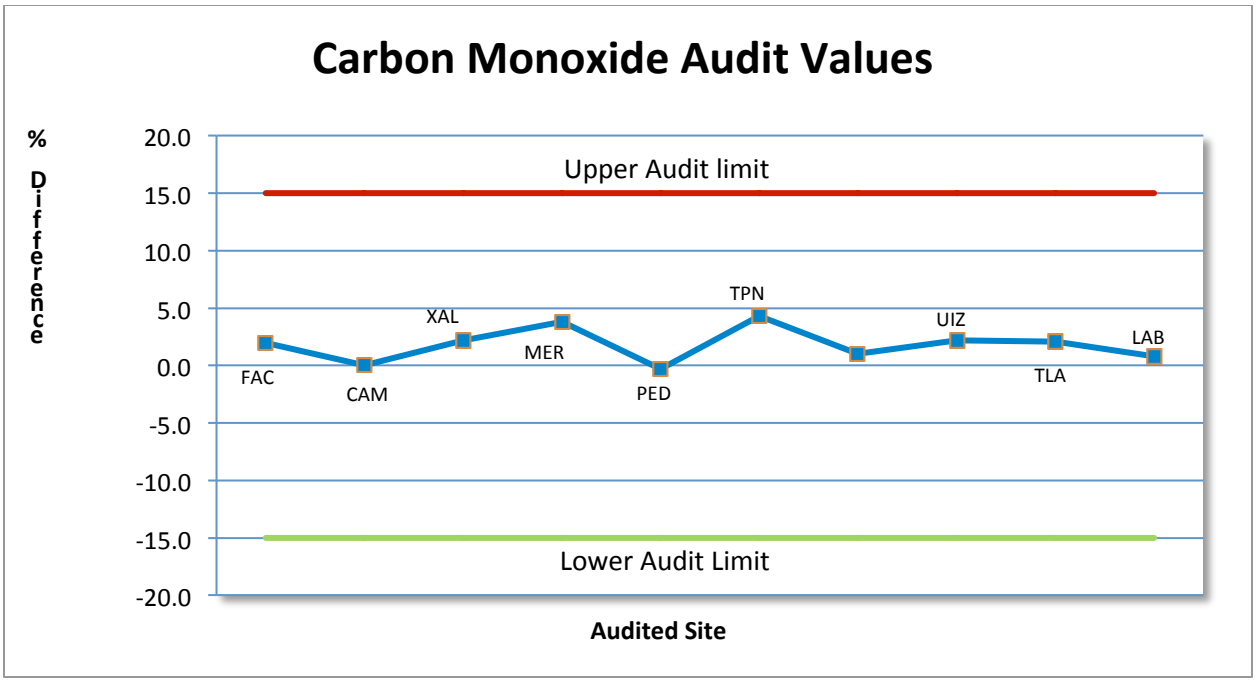

Figure ES-1. Summary of Average Carbon Monoxide Audit Results

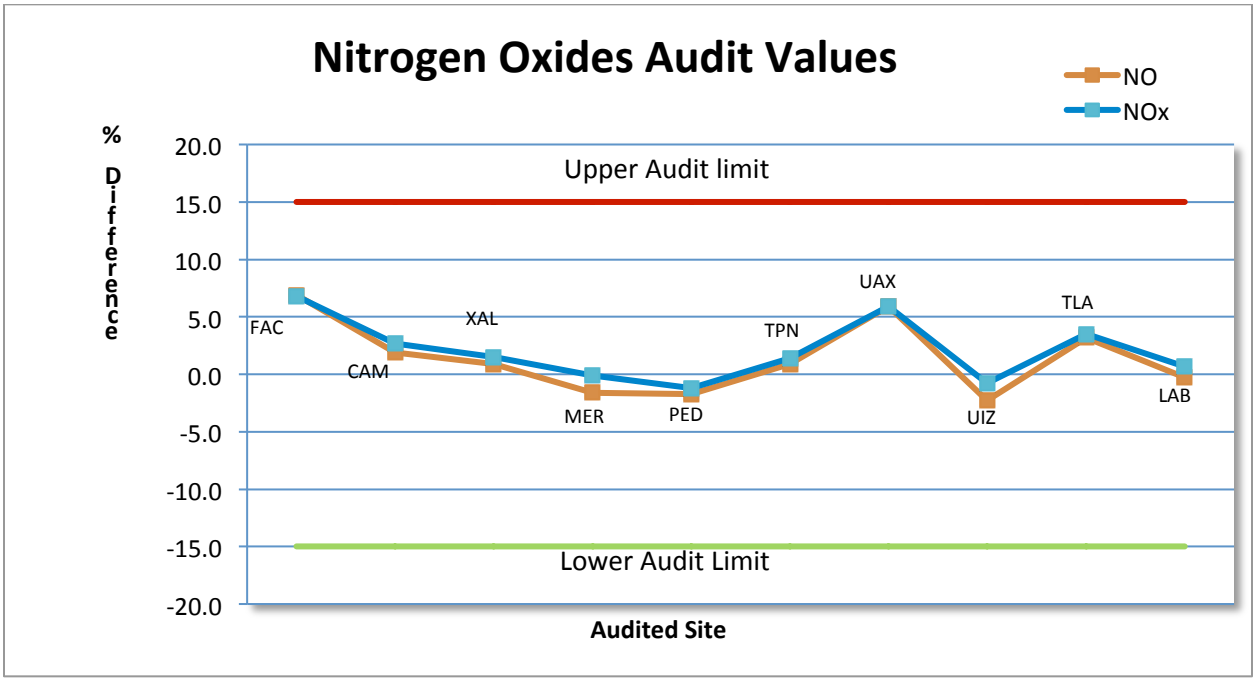

Figure ES-2. Summary of Average Nitrogen Oxides Audit Results

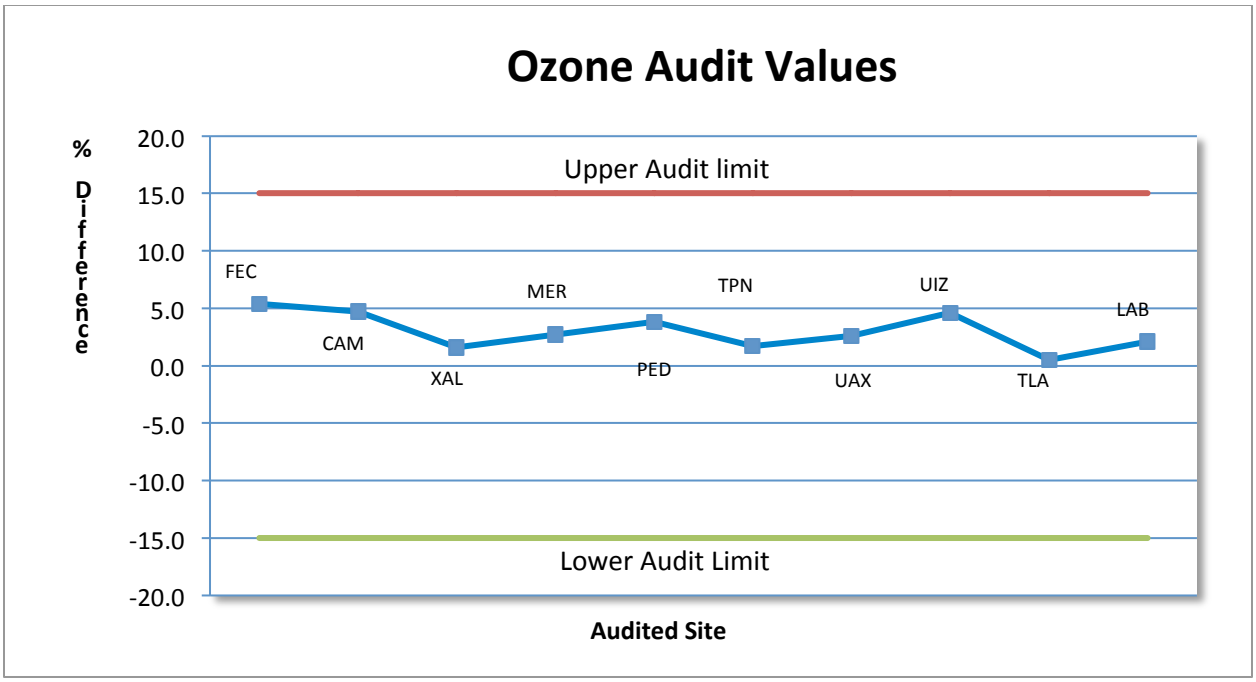

Figure ES-3. Summary of Average Ozone Audit Results

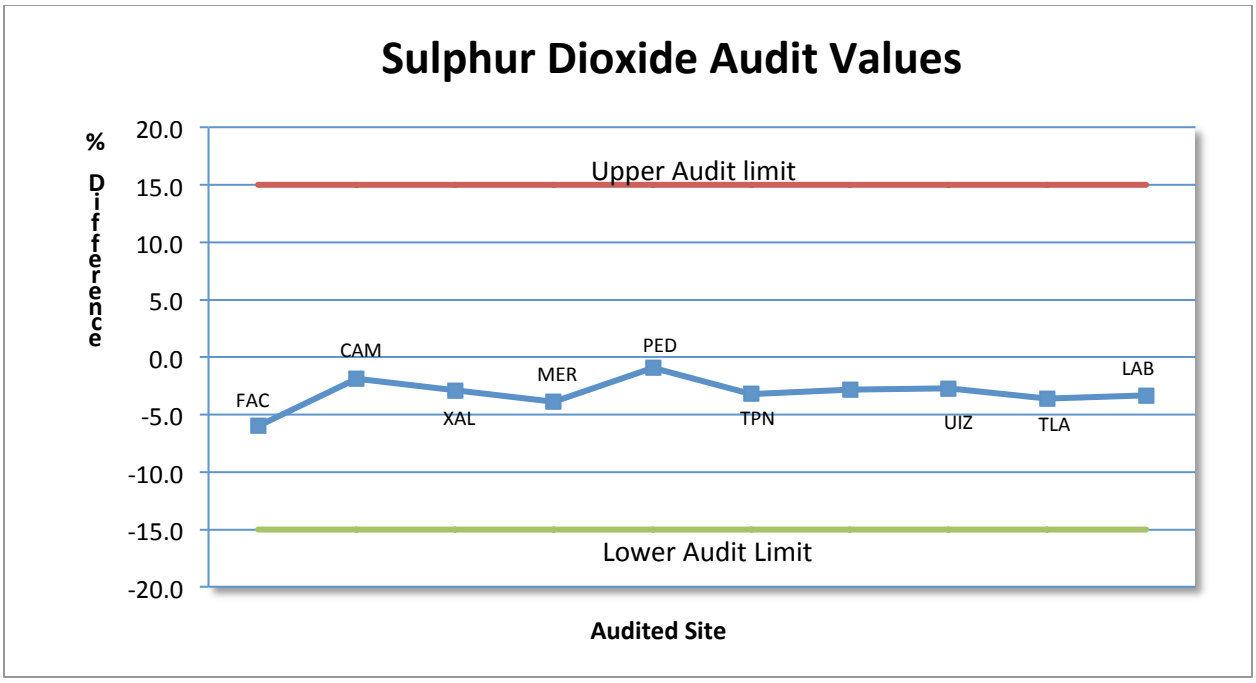

Figure ES-4. Summary of Average Sulphur Dioxide Audit Results

1.0 INTRODUCTION

This report details the technical systems and performance (TS&P) audit conducted on ten (10) ambient air monitoring sites operated by Ciudad de Mexico. Mexico City Atmospheric Monitoring System (Sistema de Monitoreo Atmosférico de la Ciudad de México, SIMAT) operates a total of 29 automated stations for criteria gases and PM in and around Mexico City. The audit was conducted between 20 and 24 August 2012 and was designed to determine the operational state of the individual criteria monitors (performance audit) as well as evaluate the systems and procedures used to calibrate and operate the network. Some monitoring stations also have particulate monitoring (manual and continuous) and meteorological monitoring, but these parameters were not part of the audit.

