UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

October 25, 1999

Dear Air Workgroup Participant:

I am pleased to present "The Technical Basis for Appendices to Annex IV of the La Paz Agreement." The EPA published this report through the U.S.-Mexico Information Center on Air Pollution (CICA), a clearinghouse that provides the public with information on air quality in the U.S.-Mexico border area. While EPA has published this report, it is not intended to be an EPA document. Instead, it is intended to be an independent assessment of Annex IV for consideration by the Air Workgroup and its participants.

The document outlines current activity under and issues salient to Annex IV to the Agreement Between the United States and Mexico for Cooperation on the Environment, called the La Paz Agreement. Annex IV deals specifically with air emissions of sulfur dioxide from primary and secondary smelters in the U.S.-Mexico border region. The EPA commissioned the report and financed an independent contractor to research and write a document evaluating how well affected sources comply with the provisions of Annex IV. The contractor concluded that, with a certain amount of effort, they could verify the level of compliance of affected sources with the Annex. The contractor's report suggests policy, administrative, and data gathering activities that could enhance the effectiveness of the Annex.

The EPA, the Government of Mexico, and members of the private sector reviewed and provided comments on the draft document. Rather than attempt to redraft the report, we chose to include the comments in the publication, preserving the integrity of both the report and the comments. Also enclosed with this letter is the resolution made by the Co-Chair's regarding this report after some public input at the May, 1999 Air Workgroup meeting in Ensenada, Baja California.

The document is available in English and Spanish, and can be downloaded at the EPA CICA web site (http://www.epa.gov/ttn/catc/cica). Hard copies are also available through CICA (919-541-1800) and the EPA border offices in El Paso (915-533-7273) and San Diego (619-235-4765). On behalf of EPA, I thank those who participated in the creation of the document. I look forward to using the report as the U.S. and Mexico find opportunities to address the issues presented in the report.

Sincerely,

David P. Howekamp, Co-Chair
Border XXI Air Work Group

Enclosure

COMMENTS ON

"TECHNICAL BASIS FOR APPENDICES TO ANNEX IV OF THE LA PAZ AGREEMENT"

Annex IV Analysis Resolution and EPA Comments

After discussion at the Air Workgroup meeting held during the National Coordinators Meeting in Ensenada on May 13, 1999, attendees agreed to the process outlined below as the process to follow as a result of the Annex IV Analysis and recommendations made by Power's Engineering and the Border Ecology Project through EPA contract funding. EPA, the Air Workgroup, and attendees agreed at that time that these comments, INE's comments, and Mexicana de Cobre's comments would be included as a package to anyone interested in this project. These comments will be made available through the CICA Web site. A hard copy of all these documents will be held at EPA Region 9, Region 6, the El Paso Border Office, the San Diego Border Office, and CICA so as to make their availability easily accessible.

EPA's Comments and Next Steps as agreed at the Ensenada Air Workgroup Meeting:

EPA has reviewed the document prepared by Powers Engineering with the assistance of Dick Kamp of the Border Ecology Project for the Air Workgroup. We have several comments to the document.

First, we would like to acknowledge that the document appears to state that Annex IV has been working well for its intended purpose. For this reason, we feel that we should analyze the recommendations further before moving on to amend or modify Annex IV. At the same time, we would like to consider the recommendations proposed in the document in more detail. While overarching comments and technical comments are included in this document, the focus will be on the process for the next steps that the Air Workgroup will take to continue the work on this project as agreed to by all attendees at the Air Workgroup meeting in Ensenada.

L. We agree with INE and PROFEPA that the document is not well balanced when discussing and describing U.S. and Mexican smelters. The text which would better balance the discussion of U.S. smelters to the same detail as the Mexican smelters is found under Appendix G of the report. So, we suggest that the reader pay close attention to the description of the U.S. smelters in Appendix G. It is our understanding that the contractor was trying to focus on the great progress that the Mexican smelters have made to reduce air pollution emissions so as to reduce the public perception that not much is being done in Mexico. The reader should be aware that process information from the U.S. Smelters such as throughput information, cost of controls, emission reductions due to emissions control devices or practices, can be found in Appendix G.

M. The document is now somewhat out of date with respect to the Mexican smelters. The Cananea smelter has been shutdown, and will therefore no longer be a major source of sulfur dioxide (SO_2) emissions. The reader may read those sections of the report for historical purposes but any references to future air monitoring or emissions controls on the Cananea smelter should be skipped since the smelter has been completely shut down. The reader should be aware, however, that if there are concerns with other media regarding mining and shutdown of smelting operations, then the Cananea smelter may still be of concern, but is not addressed here because that is out of the scope of Annex IV and out of the scope of this report. The Nacozari smelter has had some modifications that will enhance its performance and make it a cleaner facility. The facility has been retrofitted to fire on natural gas, thus reducing emissions from particulates, SO_2, and nitrogen oxides (NO_X) significantly. Future source testing done by the Nacozari smelter will tell us the actual reduction in emissions that has been made as a result. Thus, the sections regarding the Mexican Smelter need to be read with this in mind.

N. The document has a series of technical errors that must be corrected. A list of these errors are attached with the corrections. These technical errors are not so significant that they will confuse the reader. These corrections, however, should be read prior to reading the report.

O. The recommendations are of great value. We appreciate the recommendations that the Contractor has made for us with the help of the Border Ecology project. Thus, during the Air Workgroup meeting in Ensenada the Co-Chairs agreed that rather than dueling on the corrections that need to be made on the contractor's report, the Air Co-Chairs proposed to take the recommendations into consideration in the following manner:

1. Additional SO_2 monitoring for 5 minute averaging times. (1) The Air Workgroup must first take into consideration whether this program has been finalized by EPA or not. It would be premature for the Air Workgroup to put its resources to work on a program that is best handled by the agency already developing this program. So, the Air Workgroup proposes to wait until there is final resolution of this program before moving ahead on how to apply it to Annex IV. (2) In addition, because setting up an air monitoring network around the smelters is no longer legally required in the U.S. since 1972, we first have to consider the cost of setting up an air monitoring network around facilities, and then make a determination of who would pay for such a network. We understand that some networks already exist for the smelters, but those have been set up to monitor for the 24hr standard, not for 5 minute peaks. Thus, additional monitors would be required to be set up rather than just using the existing one. We must also consider who will incur the cost of such a network since it is not legally required of U.S. smelters at this time.

2. Expansion of other sources into Annex IV. The Air Workgroup appreciates the concern regarding the addition of other sources into Annex IV. However, rather than beginning to draft changes to Annex IV, we propose to analyze the benefits of adding another Annex to the La Paz Agreement for other sources. To do this, the Air Workgroup must first obtain an inventory of major sources of SO_2 within the border region, and determine the feasibility of including them in an Annex. The Air Workgroup proposes that EPA and SEMARNAP (INE and PROFEPA) create a list of sources that would fall within the realm of the recommendation,

and prepare a preliminary assessment of the possible sources and the emissions reductions benefits that would result from such an agreement.

However, before committing resources to this issue, the Air Workgroup must consider its priorities for the work that is underway in urban air sheds. SEMARNAP is currently undergoing many resource cutbacks and has asked EPA to consider completing the Mexicali and Tijuana emissions inventories and air quality plans before embarking on this project. Thus, once those projects are complete, the Co-Chairs will then analyze the preliminary assessment and determine the next course of action. The Air Workgroup agreed to set up a small task force which would include EPA Region 6 and Region 9 representatives, a SEMARNAP representative, a representative from the Border Ecology Project, a representative from Grupo Mexico, representatives from U.S. Copper smelters in the border region, and any state representatives and other members from the public that may be strongly interested in this project. Initial work will focus on planning.

3. Finally, additional recommendations have been made in the document. These include analysis and monitoring of hazardous air pollutants emitted by the smelters as well as formation of a binational audit team. The Co-Chairs recommend that a subgroup be formed to analyze and prioritize the recommendations and assess their feasibility. We recommend that for the U.S. (Matthew Witosky and Gerardo Rios) take the lead on this project, and for Mexico (SEMARNAP/PROFEPA Delegation representatives) take the lead. In addition, we ask anyone present to let us know if they would be interested in working with this subgroup. Our hope is that the small task force can systematically look at each of the recommendations and determine the best, most efficient and cost effective manner in which to implement these projects without infringing on Air Workgroup development of Air Quality Plans for the sister cities along the border.

Technical Corrections

1. P. 13, paragraph 2. Cu_2S should be Cu_2O.

2. P. 16, top paragraph. English version. The sentence that starts with "Specifically..." contains two "include." The first one should be deleted.

3. P. 16, regarding the information that should be included. The reader should be aware that the control equipment bypasses are serious violations that must be reported in the U.S. by U.S. copper smelters. The same is probably true of smelters located in Mexico.

4. P. 34. SCS is the acronym for supplementary control system in the U.S. Simply put, these were essentially a network of air monitoring stations and meteorological stations that were used to predict when the smelters might cause exceedances of the National Ambient Air Quality Standards (NAAQS). If there was a potential for an exceedance, then the smelter would curtail its operations. Another type of SCS were the construction of tall stacks. It was expected that if a stack were built high enough, then by the time the pollution reached ground level, the concentrations would not be significant. However, these practices have lead to many problems and were, therefore, made explicitly illegal under Section 123(a) of the Clean Air Act.

5. P. 40. Last sentence of the middle paragraph. It is unlikely that fugitive emissions from copper smelting operations are ever negligible because a significant amount of emissions are fugitive emissions. In fact, after installation of standard control system, fugitive emissions, usually will make up the larger portion of the total emissions from the facility.

6. P. 44. Middle paragraph. It should be noted that ASARCO claims that the contractor they had used to assist them with the applicability determination had made calculation errors. For further information on this topic, you may contact Mark Sims, at EPA Region 9.

7. P. 55. Middle paragraph. The significance level for lead is 0.6 ppm and NOT 0.06 ppm as stated in the text.

8. P. 69. Middle paragraph. This paragraph mentions Cyprus Miami Cerita as a copper roaster and molybdenum smelter facility. The facility is actually Cyprus Sierrita and it is ONLY a molybdenum roasting facility. It should be noted that this facility is currently still subject to state and federal enforcement actions.

9. The last sentence of this paragraph also states that the two facilities need not be considered if Annex IV is expanded. To be consistent, EPA feels that facilities such as Cyprus Sierrita should be considered when determining if and/or which facilities should be subject to Annex IV, and the task force should made a determination as to whether they should require that a roasting operation meet a 650 ppm SO_2 limit on a continuous basis.

COMMENTS BY THE GENERAL DIRECTOR OF ENVIRONMENTAL MANAGEMENT AND INFORMATION (*DIRECTOR GENERAL DE GESTIÓN E INFORMACIÓN AMBIENTAL, DGGIA*) OF THE NATIONAL INSTITUTE OF ECOLOGY (*INSTITUTO NACIONAL DE ECOLOGÍA, INE*) ON THE DOCUMENT ATECHNICAL BASIS FOR APPENDICES TO ANNEX IV OF THE LA PAZ AGREEMENT"

- The document was reviewed in its English version (even though it indicated in the Acknowledgments that it was translated into Spanish); therefore, the review in Spanish will have to be made once it is available, with the purpose of verifying that some official Mexican terms appear correctly.

- From Chapter 3 onward the procedures used by the smelters to report emissions and air quality are evaluated. It is to be noted that it is only for Mexican smelters that a detailed analysis is made for each smelter. This is not done for the U.S. smelters. This situation is also encountered in Chapter 7.

- A review of the list of Abbreviations and Acronyms is recommended (for example: IMECA, PIAF. RAMA, SEMARNAP).

- The analysis and review of the manner in which the five smelters that must comply with Annex IV have been reporting appears complete. However, it is considered pertinent that before endorsing the document, it would be very appropriate that the document be reviewed and commented on by the smelters. The representatives of the Mexican smelters have requested that they be given an opportunity to review and comment on the document (we request that you provide us with another copy of the document in order to forward it to the smelter representatives).

- In item 1.2, "Objectives of Annex IV Evaluation," it is mentioned that one of the objectives of the report is the evaluation of whether additional monitoring requirements should be incorporated, regarding information and reporting, that reflect the regulatory updates that have occurred following the signing of the Annex, such as control requirements for Hazardous Air Contaminants and the proposed EPA rules on the level of intervention for 5-minute peaks of SO_2 concentrations above 0.6 ppm. At this point it would serve to ask if it is possible to demand in the U.S. something which is still at the proposal stage. In Mexico something which is not regulated in the Comprehensive Environmental License (*Licencia Ambiental Única, LAU*) or in any Mexican Official Standard (*Norma Oficial Mexicana, NOM*) cannot be required.

- Recommendation 1.5.1, "Demonstration of Compliance with the Monitoring, Record keeping, and Reporting Requirements of Annex IV." In accordance with the compliance report provided by the Office of the Federal Attorney for Environmental Protection (*Procuraduría Federal de Protección Ambiental, PROFEPA*), up to this point in time Mexican smelters have complied in general with the requirements of Annex IV; however due to, as mentioned in the document, the fact that the reports are presented in a variety of forms, it is recommended that uniform guidelines be established for the five smelters so they may prepare their reports in a uniform manner.

- Recommendation 1.5.2, "Ambient Monitoring for SO_2." The recommendation is interpreted as a review of the appropriateness of the sites where the monitoring is currently taking place, both the number of sites as well as the location. It is suggested that a review be made regarding the recommendation to perform modeling exercises of the dispersion of the plumes to identify the sites of greatest impact at ground level (Maximum Ground Level Impact-MGLI); however it will be necessary to establish whether the Mexican smelters have sufficient emission data from the different areas and stacks at their plants and whether they have the necessary weather data to run the models. In any case it would be necessary to do mobile monitoring to verify the results.

- Recommendation 1.5.3, "Ambient Monitoring for Particulate HAPs and PM_{10}." HAPs monitoring is not currently regulated in Mexico. There are no NOMs regulating the concentration of HAPs in ambient air. It is recommended that the Mexican smelters be consulted about their willingness to do HAP and PM_{10} monitoring.

- Recommendation 1.5.4, "Monitoring and Community Notification Procedures for SO_2 Short-Term Peak Excursions." It is suggested that abundant technical information be provided regarding the health effects produced by this contaminant to support the proposal of notification of 5-minute SO_2 peaks over 0.6 ppm. This recommendation seems pertinent and it is suggested that it be put to the consideration of the five smelters, since as was mentioned earlier, it cannot be an obligatory requirement when it is not specified in the *LAU* or in any *NOM*.

- Recommendation 1.5.5, "Establishment of Monitoring, Recordkeeping, and Reporting Requirements for Other Mayor Air Pollutant Sources in the Border Region." We feel that this proposal should be handled separately since Annex IV is specific to copper smelters. The proposal for other major sources would require previous steps such as the identification of companies on both sides of the border, their emissions inventories, their impact on air quality, ambient monitoring of the human settlings that could be affected, etc. We feel it is appropriate that the Annex IV report deal only with copper smelters.

- Regarding draft NOM-091-ECOL-1994 which establishes the maximum permissible limits of air emissions of sulfur dioxide and particulate from copper and zinc smelters, this NOM will not be adopted this year. It will be necessary to wait until revisions and public comments on the draft NOM are incorporated before this draft NOM is finalized.

OFFICE OF THE FEDERAL ATTORNEY OF ENVIRONMENTAL PROTECTION
(PROCURADURIA FEDERAL DE PROTECCIÓN AL AMBIENTE, PROFEPA)
OFFICE OF THE SUBATTORNEY FOR INDUSTRIAL VERIFICATION
(*SUBPROCURADURÍA DE VERIFICACIÓN INDUSTRIAL)*

Document EOO.SVI.-377/98

Tecamachalco, Estado de México, Mexico, September 7, 1998

DR. ADRIÁN FERNÁNDEZ BREMAUNTZ
General Director of Environmental
Management and Information,
National Institute of Ecology
Av. Revolución 1425 Nivel 8
Col. Tiacopac San Ángel
01040 México, D.F.

In reference to your Oficial Document D.O.O.900.374 dated July 1, 1998, in which you attach the study performed by the EPA named ATechnical Basis for Appendices to Annex IV of the La Paz Agreement@, with the number EPA-456/R-97-xxx prepared in September of 1997, I formulate to you the following comments:

1. In the content of the study an abundance of information is provided for Mexican sources and, by contrast, scarcity regarding the U.S. sources since, for example, for the Mexican copper smelters descriptions are given starting from the start of operations, siting, capacities, process and control equipment technologies, production and expansion perspectives among others — information which is not presented for the U.S. smelters.

The study includes other Mexican sources such as cement plants and power generating plants, without making an equivalent reference to corresponding U.S. plants.

2. An analysis of the contamination potential of the Mexican smelters is performed by comparison with the applicable Mexican and U.S. standards (page 72), without referring to the current total emissions given that, in the case of coal-fired power plants, the two Mexican plants emit between 150 and 180 thousand tons per year, while the 22 coal-fired power plants located in Texas and New Mexico alone emit 600 thousand tons per year.

That is, it is recommended that the analysis of the potential contaminant emissions not be made solely from the perspective of the relative rigorousness of the standards, but from the magnitude of the emissions, which in the final account is what matters.

3. Incomplete or scattered information leads to solutions which are frequently partial and inequitable. For example, in the past the U.S. has insisted that the Nacozari smelter install electronic monitors as substitutes for wet chemical monitors then in operation, a substitution that was performed.; nevertheless, based on the information presented in the reference study we see that the six U.S. smelters located near the border operate monitoring networks based fundamentally on wet chemical monitors.

Mexicana de Cananea also operates electronic monitoring equipment.

Based on the information noted above we consider it is advisable not to reformulate Annex 4 until comparable information from smelters in both countries is available, such that the solutions proposed and, therefore, the resultant commitments lead to effective improvement of air quality in the border region.

ATTENTIVELY

"EFFECTIVE SUFFRAGE, NO REELECTION@
THE SUBATTORNEY

ING. ALFREDO FUAD DAVID GIDI

c.c.p. Antonio Azuela de la Cueva. Federal Attorney for Environmental Protection (*PROFEPA*).
Francisco Octavio Sandoval, Engineer. Delegate of the *PROFEPA* in Baja California.
Rogelio Cepeda Sandoval, Engineer. Delegate of the *PROFEPA* in Coahuila.
María del Pilar López Marco, Biologist. Delegada de la *PROFEPA* in Chihuahua.
José Luis Tamaz Garza, Chemist. Delegado of the *PROFEPA* in Nuevo León.
Jorge Ramón Morachis López, Attorney. Delegate of the *PROFEPA* in Sonora.
Abundio González González. Delegate of the *PROFEPA* in Tamaulipas.

GrupoMéxico September 7, 1998

NATIONAL INSTITUE OF ECOLOGY
(INSTITUTO NACIONAL DE ECOLOGÍA, INE)
AV. REVOLUCIÓN #1424
COL. TLACOPAC, SAN ÁNGEL
MÉXICO, D.F.

Attn.: DR. ADRIÁN FERNÁNDEZ BREMAUNTZ
GENERAL DIRECTOR OF ENVIRONMENTAL INFORMATION AND MANAGEMENT
(DIRECTOR GENERAL DE GESTIÓN E INFORMACIÓN AMBIENTAL)

We are aware that the U.S. Environmental Protection Agency (EPA) prepared a study titled "Technical Basis for Appendices to Annex IV of the La Paz Agreement (EPA-456/R-97-XXX of September 1997)" and that this report was sent to *PROFEPA* for review and comment.

It is understood that an official response to this study will be provided at the next meeting of the Air Group of the Border 21 Program *(Programa Frontera XXI)* in the City of Tijuana. I request that you send a copy of this study through official channels so that we can analyze it and give our points of view as the companies Mexicana de Cananea and Mexicana de Cobre of which I am in charge, would be those directly affected by any agreement reached by the representatives of both countries, and also requesting that no agreement be reached until you have our comments on the aforementioned study.

I look forward to your answer, please receive a cordial greeting.

Attentively,

OSCAR GONZÁLEZ ROCHA, ENGINEER
GENERAL DIRECTOR

Office of Air Quality Planning and Standards (OAQPS)
Office of Air and Radiation (OAR)
United States Environmental Protection Agency (EPA)
4/1/99

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<u>Comments on "Technical Basis for Appendices to Annex IV of the La Paz Agreement"</u>

Appendix H contains a page with erroneous data from ASARCO. It is part of the report "Results of a Fugitive Particulate Emissions Study at ASARCO Hayden Smelter" by TRC North American Weather Consultants. Four pages of that report (the first four pages in Appendix H) are provided. The fourth page contains a table with the erroneous data. The table is a list of heavy metal emissions with no heading. This is ASARCO data that has been thrown out because air flow data used to develop this table was miscalculated. As a result, the table significantly overstates heavy metal emissions. EPA did receive a letter from ASARCO dated March 2, 1998 that included a revised summary table that corrects the data (copy attached). EPA has reviewed this matter and has concluded that the data submitted by ASARCO with its March 2, 1998 letter is correct.

