REFERENCES

REFERENCES

01 to 10: Attached with May/10/1995 Letter of Mr. Diniz de Figueiredo to Miss. Ago
11 to 16: Attached with March/7/1995 Letter of Mr. Ladniuk to Mr. Inoue
17 to 40: Received during the First Field Work
41 to : Received & collected during the Second Field Work and following period

01
Title: (Ambient Air Quality for TSP, Smoke, Inhalable Particle, SO_2, CO, O_3, NO_2)
Source Resolucao/CONAMA/No.003 de 28 de junho de 1990

02
Title: (Stationary Source Emission for TSP, Smoke, SO_2, and Fuel Oil Consumption at each Designated Area)
Source Resolucao/CONAMA/No.008 de 06 de dezembro de 1990

03
Title: (Designation of Area I, II, and III for Air Pollution Control)
Source Resolucao/CONAMA/No. 005 de 15 de junho de 1989

04
Title: Jorge Lacerda Wind Rose (Nov/86 - Out/87) and Porto Alegre Wind Rose (1981 - 1985)
Source ELETROSUL

05
Title: Map - Monitoramento Ambiental na Regiao do Baxio Jacui
Source ELETROSUL

06
Title: Map - Monitoramento Ambiental na Regiao de Tubarao Area de Influencia do Complexo Term. Jorge Lacerda
Source ELETROSUL

07
Title: Tables - Resultados das Medias Mensais, Anuais e Maximos de 24h para SO2 & PM - 87 a 94 da Regiao de Baxio Jacui e de Tubarao/Capivari de Baxio
Source ELETROSUL

08
Title: Maintenance & Calibration Method of Hi-Vol. Sampler
Source Environmental Science and Engineering, Inc.

09
Title: Maintenance & Calibration Method of SO2 Bubbler
Source ELETROSUL

10
Title: Map - Coal Deposit around Jorge Lacerda
Source ELETROSUL

11
Author: Sergio T. Ladniuk
Title: Letter to Mr. Inoue dated March/7/1995
Source CEEE

12
Title: Map - Massas de Ar
Source CEEE

13
Title: Estacao Meteologica de Candiota & Bage
Source CEEE

14
Title: Map - Monitoramento Ambiental Localizacao, Candiota
Source CEEE

15
Title: Tablea III - Presidente Medici; Emissioes Aereas
Source CEEE

16
Title: 24 Tables - Meio Ambiente de Presidente Medici (Hi-vol & Tri-gas) (1 - 12/1994)
Source CEEE

17
Author: Carlos Gothe
Title: Brazilian Environmental Policy and Air Pollution Control Legislation
Source ELETROSUL DET/DIPT, pp2

18
Author: Edited by Noguchi
Title: Coal & Stack Gas Properties at Jorge Lacerda
Source Data from Mr. Pasquottoin of Jorge Lacerda Plant

19
Author: RSC- Regional de Santa Catarina; Complexo Jorge Lacerda
Title: Carvao Consumido (Coal & Ash analyses)
Source Jorge Lacerda

20
Title: Analises Mensais do Carvao (in 1993 & 1994 at Candiota)
Source Candiota

21
Author: Naiare Dal Molin
Title: Candiota - Origem e Historia
Source TCHE 10/1994

22
Title: Map - Tubarao
Source Minsterio da Economia, Fazenda e Planejamento

23
Title: Map - Laguna
Source Minsterio da Economia, Fazenda e Planejamento

24
Title: Map - Lagoa de Garopaba do Sul
Source Minsterio da Economia, Fazenda e Planejamento

25
Title: Map - Jaguaruna
Source Minsterio da Economia, Fazenda e Planejamento

26
Title: Map - Taquari
Source Minsterio do Exercito, Diretoria de Servico Geografico

27
Title: Map - Sao Jeronimo
Source Minsterio do Exercito, Diretoria de Servico Geografico

28
Title: Map - Morretes
Source Minsterio do Exercito, Diretoria de Servico Geografico

29
Title: Map - Guaiba
Source Minsterio do Exercito, Diretoria de Servico Geografico

30
Title: Map - Arroio dos Ratos
Source Minsterio do Exercito, Diretoria de Servico Geografico

31
Title: Map - Butia
Source Minsterio do Exercito, Diretoria de Servico Geografico

32
Title: Map - Hulha Negra
Source: Minsterio do Exercito, Departamento de Engenharia e Comunicacoes

33
Title: Map - Seival
Source Minsterio do Exercito, Departamento de Engenharia e Comunicacoes

34
Title: Map - Pedras Altas
Source Minsterio do Exercito, Departamento de Engenharia e Comunicacoes

35
Title: Map - Tupi Sileira
Source Minsterio do Exercito, Departamento de Engenharia e Comunicacoes

36
Author: CEEE, Cordenadoria Central de Planejamento
Title: CEEE em Numeros
Source CEEE, End of 1993

41
Title: Legislacao Ambiental Basica do Estado de Santa Catarina
Source FATMA, 5/1995

42
Author: Governo do Estado de Sao Paulo, Secretaria do Meio Ambiente
Title: Legislacao Federal Controle da Poluicao Ambiental
Source Companhia de Technologia de Saneamento Ambiental, as of 1989

43
Title: Qualidade do Ar na Regiao Metropolitana do Rio de Janeiro - 1984/1987
Source FEEMA, 6/1989

44
Author: Karen Walker
Title: Select a Continuous Emissions Monitoring System
Source Chemical Engineering Progress, p 28, Vol. 92, No. 2, 1996

45
Author: Aaron M. Cheng, et. al.
Title: An Accurate Predictive Emissions Monitoring System for an Ethylene Furnace
Source Environmental Progress, p 19, Vol. 15, No. 1, 1996

46
Author: World Resources Institute, UNEP, UNDP
Title: World Resources 1994-1995: a Guide to the Global Environment
Source: World Resources Institute

47
Author: SC-Secretaria de Desenvolvimento Urbano e do Meio Ambiente, and FATMA
Title: Legislacao Ambiental Basica do SC; Lei 5793 (10/80) & Decreto 14250(6/81)
Source FATMA, 5/1995

48
Title: Boletim Trimestral - Electric Power Summary Statistics for Brazil 1992
Source SIESE, 1992

49
Title: Outlook of Overseas Electric Utilities - 1993 (J)
Source Japan Electric Power Information Center, Inc.

50
Title: National Energy Balance, 1995
Source Ministry of Mines and Energy

51
Title: Annual Administrative Report, 1995
Source ELETROSUL

52
Author: Program or concessions and partnerships of the government of Rio Grande do Sul
Title: Partnerships for the future
Source Government of Rio Grande do Sul, 1995

53
Author: O. A. Cavalcante, et. al.
Title: Informativo Anual da Industria Carbonifera, 1994
Source Ministerio de Minas e Energia, 7/1994

54
Title: The Challenge of Sustainable Development - The Brazilian Report for the United Nations Conference on Environment and Development
Source Governo do Brasil, 1992

55
Author: UNDP, UNEP, World Bank, et. al.
Title: World Resources 1996-97: Guide to the Global Environment
Source World Resources Institute

56
Author: The World Bank
Title: World Development Report, 1992
Source Oxford University Press, Inc.

57
Title: ELETROSUL - Informacoes Basicas
Source ELETROSUL CDE, 12/1993

58
Title: Chapter V. De-NOx Facilities (J) - (a part of technical information book)
Source Thermal & Nuclear Power Generation Engineering Association (Japan), 6/1991

59
Author: Natural Resources, Environment and Rural Poverty Division, Country Dept. 1
Title: Brazil - Managing Environmental Pollution in the State of Rio de Janeiro
Source World Bank, August, 1996

60
Author: Infrastructure and Urban Development Division, Country Department 1
Title: Brazil - Natural Gas Pricing and Regulatory Study
Source World Bank, October 25, 1996

61
Author: JICA Planning Department
Title: Kunibetsu Kankyo Joho Seibi Chousa - (Environmental Information in Brazil)
Source JICA - Feb./1990

62
Title: World Development Indicators - 1997
Source World Bank

63
Title: Arranjo Geral (Candiota General Layout for Unit III with legends)
Source CEEE, 06/96

64
Author: Verena Nygaad, Directora-Presidente de FEPAM
Title: Letter FEPAM/GAB/258-96 addressed to President of CEEE
Source fepam, 7/30/1996

65
Title: Emissoes de Poluentes Aereos da Ute Jacui e Alternativas para Atendimento dos Padroes de Emissao da Resolucao CONAMA 08/90
Source ELETROSUL/DET/DIPT, 09/07/96, calculation based on the Contract 61.501 - Oct/82

66
Author: JICA
Title: Information on Your New Post Country (Japanese)
Source JICA, 1997, J1132779(8)

67
Author: Middle and South America Sect. No.1, J. Ministry of Foreign Affairs, 7/96
Title: General View of Brazil (Japanese)
Source JICA Library A1130637(0)

68
Title: ARC Report - Trends and Forecast of Economy and Trade in Brazil (Japanese)
Source World Economic Information Services, 1997

69
Author: Supervised by Air Pollution Sect, Japan Environment Agency
Title: Stationary Source Control Manual at Developing Countries - Power Plants (Japanese)
Source Global Environment Centre Foundation, 3/97

70
Author: Junpei Andou
Title: Flue Gas Clean-up Technologies in the World (Japanese)
Source Technical Institute for Coal, 8/1990

71
Title: Analysis and Simulation of SPM Pollution (Japanese)
Source Japan Environment Agency, 1987

APPENDICES

CONTENTS OF APPENDICES

1- 1	Solicitacao de Cooperacao Technica (Feb./7/94)	A1- 1
1- 2	Scope of Work and Minutes of Meeting for the Study on Evaluation of Environmental Quality in Regions under Influence of Coal Steam Power Plants in the Federative Republic of Brazil (1/25/95)	A1-13
1- 3	List of Existing Equipment available for the JICA Study	A1-25
1- 4	JICA Equipment Specification	A1-26
1- 5	Technology Transfer	A1-42
2- 1	Coal Mines in Brazil: Production and Sulfur Contents	A2- 1
3- 1	Comparison of International Ambient Air Quality Standards	A3- 1
3- 2	Comparison of Emission Standard of Coal Burnt Pollutants	A3- 2
4- 1	Compilation Method of the Monitoring Data	A4- 1
4- 2	Wind Roses by Month	A4- 4
4- 3	Stability Classification	A4- 7
4- 4	Diurnal and Monthly Change of Meteorological Factors	A4- 8
4- 5	Cumulative Distribution	A4-14
4- 6	TSP Concentration by High Volume Sampler	A4-16
4- 7	Monthly Change of SO_2	A4-19
4- 8	Average Concentration by Wind Directions (SO_2 & NO_x)	A4-20
4- 9	Air Borne SO_2 and NO_2 by Simple Method	A4-22
4- 9B	Regression Equations for Simple Method	A4-31
4-10	Chemical Analysis of Rain and Dry Precipitation	A4-33
4-11A	Each Correlation Graph of Rain and Dry Precipitation Data	A4-44
4-11B	ditto Correlation Tables	A4-62
4-11C	Cation/Anion Ratios of Rain Samples	A4-65
4-11D	pH of Rain in Japan	A4-67
4-12	Elemental Analyses of Particulates	A4-68
5- 1	Stack Gas Sampling Nozzle Locations	A5- 1
5- 2	Results of Stack Gas Measurement	A5- 4
5- 3	Pollutant Flow Rates per MW Plotted on Measured Dates	A5- 8
5- 4	Distribution of Velocity, Temperature, and Dust Loading	A5- 9
5- 5	Various Correlation with Outputs	A5-13
5- 6	Comparison of Calculated and Measured Flow Rates	A5-16

5-7	Heat Loss due to Excess Combustion Air	A5-17
5-8	Ratio of Emissions from Existing Units / National Standard - Pseudo-situation	A5-19
6-1	Emission Parameters under the Current Condition	A6-1
6-2	Hourly Concentration Profile under the Current Condition	A6-4
6-3	Setting of Diffusion Parameter	A6-49
7-1	Emission Parameters under the Future Condition	A7-1
7-2	Gas Volumes and Pollutant Emissions under Maximum Loading in the Future	A7-4
7-3	Hourly Concentration Profile under the Future Condition	A7-5
8-1	Various Air Pollutant Control Measures at Thermal Power Plants	A8-1
8-2	Stack Gas Monitoring Equipment in Brazilian Market	A8-21
8-3	Notes on Management of Ambient Air Monitoring Stations	A8-22
8-4	Maintenance of Continuous Stack Gas Monitoring Analyzers	A8-26
8-5	CMB (Chemical Mass Balance) Method	A8-28
8-6	Specifications of SPM Meter	A8-33

ABC/DAOC-II/ 26 /ETEC-BRAS-JAPA

O Ministério das Relações Exteriores cumprimenta a Embaixada do Japão e, em aditamento à Nota Verbal ABC/DAOC-II/03, de 06 de janeiro de 1994, tem a honra de encaminhar, em anexo, a seguinte proposta de Estudo para o Desenvolvimento, para a Programação de 1994:

ENERGIA

- Título: Avaliação da Qualidade Ambiental nas Regiões de Influência dos Pólos de Termeletricidade a Carvão Mineral

Executor: Ministério das Minas e Energia - MME.

2. O Ministério das Relações Exteriores agradeceria à Embaixada do Japão verificar a possibilidade de atender a solicitação em apreço, no âmbito do Acordo Básico de Cooperação Técnica Brasil-Japão.

Brasília, em 07 de fevereiro de 1994

SOLICITAÇÃO DE COOPERAÇÃO TÉCNICA
Fonte Externa: JAPÃO

1 TÍTULO DO PROJETO

Avaliação da Qualidade Ambiental nas Regiões de Influência dos Polos de Termeletricidade a Carvão Mineral.

2. OBJETIVOS DO PROJETO

2.1 Objetivo Superior

Formar recursos humanos e materiais, quanto a qualidade ambiental nas Regiões de influência dos polos de termeletricidade a carvão mineral, necessários à proposição de diretrizes para a implantação das futuras usinas termelétricas a carvão.

2.2 Objetivos Imediatos

- Projetar, implantar e operar redes de monitoramento com a finalidade de avaliar a qualidade ambiental nas áreas de influência dos polos de termeletricidade a carvão nos estados de Santa Catarina e Rio Grande do Sul;

- Treinamento de equipes técnicas para gerenciamento e execução de atividades de monitoramento ambiental e desenvolvimento de modelos de simulação;

- Elaboração de diagnóstico ambiental das regiões com vocação para a termeletricidade a carvão;

- Elaboração de prognósticos ambientais a partir dos planos de expansão da termeletricidade a carvão no sul do Brasil.

A ênfase neste projeto será dada nos aspectos relativos à poluição atmosférica e grau de pH das chuvas, complementarmente deverão ser abordadas, na medida do necessário, as questões relativas à contaminação de águas superficiais e subterrâneas, bem como os aspectos referentes à disposição de resíduos sólidos.

3 RESULTADOS	INDICADORES	PRAZOS
1) Duas Equipes treinadas para a concepção, planejamento implantação e operação de projetos de monitoramento da qualidade ambiental.	1) Existência das equipes treinadas	12 meses
2) Diagnóstico ambiental das seis regiões influenciadas pelos polos termelétricos,	2) Realização do diagnósticos	33 meses
3) Prognósticos ambientais para as regiões influenciadas pelos polos termelétricos.	3) Realização dos prognósticos	36 meses
4) Documento de projeto consolidado por relatórios conclusivos e diretrizes ambientais enfocando a expansão da termeletricidade a carvão.	4) Relatório final do projeto com os resultados das diversas atividades desenvolvidas.	36 meses

4. JUSTIFICATIVA

A revisão da Matriz Energética Nacional, elaborada em atendimento ao Decreto Presidencial nº 99.503, de 02.09.90, e aprovada pelo Presidente da República em 19.11.91, define expressiva expansão do consumo de carvão mineral para as próximas décadas.

O principal vetor para este crescimento é o resultado dos estudos de planejamento do setor elétrico que, a partir da constatação do gradativo esgotamento dos potenciais hidráulicos competitivos, indicaram o carvão mineral como a alternativa mais econômica para o atendimento à expansão nas regiões sul/sudeste do País.

Mantidas as expectativas de crescimento da economia, o aumento da participação da termeletricidade a carvão na produção de energia elevará o consumo deste mineral de, aproximadamente três milhões de toneladas (1990), para cerca de vinte e cinco milhões de toneladas (2010), decorrente de um aumento na capacidade instalada de 1050 MW para 7150 MW.

Esta significativa elevação da participação do carvão tem sido objeto de preocupação das entidades de proteção e controle ambiental, bem como das comunidades científicas e políticas envolvidas com as questões relativas à compatibilização do desenvolvimento com as necessidades de preservação do ambiente natural.

Este cenário sugere um aprofundamento nos assuntos referentes ao monitoramento ambiental, notadamente quanto à qualidade do ar e das chuvas, a partir de um diagnóstico das regiões com vocação termelétrica e de produção de carvão. Tendo em vista ao estabelecimento dos critérios e tecnologias a serem empregados para permitir o aproveitamento energético do carvão de forma alternativa, mantendo-se a qualidade ambiental em níveis adequados, ou seja, de forma harmônica com os ecossistemas das áreas de influência dos polos termelétricos e compatível com as necessidades das populações habitantes destas áreas.

Considerando que o Japão possui larga experiência no que tange controle e monitoramento ambiental, assim como o fato de usar o carvão mineral, como energético para geração de energia, julgamos ser de vital importância a cooperação tecnológica desse país, para a consecução desse projeto.

5. PRAZO DE EXECUÇÃO

O presente Projeto tem como prazo total uma previsão de 36 meses para sua execução, porem a etapa que aqui propomos refere-se aos primeiros 24 meses.

6. RECURSOS NECESSÁRIOS E CUSTOS ESTIMADOS

6.1 Cooperação Solicitada

a) Consultoria Especializada de Curto Prazo para:

- Conceituação e definição dos limites (escopo) do projeto;
- Treinamento de equipe de coordenação/gerenciamento;
- Planejamento detalhado do projeto.

b) Consultoria Especializada de Longo Prazo para:

- Treinamento de equipes técnicas;
- Execução do projeto;
- Compilação de dados;
- Desenvolvimento de modelos para simulação.

c) Equipamentos Científicos:

- Amostradoras;
- Analisadoras de gases;
- Computadores;
- Cromatógrafo;
- Espectrofotômetro;
- etc..