1.1 Mexico City Metropolitan Area

The Mexico City Metropolitan Area (MCMA) lies in an elevated basin at an altitude of 2,240 meter above mean sea level (amsl), near the center of the country (19º25' N latitude, 99º10' W longitude). The floor of the basin is confined on three sides by mountain ridges with a broad opening to the north and narrowed gap to the south-southwest. The surrounding peaks attain an elevation of nearly 4,000 meter asml. The metropolitan area is located on the southwest side of the basin and covers about 1500 km^2. The MCMA includes the 16 "delegaciones" within the Federal District and clusters of municipalities (municipios) including 37 in the State of Mexico. The Federal District (DF) is the country capital and is home to the national political institutions, the greatest concentration of economic investments and most of the country's industrial and financial infrastructure. MCMA has over 18 million inhabitants.

1.2 Secretaría del Medio Ambiente del Gobierno del Distrito Federal

The Secretariat of the Environment of the Federal District Government (Secretaría del Medio Ambiente del Gobierno del Distrito Federal) is responsible for environmental policies and programs, including implementing local and federal laws, in the Federal District. Since 1993, the Secretariat of the Environment of the Federal District Government has been the primary organization responsible for ambient air monitoring in the Mexico City Metropolitan Area and operates the Mexico City Atmospheric Monitoring System (Sistema de Monitoreo Atmosférico, SIMAT) for this purpose.

The Atmospheric Monitoring System consists of 41 monitoring stations, a support laboratory, an environmental information center, and an information technology support center. Monitoring is further segregated into an Automatic Ambient Air Monitoring Network (Red Automática de Monitoreo Atmosférico, RAMA), a Manual Particulate Monitoring Network, an Atmospheric Deposition Network, and a Meteorological Network. With the support of the environmental

information center and the information technology support center, monitoring data are translated daily and hourly into the Metropolitan Area Air Quality Index (Índice Metropolitano de la Calidad del Aire, IMECA). The IMECA is widely distributed to public and private sector organizations in the Mexico City area to assist in making public health decisions.

Currently the SIMAT network consist of 29 automated stations (O_3, NO_X, SO_2, CO, PM_{10} and $PM_{2.5}$), 12 manual stations (TSP, PM_{10}, $PM_{2.5}$ and heavy metals), 19 meteorological stations (RH, T, WDR, WSP, P and UV radiation) and 16 atmospheric deposition stations (wet and dry atmospheric deposition).

The audit was performed at 9 of the 29 automatic station sites operated as part of the SIMAT network. In addition, as part of the audit, the reference analyzers of the SIMAT laboratory were audited. A summary of the audit schedule along with the parameters audited is summarized in Table 1-1 below. Table 1-2 shows the make, model, and serial number (S/N) of each audited gas-phase analyzer at the 10 sites. A map showing the location of the 10 sites is presented in Figure 1-1. Site descriptions for the 10 sites are presented below in Section 1.3.

Table 1.1 - Summary of Site Parameters

Site Name	Initials	Date Audited	Parameters Monitored
FES Acatlán	FAC	20/08/2012	NO_x, CO, O_3, SO_2, PM_{10}
Camarones	CAM	20/08/2012	NO_x, CO, O_3, SO_2, PM_{10}
Xalostoc	XAL	21/08/2012	NO_x, CO, O_3, SO_2, PM_{10}, $PM_{2.5}$, $PM_{10\text{-}2.5}$
Merced	MER	21/08/2012	NO_x, CO, O_3, SO_2, PM_{10}, $PM_{2.5}$, $PM_{10\text{-}2.5}$
Pedregal	PED	22/08/2012	NO_x, CO, O_3, SO_2, PM_{10}, $PM_{2.5}$, $PM_{10\text{-}2.5}$
Tlalpan	TPN	22/08/2012	NO_x, CO, O_3, SO_2
UAM Xochimilco	UAX	23/08/2012	NO_x, CO, O_3, SO_2, $PM_{2.5}$
UAM Iztapalapa	UIZ	23/08/2012	NO_x, CO, O_3, SO_2, PM_{10}, $PM_{2.5}$, $PM_{10\text{-}2.5}$
Tlalnepantla	TLA	24/08/2012	NO_x, CO, O_3, SO_2,
SIMAT Laboratory	LAB	24/08/2012	NO_x, CO, O_3, SO_2

Note, for continuous PM only flow rates were audited

Table 1.2 - Summary of Analyzer Make, Model, and Serial Number at Each Site

Site	Analyte	Analyzer Make	Analyzer Model	Analyzer S/N
FAC	O_3	API	400E	1199
	NO_X	API	200E	1621
	SO_2	API	100E	1361
	CO	API	300	1163
CAM	O_3	API	400E	1201
	NO_X	API	200E	1610
	SO_2	API	100E	1358
	CO	API	300E	1286
XAL	O_3	API	T400	79
	NO_X	API	T200	72
	SO_2	API	T100	71
	CO	API	T300	65
MER	O_3	API	T400	76
	NO_X	API	T200	70
	SO_2	API	T100	72
	CO	API	T300	66
PED	O_3	API	T400	77
	NO_X	API	200E	1625
	SO_2	API	100E	1336
	CO	API	300E	1292
TPN	O_3	API	400A	260
	NO_X	API	200E	1609
	SO_2	API	100E	1339
	CO	API	300	1168
UAX	O_3	Thermo	49i	1034445706
	NO_X	Thermo	42i	1034445698
	SO_2	Thermo	43i	1034445694
	CO	Thermo	48i	1034445702
UIZ	O_3	API	400	792
	NO_X	API	200E	1631
	SO_2	API	100E	1352
	CO	API	300	1161
TLA	O_3	API	400E	1215
	NO_X	API	T200	73
	SO_2	API	T100	70
	CO	API	T300	64
LAB	O_3	API	400A	888
	NO_X	API	200A	2356
	SO_2	API	100A	1707
	CO	API	300	1781

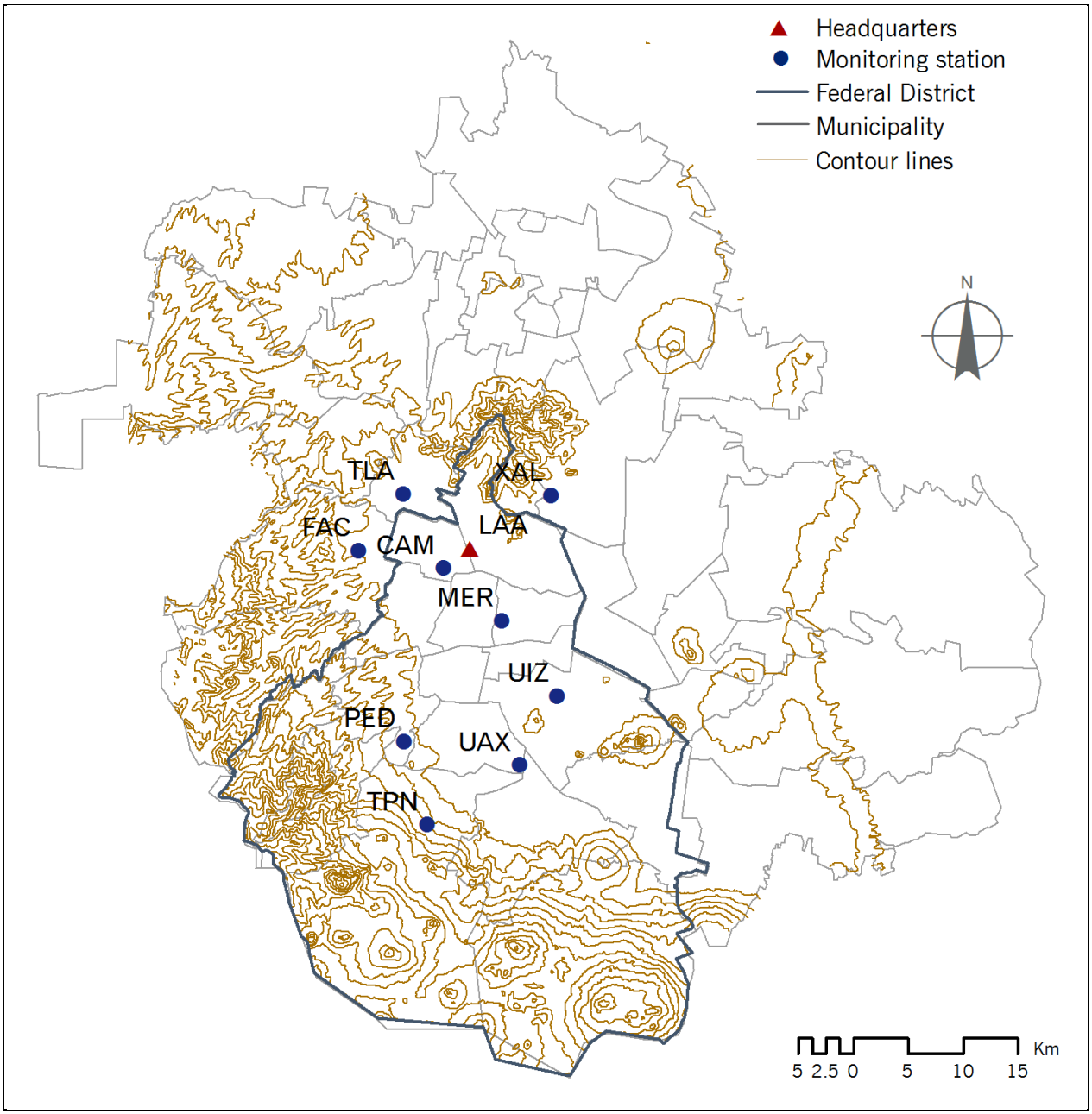

Figure 1-1. Map of Audited Mexico City Network Sites

1.3 Site Information

Site: FES Acatlán (**FAC)**

Address:

Avenida Alcanfores s/n esquina con San Juan Totoltepec, Colonia Santa Cruz Acatlán, Municipio de Naucalpan, Estado de México, CP 53240.

Geographic Location:

19º28'56.90'' N latitude, 99º14'36.69'' W longitude.

Description:

This station was known as the ENEP Acatlán (EAC) station during the 2009 Audit. The station is located at the campus of the National School of Professional Studies and housed in an Ekto Shelter on the top of the second floor of the Odontology Clinic building. There is a major avenue near the station with moderate traffic. There is a small parking lot near the clinic. Sample Inlet is approximately 12 m above ground level.

Site: Camarones (CAM)

Address:

Calle Malvón No. 20, Colonia Hogar y Seguridad, Delegación Azcapotzalco, Distrito Federal, CP 02820.

Geographic Location:

19º28'6.26'' N latitude, 99º10'11.26'' W longitude.

Description:

This station is located on the first floor roof of an elementary school in a residential neighborhood. Sample Inlet is approximately 9 m above ground level.

Site: Xalostoc (XAL)

Address:

Vía Morelos km 12.5, entre López Rayón y Av. Benito Juárez, Colonia Xalostoc, Municipio Ecatepec de Morelos, Estado de México, CP 54190.

Geographic Location:

19º31'33.58'' N latitude, 99º04'56.64'' W longitude.

Description:

This station is in an industrial/commercial/residential area, it is housed in a shed on the top of the four floor of a Regional Hospital. There is a major avenue near the station with heavy traffic. Sample inlet is 30 m above ground level.

Site: Merced (MER)

Address:

Avenida Congreso de la Unión esquina con Stand de Tiro s/n, Colonia Merced Balbuena, Delegación Venustiano Carranza, Distrito Federal, CP 15860.

Geographic Location:

19º25'28.60'' N latitude, 99º07'10.54'' W longitude.

Description:

This station is near the downtown of Mexico City in a shed on the third floor roof of a junior high school. The streets around the station are wide and heavily traveled. There is an elevated Metro railway to the west. Sample Inlet is 17 m above ground level.

Site: Pedregal (PED)

Address:

Calle Cañada No. 370 esquina con Avenida Cráter, Colonia Pedregal de San Ángel, Delegación Álvaro Obregón, Distrito Federal, CP 01900.