In general, the final draft of this report looks good with regard to Sulfur Dioxide (SO_2) and the Intervention Level Program. A few brief comments follow:

<u>Section 1.2, second paragraph</u> - The word "concentra-tions" in the last phrase of the paragraph has a hyphen that appears to be unnecessary.

<u>Section 4.1.1, 2nd paragraph</u> - EPA's Intervention Level program proposal is still active; because of the remand on the final decision on the SO_2 National Ambient Air Quality Standard (NAAQS) in the United States, final action on the program has been delayed. Final action on the proposal will occur no sooner than December 2000. (See 63 FR 24782, May 5, 1998.)

<u>Section 4.1.6, 4th paragraph</u> regarding item (3) raising the stack height - The impact of increasing stack height may not be considered in determining whether State Implementation Plan (SIP) emission limitation requirements are satisfied. In other words, if a source chooses to raise stack height to address short-term peaks, it will not be credited with that higher stack height for the purpose of establishing SIP emissions limits (i.e., the stack height regulations still apply).

ASARCO

Ray Complex

Neil A. Gambell
Environmental Services Manager

March 2, 1998

Mr. Eugene Crumpler
Emissions Standards Division (MD-13)
Office of Air Quality Planning and Standards
U. S. Environmental Protection Agency
Research Triangle Park, NC 27711

Dear Mr. Crumpler:

Enclosed is a report entitled Data Re-evaluation - Fugitive Emission Study, Particulate and Metals Emissions, ASARCO Incorporated, Hayden Smelter, prepared by TRC Environmental Corporation. This new report evaluates the six-month fugitive particulate emission study done by TRC-NAWC in late 1994 and early 1995 and concludes that the fugitive emissions were overstated due primarily to the use of an erroneous sampler flow rate in the emission calculations.

Sincerely,

Neil A. Gambell

NAG:mbp

Enclosure

pc: Nancy Wrona, ADEQ, w/encl.
T. E. Erskine, w/o encl.
J. A. Wilhelm, w/o encl.

M\EPAFUGES.LTR

ASARCO Incorporated, P.O. Box 8, Hayden, Arizona 85235 (520) 356-3284

DATA SUMMARY

DATA RE-EVALUATION
FUGITIVE EMISSION STUDY
PARTICULATE & METALS EMISSIONS
ASARCO INCORPORATED
HAYDEN SMELTER

Prepared for:

ASARCO INCORPORATED
RAY COMPLEX
64 Asarco Avenue
Hayden, Arizona 85235

ASARCO INCORPORATED
3422 South 700 West
Salt Lake City, Utah 84119

Initial Document Prepared by:

TRC NAWC
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Report AQ 95-17
Project No. 16596
Issued : November 1995

Program Re-evaluation Prepared By:

TRC ENVIRONMENTAL CORPORATION
11 Inverness Drive East
Englewood, Colorado 80112

October 12, 1997

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considered insignificant to the overall emission picture. These metals were Beryllium (Be), Cobalt (Co), Chromium (Cr), Manganese (Mn), Nickel (Ni), and Vanadium (V). In the reported metals were selected samples were non-detectable in the lab report, a value of one-half the analytical limit of detection was used, as a detectable quantity, to support metals averaging.

The initial month of September 1994, in the six-month study, represented a series of start up problems, inoperable fans affecting the manifold flow, and lost sample periods. Due to these issues and limited documentation, this month was omitted from the total program database for the statistical averaging and reporting.

One additional note that must be addressed when reviewing the data presented in this report. The reported emission summaries are based upon the data review and calculational summaries of all raw field data. ***The data does not incorporate any modifiers of adjustment factors.*** However, an initial visualization and confirmation study was completed by NAWC using tracer gases entitled *"Evaluation of the Installed Fugitive Emission Monitoring System September, 1994 – Report EM 94-43, November 1994."* In this study, the overall fugitive emission monitoring system collection efficiency was determined to be 76%. Based upon this, the emissions data, provided in this report for particulate and metals, can be increased by a collection efficiency factor of 1.3158 (i.e. a reported emission value of 100 lbs/day can be normalized to 131.58 pounds per day).

Table 1
Fugitive Emission Program Overall Summary
Average Emissions in Pounds per Day
October 1, 1994 through March 1, 1995

Parameter	Furnace Building	Converter Building	Anode Building	Total Emissions
Particulate (PM)	244.48	138.53	350.69	733.61
Silver (Ag)	0.08	0.06	0.60	0.74
Arsenic (As)	3.55	3.40	13.24	20.20
Cadmium (Cd)	0.20	0.14	0.13	0.47
Copper (Cu)	48.01	22.21	111.86	182.08
Iron (Fe)	19.08	5.21	2.37	26.65
Lead (Pb)	6.28	9.26	9.03	24.58
Antimony (Sb)	0.23	0.64	0.30	1.17
Selenium (Se)	0.95	1.10	11.87	13.92
Zinc (Zn)	3.11	8.63	2.89	14.63

The *Data Summary* section of this report provides detailed program results for each month and each source. Complete data summaries and documentation of daily data runs are provided in the *Appendix* of this report.

Technical Basis for Appendices to Annex IV of the La Paz Agreement

Prepared by:

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EPA Order No. 7D-1550-NASA

EPA Project Manager:

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Information Transfer Group
Information Transfer and Program Integration Division
Office of Air Quality Planning and Standards
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Research Triangle Park, NC 27711

Prepared for:

U.S.-Mexico Border Information Center on Air Pollution
Centro Información sobre Contaminación de Aire/CICA
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

EPA REVIEW NOTICE

This report was prepared by Powers Engineering for the U.S.-Mexico Border Information Center on Air Pollution (*Centro de información sobre Contaminación de Aire para EE.UU.-México*, or **CICA**), Office of Air Quality Planning and Standards (OAQPS), U.S. Environmental Protection Agency (EPA), pursuant to Purchase Order Number 7D-1550-NASA. The contractor's final draft of this report was delivered in September 1997 and reviewed by EPA, the Government of Mexico, and other affected groups. This August 1999 version of the report has been updated by EPA to reflect changes in EPA regulations and policy cited in the report that occured after September 1997. This updated contractor's report is being made availbale for public review by EPA. This action does not indicate EPA approval of its content. Also, the contractor's comments do not necessarily reflect the view and policies of EPA, nor does mention of trade names, organization names, or commercial products constitute endorsement or recommendation for use.

ACKNOWLEDGEMENTS

This document was prepared for the EPA's U.S.-Mexico Border Information Center on Air Pollution by Bill Powers, P.E. of Powers Engineering (Escondido, CA) and Dick Kamp of Border Ecology Project (Bisbee, AZ). The authors extend their thanks to Border Ecology Project staffers Caroline Hotaling, for writing much of the text relating to short-term SO_2 impacts, and to Marc Coles Ritchie, for coordinating writing assignments and translation services. Gildardo Acosta prepared the excellent Spanish translation of this document. The authors would also like to thank the Texas Natural Resources Conservation Commission, New Mexico Environmental Department, Arizona Department of Environmental Quality, Mexicana de Cobre, Mexicana de Cananea, ASARCO El Paso, Phelps Dodge Hidalgo, Phelps Dodge Hurley, Cyprus Miami, ASARCO Hayden, BHP San Manuel, SEMARNAP, and EPA for their cooperation and assistance during the course of this project.

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APPENDICES

ABBREVIATIONS AND ACRONYMS

AA	Atomic Absorption Spectrophotometry
ADEQ	Arizona Department of Environmental Quality
ASARCO	American Smelting and Refining Company
BHP	Broken Hill Petroleum
CAA	Clean Air Act
CARB	California Air Resource Board
CEC	Commission for Environmental Cooperation
CEM	Continuous Emissions Monitor
CFE	Comisión Federal de Electricidad
CFR	Code of Federal Regulations (U.S.)
CO	Carbon Monoxide
COM	Continuous Opacity Monitor
DAS	Data Acquisition System
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
ESP	Electrostatic Precipitator
FEV1	Forced Expiratory Volume in one second
HAP	Hazardous Air Pollutant
ILP	Intervention Level Program
IMECA	*Indice Metropolitano de Calidad del Aire* (Mexico City ambient air quality index)
INE	*Instituto Nacional de Ecología* (Mexico's National Ecology Institute within SEMARNAP)
ISCST3	Industrial Source Complex Short Term 3 air dispersion model
MACT	Maximum Achievable Control Technology
MGLI	Maximum Ground Level Impact
mtpd	Metric Ton Per Day
mtpy	Metric Ton Per Year
NAAQS	National Ambient Air Quality Standards
NESHAPs	National Emission Standard for Hazardous Air Pollutants
NMED	New Mexico Environmental Department
NOM	*Norma Oficial Mexicana* (Mexican federal environmental standard)
NOV	Notice of Violation
NO_x	Nitrogen Oxides
NSPS	New Source Performance Standard
NSR	New Source Review

ABBREVIATIONS AND ACRONYMS (continued)

O_3	Ozone
PD	Phelps-Dodge
PIAF	*Plan Integral de Ambiente Fronteriza*
PM_{10}	Particulate less than 10 microns in diameter
PSD	Prevention of Significant Deterioration
PTO	Permit to Operate
QA	Quality Assurance
QA-QC	Quality Assurance - Quality Control
RAMA	*Red Automática de Monitoreo Atmosférico* (ambient air quality monitoring network in Mexico City)
RATA	Relative Accuracy Test Audit
SCS	Supplementary Control System
SEMARNAP	*Secretaría de Medio Ambiente, Recursos Naturales y Pesca* (federal environmental and fisheries department in Mexico)
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
STP	Short Term Peak
TNRCC	Texas Natural Resources Conservation Commission
TSP	Total Suspended Particulate
UV	Ultraviolet

1.0 Executive Summary

1.1 Description of the La Paz Border Environmental Agreement

The La Paz Border Environmental Agreement (Agreement) was signed in August 1983 and provides a unique framework for the United States and Mexico to address pollution problems in the border region. The Agreement established a series of Annexes to address specific pollution problems such as: sulfur dioxide (SO_2) emissions from copper smelters, hazardous materials emergency response, hazardous waste handling and transport, and sewage problems. A series of Working Groups with representatives from both the U.S. and Mexico were also established to ensure compliance with the objectives of the Annexes.

Although the Agreement defines the "border region" as a 100 kilometer-wide zone on either side of the international boundary, a broader definition is provided in at least one annex to the Agreement. Annex III for example, established in January 1987 to address hazardous materials management, recognized that a fundamental principle of the Agreement is protection of the common environments of Mexico and the U.S. from negative transboundary impacts. Annex III defined the areas to be protected from improper management of transboundary hazardous waste shipments as the area between the U.S. border with Canada and the Mexican border with Guatemala. Given these antecedents and the potential long-range impacts of air pollution, the protection of U.S. and Mexican environments from transboundary environmental impacts is recommended as the context in which to view this document. The pending signing by Mexico, U.S., and Canada of the Transboundary Environmental Impact Assessment Protocol through the Commission for Environmental Cooperation reflects a similar cooperative philosophy.

1.2 Objectives of Annex IV Evaluation

This report is a technical evaluation of Annex IV to the Agreement, Copper Smelters. Annex IV was signed in January 1987 and is currently applicable to five copper smelters, three in the U.S. and two in Mexico. Annex IV represents a successful precedent in establishing bi-national emission limits and monitoring procedures for a source category, copper smelters, that has a major impact along the U.S.-Mexico border. SO_2 has been the major air pollutant of regulatory concern.

The fundamental purposes of this evaluation are twofold: (1) to evaluate smelter compliance with the SO_2 monitoring, recordkeeping, and reporting requirements of Annex IV; and (2) to assess if additional monitoring, recordkeeping, and reporting requirements should be incorporated into Annex IV that reflect regulatory developments in the U.S. and Mexico since the signing of Annex IV in 1987. These regulatory developments include possible control requirements for Hazardous Air Pollutants such as lead and arsenic emitted from primary copper smelters, as well as proposed EPA rules for an SO_2 Intervention Level Program for short-term 5-minute SO_2 peak concentrations above 0.6 ppm.

The following specific issues are evaluated in this report:

- What are the major air pollutants associated with copper smelter operations?
- What are the health impacts of these pollutants?
- How are the smelters currently controlling these emissions?
- How are the smelters currently monitoring these emissions?
- How is compliance with Annex IV SO_2 monitoring, recordkeeping, and reporting requirements being determined?
- How could compliance with Annex IV SO_2 monitoring, recordkeeping, and reporting requirements be determined?
- What additional pollutants could be monitored by copper smelters?
- How could these additional pollutants be monitored by copper smelters?

- How could the surrounding community be notified of short term, high level SO_2 concentrations?
- What other source types located in the border region are of sufficient transboundary air pollution significance that they should also be subject to monitoring, recordkeeping, and reporting requirements similar to those in Annex IV for copper smelters?

1.3 Copper Smelter Air Emissions and Associated Health Effects

SO_2 is the major regulated air pollutant emitted by copper smelters in the border region subject to Annex IV. Health effects of concern associated with exposure to elevated concentrations of SO_2 include effects on breathing, respiratory illness, alterations in the lungs' defenses and aggravation of existing respiratory and cardiovascular disease. Asthmatics, individuals with cardiovascular or chronic lung disease, children and the elderly are most sensitive to SO_2. Exercising asthmatics are particularly sensitive to short-term 5-minute peak concentrations of SO_2. Emissions of SO_2 also contribute to secondary fine particle formation. Fine particles are associated with premature mortality, excees hospital admissions, aggravated asthma and other respiratory symptoms. SO_2 also causes adverse environmental effects, such as foliar damage to trees and agricultural crops, visibility impairment and acid deposition.

Particulate hazardous air pollutants (HAPs) and particulate matter less than 10 microns in diameter (PM_{10}) are also emitted from copper smelters. Particulate HAPs include heavy metals such as lead and arsenic. Exposure to lead can occur through multiple pathways, including inhalation and ingestion of lead in food, water, soil or dust. Lead accumulates in the blood, bone and soft tissues of the body and can affect the kidneys, liver, nervous system and blood-forming organs. Acute exposure may cause neurological effects such as seizures, mental retardation and/or behavioral disorders. Fetuses, infants and children are sensitive to lower exposures to lead bringing about central nervous system damage. Health effects associated with high exposures to PM_{10} include premature mortality, effects on breathing, respiratory symptoms, aggravation of existing respiratory and cardiovascular disease potentially leading to excess hospital admissions, alterations to the body's defense mechanisms, lung tissue damage and carcinogenesis. Individuals considered most sensitive to PM_{10} include those with cardiopulmonary disease, asthmatics, elderly and children. PM_{10} also causes visibility impairment, soiling and materials damage.

1.4 Summary of Current Smelter Control and Monitoring Practices

All five smelters subject to Annex IV currently operate SO_2 ambient monitoring networks ranging in size from 2 to 9 monitors. None of these smelters currently records ambient 5-minute SO_2 averages. As a result, there is no record of 5-minute STPs above 0.6 ppm and no community notification system when 5-minute STPs above 0.6 ppm are reached.

The sulfuric acid plant stacks at all three U.S. smelters and one Mexican smelter are equipped with SO_2 continuous emissions monitors (CEMs) to continuously monitor compliance with the Annex IV SO_2 emission limit of 650 ppm SO_2 (6-hour average). The remaining Mexican smelter, Cananea, is uncontrolled and has no SO_2 CEMs. The three U.S. smelters also control concentrate dryer and converter secondary hood emissions with high efficiency particulate control equipment. In most cases, the treated dryer and secondary hood exhaust gases are continuously monitored with a continuous opacity monitor (COM) and/or and SO_2 CEM.

A wide variety of reporting formats are used by the smelters subject to Annex IV, in response to local, state, and federal reporting requirements that have been imposed on these smelters over the years. All five smelters subject to Annex IV prepare either monthly or quarterly SO_2 emissions summary and/or monitoring reports. These reports are submitted to the environmental agency with jurisdiction over the facility. The reports vary from a brief summary of the smelter sulfur balance for the time period covered by the report, to a complete listing of the hourly average SO_2 concentrations at each SO_2 monitoring station during the reporting period, to a summary of the number of exceedances of the applicable SO_2 standard and reasons for any acid plant bypasses that occurred during the reporting period. In some cases state agency personnel or third party contractors perform periodic audits of the smelter CEMs or COMs. In other cases the audits are performed by smelter personnel. CEM/COM calibration records are kept on file at the smelters, and available for state/federal agency review on a request basis. Ambient SO_2 monitor calibration is performed by smelter personnel and this calibration data is not typically reviewed by external parties. In summary, sufficient records are available at most or all of the smelters subject to Annex IV to determine whether the smelters are complying with the SO_2 monitoring, recordkeeping, and reporting requirements of Annex IV, though this information is not necessarily included in routine reports prepared by these smelters.

U.S. smelters subject to Annex IV do periodically test stack emissions for particulate HAP and PM_{10} emissions. No particulate HAP or PM_{10} emissions stack testing has been conducted to date at the two Mexican smelters subject to Annex IV. Neither the U.S. smelters nor the Mexican smelters perform ambient particulate HAP or PM_{10} monitoring.

Uncollected fugitive particulate HAP emissions potentially represent the largest source of particulate HAP emissions from copper smelters, based on EPA findings in support of the Primary Copper Smelter Maximum Achievable Control Technology (MACT) standard. Uncollected fugitive particulate HAP emissions are generally difficult to quantify accurately.

One U.S. smelter subject to Annex IV, ASARCO El Paso, collects all converter building fugitives and directs these gases to a baghouse. This is a tertiary fugitive particulate control system that essentially eliminates the principal source of uncollected fugitive emissions.

1.5 Recommendations

1.5.1 Demonstration of Compliance with the Monitoring, Recordkeeping, and Reporting Requirements of Annex IV

It is recommended that a bi-national audit review team be formed to review pertinent data from each smelter subject to Annex IV to determine if each smelter is complying with the SO_2 monitoring, recordkeeping, and reporting requirements of Annex IV. The audit review team would be composed of two technical experts from the U.S. and two technical experts from Mexico, and supplemented with with additional personnel as dictated by site-specific needs. The audit review team would review, on an annual basis, all necessary records and reports from the affected smelters; review calibration logs and independent audit test results; and issue a summary report to the Air Working Group regarding the compliance status of each facility. The Air Working Group would assure that the data gathered would be publicly available through an appropriate database that is readily accessible in the U.S. and Mexico. In cases where established U.S. or Mexican CEM/COM instrument siting or audit protocols are not being followed, or periodic independent calibration audits are not being performed, that audit review team would recommend that appropriate action be taken in the report presented to the Air Working Group.

If Annex IV monitoring, recordkeeping, and reporting requirements are expanded to include smelter ambient SO_2 monitors, and possibly ambient particulate HAP and PM_{10} monitors (see recommendations below), audit review team responsibilities would include a thorough review of the siting and instrument calibration audit procedures used with these monitors as well.

1.5.2 Ambient Monitoring for SO_2

It is recommended that minimum SO_2 ambient monitor coverage requirements be included in Annex IV, in addition to the inclusion of monitoring, recordkeeping, and reporting requirements for these monitors. Minimum coverage should include an ambient SO_2 monitor at the following "Maximum Ground Level Impact" (MGLI) locations, as determined through appropriate dispersion modeling and model validation monitoring: (1) long-term SO_2 MGLI for tall stack emissions; (2) short-term SO_2 MGLI for tall stack emissions; (3) long-term SO_2 MGLI for uncollected fugitive emissions; and (4) short-term SO_2 MGLI for uncollected fugitive emissions. In addition, one ambient SO_2 monitor should be located at the leading edge of any community (relative to the smelter) within 20 kilometers of the smelter.

EPA's Industrial Source Complex Short Term 3 (ISCST3) air dispersion model, or equivalent, is an appropriate model for determining the location of the short- and long-term MGLIs for stack and fugitive SO_2 emissions (EPA 1995b). Continuous ambient SO_2 monitoring is necessary at the MGLIs due to the current lack of air dispersion models that accurately predict the magnitude of SO_2 short term peaks (EPA 1997). EPA's review of SO_2 levels across the U.S. indicates that the highest short-term values of SO_2 are found in the vicinity (<20 kilometers) of major point sources (EPA 1994). For this reason it is recommended that ambient SO_2 levels in communities within 20 kilometers of smelters subject to Annex IV be continuously monitored.