6.1.1 - PERITOS PARA PRESTAÇÃO DE CONSULTORIA

a) DE LONGO PRAZO:

.Perfil Profissional:	Especialização em modelagem de dispersão de poluentes atmosféricos.
.Duração da Missão:	10 meses
.Início Previsto:	Dez/94
.Valor:	US$ 100,000
.Perfil Profissional:	Projeto de redes de monitoramento da qualidade do ar e das precipitações.
.Duração da Missão:	10 meses
.Início Previsto:	Jul/94
.Valor:	US$ 100,000
.Perfil Profissional:	Medição e Controle de Emissões Gasosas em Chaminés
.Duração da Missão:	5 meses
.Início Previsto:	Jan/95
.Valor:	US$ 50,000

.Perfil Profissional: Monitoramento da qualidade de águas da superfície e subsolo
.Duração da Missão: 5 meses
.Início Previsto: Jan/95
.Valor: US$ 50,000

.Perfil Profissional: Disposição e/ou aproveitamento de resíduos da combustão
.Duração da Missão: 10 meses
.Início Previsto: Jul/95
.Valor: US$ 100,000

b) DE CURTO PRAZO (6 MESES)

.Perfil Profissional: Análise Instrumental
.Duração da Missão: 3 meses
.Início Previsto: Jul/94
.Valor: US$ 30,000

.Perfil Profissional: Planejamento Ambiental
.Duração da Missão: 3 meses
.Início Previsto: Jan/94
.Valor: US$ 30,000

.Perfil Profissional: Processo de Limpeza de gases de combustão
.Duração da Missão: 2,5 meses
.Início Previsto: Ago/94
.Valor: US$ 25,000

6.1.2 - TREINAMENTO

a) No Japão

Clientela: Equipe de Coordenação
Duração: de 15 a 30 dias
Quantidade: 10 homens/mês
Valor: US$ 30.000,00
Natureza:

1) Familiarização com os aspectos de planejamento e gerenciamento de atividades de diagnósticos ambientais;

2) Atualização do estado-da-arte das técnicas em monitoramento da qualidade do ar;

3) Atualização do estado-da-arte na geração termelétrica a carvão.

b) No Brasil

Clientela: Equipes Técnicas do Projeto (On Job Trainning);

Técnicos e Cientistas de Outras Entidades:

- Universidades
- Centros de Pesquisas
- Órgãos Oficiais de Controle Ambiental
- Outros Interessados

Duração: Variada em função da natureza (base 40 - 80 horas)
Natureza: Diversa (aproveitamento da presença dos consultores), com assuntos relacionados às especialidades e/ou equipamentos científicos a serem utilizados pelo projeto.

Quantidade: 33 homens/mês

1/3 - nível superior, sendo:

- engenheiros;
- químicos;
- biólogos.

2/3 - Nível médio, sendo:

- técnicos em química;
- técnicos em biologia;
- laboratoristas.

6.1.3 - EQUIPAMENTOS

a) Analisadores de gases em chaminés e/ou dutos SOx, NOx, CO, CO_2, HC's.

b) Aparelhos de Amostragem/Análise do ar Atmosférico SOx, NOx, CO, CO_2, Partículas, etc.

c) Amostradores de Precipitações Secas e Chuvas

d) Equipamentos para Análise Instrumental cromatógrafos, espectrofotômetros, etc. (laboratório e campo)

e) Amostradores e analisadores para águas superficiais, subsolo e pluviais pH, DBO, DQO, Sólidos suspensos, Metais Dissolvidos, etc.

f) Infra-estrutura de apoio em informática

.computadores
.impressoras
."scanners"
."plotters"

6.1.4 Valores Solicitados

Perito:	US$ 485,000.00
Treinamento:	US$ 129,000.00
Equipamentos:	US$ 650,000.00

6.2 - Contrapartida Oferecida

6.2.1 - Pessoal

Todo o efetivo de pessoal necessário à composição das equipes de gerenciamento e execução do projeto.

6.2.2 - Treinamento

Toda a infra-estrutura administrativa de apoio necessário à organização, divulgação, meios didáticos e instalação dos cursos a serem ministrados no Brasil.

6.2.3 - Material Permanente

Mobiliário e facilidades para a instalação das equipes de projeto, equipamentos de transporte terrestre e fluvial equipamentos de laboratório.

6.2.4 - Instalações

Salas de trabalho para consultores estrangeiros e equipes de projeto, bem como laboratórios de análise químicas.

6.2.5 - Diversos

Contratação de transportes especiais, bem como análise químicas e físico-químicas que não possam ser realizadas nos laboratórios das empresas.

6.2.5 - Valores de contrapartida

- Pessoal:	US$	569,000.00
- Serviço de Terceiros:	US$	50,000.00
- Material de Consumo:	US$	41,000.00
- Material Permanente:	US$	54,000.00
- Instalação:	US$	57,000.00
- Passagens Diárias:	US$	238,000.00

7. ENTIDADES PARTICIPANTES:

Ministério de Minas e Energia MME

Centrais Elétricas do Sul do Brasil S/A ELETROSUL

Companhia Estadual de Energia Elétrica CEEE

7.1 Credenciais Técnicas da Instituição Coordenadora e Executora

Coordenação

Ministério de Minas e Energia - MME
Secretaria Executiva
Esplanada dos Ministérios Bloco U - 7º Andar
Brasília DF

Titular: William S. Penido Vale - Secretário Executivo do MME
Ivonice Aires Campos - Coordenadora de Tecnologia e Meio Ambiente do MME
Telefone com prefixo :55 61 225-4072
218-5708
Fax :55 61 322-3615

Execução

A execução deste projeto está a cargo da ELETROSUL E CEEE

ELETROSUL é uma das quatro empresas regionais da "holding" ELETROBRÁS, voltada principalmente para geração e transmissão de energia elétrica, atuando com termelétricas a carvão mineral e hidrelétricas na região sul do Brasil e no Mato Grosso do Sul, sendo vetor de integração energética dos países do Cone Sul.

CEEE é um empresa estadual, coligada a ELETROBRÁS, cabendo ao Estado do Rio Grande do Sul a participação majoritária no seu capital social, e está voltada principalmente na geração e distribuição de energia elétrica, atuando também com termelétrica a carvão mineral.

A1. CURRICULUM VITAE

1. Nome 2. Nacionalidade, naturalidade, data de nascimento 3. Graduação 4. Pós graduação 5. Principais trabalhos realizados

JOSÉ CARLOS CARVALHO DA CUNHA - ELETROSUL

Nacionalidade: Brasileira
Naturalidade: São Gabriel/RS
Data de Nascimento: 29.11.49
Engenheiro Químico
Especialização em combustão de carvão e tecnologias limpas para o uso energético do carvão.
Principais Trabalhos Realizados:
-Desenvolvimento de tecnologia de combustão e gaseificação de carvão em reatores de leito fluidizado;
-Professor do Curso de especialização em carvão mineral (MME-CAEEB/PLANFAP);
-Projeto de caldeiras e fornalhas com queima de carvão em leito fluído;
-Estudos de atualização do estado-da-arte da termeletricidade com base na queima de carvão em caldeiras de leito fluidizado;
-Elaboração de projetos ambientais para a recuperação da região carbonífera do sul catarinense - Projeto Provida;
-Estudos preliminares de viabilidade para usina termelétrica baseadas nas chamas tecnologias limpas para o carvão;

A1. CURRICULUM VITAE

1. Nome 2. Nacionalidade, naturalidade, data de nascimento 3. Graduação 4. Pós graduação 5. Principais trabalhos realizados

SÉRGIO TADEU LADNIUK - CEEE

Nacionalidade: brasileira
Naturalidade: Porto Alegre - RS
Data de Nascimento: 09.04.57
Engenheiro Químico
Especialização em Ecologia Humana e Gerenciamento Ambiental
Principais Trabalhos Realizados:
- Coordenação EIA/RIMA da Usina Termelétrica Candiota III
- Programa de Monitoramento Ambiental de Candiota
- Participação no Projeto de Equipamentos anti-poluentes para usinas termelétricas.

Appendix 1-2

SCOPE OF WORK
FOR
THE STUDY
ON
EVALUATION OF ENVIRONMENTAL QUALITY
IN REGIONS UNDER INFLUENCE OF COAL STEAM POWER PLANTS
IN
THE FEDERATIVE REPUBLIC OF BRAZIL

AGREED UPON AMONG
CENTRAIS ELETRICAS DO SUL DO BRASIL S/A,
COMPANHIA ESTADUAL DE ENERGIA ELETRICA
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

BRASILIA, JANUARY 26, 1995

Mr. Claudio Avila da Silva
President
Centrais Elétricas do Sul do
Brasil S/A

Mr. Nobuyuki Yamaura
Leader of Preparatory Study
Team
Japan International
Cooperation Agency

Mr. Telmo Borba Magadan
President
Companhia Estadual de Energia
Elétrica

Mr. Sergio de Souza Fontes Arruda
Director
Agência Brasileira de Cooperaçao

DEPARTAMENTO JURIDICO
30 JAN 1995
ELETROSUL

I. INTRODUCTION

In response to the request of the Government of the Federative Republic of Brazil (hereinafter referred to as "the Government of Brazil"), the Government of Japan decided to conduct the Study on Evaluation of Environmental Quality in Regions under Influence of Coal Steam Power Plants (hereinafter referred to as "the Study ") together with the Government of Brazil, in accordance with the Basic Agreement on Technical Cooperation between the Government of Japan and the Government of Brazil, signed in Brasília on September 22, 1970 (hereinafter referred to as "the Basic Agreement").

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, Agência Brasileira de Cooperação (hereinafter referred to as "ABC") as legal intervenient agency on behalf of the Government of Brazil, Centrais Elétricas do Sul do Brasil S/A (hereinafter referred to as "ELETROSUL"), and Companhia Estadual de Energia Elétrica (hereinafter referred to as "CEEE"), the executing agencies responsible for the implementation of the technical cooperation for the Study, will undertake the Study in close cooperation with the other Brazilian authorities concerned.

The present document sets forth the Scope of Work with regard to the Study.

II. OBJECTIVES OF THE STUDY

The Objectives of the Study are to evaluate environmental quality of air in regions under influence of coal steam power plants and to contribute to the planning for development of coal steam power plants.

The study areas are around the following three power plants.

a) Jorge Lacerda
b) Charqueadas
c) Candiota

III. SCOPE OF THE STUDY

In order to achieve the objectives mentioned above, the Study shall cover following items:

1. Review of existing data and information

(1) Socio-economic conditions and economic development policy

(2) National policy and present situation of the electric power sector

(3) Present situation and future plan of coal steam power plants.

(4) Laws and regulations for air pollution control

(5) Specification of objective power plants (facilities, fuel, stack)

(6) Future plans of air pollution control

(7) Collection and review of existing data concerning air pollution (ambient air quality and stationary source)

2. Survey of present status of air pollutants

(1) Measurement of ambient conditions at each coal steam power plant
SO2, NOx, TSP, Acid rain, Wind direction and Velocity, Solar radiation

(2) Measurement of flue gas of each coal steam power plant
SOx, NOx, Dust, Heavy metals, Others (exhaust gas temperature and gas volume)

3. Assessment of environmental impact by pollutants from each coal steam power plant

(1) Assessment of present environmental impact (hourly average, daily average and annual average)

(2) Assessment of the future environmental impact after completing the reinforcement plan (hourly average, daily average and annual average)

4. Formulation of appropriate monitoring system for both ambient air quality and emission from each coal steam power plant

(1) Planning of ambient air monitoring system surrounding of each coal steam power plant

(2) Planning of inspecting system for emission of pollutants from each coal steam power plant

(3) Recommendation of suitable organization and its responsibility

5. Training

In order to transfer technologies to Brazilian counterpart personnel, training on following items shall be held.

(1) Planning of environmental monitoring and maintenance of the monitoring system

(2) Measurement of emission gases from sources

(3) Estimation of the effects of each power plant by numerical simulation model

IV. STUDY SCHEDULE

The Study will be carried out in accordance with the attached tentative work schedule, as shown in Appendix I.

V. REPORT

JICA shall prepare the following report in English, which will be submitted by JICA to the Government of Brazil:

1. Inception Report
Twenty (20) copies at the beginning of the Study in Brazil;

2. Interim Report
Twenty (20) copies within twelve (12) months after commencement of the Study

3. Draft Final Report and its Summary Report
Twenty (20) copies within twenty four (24) months after commencement of the Study

4. Final Report and its Summary Report
Within two (2) months after receiving the written comments on the Draft Final Report from the Government of Brazil. These comments shall be submitted to JICA by the Government of Brazil within four (4) weeks after explanation of the Draft Final Report by the Japanese Study Team.

VI. DIVISION OF TECHNICAL UNDERTAKINGS

The division of technical undertaking conducted by ELETROSUL, CEEE and JICA for the Study are shown in Appendix II.

VII. UNDERTAKING OF THE GOVERNMENT OF BRAZIL

1. The Government of Brazil shall accord privileges, immunities and other benefits to the Japanese Study Team in accordance with the Basic Agreement on Technical Cooperation between the Government of Japan and the Government of Brazil, as follows.

(1) to ensure the safety of the Japanese Study Team;

(2) to permit the members of the Japanese Study Team to enter, leave and stay in Brazil for the duration of their assignment therein, and exempt them from foreign registration requirements and consular fees;

(3) to exempt the members of the Japanese Study Team from taxes , duties, and any other charges on equipment, machinery and other materials brought into Brazil and out for the conduct of the Study;

(4) to exempt the members of the Japanese Study Team from income tax and other charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Japanese Study Team for their services in connection with the implementation of the Study;

(5) to provide necessary facilities to the Japanese Study Team for remittance as well as utilization of the funds introduced into Brazil from Japan in connection with the implementation of the Study;

(6) to ensure permission for entry into private properties or restricted areas for the implementation of the Study within the laws and regulations in force in the Federative Republic of Brazil;

(7) to ensure permission for the Japanese Study Team to take necessary data and documents (including maps, photographs) related to the Study out of Brazil to Japan;

(8) to provide medical services as needed. Its expenses will be chargeable to the members of the Japanese Study Team.

2. The Government of Brazil shall bear claims, if any arises, against the members of the Japanese Study Team resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Japanese Study Team.

3. ELETROSUL and CEEE shall act as counterpart agency to the Japanese Study Team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

4. ELETROSUL and CEEE shall, at its own expense, provide the Japanese Study Team with the following, in cooperation with other relevant organizations concerned:
(1) available data and information related to the Study;
(2) counterpart personnel;
(3) suitable office space with necessary equipment;
(4) credentials or identification cards;
(5) appropriate number of vehicles with drivers.

VIII. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take the following measures:

(1) to dispatch, at its own expense, the Japanese Study Teams to Brazil;

(2) to pursue technology transfer to the Brazilian counterpart personnel in the course of the Study.

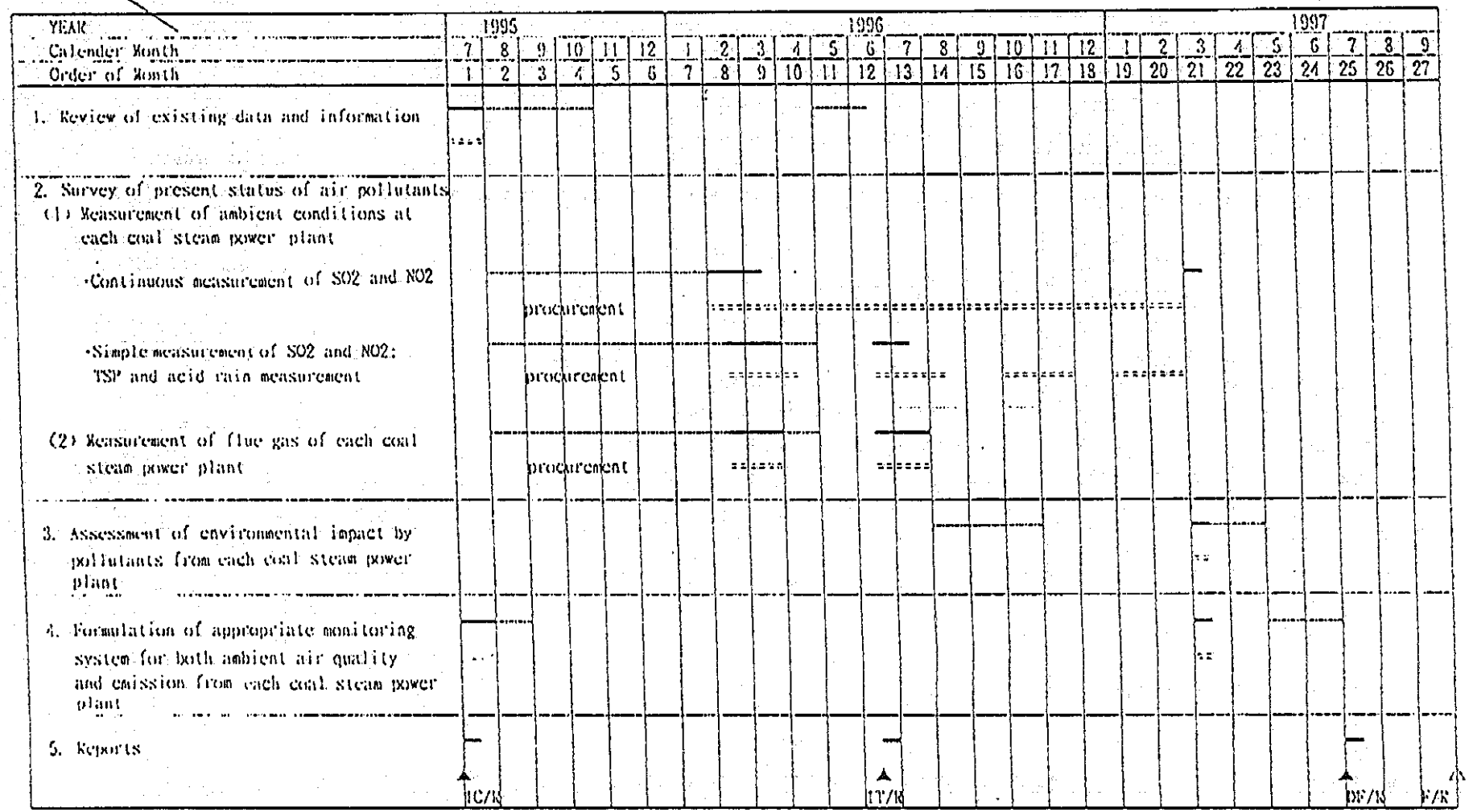
IX. OTHERS

JICA, ELETROSUL and CEEE shall consult with each other in respect of any matter that may arise from or in connection with the Study.