Geographic Location:

19º19'30.52'' N latitude, 99º12'14.89'' W longitude.

Description:

This station is in a high-income residential area at the southwest of Mexico City, housed in a shed on the top of the second floor of an elementary school. There are no major streets adjacent to the station. Sample inlet is 11 m above ground level.

Site: Tlalpan (TPN)

Address:

Calle Cerro Tetenco No. 1, Colonia Maria Esther Suno de Echeverría, Delegación Tlalpan, Distrito Federal, CP 14659.

Geographic Location:

19º15'25.35'' N latitude, 99º11'3.04'' W longitude.

Description:

This station is located at an elementary school in a concrete building located on the second story of the building. The sample inlet was located less than 1 meter above a large block wall. Air flow to the site was blocked almost entirely on one side, however, there was still a 270° free air flow around the inlet.

Site: UAM Xochimilco (UAX)

Address:

Universidad Autónoma Metropolitana, Campus Xochimilco, Edificio H. Calzada del Hueso No. 1100, Colonia Villa Quietud, Delegación Coyoacán, Distrito Federal, CP 04960.

Geographic Location:

19º18’16.00’’ N latitude, 99º06’13.20’’ W longitude.

Description:

This station is located on the fourth floor roof of the science building at Universidad Autónoma Metropolitana Campus Xochimilco. The system was housed in a concrete building. The university is situated in a gated residential area with no major streets adjacent to the station. The sample inlet is approximately 20 m above ground level.

Site: UAM Iztapala (UIZ)

Address:

Universidad Autónoma Metropolitana Campus Iztapalapa, Edificio T. Av. San Rafael Atlixco No. 186, Colonia La Vicentina, Delegación Iztapalapa, Distrito Federal, CP 09340.

Geographic Location:

19º21’38.86’’ N latitude, 99º04’25.97’’ W longitude.

Description:

This station is located on the top of the third floor building at Universidad Autónoma Metropolitana Campus Iztapalapa and housed in an Ekto Shelter. There are no major streets adjacent to the station. Sample inlet is approximately 18 m above ground level.

Site: Tlalnepantla (TLA)

Address:

Glorieta de Atlacumulco. Avenida Toluca s/n, Glorieta Atlacomulco, Colonia Tlalnemex, Municipio de Tlalnepantla de Baz, Estado de México, CP 54070.

Geographic Location:

19º31’44.68’’ N latitude, 99º12’16.55’’ W longitude.

Description:

This station is located in a shed on the top of a 2 meter platform in the northwest of the city in the municipality of Tlalnepantla, Estado de México. This site is located at a municipal water facility in a generally residential neighborhood. There are no major streets adjacent to this site. This site is downwind from a major industrial area located north of the site. Sample Inlet is approximately 6.8 m above ground level.

Site: SIMAT Laboratory

Address:

Avenida Sur de los Cien Metros s/n, Colonia Nueva Vallejo, Delegación Gustavo A. Madero, Distrito Federal, CP 07750.

Geographic Location:

19º29'1.34'' N latitude, 99º08'50.12'' W longitude.

Description:

This is the headquarters of the Sistema de Monitoreo Amosférico de la Ciudad de México and houses some of the network's reference analyzers. These units are not typically used to monitor ambient air but rather are used to do comparisons to field analyzers.

1.4 Background

This section provides background on the organizations involved with this audit.

1.4.1 Secretaría del Medio Ambiente del Gobierno del Distrito Federal (GDF)

The Secretariat of the Environment of the Federal District Government (*Secretaría del Medio Ambiente del Gobierno del Distrito Federal*) is responsible for environmental policies and programs, including implementing local and federal laws, in the Mexico City metropolitan area (Federal District and adjoined municipalities in the State of Mexico). The GDF became the primary organization responsible for ambient air monitoring in the Mexico City area in 1993 when the Automatic Ambient Air Monitoring Network (RAMA) was transferred to the GDF.

Prior to the early 1970's, air quality monitoring in Mexico City was part of the Normalized Pan American Sampling Network (*Red Panamericana de Muestreo Normalizado*). In 1971, Mexico passed the "Law for Preventing and Controlling Environmental Contamination", (*Ley para Prevenir y Controlar la Contaminación Ambiental*). In 1972 the Sub-secretary for Environmental Improvement (Subsecretaría de Mejoramiento del Ambiente) was created under the Secretary of Health. These events led to the creation of a 48 station National monitoring network, with 22 of these stations being in the Mexico City air basin. Currently the Mexico City Atmospheric Monitoring System (SIMAT) consists of 41 monitoring stations, a support laboratory, an environmental information center, and an information technology support center. Monitoring is further segregated into an Automatic Monitoring Network (RAMA), a Manual Particulate Monitoring Network, an Atmospheric Deposition Network, and a Meteorological Network. With the support of the environmental information center and the information technology support center, monitoring data are translated daily and hourly into the Metropolitan Area Air Quality Index (*Índice Metropolitano de la Calidad del Aire* (IMECA). The IMECA is widely distributed to public and private sector organizations in the Mexico City area to assist in making public health decisions.

1.4.2 Secretariat of the Environment and Natural Resources (SEMARNAT)

The Secretariat of the Environment and Natural Resources (*Secretaría de Medio Ambiente y Recursos Naturales* (SEMARNAT)) is the primary federal agency responsible for environmental

protection in the Country of Mexico. The Sub-secretary of Environmental Protection Management (*Subsecretaría de Gestión para la Protección Ambiental*) is the SEMARNAT organizational unit primarily responsible for environmental quality. However, the National Institute of Ecology (*Instituto Nacional de Ecología* (INE)) provides technical and research support for environmental issues (including monitoring).

Prior to the 2009 air monitoring audit, the United States Environmental Protection Agency (USEPA) performed the Mexico City ambient air monitoring network audits as requested by the Environmental Secretariat of the Government of the Federal District (*Secretaría del Medio Ambiente del Gobierno del Distrito Federal* (GDF)) and the Pan American Health Organization (PAHO). The physical audits were performed by the USEPA Office of Air Quality Planning and Standards (OAQPS) and were conducted in 2003 and 2005. Prior to this, audits were performed as an adjunct to a research program in Mexico City by the USEPA Office of Research and Development (ORD). No additional audits by any agency of the USEPA since 2005 have been performed.

2.0 DESCRIPTION OF AUDIT METHODOLOGY

Performance audits are intended to independently evaluate the performance of an organization's monitoring equipment, calibration equipment, standards, and all operating, calibration, maintenance, quality assurance, and quality control procedures. Performance audits involve independent audit equipment, an independent auditor, and independent gas standards to challenge the instrumentation. Gaseous pollutant audits were accomplished by challenging the instruments through the inlet to the sampling probe. The acceptance criterion for gaseous pollutants is 15% mean absolute difference and 15% for each concentration level of each pollutant analyzer. Monitors that exceed this criterion require corrective action. Also evaluated are the instruments response to individual audit concentrations, instrument linearity based on multiple standards, and zero checks.

Technical System Audits (TSAs) and Management System Reviews (MSRs) are reviews intended to evaluate how well the established quality system is working. TSAs are used to verify that appropriate technical and quality control procedures have been established and are being followed. For air monitoring organizations, some areas which are audited include:

- Written procedures;
- Documentation;
- Monitoring network design;
- Site appropriateness/siting requirements;
- Instrument operation;
- Laboratory procedures;
- Sample/data custody;
- Data handling systems;
- Data processing and calculation;
- Quality control; and
- Performance audit system.

Management System Reviews (MSRs) are evaluations of how effectively the QA program is working. These audits evaluate the overall quality system but may not effectively identify technical defects with the system. Possible elements of a MSR include the evaluation of:

- Organizational structure;
- Quality policy;
- Quality manager empowerment and effectiveness;
- Quality documentation;
- Corrective actions;
- Training and qualifications of staff;
- Commitment to quality by management and staff; and
- Overall effectiveness of the quality system.

The technical systems audit addressed a number of the issues outlined above.

2.1 Performance Audit Procedures

The station performance audits were performed using an Environics Model 6103 (S/N 4880) calibrator and an API Model 701 air source. An EPA Protocol 1 calibration standard manufactured by Scott Marrin of Riverside, California was used to make individual dilution concentrations for the NO_x, SO_2 and CO analyzers. Ozone concentrations were produced by the Environics calibrator using the on-board ozone generator and certified photometer.

The calibrator had not been used in the field prior to the audit so the original (manufacturer's) source and dilution mass flow controller calibrations were used for the flow values. The photometer however, was checked prior to the audit using the Texas Commission on Environmental Quality's (TCEQ's) primary ozone standard and support equipment. This is the agency responsible for all of the air monitoring stations for the state of Texas and their primary ozone photometers are directly traceable to the USEPA.

Table 2-1 presents the concentrations of the individual criteria pollutant analytes with a copy of the gas certification provided in Appendix A. The cylinder's certification is considered valid for 24 months from manufacture. The ozone concentrations were generated by the Environics 6103 (S/N 4880) based on the ozone certification performed in June 2012 in the TCEQ air quality laboratory in Austin, Texas. Ozone transfer standards need to be re-calibrated every three months.

During the audit, each instrument was challenged with at least five different gas concentrations (four to five upscale points plus zero). In addition, a gas-phase titration (GPT) was performed on each NO_x analyzer to test the NO_2 conversion efficiency. The GPT was performed by first creating a stable ozone concentration and then adding NO at a concentration approximately 100 ppb higher than the ozone concentration. This was done at three different ozone and NO concentrations to calculate the NO_2 converter efficiency.

The flow rates though the continuous PM monitors were checked using a BGI DeltaCal calibrator (S/N 351). This device measures the total flow through the sample inlet which is critical to ensure that the cut-point of the sample head is accurate.

Because of site logistics, site security, and shortage of open space, most of the air quality stations in the Mexico City network are located on the roofs of governmental buildings, such as clinics, schools, or universities. Each of the nine field sites and the main laboratory reference site were equipped with air quality monitors for nitrogen oxides (NO_x), sulphur dioxide (SO_2), ozone (O_3), and carbon monoxide (CO). In addition, most of the sites had continuous particulate monitors. These particulate monitors were typically either BAM 1020 beta attenuation analyzers or R&P Model 1400a tapered element oscillating microbalances (TEOM) measuring PM_{10} or were

Thermo FDMS combined PM_{10} / $PM_{2.5}$ samplers which measure $PM_{2.5}$ and PM_{10} simultaneously. The main flow rate through each unit was checked using a BGI DeltaCal to help verify proper impactor cut-point. In addition, many of the sites also had manual PM_{10} and $PM_{2.5}$ samplers along with meteorological sensors for wind speed and wind direction, ambient temperature, and solar radiation, however the audit scope did not include these parameters so they were not audited.

Other elements of the TSA and MSR audits included evaluating the physical condition of each site, site record keeping, operator knowledge and training, and overall operating procedures that can impact the data quality. Due to the cost of air sources, dilution calibrators, and individual gas standards, not all of the sites were configured for automatic calibration. For sites not configured with dilution calibrators and air sources, during bi-weekly calibrations an air source, calibrator, and gas standard are taken to each site to perform calibrations.

The Mexico City operations staff conducts a series of calibrations at each site. These calibrations include:

- Instrument zero checks;
- Level One precision checks;
- Gas-phase titrations (GPTs); and
- Multipoint calibrations.

Table 2-2 summarizes the calibration frequency and calibration levels. The audit results from each station are discussed below in Section 3.