1.5.3 Ambient Monitoring for Particulate HAPs and PM_{10}

It is also recommended that minimum particulate HAP and PM_{10} ambient monitor coverage requirements be included in Annex IV, in addition to the inclusion of monitoring, recordkeeping, and reporting requirements for these monitors. Appropriate dispersion modeling should be performed to determine PM_{10} monitor locations. The PM_{10} modeling results will serve to locate both the particulate HAP monitors and the PM_{10} monitors. Minimum coverage should include an ambient particulate HAP monitor and a PM_{10} monitor located in parallel at the following MGLI locations: (1) long-term PM_{10} MGLI for tall stack emissions; (2) short-term PM_{10} MGLI for tall stack emissions; (3) long-term PM_{10} MGLI for uncollected fugitive emissions; and (4) short-term PM_{10} MGLI for uncollected fugitive emissions. In addition, one ambient PM_{10} monitor should be located at the leading edge of any community (relative to the smelter) within 20 kilometers of the smelter.

1.5.4 Monitoring and Community Notification Procedures For SO_2 Short-Term Peak Excursions

It is recommended that all SO_2 monitors in the SO_2 ambient monitoring networks operated by the smelters be capable of reporting 5-minute SO_2 averages, and that all monitors operate on a 0-2.0 ppm SO_2 scale to enable effective quantification of SO_2 "short term peaks" (STPs). In locations where STPs exceed 2.0 ppm, the monitor scale should be adjusted accordingly to assure accurate quantification of the STP.

It is also recommended that a program of community meetings be initiated in each smelter community with the objective of identifying appropriate SO_2 STP notification procedures in the case of STP excursions. The notification procedure should be directed at notifying SO_2 sensitive individuals, for example asthmatics, the elderly and children. Following the identification of appropriate community notification procedures for each community, these procedures should be considered for inclusion in the reporting requirements of Annex IV.

1.5.5 Establishment of Monitoring, Recordkeeping, and Reporting Requirements for Other Major Air Pollutant Sources in the Border Region

A number of major sources of air pollutants, and sources of highly toxic air pollutants, should be considered for inclusion in Annex IV. If these sources are not related to a nonferrous metal smelting process, separate Annexes that include specific monitoring, recordkeeping, and reporting requirements should be developed for these sources. These sources include: copper smelter roasters and dryers, power plants, hazardous waste incinerators and cement kilns firing hazardous waste. Other source types that may be potential candidates for inclusion in a separate Annex include refineries, petrochemical facilities, brick-making kilns using waste tires as fuel, and open burning of municipal or industrial waste. Other than nonferrous metal melting facilities, the project team has not performed a detailed inventory of existing or planned industrial facilities in the border region. It is recommended that an inventory of this type be prepared as a first step toward evaluating the possible inclusion of other source types in Annex IV or a separate annex.

1.5.5.1 Other Copper Smelter Sources

Annex IV does not explicitly identify what sources within a copper smelter beyond furnaces and converters are subject to the 0.065 percent SO_2 emission limit. It is recommended that Annex IV explicitly identify roasters as subject to the 0.065 percent SO_2 emission limit, given that the federal legislation in both the U.S. and Mexico subjects roasters to the 0.065 percent SO_2 emission limit. This same logic is applicable to opacity and PM_{10} emission limits for copper smelter dryers, as both NSPS Subpart P and the proposed NOM-091-ECOL-1994 require the same opacity (20 percent) and PM_{10} emission limits (50 mg/m^3) for copper smelter dryers.

1.5.5.2 Power Plants

It is recommended that the Air Working Group consider the addition of a separate Annex to address power plant SO_2, PM_{10}, and nitrogen oxide (NO_x) emissions. An electricity demand growth rate of 500 MW/year is estimated for the Mexican side of border subject to Annex IV (CFE 1997). A 500 MW coal-fired or oil-fired power plant meeting January 1, 1998 Mexican SO_2 standards will potentially emit 48,000 tons/year of SO_2, or 20,000 tons/year more SO_2 than the same plant meeting 1978 U.S. New Source Performance Standard (NSPS) Da, Standards of Performance for Electric Utility Steam Generating Units, for utility boilers. Simple-cycle gas turbine power plants are exempt from NO_x limits in Mexico. As a result of chronic electricity shortages along the border, these plants potentially operate in a baseload capacity mode. A baseloaded 500 MW simple cycle uncontrolled gas turbine power plant will emit 19,000 tons/year of NO_x, approximately 11,000 tons/year more NO_x than the same plant meeting the 1977 U.S. NSPS for gas turbines.

1.5.5.3 Hazardous Waste Incinerators/Cement Kilns Firing Hazardous Waste

It is recommended that the Air Working Group consider developing a separate Annex for hazardous waste incinerators and cement kilns firing hazardous waste. There are approximately 30 cement kilns in the U.S. currently co-firing hazardous waste. None of these kilns are located in the 100 kilometer border region, though two are located in border states. There are approximately 20 cement kilns in Mexico that are authorized to co-fire hazardous waste, though not all of these kilns are co-firing waste at this time. Two of these kilns are located in the 100 kilometer border region, and seven kilns are located in border states. Co-firing hazardous waste in cement kilns is expected to be a growth industry in Mexico due to the financial advantages of essentially "free" fuel. Up to 60 percent (COSYDDHAC 1997) of the total fuel requirement of the kiln can consist of hazardous waste under current Mexican permitting guidelines.
The toxicity of hazardous waste combustion exhaust gases is the reason this source type should be evaluated for inclusion in Annex IV. Dioxins, hexavalent chromium, and a variety of other HAP metals are typically emitted from hazardous waste combustion sources. These pollutants can pose significant health risks at extremely low ambient concentrations.

2.0 Technical Background

2.1 Administrative Justification for Performing Evaluation of Annex IV

Annex IV to the La Paz Border Environmental Agreement (Agreement) was signed on January 15, 1987 and established an effective binational framework for the control and monitoring of SO_2

emissions from copper smelting sources within 100 kilometers of the border. A copy of Annex IV is provided in Appendix A. The justification for performing this evaluation is provided in the following provisions of the Annex IV:

Article II, Section 3: Emissions monitoring, recordkeeping and reporting systems - "The parties shall consult in order to find effective means of cooperation, to ensure the most immediate means for the prompt and full implementation of the provisions in this Article."

Article III: Atmospheric monitoring facilities - "The parties shall continue to consult concerning their existing atmospheric monitoring facilities located in the border area, and will continue to cooperate to enhance effective monitoring."

Article IV, Section 2: Working group of technical experts - "The working group shall meet at least once every six months to review progress in abating smelter pollution in the border area, as contemplated by this Annex and, if necessary, to make findings on additional corrective measures for recommendation to the national coordinators."

Article IX: Review - "The parties shall meet at least every two years from the date of entry into force of this Annex, at a time and place to be mutually agreed upon, in order to review the effectiveness of its implementation and to agree on whatever individual and joint measures are necessary to improve such effectiveness."

Annex IV also includes the following provisions for implementing the recommendations presented in this report, should the National Coordinators choose to do so:

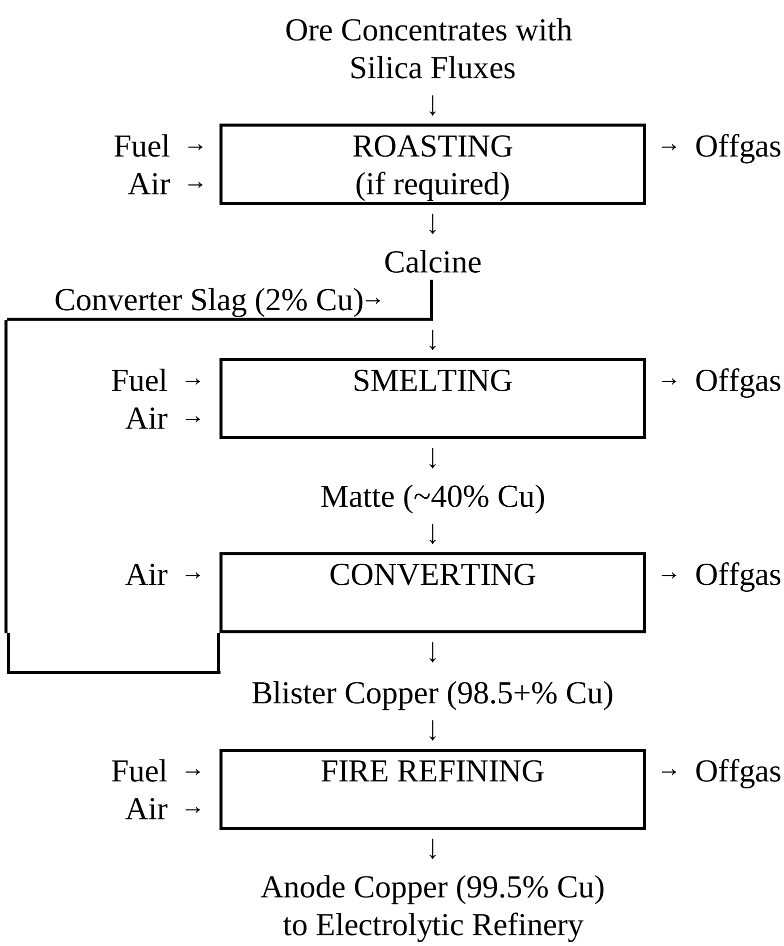
Article V: "The parties will promote legislative authority, as may be necessary, to provide for the abatement of transboundary air pollution caused by copper smelters. The parties shall continue to consult with respect to these matters."

Article VIII: "Any appendices to this Annex may be added through an exchange of diplomatic notes and shall form an integral part of this Annex."

2.2 General Copper Smelting Process Description

A conventional copper smelter process (AWMA 1992) is shown in Figure 1-1. The process includes roasting of ore concentrates to produce calcine, smelting of roasted (calcine feed) or

Figure 1-1. Typical Primary Copper Smelter Process



unroasted (green feed) ore concentrates to produce matte, and converting of the matte to yield blister copper product. Typically, the blister copper is fire-refined in an anode furnace, cast into "anodes," and sent to an electrolytic refinery for further impurity elimination.

In the smelting process, either hot calcines from the roaster or raw unroasted concentrate is melted with siliceous flux in a smelting furnace to produce copper matte, a molten mixture of cuprous sulfide (Cu_2S), ferrous sulfide (FeS), and some heavy metals. The required heat comes from the partial oxidation of the sulfide charge and from the burning of external fuel. Most of the iron and some of the impurities in the charge oxidize with the fluxes to form a slag atop the molten bath; this slag is periodically removed and discarded. Copper matte remains in the furnace until tapped.

The final step in the production of blister copper is converting, with the purposes of eliminating the remaining iron and sulfur present in the matte and leaving molten “blister” copper. An opening in the center of the converter functions as a mouth through which molten matte, siliceous flux, and scrap copper are charged and gaseous products are vented. Air or oxygen-rich air is blown through the molten matte. Iron sulfide is oxidized to iron oxide (FeO) and SO_2, and the FeO flowing and slag skimming are repeated until an adequate amount of relatively pure Cu_2S, called “white metal,” accumulates in the bottom of the converter. The blister copper is subsequently removed and transferred to refining facilities.

Copper smelter emissions can be divided into two categories: (1) stack emissions; and (2) uncollected fugitive emissions. Stack emissions represent process exhaust gases or gases collected in the vicinity of these processes (collected fugitives) that are captured and directed to some form of exhaust stack. Uncollected fugitive emissions represent those emissions that escape into the ambient air through building openings, such as roof vents, bay doors, and open windows. Uncollected fugitive emissions are generally released at or near ground level, and for this reason can have a significant adverse impact on workers and nearby populations even when uncollected fugitive emission rates are small compared to stack emission rates.

2.3 Annex IV Requirements and Current Smelter Practices

The five smelters subject to the requirements of Annex IV include: ASARCO El Paso (El Paso, TX), Phelps-Dodge Hurley (Hurley, NM), Phelps-Dodge Hidalgo (Playas, NM), Cananea (Cananea, Sonora) and Nacozari (Nacozari, Sonora). As a result of the Agreement, all smelters subject to Annex IV are required to: (1) meet the equivalent of New Source Performance Standard (NSPS) Subpart P, Standards of Performance for Primary Copper Smelters, through operation of continuous SO_2 controls and continuous emissions monitoring (Article I); or (2) meet applicable state standards in effect at the time the Agreement was signed, if the smelter was constructed or modified prior to the implementation date (October 16, 1974) of NSPS Subpart P. The exception to these requirements was the Cananea, Sonora copper smelter. Cananea was prohibited from expanding its emissions beyond (unspecified) historical levels up to that time, or if a major expansion was initiated, to install efficient SO_2 controls. The Agreement also required that the Douglas, Arizona copper smelter be closed and that the Nacozari, Sonora smelter install a sulfuric acid plant to achieve the NSPS Subpart P SO_2 emission limit for furnace and converter emissions of 650 ppm averaged over six hours.

Although NSPS Subpart P is applicable to all copper smelters other than an unexpanded Cananea, some confusion has remained (Air Working Group Meeting, Mexico City, February 28, 1997) as to whether the emissions monitoring and reporting provisions described in the Agreement as applicable to the Nacozari copper smelter are precisely applicable to all smelters on both sides of the border in the affected region. Article II could be interpreted in this manner.

Since the signing of the Agreement, all three U.S. smelters in the border region subject to Annex IV, the Phelps-Dodge (PD) smelters in Playas, NM and Hurley, NM, and the ASARCO smelter in El Paso, TX, have expanded production rates. The Nacozari, Sonora smelter, has also expanded production.

The U.S. smelters are subject to a relatively complex mix of federal, state, and local air quality requirements that vary depending on a variety of factors, such as:

- When the smelter was constructed or modified;
- The SO_2 and PM_{10} NAAQS attainment status of the region where the smelter is located;
- Proximity to an urban area.

As a result, the target pollutants and formats used by these smelters to quantify and report emissions differ significantly.

All three U.S. smelters subject to Annex IV are equipped with sulfuric acid plants to control converter SO_2 emissions. The acid plant stacks are equipped with SO_2 continuous emission monitors (CEMs). Concentrate dryer particulate emissions are controlled with high efficiency control devices and monitored in all cases with COMs. Finally, collected fugitives from the converter building are directed to a baghouse in all cases. Exhaust gases are monitored with a COM after the baghouse at ASARCO El Paso and PD Hidalgo smelters. These smelters are also required to submit monthly reports identifying the percentage of certain metals, specifically lead, arsenic, antimony, and zinc, in the concentrate feed. Periodic stack testing is performed to determine HAP metal concentrations in the flue gas. Fugitive HAP metals studies have been conducted.

All three U.S. smelters subject to Annex IV operate SO_2 ambient air quality monitoring networks. These smelters do not operate “total suspended particulate” (TSP) or PM_{10} ambient monitoring networks. By way of comparison, the three smelters located in Arizona, all of which are outside the region covered by Annex IV, do operate PM_{10} ambient monitoring networks. These PM_{10} ambient monitoring networks are operated by the Arizona smelters in fulfillment of an Arizona Department of Environmental Quality (ADEQ) requirement. The principal objective of the PM_{10} ambient monitoring is to determine the PM_{10} attainment status near the smelters. The ambient PM_{10} samples are also analyzed for HAP metals.

Cananea and Nacozari are the two Mexican smelters subject to Annex IV. Cananea is exempt from SO_2 control requirements. No SO_2 or particulate controls are in use at Cananea. As a result of Annex IV, Nacozari was required to install an acid plant to control furnace and converter SO_2 emissions. Nacozari recently installed a second acid plant. SO_2 CEMs are in use on the acid plant stacks. No particulate controls are in use on the concentrate dryer or collected fugitive exhasut gas at Nacozari.

Both Cananea and Nacozari operate SO_2 ambient air quality monitoring networks. No ambient particulate monitoring is performed at either of these smelters.

Critical emissions information is often difficult to interpret consistently for the smelters affected by the Agreement due to the different target pollutants, monitoring methods, and reporting formats used by these facilities. "Critical information" is defined for the purposes of this evaluation as valid and quality-assured data on pollutants emitted by the smelters that could potentially have adverse health effects on nearby populations and/or contribute significantly to transboundary pollutant transport. This critical information includes stack emission rates, annual emission rates, and ambient concentrations of SO_2, HAPs and respirable particulate (PM_{10}) emitted by the smelters subject to Annex IV. Specifically this information include would include:

- Tonnage and ambient concentrations of SO_2, HAP and PM_{10} emissions;
- Frequency of control equipment bypasses - are they carried out only in emergencies?
- When control equipment bypasses occur, are they reported promptly and the problem remediated?
- Calibration, auditing and reporting procedures for stack continuous emission monitors (CEMs);
- Justification for ambient monitor siting, monitor measurement range, and calibration procedures.

The monitoring data currently required by Annex IV is limited to acid plant SO_2 CEMs.

Details on applicable emission limits, CEM monitoring and calibration procedures, ambient monitor siting and calibration procedures, estimated sulfur capture, and investments in air pollution control equipment since 1988 are provided in Appendix B (as shown in the table below) for all eight copper smelters located in the border region or in border states.

Appendix B Table or Summary	Smelter
Table 1.A	ASARCO El Paso (TX)
Table 1.B	Phelps Dodge Hurley (NM)
Table 1.C	Phelps Dodge Hidalgo (NM)
Table 2.A	ASARCO Hayden (AZ)
Table 2.B	BHP San Manuel (AZ)
Table 2.C	Cyprus Miami (AZ)
Summary Mexico 1	Cananea, Sonora
Summary Mexico 2	Nacozari, Sonora

The three Arizona smelters are located outside of the 100 kilometer border region applicable to Annex IV. These three smelters have been included in this evaluation for the following three reasons:

1. To provide working models of emissions monitoring, monitor calibration/audit procedures, and reporting that could potentially improve the evaluation and reporting of border smelter emissions;
2. To evaluate the ability of smelter ambient SO_2 monitoring networks to accurately quantify short term SO_2 peaks;
3. To assess whether these three sources could theoretically impact transboundary air quality per the parameters described in the Commission for Environmental Cooperation 1997 Transboundary Environmental Impact Assessment Procedures.

There is also a need for guidelines to notify smelter communities when sensitive individuals could be exposed to levels of SO_2 that could cause respiratory distress, such as bronchial constriction or aggravate the effects of asthma. These “endangerments” to health have been assessed by the EPA since the 1970s and are discussed in Section 4.1. Such notification procedures would also involve local residents more directly in: (1) understanding the air quality impacts of the smelters;
(2) understanding the regulatory process; and (3) improving the health and welfare of border

residents consistent with the objectives of Annex IV. The proposed new EPA rules to analyze community protection, including community notification procedures during "short-term peak" (STP) SO_2 ambient concentrations, could apply to all smelters, while more detailed and cooperative discussions to take steps to avoid high levels of SO_2 could be analyzed at a later time.

Finally, as discussed during the May 27-28, 1997 National Coordinators Meeting, this evaluation addresses the potential application of the La Paz Agreement to other major nonferrous emission sources in the border region. Concern has been expressed that nonferrous emission sources such as roasters should also be included within Annex IV, because roasters that predate the implementation of NSPS Subpart P are not well regulated within the U.S. No comprehensive analysis has been done of other major nonferrous emission sources in the border states of both countries.

3.0 Evaluation of Current Source and Ambient Monitoring and Reporting Procedures

3.1 SO_2 Stack and Ambient Monitoring/Reporting Procedures

The project team has evaluated SO_2 source and ambient monitoring and reporting procedures currently used at smelters in the border region. Both the U.S. and Mexico have detailed procedures for continuous stack monitoring of SO_2 that are consistent with the SO_2 stack monitoring commitments in Annex IV. All six U.S. smelters in the border region are following NSPS calibration and audit procedures for stack CEMs, even in instances where NSPS is not applicable to the smelter, as shown in the tables included in Appendix B. A formal description of SO_2 CEM monitor quality assurance and control procedures has not been received for the acid plant monitors operated by the Nacozari smelter. There are no permanent stack CEMs in use at the Cananea smelter.

The periodic audit procedure conducted on U.S. smelter CEMs and COMs is known as the Relative Accuracy Test Audit (RATA) procedure. A sample of an annual RATA test report prepared for SO_2 and NO_x CEMs at the BHP San Manuel smelter is provided in Appendix C.

All five smelters subject to Annex IV operate ambient SO_2 monitoring networks. Two distinct types of ambient SO_2 monitors are operated by these smelters: (1) ultraviolet (UV) fluorescence electronic monitors, in all cases manufactured by Thermo Environmental Instruments, Inc., and known as TECO 43 series analyzers; and (2) wet chemistry SO_2 monitors originally developed by ASARCO in the 1930s. The TECO 43 series analyzer can collect average SO_2 concentrations in time intervals as short as every minute. The wet chemistry SO_2 analyzer collects a continuous series of 30-minute samples, and can not be easily modified to collect SO_2 samples at shorter intervals.