DEPARTAMENTO JURÍDICO ELETROSUL 30 JAN 1995

Appendix 1

TENTATIVE TIME SCHEDULE



——— JICA Work in BRAZIL
- - - JICA Work in JAPAN
··· Brazilian Side Work

▲ Discussion on Report
/\ Submission of Report

IC/R : Inception Report
IT/R : Interim Report
DF/R : Draft Final Report

Appendix II DIVISION OF TECHNICAL UNDERTAKINGS

Working Items	Undertaking by JICA	Undertaking by ELETROSUL and CEEE
1. Review of existing data and information	- Review and analysis	- Provision of necessary data and information
2. Survey of present status of air pollutants		
(1) Measurement of ambient conditions at each coal steam power plant	- Planning and establishment of air monitoring system - Procurement of equipment - Installation of equipment - Data analysis - Review of results	- Preparation of monitoring place and electricity etc. - Assistance for installation - Measurement by simple method (SO_2, NO_2) - TSP and acid rain sampling - Routine maintenance for automatic analyzers - Chemical analysis - Data reporting
(2) Measurement of flue gas of each coal steam power plant	- Planning of flue gas measurement - Procurement of equipment - Execution and direction of flue gas and dust measurement - Review of results	- Installation of sampling hole, working space and electricity - Execution of measurement and assistance - Chemical analysis

Working Items	Undertaking by JICA	Undertaking by ELETROSUL and CEEE
3. Assessment of environmental impact by pollutants from each coal steam power plant	- Programming - Estimation and assessment	- Provision of necessary data and information - Confirmation of results
4. Formulation of appropriate monitoring system for both ambient air quality and emission from each coal steam power plant	- Formulation of inspection system for emissions - Formulation of monitoring system for ambient air quality - Cost estimation - Scheduling	- Provision of necessary data and information - Confirmation of results

MINUTES OF MEETING
FOR
THE STUDY
ON
EVALUATION OF ENVIRONMENTAL QUALITY
IN REGIONS UNDER INFLUENCE OF COAL STEAM POWER PLANTS
IN
THE FEDERATIVE REPUBLIC OF BRAZIL

The Preparatory Study Team (the Team) organized by the Japan International Cooperation Agency (JICA) of the Government of Japan, headed by Mr. Nobuyuki Yamaura, Leader of the Team, visited the Federative Republic of Brazil from January 17 to 27, 1995 for the purpose of discussing on the Scope of Work of the Study on Evaluation of Environmental Quality in Regions under Influence of Coal Steam Power Plants in the Federative Republic of Brazil (the Study).

The Team made a series of discussion with the authorities concerned of Centrais Elétricas do Sul do Brasil S/A (ELETROSUL) and Companhia Estadual de Energia Elétrica (CEEE).

The salient result of the discussions mutually confirmed are as follows:

1. The study area of Charqueadas power plant also covers the area of prospective Jacui power plant.

2. Measurement methods are generally based on the Japanese Industrial Standard (JIS) method.

3. Brazilian side requested to analyze Co, Cr(VI), Pb, As, Be, Ni, F and Cl in suspended particulates and emission dusts.

4. Brazilian side requested to perform chemical analysis of anionic components (SO4, NO3, Cl and F) in rain.

5. Brazilian side requested that technical training in Japan shall be provided to counterpart personnel in the implementation of the project. The Team stated to convey the request to JICA head office.

6. Workshop shall be held when Draft Final Report Team comes to Brazil.

7. Brazilian side requested to the Team that the equipment shall be supplied for the implementation of the study, and the Team stated to convey the request to the authorities concerned.

8. Vehicles provided do not serve for commutation of Study Teams.

9. When IC/R Team comes to Brazil, precise discussion shall be held with regard to the schedule of the team in charge of installation and instruction of the measurement equipments.

10. The Participants accorded with the items of the scope of work. ELETROSUL and CEEE will perform the necessary internal procedures and will sign the S/W as soon as possible.

PORTO ALEGRE, JANUARY 25, 1995

Mr. Duílio Diniz de Figueiredo
Gerente do Departamento de Planejamento da Expansão
Centrais Elétricas do Sul do Brasil S/A

Mr. Nobuyuki Yamaura
Leader of Preparatory Study Team
Japan International Cooperation Agency

Mr. Sergio Tadeu Sadniuk
Coordenador de Meio Ambiente
Companhia Estadual de Energia Elétrica

Mr. Oswaldo Baumgarten
Diretor Adjunto do Departamento Nacional de Desenvolvimento Energético do
Ministério de Minas e Energia

Attendants of the Meeting

Nelson de Oliveira	ABC / MRE
Raimundo Alves de Lima Filho	ABC / MRE
Oswaldo Baumgarten	MME
Duilio Diniz de Figueiredo	ELETROSUL
Jose de M. Ramos Filho	ELETROSUL
Edison Pereira de Lima	ELETROSUL
Fernando Yutak Takasugi	ELETROSUL
Jose Lourival Magri	ELETROSUL
Mario Rache Freitas	ELETROSUL
Sergio Ladniuk	CEEE
Luiz Henrique Mengatto	CEEE
Plinio Slomp	CEEE
Antonio Carlos Rossato	CEEE
Nobuyuki YAMAURA	JICA
Tomoyuki OKUMURA	JICA
Tsuyoshi ISHIKAWA	JICA
Mitsuru FUJIMURA	JICA
Haruo ONO	JICA
Jorge NINOMIYA -	Interpreter

Appendix 1-3

List of Existing Equipment available for the JICA Study

Jorge Lacerda Power Station

Power Plant's Laboratory	Electric Oven, Desiccator, pH meter, Electro-conductivity meter, and others
Power Plant's Mete. Observatory	Anemoscope (AH120/5: 0 - 540°) Anemometer (AH-110/5: 0 - 30 m/s) Pyranometer (RH-6010: 0 - 1330 W/m) Rain Guage (PH-310P: 0 - 330 mm/h)
Capivari Air Monitoring Station	High Volume Sampler of TSP Low Volume Sampler of SPM 15 μm Shelter & Accessories for JICA Equip.
Vila Moema Air Monit. Station	High Volume Sampler of TSP Shelter & Accessories for JICA Equip.
Sao Bernardo Air Monit. Station	High Volume Sampling of TSP Shelter & Accessories for JICA Equip.

Charqueadas Power Plant

Power Plant's Laboratory	Room & Furniture for JICA Lab. Electric Oven, Desiccator and others
Jaqui Air Monitoring Station	Anemoscope Anemometer Pyranometer Rain Gauge High Volume Sampler of TSP Shelter & Accessories for JICA Equip.
Arranca Toco Air Monit. Station	High Volume Sampler of TSP Shelter & Accessories for JICA Equip.
DEPRC Air Monitoring Station	Shelter & Accessories for JICA Equip.

Candiota Power Plant

Power Plant's Laboratory	Electric Oven, Desiccator, pH meter Electro-conductivity meter, and others
Airport Air Monitoring Station	Anemoscope Anemometer Pyranometer Rain Guage High Volume Sampler of TSP Shelter & Accessories for JICA Equip.
Candiota III Air Monit. Station	High Volume Sampler of TSP Shelter & Accessories for JICA Equip.
Lago Air Monitoring Station	Shelter & Accessories for JICA Equip.

Appendix 1-4

JICA Equipment Specification

as of April 15, 1996

ITEM	SPECIFICATION	No.of Req'd
Ambient Air Monitoring		
1-1-1	Automatic NOx Analyzer - HORIBA Co., APNA-360	3 sets
	Method:Chemiluminescence	
	Range:0 - 0.1/0.2/0.5/1.0ppm (changeable automatically & manually)	
	Detectable Limit: 0.5 ppb	
	Zero Point Adjustment: Automatic	
	Zero Drift:±1.0% of full scale/24hrs or ±2.0% of full scale/week	
	Span Drift: ditto	
	Analogue Output:Selectable 0-1 V(DC), 0-10 V(DC), 4-20 mA(DC)	
	Two Outputs: Current and summation (or average) values	
	Data Storage:1 hr summation value - 1000 data (equiv. to 1.5months)	
	Sensitivity: Zero drift free, 0.1 ppm sensitivity, High stability	
	Power: Supply 100 VAC, 60 Hz; Consumption less than 200 VA	
	Consumable and Spare Parts	
	1. PPD Capillary — U801200600	6 sets
	2. Air Filter — H443672-02	3 sets
	3. DO Unit — U801154200	3 sets
	4. Filter Element — F021434400	3 sets
	5. O-Ring — F020223700	3 sets
	6. F-Packing — H457606-02	3 sets
	7. UV Lamp Unit — U800952700	3 sets
	8. UV Liner — H533781-01	3 sets
	9. CAT Pipe Unit — U800694300	3 sets
	10. Diaphragm — 9022002900	6 sets
	11. Silica Gel — F022298500	3 sets
	12. Pump Unit (100V, 60Hz) — U801145900	3 sets
	13. Solenoid Valve — U801163300	9 sets

ITEM	SPECIFICATION	No.of Req'd
1-1-2	Automatic SO_2 Analyzer - HORIBA APSA-360	9 sets
	Method: Ultraviolet Fluorimeter	
	Range: 0-0.05/0.1/0.2/0.5 ppm (changeable automatically & manually)	
	Detection Limit: 0.5 ppb	
	Zero Drift: ±1.0 ppb/24hrs or ±2.0 ppb/week	
	Span drift: ±1.0% of full scale/24hrs or ±2.0% of full scale/week	
	Analogue output: Selectable of 0-1 V(DC), 0-10 V(DC), or 4-20 mA(DC)	
	Two Outputs: Current and summation (or average) values	
	Connectable to RS-232C (deci-chain)	
	Data Memory: 1000 data of 1 hr value (equiv. to 1.5 months data)	
	Light source: Long life xenon lamp	
	Power: Supply-100 VAC, 60Hz, Consumption-150 VA	
	Automatic Voltage Regulator (SVC-1030-A)	9 sets
	Input : single phase 220 VAC, 48Hz-62Hz	
	Input Variation: ±15% (187 - 253 V)	
	Output : 100 VAC, Accuracy ±(1.0 - 1.5)%	
	Capacity : 3.0 KVA	
	Response Speed : within 1.0 sec to 10% of abrupt change of input voltage	
	Lightning Arrester (RP-200, Mfg No. 59920804M)	9 sets
	Input : single phase 220 VAC	
	Output : single phase 220 VAC	
	Capacity : 3 KVA	
	Including double coils, case cover and connectors	
	Earth rod: Length more than 30 cm/set	9 sets
	Earthing Line: total 150 m	150 m
	1 V more than 5.5 mm^2 or better grade than UL-AWG-No. 10	
	File Conversion CPU Soft: total 1 unit/9 sets	1 set
	Possible to convert binary file of data floppy to text file	
	Consumable and Spare Parts	

Name	Code	Req'd No./set	
1. Filter Element	F021434400	4	36 sets
2. Diaphragm	9022002900	1	9 sets
3. HC Cutter	9022003700	1	9 sets
4. Xenon Lamp	9022003800	1	9 sets
5. Air Filter	H443672-02	1	9 sets
6. Filter Element	F021565700	1	9 sets
7. CAT Pipe Unit	U801145600	1	9 sets
8. O-ring	U801150900	1	9 sets
9. Pump Unit (110 V, 60 Hz)	9022003400	1	9 sets

ITEM	SPECIFICATION	No.of Req'd
1-1-3	NOx Span Gas Generator - HORIBA SGGU-514 Blank Gas: Air to be purified in the generator Purity - NO less than 0.001 ppm H_2O saturation at 0℃ Stabilized within 5 min NO Gas: Packed in cylinder, 90 ppm in nitrogen gas Span Gas: NO gas dilution with purified air by regulated flow ratio Dilution Ratio Indication: ±5%; Accuracy ±2% of indicated dilution Span Gas Concentration: 0.09 ppm of NO in purified air Span Gas Flow Rate: 2.5 l/min (overflow at 500 ml/min) Span Gas Pressure: 10 mmAq Gauge Span Gas Stabilization: within 10 min Power: AC 100 VAC, 60 Hz, Consumption-100 VA Consumable and Spare Parts	3 sets
	1. Silicagel — F021100500 — 8	24 pc's
	2. Charcoal — F021100600 — 4	12 pc's
	3. Purifier Unit — F02191100 — 1	3 pc's
	4. Filter Element — H435126-01 — 4	12 pc's
	5. Gas Filter — F021100400 — 8	24 pc's
1-1-4	SO_2 Span Gas Generator - HORIBA SGGU-514 Blank Gas: Air to be purified in the generator Purity - SO_2 less than 0.01 ppm H_2O saturation at 0℃ Stabilized within 5 min SO_2 Gas: Packed in cylinder, 45 ppm in nitrogen gas Span Gas: SO_2 gas dilution with purified air by regulated flow ratio Dilution Ratio Indication: ±5%; Accuracy ±2% of indicated dilution Span Gas Concentration: 0.045 ppm of SO_2 in purified air Span Gas Flow Rate: 2.5 l/min (overflow at 500 ml/min) Span Gas Pressure: 10 mmAq Gauge Span Gas Stabilization: within 10 min Power: AC 100 VAC, 60 Hz, Consumption-100 VA	3 sets

Name	Code	Require No./set

ITEM	SPECIFICATION			No.of Req'd
1-1-4 cont'd	Consumable and Spare Parts			
	Name	Code	Require No./set	
	1. Silicagel	F021100500	8	24 pc's
	2. Charcoal	F021100600	4	12 pc's
	3. Purifier Unit	F02191100	1	3 pc's
	4. Filter Element	H435126-01	4	12 pc's
	5. Gas Filter	F021100400	8	24 pc's
1-1-5	Data Logger - HORIBA DL-360			9 sets
	No. of Channel: 8			
	Analogue Input: Selectable of 0-1 V(DC), 0-10 V(DC), 0-16 mV, or 4-20 mA(DC)			
	Resolution: 12 bits			
	Accuracy: ±0.5% or within ±1 digit , to be isolated			
	Data File: 3.5 inches floppy			
	Recordable - Hourly data for more than 1 month/floppy			
	Record Frequency - every hour on the hour			
	Data: binary			
	Watch: year to second (autocalender) with power failure compensation			
	Memory Back-up: When power failure, set values and data to be backed up with automatic recovery system upon power supply			
	Power Supply: 100 VAC, 50 - 60 Hz			
	Consumable and Spare Parts for 24 months operation			
1-1-6	6 Points Recorder - YOKOGAWA μ R-1800			9 sets
	Input Signal: DC 0-100 mV, 0-1 V			
	Recording Paper Speed: 1 - 10 mm/hr (1 mm/hr step)			
	Effective Paper Width: 180 mm			
	Power: 100 VAC, 60 Hz, Consumption 22VA			
	Consumable and Spare Parts			
	1. Ribbon Cassette	3 pc's/set		27 pc's
	2. Recording Paper	25 volumes/set		230 vols
1-1-7	Cylinder Gases			
	1. 90 ppm of NO in nitrogen	10 liter cylinder	1 cylinder/set	3 cyldrs
	2. 45 ppm of SO_2 in nitrogen	ditto	3 cylinders/set	9 cyldrs
	3. Two Stage Pressure Controller		4 pc's /set	12 pc's
	Inlet 250 kg/cm², Secondary Stage 5 kg/cm²			
	Outlet Joint RC 1/4 T joint (for Teflon tube)			

ITEM	SPECIFICATION	No.of Req'd
1-1-8	Miscellaneous for ITEM 1-1-	
1-1-8-1	Equipment Support Rack	9 sets
	Cylinder Rack for 3 cylinder	3 sets
	for 2 cylinder	6 sets
	Cables and Pipings	9 sets
1-1-8-2	Sampling Fittings for NOx and SO_2	
	1. Teflon Tube: 6 x 8 mm	150 m
	2. Polypropylene Funnel	22 pc's
	3. Silicon Tube: 7 x 12 mm	10 m
1-1-8-3	Cable: CVV 5.5 mm^2 100 m/coil	1 coil
1-2-1	Automatic Rain Sampler - OGASAWARA US-410 "SUMPLER"	4 sets
	Rain Fall: Receiver - 200 mm diameter; made with stainless and coated with Teflon	
	Filter - membrane; 0.8 μ m, 47 mm diameter	
	Water Tank - 20 liter polyethylene tank	
	Dry Deposition Collector: Receiver - 200 mm diameter; made with stainless and coated with Teflon	
	Power: 100 VAC, 60 Hz, 125 VA for 3 sets (M. No. 51247 - 9)	
	125 VAC, 60 Hz, 125 VA for 1 set (M. No. 51246)	
	Consumable and Spare Parts	
	1. Deposit gage 1 unit/set	4 units
	2. Water tank 1 unit/set	4 units
	3. Membrane filter 100 sheets/unit	4 units
1-3	Net Pyrradiometer - EIKO MF-11	3 sets
	Principle: Cu-Constantan bi-metal thermocouple	
	Sensitivity: more than 25 mV/KW x m^{-2}, Shunt box sensitivity - 7 mV	
	Wave Range: 0.3 - 30 μ m	
	Power: 100 VAC, 60 Hz	
	Including: Supports, Shunt box(SS-1), 2 boxes of Polyethylene domes, Summater (MP-200) Output= 0-10 mV DC, Cable (50 m) Silicagel (500 g), Scale; each/set	
	Messenger Cable 5 mm diameter 50 m in total/3 sets	50 m
	Wire Clips 30 pc's in total/3 sets	30 pc's