Table 2-1. Summary of Gas Standard Concentrations

Gas Standard	Cylinder Number	Concentration (ppm)	Date Manufacture	Stability (months)
SO_2	CB09813	30.8	05/01/2012	24
NO		29.57		
CO		3030		

Table 2-2. Summary of Calibration Type, Frequency, and Acceptance Criteria

Calibration Type	Recommended Frequency	Concentration Levels	Criteria
Zero	Weekly	Zero for CO, NO, SO_2, O_3	Zero ±3 ppb for O_3 Zero ±5 ppb for NO and SO_2 Zero ±0.5 ppm for CO
Level One Precision Check (performed though instrument's sample port) Note: This is referred to as zero and span calibrations by the network	Bi-Weekly	**Level 1** – 400 ppb for NO, SO_2, O_3, and 40 ppm for CO **Level 2** – 50 ppb NO, SO_2, O_3, and 5 ppm for CO **Level 3** – Zero	**Level 1 –** If instrument reponse is more than ±5% from standard values the analyzer is adjusted **Level 2 –** ±5 ppb for O_3, NO, SO_2 ±0.5 ppm for CO **Level 3 –** Zero ±3 ppb for O_3 Zero ±5 ppb for NO, SO_2 Zero ±0.5 ppm for CO
Gas Phase Titration (GTP) for NO_X analyzer converter efficiency	Bi-Weekly	400 ppb NO with 350 ppb O_3	Converter efficiency >96%
Gas Phase Titration (GPT)	During Each Multipoint Calibration	**Level 1** – 400 ppb NO with 350 ppb O_3 **Level 2 -** 400 ppb NO with 50 ppb O_3	Converter Efficiency greater than 96% or converter should be replaced
Multipoint Calibration, performed though instrument's sample	Quarterly	**Level 1** – 400 ppb for NO, SO_2, O_3, and 40 ppm for CO **Level 2** – 300 ppb NO, SO_2, O_3, and 30 ppm for CO **Level 3** – 200 ppb NO, SO_2, O_3, and 20 ppm for CO **Level 4 -** 50 ppb NO, SO_2, O_3, and 5 ppm for CO **Level 5** –Zero	If instrument response is more than ± 3% from standard values analyzer is re-calibrated

3.0 INDIVIDUAL SITE AUDIT RESULTS

This section describes the audit results for each of the nine field sites plus the main laboratory. During the audit, audit data were recorded into a formatted Excel spreadsheet that calculated percent difference from each known concentration value. In addition, each site was reviewed to check that the systems met general siting and operational specifications. This check assessed the overall site conditions including preventative maintenance, documentation, and overall system operation. In general, the audits followed US EPA guidelines for ambient air monitoring systems found in the following documents:

- Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Part 1, Ambient Air Quality Monitoring Program System Development, EPA-454/R-98-004, December 2008.

- Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, EPA/600/R-94/038d, March 2008.

- Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I: A Field Guide to Environmental Quality Assurances, EPA/600/R-94/038a, April 1994.

3.1 General Observations

All of the sites were very well maintained, the plumbing and electrical wiring were well designed and consequently easy to work on, and finally, the shelters were quite clean. All of the glass sampling manifolds were found to be free of dirt and debris and the sampling heads (PM_{10} and $PM_{2.5}$) were regularly cleaned and maintained. Standard protocols specify that each PM sampling head and each glass manifold is cleaned monthly as part of the preventative maintenance regime.

There were a number of "best practices" that the network uses to help ensure quality. For instance, all operators carry hand-held PDA's to record operating information from each site during each site visit. These data are then downloaded at the main laboratory so that changes in instrument performance can be tracked and monitored. There are Standard Operating Procedures (SOPs) for each analyzer make and model that can be referred to for new operators or used for training. During each quarterly multipoint calibration, instrument diagnostics information and instrument performance parameters are recorded for each instrument and written on a heavy paper tag that is affixed to each analyzer. A photograph of one of these tags is shown in Figure 3-1. Each time an operator goes to a site to perform calibrations or other maintenance activities, the current operational parameters are reviewed based on the values listed on each instruments performance tag. Any significant changes from the values on the tag may be indicative of a

possible instrument malfunction or degraded performance. As this information is typically available (depending on how long an individual instrument has been at a site) for a given instrument for at least one year, these tags allow an operator to very quickly determine if the current instrument performance has degraded (such as PMT voltage) since last multipoint calibration.

A review of the site operator logs showed that the operators were very good at documenting their on-site activities, entries were written in ink, cross-outs were properly done, entries were signed and dated, and usually the time in and out documented. The only deficiency noted with the log books was that while almost all entries had a starting time, some of the operators did not record finish times. Most of the operators were very reliable with start/finish times, but a few were not so this small aspect of the documentation could be improved. Operator logs are needed to reproduce data or determine the extent of downtime. It needs to be noted that site operators do call the main laboratory each time they arrive or leave each site, so this information is documented in the main laboratory logs.

Another best practice noted at each site included control charting of the zero and span data for each analyzer at the site. These data were kept at each site so the operator could quickly see if an analyzer's performance was different from previous results or if an analyzer's performance was slowly changing.

Overall, the nine ambient stations appeared to be very well operated, the operators appeared to be well trained, were very knowledgeable about QA/QC procedures and, clearly cared about the quality of their work.

Further discussions and audit results from each of the individual sites are presented in the sections presented below.

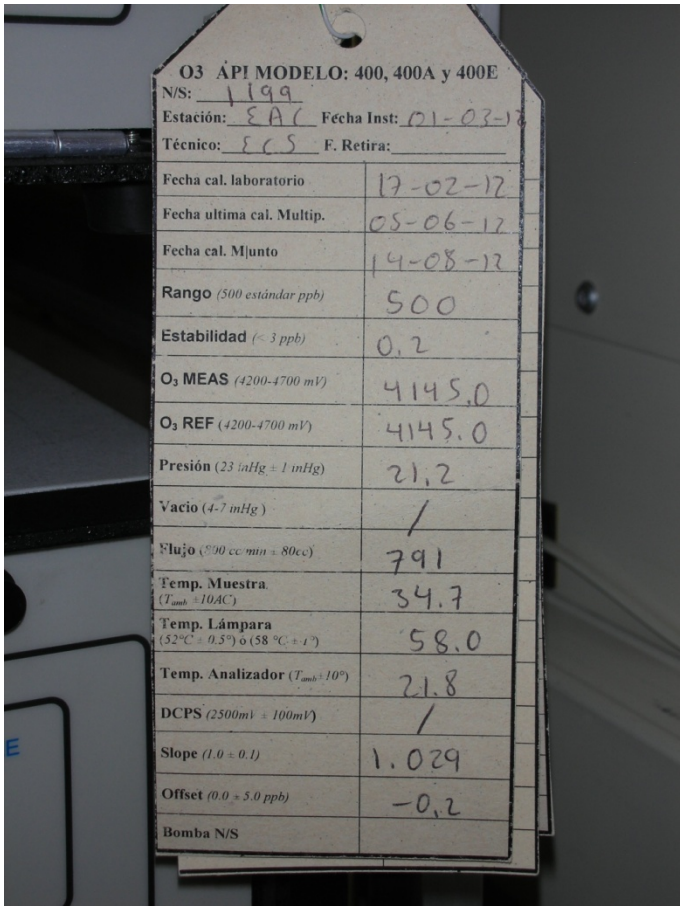

Figure 3-1. Photo of Instrument Information Tag

3.2 FES-ACATLAN (FAC) Site

This site was located at the campus of the National School of Professional Studies on the roof of the Odontology Clinic building. During the 2009 audit this site was known as the EAC Site. The audit results showed that all of the parameters {SO_2 (-6.0%), O_3 (5.4%), CO (2.0%), NO (6.9%), and NO_x (6.8%)} were well within the audit objective of ± 15%. In addition, the GPT showed a NO_2 convertor efficiency of 99.3%. In addition to the gas-phase instruments the site contained a TEOM 1400a PM_{10} analyzer. The total measured flow rate through the analyzer was 16.93 lpm, 1.4% higher than the design specification of 16.7 lpm and well within acceptable flow rate limits to maintain the proper impactor cut-point. Sample results for each of the analyzers at this site are shown in Tables 3-1 to 3-6. A photo of this site is shown in Figure 3-2 below.

Table 3-1. Summary of Sulphur Dioxide (SO_2) Audit Results, FAC Site

SO_2 Input (ppm-v)	SO_2 Response (ppm-v)	Percent Difference [1]	SO_2 Analyzer Regression Data	
0.000	0.0026	---	***Slope:***	0.9361
0.075	0.0698	-6.7%	***Intercept:***	0.0014
0.200	0.1891	-5.5%	***Correlation:***	0.99997
0.400	0.3760	-6.0%		

[1] **Objective ±15%**

Table 3-2. Summary of Ozone (O_3) Audit Results, FAC Site

O_3 Input (ppm-v)	O_3 Response (ppm-v)	Percent Difference[1]	O_3 Analyzer Regression Data	
0.000	0.0020	---	***Slope:***	1.0553
0.078	0.0816	4.6%	***Intercept:***	0.00062
0.199	0.2100	5.5%	***Correlation:***	0.99998
0.297	0.3140	5.7%		
0.394	0.4170	5.8%		

[1] **Objective ±15%**

Table 3-3. Summary of Carbon Monoxide (CO) Audit Results, FAC Site

CO Input (ppm-v)	CO Response (ppm-v)	Percent Difference[1]	CO Analyzer Regression Data	
0.0	0.1	---	***Slope:***	0.9990
7.4	7.6	3.0%	***Intercept:***	0.1490
19.7	19.8	0.5%	***Correlation:***	0.99998
39.4	40.4	2.5%		

[1] Objective ±15%

Table 3-4. Summary of Nitrogen Oxides (NO_x) Audit Results, FAC Site

NO_X / NO Input (ppm-v)	Response		Percent Difference[1]		NO_x Analyzer Regression Data		
	NO_X (ppm-v)	NO (ppm-v)	NO_X	NO	Parameter	NO_X	NO
0.000	0.0008	0.0033	---	---	***Slope:***	1.0422	1.0522
0.050	0.0548	0.0541	9.6%	8.2%	***Intercept:***	0.00249	0.00226
0.072	0.0776	0.0779	7.8%	8.2%	***Correlation:***	0.99995	0.99995
0.200	0.2140	0.2136	7.0%	6.8%			
0.300	0.3149	0.3150	5.0%	5.0%			
0.400	0.4180	0.4250	4.5%	6.2%			

[1] Objective ±15%

Table 3-5. Summary of Nitrogen Oxides (NO_x) Audit Results, FAC Site

Gas Phase Titration					
Ozone Setting	Response		Corrected		NO Corrected
	NO_X	NO	NO_X	NO	
Off	0.4180	0.4250	0.399	0.402	
0.35	0.4159	0.0850	0.397	0.079	0.079
Off	0.3149	0.3150	0.300	0.297	
0.2	0.3152	0.1234	0.300	0.115	0.115
Off	0.2140	0.2136	0.203	0.201	
0.08	0.2128	0.1420	0.202	0.133	0.133

Table 3-6. Summary of Nitrogen Oxides (NO_x) GPT Results, FAC Site

NO_2 Audit Data					
NO_2 Input (ppm-v)	NO_2 Response (ppm-v)	NO_2 Percent Difference	NO_2 Converted (ppm-v)	NO_2 Analyzer Regression Data	
0.000				***Slope:***	1.01870
0.068	0.0708	4.1%	0.067	***Intercept:***	0.00326
0.182	0.1918	5.4%	0.182	***Correlation:***	0.99978
0.323	0.3309	2.4%	0.321	***Converter Efficiency***[1]	**99.3**

[1] **Acceptance Criteria >96%**

Figure 3.2. Photo of FAC Site, Front View

Figure 3.3. Photo of FAC Site, Back View

3.3 Camarones (CAM) Site

This station is located on the first floor roof of an elementary school in a residential neighborhood. The audit results showed that all of the parameters {SO_2 (-1.9%), O_3 (4.7%), CO (0.0%), NO (1.9%), and NO_x (2.7%)} were well within the audit objective of ± 15%. The the GPT showed a NO_2 convertor efficiency of 101.2%. In addition to the gas-phase instruments, the site contained a Thermo FDMS $PM_{10}/PM_{2.5}$ analyzer. The total measured flow rate through the analyzer was 16.86 lpm, 0.99% higher than the design specification of 16.7 lpm and well within acceptable flow rate limits to maintain the proper impactor cut-point. Sample results for each of the analyzers at this site are shown in Tables 3-7 to 3-12. Photos of this site are shown in Figures 3-4 and 3-5 below.