Ambient SO_2 analyzers that are certified as U.S. EPA 40 CFR 53 reference method equivalents, such as the TECO 43 series monitor, must demonstrate the ability to maintain accuracy within explicitly defined zero and span drift limits over time. To demonstrate compliance with these zero/span drift limits, the TECO 43 series analyzers are typically subject to daily zero and span calibration checks and/or adjustments. The data gathered during each 24-hour period between calibration checks/adjustments is considered acceptable if the zero and span drift fall within the limits defined in the EPA reference method specification, prior to adjusting the monitor. Essentially the same procedure is used to check and calibrate the wet chemistry monitors.

Ambient SO_2 monitors operated by the three smelters in Arizona are subject to quarterly multi-point calibration audits conducted by Arizona Department of Environmental Quality (ADEQ) staff. A summary of the quarterly multi-point performance audits conducted on two ASARCO Hayden ambient SO_2 monitors by ADEQ is provided in Appendix C. Ambient SO_2 monitors operated by the PD Hurley Smelter in New Mexico are subject to quarterly audits conducted by both smelter personnel and an independent monitoring firm. Ambient SO_2 monitors operated by the PD Hidalgo Smelter in New Mexico are subject to quarterly audits conducted by smelter personnel only. The ASARCO El Paso Smelter ambient SO_2 monitors are subject to quarterly audits conducted by an internal ASARCO ambient monitor audit team. Texas Natural Resources Conservation Commission (TNRCC) inspectors are on site to witness these internal ASARCO audits.

It is understood that the wet chemistry ambient SO_2 monitors at Cananea and Nacozari are visited every 3 days to collect strip chart data, and the strip chart rolls are replaced every 15 days. The internal chemical capsules used with these monitors are replaced every 2 years. The monitor manufacturer inspects the monitors every 4 years.

State environmental agency TECO 43 analyzers are located at or near the modeled point of maximum SO_2 concentration at each of the six U.S. smelters evaluated in this report. The agency monitors are subject to daily zero and span calibration checks quarterly multi-point calibration audits. Extensive calibration documentation is required for the agency monitors as any "Notice of Violation" (NOV) issued to a smelter for exceeding ambient SO_2 air quality limits is based on data obtained from these monitors. These agency SO_2 monitors also serve as an independent check of ambient air quality concentrations measured by the smelter SO_2 monitoring network. In the case of Arizona smelters, the agency (ADEQ) also audits these instruments, as NOVs can also be issued based on exceedances measured by the smelter ambient monitors.

Typically the monthly or quarterly emissions reports that are submitted by these smelters include only enough information to determine whether or not a stack or ambient SO_2 exceedance took place during the reporting period. Copies of representative U.S. and Mexican smelter monthly or quarterly emission reports are provided in the following appendices:

- Appendix D: U.S. Smelters within 100 Kilometers of Border
- Appendix E: Mexican Smelters within 100 Kilometers of Border
- Appendix F: U.S. Smelters in Border States and Greater Than 100 Kilometers from Border

3.1.1 SO_2 and Opacity Stack Continuous Emissions Monitoring (CEM)

The objective of this subtask was to answer the following questions for each smelter included in this evaluation:

- How is CEM monitoring applied?
- Where is it needed or lacking?
- What are the calibration procedures used?
- What reporting formats are used?
- Recommendations for improving monitoring format.

With the exception of recommendations for improving monitoring format, these questions are answered in the tables/summaries appearing in Appendix B. A representative comprehensive reporting format is shown in Appendix F for the Cyprus Miami and Magma (now BHP) San Manuel smelters.

3.1.1.1 U.S. Smelters in the Border Region

Detailed process information, flow diagrams, and CEM locations are provided in Appendix G. All furnace and converter exhaust gases are ducted to acid plants at all six U.S. smelters included in this evaluation. Acid plant stacks are equipped with SO_2 CEMs, and in some cases opacity monitors. In all cases, concentrate dryer exhaust gases are passed through either a baghouse or electrostatic precipitator (ESP) and a COM is used to monitor exhaust particulate emissions. Secondary converter hoods are in use at all six smelters. In all cases, secondary converter hood exhaust gases are sent to a baghouse, ESP, or wet scrubber. SO_2 or opacity or both are continuously monitored at the outlet of the control device treating the secondary converter hood exhaust gases. The level of continuous stack monitoring appears to be adequate at these smelters.

COM/CEM calibration procedures also appear to be adequate. In all cases U.S. EPA 40 CFR 60

Appendix B COM/CEM monitoring procedures are followed. Periodic independent audits are performed by independent firms or in-house monitoring teams with state agency inspectors on-site.

Reporting formats vary widely, depending on the reporting requirements mandated by the Permit to Operate (PTO), state rules affecting copper smelters, and, if applicable, federal NSPS Subpart P or National Emission Standard for Hazardous Air Pollutants (NESHAP) Subpart O, National Emission Standard for Inorganic Arsenic Emissions from Primary Copper Smelters (1986). In all cases the smelters are collecting data on emissions exceedances, reasons for exceedance, CEM accuracy, availability, calibrations, and audits, though this data is not necessarily consolidated in one report.

In the case of Arizona smelters, for example, smelter COM and CEM reports are sent to the ADEQ Air Quality Compliance Section while smelter ambient monitor reports are sent to the Monitoring Section. Typically only certain types of information are provided by the smelter to the state agency to fulfill specific permit reporting requirements, while other data remains in onsite files available for inspection on an "as needed" basis.

Annex IV, Article II, Emissions Monitoring, Recordkeeping and Reporting Systems, requires the the following:

Article II Citation	Monitoring, Recordkeeping and/or Reporting Requirement
1.a	Monitoring: SO_2 CEM shall be installed, calibrated and maintained by any smelter required to meet the 650 ppm SO_2 (six-hour) emission limit. Daily zero and span checks will be performed and a monitor quality assurance program will be in place.
1.b.i	Recordkeeping: Other information to be kept on file may include: performance test results, calibration check results, adjustments or maintenance performed on CEMs, and other data deemed necessary by the competent national authority.
1.b.ii	Recordkeeping: Operator shall be required to keep a monthly record of total smelter charge.
1.b.iii	Reporting: Operator shall be required to submit, on a quaterly basis, written reports of SO_2 emissions that exceed the 650 ppm, 6-hour standard, as well as : - Magnitude of the exceedance; - Specific identification of each 6-hour period when smelter emissions exceed 650 ppm limit, such as startup, shutdown, malfunction, nature and cause of the malfunction, and corrective action taken; - Date, time and duration of each period when the CEM was inoperative, except during zero and span checks, and the nature of the system repairs and adjustments.

From the standpoint of Annex IV information requirements shown above, the quarterly reports submitted by the Arizona smelters are good examples of fairly complete SO_2 CEM and COM emission reports. These quarterly reports contain data on sulfur balance, availability of COMs/CEMs, and number of exceedances. Separate detailed reports are submitted within 24 hours of each exceedance that specify: reason(s) for exceedance, duration, and action taken to rectify the exceedance. The quarterly reports also include information on smelter ambient SO_2 monitor availability and ambient SO_2 exceedances.

Ambient SO_2 monitoring procedures are not currently included in Annex IV. All smelters subject to Annex IV currently operate and maintain ambient SO_2 monitoring networks to determine compliance with the applicable ambient SO_2 standard. Given that this ambient monitoring data is the principal measure of whether smelter emissions exceed an acceptable health-based ambient concentration standard, it is appropriate that Annex IV include minimum monitoring, calibration, recordkeeping and reporting requirements for these monitors. Information necessary to evaluate the validity of the ambient SO_2 data generated by these ambient SO_2 monitoring networks would include: (1) basis for siting of ambient SO_2 monitors; (2) monitor operating scale; (3) monitor quality assurance schedule (for example, day, week, month/quarter, annual); and (4) summary of results of all quality assurance procedures conducted during the reporting period. Understanding the rationale for siting the existing SO_2 monitors is necessary to determine whether the monitors are properly located to measure peak SO_2 levels for short-term and long-term averaging times. If the monitors are not properly located to measure peak short- and long-term SO_2 levels, high exposure levels could be occurring that are not being quantified by the existing ambient SO_2 monitors due to inadequate siting of these monitors.

Proper SO_2 monitor scales are necesssary to capture the range of potential SO_2 concentrations at the monitoring site location. For example, the NMED monitor located near the PD Hidalgo Smelter operates on a 0.0 -0.5 ppm scale. On one occasion in 1996, the monitor remained at the maximum 0.5 ppm level for several hours, indicating that the actual concentration probably exceeded 0.5 ppm during this period. It is not possible to confirm what the actual ambient SO_2 concentration was during this period, due to the scale used.

Frequent monitor calibrations, and documented results of all calibration procedures on the monitors, are necessary to confirm the accuracy of the SO_2 concentrations measured by the monitors. Annex IV does require that daily zero and span checks be performed on the SO_2 CEMs and that a monitor quality assurance program be in place. SO_2 CEM quality assurance programs typically include periodic performance tests, calibration checks and adjustments, and instument maintenance. Article II, 1.b.i, does imply that records are to be maintained on all of these procedures, and any other procedures that may impact the accuracy of the instrument.

A binational audit review team may be the most efficient mechanism available for evaluating smelter compliance with the existing and proposed monitoring, recordkeeping and reporting requirements in Annex IV. The primary purpose of this audit review team would be to ensure that the monitoring, recordkeeping, and reporting requirements of Annex IV are being met. Functions of the audit review team would include: evaluating monthly/quarterly SO_2 CEM calibration/audit reports and emission monitoring results, consolidating these reports/results in one place to permit rapid dissemination of this information to interested parties on both sides of the border, and providing recommendations for improvements in existing monitoring, recordkeeping, and reporting procedures as necessary to conform with the requirements of Annex IV. It is recommended that the scope of audit review team responsibilities also include periodic evaluation of the SO_2 ambient monitoring network monitoring, recordkeeping and reporting procedures used at each of the smelters covered by Annex IV. The rationale for including the ambient SO_2 monitors in the scope of the audit review team's activities is that the concentrations measured by these monitors are used by the smelters to determine whether exceedances of the SO_2 ambient air quality standard are occurring. Ambient particulate/HAPs monitoring procedures would also be evaluated by the audit review team if requirements to monitor these pollutants are incorporated into Annex IV. The proposed binational audit review team is discussed in more detail in Section 3.2.

3.1.1.2 Mexican Smelters in the Border Region

3.1.1.2.1 Nacozari, Sonora Smelter

The Mexicana de Cobre copper company owns and operates the Nacozari smelter. The Cananea smelter is owned and operated by the Mexicana de Cananea copper company. Both of these companies are subsidiaries of Grupo Mexico S.A. de C.V. As a result, the owners of the Nacozari and Cananea smelters are essentially the same. Grupo Mexico is a Mexican-majority owned company, the largest mining company in Mexico. The largest foreign ownership in Mexicana de Cananea is by ASARCO, which owns in excess of 31 percent.

The Nacozari smelter is known as the “El Tajo” smelter in the region, and is located about 15 kilometers north of the town of Nacozari, Sonora. The smelter consists of an Outokumpu Flash Furnace, one Teniente converter that began operation in early 1997, three Pierce-Smith converters and anode casting units. By October 1997 the smelter will have an operating refinery that electrolytically refines copper, precious metals, and lead. A wire rolling mill and gold/ precious metals plant, as well as a molybdenum processing facility, will be operational by 1998. Also, a molybenum roaster will be brought on-line at the smelter in 1999, with roaster exhaust gas vented directly to the acid plant to control particulate and SO_2 emissions. An existing molybdenum roaster, not owned by Grupo Mexico but processing a substantial amount of feed from the Nacozari mine, is located in Cumpas approximately 40 kilometers to the south of the smelter. This molybdenum roaster is believed to be a large SO_2 emitter. Regional SO_2 emissions associated with molybenum roasting should decline by processing molybdenum in the new molybdenum roaster from 1999 onward.

As of June, 1997, the smelter was processing approximately 2,800 metric tons per day (mtpd) of concentrate (average of 1,600 mtpd from Nacozari and 1,200 mtpd from the mine in Cananea), with anticipated maximum capacity of 3,200 mtpd. Other concentrates come from Chile and Peru. The operating capacity of the Nacozari El Tajo smelter places it among the three largest copper smelting operations in the U.S. and Mexico, after the Kennecott smelter in Utah and the BHP San Manuel smelter in Arizona.

The plant has two Monsanto double-contact sulfuric acid plants that were brought on-line in 1988 and 1997. Their respective capacities are 2,100 mtpd and 1,600 mtpd each of sulfuric acid production. The two acid plants operate in parallel.

The installed cost of the acid plant installed in 1988 to meet the requirements of Annex IV was approximately $55,000,000. The installed cost of the acid plant installed in 1997 to permit an expansion of production was approximately $45,000,000. The precipitators used to protect the new (1997) acid plant catalysts from particulate cost an additional $12,000,000. Finally,

$3,000,000 has been spent in the last year to install: hoods to capture secondary converter fugitives, gas cooling, and associated baghouses. The total investment in air pollution control systems within the last two years is approximately $60,000,000.

Nacozari has a permitted SO_2 emissions limit of 650 ppm averaged over a 6-hour period. Continous SO_2 monitoring of acid plant emissions is required. Company management anticipates that this will become the national Mexican emission standard for copper smelter emissions sometime in 1997. No sulfur balance or emissions data is currently released.

There is one SO_2 CEM in the acid plant exhaust stack, as well as a SO_2 CEM measuring SO_2 entering the acid plants. There is no measurement of stack or fugitive SO_2 elsewhere in the facility.

The smelter was inconsistent in meeting the Annex IV stack SO_2 limit, 650 ppm over 6-hour average, on a monthly basis prior to the 1997 expansion. There are two reasons for this inconsistent performance:

1. The original acid plant (No. 1 Acid Plant) was unable to operate at high smelting levels without exceeding the Annex IV limit. This was "bottlenecking" the capacity of the smelter. Smelter management believes that the installation of the No. 2 Acid Plant earlier this year has remedied the problem. Monthly exhaust gas SO_2 concentrations from the No. 1 Acid Plant averaged 500-850 ppm during the first quarter of 1996. Monthly combined exhaust gas SO_2 concentrations for the No. 1 and No. 2 Acid Plants, estimated for the first quarter of 1997, averaged 280-410 ppm. These SO_2 concentration averages include the estimated SO_2 stack gas concentration during bypasses.

2. Power outages require bypassing the acid plants, causing temporary (maximum 3-hour) high SO_2 emissions. The bypasses tend to occur during the summer months during electrical storms, and result in a 12 percent SO_2 concentration (by volume) exhaust gas being released to the atmosphere. The smelter operates under a standard in such "emergencies" of no more

than a 3 percent SO_2 exhaust gas (8-hour average), but it is not unusual for this exhaust gas to average 9 percent over the first hour as converters and furnaces are removed from production. Stack gases are diluted with additional air during bypass events.

3.1.1.2.2 Cananea, Sonora Smelter

The Cananea Smelter is located on the southwest edge of the town of Cananea (population 30,000) approximately 40 kilometers from the Arizona-Sonora border. The smelter has operated continuously since 1891 with the last major reconstruction of furnaces in 1976. The current estimated capacity of the smelter is 65,000 metric tons per year (mtpy) of copper, with a capacity to smelt approximately 950 mtpd of concentrate. Normal production is approximately 55,000 mtpy. These figures were a subject of controversy after reconstruction of the smelter in 1992. It was not clear whether, as a result of the reconstruction project, the smelter had increased smelting capacity. This question is relevant as the smelter has no SO_2 controls and was prohibited from expanding beyond an (unspecified) capacity at the time Annex IV was signed in January, 1987. Expansion beyond the 1987 capacity level would require the smelter to meet the equivalent of U.S. NSPS Subpart P SO_2 emission limits.

In 1992, INE estimated that SO_2 emissions from Cananea varied between 103,000 and 140,000 mtpy for the period 1980-1990 (Appendix E). It is probable that the Cananea smelter is the largest non-ferrous smelting source of SO_2 in the U.S. or Mexico. If Cananea processes 950 mtpd of concentrate, it could potentially emit approximately 570 mtpd of SO_2 (627 short tons/day). Statistics from Mexicana de Cananea for 1995-1997 indicate that actual smelting throughput averaged around 650 mtpd of concentrate during this period. Actual SO_2 emissions are therefore approximately 390 mtpd of SO_2 or, by the author's estimate, approximately 150,000 short tons/year. This emissions estimate is based on Mexicana de Cananea's 1995-1997 estimate of 30 percent sulfur in the concentrate.

There are no SO_2 CEMs in operation at the smelter. However, the 1995-1997 INE Licencia de

Funcionamiento (operating permit) required that stack SO_2 emissions testing be conducted on four occasions during the course of the two-year operating permit. The results of this SO_2 stack test program have not been reviewed by the project team.

An noted above, the Cananea smelter has no SO_2 emissions control system. The Mexicana de Cananea environmental manager, Ing. Juan Del Castillo, has indicated that the 1997-1999 Licencia de Funcionamiento may require a "Supplementary Control System" (SCS), similar to the SCS required by the EPA at U.S. smelters in the 1970s. The SCS combines continuous ambient SO_2 monitoring and meteorological forecasts to reduce production when ambient SO_2 concentrations reach elevated levels. The most common control measure used to reduce elevated ambient SO_2 concentrations is to take the converters off-line and gradually reduce feed to the reverberatory furnaces.

Mexicana de Cananea believes that SEMARNAP may soon promulgate copper smelter emission limits [NOM-091-ECOL-1994] that limit furnace and converter SO_2 emissions to 650 ppm SO_2 by volume (6-hour average). The Cananea smelter will be unable to comply with the 650 ppm SO_2 limit without major alterations.

Mexicana de Cananea has indicated that the more probable scenario is that the company would develop a closure plan for the smelter. The closure plan would include a request for a transition period to develop labor alternatives for the workforce at the smelter.

3.1.1.2.3 Potential Control Strategies and Control Costs for Cananea to Meet Annex IV SO_2 Emission Limits

Mexicana de Cananea has indicated that there are several control scenarios for the Cananea smelter:

- No change until regulatory closure date under proposed NOM-091-ECOL-1994. If the proposed NOM-091-ECOL-1994 is promulgated in its current form, the Cananea smelter will close no later than January 1, 2005. The smelter must develop a labor closure plan prior to shutdown. The company is not required to take any pollution control action prior to the 2005 closure date unless Mexican environmental authorities require action based on health or other environmental considerations.

- Close the smelter prior to the proposed compliance date in 2005. Mexicana de Cananea will close the smelter for economic reasons in this scenario. The company indicates that copper produced at Cananea is far more expensive to produce than at Nacozari. The company could also be forced to close the smelter for environmental reasons due to public pressure or regulatory orders. The city of Cananea has been divided between pressuring MEXICANA DE CANANEA to close the smelter for environmental health reasons and the desire to preserve 350 jobs at the smelter.
- Mexicana de Cananea determines to meet Annex IV requirements by the required closure date in 2005. The company believes oxygen could be injected into the existing furnace, potentially doubling the actual copper production to around 110,000 mtpy, if a large volume of inexpensive concentrates could be secured. These concentrates would originate from Peru, Chile, or the planned El Arco copper mine in Baja California Sur. A double contact acid plant capable of capturing up to 800 mtpd of SO_2 and converting it to sulfuric acid would be added, as well as high efficiency particulate control equipment to protect the acid plant catalysts. Investments would include approximately $10,000,000 to add oxygen and $15,000,000 to $20,000,000 for acid plant purchase and installation. The total investment would sum to $25,000,000 to $30,000,000. An anode casting facility could be added for approximately $20,000,000, though the economic feasibility of this step is uncertain.

3.1.1.3 Monitoring, Recordkeeping and Reporting Procedures Necessary to Meet Requirements of Annex IV

The specific Annex IV monitoring, recordkeeping and reporting requirements are shown in Section 3.1.1.1. The actual monitoring, recordkeeping and reporting procedures in use at smelters in the border region are summarized for each smelter in Appendix B. The quarterly reporting data required of the Arizona smelters, as shown in the Cyprus Miami and BHP San Manuel monthly reports included in Appendix F, serve as a good model of "reporting completeness" for smelters subject to Annex IV, with the exception of site-specific 3-hour SO_2 exceedance limits required by ADEQ. The site-specific 3-hour SO_2 exceedance limit data supplied in the Cyprus Miami and BHP monthly reports is an ADEQ-only reporting requirement.