ITEM	SPECIFICATION	No.of Req'd
1-4	Ambient Air Simple Monitor - NIGORIKAWA	
	Shelter: NG-KN-SH	110 pc's
	Sampler Case: NG-KN-S	340 pc's
	Case Stem: PVC 26 mmOD x 20 mmID x 1800 mm(length)	110 pc's
	Support Metal Rod: Length 80 cm, OD 20 mm	110 pc's
	Sampler Transporter: Wooden, containable 20 samplers	6 pc's
	Filter Paper: 26 mm round, cellulose fibers, 100 sheets	24 boxes
	Metal Wire: 1 mm in diameter	200 m
1-5	Tools and Miscellaneous Parts:	
	1. Tool Kit, HOZAN S-45	3 sets
	2. Adjustable Wrench for Gas Cylinder	3 pcs
	3. Wire Binder, 100 mm, 100 pcs / case	3 cases
	4. Wire Binder, 140 mm, ditto	3 cases
	5. Wire Binder, 180 mm, ditto	3 cases
	6. Gum Tape, 50 mm x 25 m	9 pcs
	7. Vinyl Tape, 19 mm x 10 m	30 pcs
	8. Teflon Seal Tape, 0.1 mm x 13 mm x 15 m	15 pcs
	9. Instant Bond, ARON-ALFA, 2 g, 5 tubes / box	3 boxes
	10. Bond, Two Chemicals Type, 30 g	3 sets
	11. Saw	1 pcs
	12. Saw Blade	15 pcs
	13. Portable Electric Drill	3 pcs
	14. Drill Blade, 1,2,3,4,5,6,7,8,9,10 mm diameter	3 sets
	15. Silicon Sealing Compound, White, 330 ml / pcs	6 pcs
	16. Pipe Wrench, 300 mm	3 pcs
	17. Electric Wire Terminal Set, T-10	6 sets
	18. ditto, T-20	6 sets
	19. ditto, T-30	6 sets
	20. Digital Tester	3 pcs
	21. Wire Terminal Crimping Tool with Wire Stripper	3 pcs
	22. Wire Terminal Crimping Tool	3 pcs
	23. Precision Screw Driver set	3 sets

ITEM	SPECIFICATION	No.of Req'd
Stack Gas Measurement		
2-1	Automatic Infrared SO_2 Analyzer - SHIMADZU SOA-7000	2 sets
	Principle: Infra-red absorption (single light source, two bundle non-dispersion type)	
	Range: 0-1000 ppm/2000 ppm/0.25%/0.5%	
	Re-producibility: ±0.5% of full scale	
	Zero Drift: ±1.0% of full scale or ±1.5 ppm/day	
	Span Drift: ±1.0%/day	
	Response: within 3 min	
	Sample Gas: Flow rate 2.0 liter/min (0.5 liter/min to cell)	
	Pressure -100 to +100 mmAq G	
	Dust less than 0.1 g/Nm^3	
	Contaminants CH_4 less than 30% of SO_2	
	NH_3 less than 3% of SO_2	
	SO_3 less than 30 ppm	
	H_2O less than 10 wt%	
	Display: Liquid crystal (320 x 200 dots), 3 displays simultaneously	
	Output: 0-1 VDC (2 channels and 1 spare channel)	
	Data: Memory card	
	Operation: within 5-40℃	
	Power: AC 100 V, 60 Hz	
	Carry Case: one/set	
	Cylinder Gas: SO_2 200 ppm in nitrogen, and nitrogen blank, with each pressure regulator, 3.4 litre cylinder	each 2 cylinders
	Consumable and Spare Parts	
	1. Teflon Tube 4 mmID x 6 mmOD x 5 m 1/set	2 pc's
	2. Mist Absorbent 2/set	4 packs
	3. SO_2 Absorbent 2/set	4 packs
	4. O-ring (5 units in box) 1 box/set	2 boxes
	5. Polypropylene Cotton (100 g) 2 boxes/set	4 boxes
	6. Ring Filter (40 pc's in box) 2 boxes/set	4 boxes
	7. Diaphragm 4 boxes/set	8 boxes

ITEM	SPECIFICATION	No.of Req'd
2-2	Automatic NOx-O_2 Analyzer - SHIMADZU NOA-7000	2 sets
	Principle: For NOx - atmospheric chemiluminesence	
	O_2 - Zirconia method	
	Range: NOx 0-25/50/250/500/1000/2500/4000 ppm	
	O_2 0-5/10/25 vol%	
	Re-producibility: ±0.5% of full scale	
	Zero Drift: ±1.5% of full scale in ±5℃	
	Span Drift: ditto	
	Linerability: ±2% of full scale	
	Response: NOx - 20/30/60 sec changeable	
	O_2 - 30/60 sec changeable	
	Sample Gas: Flow rate 2.0 liter/min , Pressure -100 to +100 mmAq G Dust less than 0.1 g/Nm^3 Contaminants CO less than 500 ppm SO_2 less than 1000 ppm NO_2 less than 300 ppm NH_3 less than 20 ppm CO_2 less than 30 vol% SO_3 less than 50 ppm H_2O less than 10 wt% CH_4 less than 1000 ppm	
	Display: Liquid crystal (320 x 200 dots), 3 displays simultaneously	
	Output: 0-1 VDC (3 channels)	
	Data: Memory card	
	Operation: within 5-37℃	
	Power: AC 100 V, 60 Hz	
	Carry Case: one/set	2 sets
	Cylinder Gas: 250 ppm NO in nitrogen, 0.5% O_2 in nitrogen, 9.0% O_2 in nitrogen, and nitrogen blank gas, each 3.4 liter cylinder	each 3 cylinders
	Recorder: US-211, 100 mm width	2 units
	Pressure Regulator: TUS-1090	2 units
	Pressure Regulator: TU-1085	4 units
	Cylinder Support: for 4 cylinders	3 units
	Pretreatment Unit - SHIMADZU CFP-301	2 sets
	Cooler Capacity: cool sample down to 1.5 - 3.5℃	
	Sampling Rate: max. 3 liter/min	

ITEM	SPECIFICATION	No.of Req'd
2-2 cont'd	Consumable and Spare Parts	2 sets
	1. Chart 3AA	2 boxes
	2. Cartridge Ink Pad 2 in one pack	2 packs
	3. Diaphragm for Sample Pump, Air Pump, and Drain Pump	each 2 sets
	4. Converter Reaction Tube with Catalyst	2 sets
	5. NH_3 Absorbent 6 pc's in one box	4 boxes
	6. SO_2 Absorbent 186 g packed	4 packs
	7. O-ring 5 pc's in one pack	2 packs
	8. Polypropylene Cotton 100 g	2 packs
	9. Filter Membrane 50 sheets in one pack	2 packs
	10. Ozone Killer Catalyst 300 g in one pack	2 packs
	11.Front Filter 2 sheets in one pack	2 packs
	12.Rear Filter 6 sheets in one pack	2 packs
	13.Silicagel Case	2 cases
2-3	TSP Measurement	
2-3-1	Dynamic Balance Dust Sampler - NIGORIKAWA NG-Z-2N,	
	Sampler Probe - NIGORIKAWA NG-Z-4	2 sets
	Pitot Tube: Type 304 stainless steel, 6 mm in diameter with a cylindrical filter paper holder of 34 mm in diameter, each one piece of 2 and 4 m length/set; in Al cases	
	Accessories	
	1. Gas Pump - NIGORIKAWA NG-17S; Capacity: 100 liter/min, Equipped with mist oil separator, needle valve, and casters; in Al cases	2 sets
	2. Wet Gas Meter - NIGORIKAWA W-NK-2.5A; 5 liter/revolution; in AL case	2 sets
	3. Mist Separator - NIGORIKAWA NG-Z-19; SO_2 Remover-700 ml bottle; Dryer-500 ml bottle; each one bottle/set	2 sets
	4. Gas Hose - 9 mmID x 21 mm OD x 30 mLength rubber	2 hoses
	5. Timble Filter set	
	5-1. Holder - Type G-23; Stainless 304; 25 mmDiameter x 90 mm	10 sets
	5-2. Suction Nozzle - NG-25; Stainless 304; 4,6,8,10 mm Diameter; each 3 pieces/set	2 sets
	5-3. Clamp - NG-28; Stainless 304	12 pieces
	5-4. Case - NG-23B	4 sets

ITEM	SPECIFICATION	No.of Req'd
2-3-1	6. Flange - NG-30; 200 mm diameter x 3 mmThickness	2 pieces
cont'd	7. Cord Reel - AC100, 15A; 30 m coil	4 coils
	8. Table Tap - 3 outlets	8 pieces
	9. Tool Set	2 sets
	Consumable	
	1. Cylindrical Filter - 25 mmDiameter x 90 mm; 10 pieces/set; Silica	50 sets
	2. Differential Pressure Tube - 4 colors; 6 mmID x 8 mmOD x 30 m L	2 pieces
	3. Pincette - IPT-05; 120 mm Length	6 pieces
	4. Pincette - IPT-12; 165 mm Length	6 pieces
	5. Glove - NT-100; 350℃ heat resistance; 400 mmLength	20 pairs
	6. Teflon Tube - 6 mmID x 8 mmOD x 30 mLength	4 pieces
	7. Silicon Tube - 6 mmID x 10 mmOD x 10 mLength	4 pieces
	8. Silica Gel - 18 liter canned	2 cans
	9. Container Case - Type 75H; 656 x 456 x 356 mm; 2/set	
2-3-2	Water Measurement Unit - NIGORIKAWA	2 sets
	1. Suction Tube - NG-11-H with regulator; with Case of Stainless 304	
	2. Flange - Stainless 304; 200 mmDiameter x 3 mmThickness	
	3. Gas Meter (wet) - W-NK-1A; 1 liter/revolution; in Al case	
	4. Gas Pump - NG-15-N; 15 liter/min; in a case	
	5. SO_2 Washer - NG-19; Bottle in a case	
	6. Cooling Water Box - NG-15; with a support stand and in a case	
	7. Electronic Balance - PB303; Metler; 310 g; Sensitivity-1 mg; Dish-100mm Diameter	
	8. Dehumidifier - NG-12; Shefield 10 piece/set in a case	
	Accessory	
	1. Seal for Measurement Hole - SC cloth; 3 mmT x 50 mm x 30 mL	4 roles
	2. Stopwatch - SSj018; with spare battery	4 sets
	3. Gas Hose - 6 mmID x 15 mmOD x 30 m	2 hoses
	Consumable	
	1. $CaCl_2$ - 500 g	20 bottles
	2. Rock Wool - 1 kg	4 packs
	3. Heat Resistance Adhesive Tape - 0.18 mmT x 19 mmW x 10 mL	40 roles
	4. Vinyl Tape - 0.2 mmT x 19 mmW x 10 mL	40 roles
	5. Seal Tape - 0.1 mmT x 13 mmW x 5 mL	40 roles
	6. Silicon Grease - 50 g	20 bottles
	7. Cotton - 10 boxes/case	2 cases

ITEM	SPECIFICATION	No.of Req'd
2-3-3	Pitot Tube Velocity Meter - NIGORIKAWA NG-V-1	2 sets
	Dynamic Pressure Range 99.9 mmAq	
	γ -value Setting 0.3 - 1.3 kg/m³	
	Accessory	
	1. Pitot Tube - 4 mL in a case	2 pieces
	2. Thermocouple - SK-1250MC; 0 - 1200℃; 1.6 mmD x 3 mL in a case	2 pieces
	Consumable	
	1. Hydrogen Peroxide - 500 g	10 bottles
	2. Kim Wipe - S-200; 72 boxes in a case	2 cases
	3. Rope - 30 m	4 coils
	Safety Device	
	1. Mask - GM-76D; 10 sets/box	2 boxes
	2. Cartridge for Mask - CA-104-NZ; 20 pieces/box	2 boxes
	3. Eyeglass - SP-66; 5 pairs/box	2 boxes

ITEM	SPECIFICATION	No.of Req'd
Chemical Analysis		
3-1	Digital Electric Conductivity Meter - TOA Electronics CM-40V	1 set
	Display - Digital, Fluorescent	
	Indication - Conductivity; 0-199.9 μ S/m, -1.999 mS/m, -19.99 mS/m, -199.9 mS/m, -1.999 S/m, -19.99 S/m, -199.9 S/m	
	Resistivity; 0-1.999 Ω m, -19.99 Ω m, -199.9 Ω m, -1.999k Ω m, -19.99k Ω m, -199.9k Ω m, -1.999M Ω m	
	Concentration; 0-1.999%, -19.99%, -199.9%	
	Temperature; 0-100℃	
	Range Selection - Automatic or Manual	
	Temperature Compensation - 0-100℃	
	Temperature Coefficient - 0-10%/deg C	
	Standard Temperature - 0-100℃ variable	
	Measuring Wave Frequency - 80 Hz and 3 KHz	
	Output - 0-1 V full scale	
	Accessory	
	1. Conductivity Cell - CT-54101B; including spares	3 cells
	2. Plastic Beaker - 150 ml	1 pieces
	3. Cell Holder - Free arm	1 set
	4. Earthing wire, Cord, and AC adapter	1 set
	Power Supply - 220V and 60 Hz	
3-2	Digital pH Meter - TOA Electronics HM-40V	1 set
	Indication - Digital; pH, mV, and temperature	
	Temperature Compensation - Automatic 0-100℃	
	Measuring Range - pH 1-14 (0.01pH), 0-±1999 mV(1 mV), 0-100℃ (0.1℃)	
	Output - pH ±700 mV, mV ±1 mV, Temp.0-1 V	
	Calibration - Automatic at pH 1, 4, 7, 9, 12	
	Standard Accessory	
	1. Cell - GST-5421C; including spare	3 cells
	2. Standard Solution - pH=4.01, 6.86, 9.18, and 3.3 mol/liter KCl each 500 ml	each 2 bttls
	3. Plastic Beaker 150 ml	1 set
	4. Earthing Wire, Cord, AC Adapter	1 set

ITEM	SPECIFICATION	No.of Req'd
3-3	Glass Wares	1 set
	1. Graduated Cylinder, Stand Grade, w/Glass Stopper	100 pcs
	2. Centriguge Tube, round Bottom, w/Stopper	100 pcs
	3. Support Stand for 50 Test Tubes	2 pcs
	4. Pipette, 10 ml	20 pcs
	5. Rubber Bulb for 10 ml Pipette	10 pcs
	6. Macro-pipette Dispenser, 0.2 - 1.0 ml, accuracy ±1 %	2 pcs
	7. Support Stand for 5 macro-pipettes	1 pcs
	8. 200 Tips for Macro-pipette / box	2 boxes
	9. Micro-syringe, 250 μ litre, Changable Needles	2 pcs
	10. Needles, Type A, 50 mm, 5 pcs / box	2 boxes
	11. Para-film, 4 inches x 125 feet	2 pcs
3-4	Chemicals	
	1. Methan-sulfonic acid - First Grade, 500 g	2 bottles
	2. Sodium carbonate - Extra Grade, 500 g	2 bottles
	3. Sodium bicarbonate - ditto	2 bottles
	4. PTIO - TOKYO KASEI Reagent, 5 g	15 bottles
	5. Acetone - Extra Grade, 500 ml	5 bottles
	6. 30% Hydrogen peroxide - Extra Grade, 500 ml	2 bottles
3-5	Ion Chromatograph; Puchased from ACATEC - Sao Paulo	
1)	43066 - DX-100 Ion Chromatograph - two column set Power Supply: 110 V, 60 Hz	1 set
	(Component Parts of ITEM 3-5 - 1))	
2)	43117 - TS-2 Thermal Stabilizer	1 set
3)	43174 - IONPAC AS4A-SC 4mm Column	1 set
4)	43175 - IONPAC AG4A-SC 4mm Guard Column	2 sets
5)	43189 - ASRS 4mm Anion Self Regenerating Suppressor	1 set
6)	38018 - MMS/SRS External Regen Installation Kit	2 sets
7)	46073 - IONPAC CS-12A 4mm Analytical Column	1 set
8)	46074 - IONPAC CG-12A 4mm Guard Column	2 sets
9)	43190 - CSRS 4mm Cation Self Regenerating Suppressor	1 set
10)	42132 - 4400 Integrator 115/230V 1 Channel with Extended BASIC	1 set
11)	42819 - 4400 Startup Kit (Paper Rack, Paper, Printhead Cartridge)	1 set
12)	46029 - AS40 Automated Sampler with Starter Vial Kit (5ml)	1 set
13)	43051 - DX100 Automation Cable, DX100 to Integrator to ASM	1 set

ITEM	SPECIFICATION	No.of Req'd
14)	43050 - DX100 Spare Parts Kit	1 set
15)	37157 - Combined Five Anion Standard, 100mL	1 set
16)	40187 - Combined Six Cation Standard-I, 50mL	1 set
17)	Nitrogen Cylinders (99.99%) 7 M^3	2 btls
18)	Pressure Regulator Stainless Steel	1 set
	(Comsumable & Spare Parts, and Manuals of ITEM 3-5)	
19)	35686 - Piston Seal	4 sets
20)	38599 - Portface, CHA	16 sets
21)	42368 - Pressure Bolts (10-32 fitting)	4 sets
22)	43275 - Bolt, Double Cone Ferrule Fitting(10-32 thread)	10 sets
23)	37627 - Fitting, 1/8"	5 sets
24)	30538 - Fitting Tee, Air Line	4 sets
25)	30538 - Fitting Tee, Air Line	4 sets
26)	43276 - Ferrule, Double Cone(10-32 thread)	10 sets
27)	39167 - Quick Disconnect for Air Tubing	2 sets
28)	42690 - Tube, PEEK, 100 m	1 set
29)	14157 - Tube, Teflon, Low Pressure, 100 m	1 set
30)	35113 - Gasket, Transducer	2 sets
31)	35777 - O-ring, 0.614 x 0.07	2 sets
32)	35014 - Spring, Piston for DX-100	2 sets
33)	36901 - Back-up Seal	2 sets
34)	42955 - Bed Support	10 sets
35)	43146 - Inline Filter Kit	2 sets
36)	43112 - Inline Filter Refills	2 sets
37)	43945 - Pulse Damper for DX-100	1 set
38)	43174 - IONPAC AS4A-SC 4mm Analytical Column	1 set
39)	43175 - IONPAC AG4A-SC 4mm Guard Column	2 sets
40)	43189 - ASRS 4mm Anion Self Regenerating Suppressor	1 set
41)	46073 - IONPAC CS-12A 4mm Analytical Column	1 set
42)	46074 - IONPAC CG-12A 4mm Guard Column	2 sets
43)	43190 - CSRS 4mm Cation Self Regenerating Suppressor	1 set
44)	42821 - 4400-4460 Printhead (5 packages)	2 boxes
45)	4400 - Paper, 2500 sheets	4 boxes
46)	38141 - Polyvials, c/Cap 5ml Dionex (250 ea per pack)	50 bxes
47)	Thermo-syringe (poly), 2.5 ml, (100 per pack)	5 boxes
48)	Chromato-disk 25A (100 per pack)	5 boxes
49)	Manuals (Operation, Maintenance, etc.)	6 sets