Table 3-7. Summary of Sulphur Dioxide (SO_2) Audit Results, CAM Site

SO_2 Input (ppm-v)	SO_2 Response (ppm-v)	Percent Difference[1]	SO_2 Analyzer Regression Data	
0.000	0.0013	---	***Slope:***	0.97916
0.052	0.0506	-2.9%	***Intercept:***	0.00060
0.104	0.1031	-1.1%	***Correlation:***	0.99999
0.208	0.2037	-2.1%		
0.313	0.3070	-1.8%		

[1] **Objective ±15%**

Table 3-8. Summary of Ozone (O_3) Audit Results, CAM Site

O_3 Input (ppm-v)	O_3 Response (ppm-v)	Percent Difference[1]	O_3 Analyzer Regression Data	
0.000	0.0013	---	***Slope:***	1.03106
0.082	0.0872	6.3%	***Intercept:***	0.00231
0.201	0.2107	4.8%	***Correlation:***	0.99998
0.301	0.3134	4.1%		
0.396	0.4094	3.4%		

[1] **Objective ±15%**

Table 3-9. Summary of Carbon Monoxide (CO) Audit Results, CAM Site

CO Input (ppm-v)	CO Response (ppm-v)	Percent Difference[1]	CO Analyzer Regression Data	
0.0	0.0	---	***Slope:***	1.01026
5.1	5.0	-2.0%	***Intercept:***	-0.05200
10.3	10.3	0.2%	***Correlation:***	0.99995
20.5	20.7	1.0%		
30.7	31.1	1.3%		

[1] **Objective ±15%**

Table 3-10. Summary of Nitrogen Oxides (NO_x) Audit Results, CAM Site

NO_X / NO Input (ppm-v)	Response		Percent Difference[1]		NO_x Analyzer Regression Data		
	NO_X (ppm-v)	NO (ppm-v)	NO_X	NO	Parameter	NO_X	NO
0.000	0.4540	0.4514	---	---	***Slope:***	1.00474	0.99798
0.050	0.4570	0.1247	5.0%	6.0%	***Intercept:***	0.00248	0.00237
0.100	0.3048	0.3018	5.0%	1.5%	***Correlation:***	0.99997	1.00000
0.200	0.3074	0.1407	1.3%	1.1%			
0.300	0.2025	0.2022	1.6%	0.6%			
0.450	0.2047	0.0650	0.9%	0.3%			

[1] **Objective ±15%**

Table 3-11. Summary of Nitrogen Oxides (NO_x) Audit Results, CAM Site

Gas Phase Titration					
Ozone Setting	Response		Corrected		NO Corrected
	NO_X	NO	NO_X	NO	
Off	0.4540	0.4514	0.449	0.450	---
0.35	0.4570	0.1247	0.452	0.123	0.123
Off	0.3048	0.3018	0.301	0.300	---
0.2	0.3074	0.1407	0.303	0.139	0.139
Off	0.2025	0.2022	0.199	0.200	---
0.08	0.2047	0.0650	0.201	0.063	0.063

Table 3-12. Summary of Nitrogen Oxides (NO_x) GPT Results, TLA Site

NO_2 Audit Data					
NO_2 Input (ppm-v)	NO_2 Response (ppm-v)	NO_2 Percent Difference	NO_2 Converted (ppm-v)	NO_2 Analyzer Regression Data	
0.000				***Slope:***	1.00778
0.137	0.140	2.0%	0.139	***Intercept:***	0.00295
0.161	0.167	3.5%	0.163	***Correlation:***	0.99991
0.327	0.332	1.6%	0.330	***Converter Efficiency***[1]	**101.2%**

[1] **Acceptance Criteria >96%**

Figure 3-4. Photo of CAM Site, Side View

Figure 3-5. Photo of CAM Site, Front View

3.4 Xalostoc (XAL) Site

During the 2009 audit this station was in an industrial/commercial/residential area in a shed on the back lot of a car dealership. During 2012, this site had been relocated to the top of the fourth floor of a Regional Hospital. The shelter was fairly old (same shelter as the 2009 audit) old and cramped but the equipment was well maintained. The audit results showed that all of the parameters {SO_2 (-2.9%), O_3 (1.6%), CO (2.2%), NO (0.9%), and NO_x (1.5%)} were well within the audit objective of ± 15%. The GPT showed a NO_2 convertor efficiency of 100.4%. In addition to the gas-phase instruments, the site contained a Thermo FDMS $PM_{10}/PM_{2.5}$ analyzer. The total measured flow rate through the analyzer was 16.76 lpm, 0.36% higher than the design specification of 16.7 lpm and well within acceptable flow rate limits to maintain the proper impactor cut-point. Sample results for each of the analyzers at this site are shown in Tables 3-13 to 3-18. Photos of this site are shown in Figures 3-6 and 3-7 below.

Table 3-13. Summary of Sulphur Dioxide (SO_2) Audit Results, XAL Site

SO_2 Input (ppm-v)	SO_2 Response (ppm-v)	Percent Difference [1]	SO_2 Analyzer Regression Data	
0.000	0.0002	---	***Slope:***	0.97178
0.052	0.0502	-3.4%	***Intercept:***	0.00010
0.104	0.1013	-2.8%	***Correlation:***	0.99999
0.208	0.2023	-2.9%		
0.313	0.3049	-2.4%		
0.468	0.4543	-2.9%		

[1] **Objective ±15%**

Table 3-14. Summary of Ozone (O_3) Audit Results, XAL Site

O_3 Input (ppm-v)	O_3 Response (ppm-v)	Percent Difference[1]	O_3 Analyzer Regression Data	
0.000	0.0000	---	***Slope:***	1.03964
0.082	0.0809	-2.1%	***Intercept:***	-0.00182
0.202	0.2024	2.6%	***Correlation:***	0.99982
0.301	0.3032	3.0%		
0.394	0.3980	2.8%		

[1] **Objective ±15%**

Table 3-15. Summary of Carbon Monoxide (CO) Audit Results, XAL Site

CO Input (ppm-v)	CO Response (ppm-v)	Percent Difference[1]	CO Analyzer Regression Data	
0.0	-0.06	---	***Slope:***	1.01883
5.1	5.30	3.9%	***Intercept:***	0.03625
10.3	10.57	3.1%	***Correlation:***	0.99995
20.5	20.86	1.8%		
30.7	31.30	2.0%		
46.1	46.10	0.0%		

[1] Objective ±15%

Table 3-16. Summary of Nitrogen Oxides (NO_x) Audit Results, XAL Site

NO_X / NO Input (ppm-v)	Response		Percent Difference[1]		NO_x Analyzer Regression Data		
	NO_X (ppm-v)	NO (ppm-v)	NO_X	NO	Parameter	NO_X	NO
0.000	0.0020	0.0013	---	---	**Slope**	0.99652	0.99883
0.050	0.0523	0.0510	5.0%	2.4%	***Intercept:***	0.00215	0.00123
0.100	0.1009	0.1013	0.9%	1.3%	***Correlation:***	0.99999	0.99998
0.200	0.2017	0.2017	0.8%	0.8%			
0.300	0.3019	0.2990	0.6%	-0.3%			
0.450	0.4501	0.4516	0.0%	-0.4%			

[1] Objective ±15%

Table 3-17. Summary of Nitrogen Oxides (NO_x) Audit Results, XAL Site

Gas Phase Titration					
Ozone Setting	Response		Corrected		NO Corrected
	NO_X	NO	NO_X	NO	
Off	0.4501	0.4516	0.450	0.451	---
0.35	0.4550	0.1380	0.454	0.137	0.137
Off	0.3019	0.2990	0.301	0.298	---
0.2	0.2998	0.1134	0.299	0.112	0.112
Off	0.2017	0.2017	0.200	0.201	---
0.08	0.2022	0.1152	0.201	0.114	0.114

Table 3-18. Summary of Nitrogen Oxides (NO_x) GPT Results, XAL Site

NO_2 Audit Data					
NO_2 Input (ppm-v)	NO_2 Response (ppm-v)	NO_2 Percent Difference	NO_2 Converted (ppm-v)	NO_2 Analyzer Regression Data	
0.000		---	---	***Slope:***	1.01355
0.087	0.0870	0.0 %	0.088	***Intercept:***	-0.00152
0.186	0.1864	0.2%	0.184	***Correlation:***	0.99999
0.314	0.3170	1.0%	0.318	***Converter Efficiency***[1]	**100.4%**

[1] **Acceptance Criteria >96%**

Figure 3-6. XAL Site, Side View

Figure 3-7. XAL Site, Rear View

3.5 Merced (MER) Site

This station is near the downtown of Mexico City in a shed on the third floor roof of a junior high school. The streets around the station are wide and heavily traveled and there is an elevated Metro railway to the west. This site had been relocated since the 2009 audit when this station was located inside a shed located on the roof of a health care center. The audit results showed that all of the parameters {SO_2 (-3.9%), O_3 (2.7%), CO (3.8%), NO (-1.6%), and NO_x (-0.1%)} were well within the audit objective of ± 15%. The GPT showed a NO_2 convertor efficiency of 102.6%. In addition to the gas-phase instruments, the site contained a Thermo FDMS $PM_{10}/PM_{2.5}$ analyzer. The total measured flow rate through the analyzer was 16.83 lpm, 0.78% higher than the design specification of 16.7 lpm and well within acceptable flow rate limits to maintain the proper impactor cut-point. Audit results for each of the analyzers at this site are shown in Tables 3-19 to 3-24.

This site also had a TEOM 1405 $PM_{10}/PM_{2.5}$ monitor. The measured flow rate through this sampler was determined to be 16.83 lpm, well within specification of 16.7 ± 1.67 lpm for adequate impactor cut-points. A photo of this site is shown in Figure 3-8 below.

Table 3-19. Summary of Sulphur Dioxide (SO_2) Audit Results, MER Site

SO_2 Input (ppm-v)	SO_2 Response (ppm-v)	Percent Difference [1]	SO_2 Analyzer Regression Data	
0.000	-0.0040	---	***Slope:***	0.97679
0.052	0.0490	-5.6%	***Intercept:***	-0.00265
0.104	0.1004	-3.6%	***Correlation:***	0.99998
0.208	0.2006	-3.7%		
0.313	0.3014	-3.6%		
0.468	0.4550	-2.8%		

[1] **Objective ±15%**

Table 3-20. Summary of Ozone (O_3) Audit Results, MER Site

O_3 Input (ppm-v)	O_3 Response (ppm-v)	Percent Difference[1]	O_3 Analyzer Regression Data	
0.000	0.0001	---	***Slope:***	1.03631
0.082	0.0840	2.4%	***Intercept:***	-0.00069
0.201	0.2069	2.9%	***Correlation:***	0.99986
0.297	0.3060	3.0%		
0.396	0.4061	2.6%		

[1] **Objective ±15%**

Table 3-21. Summary of Carbon Monoxide (CO) Audit Results, MER Site

CO Input (ppm-v)	CO Response (ppm-v)	Percent Difference[1]	CO Analyzer Regression Data	
0.0	0.005	---	***Slope:***	1.03319
5.1	5.43	6.1%	***Intercept:***	0.11120
10.2	10.86	6.1%	***Correlation:***	0.99990
20.5	21.20	3.4%		
30.7	31.70	3.1%		
46.1	46.17	0.2%		

[1] Objective ±15%

Table 3-22. Summary of Nitrogen Oxides (NO_x) Audit Results, MER Site

NO_X / NO Input (ppm-v)	Response		Percent Difference[1]		NO_x Analyzer Regression Data		
	NO_X (ppm-v)	NO (ppm-v)	NO_X	NO	Parameter	NO_X	NO
0.000	0.0000	-0.0005	0.000	-0.001	***Slope:***	0.97596	0.97551
0.050	0.0500	0.0494	0.050	0.049	***Intercept:***	0.00259	0.00077
0.100	0.1020	0.0982	0.102	0.098	***Correlation:***	0.99989	0.99998
0.200	0.2001	0.1976	0.200	0.198			
0.300	0.2975	0.2938	0.298	0.294			
0.450	0.4390	0.4387	0.439	0.439			