3.1.1.4 Stack SO_2 and Opacity Monitoring/Reporting Recommendations

The project team recommends that:

1. COMs and/or SO_2 CEMs be installed, maintained, and calibrated (by smelter personnel) and periodically audited by an independent entity on any smelter stack or uncollected fugitive emissions source subject to specific SO_2, PM_{10} or opacity limits. In the case of uncollected fugitive emissions monitoring, a validated mass balance or parametric emissions monitoring approach may be considered as an alternative to COMs/CEMs;
2. Quarterly reports be compiled by smelter staff or an independent audit review team that address all of the monitoring, recordkeeping and reporting requirements of Annex IV. These quarterly reports will include information on the following:

   <u>Monitoring</u>: An SO_2 CEM shall be installed, calibrated and maintained by any smelter required to meet the 650 ppm SO_2 (six-hour) emission limit. A COM will be installed on any source at the smelter with a source site-specific opacity or PM_{10} limit. Daily zero and span checks will be performed and a monitor quality assurance program will be in place.
   <u>Recordkeeping</u>: Other information to be kept on file may include: performance test results, calibration check results, adjustments or maintenance performed on COM/CEMs, and other data deemed necessary by the competent national authority.

Recordkeeping: Operator shall be required to keep a monthly record of total smelter charge.

Reporting: Operator shall be required to submit, on a quaterly basis, written reports of SO_2 emissions that exceed the 650 ppm, 6-hour standard, as well as :

- Magnitude of the exceedance;
- Specific identification of each 6-hour period when smelter emissions exceed 650 ppm limit, such as startup, shutdown, malfunction, nature and cause of the malfunction, and corrective action taken;
- Date, time and duration of each period when the CEM was inoperative, except during zero and span checks, and the nature of the system repairs and adjustments.

Similar information shall be required on a quarterly basis for each COM exceedance.

3.1.2 SO_2 Ambient Monitoring

Ambient SO_2 monitoring is necessary near major SO_2 sources such as primary copper smelters to determine whether the ambient SO_2 concentration standard is being maintained. Historically the requirement that smelters operate and maintain ambient SO_2 monitoring networks has been imposed as an operating permit condition by the responsible state or federal environmental agency and predates the signing of Annex IV in 1987.

The objective of this subtask was to address the following issues for each smelter included in this evaluation:

- Current monitor siting and justification for siting;
- Telemetry justification - standardization of monitor technology;
- Appropriate sampling/calibration ranges to indicate health impact levels;
- Availability of appropriate ambient SO_2 monitor QA procedures for Mexican smelters;
- Quality assurance procedures used to confirm validity of data

3.1.2.1 U.S. and Mexican Ambient SO_2 Air Quality Standards

The following table summarizes the current SO_2 health-based and welfare-based ambient air quality standards in the United States and Mexico (EPA 1996a):

SO_2 Ambient Air Quality Standards		
Averaging Time	**United States**	**Mexico**
Health-based standards: 24-hour Annual	 0.14 ppm 0.030 ppm	 0.13 ppm 0.030 ppm
Welfare-based standards: 3-hour	 0.50 ppm	 None

The health-based standards are for the most part the same between the U.S. and Mexico. However, Mexico does not have a 3-hour secondary SO_2 standard designed to protect public welfare from adverse effects associated with elevated ambient levels of SO_2. Welfare effects include impacts on vegetation, such as agricultural crops and forests, ecosystems, and visibility.

The SO_2 health-based air quality standards are set at ambient concentration levels that protect public health with an adequate margin of safety. The major health effects of concern associated with exposure to concentrations that exceed the 24-hour and annual SO_2 standards include effects on breathing, respiratory illness, alterations in the lung's defenses, and aggravation of existing repiratory and cardiovascular disease. The population subgroups that are most sensitive to ambient SO_2 are asthmatics and individuals with cardiovascular disease or chronic lung disease (e.g., bronchitis, emphysema), as well as children and the elderly. SO_2 is also an important precursor to fine particle formation. Fine particles are associated with adverse health impacts such as premature mortality, excess hospital admissions, and aggravated asthma as well as visibility impairment. Additionally, SO_2 can cause foliar damage to trees and agricultural crops. Finally, SO_2 is a major contributor to acidic deposition resulting in acidification of lakes and streams and accelerated corrosion of buildings and monuments.

The most effective method for determining compliance with the ambient SO_2 standards in the vicinity of major SO_2 sources, such as copper smelters, is to perform continuous ambient SO_2 monitoring. The EPA required that copper smelters operate SO_2 ambient air quality monitoring networks in the 1970s and 1980s as a component of an SO_2 control strategy. The history of SO_2 ambient monitoring at U.S. smelters in the border region is discussed in more detail in Section 3.1.2.2. The history of SO_2 ambient monitoring at the two Mexican smelters in the border region is discussed in Section 3.1.2.3.

3.1.2.2 U.S. Smelters in the Border Region

Ambient SO_2 monitoring has been conducted at some copper smelters in the border region, such as ASARCO El Paso, since the 1930s. ASARCO developed the wet chemistry ambient SO_2 monitoring technique that still serves as the backbone of the monitoring systems used at four of the five copper smelters affected by Annex IV. The sole exception is the PD Hidalgo smelter, where all ambient SO_2 monitors are TECO 43 monitors. The wet chemistry ambient SO_2 monitor takes 30-minute samples in a continuous series.

Ambient SO_2 monitoring networks reached their peak size in the 1970s when SCS, using an array of ambient SO_2 monitors and real-time meteorological data, was required by the EPA. SCS was used to curtail production when exceedances were measured at one or more monitoring sites around a smelter. The number of monitors in use has declined at all smelters as high efficiency SO_2 control systems have come on-line and the number of exceedances has dropped dramatically. Newer electronic UV fluorescence ambient SO_2 monitors, generally TECO 43 monitors, have been added at all U.S. smelters in the border region over time, for a variety of reasons. These include: validation of a site-specific SO_2 dispersion model, State Implementation Plan (SIP) requirements, Prevention of Significant Deterioration (PSD) demonstration projects, or fulfillment of Consent Decree requirements.

The ambient SO_2 monitors currently in use at smelters in the border region are not necessarily sited to measure the "Maximum Ground Level Impact" (MGLI) for short (1-hour, 3-hour, or 6-hour) or long (annual) ambient SO_2 concentration averaging times. Generally there is a monitor at or near the point of MGLI for tall stack SO_2 emissions. There may or may not be a monitor at the point of modeled MGLI for fugitive SO_2 emissions.

3.1.2.3 Mexican Smelters in the Border Region

3.1.2.3.1 Nacozari Smelter

The Mexicana de Cobre Nacozari smelter operates an ambient SO_2 monitoring network consisting of five wet chemistry monitors. The positions of these SO_2 monitors relative to the smelter are: 2 kilometers SSW, 26 kilometers NNW, 25 kilometers SSW, 21 kilometers SE and 20 kilometers S. These monitors are generally located in the population centers surrounding the smelter. Nacozari and Esqueda are nearby communities that house the workforce. There are also populations that lived in the area prior to the opening of the mine and smelter. Mexicana de Cobre has portable SO_2 monitors availabe for use. It does not appear that these monitors are currently deployed. A new UV flourescence monitor, TECO 43 series, is being purchased and may be installed at the lime plant in Agua Prieta some 85 kilometers north of the smelter to monitor potential transboundary SO_2 emissions from the smelter.

The Nacozari smelter has recorded no 24-hour exceedances of the 0.13 ppm Mexican ambient SO_2 24-hour standard since the No. 1 Acid Plant began operation in 1988. There is no ambient SO_2 3-hour standard in Mexico.

The wet chemistry monitors used in the Nacozari ambient SO_2 monitoring network provide 30-minute averages. Two 30-minute averages are combined to produce a 1-hour reported average. The only monitor located close to the smelter (2 kilometers SSW) has very few 1-hour averages that exceed 0.1 ppm. The vast majority of the 1-hour readings recorded by the five monitors in the network are “0.00 ppm.” The span scale used on all five monitors is 0-1.0 ppm SO_2.

A calibration check is performed on the ambient SO_2 monitors every 15 days. Further information on periodic calibration audits or related quality assurance procedures is not currently available.

Prevailing daily winds are from the south and west. However, in windless conditions natural diurnal flows would send the plume to the south at night. The monitor located 2 kilometers SSW of the smelter, at the airport, is not downwind of the smelter when prevailing winds are present. The smelter is subject to power outages an average of 3 to 4 times per month that are beyond the smelter’s control. Presumably high ambient SO_2 levels exist on a periodic basis as a result of emergency bypass conditions caused by the power outages.

The smelter is relatively isolated from larger population centers. However, hundreds of workers could be routinely affected by uncollected fugitive SO_2 emissions. These workers would also be affected by uncontrolled acid plant bypasses directed to the tall stack.

It is unlikely that significant concentrations of smelter-generated SO_2 will be measured at the new SO_2 monitoring site in Agua Prieta, given the distance of this border community from the smelter. Agua Prieta is 85 kilometers from the Nacozari smelter. Monitoring in Agua Prieta is being implemented because it is the northernmost Mexican point that could be impacted by the Nacozari smelter. In many respects monitoring in this location with be largely symbolic, although Agua Prieta did experience high SO_2 levels prior to the shutdown of the Douglas, Arizona smelter in 1987.

3.1.2.3.2 Cananea Smelter

The ambient SO_2 monitoring network at the Cananea smelter consists of five wet chemistry ambient SO_2 monitors. The positions of these SO_2 monitors relative to the smelter are: 5

kilometers S, 2 kilometers SE, 3.5 kilometers ESE, 22 kilometers NE and 27 kilometers N. Two 30-minute averages are combined to produce a 1-hour reported average.   The span scale used on all five monitors is 0-1.0 ppm SO_2.

The following additional monitoring equipment will be installed in the near term:

- One (1) UV fluorescence SO_2 analyzer (TECO 43A),
- Calibrador Thermo Electron Model 143
- Graficador Yokogawa MR100
- Chessel Euroterm 301E

A calibration check is performed on the ambient SO_2 monitors every 15 days. Further information on periodic calibration audits or related quality assurance procedures is not currently available.

There has been a dramatic drop in ambient SO_2 levels at the site that typically records the highest SO_2 concentrations, the Las Mexicanas site, when levels measured in the 1986-1987 era are compared to current ambient SO_2 levels. There is insufficient information to determine the cause(s) of this difference, though there has been no major change in either the monitors, production levels, or SO_2 emissions control strategies since the 1986-1987 period. The current monitoring network contains five stations. The ambient SO_2 monitoring network operational in 1986 consisted of four stations. Only one of these five monitoring sites is located in Cananea. This site is located well above and west of the populated core of Cananea, which is characterized by steep canyons, in a development known as the Club Campestre.   The SO_2 monitor is actually located on the roof of the home of the manager of the Cananea and Nacozari mines.

There are dramatic differences in ambient SO_2 concentrations when the 24-hour SO_2 averages from the first 24 months of monitoring network operation (May 1986-April 1988), are compared with 24-hour averages from January 1995-December1996 or May, 1997 (see Appendix B) . The Las Mexicanas station located approximately 5 kilometers SSE of the smelter recorded up to 12 exceedances of the 0.13 ppm 24-hour standard per month in the late 1980s. 129 exceedances were recorded in a 24-month period at this monitoring site alone. During the 25 months included in the period 1995-1996 and May 1997, no exceedances were recorded. The 24-hour SO_2 concentration measured at the Las Mexicanas site did not exceed .08 ppm during these 25 months of available recent data.

The SO_2 concentrations measured at the Las Mexicanas site, historically the site with the highest number of exceedances, have dropped by a factor of five since the late 1980s. No SO_2 controls have been added to the smelter that could potentially acount for this large drop in average ambient SO_2 concentration at the Las Mexicanas site. No similar drop in SO_2 concentration has been measured at the Club Campestre site 3.5 kilometer ESE of the smelter. At this site, SO_2 concentrations have increased slightly when comparing May 1987 data to May 1997 data. The Club Campestre site has historically had relatively low ambient SO_2 concentrations.

This recent monitoring data is not consistent with the historical ambient SO_2 monitoring data available for the three Arizona smelters. Prior to the installation of high efficiency SO_2 control systems at the Arizona smelters, it was common to have dozens of ambient SO_2 exceedances per year, both 3-hour and 24-hour exceedances.

The newest Cananea monitoring site, the Servicios site, recorded no 24-hour exceedances in 1995-1996. The monthly data for May 1997 shows a near 24-hour exceedance on May 16, 1997. Hourly levels averaged 0.4 ppm or greater during fourteen 1-hour periods in May 1997 at this site.

3.1.2.4 Summary of Current Ambient SO_2 Monitoring, Recordkeeping and Reporting Procedures Used by Smelters Subject to Annex IV

A summary of the number of ambient SO_2 monitors operated by the five smelters subject to Annex IV is provided below:

Smelter	Number of Smelter Ambient SO_2 Monitors
ASARCO El Paso	5
Phelps-Dodge Hidalgo	9
Phelps-Dodge Hurley	2 (12 monitors were in operation until 1996 as part of a stack height study designed and conducted by Phelps-Dodge)
Cananea	5
Nacozari	5

These monitors are maintained, calibrated, and audited by smelter personnel. In the case of ASARCO El Paso, an internal ASARCO audit team performs periodic audits of the ambient monitors. State agency personnel do not audit these monitors. By way of comparison, the ADEQ does audit the ambient SO_2 monitoring networks in operation at the three smelters in Arizona.

In the case of the three U.S. smelters subject to Annex IV, state agency SO_2 monitors are located at the modeled MGLI point for tall stack SO_2 emissions. Typically one of the smelter ambient monitors is collocated with the state agency monitor. In the case of the two Mexican smelters, no state or federal environmental agency ambient SO_2 monitors are sited near the smelters. The rationale for monitor siting at these smelters varies from highly sophisticated dispersion modeling exercises to wind rose data alone. In some cases the dispersion modeling used to site the monitors is directed exclusively at identifying the MGLI for long-term SO_2 impacts from tall stack emissions, and does not consider the MGLI for short-term SO_2 impacts or uncollected fugitive SO_2 emissions. Though uncollected fugitive SO_2 emissions are typically less than stack SO_2 emissions on a mass basis, these uncollected fugitive emissions are released at or near ground level. As a result, the adverse health impact on nearby populations of these uncollected fugitive emissions can be greater than stack emissions.

A common sense approach to ensuring that maximum short- and long-term stack and fugitive SO_2 emissions are effectively quantified would include monitors located at the following points:

- Long-term MGLI for stack emissions;

- Short-term MGLI for stack emissions;
- Long-term MGLI for fugitive emissions;
- Short-term MGLI for fugitive emissions;
- Leading edge of any community in reasonable proximity to the smelter (within 20 kilometers).

EPA's ISCST3 air dispersion model, or equivalent, is an appropriate model for determining the location of the short- and long-term MGLIs for stack and fugitive SO_2 emissions. Continuous ambient SO_2 monitoring is necessary at the MGLIs due to the current lack of air dispersion models that accurately predict the magnitude of SO_2 short term peaks (EPA 1997). EPA's review of SO_2 levels across the U.S. indicates that the highest short-term values of SO_2 are found in the vicinity (<20 kilometers) of major point sources (EPA 1994). For this reason it is recommended that ambient SO_2 levels in communities within 20 kilometers of smelters subject to Annex IV be continuously monitored.

3.1.2.5 Ambient SO_2 Monitoring, Recordkeeping and Reporting Recommendations

The project team recommends that:

1. A minimum of five smelter-owned/operated ambient SO_2 monitors should be located in the vicinity of each smelter. One monitor should be located at the modeled point of maximum long-term SO_2 impact from stack emissions. A second monitor should be located at the modeled point of maximum short-term SO_2 impact from stack emissions. The third monitor should be located at the modeled point of of maximum short-term SO_2 impact from fugitive SO_2 emissions. The fourth monitor should be located at the modeled point of of maximum long-term SO_2 impact from fugitive SO_2 emissions. A fifth monitor should be located at the closest edge (to the smelter) of the nearest population center. It is important to emphasize that in some cases the closest population center is a worker housing area. In cases where the modeled points of maximum short- and long-term SO_2 impact are essentially coincident, or where the fugitive component is neglible in all emission cases when compared to stack

emissions, less than five monitors would be acceptable.

2. If there is more than one population center within 20 kilometers of the smelter, locate a continuous SO_2 monitor at the leading edge (relative to the smelter) of each population center within this zone. If there are no population centers within 20 kilometers of the smelter, locate a continuous SO_2 monitor at the leading edge of the nearest population center.
3. Perform appropriate air dispersion modeling to identify the modeled point of maximum SO_2 impact for short-term (3-hr to 6-hr range) and long-term (annual) impacts. Model both stack and fugitive SO_2 emissions. In some cases, appropriate modeling has already been performed.
4. The monitor(s) should have automatic scale switching capability to permit accurate quantification of both typical ambient SO_2 levels and peaks, or use a scale, such as 0 - 2.0 ppm, capable of capturing both typical concentrations and peaks. The monitors must be capable of measuring and reporting via telemetry 5-minute averages (at a minimum) to permit an accurate assessment of short exposures to SO_2.
5. The number of 5-minute intervals averaging more than 0.6 ppm SO_2 (EPA's proposed concern level that will require evaluation of impact on the population) should be recorded. Exceedances of 10-minute averages greater than 0.6 ppm SO_2 should result in community notification. This process should be reevaluated after one year based on community response effectiveness. A precedent for monitoring exists in the 1989-1992 short term SO_2 reports (6-minute and 1-hour) for the Magma (now BHP) San Manuel smelter.
6. Comprehensive QA-QC records should be maintained showing the percent of time that the monitors operate and the criteria used to determine "good" data. This data should be made available for periodic review by the Air Working Group.

3.1.3 Stack and Ambient Particulate and HAPs Monitoring

Primary copper smelters are sources of particulate and heavy metals emissions. Particulate emissions from copper smelters contain a number of metals, such as lead, arsenic, antimony, and zinc, that are classified as HAPs by the EPA. Respirable particulate (PM_{10}) can cause adverse health effects based on particle size alone, regardless of chemical composition, as PM_{10} tends to deposit in the lower reaches of the lungs and impact sensitive lung tissue. HAP metals can potentially be absorbed at any point in the respiratory tract, and cause adverse health impacts in a variety of ways. Significant concentrations of lead in the blood, for example, impact the central nervous system and result in reduced alertness and responsiveness.

The objective of this subtask was to address the following two issues for each smelter included in this evaluation:

- Procedures used to quantify stack and fugitive particulate/HAPs;
- Current particulate/HAP monitor siting and justification for siting.

Particulate emissions from primary copper smelters often contain significant concentrations of heavy metals, principally lead and arsenic. NSPS Subpart P (1976) includes a 50 mg/m^3 particulate limit for smelter dryers, as well as a 20 percent opacity limit for dryers and acid plants. A COM is required for the drier stack. Smelters subject to Subpart P are also required to maintain a monthly record of total smelter charge and of the percent of lead, arsenic, antimony, and zinc in the smelter charge.

Ambient particulate monitoring has been required near some U.S. copper smelters. All three copper smelters in Arizona operate ambient PM_{10} monitoring networks. These copper smelters are required to monitor ambient levels of PM_{10} in the vicinity of the smelter as a component of the Arizona SIP to evaluate PM_{10} attainment status. The PM_{10} filters are also analyzed for particulate HAP metals, including lead, arsenic, antimony and zinc.

The U.S. and Mexico have similar ambient air quality standards for PM_{10}. The annual PM_{10} standard is expressed in both countries as the annual arithmetic mean PM_{10} concentration not to exceed 50 ug/m^3. However, the form of the 24-hour PM_{10} standard is different for the U.S. and Mexico. The U.S. has recently revised the 24-hour PM_{10} standard to reflect a concentration-based percentile form from an expected exceedance form. The U.S. 24-hour PM_{10} standard is now

expressed as the 3-year average of the 99th percentile of 24-hour concentrations not to exceed 150 $\mu g/m^3$. Mexico also has an ambient air quality standard for total suspended particulates (TSP) of 260 $\mu g/m^3$ averaged over 24 hours and 75 $\mu g/m^3$ annual geometric mean.
The U.S. had the same standard for TSP until this standard was discontinued in the late 1980s in favor of the PM_{10} standard.

The U.S. also has a $PM_{2.5}$ standard that was promulgated in July 1997. Ambient $PM_{2.5}$ monitoring has already been initiated on a large scale in the U.S. This $PM_{2.5}$ data will be evaluated over time to determine specific $PM_{2.5}$ control requirements that may be necessary to maintain the short-term (65 $\mu g/m^3$ 24-hour average) and long-term (15 $\mu g/m^3$ annual average) ambient $PM_{2.5}$ concentration limits.