ITEM	SPECIFICATION	No.of Req'd
3-6	WaterPro PS 90005 - Ultra-Pure Water Unit; Purchased from ACATEC	1 set
1)	Power Supply: 115V, 60Hz Purification System: Activated Carbon + Ionexchange Resin + UF Membrane Filter Flow Rate: 2.0 Liter/Minute (Changeable) Required Quality: More Than 18M Ω · cm Raw Water Inlet Pressure: 0 to 1.0 kg/cm²G Operating Temperature: 10 to 35℃ Feature: Automatically maintained water quality Indications: water flow rate, water temperature, and change timing of cartridge and final filter	
	Consumable & Spare Parts of ITEM 3-6	
2)	WaterPro PS 90474-01 & -03 - Purification Cartridges	5 sets
3)	WaterPro PS 90929 - Final Filter	5 sets
4)	WaterPro PS 90764 - Water tank (15 liter) with One-touch Connector	2 units
5)	WaterPro PS 90774 - Support Stand	1 set
6)	Manuals (Operation, Maintenance, etc.)	6 sets

ITEM	SPECIFICATION	No.of Req'd
Computer System		
4-1-1	Computer	
	CPU - COMPAQ DESKPRO 2000M5166/250	1
	Extended Memory - 16MB EDO RAM	1
	Extended Hard Disk - 2GB HD	1
	External Memory Device - SCSI Controller + PD-CD Drive	1
	Power Cord (Cable)	1
	Keyboard (with connecting cable to Desktop)	1
	Mouse (with connecting cable to Desktop)	1
4-1-2	Monitor - 171FS Color Monitor (Connecting cable to main body)	1
	Power cord (Cable) for Monitor	1
4-1-3	Printer - Hewlett Packard Laser Jet 5L	1
	Power Cord for Printer	1
	Printer (Parallel) Cable	1
	Toner Cartridge (Spare)	1
4-1-4	Backup Media - PD disk	10
4-1-5	Spare parts for future extension (Drive Bracket, SCSI Cable, Screw, etc.)	1 set
4-1-6	Software - Windows 95 (English version) installed	
	Backup Disks	32 FD
	MS FORTRAN Power Station	1 set
	Vz Editor	1 set
	Other Software - FD : Floppy Disk, Diskette (15 FD and 2 CD-ROM)	1 set
4-1-7	Manuals in English	1 set

Miscellaneous Local Supply		
	Tri-ethanol Amine: 500 cc - courtesy of ELETROSUL & CEEE	
	Cylinder Gas: SO_2 2500 ppm in nitrogen - 5 litre cylinder with pressure regulator	2 cylinders

Appendix 1-5

Technology Transfer

(Chapter 7 of Interim Report, June 1996)

7.1 Preface

Scope of Work for the Study has stated as follows for the technology transfer:

In order to transfer technologies to Brazilian counterpart personnel, training on following items shall be held.
(1) Planning of environmental monitoring and maintenance of the monitoring system,
(2) Measurement of emission gases from sources, and
(3) Estimation of the effects of each power plant by numerical simulation model

The Study is scheduled only for a little more than two years and is evaluating only the coal fired boilers. Pollution issues must be dealt with long and wide ranged actions. Air and stack gas qualities have to be monitored continuously in order to meet variations of weather and emission sources. And accordingly, future qualities have to be predicted and countermeasures have to be planned.

The JICA Team planned and carried out classroom lectures and on-the-job training during the Second Field Work to implement the statements of the Scope of Work. Acquired technologies by Brazilian counterparts can be applied not only for regions influenced of coal boilers but any other regions influenced of any air pollution sources.

7.2 Classrooms

CEEE's Training Center hosted three classrooms as follows:

a) Ambient Air Monitoring on February 8, 1996
b) Stack Gas Measurement on February 8, 1996
c) Data Management on March 5, 1996

Altogether 41 Brazilian audiences from FEPAM, two power company headquarters, and three power plants had signed up to the lectures on February 8. Texts had been delivered to the two power companies ten copies each with guaranteed arrival of two

weeks beforehand. The lectures were designed to impress the audiences practical aspects for principles, operation, maintenance, calibration, and trouble findings of the related JICA Equipment. They might have difficulties in digesting the details, because there was no real equipment in hand to see. Besides, there was unavoidable language barriers. However, the JICA Team evaluated the lectures were worth to give the audiences general idea on the equipment and its operation and maintenance. Parts of the lectures important for the field work were repeated in small classrooms at each site with seeing and touching the real equipment and with interpreters gradually accustomed in technical terms with repeated discussion.

The third classroom at the CEEE Training Center was for pollutant diffusion in the air. Around 15 people attended the class. For those who were specialized in air pollution, the lecture may be worthy for reconfirmation of one's knowledge. However, for starters or novices to the air pollution issue, it was the must to realize. It covered factors affecting air diffusion, data analyses, and diffusion simulation in general. The JICA Team will open similar classes with advanced topics.

In Charqueadas, a classroom was held for theoretical and operational training courses about ion-chromatography and pure-water preparation given by a local representative of the equipment supplier. More than ten people from ELETROSUL had attended at the class.

7.3 On-The-Job Training

On-the-job training (OJT) is the most effective method to transfer technologies in shorter period to a small group, because it is carried out person to person directly.

The JICA Team carried out OJT always when any new kind of the JICA Equipment was mobilized to use primarily at the site. An experienced member of the JICA Team showed his technology at first to his counterparts with explanation and subsequently guided the counterparts to follow the explanation repeatedly until the JICA member felt confident his trainees to be able to use by themselves the equipment without giving damages on it.

There is no other method than the OJT to transfer stack gas monitoring technologies. However it is very laborious because of noisy and dusty conditions around boilers. At least two people is needed to carry out the monitoring, one at the sampling nozzle and the other at the analyzer. Both are usually separated apart from each other: on top of

the duct and on the ground. These were true in all three power plants. Especially where there was only one instructor, the technology transfer by OJT was very difficult. The most troublesome part was for monitoring of TSP loading in stack gas. The JICA Team will continue OJT on TSP monitoring at the sites stressing technologies or know how as mentioned in Item 4.2, Chapter 4.

The first OJT for the stack gas monitoring was at the Charqueadas Plant. Because of the first, there were many people circled around the instructor and raised many questions of the same kinds repeatedly. Progress was slow, probably partly because of too many people having wide variety of vocational backgrounds, unbearable site conditions, in-experience of interpreters in technical terms. Both sides were patient enough for the technology to be transferred finally to the satisfaction of the JICA Team. However, the satisfaction is limited just in keeping functions of analyzers without damages. Among the first group, if named only two, Mr. Jose L. Magri and Ms Christine R. Coelho had well acquired the technologies. The JICA Team asked and ELETROSUL kindly agreed to dispatch Mr. Magri to Candiota to assist the JICA Team in transferring his knowledge to people in the Candiota Plant. Ms. Coelho helped also in leading operators for understanding technologies.

OJT was carried out in many events for operation and maintenance instruction of the fixed ambient air monitoring stations and of the chemical laboratory, also. From now on, experiences will help accumulation of know-how in Brazilian Team member on handling of the JICA Equipment.

7.4 JICA Courses

In its various acitivities, the JICA Headquarters has two training courses for foreigners, namely the project counterpart course and the group course. These courses are under separated account from an ordinary project such as this Study. As the project counterpart in the fiscal year of 1995, Mr. Sergio Ladniuk was invited to Japan in January 1996 to acquire facts on monitoring, control, public relation, and so on of air pollution at a power company, a steel mill, and a typical local municipality of Japan. By his understanding of Japanese conducts on air pollution issue, both Brazilian and Japanese Teams have been able to have common points of view in the Study.

Also, there were several engineers in Brazilian Teams who had visited Japan in the group courses in relation to power plant operation. They were and would be very

helpful for the duration of the Study, and beyond for the future in Brazil.

(p1 - 7 of Interim Report, June 1996)

JICA dispatched an instrument expert, Hisao Sugidomari, for a month and a local ion-chromatography specialist, Eduardo Alberto Giachero, for 5 days, together with the JICA Team under separate contracts. Their contribution to installation, commissioning, and technology transfer for operation, inspection and maintenance of the equipment was very much appreciated by Japanese and Brazilian Teams.

(Addition, August 1997)

JICA Courses

As the project counterpart course trainee in the fiscal year of 1996, Mr. Edison Pereira de Lima was invited to Japan in September-October, 1996. His courses were almost the same as those of Mr. Ladniuk's visit. By his study in Japan, both the Brazilian Teams were in the same understanding of Japanese conducts on air pollution issues.

Mrs. Rita Tissot was invited as the last project counterpart trainee in July - August 1997. Her course was mainly to acquire technologies on heavy metal analyses using the atomic absorption method, and to improve the ion chromatography technology in addition to those acquired during the Study. She brought samples of air borne TSP and stack gas fly ash for her analyses. The results were reported in Appendix 4-12 and cited in Section 4.4.3.

(Addition, June 1997)

Numerical Simulation Model Transfer

During the period of every Field Work, analyses of numerical data and air pollution mechanism had been discussed. Finally, during the Fourth Field Work (March 1997), the dispersion simulation system fabricated by the JICA Team was installed in the computer of the JICA Equipment. Usage of the system, function of each module composing the system, etc. were transferred to both Brazilian Teams in detail.

(Addition June 1997)

Materials Handed-over to Brazilian Side for Technology Transfer

a. Class Room Text - Volume A: Ambient Air Monitoring, pp 71
b. Class Room Text - Volume B: Stack Gas Monitoring, pp 63
c. Venders Instruction Manuals - HORIBA, EKO, OGASAWARA KEIKI, NIGORIKAWA -RIKAKOGYO, TOA Electronics, SHIMADZU, Water Pro, and DIONEX-USA
d. JIS Handbook - Environmental Technology, 1992
e. Industrial Pollution Control Vol. I, published by Industrial Pollution Control Association (Japan)

Appendix 2-1

Coal Mines in Brazil: Production and Sulfur Contents

Source (#053)

State of Santa Catarina

	ROM in 1993		Recovery	Major Products in 1993			
Mine	tons	S %	tons	tons	S%	kcal/kg	Name
Nova Prospera Miner.							
Mina A - Sangao	804,714	3.19	284,825	266,049	1.6	4,550	CE4500
Carb. Metropolotana							
Esperanca	1,213,719	4	295,116	242,018	2.22	4,592	CE4500
Fontanella	66,302	4.1					
Carb. Criciuma	671,022	na	301,923	225,785	1.8	4,500	CE4500
Co. Carb. de Urussanga							
Santana	201,033	4.75	65,436	40,649	2.5	4,550	CE4500
Santa Agusta		3.65	50,413	31,625			CE4500
Sao Geraldo	1,093,827	4.2	289,932	131,578	2.57	4,687	CE4500
C. Treviso-Itanema II	573,900		106,930	87,405	4.5	5,600	CPL
Massa Falida de CBCA							
Mina 3-Verdin.	584,072	3.1	219,274	102,820	1.9	4,500	CE4500
				99,004	2.0	5,400	CE5400
Sao Simao	88,290	2.8	25,604	10,000			CE4500
				12,955	(2.0	5,400	CE5400
Sao Pedro	91,762	2.85	26,611	20,042			CE5400
Barro Branco, Mina 3G	336,623	3.21	167,132	151,094	2.75	4,510	CE4500
Ibramil-Plano Legeado	80,858	2.79	26,762	18,025	2.7		CE4500
C. Catarinense - Poco 3	337,786	3.5	170,566	92,993	1.4	5460	CE5400
				28,506			CE5800
				28,580	2.5	4,500	CE4500
Coque Catar. - COCALIT							
Rio Fiorita - Sideropolis	87,493		35,308	13,138	2.18	4524	CE4500
Capivari	0						
Rio Deserto	114,837	4.47	na	na	na	na	
C. Belluno, Vila Irapua	22,000	4.3	12,800	12,800	3.5	4500	CE4500
Miner. Perola, S. Pedro	91,762	2.85	26,610	21,858	na	na	CE5400

Refer to attached figures for locations of mines.

State of Rio Grande do Sul

	ROM in 1993		Recovery	Major Products in 1993			
Mine	tons	S %	tons	tons	S%	kcal/kg	Name
CRM-Mina Candiota	1,216,171	1.58	1,210,648	na	1.58	2,930	ROM
				2,096	na	na	CE3300
				1,239	0.9	4,605	CE4200
Mina Leao I	153,667	0.9	102,613	53,101	0.7	4,250	CE4200
Taquara	71,833	na	na	48,523	0.65	4,750	CE4700
Copelmi Mineracao							
Recreio	969,655	1.9	849,272	236,902	1.3	3,044	CE3100
Butia-Leste	480,705	2.3		323,640	1.9	3,750	CE3700
				240,135	0.8	4,752	CE4700
Faxinal	28,620	1.6		62,456	1.3	3,044	CE3100
Recreio	87,476			47,950	0.8	4,752	CE4700
Charqueadas	0						
Santa Heloisa	0						
Carbonifera Palermo	253,259	na	111,703	62,908	0.55	4,195	CE4200
				39,067	0.38	4,721	CE4700
Co. Nacional de Miner. Candiota, Mina de Seival	46,701	1.5	46,701	46,701	1.5	3,200	ROM

State of Parana

	ROM in 1993		Recovery	Major Products in 1993			
Mine	tons	S %	tons	tons	S%	kcal/kg	Name
Carbonifera do Cambui							
Amando Simoes	194,395	5.5		94,816	3.4	6,050	CPL
Poco 115 ss	66,610	6.5		23,612	3.5	6,000	Fino
Frente 20	7,101	7.5		3,917		4,880	ROM
830 ss	5,205	7.5	Total 150,647			4,880	
Klabin do Parana Miner. Mina 2	7,119	13.23	4,505	4,505	9.46	5,855	CE6000

Note:

1) Mine name order:

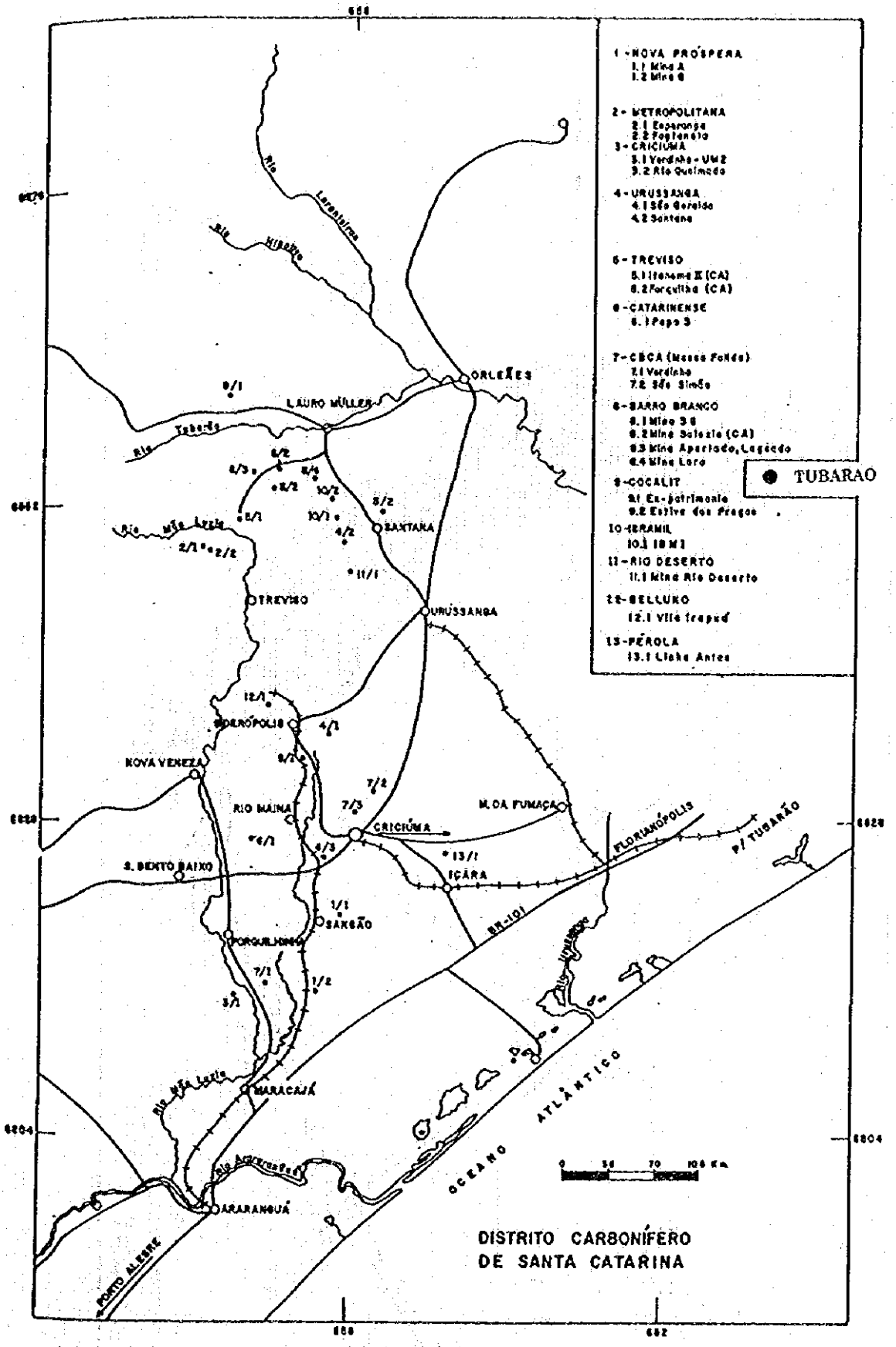
Company Name - Mine Name - and indented mine names where coals are produced if several kinds of coals are processed at the mine (the name not indented).