[1] Objective ±15%

Table 3-23. Summary of Nitrogen Oxides (NO_x) Audit Results, MER Site

Gas Phase Titration					
Ozone Setting	Response		Corrected		NO Corrected
	NO_X	NO	NO_X	NO	
Off	0.4390	0.4387	0.449	0.449	---
0.375	0.4507	0.0950	0.459	0.097	0.097
Off	0.2975	0.2938	0.302	0.300	---
0.2	0.3016	0.1115	0.306	0.114	0.114
Off	0.2001	0.1976	0.202	0.202	---
0.1	0.2020	0.1113	0.204	0.113	0.113

Table 3-24. Summary of Nitrogen Oxides (NO_x) GPT Results, MER Site

NO_2 Audit Data					
NO_2 Input (ppm-v)	NO_2 Response (ppm-v)	NO_2 Percent Difference	NO_2 Converted (ppm-v)	NO_2 Analyzer Regression Data	
0.000				***Slope:***	1.00652
0.089	0.0907	1.9%	0.091	***Intercept:***	0.00180
0.186	0.1901	2.2%	0.190	***Correlation:***	0.99997
0.352	0.3557	1.1%	0.364	***Converter Efficiency***[1]	**102.6%**

[1] **Acceptance Criteria >96%**

Figure 3-8. MER Site, Side View

3.6 Pedregal (PED) Site

This station is in a high-income residential area in southwest Mexico City housed in a shed on the top of the second floor of an elementary school. The shelter was very old and cramped but the equipment was well maintained. This site was equipped with API Model 700 calibrator and Model 701air source to perform weekly calibrations. The system is not however, setup to perform automatic calibrations. The audit results showed that all of the parameters {SO_2 (-0.9%), O_3 (3.8%), CO (-0.3%), NO (-1.7%), and NO_x (-1.2%)} were well within the audit objective of ± 15%. In addition, the GPT showed a NO_2 convertor efficiency of 101.1%. Audit results for each of the analyzers at this site are shown in Tables 3-25 to 3-30.

The shelter was equipped with a TEOM1405-DF $PM_{10}/PM_{2.5}$ analyzer. The measured flow rate through the sampler was slightly high at 17.34 lpm, but still within the 16.7 ± 1.67 lpm specification for adequate impactor cut-points. Photos of this site are shown in Figures 3-9 and 3-10 below.

Table 3-25. Summary of Sulphur Dioxide (SO_2) Audit Results, PED Site

SO_2 Input (ppm-v)	SO_2 Response (ppm-v)	Percent Difference [1]	SO_2 Analyzer Regression Data	
0.000	-0.0040	---	***Slope:***	0.98740
0.052	0.0523	0.8%	***Intercept:***	-0.00079
0.104	0.1031	-1.1%	***Correlation:***	0.99994
0.208	0.2058	-1.2%		
0.313	0.3085	-1.3%		
0.468	0.4600	-1.7%		

[1] **Objective ±15%**

Table 3-26. Summary of Ozone (O_3) Audit Results, PED Site

O_3 Input (ppm-v)	O_3 Response (ppm-v)	Percent Difference[1]	O_3 Analyzer Regression Data	
0.000	0.0020	---	***Slope:***	1.02950
0.101	0.1071	6.0%	***Intercept:***	0.00196
0.201	0.2074	3.2%	***Correlation:***	0.99984
0.297	0.3068	3.3%		
0.395	0.4049	2.5%		

[1] **Objective ±15%**

Table 3-27. Summary of Carbon Monoxide (CO) Audit Results, PED Site

CO Input (ppm-v)	CO Response (ppm-v)	Percent Difference[1]	CO Analyzer Regression Data	
0.0	0.02	---	***Slope:***	1.00391
5.1	5.06	-1.2%	***Intercept:***	-0.01669
10.2	10.19	-0.5%	***Correlation:***	0.99998
20.5	20.60	0.5%		
30.7	30.90	0.5%		
46.1	45.69	-0.9%		

[1] Objective ±15%

Table 3-28. Summary of Nitrogen Oxides (NO_x) Audit Results, PED Site

NO_X / NO Input (ppm-v)	Response		Percent Difference[1]		NO_x Analyzer Regression Data		
	NO_X (ppm-v)	NO (ppm-v)	NO_X	NO	Parameter	NO_X	NO
0.000	0.0042	0.0032	---	---	**Slope:**	.96415	.95867
0.050	0.0500	0.0500	0.0%	0.0%	**Intercept:**	0.00361	0.00337
0.100	0.1001	0.0993	0.4%	-0.4%	**Correlation:**	0.99998	0.99997
0.200	0.1973	0.1968	-1.1%	-1.4%			
0.300	0.2927	0.2903	-2.3%	-3.1%			
0.450	0.4370	0.4342	-2.9%	-3.5%			

[1] Objective ±15%

Table 3-29. Summary of Nitrogen Oxides (NO_x) Audit Results, PED Site

Gas Phase Titration					
Ozone Setting	Response		Corrected		NO Corrected
	NO_X	NO	NO_X	NO	
Off	0.4370	0.4342	0.450	0.449	
0.375	0.4396	0.0924	0.452	0.093	0.093
Off	0.2927	0.2903	0.300	0.299	
0.2	0.2955	0.1099	0.303	0.111	0.111
Off	0.1973	0.1968	0.201	0.202	
0.1	0.1985	0.1086	0.202	0.110	0.110

Table 3-30. Summary of Nitrogen Oxides (NO_x) GPT Results, PED Site

NO_2 Audit Data					
NO_2 Input (ppm-v)	NO_2 Response (ppm-v)	NO_2 Percent Difference	NO_2 Converted (ppm-v)	NO_2 Analyzer Regression Data	
0.000	0.0010			***Slope:***	0.97376
0.092	0.0899	-2.3%	0.093	***Intercept:***	0.00110
0.188	0.1856	-1.3%	0.191	***Correlation:***	0.99998
0.356	0.3472	-2.5%	0.358	***Converter Efficiency***[1]	**101.1%**

[1] **Acceptance Criteria >96%**

Figure 3-9. PED Site Front View

Figure 3-10. PED Site Side View

3.7 Tlalpan (TPN) Site

This station is located at an elementary school in a concrete building located on the second story of the building. The sample inlet was located less than 1 meter above a large block wall. Air flow to the site was blocked almost entirely on one side however, there was still a 270° free air flow around the inlet so the site still meets the siting requirements defined in the ambient monitoring guidelines of USEPA's Prevention of Significant Determination (PSD) permitting guidance. The audit results showed that all of the parameters {SO_2 (-3.2%), O_3 (1.7%), CO (4.3%), NO (0.9%), and NO_x (1.4%)} were well within the audit objective of ± 15%. The GPT showed a NO_2 convertor efficiency of 100.1%. In addition to the gas-phase instruments, the site contained a Thermo Model FH62 Beta gauge $PM_{2.5}$ analyzer. The total measured flow rate through the analyzer was 16.84 lpm, 0.82% higher than the design specification of 16.7 lpm and well within acceptable flow rate limits to maintain the proper impactor cut-point. Audit results for each of the analyzers at this site are shown in Tables 3-31 to 3-36. A photo of the site is shown in Figure 3-11.

Table 3-31. Summary of Sulphur Dioxide (SO_2) Audit Results, TPN Site

SO_2 Input (ppm-v)	SO_2 Response (ppm-v)	Percent Difference [1]	SO_2 Analyzer Regression Data	
0.000	0.0012	---	***Slope:***	0.96422
0.052	0.0501	-3.5%	***Intercept:***	0.00086
0.104	0.1012	-2.9%	***Correlation:***	0.99999
0.208	0.2022	-2.9%		
0.313	0.3028	-3.1%		
0.468	0.4516	-3.5%		

[1] **Objective ±15%**

Table 3-32. Summary of Ozone (O_3) Audit Results, TPN Site

O_3 Input (ppm-v)	O_3 Response (ppm-v)	Percent Difference[1]	O_3 Analyzer Regression Data	
0.000	0.0007	---	***Slope:***	1.03495
0.085	0.0853	0.0%	***Intercept:***	-0.00137
0.202	0.2059	1.9%	***Correlation:***	0.99975
0.296	0.3050	3.0%		
0.396	0.4037	1.9%		

[1] **Objective ±15%**

Table 3-33. Summary of Carbon Monoxide (CO) Audit Results, TPN Site

CO Input (ppm-v)	CO Response (ppm-v)	Percent Difference[1]	CO Analyzer Regression Data	
0.0	0.10	---	***Slope:***	1.01627
5.1	5.60	9.4%	***Intercept:***	0.26414
10.2	10.80	5.5%	***Correlation:***	0.99985
20.5	21.00	2.4%		
30.7	31.40	2.1%		
46.1	47.00	2.0%		

[1] Objective ±15%

Table 3-34. Summary of Nitrogen Oxides (NO_x) Audit Results, TPN Site

NO_X / NO Input (ppm-v)	Response		Percent Difference[1]		NO_x Analyzer Regression Data		
	NO_X (ppm-v)	NO (ppm-v)	NO_X	NO	Parameter	NO_X	NO
0.000	-0.0001	-0.0001	---	---	***Slope:***	1.01969	1.00655
0.050	0.0506	0.0502	1.6%	0.8%	***Intercept:***	-0.00077	0.00038
0.100	0.1008	0.1002	1.1%	0.5%	***Correlation:***	0.99995	0.99998
0.200	0.2027	0.2036	1.5%	1.9%			
0.300	0.3021	0.3023	0.7%	0.7%			
0.450	0.4602	0.4526	2.3%	0.6%			

[1] Objective ±15%

Table 3-35. Summary of Nitrogen Oxides (NO_x) Audit Results, TPN Site

Gas Phase Titration					
Ozone Setting	Response		Corrected		NO Corrected
	NO_X	NO	NO_X	NO	
Off	0.4602	0.4526	0.452	0.449	---
0.375	0.4533	0.0979	0.445	0.097	0.097
Off	0.3021	0.3023	0.297	0.300	---
0.2	0.3057	0.1140	0.301	0.113	0.113
Off	0.2027	0.2036	0.200	0.202	---
0.1	0.2029	0.1095	0.200	0.108	0.108

Table 3-36. Summary of Nitrogen Oxides (NO_x) GPT Results, TPN Site

NO_2 Audit Data					
NO_2 Input (ppm-v)	NO_2 Response (ppm-v)	NO_2 Percent Difference	NO_2 Converted (ppm-v)	NO_2 Analyzer Regression Data	
0.000	0.0010	---	---	***Slope:***	1.00998
0.094	0.0934	-0.6%	0.094	***Intercept:***	0.00055
0.187	0.1917	2.5%	0.191	***Correlation:***	0.99993
0.352	0.3554	1.0%	0.345	***Converter Efficiency***[1]	**100.1%**

[1] **Acceptance Criteria >96%**

Figure 3-11. TPN Site Front View

3.8 UAM Xochimilco (UAX) Site

This station is located on the fourth floor roof of the science building at Universidad Autónoma Metropolitana Campus Xochimilco. The system was housed in a concrete building. The audit results showed that all of the parameters {SO_2 (-2.8%), O_3 (2.6%), CO (1.0%), NO (5.9%), and NO_x (5.9%)} were well within the audit objective of ± 15%. In addition, the GPT showed a NO_2 convertor efficiency of 100.5%. Audit results for each of the analyzers at this site are shown in Tables 3-37 to 3-42. Photos of the site are shown in Figures 3-12 and 3-13.