The U.S. and Mexico have the same standard for lead, 1.5 $\mu g/m^3$ averaged over three months. The monitor used to collect the ambient lead sample is a "total suspended particulate" (TSP) monitor. The TSP filter is analyzed by atomic absorption spectroscopy to determine lead concentration in the ambient air. Lead can potentially be absorbed by the body at any point after entering the respiratory system. For this reason, a TSP monitor is used to collect ambient air lead samples instead of a PM_{10} monitor when the objective of the monitoring is to assess compliance with the lead NAAQS.

NESHAP Subpart O, National Emission Standard for Inorganic Arsenic Emissions From Primary Copper Smelters, was promulgated in 1986. All eight U.S. smelters meet the Subpart O exemption criterion of $\leq$ 75 kg/hr of arsenic in the converter feed, and as a result are not subject to the inorganic arsenic control requirements specified in Subpart O. However, all smelters, whether exempt or not from Subpart O control requirements, must maintain and report monthly arsenic and lead in the smelter feed. There are no ambient monitoring requirements associated with the NESHAP Subpart O standard.

The EPA is currently developing a MACT standard for HAP emissions from primary copper smelters. A significant amount of HAPs stack testing and uncollected fugitive HAPs testing/ emissions estimates have been performed by primary copper smelters in the U.S. as a component of this MACT standard development process. The HAP test results generated by this process are discussed in more detail in Section 2.1.3.1. The EPA report describing these results is provided in Appendix G.

3.1.3.1 U.S. Smelters in the Border Region

The requirement that copper smelters perform HAP studies to determine the significance of stack and fugitive HAP emissions evolved from the 1990 Clean Air Act Amendments. These studies serve as the basis for the development of a MACT standard for primary copper smelters, which is currently in draft form. The initial EPA compilation of these HAP studies, dated July 1995, is provided in Appendix G (EPA 1995a). Many of these studies were a combination of stack tests and mass balance fugitive HAP estimates. More comprehensive fugitive HAP studies were conducted following the publication of the July 1995 EPA document. Arguably the most comprehensive of these fugitive HAP studies was conduct by TRC North American Weather Consultants (TRC) for ASARCO Hayden (November 1995). Samples of fugitive HAP studies conducted by ASARCO Hayden and the PD Hidalgo and Hurley smelters are provided in Appendix H.

HAP stack test procedures for metals are relatively well developed. For this reason, HAP emission estimates based on stack test results, when collected under representative smelter operating conditions, can be considered reasonably accurate. The quantification of uncollected fugitive HAP emissions is more problematic. The results of the November 1995 TRC test program at ASARCO Hayden indicated that actual fugitive HAP emissions were a factor of 5-10 higher than the earlier fugitive HAP emissions estimate included in the July 1995 EPA document, and that arsenic or lead emissions alone would result in the smelter being classified as a major source of HAPs and subject to the proposed MACT standard. The EPA July 1995 HAP emissions estimate indicated that the ASARCO Hayden smelter was below all MACT threshold criteria.

Based on the history of fugitive HAP quantification at ASARCO Hayden, it is clear that more comprehensive and defensible fugitive HAP test programs are necessary at some of the smelters in the border region to accurately determine the significance of fugitive HAP emissions. The possible exception to this observation is ASARCO El Paso, where all converter building "uncollected" fugitives are captured and controlled by a baghouse. HAP emissions from the converter building baghouse stack have been accurately quantified using stack testing procedures.

The only well-established U.S. procedure for monitoring HAPs is the monthly requirement to report arsenic and lead concentrations in the smelter feed streams. This data does indicate that the Phelps Dodge Hurley and Hidalgo smelters have the lowest feedstream arsenic and lead concentrations of any U.S. smelters in the border region. ASARCO El Paso feedstream concentrations of arsenic and lead are approximately a factor of ten higher than those of the two Phelps Dodge smelters. As noted above, the ASARCO El Paso smelter has addressed this issue by capturing and controlling all converter building "uncollected" fugitives.

No ambient TSP/HAP monitoring is performed on a routine basis at any of the smelters in the border region, though Arizona smelters do perform ambient PM_{10} monitoring and analyze the collected particulate for metals. This PM_{10} monitoring is performed as a component of a SIP PM_{10} attainment demonstration requirement. Again, Annex IV is sufficient alone to justify adding TSP/HAP monitors at selected locations near the smelters. It is important to note that more accurate fugitive HAP test programs may show that a number of additional smelters in the border region are major sources of HAPs and will be subject to the MACT standard for primary copper smelters. This would serve as additional justification for ambient monitoring of HAPs. Finally, the U.S. has had a federal standard NAAQS for lead for almost thirty years. Operating ambient lead monitors near major stationary sources of lead emissions is readily justified based on the need to determine whether or not the federal standard for lead is being exceeded near the source. Given there is also a federal standard for PM_{10}, this same rationale can be used to require the siting of PM_{10} monitors near major sources of PM_{10} emissions.

3.1.3.2 Mexican Smelters in the Border Region

3.1.3.2.1 Nacozari Smelter

Particulate removal is necessary to ensure that all furnace and converter gases are cleaned before entering the acid plants. The acid plant particulate control system achieves greater than 99 percent removal of particulate/HAPs. The opacity standard that the company uses is 20 percent or less for acid plant stack emissions. Ordinarily there is little or no visible smoke from the main stack.

There has been no particulate/HAPs monitoring of fugitive emissions in any portion of the smelter to date. There are primary hoods above the converters, and plans to install secondary hoods in 1998. No other process or building at the smelter directs process gases to the acid plant.

Arsenic percentages in matte entering the converter were quite high in the years for which data is available (1990-1991) compared to U.S. smelters, averaging 1,200-2,100 ppm or 0.12-0.21 percent. U.S. smelters averaged 0.01-0.11 percent. These averages indicate that uncollected fugitives are high in arsenic.

Lead levels in the concentrate entering the smelter furnace were about average compared to U.S. smelters. Lead concentration averaged approximately 0.06 percent compared to a range of 0.01-0.45 percent for all U.S. smelters. Lead and arsenic are product flaws if they end up in copper anodes or cathodes, and lower the value of the copper.

3.1.3.2.2 Cananea Smelter

There has been no air monitoring for HAPs at the smelter or in ambient air surrounding the smelter. Neither baghouses or electrostatic precipitators are in operation at Cananea. There is no control equipment that would reduce HAPs emissions levels. Mexicana de Cananea has reported concentrations of 0.13 percent lead and 0.15 percent arsenic in concentrate entering the smelter for the period 1995-1997.

The city of Cananea is built on hills and canyons in line with the stack which is about 200 feet in height. Local residents and workers face high potential health risks from smelting. Statewide and national data from Secretaría de Salud (Salud 1991, Salud 1996) indicate that high levels of respiratory disease and respiratory cancers are found in Cananea.

3.1.3.3 Current Smelter Practices: Ambient Particulate and HAP Monitoring, Recordkeeping and Reporting

No smelter subject to Annex IV currently operates a TSP or PM_{10} ambient monitoring network. Potential health effects and current lack of accurate data indicate the need for effective quatification of ambient particulate HAPs. The EPA's ambient lead monitoring method specifies collection of TSP followed by atomic absorption (AA) analysis of the filter for lead. Performing ambient PM_{10} monitoring in the vicinity of the smelters subject to Annex IV is also advisable, given that PM_{10} is the only ambient particulate standard in the U.S. at this time and copper smelters are a potentially large source of PM_{10} emissions.

A practical incentive for performing ambient TSP and PM_{10} monitoring is that this type of monitoring is relatively inexpensive. TSP monitors typically cost between $2,500 and $3,000. PM_{10} monitors typically cost between $5,000 and $6,000. Sampling is normally conducted once every six days for a 24-hour period. For remote locations without electricity, solar power supply systems are available. Approximately sixty filters would be required per monitor per year, at a cost of less than $2.00/filter. Gravimetric analysis (weighing) of filters is an inexpensive procedure. AA analysis of a limited set of metals would be the most expensive ongoing cost associated with this type of monitoring program. A reasonable AA analytical cost per sample for a limited set of metals, such as lead, arsenic, antimony, and zinc, assuming a large number of analyses, would be in the \$30/sample to \$50/sample range. All smelters have modern analytical laboratories on site, and the possibility exists that the gravimetric and AA analyses could be performed onsite to minimize analytical expenditures.

Following the logic developed in Section 3.1.2 for ambient SO_2 monitoring, a common sense approach to ensuring that maximum short- and long-term stack and fugitive particulate HAP and PM_{10} emissions are effectively quantified would include monitors located at the following points:

- Long-term MGLI for stack particulate HAP and PM_{10} emissions;
- Short-term MGLI for stack particulate HAP and PM_{10} emissions;
- Long-term MGLI for fugitive particulate HAP and PM_{10} emissions;
- Short-term MGLI for fugitive particulate HAP and PM_{10} emissions;
- Leading edge of any community in reasonable proximity to the smelter (within 20 kilometers).

EPA air dispersion modeling guidelines (EPA 1995b) do permit facilities to forego ambient PM_{10} monitoring if the facility can conclusively demonstrate through the use of approved modeling that no violations of ambient PM_{10} short-term (24-hour average) and long-term (annual average) standards are occurring. This option is available for facilities that prefer to opt out of ambient PM_{10} monitoring by using air dispersion modeling to demonstrate compliance with ambient standards. It is important to note that the modeling option presupposes that the facility has an accurate emissions estimate for uncollected fugitive PM_{10} emissions.

This option is not necessarily appropriate for particulate HAPs monitoring, as the accuracy of any model prediction depends heavily on the emissions estimate used in the model. The uncollected fugitive particulate HAP emissions estimates presented by U.S. smelters to date suggest that there is a large degree of uncertainty in these HAP emissions estimates. For this reason, ambient monitoring would appear to be a more appropriate means of assessing the significance of particulate HAP emissions than dispersion modeling, at least until the accuracy of uncollected fugitive particulate HAP emissions can be validated.

3.1.3.4 Particulate/HAPs Monitoring/Reporting Recommendations

The project team recommends that:

1. Smelters perform a comprehensive and defensible fugitive HAP emission quantification study. With the exception of the ASARCO El Paso smelter, use the ASARCO Hayden November 1995 fugitive HAPs quantification study as the standard to plan and conduct the fugitive HAP emissions study. The ASARCO El Paso smelter is unique in that the smelter has a tertiary control system in the converter building and collects and controls virtually all converter building fugitives.
2. Worker monitoring for HAPs should be a component of the fugitive HAP emission quantification study. If worker exposure levels to HAPs exceed established permissible exposure limits, it is recommended that secondary hoods be installed around principal process equipment and exhaust gases from this equipment be directed to a high efficiency particulate control device.
3. Minimum coverage should include an ambient particulate HAP monitor and a PM_{10} monitor located in parallel at the following MGLI locations: (1) long-term PM_{10} MGLI for tall stack emissions; (2) short-term PM_{10} MGLI for tall stack emissions; (3) long-term PM_{10} MGLI for uncollected fugitive emissions; and (4) short-term PM_{10} MGLI for uncollected fugitive emissions. In addition, one ambient PM_{10} monitor should be located at the leading edge of any community (relative to the smelter) within 20 kilometers of the smelter. As stated in Section 3.1.2.3, it is important to emphasize that in some cases the closest population center is a worker housing area.
4. If there is more than one population center within 20 kilometers of the smelter, locate a TSP/HAP monitor at the leading edge (relative to the smelter) of each population center within 20 kilometers of the smelter. If there are no population centers within 20 kilometers of the smelter, locate a TSP/HAP monitor at the leading edge of the nearest population center.
5. Perform appropriate air dispersion modeling to identify the modeled point(s) of maximum PM_{10} impact for 24-hour and annual time periods. The PM_{10} modeling results will serve to

locate both the particulate HAP monitors and the PM_{10} monitors. The TSP monitors must use quartz filters to permit accurate quantification of heavy metals such as arsenic and lead.

6. PM_{10} monitors should be located in parallel with the TSP monitors. This will permit quantification of the component of TSP that may cause adverse health effects independent of the chemical composition of the particulate. PM_{10} monitoring will also permit a direct comparison of the inorganic metals composition in TSP and in the respirable component (PM_{10}) of TSP.
7. TSP/HAP and PM_{10}/HAP sampling should be conducted for 24 hours every six days and for continuous 24-hour increments during any extended upset condition.
8. Comprehensive QA-QC records should be maintained showing the percent of time that the TSP and PM_{10} monitors operate and the criteria used to determine "good" data.

3.2 Bi-National Quality Assurance Review Team

A binational audit team may be the most efficient mechanism available for evaluating smelter compliance with the terms of Annex IV. As stated earlier, the primary purpose of the audit team would be to ensure that all relevant historical siting information, calibration/audit reports, and emission monitoring results are consolidated in one place and disseminated to interested parties on both sides of the border. In some cases, the function of the audit team would consist of receiving and reviewing copies of periodic quality assurance audits and summary reports that are already conducted by state agencies, independent auditors, or smelter personnel. In other cases, where routine audits are not performed, the binational team may need to perform the audit to evaluate whether data quality is acceptable.

A permanent bi-national audit team selection committee could determine the composition of the audit team. The bi-national audit team selection committee would function under the auspices of the Air Working Group. The bi-national audit team selection committee would consist of high level air quality and health experts from U.S. and Mexican environmental agencies that have demonstrated experience in the technical areas to be addressed by the audit review team.

The audit review team would consist of four air quality and/or health effects technical specialists from the U.S. and Mexico. These specialists would include: one U.S. consultant, one Mexican consultant, one EPA representative and one INE representative. Once a year the audit review team would conduct a thorough quality assurance review of all monitoring/calibration, recordkeeping and reporting procedures conducted at each smelter subject to Annex IV. The audit team would be led by either the U.S. or Mexican consultant, with the leadership responsibility alternating each year. Following consultation with all audit team members, summary audit review reports will be issued by the U.S. consultant for U.S. smelters and by the Mexican consultant for Mexican smelters. All four audit team members will approve and sign the audit review reports for both U.S. and Mexican smelters before these reports are released as final documents. The audit review team will be led by either the U.S. or Mexican consultant to eliminate the possibility that an agency representative is the lead author on a document that may be critical of agency procedures.

The audit review team will work closely with smelter environmental engineering personnel and appropriate state agency personnel during the course of the audit review. In addition, a local health effects specialist will be invited to participate in the audit review for each smelter. Using the Cananea smelter as an example, a technical representative from the Centro de Salud and Seguro Social in Cananea could be added to the proposed binational auditing team specifically for the Cananea audit review.

The proposed responsibilities of the audit team include:

1. Requesting and reviewing all monitoring, calibration, recordkeeping and reporting data from each smelter to determine compliance with the monitoring, calibration, recordkeeping and reporting requirements of Annex IV. The review process would be conducted in the offices of the consultants and agency representatives. If the audit data requested from the smelters is insufficient to determine compliance with Annex IV requirements, a site visit would be arranged to gather the necessary information, if appropriate.
2. Performing the audit review on an annual basis. Annex IV requires quarterly submittal of

information demonstrating compliance with Annex IV monitoring, recordkeeping and reporting requirements. Periodic calibration audit procedures, such as periodic RATAs (stack CEMs) or multi-point calibration audits (ambient SO_2 monitors), are often performed on longer time intervals, such as six months or a year. An annual review of smelter monitoring, recordkeeping and reporting procedures would permit an evaluation of a complete "cycle" of routine and periodic audit procedures conducted at the smelters subject to Annex IV.

3. Confirming completeness of smelter compliance with the monitoring, recordkeeping and reporting requirements of Annex IV. Identify and deficiecies, discrepancies or omissions in the data summitted by the smelters.
4. Recommending that a third party firm be contracted to conduct certain audit procedures, if the audit team determines that these procedures, such as periodic RATAs (stack CEMs) or multi-point calibration audits (ambient SO_2 monitors), are not being performed at appropriate intervals. The audit review team members will be prohibited from bidding on or conducting these equipment audits to avoid a potential conflict of interest.
5. Consolidating all audit-related information. All audit related information requested from the smelters would be provided to one point of contact, either the U.S. or Mexican consultant, so that the audit-related data for any given year is consolidated in one location. This will facilitate the audit review team's ability to respond to any technical information requests from the audit review team selection committee or the Air Working Group.
6. Providing separate U.S. and Mexican smelter audit review reports. These reports will be issued within 90 days of the mailing of data requests to the smelters subject to Annex IV. These will be public documents available through appropriate EPA and INE public information channels.
7. Providing feedback to the Air Working Group on SO_2 STP community notification procedures utilized by each smelter, if any. This feedback would include: 1) a summary of the SO_2 STP data available in each smelter community, and 2) description of the STP community notification procedures in use by the smelters.

4.0 Guidelines for Community Notification in Event of SO_2 Exceedances

An evaluation has been conducted of the advisability of providing community notification in case of: NSPS exceedance, emission control system bypass, projected high SO_2 "Short Term Peaks" (STPs) or longer exposure and/or actual exceedance of the ambient SO_2 standard. This section addresses the following issues:

- SO_2 STP health effect levels;
- Relationship between SO_2 1-hour average and 5-minute STP;
- Number of SO_2 STP excursions at controlled and uncontrolled smelters;
- STP monitoring and response options to high SO_2 levels;
- Possible notification mechanisms.

4.1 SO_2 Short Term Impacts On Health

4.1.1 Regulatory History

In January of 1997, the EPA (EPA 1997) proposed a new Intervention Level Program (ILP) for the control of short-term SO_2 peaks, under the authority of Sections 301(a)(1) and 303 of the Clean Air Act. The ILP is the proposed agency response to the finding that repeated exposures to 5-minute STP SO_2 levels of 0.6 ppm and above could pose a risk of significant health effects for asthmatic individuals at elevated ventilation rates in some localized situations. This program is to be run by the States and tribes with EPA assistance as necessary and will supplement protection already provided by the primary and secondary NAAQS for SO_2. The program establishes 5-minute concern and endangerment ambient air levels of 0.6 ppm and 2.0 ppm of SO_2, respectively, for reasons discussed below.

The effort to address short-term peaks was an outcome of EPA review of the existing SO_2 NAAQS which occurred in 1994, and the body of health studies concerning the effects of short-term SO_2 peaks on asthmatics. These studies were reviewed by the staff, and on March 7, 1995 the EPA proposed to address high 5-minute peaks, through one of three proposed regulatory measures. The EPA then requested, received, and reviewed public comment on these measures, and determined that the proposed regulatory measures were not appropriate, but that the ILP should be established. These findings were reported in the Federal Register of May 22, 1996, and the ILP was proposed on January 2, 1997.

4.1.2 Sensitive Populations

The health justification for the proposed ILP is based on effects within a subsection of the population, specifically mild and moderate asthmatics of all ages engaged in outdoor physical activity. Moderate physical activity is defined by ventilation rates of roughly 30 to 50 l/min and would include activities such as climbing hills or stairs, playing tennis, light jogging, shoveling snow, etc. This would also include certain types of manual labor as well.

The chosen concern and intervention ambient levels are not directly based upon decreases in lung function symptoms or effects on other potentially sensitive individuals, including severe asthmatics and atopics. Atopics are individuals with environmental hypersensitivities, such as hay fever and
other allergies. About 8 percent of the U.S. population is atopic. It was concluded that severe asthmatics were unlikely to achieve requisite ventilation rates during outdoor activity to experience effects. There is no evidence that atopics are as sensitive to SO_2 as asthmatics (EPA 1994).

However, it was noted (EPA 1994) that moderate asthmatics without adequate access to the health care system may not be adequately medicated and suffer "frequent deterioration of their lung function" as a result, and that "because of the lower baseline function in moderate and severe asthmatic persons, .. any effect of SO_2 would further reduce their lung function toward levels that may be cause for medical concern."

In the U.S., 4 percent of the population, or roughly 10 million people, are estimated to have asthma, and the prevalence is higher in African-Americans, children 8 to 11 years old, and urban residents, according to the EPAs supporting documentation. In a sociodemographic general screening analysis of case study areas identified by the EPA, the agency found that "there is an indication that a disproportionate number of children and households below the poverty level are exposed to short-term SO_2 peaks. There are roughly twice as many households below the poverty levels and twice as many children residing in the case study areas as compared to the national averages."

4.1.3 Characteristics of Smelter SO_2 Emissions

4.1.3.1 General

EPA's review of SO_2 levels across the U.S. has led to the understanding that short-term values of SO_2 greater than the concern level 0.60 ppm, are found in the vicinity (<20 kilometers) of major point sources (EPA 1994). This concept, that the problem is geographically limited, is part of the justification for the decision not to set a 5 minute SO_2 NAAQS and to develop the ILP which will be implemented by only the affected States and tribes. On the U.S.-Mexico border, the occurrence of STPs may be more widespread due to the use of high sulfur fuel in Mexico.