2) ROM: Run of Mine, 3) CPL: coal pre-washed

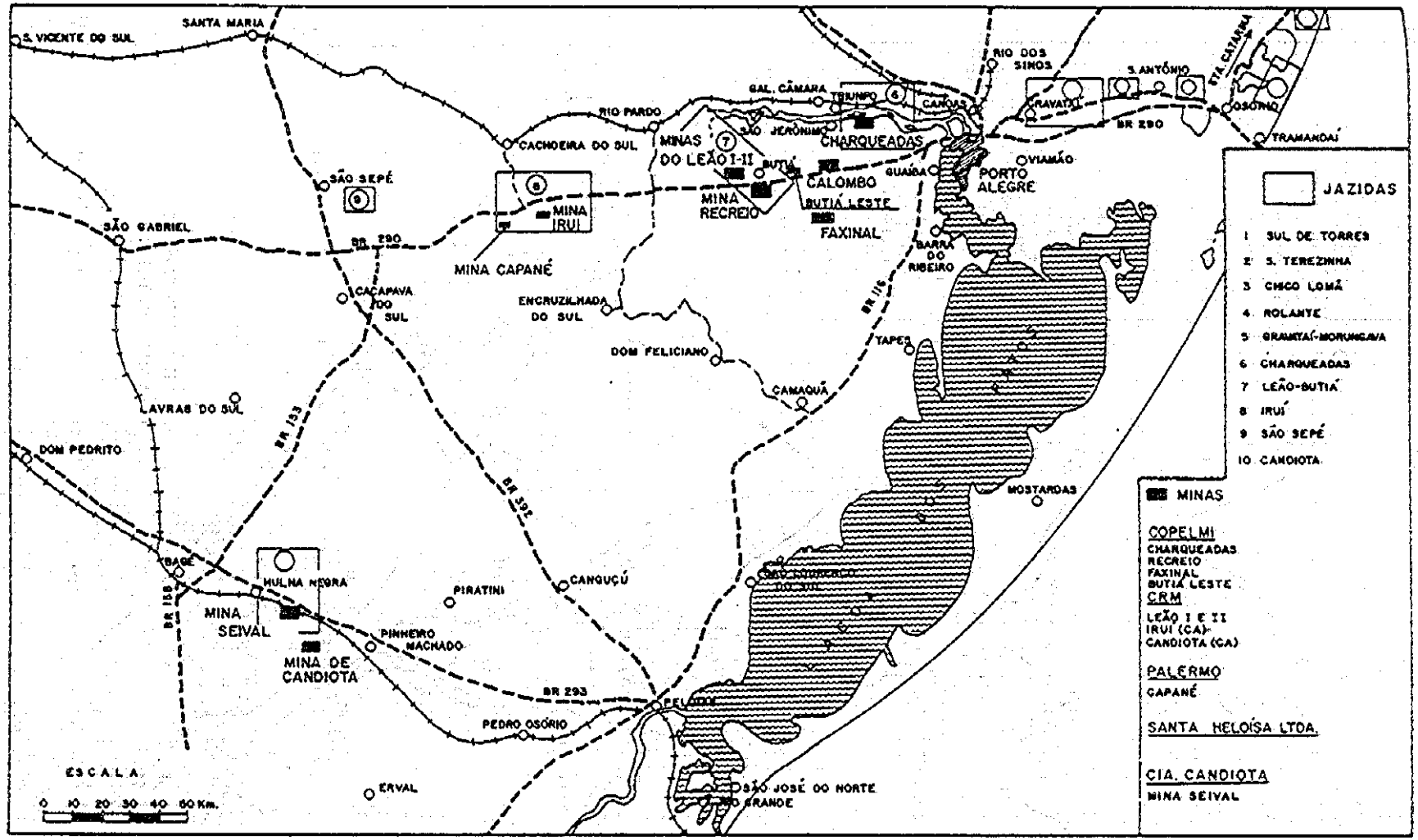
4) Long names are abbreviated and to be referred to the original source.

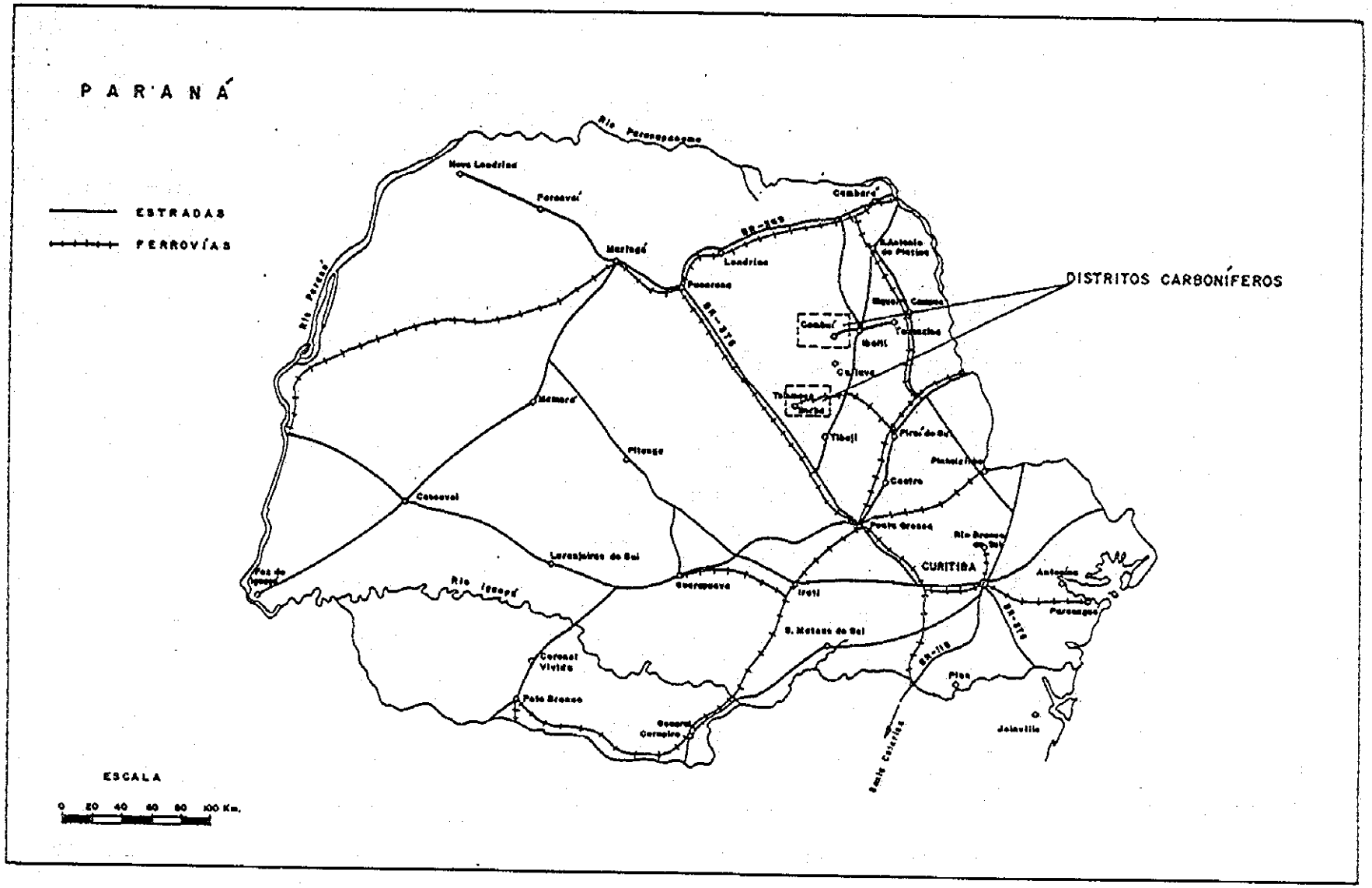
5) C. or Carb.: Carbonifera, 6) Miner.: Mineracao, 7) Co.: Companhia 8) na: not available

Refer to attached figures for locations of mines.


1 - NOVA PROSPERA
1.1 Mina A
1.2 Mina B
2 - METROPOLITANA
2.1 Esperança
2.2 Paglianelo
3 - CRICIÚMA
3.1 Verdinho - UM2
3.2 Rio Queimado
4 - URUSSANGA
4.1 São Geraldo
4.2 Santana
6 - TREVISO
6.1 Treviso II (CA)
6.2 Forquilha (CA)
8 - CATARINENSE
8.1 Papo 3
7 - CBCA (Massa Falida)
7.1 Verdinho
7.2 São Simão
8 - BARRO BRANCO
8.1 Mina 3 B
8.2 Mina Soleza (CA)
8.3 Mina Aparicio, Lagicido
8.4 Mina Loro
9 - COCALIT
9.1 Ex-patrimonio
9.2 Estiva dos Pregos
10 - IBRAMIL
10.1 IBM 1
11 - RIO DESERTO
11.1 Mina Rio Deserto
12 - BELLUNO
12.1 Vila Irapuá
13 - PÉROLA
13.1 Linha Antas
TUBARAO
ORLEÃES
LAURO MÜLLER
SANTANA
TREVISO
URUSSANGA
SIDERÓPOLIS
NOVA VENEZA
RIO MAINA
CRICIÚMA
M. DA FUMAÇA
FLORIANÓPOLIS
P/ TUBARÃO
S. BENTO BAIXO
IÇARA
SANGÃO
FORQUILHINHA
MARACAJÁ
ARARANGUÁ
PORTO ALEGRE
BR-101
OCEANO ATLÂNTICO
Rio Mãe Luzia
Rio Laranjeiras
Rio Hipólito
Rio Tubarão
Rio Araranguá
DISTRITO CARBONÍFERO
DE SANTA CATARINA

MINAS E JAZIDAS DO RIO GRANDE DO SUL




PARANÁ
ESTRADAS
FERROVÍAS
DISTRITOS CARBONÍFEROS
Rio Paranapanema
Nova Londrina
Porecatú
Cambará
Maringá
Londrina
Rio Paraná
Mamborê
Pitanga
Cascavel
Laranjeiras do Sul
Foz do Iguaçu
Rio Iguaçu
Guarapuava
Irati
CURITIBA
Ponta Grossa
Castro
Tibagi
Piraí do Sul
Rio Branco do Sul
Antonina
Paranaguá
S. Mateus do Sul
Coronel Vivida
Pato Branco
Francisco Beltrão
Pien
Joinville
Santa Catarina
ESCALA
0 20 40 60 80 100 Km.

Appendix 3-1 : Comparison of Environmental Criteria of Air Quality

Pollutant	Valuation time	Brazil		Japan	World Bank (WB)	World Health Organization (WHO)
		Primary Criteria	Secondary Criteria			
Total suspended particulate ($\mu g/m^3$)	Annual mean	80	60	-	-	0.04-0.06mg/m³ (40-60)
	24 hours	240	150	-	-	0.15-0.23mg/m³ (150-230)
Smoke ($\mu g/m^3$)	Annual mean	60	40	-	-	-
	24 hours	150	100	-	-	-
Thoracic particles ($\mu g/m^3$)	Annual mean	50	50	-	-	-
	24 hours	150	150	0.1mg/m³ (100)	-	0.07mg/m³ (70)
	1 hour	-	-	0.2mg/m³ (200)	-	-
Sulfur dioxide ($\mu g/m^3$)	Annual mean	80	40	-	-	-
	24 hours	365	100	0.04ppm (114)	-	0.15mg/m³ (150)
	1 hour	-	-	0.1ppm (285)	-	0.35mg/m³ (350)
Carbon monoxide ($\mu g/m^3$)	24 hours	-	-	10ppm (12,500)	-	-
	8 hours	10.000	10.000	20ppm (25,000)	-	10mg/m³ (10,000)
	1 hour	40.000	40.000	-	-	30mg/m³ (30,000)
Ozone ($\mu g/m^3$)	8 hours	-	-	Oxidant -	Oxidant -	-
	1 hour	160	160	0.06ppm (128)	160	-
Nitrogen dioxide ($\mu g/m^3$)	Annual mean	100	100	-	Nitrogen oxides 100	-
	24 hours	-	-	0.04-0.06 (82 - 123)	-	0.15mg/m³ (150)
	1 hour	320	190	-	-	0.4mg/m³ (400)

Notes :

1) Equivalent values which are converted into the units used in Brazilian criteria, are given in parentheses.
2) These concentrations are measured at the condition of 25 ℃ and 1 atm. for the criteria of Brazil, WB and WHO, and at 15℃ and 1 atm. for the Japanese, respectively

Appendix 3-2 Comparison of Emission Standard of Pollutants

Scale of facilities / Area categories / Pollutants and unit	Emission Standard of Brazil				Emission Standard of Japan	Emission Standard of the Guideline of World Bank(WB)
	70 MW or less		70 MW or more			
	Class I	Class II, III	Class I	Class II, III		
Total dust and soot (g/1 million Kcal)	120 (g/1 million Kcal)	350(petroleum) 1,500(coal)	Impermissible for new Installation	120(petroleum) 800(coal)	0.05g/m³ N	Suspended particulate 100mg/m³ N
Smoke color (%)	20*1)	25*1)		20*1)	-	-
Sulfur dioxide (g/1 million Kcal)	2,000 (g/1 million Kcal)	5,000		2,000	k = 17.5 *3) 3～17.5 : 16 phases	Sulfur oxides 500t/day
Fuel oil consumption limit (t/year)	3,000*2)	-		-	-	-
Nitrogen oxides	-	-		-	130ppm (266mg/m³ N)	130ng/Joule (500mg/m³ N)

Notes :

*1) Except for the case of cleaning and of installation of facilities.

*2) The approval from the State Environmental Organ should be required for the consumption of the amount of fuel oil which exceeds this value.

*3) K-value is determined to calculate the emission standard of sulfur oxides for each area. and classified into 16 phases within the range from3.0 to 17.5. The calculation method of emission standard for sulfur oxides is as follows.

Calculation method :

(1)The emission standard of sulfur oxides is identified as a emission quantity of sulfur oxides which is calculated by the following equation.

$$q = K \times He^{2} \times 10^{-3}$$

where:

q : Emission quantity of sulfur oxides (converted into the condition at 0℃ and 1 atm. Unit : m³ N/H)

K : The value determined for each area.

He: Height of outlet corrected by the following method. that is determined in the next term. (Unit:m)

(2)The corrected height of outlet is calculated by the equations below.

$$H_e = H_o + 0.65\,(H_m + H_t) \qquad H_t = 2.01 \times 10^{-3} \cdot Q \cdot (T - 228) \cdot \left(2.30 \log J + \frac{1}{J} - 1\right)$$

$$H_m = \frac{0.795\sqrt{Q \cdot V}}{1 + \frac{2.58}{V}} \qquad J = \frac{1}{\sqrt{Q \cdot V}}\left(1460 - 296 \times \frac{V}{T - 228}\right) + 1$$

where:

H_e : Corrected height of outlet (m)

H_o : Real height of outlet (m)

Q : Emission gas quantity at 15 ℃ (m³ /s)

V : Velocity of emission gas (m/s)

T : Temperature of emission gas (absolute temperature)

Appendix 4-1 Compilation Method of the Monitoring Data

A4.1.1 Monitoring data measured by JICA equipment

The data copied from the data logger to floppy disks are converted into text data of DOS system with the program 'APCONV.EXE'. However, this program only converts the binary data of the logger to text data, and some more processing is necessary for compilation as hourly data base.

(1) Abnormal Data Screening
(2) Unit Conversion

(1) Abnormal Data Screening

Abnormal data should be excluded based on the information like 'Value Code' and 'Device Alarm' of text data (Fig. 1). The value code indicates '0' for no data and '1' for hourly average value. The equipment installed in Brazil usually takes 3600 data for one hour and average them to obtain the hourly average value. At present, the 'Log Alarm' is not used, and alarm information from analyzer and measuring device is stored as the device alarm information. The device alarm area takes 2 bytes (= 16bits) and each bit is defined as Table 1 (Also included in Instruction Manual by HORIBA).

Table 1. Definition of Device Alarm Bits

Bit	Meaning of Alarm
bit00	Analyzer Alarm
bit01 ↓ bit12	Reserve (Don't Care)
bit13	Calibration Alarm
bit14	Maintenance Alarm
bit15	Power Failure

Only once alarm during one hour results in changing the bit value from 0 to 1. The device alarm bit is converted in hexadecimal expression, and right side is lower bit.

The algorithm to exclude abnormal data was defined as the followings:

Device Alarm=0;	Normal
Device Alarm=1;	
Value Code=0;	Abnormal
Value Code=1;	
1800 <= Valid Data < 5400;	Normal
Valid Data<1800 or 5400 <= Valid Data;	Abnormal

Essentially, the monitoring staff should check the original data with editor based on the above information to obtain certified values.

(2) Unit Conversion

The 'value' of the text data is shown to the fifth decimal place with the original unit as in Table 2, but the fifth or the fourth decimal is nonsense considering the accuracy of monitoring equipment. Moreover, the usual range of the items are known from the experience. The units of the monitoring items are converted as in Table 2.

Table 2. Unit Conversion

Items	Item Code	Before	After
SO_2	2	ppm	ppb
NOx	3	ppm	ppb
NO	4	ppm	ppb
NO_2	5	ppm	ppb
Net Radiation	135	KJ/m^2	W/m^2

When NOx value is not equal to the sum of NO and NO_2 values because of rounding off, NO_2 value is determined by subtracting NO value from NOx value to keep the equality. This processing is justified from the fact that NO_2 value is also calculated with NO and NOx in the monitoring equipment.

A4.1.2 Monitoring data measured by Brazilian equipment

Meteorological data except net radiation are measured by Brazilian side, and provided to the JICA study team in floppy disks. The items used in this report are wind speed, wind direction, solar radiation and rainfall amount. Six of 10 minutes average data for wind speed and wind direction are recorded for every one hour, hourly integrated data are recorded for solar radiation and hourly accumulated data (rainfall total for each

hour) are recorded for rainfall amount. Basically, unit conversion is not necessary for solar radiation and rainfall amount, but the solar radiation data during the nighttime are assumed as zero for the convenience of the analysis.

For the data of wind speed and wind direction, the following processing are necessary.

(1) Averaging from 10 minutes data to hourly data

(2) Unit conversion of wind direction data

(1) Averaging to Hourly Data

Usually, six of 10 minutes values are averaged to one hourly value for wind speeds and wind directions. There are two options for averaging wind data. One is vector averaging method and another is scalar averaging method. For the purpose of this study, the scalar averaging method should be used because the scalar value of wind speed is the important parameter for dispersion simulation.

Algorithm to calculate the scalar average (AS) of wind direction is as the followings.

$$AS = \frac{\sum_{i=1}^{6} D_i(i)}{N}$$

If i = 1,

$D_i(i) = A_i(i)$

If i > 1,

$DELTA = A_i(i) - D_i(i-1)$

If DELTA < -180, $D_i(i) = D_i(i-1) + DELTA + 360$

If DELTA < 180, $D_i(i) = D_i(i-1) + DELTA$

If DELTA > 180, $D_i(i) = D_i(i-1) + DELTA - 360$

Here, $A_i(i)$ is each 10 minutes value of wind direction in degrees from 0 to 360.