Table 3-37. Summary of Sulphur Dioxide (SO_2) Audit Results, UAX Site

SO_2 Input (ppm-v)	SO_2 Response (ppm-v)	Percent Difference [1]	SO_2 Analyzer Regression Data	
0.000	0.0002	---	***Slope:***	0.97871
0.052	0.0494	-4.8%	***Intercept:***	-0.00034
0.104	0.1009	-3.2%	***Correlation:***	0.99998
0.208	0.2050	-1.6%		
0.313	0.3060	-2.1%		
0.468	0.4570	-2.4%		

[1] **Objective ±15%**

Table 3-38. Summary of Ozone (O_3) Audit Results, UAX Site

O_3 Input (ppm-v)	O_3 Response (ppm-v)	Percent Difference[1]	O_3 Analyzer Regression Data	
0.000	0.0002	---	***Slope:***	1.03048
0.082	0.0847	3.3%	***Intercept:***	-0.00007
0.200	0.2059	2.9%	***Correlation:***	0.99975
0.298	0.3050	2.3%		
0.395	0.4020	1.8%		

[1] **Objective ±15%**

Table 3-39. Summary of Carbon Monoxide (CO) Audit Results, UAX Site

CO Input (ppm-v)	CO Response (ppm-v)	Percent Difference[1]	CO Analyzer Regression Data	
0.0	-0.018	---	***Slope:***	1.02167
5.1	5.05	-1.4%	***Intercept:***	-0.12878
10.2	10.19	-0.5%	***Correlation:***	0.99991
20.5	20.90	2.0%		
30.7	31.70	3.1%		
46.1	46.90	1.7%		

[1] Objective ±15%

Table 3-40. Summary of Nitrogen Oxides (NO_x) Audit Results, UAX Site

NO_X / NO Input (ppm-v)	Response		Percent Difference[1]		NO_x Analyzer Regression Data		
	NO_X (ppm-v)	NO (ppm-v)	NO_X	NO	Parameter	NO_X	NO
0.000	-0.0001	0.0005	---	---	***Slope:***	1.05140	1.05260
0.050	0.0528	0.0530	6.2%	6.6%	***Intercept:***	0.00079	0.00079
0.100	0.1064	0.1059	6.8%	6.3%	***Correlation:***	0.99999	1.00000
0.200	0.2110	0.2110	5.7%	5.7%			
0.300	0.3170	0.3170	5.7%	5.7%			
0.450	0.4730	0.4740	5.1%	5.3%			

[1] Objective ±15%

Table 3-41. Summary of Nitrogen Oxides (NO_x) Audit Results, UAX Site

Gas Phase Titration					
Ozone Setting	Response		Corrected		NO Corrected
	NO_X	NO	NO_X	NO	
Off	0.4730	0.4740	0.449	0.450	---
0.35	0.4740	0.0930	0.450	0.088	0.088
Off	0.3170	0.3170	0.301	0.300	---
0.2	0.3170	0.1110	0.301	0.105	0.105
Off	0.2110	0.2110	0.200	0.200	---
0.08	0.2120	0.1130	0.201	0.107	0.107

Table 3-42. Summary of Nitrogen Oxides (NO_x) GPT Results, UAX Site

NO_2 Audit Data					
NO_2 Input (ppm-v)	NO_2 Response (ppm-v)	NO_2 Percent Difference	NO_2 Converted (ppm-v)	NO_2 Analyzer Regression Data	
0.000	0.0010	---	---	***Slope:***	1.04950
0.093	0.0990	6.5%	0.094	***Intercept:***	0.00121
0.195	0.2060	5.6%	0.195	***Correlation:***	1.00000
0.362	0.3810	5.2%	0.363	***Converter Efficiency***[1]	**100.5%**

[1] **Acceptance Criteria >96%**

Figure 3-12. UAX Site Side View

Figure 3-13. UAX Site Front View

3.9 UAM Iztapalapa (UIZ) Site

This station is located on the top of the third floor building at Universidad Autónoma Metropolitana Campus Iztapalapa and housed in an Ekto Shelter. The audit results showed that all of the parameters {SO_2 (-2.7%), O_3 (4.6%), CO (2.2%), NO (-2.3%), and NO_x (-0.8%)} were well within the audit objective of ± 15%. The GPT showed a NO_2 convertor efficiency of 102.1%. In addition to the gas-phase instruments, the site contained a Thermo FDMS $PM_{10}/PM_{2.5}$ analyzer. The total measured flow rate through the analyzer was 17.47 lpm, 4.6% higher than the design specification of 16.7 lpm and well within acceptable flow rate limits to maintain the proper impactor cut-point. Audit results for each of the analyzers at this site are shown in Tables 3-43 to 3-48. Photos of the site are shown in Figures 3-14 and 3-15.

Table 3-43. Summary of Sulphur Dioxide (SO_2) Audit Results, UIZ Site

SO_2 Input (ppm-v)	SO_2 Response (ppm-v)	Percent Difference [1]	SO_2 Analyzer Regression Data	
0.000	0.0012	---	***Slope:***	0.97407
0.052	0.0501	-3.5%	***Intercept:***	-0.00033
0.104	0.1014	-2.7%	***Correlation:***	0.99999
0.208	0.2033	-2.4%		
0.313	0.3051	-2.4%		
0.468	0.4561	-2.5%		

[1] **Objective ±15%**

Table 3-44. Summary of Ozone (O_3) Audit Results, UIZ Site

O_3 Input (ppm-v)	O_3 Response (ppm-v)	Percent Difference[1]	O_3 Analyzer Regression Data	
0.000	0.0011	---	***Slope:***	1.03327
0.081	0.0872	7.7%	***Intercept:***	0.00198
0.200	0.2082	4.1%	***Correlation:***	0.99992
0.298	0.3092	3.8%		
0.396	0.4082	3.1%		

[1] **Objective ±15%**

Table 3-45. Summary of Carbon Monoxide (CO) Audit Results, UIZ Site

CO Input (ppm-v)	CO Response (ppm-v)	Percent Difference[1]	CO Analyzer Regression Data	
0.0	0.10	---	***Slope:***	0.99620
5.1	5.50	7.4%	***Intercept:***	0.24404
10.2	10.50	2.5%	***Correlation:***	0.99989
20.5	20.60	0.5%		
30.7	30.80	0.2%		
46.1	46.30	0.4%		

[1] **Objective ±15%**

Table 3-46. Summary of Nitrogen Oxides (NO_x) Audit Results, UIZ Site

NO_X / NO Input (ppm-v)	Response		Percent Difference[1]		NO_x Analyzer Regression Data		
	NO_X (ppm-v)	NO (ppm-v)	NO_X	NO	Parameter	NO_X	NO
0.000	0.002	0.001	---	---	***Slope:***	0.95785	0.96094
0.050	0.052	0.049	3.5%	-2.2%	***Intercept:***	0.00396	0.00196
0.100	0.100	0.100	-0.3%	0.3%	***Correlation:***	0.99991	0.99996
0.200	0.198	0.194	-1.2%	-3.2%			
0.300	0.294	0.292	-1.9%	-2.8%			
0.450	0.432	0.434	-4.0%	-3.7%			

[1] Objective ±15%

Table 3-47. Summary of Nitrogen Oxides (NO_x) Audit Results, UIZ Site

Gas Phase Titration					
Ozone Setting	Response		Corrected		NO Corrected
	NO_X	NO	NO_X	NO	
Off	0.4324	0.4335	0.447	0.449	---
0.375	0.4353	0.0921	0.450	0.094	0.094
Off	0.2940	0.2915	0.303	0.301	---
0.2	0.3002	0.1088	0.309	0.111	0.111
Off	0.1975	0.1935	0.202	0.199	---
0.1	0.1996	0.1086	0.204	0.111	0.111

Table 3-48. Summary of Nitrogen Oxides (NO_x) GPT Results, UIZ Site

NO_2 Audit Data					
NO_2 Input (ppm-v)	NO_2 Response (ppm-v)	NO_2 Percent Difference	NO_2 Converted (ppm-v)	NO_2 Analyzer Regression Data	
0.000	0.0010			***Slope:***	0.96203
0.088	0.0910	3.4%	0.090	***Intercept:***	0.00441
0.190	0.1914	0.7%	0.196	***Correlation:***	0.99969
0.355	0.3432	-3.3%	0.358	***Converter Efficiency***[1]	**102.1%**

[1] **Acceptance Criteria >96%**

Figure 3-14. UIZ Site Front View

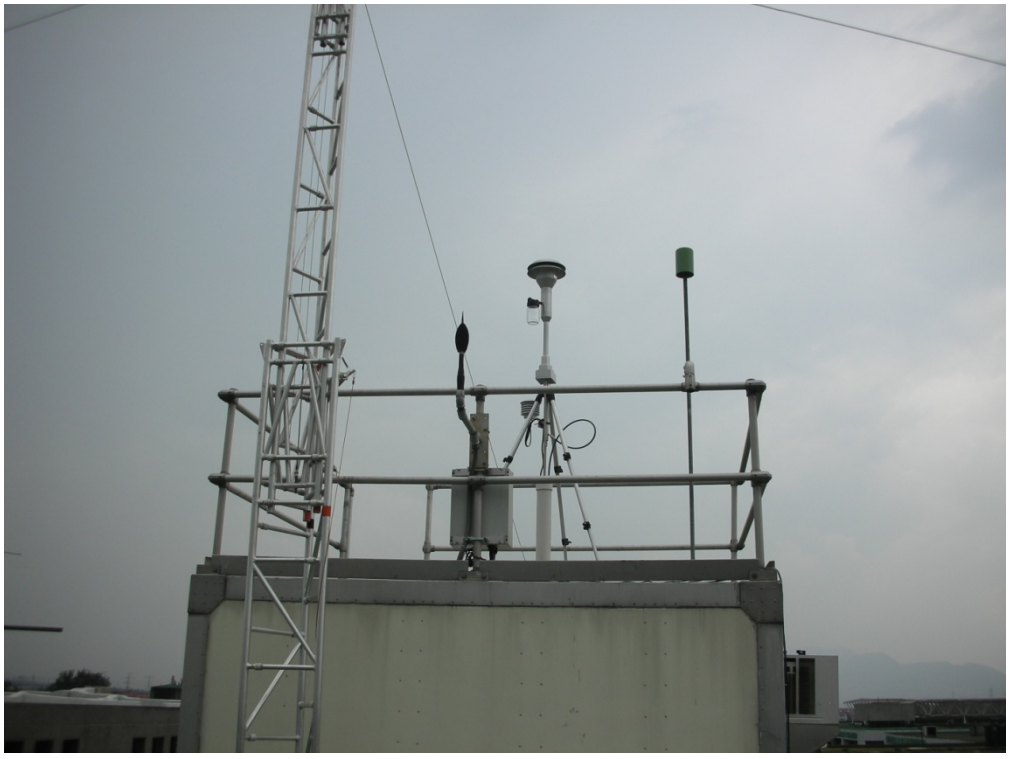

Figure 3-15. UIZ Site Side and Roof View

3.10 Tlalnepantla (TLA) Site

This site was located in a shed about 2 meters above ground level adjacent to a municipal water storage tank. This was an older site but still appeared well maintained and relatively clean. The audit results showed that all of the parameters {SO_2 (-3.6%), O_3 (0.5%), CO (2.1%), NO (3.2%), and NO_x (3.5%)} were well within the audit objective of ± 15%. In addition, the GPT showed a NO_2 convertor efficiency of 99.5%. This site had previously held a PM_{10} analyzer, but at the time of the audit, the particulate analyzer had been removed. Audit results for each of the analyzers at this site are shown in Tables 3-49 to 3-54. Photos of the site are shown in Figures 3-16 and 3-17.