The specific characteristics of the point source and the surrounding environment are critical to the risk of exposure to short-term ambient levels of SO_2 which exceed the concern and intervention levels. The combination of SO_2 with other air pollutants, such as O_3, NO_2, and particulates below 10 microns may cause greater effects than exposure to SO_2 alone. The local terrain and meteor-
ology affect the likelihood of the SO_2 reaching sensitive populations. For example, broncho-constriction may be compounded by higher elevation and cold, dry air conditions present in the natural environment around border smelters.

4.1.3.2 Relationship of 5-Minute SO_2 STP Concentrations to 1-Hour SO_2 Concentrations

In 1995, the Texas Natural Resources Conservation Commission (TNRCC) conducted an analysis of 5-minute and 1-hour SO_2 concentration data collected by the TNRCC SO_2 monitor located on the University of Texas El Paso campus. This monitor is sited to monitor MGLI SO_2 emissions from the ASARCO El Paso smelter. The maximum 5-minute average concentration was as much as ten times higher than the 1-hour average recorded by this monitor. This comparison indicates that 5-minute STPs that reach significant health impact levels can be occurring even when the 1-hour average is far below a level of concern. The TNRCC 5-minute to 1-hour comparison data is shown in Appendix I.

4.1.3.3 SO_2 Emission Characteristics of Highly Controlled Smelters

The BHP San Manuel Smelter in Arizona is one of the most effectively controlled smelters in North America, averaging 98.5 percent sulfur capture. Controlled annual SO_2 emissions from the BHP smelter are less than 10,000 tons/year. If uncontrolled, annual SO_2 emissions from the BHP smelter would exceed 700,000 tons/year.

BHP conducted 6-minute STP monitoring from 1989 to 1992. BHP reinitiated 5-minute STP monitoring in 1995 and continues to collect 5-minute STP data. The table below shows the number of 5-minute SO_2 STPs above 0.6 ppm compared to the number of exceedances of the 0.50 ppm 3-hour standard (1,300 $\mu g/m^3$) at the BHP smelter in 1995 and 1996:

Comparison of 5-Minute and 1-Hour SO_2 Concentrations at BHP Smelter

Year	Number of 5-Minute Averages Above 0.6 ppm	Number of 3-Hour Averages Above 0.50 ppm
1995	31	0
1996	25	0

This data indicates that even highly controlled smelters experience 5-minute SO_2 STPs that exceed the concern level of 0.6 ppm on a periodic basis.

4.1.3.4 SO_2 Emission Characteristics of Partially Controlled or Uncontrolled Smelters

The table below shows the number of 3-hour and 24-hour SO_2 NAAQS exceedances recorded during the late 1970s at three smelters in the border region. The time period included in the table represents a period when SO_2 emissions from the furnaces and/or converters at these smelters were either uncontrolled or partially controlled.

Number of 3-Hour and 24-Hour SO_2 Exceedances Measured at Selected Smelters with Uncontrolled or Partially Controlled SO_2 Emissions in Late 1970s (ADHS 1985)

Year	Smelter	Number of 3-Hour Exceedances ($\geq$ 0.50 ppm)	Number of 24-Hour Exceedances ($\geq$ 0.14 ppm)
1978	1. ASARCO Hayden	13	9
	2. BHP San Manuel	24	3
	3. Cyprus Miami	34	14
1979	1. ASARCO Hayden	40	21
	2. BHP San Manuel	19	6
	3. Cyprus Miami	56	21

Based on the above data, it can reasonably be assumed that a smelter with partially or uncontrolled furnace and converter emissions will have a significant number of 3-hour and 24-hour SO_2 NAAQS exceedances in any given year. The BHP smelter 5-minute STP data for 1995 and 1996 indicate that a relatively large number of 5-minute STP periods at concentrations above the concern level of 0.6 ppm can occur even when there are no exceedances of the 3-hour SO_2 NAAQS. A reasonable conclusion from all this information is that a large number of 5-minute SO2 excursions above the 0.6 ppm level of concern are occurring at smelters that record excursions of the 3-hour and 24-hour SO_2 NAAQS.

Cananea is the only uncontrolled smelter currently operational in the border region subject to Annex IV. The estimated annual SO_2 emissions from this smelter are approximately 150,000 tons/year. It is reasonable to assume that a large number of 5-minute SO_2 STP excursions above

0.6 ppm are occurring in the vicinity of the Cananea smelter, given the late 1970s data available for uncontrolled and partially controlled U.S. smelters.

4.1.4 Duration of Short-Term Peaks

The EPA determined that the concern and intervention levels would be set based on the maximum hourly 5-minute block average, which is the highest of the 5-minute averages from the 12 possible nonoverlapping periods during a clock hour. The basis for this duration is EPA health studies, in which it was found that . . . "bronchoconstriction (airway narrowing), usually evidenced as increased airway resistance, decreased "forced expiratory volume in one second" (FEV1), or decreased peak flow, and the occurrence of symptoms such as wheezing, chest tightness, and shortness of breath, does not reach maximal levels until the exposure lasts five or more minutes." It was noted in the 1994 Supplement, however, that these symptoms can occur within an exposure time of less than 5 minutes. Conversely, "... longer periods of exposure while at exercise do not lead to a statistically significant worsening of the initial response."

The effects of short-term SO_2 peaks were found to be relatively transient. Lung function usually returns to normal within an hour of exposure, and exposure to a high short-term peak of SO_2 does not seem to induce the particularly dangerous late-phase response more typical for allergens, such as pollen and dust mites. Late-phase inflammatory responses often occur 4-8 hours after exposure and are often much more severe and dangerous then earlier immediate responses. However, 5-minute peaks were nonetheless found to be sufficient to create significant negative health impacts, as discussed below.

4.1.5 Exposure Levels

The concern and intervention levels proposed by the EPA for the ILP were based on health studies evaluated during the NAAQS review. The reviews completed in 1986 and 1994 revealed that as a result of short-term exposure to 0.6 ppm SO_2, both FEV1 decreased and specific airway resistance increased markedly in the most sensitive 25% of mild-to-moderate asthmatics at elevated ventilation rates when compared to their response to clean air. The EPA Administrator concluded in the May 22, 1996 final decision on the SO_2 NAAQS that a substantial percentage, defined as 20 percent or more, of mild-to-moderate asthmatic individuals exposed to 0.6 to 1.0 ppm SO_2 for 5 to 10 minutes at elevated ventilation rates, such as would be expected during moderate exercise, would be expected to have lung function changes and severity of respiratory symptoms that clearly exceed those experienced from typical daily variation in lung function or in response to other stimuli, such as moderate exercise or cold/dry air. At this level, many responders are likely to interrupt what they are doing, take bronchodilator medication, and/or seek medical attention in reaction to the severity of the effects they are experiencing.

The 2.0 ppm SO_2 intervention level is based in part on the understanding that at 5-minute peak SO_2 levels of 2.0 ppm and above, 80 percent of active mild-to-moderate asthmatics will respond. This higher level is accompanied by an EPA determination of imminent and substantial endangerment, that exposure of a sensitive population to a 5-minute ambient concentration of 2.0 ppm or above would pose an imminent and substantial endangerment to public health and welfare and, therefore, would justify corrective action under the authority of Section 303.

4.1.6 EPA's Proposed Implementation of the Short-Term SO_2 ILP

Through the ILP, the EPA is proposing to give States and tribes the power to: (1) analyze point sources for their potential to produce short-term ambient SO_2 peaks which exceed the concern and intervention levels; and (2) to address the situation in concert with the smelters and the surrounding communities. It is recommended in the proposed rule that the States or tribes use area-specific analyses to develop an effective program for each point source. The key to this program is, in essence, the interaction between the point source and the surrounding communities. Once a problem is identified, the control program would include actions to reduce emissions, or in cases where such actions are deemed inappropriate, alternative approaches would be employed such as community notification.

During the area-specific analysis, the State or tribal agency is encouraged to consider: (1) the magnitude of the 5-minute peak concentrations; (2) the frequency of the episodes, based on those episodes detected by monitors and an estimate of the number of 5-minute peaks not recorded by the monitoring network; (3) the history and nature of citizen complaints; (4) available information on potential population exposure, inferred in part by the population in the vicinity of the source; (5) the type of process being used, as one type of process within a source category may be less efficient and known to emit more SO_2 than another; (6) the history of past upsets or malfunctions; (7) the type of fuel used; (8) knowledge of how well the source is controlled; and (9) any other considerations the State or tribe finds to be appropriate.

The proposed rule emphasizes the gathering of information which describes the actual potential for exposure in each community. In part, this is because "the use of models is not currently an effective means for predicting 5-minute SO_2 excursions." The reasons for this are: (1) model validation studies have not been conducted to determine if existing SO_2 STP models can estimate with sufficient accuracy to be used in a regulatory context; (2) it is difficult to obtain accurate source emission data for 5-minute periods, since such data often depend on attempting to measure emissions that may occur infrequently and at unpredictable times, concentrations, and flow rates; and (3) a method for determining the expected frequency of emission releases due to malfunctions would have to be employed in order to model these releases. Likewise, for the sources affected by Annex IV, air pollution models are poor indicators of actual exposures experienced by the surrounding populations. Therefore consistent and accurate monitoring which can reflect short- and long-term SO_2 peaks needs to be developed and maintained for these sites.

Among the preventive measures suggested in the proposed rule regarding 5-minute SO_2 peaks are: (1) better maintenance of control equipment; (2) better control of stack and fugitive emissions; (3) raising the stack height; (4) restriction of operations during times of peak exposure, for example conducting activities during hours when fewer people are outside; or (5) other innovative courses of action that address the health risk from short-term SO_2 peaks.

A stopgap "control" method to reduce ambient SO_2 levels applied to smelters in the 1970s-80s with inadequate continuous control was the use of SCS to curtail production to avoid or end exceedances of SO_2 NAAQS ambient standards. This approach may be useful to avoid STPs in Cananea when concern and/or intervention levels of SO_2 are imminent or present. When a State or tribal investigation reveals that control measures are not the best alternative, alternative approaches can be considered, such as public education campaigns for asthma prevention, public warning/ notice of potential health problems due to peak episodes (such as a local alert system, posting of areas where short-term peaks occur), or providing support for State, tribal or other local public health programs. Should an alternative approach be chosen, the State/ tribe should ensure that the alternative measures required of the source are federally enforceable.

4.2 Technical Issues Involved In Monitoring STPs And In Establishing Community Notification Plans

Accurate ambient monitoring for SO_2, as well as other pollutants, requires as a prerequisite a sound technical justification for the monitoring locations chosen. Historically in the U.S., multi-topographical modeling of ambient SO_2 monitoring has been used to predict the highest 3-hour and 24-hour concentrations. Multi-topographical modeling was used frequently in the 1970s to site ambient SO_2 monitors around smelters that had little or no SO_2 emissions control. These smelters used the monitors as a component of a SCS. The ambient SO_2 concentration data was used, in combination with meteorological data, to determine when a reduction in production was necessary to avoid SO_2 NAAQS exceedances.

Mexicana de Cananea has indicated that some form of SCS will be incorporated in the near-term for the Cananea smelter. The Cananea smelter currently operates a five-monitor ambient SO_2 monitoring network that could be adapted to function as a component of a SCS.

Once the SCS indicates that a SO_2 level of concern is about to be reached, the control measures to reduce SO_2 emissions would be initiated by the smelter. Typically the converters would be withdrawn from operation when meteorological data indicate the likelihood of SO_2 concentrations that exceed the 5-minute STP level of concern concentration of 0.6 ppm, or the equivalent Mexican level of concern. Furnace production would also be reduced to further drop SO_2 emissions. Such actions would be taken whenever SO_2 levels appear to be rising on the monitors.

In the case of a highly controlled smelter, any 5-minute SO_2 STPs above the 0.6 ppm level of concern that occur during normal operation of the smelter would probably be due to uncollected fugitive emissions. The short-term solution to STP exceedances of this type might consist of notifying sensitive individuals, or notifying sensitive individuals and cutting production simultaneously. The long-term solution may be to capture uncollected fugitives and eliminate uncollected fugitives as a cause of SO_2 STPs.

4.3 Record Exchange And Programming To Improve Monitoring And Response

It is important to emphasize that the ability to either predict in advance the potential for STPs and/or to respond immediately when an STP occurs is integral to the effectiveness of any community notification plan. Realtime electronic data acquisition system (DAS) computer software, often in a Microsoft Windows™ format, is readily available that can both initiate an alarm and diagnose conditions (such as emissions, monitor status, meteorology, etc.) when SO_2 levels exceed a certain level in a certain period (such as 5-10 minutes). The DAS can also be programmed to dial selected phone numbers when certain alarm conditions are present. Asthmatics in the community could be equipped with pagers (or similar link) and notified automatically by the DAS in realtime when an STP exceedance occurs.

The DAS also could provide a simple means to develop data to share and exchange under Annex

IV provisions and could be programmed to present a list of names of asthmatics and institutions requiring notification in a smelter community should any of the following conditions occur: high short term SO_2 levels; high 3-hour or 24-hour averages; control equipment bypasses; or exceedances of stack emission limits.

Data on levels of HAP pollutants common to smelter emissions, for example arsenic, lead, cadmium, antimony, zinc, and copper, are lacking in most smelter communities. Existing copper smelter HAP control requirements in the U.S., specifically for inorganic arsenic, are triggered only by the concentration of HAPs in the converter feed. No U.S. smelters are currently required to control HAPs based on this standard.

Although rapid response to measured levels of particulate HAPs such as lead or arsenic is not practical, as there is normally a minimum 3 to 5 day delay in obtaining analytical results, community understanding of the levels of exposure to these contaminants could lead to further decisions on whether, and to what degree, controls are needed.

4.4 Community Notification Procedures In Mexico

In the communities of Nacozari and Cananea, as in most of Mexico, an emergency response system is in place. The smelters are responsible for notifying the Municipio and Protección Civil in case of a hazardous materials emergency. Available emergency response systems can be modified to provide notification when any of the following conditions occur: (1) SO_2 STPs; (2) planned higher levels of SO_2 emissions due to equipment problems; and (3) unplanned break-downs in control equipment that may result in high STPs or possible exceedances due to poor meteorological conditions. The notification process itself could be no more advanced than a simple local telephone "tree" which targets the most sensitive populations. Each country should be looked at for distinct ways to approach the community notification procedure, due to the differing nature of their social networks and communities in addition to official networks. Mexico City's *Red Automática de Monitoreo del Aire* (RAMA) network provides a good example of a successful air pollution community notification system. RAMA detects *Indice Metropolitano de Calidad del Aire* (IMECA) violations, usually high ozone, and enters into broad communi-cation with decisionmakers to reduce emissions on a near realtime basis.

Mexicana de Cananea's Ing. Del Castillo made the following comments regarding the implementation of an SO_2 community notification procedure for Cananea:

1. If SCS is applied in the short term, monitoring and notification to implement an SCS may become the basis for community notification. Continuous monitoring indicating high SO_2 levels would result in the notification of the proper authorities within the community (such as the Presidente Municipal and Protección Civil), as well as a reduction in production at the smelter.
2. Protección Civil should be in charge of community notification through the office of the Presidente Municipal, with appropriate links to local media, as well as schools, hospitals, and other sensitive populations in the region of impact.
3. Mexicana de Cananea is open to suggestions on siting and calibrating monitors.
4. A means to provide audible notice to the community of high expected or actual levels of SO_2 could be developed. Different tones could be applied to different sections of Cananea. He suggests that a siren may not be an appropriate signal due to the associations with other disasters (such as air raids).
5. A list of asthmatics in the community could be prepared and these asthmatics notified in case of an STP occurance.

Under the 1997-1999 Licencia de Funcionamiento, the Cananea smelter will be required to curtail production when atmospheric conditions would result in high ambient levels of SO_2. An SCS-type monitoring system may be used to determine when production curtailments are necessary. This SCS process could also include notifications to individuals impacted by SO_2, as well as monitoring that integrates recording of SO_2 STPs.

4.5 Community Notification Procedures In the U.S.

Although similar measures to those described for Cananea would be appropriate in the U.S., coordination would probably be less formal. Emergency response plans are shared between counties, cities, law enforcement, and emergency service agencies in the U.S. A health-based SO_2 STP notification system would probably be a site-specific system based on discussions between the smelters, electronic media, health institutions, schools and other stakeholders. The recom-mended forum could bring in appropriate experts in the areas of community notification and response.

4.6 Recommended Steps to Develop Community SO_2 STP Notification Procedures

The alternative approaches suggested by the EPA for sites affected by SO_2 STPs provide options for possible Annex IV community STP notification requirements. Public meetings and binational working sessions addressing issues specific to each country and community are a logical first step in developing effective STP community notification procedures. These meetings would address how best to implement monitoring and notification programs to protect smelter communities from exposure to SO_2 short-term or longer-term exposures.

Some generalizations can be made regarding community notification issues that will need to be addressed at the public meetings. The literature suggests that those negatively impacted by SO_2 STPs are mild to moderate asthmatics who are physically active. Smelter workers with asthma are another group potentially adversely affected by SO_2 STPs. Workers may be exposed to STPs during their non-working hours as well as during their working hours. This would be particularly true near the Hurley, Cananea, and Nacozari smelters, where the workers live within 2 to 3 kilometers of the smelter.

Sensitive individuals may potentially be found at the following locations: (1) day care centers; (2) schools; and (3) sports facilities. These entities should be among the first to be notified of

SO_2 STPs. Highly populated areas, such as downtowns, markets, and mall parking lots are also likely sites for notifications. Worker housing locations would be obvious sites for notification, as well as the workplace itself if monitoring demonstrates persistent high exposure. For example, since the majority of thermal inversions that trap SO_2 occur during morning hours resulting in a higher probability of STPs occurring during this time of day, notification would be critical for those working or engaged in athletics outside during the morning hours, such as road crews, construction or agricultural workers, and sports teams. However, a notification program operational at all times of the day would be important as any SO_2 peak above 0.6 ppm can have severe effects.

There may be little the affected individuals can do during SO_2 STPs other than cease exercise, use bronchodilator medication or go indoors and close windows, and use closed cooling/heating/ventilation systems. However, these steps will greatly reduce the health impacts of the STP on sensitive individuals than would otherwise occur if physically strenuous activity were to continue during the STP.

5.0 Smelter Investments in Air Pollution Control Equipment Since the Signing of Annex IV in 1987

The table below indicates the cost and type of air pollution control equipment investments made by smelters subject to Annex IV since the Annex was signed in 1987:

Investments in Air Pollution Control Equipment by Smelters Subject to Annex IV Since Signing of Annex in 1987[a]		
Smelter	Cost of Air Pollution Control Equipment ($US)	Description of Air Pollution Control Equipment
1. ASARCO El Paso	$25,000,000	Air pollution control equipment associated with the CONTOP furnace modification project (1993).
2. PD Hurley	$10,000,000	Baghouses to control secondary converter hooding exhaust gas (1996).
3. PD Hidalgo	$14,000,000	Converter secondary hooding, matte and slag tapping hooding and associated baghouses (1994).
4. Cananea	$0	No pollution control equipment has been added.
5. Nacozari	$60,000,000	Second acid train put in operation in 1997. Secondary converter hooding and associated baghouse also put in operation in 1997.
Note (a): Costs for the initial acid plant constructed at Nacozari in 1987-1988 are not included, as this investment was made explicitly to comply with the SO_2 emission limits established in Annex IV.		

All smelters in the border region subject to Annex IV continue to invest in air pollution control systems over time, with the exception of Cananea. If the proposed NOM-091-ECOL-1994 is not promulgated, Cananea will be under no regulatory mandate to control SO_2 emissions or close the facility. The fact that Cananea is not investing in air pollution control systems actually provides the smelter with a competitive advantage over other smelters in the region that are complying with the 650 ppm SO_2 Annex IV limit. Cananea has estimated a cost of $25,000,000 to modify the furnaces and install an acid plant at the smelter. This cost is on the same scale as the investments in air pollution control equipment at other smelters subject to Annex IV over the past ten years. Given this cost scenario, it is recommended that adoption of the proposed NOM-091-ECOL-1994 emission limits and timelines be considered for the region subject to Annex IV regardless of whether these limits and timelines are adopted for all of Mexico.

6.0 Expansion of Number of Major Source Categories Addressed by Agreement

6.1 Additional Primary Copper Smelter Sources: Roasters and Dryers

Annex IV currently regulates only SO_2 emissions from primary copper smelter furnaces and converters. The project team has performed a preliminary assessment of other copper smelter emission points that could be regulated under Annex IV, such as roasters and dryers. NSPS Subpart P, Standards of Performance for Primary Copper Smelters, subjects roasters, smelting furnaces, and copper converters to the 0.065 percent SO_2 emission limit. Dryers are subject to a particulate limit of 50 mg/m^3 and an opacity limit of 20 percent. The sulfuric acid plant at any smelter using a sulfuric acid plant as a control device to comply with the NSPS Subpart P 0.065 percent SO_2 emission limit is subject to a 20 percent opacity limit.