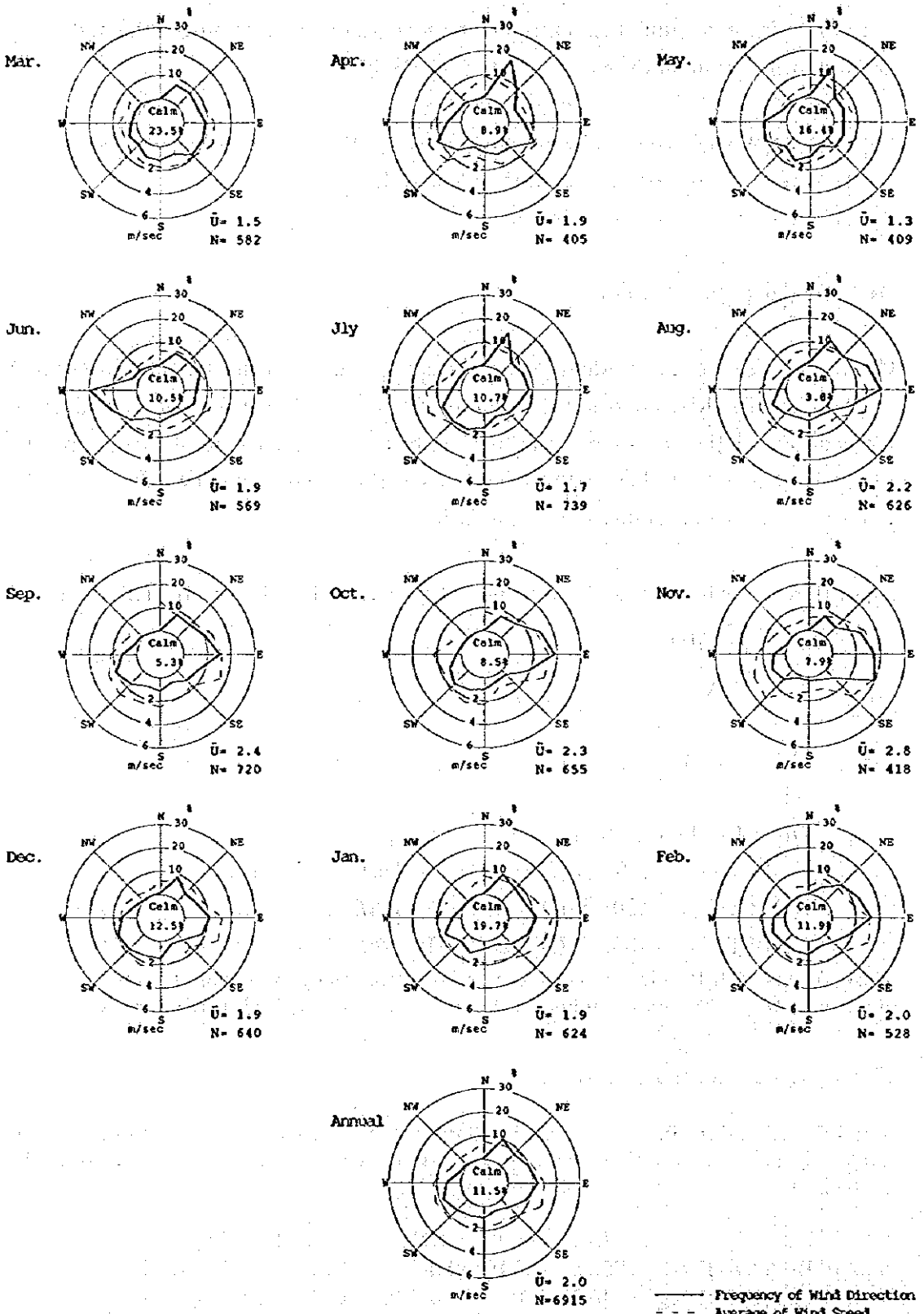
Reference: On-site Meteorological Program Guidance for Regulatory Modeling Applications, U.S.EPA, 1987

(2) Unit conversion of wind direction

Wind direction data in degrees will be converted into 16 wind direction to be used for the analysis and simulation system of this study. The conversion is conducted as the followings.

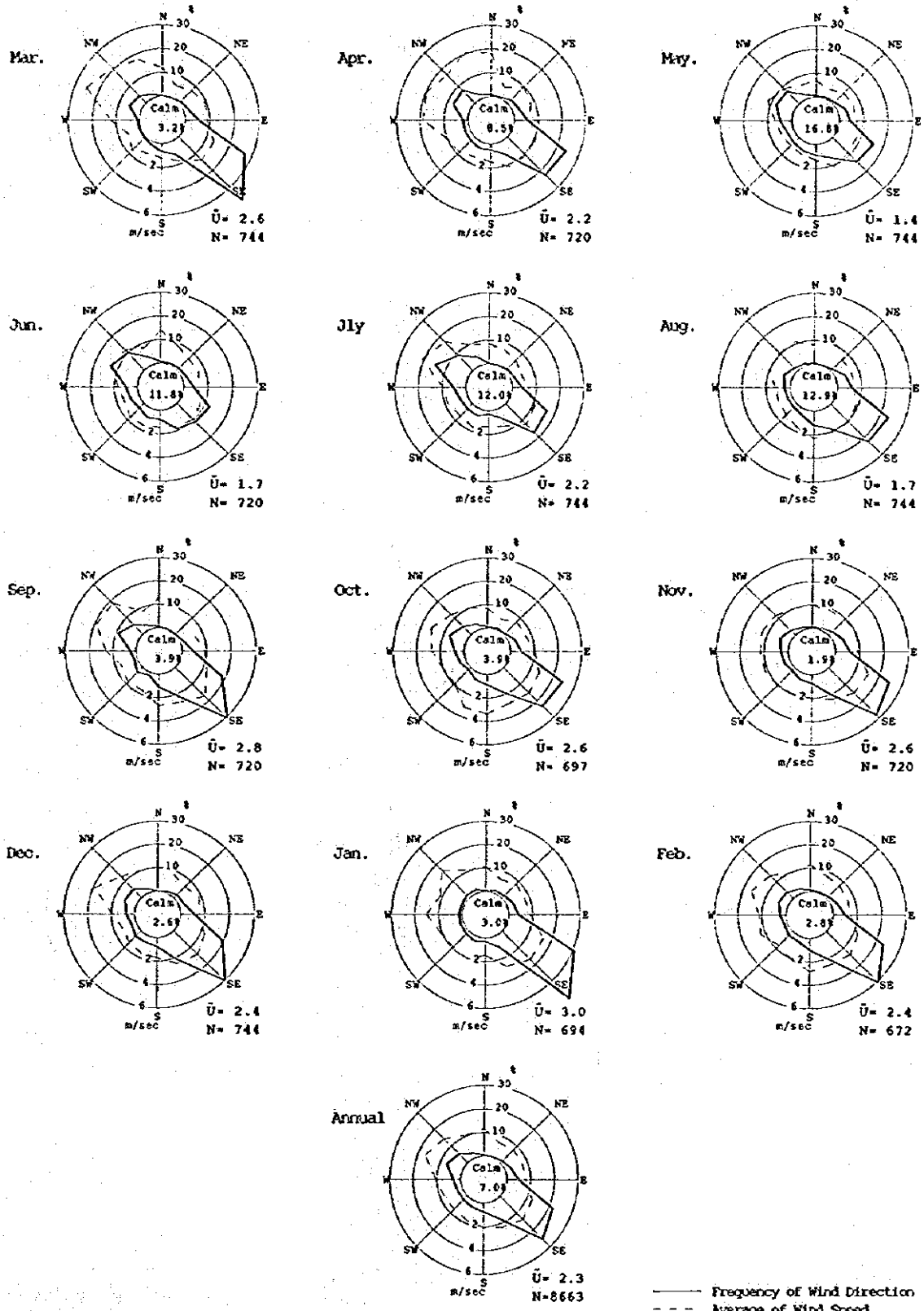
0≦D≦11.25:N 11.25<D≦33.75:NNE 33.75<D≦56.25:NE
56.25<D≦78.75:ENE 78.75<D≦101.25:E 101.25<D≦123.75:ESE
123.75<D≦146.25:SE 146.25<D≦168.75:SSE 168.75<D≦191.25:S
191.25<D≦213.75:SSW 213.75<D≦236.25:SW 236.25<D≦258.75:WSW
258.75<D≦281.25:W 281.25<D≦303.75:WNW 303.75<D≦326.25:NW
326.25<D≦348.75:NNW 348.75<D≦360.0:N

Appendix 4-2 Wind Rose by Month



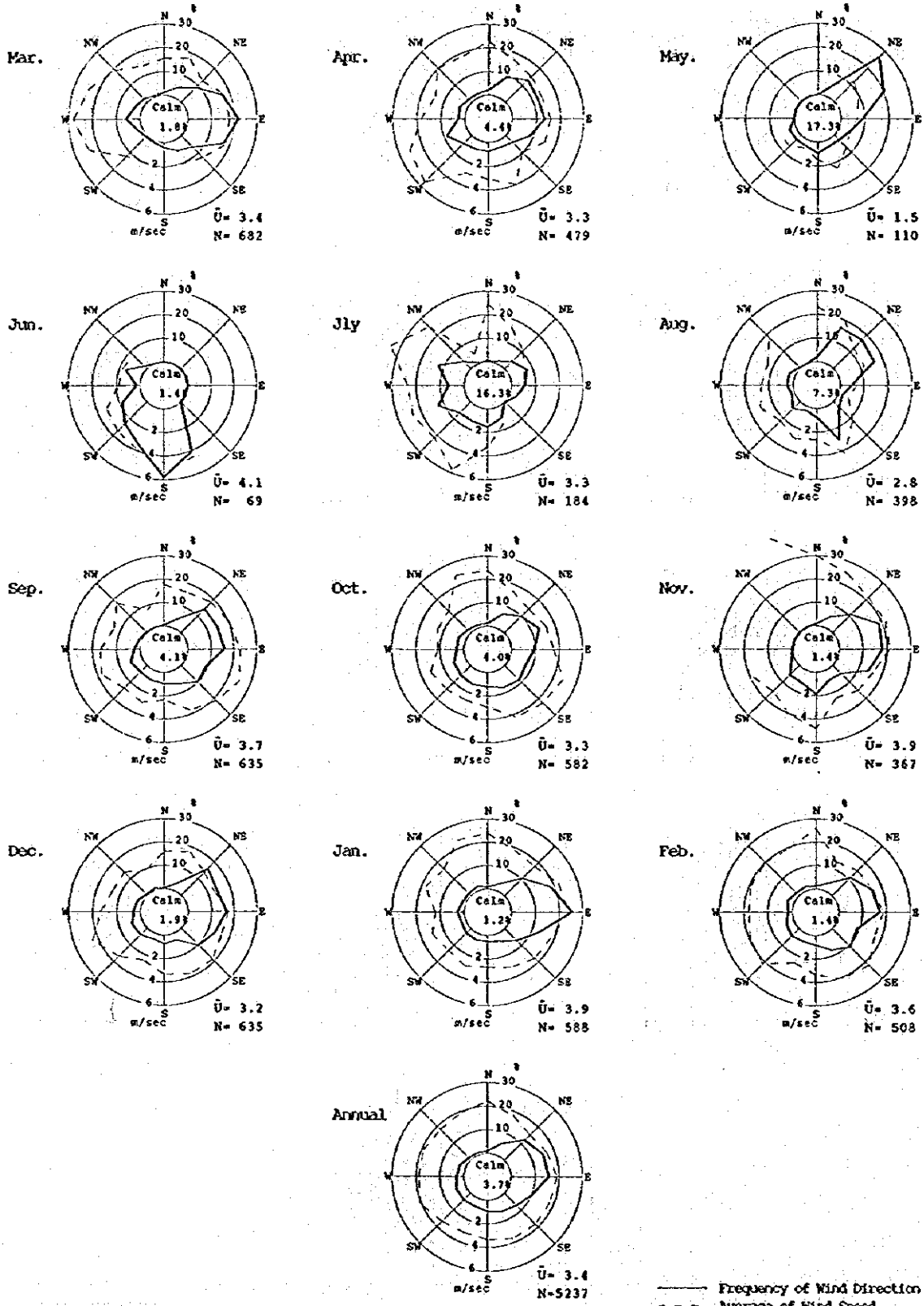
LACERDA

Fig. Wind Rose Diagram Year: 1996 (Mar. to Feb.)



JACUI

Fig. Wind Rose Diagram Year: 1996 (Mar. to Feb.)



CANDIOTA

Fig. Wind Rose Diagram Year: 1996 (Mar. to Feb.)

Appendix 4-3 Stability Classification

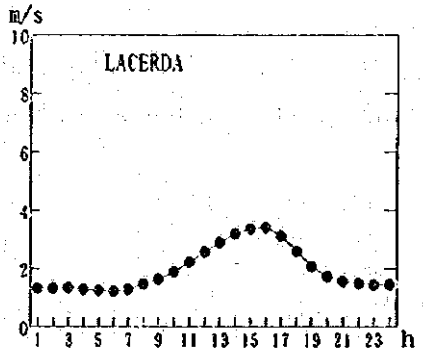
Table 1 Pasquill's Stability Classification
(Wind Speed, Solar Radiation, Net Radiation)

Wind Speed (U)m/s	Solar Radiation(T) kW/m²				Net Radiation(Q) kW/m²		
	T≧0.60	0.60>T ≧ 0.30	0.30>T ≧0.15	0.15>T	Q≧-0.020	-0.020> Q≧-0.040	-0.040>Q
U<2	A	A-B	B	D	D	G	G
2≦U<3	A-B	B	C	D	D	E	F
3≦U<4	B	B-C	C	D	D	D	E
4≦U<6	C	C-D	D	D	D	D	D
6≦U	C	D	D	D	D	D	D

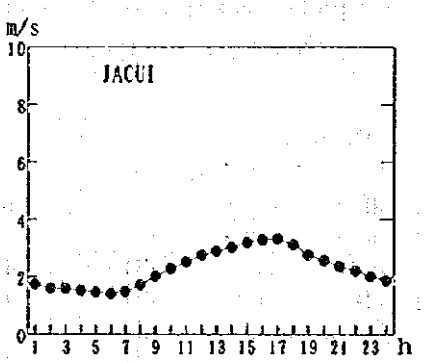
Table 2 Pasquill's Stability Classification (Senshu, 1977)
(Wind Speed, Net Radiation)

	Daytime				Nighttime		
	Net radiation (γ, cal/cm²/h)						
Surface wind Speed (m/sec)	γ >=30	30>γ >=15	15>γ >=7.5	7.5>γ >=0	0>γ >=-1.8	-1.8>γ >=-3.6	-3.6>γ
U<2	A	A-B	B	dD	nD	G	G
2<=U<3	A-B	B	C	dD	nD	E	F
3<=U<4	B	B-C	C	dD	nD	nD	E
4<=U<6	C	C-D	dD	dD	nD	nD	E
6<=U	C	dD	dD	dD	nD	nD	E

Jorge Lacerda Power Plant



Charqueadas Power Plant



Candiota Power Plant

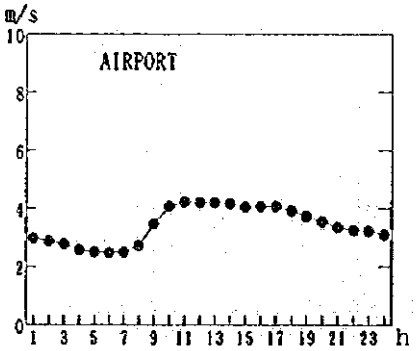
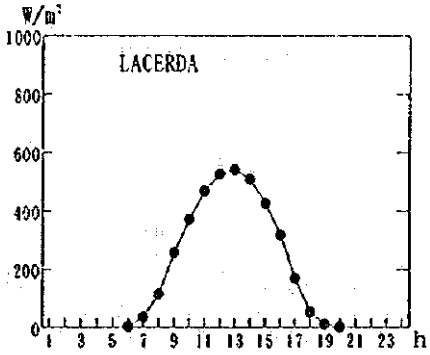


Fig. Diurnal Change of Wind Speed Year 1996 Mar to 1997 Feb

Jorge Lacerda Power Plant



Charqueadas Power Plant

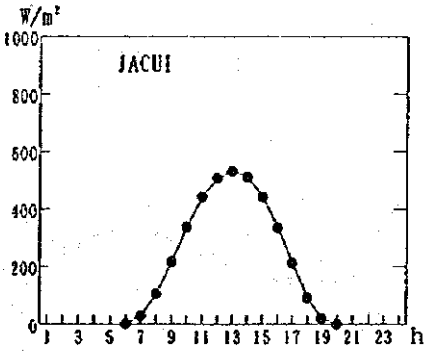
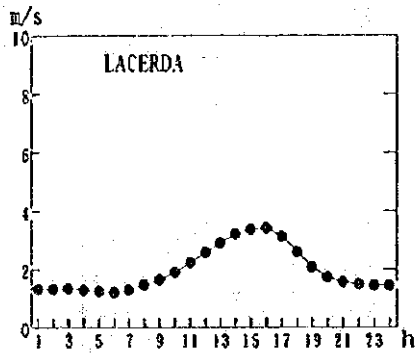
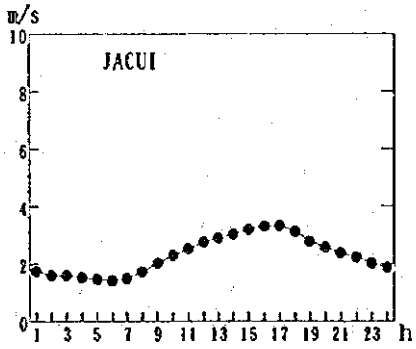


Fig. Diurnal Change of Solar Radiation Year 1996 Mar to 1997 Feb

Jorge Lacerda Power Plant



Charqueadas Power Plant



Candiota Power Plant

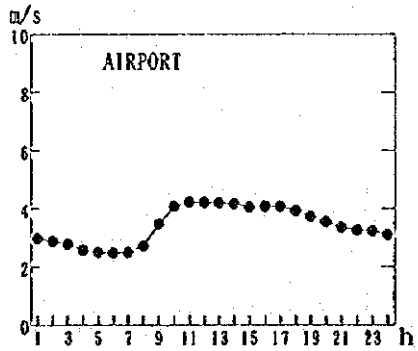
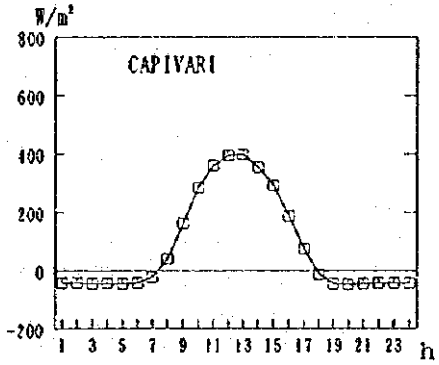
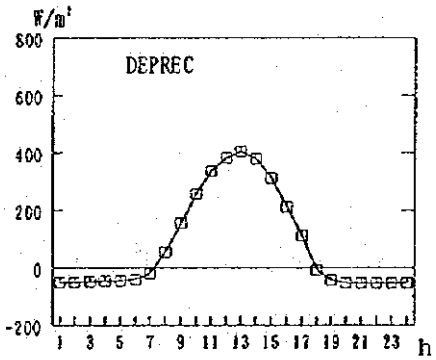