Table 3-49. Summary of Sulphur Dioxide (SO_2) Audit Results, TLA Site

SO_2 Input (ppm-v)	SO_2 Response (ppm-v)	Percent Difference [1]	SO_2 Analyzer Regression Data	
0.000	-0.0010	---	***Slope:***	0.98200
0.052	0.0488	-6.0%	***Intercept:***	-0.00215
0.104	0.1005	-3.6%	***Correlation:***	0.99997
0.208	0.2004	-3.8%		
0.313	0.3039	-2.8%		
0.468	0.4588	-2.0%		

[1] **Objective ±15%**

Table 3-50. Summary of Ozone (O_3) Audit Results, TLA Site

O_3 Input (ppm-v)	O_3 Response (ppm-v)	Percent Difference[1]	O_3 Analyzer Regression Data	
0.000	0.0005	---	***Slope:***	1.01853
0.082	0.0833	1.6%	***Intercept:***	-0.00085
0.200	0.2011	0.5%	***Correlation:***	0.99917
0.299	0.2991	0.0%		
0.395	0.3938	-0.3%		

[1] **Objective ±15%**

Table 3-51. Summary of Carbon Monoxide (CO) Audit Results, TLA Site

CO Input (ppm-v)	CO Response (ppm-v)	Percent Difference[1]	CO Analyzer Regression Data	
0.0	0.10	---	***Slope:***	1.01516
5.1	5.30	3.5%	***Intercept:***	0.12409
10.2	10.60	3.5%	***Correlation:***	0.99998
20.5	20.90	2.0%		
30.7	31.30	1.8%		
46.1	45.90	-0.4%		

[1] Objective ±15%

Table 3-52. Summary of Nitrogen Oxides (NO_x) Audit Results, TLA Site

NO_X / NO Input (ppm-v)	Response		Percent Difference[1]		NO_x Analyzer Regression Data		
	NO_X (ppm-v)	NO (ppm-v)	NO_X	NO	Parameter	NO_X	NO
0.000	0.0021	0.0013	---	---	***Slope:***	1.03289	1.02692
0.050	0.0536	0.0527	7.7%	5.9%	***Intercept:***	0.00018	0.00017
0.100	0.1015	0.1024	1.8%	2.7%	***Correlation:***		0.99985
0.200	0.2006	0.2012	0.4%	0.7%			
0.300	0.3127	0.3117	4.3%	4.0%			
0.450	0.4661	0.4618	3.5%	2.6%			

[1] Objective ±15%

Table 3-53. Summary of Nitrogen Oxides (NO_x) Audit Results, TLA Site

Gas Phase Titration					
Ozone Setting	Response		Corrected		NO Corrected
	NO_X	NO	NO_X	NO	
Off	0.4661	0.4618	0.451	0.450	
0.375	0.4583	0.0947	0.444	0.092	0.092
Off	0.3127	0.3117	0.303	0.303	
0.2	0.3074	0.1121	0.297	0.109	0.109
Off	0.2006	0.2012	0.194	0.196	
0.1	0.2039	0.1107	0.197	0.108	0.108

Table 3-54. Summary of Nitrogen Oxides (NO_x) GPT Results, TLA Site

NO_2 Audit Data					
NO_2 Input (ppm-v)	NO_2 Response (ppm-v)	NO_2 Percent Difference	NO_2 Converted (ppm-v)	NO_2 Analyzer Regression Data	
0.000	0.0010			***Slope:***	1.00870
0.088	0.0932	5.9%	0.091	***Intercept:***	0.00188
0.194	0.1953	0.7%	0.188	***Correlation:***	0.99991
0.358	0.3636	1.6%	0.351	***Converter Efficiency***[1]	**99.5%**

[1] **Acceptance Criteria >96%**

Figure 3-16. TLA Site Front View

Figure 3-17. TLA Site Side View

3-11 SIMAT Air Monitoring Laboratory (LAB) Site

The air monitoring laboratory maintains a series of analyzers used as reference instruments and are not used to monitor air quality. The audit results showed that all of the parameters {SO2 (-3.3%), O_3 (2.1%), CO (0.8%), NO (-0.3%), and NOx (0.7%)} were well within the audit objective of ± 15%. In addition, the GPT showed a NO_2 convertor efficiency of 99.8%. Audit results for each of the analyzers at this site are shown in Tables 3-55 to 3-60. Photos of the instrument laboratory are shown in Figures 3-18 and 3-19.

Table 3-55. Summary of Sulphur Dioxide (SO_2) Audit Results, LAB Site

SO_2 Input (ppm-v)	SO_2 Response (ppm-v)	Percent Difference [1]	SO_2 Analyzer Regression Data	
0.000	-0.0001	---	***Slope:***	0.97263
0.052	0.0496	-4.4%	***Intercept:***	-0.00049
0.104	0.1005	-3.6%	***Correlation:***	1.00000
0.208	0.2023	-2.9%		
0.313	0.3038	-2.8%		
0.468	0.4545	-2.9%		

[1] **Objective ±15%**

Table 3-56. Summary of Ozone (O_3) Audit Results, LAB Site

O_3 Input (ppm-v)	O_3 Response (ppm-v)	Percent Difference[1]	O_3 Analyzer Regression Data	
0.000	-0.0010	---	***Slope:***	1.0332
0.082	0.0839	2.3%	***Intercept:***	-0.00136
0.199	0.2040	2.5%	***Correlation:***	0.99974
0.298	0.3036	1.9%		
0.394	0.4023	1.8%		

[1] **Objective ±15%**

Table 3-57. Summary of Carbon Monoxide (CO) Audit Results, LAB Site

CO Input (ppm-v)	CO Response (ppm-v)	Percent Difference[1]	CO Analyzer Regression Data	
0.0	0.00	---	***Slope:***	0.99230
5.1	5.30	3.5%	***Intercept:***	0.10401
10.3	10.30	0.6%	***Correlation:***	0.99994
20.4	20.40	-0.5%		
30.6	30.60	-0.5%		
46.4	46.40	0.7%		

[1] Objective ±15%

Table 3-58. Summary of Nitrogen Oxides (NO_x) Audit Results, LAB Site

NO_X / NO Input (ppm-v)	Response		Percent Difference[1]		NO_x Analyzer Regression Data		
	NO_X (ppm-v)	NO (ppm-v)	NO_X	NO	Parameter	NO_X	NO
0.000	-0.0008	-0.0010	---	---	***Slope:***	1.0438	1.03396
0.050	0.0479	0.0478	-3.7%	-3.9%	***Intercept:***	-0.00371	-0.00403
0.100	0.0991	0.0979	-0.7%	-1.9%	***Correlation:***	0.99992	0.99989
0.200	0.2028	0.1989	1.5%	-0.4%			
0.300	0.3062	0.3045	2.2%	1.6%			
0.450	0.4681	0.4640	4.0%	3.1%			

[1] Objective ±15%

Table 3-59. Summary of Nitrogen Oxides (NO_x) Audit Results, LAB Site

Gas Phase Titration					
Ozone Setting	Response		Corrected		NO Corrected
	NO_X	NO	NO_X	NO	
Off	0.4681	0.4640	0.453	0.453	
0.35	0.4599	0.1064	0.445	0.107	0.107
Off	0.3062	0.3045	0.297	0.298	
0.2	0.3090	0.1061	0.300	0.107	0.107
Off	0.2028	0.1989	0.198	0.196	
0.1	0.2025	0.1072	0.198	0.108	0.108

Table 3-60. Summary of Nitrogen Oxides (NO_x) GPT Results, LAB Site

NO_2 Audit Data					
NO_2 Input (ppm-v)	NO_2 Response (ppm-v)	NO_2 Percent Difference	NO_2 Converted (ppm-v)	NO_2 Analyzer Regression Data	
0.000	0.0010			***Slope:***	1.01783
0.088	0.0953	8.3%	0.088	***Intercept:***	0.00414
0.191	0.2029	6.2%	0.194	***Correlation:***	0.99971
0.346	0.3535	2.2%	0.338	***Converter Efficiency***[1]	**99.8**

[1] **Acceptance Criteria >96%**

Figure 3-18. SIMAT Laboratory Reference Analyzers

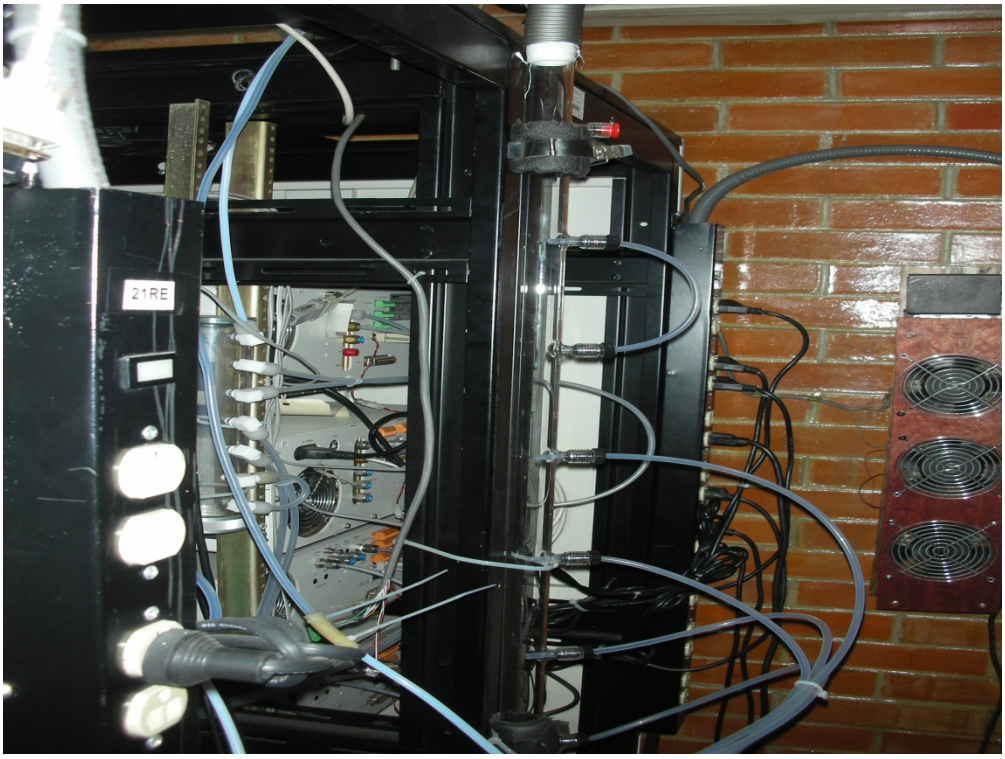

Figure 3-19. SIMAT Laboratory Reference Analyzers Rear View

4.0 RESPONSE REQUIREMENTS

This section summarizes the primary and secondary concerns and observations from the audit. Table 4-1 presents a summary of the audit observations and concerns. Primary concerns are those that may affect the ability of the measurement system to produce data within the data quality objectives (DQOs) of the program while secondary concerns are minor issues that likely do not have any impact on the DQOs.

Primary concerns or observations identified in this audit report require a written response by the appropriate personnel assigned to each portion of the monitoring program. The purpose of a written response is to insure that all project team members are aware of the area of concern and that a corrective action plan is in place to prevent reoccurrence. Once the written response is received, the auditor can review the action or actions and close the audit. Based on the results of the 2012 audit there were no primary concerns so no additional follow-up is required.

During the 2009 audit there were three primary concerns identified. These three issues are shown in Table 4-2 and all focused on SO_2 analyzers and either out of project objective accuracy issues or very slow response times. While the 2012 audit did not revisit the IZT and SUR sites, the MER site was re-audited, with the SO_2 analyzer well within specification for both analyzer accuracy and response time.

Table 4-1. Summary of Audit Observations and Concerns

Site	Description of Concern or Observation	Recommendation
Primary Concerns		
Secondary Concerns		
All Sites	Occasionally site departure times were not recorded in the station logbook	Record both arrival and departure time in the station logbook

Table 4-2. Summary of Primary Audit Concerns from 2009 Audit

Site	Description of Concern or Observation	Recommendation
Primary Concerns		
MER	One SO_2 audit response was outside the audit objective of ±15% and analyzer was slow to respond	Perform maintenance on analyzer and determine reason for slow (and low) response
IZT	Three SO_2 audit responses were outside the audit objective of ±15% and analyzer was slow to respond	Perform maintenance on analyzers and determine reason for slow (and low) response

SUR	Two SO_2 audit responses were outside the audit objective of ±15% and analyzer was slow to respond	Perform maintenance on analyzers and determine reason for slow (and low) response