The proposed emission limits for existing and new Mexican copper and zinc smelters are essentially the same as those limits established in NSPS Subpart P. These limits were originally published as a proposed "Norma Oficial Mexicana" on September 20, 1994 [NOM-091-ECOL-1994]. The proposed limits are shown in Section 7.2.1.

Annex IV does not explicitly identify what sources within a copper smelter beyond furnaces and converters are subject to the 0.065 percent SO_2 emission limit. It is appropriate that Annex IV explicitly identify roasters as subject to the 0.065 percent SO_2 emission limit, given that the federal legislation in both the U.S. and Mexico subjects roasters to this 0.065 percent SO_2 emission limit. This same logic is applicable to opacity and PM_{10} emission limits for copper smelter dryers, as both NSPS Subpart P and the proposed NOM-091-ECOL-1994 require the same opacity, 20 percent, and PM_{10} emission limits, 50 mg/m^3, for copper smelter dryers.

6.2 Additional Nonferrous Metal Smelting Sources

In light of the recent Commission for Environmental Cooperation (CEC) Agreement on Transboundary Environmental Impact Assessments (EIAs) for North America, it becomes more important to continue the analytical process begun in this report and apply it to other point sources that could be impacting domestic or transboundary airsheds in the border region and should be regulated under the La Paz Agreement. The project team has performed a very preliminary assessment of other nonferrous combustion sources in the region that could be possible candidates for control under Annex IV (or a separate Annex) based on their contribution to the regional SO_2, PM_{10} and HAPs burden.

The only other major nonferrous combustion sources in the U.S. border region subject to the La Paz Agreement, other than the three primary copper smelters addressed in this report, are the Cyprus Miami Cerita copper roaster and molybdenum smelter facility near Green Valley, Arizona, and the Phelps-Dodge El Paso Refining Company secondary aluminum smelter in El Paso, Texas. Emissions from the Cerita copper roaster and molybdenum smelter facility have been a concern of local residents, the ADEQ, and EPA Region 9. The El Paso Refining Company secondary aluminum smelter is a highly regulated source located in the most contaminated airshed along the U.S.-Mexico border. Beyond gathering emissions data on these two facilities to determine current emissions levels, it does not appear that there is an immediate need to expand Annex IV to include other existing nonferrous metal smelting sources in the U.S border region subject to Annex IV.

Future nonferrous metal smelting operations planned for the border region subject to Annex IV are another matter. The project team has not collected comprehensive data on near-, mid-, and long-range industrial development plans for the border region subject to Annex IV. This will be an important follow-up activity when assessing the possible expansion of Annex IV to include additional source categories.

6.3 Other Major Sources

Power plants and hazardous waste combustors are among the additional source categories that are candidates for inclusion within the La Paz Agreement process, due either to the volume of emissions (power plants) or the toxicity of emissions (hazardous waste incinerators). These source categories are discussed below. Other categories could include petroleum refineries and petrochemical plants, as well as open burning or partial burning of combustible waste, such as municipal solid waste or used tires. Monitoring, recordkeeping, and reporting requirements for sources currently operational or that may be built/modified in the future could be included in the scope of this effort.

6.3.1 Power Plants

Power plants located in the border region currently range from coal-fired plants (Carbon I and II) with no SO_2 control equipment to older coal-fired power plants (Mojave, Nevada) to heavy oil-fired boilers (Rosarito Beach, Baja California) to gas-fired boilers (San Diego County) and gas turbines (Salamayuca). Mexican NOM-085-ECOL-1994 establishes limits for opacity, particulate, NO_x and SO_2 emissions from solid- and liquid-fired stationary combustion sources. Gas-fired stationary combustion sources are subject only to NO_x limits. NOM-085-ECOL-1994 applies to new and existing sources. U.S. New Source Performance Standards (NSPS) establish minimum requirements for boilers and gas turbines constructed since the mid-1970s. U.S. New Source Review (NSR) requirements have resulted in new sources currently being subject to much more rigorous emissions limits and monitoring requirements than those established in the NSPS standards over 20 years ago.

U.S. sources are also generally required to continuously monitor opacity (solid fuel-fired only), NO_x, CO, and SO_2 or fuel sulfur, and report any emission violations in quarterly Excess Emission Reports. The emissions testing requirements in NOM-085-ECOL-1994 subject sources in “zonas críticas”, which includes the border region subject to Annex IV, to periodic source testing and fuel sulfur certification requirements only.

The *Comisión Federal de Electricidad* (CFE) publicly announced (CFE 1997) that electricity demand is growing at a rate of five percent per year in Mexico, and estimates that fifteen new power plants will be tendered in Mexico by the year 2000. The CFE also announced that the Baja California grid will import 220 MW in 1997 and 350 MW in 1998 to cover electricity shortfalls. Given that Baja California represents only a third of the population and industrial base in the Mexican border region subject to Annex IV, an electricity demand growth rate of 500 MW/year is a reasonable estimate for the Mexican side of border subject to Annex IV. The 500 MW figure will be used to evaluate the additional emissions impact of coal, oil, or natural gas power plants complying with NOM-085-ECOL-1994 compared to these same power plants complying with applicable NSPS emission limits.

The two tables below provide a comparison of the potential emissions from power plants complying with applicable emission limits in the U.S. and Mexico. A 500 MW coal-fired or oil-fired power plant meeting January 1, 1998 Mexican SO_2 standards will potentially emit 48,000 tons/year of SO_2, or 20,000 tons/year more SO_2 than the same plant meeting 1978 NSPS Da, <u>Standards of Performance for Electric Utility Steam Generating Units</u>, for utility boilers. Simple-cycle gas turbine power plants are exempt from NO_x limits in Mexico. As a result of chronic electricity shortages along the border, these plants potentially operate in a baseload capacity mode. A baseloaded 500 MW simple cycle uncontrolled gas turbine power plant will emit over 19,000 tons/year of NO_x, approximately 11,000 tons/year more NO_x than the same plant meeting the 1977 U.S. NSPS for gas turbines. The supporting calculations for the values shown are provided in Appendix J.

Comparison of Emissions Generated if 500 MW Power Plant Complies with NOM-085-ECOL-1994 or NSPS Subpart Da (Thermal Plants) [Thermal efficiency of all plants is 34%]						
Source Type	NOM-085-ECOL-1994			NSPS Subpart Da (1978)		
	SO_2 (tons/yr)	NO_x (tons/yr)	Particulate (tons/yr)	SO_2 (tons/yr)	NO_x (tons/yr)	Particulate (tons/yr)
Coal-fired boiler	48,563	3,482	4,148	26,280	13,140	657
Oil-fired boiler	45,596	3,267	3,894	17,520	6,570	657
Gas-fired boiler	Exempt	3,097	Exempt	17,520	4,380	657
Comparison of Emissions Generated if 500 MW Power Plant Complies with NOM-085-ECOL-1994 or NSPS Subpart GG (Gas Turbines) [combined cycle thermal efficiency = 50%, simple cycle thermal efficiency = 34%]						
Source Type	NOM-085-ECOL-1994			NSPS Subpart GG (1977)		
	SO_2 (tons/yr)	NO_x (tons/yr)	Particulate (tons/yr)	SO_2 (tons/yr)	NO_x (tons/yr)	Particulate (tons/yr)
Gas-fired Combined-cycle gas turbine (eff. = 50%)	Exempt	2,106	Exempt	11,498	5,591	Exempt
Gas-fired simple cycle gas turbine	Exempt	19,270[a]	Exempt	16,907	8,222	Exempt
Note (a): Simple-cycle gas turbines are exempt from NOM-085-ECOL-1994 NO_x limits. The NO_x emission rate shown is based on the average NO_x emission rate of an uncontrolled General Electric LM6000 turbine (EPA 1993).						

As shown in the comparison table, in some cases NOM-085-ECOL-1994 is more restrictive than equivalent NSPS limits, while in other cases the reverse is true. One potential emission limit option for new power plants located in the region subject to Annex IV would be to default to the most restrictive limit in either NOM-085-ECOL-1994 or the applicable NSPS, on a pollutant-by-pollutant basis, and apply these hybrid limits to the the proposed facility.

Simple cycle gas turbine (SCGT) power plants of special interest when considering potential air pollution impacts in the border region. Uncontrolled SCGT power plants, whether fired with natural gas or diesel fuel, are high emitters of NO_x. NO_x is both a pulmonary irritant and a precursor to ozone and fine particulate formation, causing adverse health effects and visibility impairment. Historically SCGT power plants have been used in the U.S. and Mexico as "peaking" plants to provide additional power to the power grid during periods of peak demand, such as hot summer days with exceptionally high air conditioning loads. These plants typically experience relatively little use in electric grids with an adequate generation base, and as a result even uncontrolled SCGTs produce relatively low cumulative NO_x emissions due to a low turbine usage rate.

NOM-085-ECOL-1994 exempts SCGTs from any emission requirements. This could be interpreted to imply that SCGTs are used exclusively as peaking units in Mexico and therefore are not a major source of NO_x emissions. This is not necessarily the case. Mexican law permits the development of private power projects, especially those that serve dedicated industrial customers and can also supply peak demand auxiliary power to the CFE grid. Adequate supplies of natural gas are now available to a number of Mexican border cities through interconnections with U.S. natural gas pipeline networks. These natural gas networks are isolated from the natural gas pipeline networks in Central and Southern Mexico. Electricity demand is greater than existing power generation capacity in the Mexican border region. These conditions have created a strong demand for small- to medium-sized power plants that can generate electricity inexpensively and be brought on-line quickly.

SCGT power plants are relatively cheap, can be installed quickly, and achieve a thermal efficiency comparable to steam generator power plants. They are ideal for the rapidly expanding industrial economy based in the Mexican border region.

A good example is the SCGT power plant currently planned for San Luis Colorado, Sonora. This plant will consist of three 45 MW SCGTs for a total plant capacity of 135 MW.

Approximately a third to one-half of the power production capacity will be baseload capacity dedicated to industrial park customers. The remaining capacity will be sold to the CFE to meet peak demand needs. If economic conditions warrant, this plant will be converted to a more efficient combined-cycle gas turbine (CCGT) power plant at some future date. NOM-085-ECOL-1994 does subject CCGTs to strict NO_x limits.

Two factors indicate that the proposed San Luis Colorado SCGT power plant may operate at or near rated capacity most of the time:

1. The cost of electricity production from this plant should be considerably less than the cost of production from existing steam generator capacity, such as the large heavy oil-fired Rosarito Beach power plant (Baja California). The CFE generally seeks to utilize the least cost power generation resources in the grid first for economic reasons.
2. Electricity generation capacity is not keeping pace with electricity demand in the Mexican border region. Given this reality, it is likely that the peak demand component of the San Luis Colorado SCGT power plant will rapidly be converted to baseload capacity to meet ever increasing power demand.

Due to the potential quantity of NO_x and SO_2 emissions generated, NO_x and SO_2 limits are appropriate for SCGTs located in the border region if these turbines operate above some minimum annual capacity level, such as 10 percent. The NO_x control approach described in NSPS Subpart GG for gas turbines is water injection to the combustor. This is a simple, low cost, effective control technique that reduces NO_x by 80 to 90 percent. Water injection also increases available turbine power output by up to 5 percent by increasing mass flow through the turbine. In some developing countries using SCGT power plants, such as Peru, that are currently experiencing power shortages, water injection is utilized primarily to augment turbine power output.

All Mexican border cities with gas pipeline infrastructure currently in place receive gas from the U.S. at this point in time. In all cases, this is pipeline quality natural gas that is essentially free of sulfur (by specification requirement). The possibility of major SO_2 emissions from gas turbine power plants located along the Mexican border could essentially be eliminated by requiring that these plants burn pipeline quality natural gas as the primary fuel. Diesel fuel would continue to be acceptable for emergencies or for facilities that operate as true peaking plants. The pipeline quality natural gas requirement is also appropriate for CCGT power plants.

The privatization of Mexican power plants also presents an opportunity to upgrade the emission limits and monitoring requirements applicable to existing plants located in the border region subject to Annex IV. In many Latin American countries, Venezuela and Peru for example, the cost of upgrading state owned industries to international environmental standards is included as a condition of the sale, and the estimated cost of the upgrade is discounted from the selling price in exchange for a contractual commitment by the new owner to invest the identified amount in environmental upgrades. Incorporating this approach in an annex dealing with power plants would provide a mechanism for improving the emission controls on Carbon I and II and Rosarito Beach should they be privatized in the future.

6.3.2 Hazardous Waste Combustion: Cement Kilns and Incinerators

There are approximately 30 cement kilns in the U.S. currently cofiring hazardous waste. None of these kilns are located in the 100 kilometer border region, though two are located in border states. There are approximately 20 cement kilns in Mexico that are authorized to cofire hazardous waste, though not all of these kilns are actually cofiring waste at this time. Two of these kilns are located in the 100 kilometer border region, and seven kilns are located in border states. Cofiring hazardous waste in cement kilns is expected to be a growth industry in Mexico due to the financial advantages of essentially “free” fuel. Up to 60 percent (COSYDDHAC 1997) of the total fuel requirement of the kiln can consist of hazardous waste under current INE permitting guidelines.

The potential toxicity of hazardous waste combustion exhaust gases is the reason this source type should be evaluated for inclusion in Annex IV. Dioxins, hexavalent chromium, and a variety of other HAP metals are potentially emitted from hazardous waste combustion sources. These pollutants can pose significant health risks at extremely low ambient concentrations.

In the U.S., current emission limits and monitoring requirements for cement kilns firing hazardous waste are considerably less strict (1991 Boiler and Industrial Furnace regulations) than similar regulations for hazardous waste incinerators. A Maximum Achievable Control Technology (MACT) standard will be promulgated in 1997 or 1998 for cement kilns burning hazardous waste and hazardous waste incinerators (COSYDDHAC 1997). This MACT standard will narrow the differences in current emission limits and monitoring requirements between these two source types. Under the proposed MACT standards, continuous monitoring would be required for particulates, hydrocarbons and CO.

In Mexico, particulate limits are defined for cement kilns in NOM-CCAT-002-ECOL/93. The border region is considered a "critical zone" in the context of Mexican NOMs, and for this reason the particulate limit for cement kilns in the border region is about one-half the limit in non-critical zones of the country. Toxic air contaminant emissions from cement kilns are currently regulated by site-specific permits, which include some continuous monitoring requirements. A draft NOM (NOM-CRP-ECOL/95) has been proposed which will establish emission limits and monitoring requirements for a number of toxic air contaminants. This NOM is still in draft form and it is not clear when it will be finalized.

The emission limits for particulates and air toxics will be roughly comparable between U.S. MACT requirements and the Mexican NOMs, assuming the proposed MACT standard and the draft NOM-CRP-ECOL/95 are promulgated in their present form. These regulations basically level the emission limit and monitoring playing field between cement kilns firing hazardous waste and hazardous waste incinerators. The biggest question mark will be assuring compliance with the regulations through accurate monitoring of the hazardous waste feed stream and stack/fugitive emissions.

7.0 Integration of Proposed Changes with Appropriate National Regulatory Systems

7.1 Existing and Proposed U.S.Regulations/Procedures Governing Copper Smelter Emission Limits, Monitoring, Quality Assurance and Reporting

The La Paz Treaty Annex IV Agreement is the appropriate vehicle for requiring that the proposed recommendations be incorporated into a revised and updated Annex IV. No further justification should be necessary to require modeling studies or site ambient SO_2, TSP/HAP, or PM_{10}/HAP monitors. The project team is not recommending SO_2, PM_{10}, and/or opacity limits that are more stringent than existing NSPS Subpart P emission limits. All U.S. smelters in the border region are, or in the case of PD Hidalgo smelter, will be subject to NSPS Subpart P emission limits. For this reason, integration of proposed criteria pollutant emission limit changes with current U.S. emission limits is not an issue.

As discussed in detail in Section 4.0, the EPA has a proposed notification procedure for SO_2 STPs.

7.2 Existing and Proposed Mexican Regulations/Procedures Governing Copper Smelter Emission Limits, Monitoring, Quality Assurance and Reporting

7.2.1 Mexican Emission Limits

The proposed emission limits for Mexican copper and zinc smelters are shown below. These limits were originally published as a proposed NOM on September 20, 1994 [NOM-091-ECOL-1994]. This NOM has not yet been finalized.

Proposed NOM-091-ECOL-1994				
Type of Source	Compliance Date	Contaminant	Emission Limit	Affected Process
Copper Smelters				
New Plants	May 1, 1995	SO_2	650 ppm, 6-hour average	Roasters, Flash Furnaces, Converters, Acid Plants
		PM	50 mg/m^3, 20% opacity	Dryers
Existing Plants	May 1, 2000	SO_2	650 ppm, 6-hour average	Flash Furnaces and Associated Converters, Acid Plants
	May 1, 2005	SO_2	650 ppm, 6-hour average	Reverberatory Furnaces and Associated Converters, Acid Plants
		PM	60 mg/m^3, 20% opacity	Dryers, Dust Collectors
Zinc Smelters				
New Plants	May 1, 1995	SO_2	650 ppm, 6-hour average	Roasters, Acid Plants
		PM	50 mg/m^3, 20% opacity	Aglutinator
Existing Plants	May 1, 1997	SO_2	650 ppm, 6-hour average	Roasters, Acid Plants.
		PM	50 mg/m^3, 20% opacity	Acid Plants, Dust Collectors

The particulate and SO_2 continuous monitoring procedures in the proposed copper/zinc smelter

NOM specify in-stack COM and SO_2 CEM. However, no equipment specification standard is referenced for the COM and SO_2 CEM. Also, QA test methods are specified for the COM and SO_2 CEM, but no schedule is provided for performing these periodic QA tests.

7.2.2 Mexican Monitoring Requirements

Ambient SO_2 NOM [NOM-CCAM-005-ECOL/1993]: The ambient SO_2 NOM defines procedures for a wet chemistry methodology only. It is recommended that this NOM be updated to include procedures for UV fluorescence electronic monitors, or require use of procedures equivalent to those used with the IMECA ambient air quality monitoring network in Mexico City.

Ambient TSP NOM [NOM-CCAM-002-ECOL/1993]: The ambient TSP procedures described in this NOM are consistent with U.S. Hi-Vol sampling procedures.

The project team is not aware of any specific requirements for stack COM or SO_2 CEM monitors that have been promulgated by SEMARNAP.

7.2.3 Mexican Continuous Monitor Quality Assurance Requirements

Independent audits using clearly defined audit procedures for both stack CEMs and ambient monitors are recommended. This may already be occurring, though the project team has not yet obtained this information. Again, in the case of ambient SO_2 monitors, these procedures are being carried-out on a routine basis with the IMECA network.

7.2.4 Mexican Emission Data and Continuous Monitor Reporting Requirements

Both the Cananea and Nacozari smelters report hourly data for each ambient monitor in each monthly monitoring report. This is very useful information, though it is not clear whether this reporting procedure was developed by these facilities or whether the reporting format follows a permit requirement. No calibration data is included in the monthly monitoring report. Both the calibration procedures used and the results of each calibration should be included in the monthly monitoring reports to confirm the validity of the data.

7.2.5 Mexican SO_2 STP Notification/Reporting Requirements

As in the U.S., there is currently no regulatory requirement to notify the public of SO_2 STP occurrences above a certain threshold. Annex IV is the appropriate rationale for requiring such notification, as any national STP notification regulation could potentially expand to encompass all polluting industries. It would be more effective to apply a STP notification system to Cananea and Nacozari as part of Annex IV rather than as part of the development of a longer-term Mexican national STP program for two reasons: (1) U.S. and Mexican data could be shared and assessed jointly, which would increase the efficiency of evaluating and reducing the SO_2 health risk; and (2) it could serve as a working model for any proposed national STP program.

Recent reforms to the fundamental Mexican environmental statute, "*Ley del Equilibrio Ecológico y la Protección al Ambiente*," promulgated on December 13, 1996, provide a legal basis for the proposed community notification/reporting requirements. Article 5 of the law states that one of the responsibilities of SEMARNAP is to promote the participation of society in environmental matters, and to integrate the National System for Environmental and Natural Resources Infor-mation. Article 109B explains that this system will consolidate information from authorizations, licenses, and permits issued by the SEMARNAP to regulated entities. The inclusion of the results of air quality monitoring into the information system is specifically addressed in Article 159B(i)(s), which also states that the data in the information system will be available to the public upon request through mechanisms that will be established for such a purpose.

8.0 List of Contacts

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