Fig. Diurnal Change of Wind Speed Year 1996 Mar to 1997 Feb

Jorge Lacerda Power Plant



Charqueadas Power Plant



Candiota Power Plant

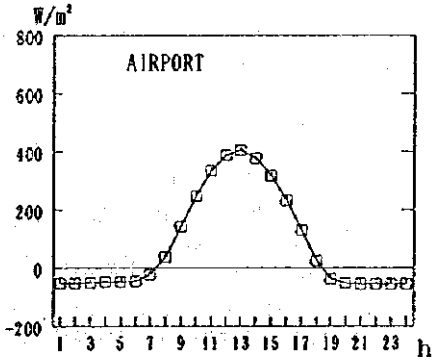
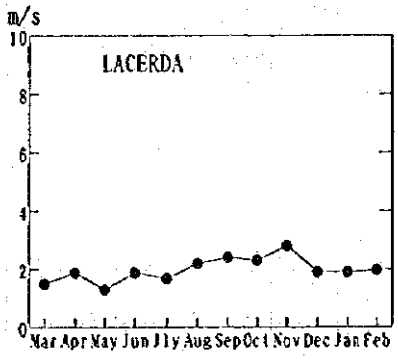
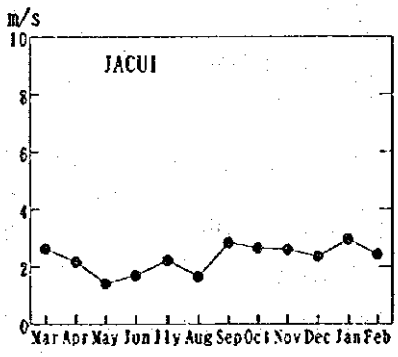


Fig. Diurnal Change of Net Radiation Year 1996 Mar to 1997 Feb

Jorge Lacerda Power Plant



Charqueadas Power Plant



Candiota Power Plant

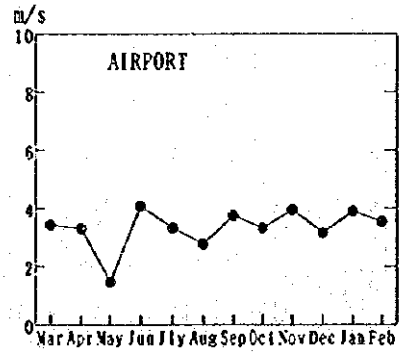
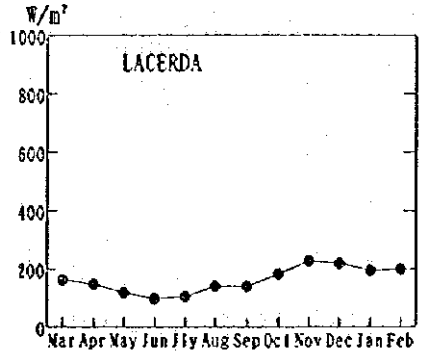


Fig. Monthly Change of Wind Speed Year 1996 Mar to 1997 Feb

Jorge Lacerda Power Plant



Charqueadas Power Plant

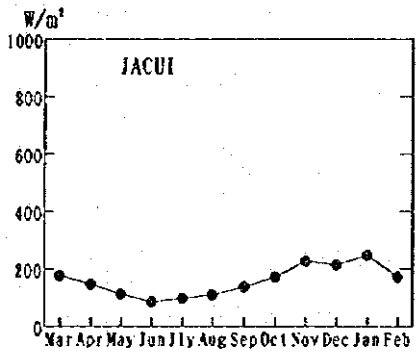
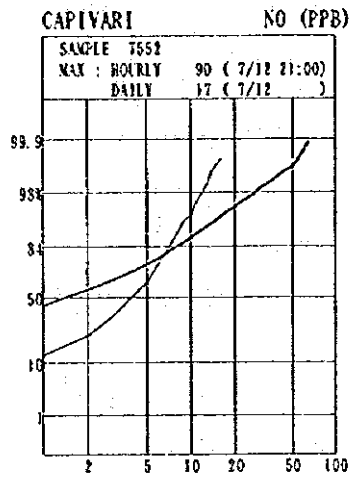


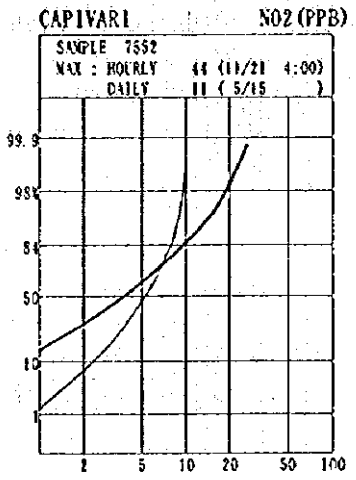
Fig. Monthly Change of Solar Radiation Year 1996 Mar to 1997 Feb

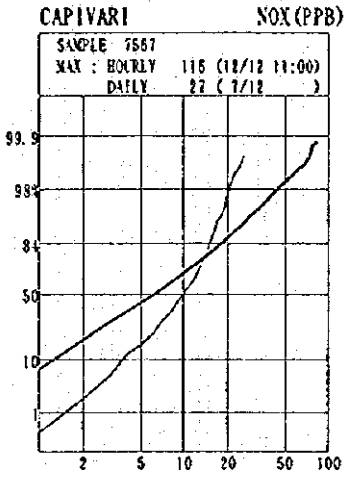
Appendix 4-5 Cumulative Distribution

—Daily Average
--Hourly Average

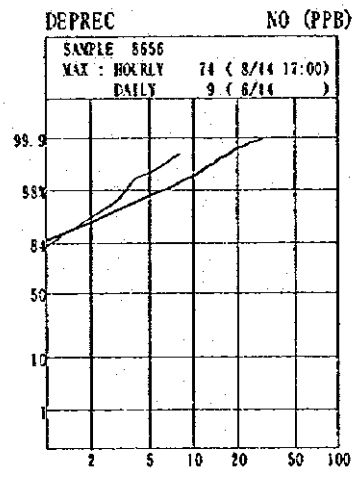
Jorge Lacerda Power Plant

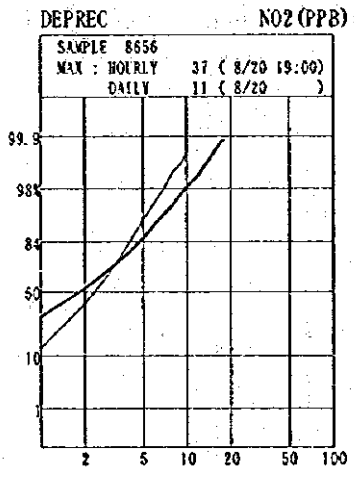


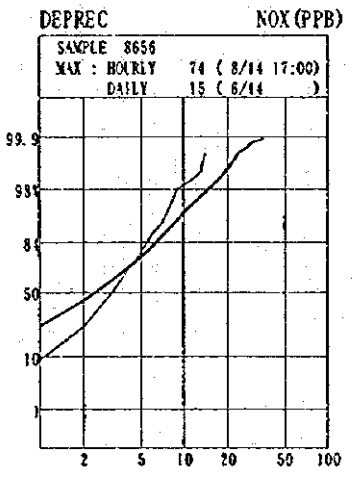




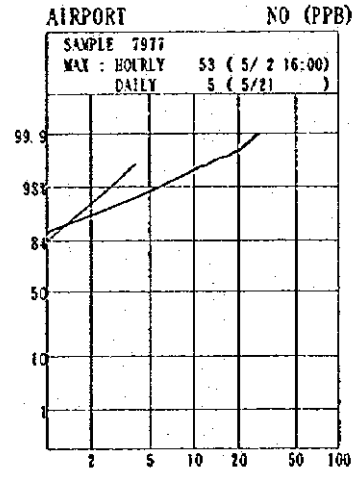
Charqueadas Power Plant

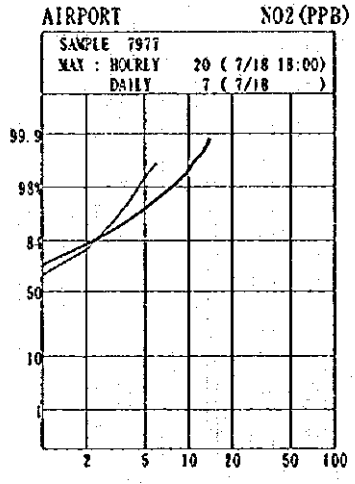


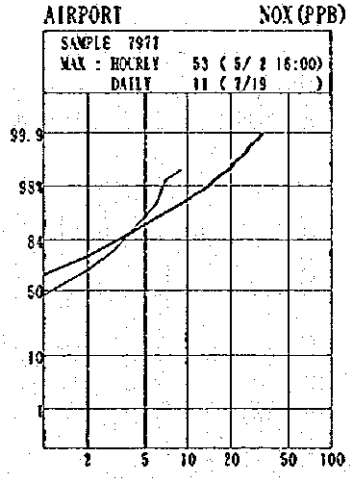




Candiota Power Plant





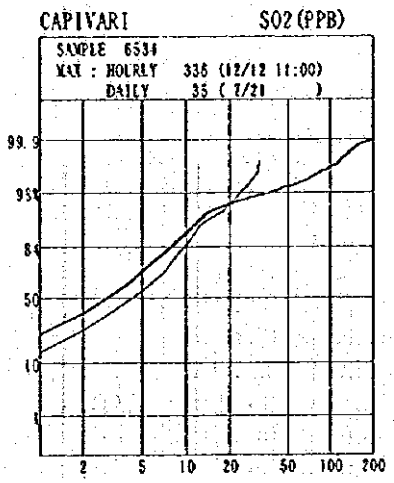


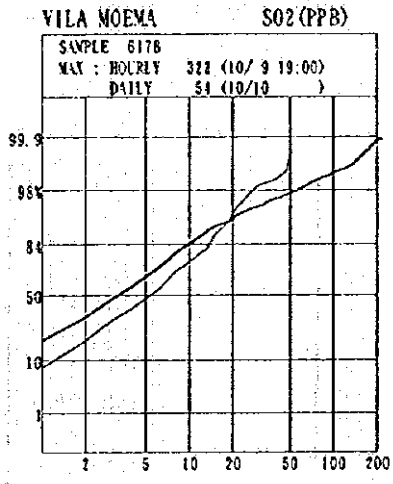
Cumulative Distribution

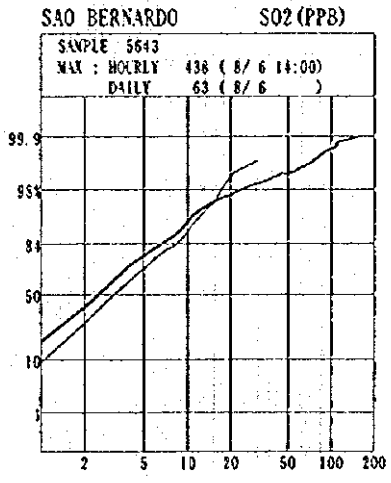
Year 1996 Mar to 1997 Feb

—Daily Average
—Hourly Average

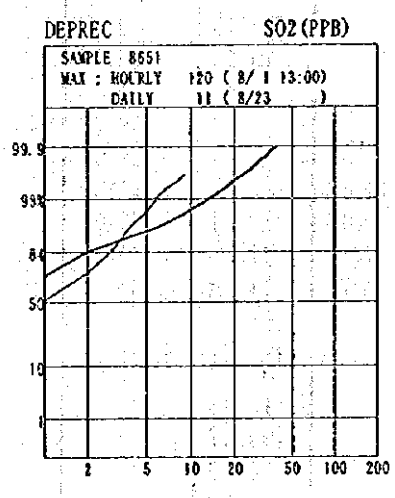
Jorge Lacerda Power Plant

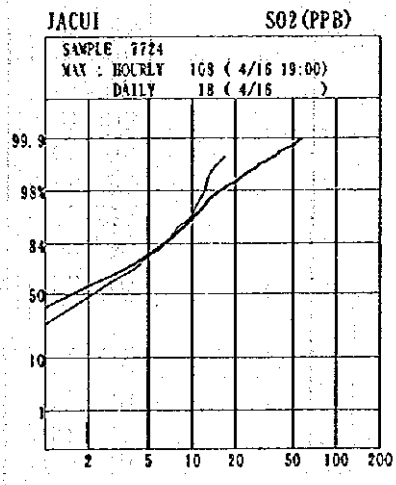


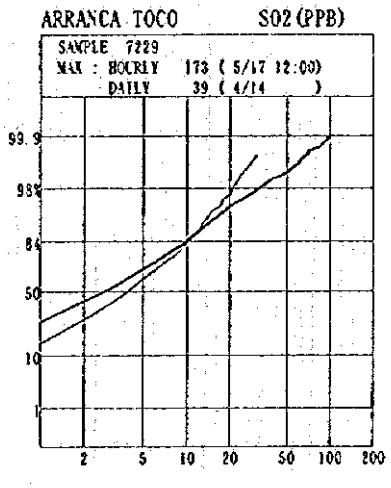




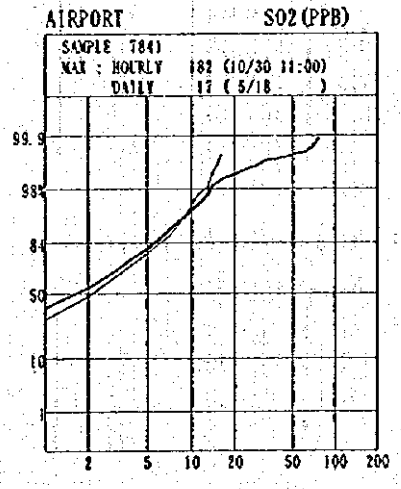
Charqueadas Power Plant

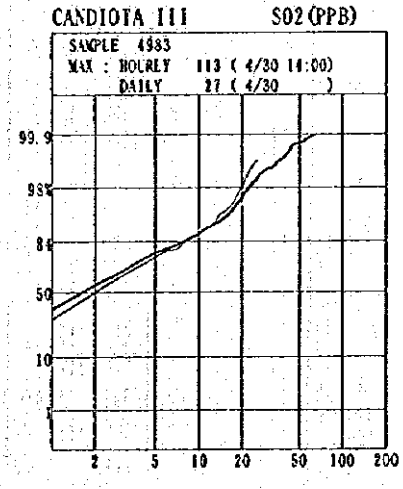


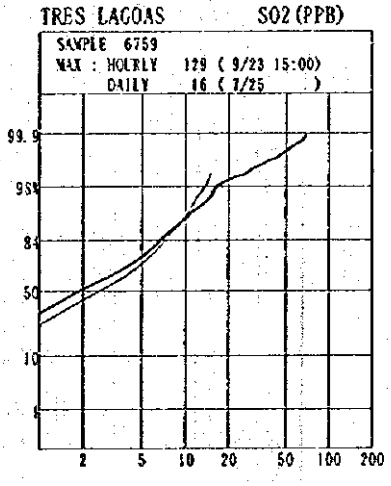




Candiota Power Plant







Cumulative Distribution

Year 1996 Mar to 1997 Feb

Appendix 4-6 TSP Concentration by High Volume Sampler (μ g/m^3)

Data taken by the Brazilian Team

Jorge Lacerda

Date	Vila Moema	Capivari	Sao Bernardo
07/01/96	56.21	59.78	24.49
07/04/96	67.71	136.40	35.43
07/09/96	54.43	63.10	28.14
07/11/96	82.44	213.26	
07/16/96	119.49	291.20	61.77
07/18/96	199.05	182.90	74.46
07/23/96	43.50	115.42	25.09
07/25/96	66.46	102.50	61.92
07/29/96	123.84	175.98	197.28
07/31/96	107.35	227.33	60.11
08/06/96	119.28	218.53	40.76
08/08/96	89.04	134.85	68.62
08/15/96	80.06	140.28	63.24
08/20/96	167.65	174.60	104.26
08/22/96	126.12	181.78	78.15
08/26/96	19.91	29.88	14.74
08/29/96		123.54	48.29
09/06/96		313.07	94.70
09/12/96		203.73	54.42
09/12/96		186.40	53.50
09/18/96		87.90	33.54
09/24/96		13.39	11.03
09/26/96		18.46	11.56
10/01/96			30.29
10/08/96		46.40	31.29
10/10/96		51.48	
10/15/96			32.62
10/17/96		44.71	32.42
10/22/96	32.83	44.67	26.67
10/24/96	29.83	48.69	30.00
10/29/96		46.67	31.80
10/31/96		46.17	32.21
11/05/96	189.52	232.68	
11/07/96	179.80	152.58	
11/19/96		99.91	75.17
11/27/96		110.46	
12/03/96		133.38	
12/05/96		72.40	
12/10/96		26.00	
12/12/96		94.10	
12/17/96	95.24	110.00	
12/26/96	102.78	109.20	72.84
01/02/97	49.00	46.12	
01/06/97	129.47	144.01	112.42
01/08/97	101.59	147.42	116.92
01/13/97	78.46	102.11	
01/16/97	59.21	78.68	54.43
01/20/97		46.69	68.08
01/22/97		23.92	52.41
01/27/97		39.84	68.30

Date	Vila Moema	Capivali	Sao Bernardo
03/04/96	22.93		18.45
03/11/96	38.32	77.57	
03/20/96	43.22	32.21	
03/27/96	47.08	63.98	
04/03/96	56.27	117.94	
04/10/96	22.12	35.32	23.69
04/18/96	58.63	106.37	47.66
04/23/96	96.91	124.91	97.83
04/25/96	100.59	79.20	44.08
05/02/96		43.19	38.48
05/07/96		121.70	68.03
05/09/96		141.48	59.20
05/22/96		49.43	18.98
05/27/96		46.33	45.93
06/04/96			69.73
06/10/96	92.57		59.96
06/12/96	117.60		77.97
06/17/96	39.65	42.74	47.66
06/26/96	27.14	21.78	11.12
07/02/96	45.76	91.48	54.72

02/03/97		33.62	57.91
02/05/97		113.95	
02/13/97		94.47	
02/18/97		75.26	
02/20/97		211.13	
02/25/97		69.38	
03/06/97	43.83	114.55	38.85
03/11/97	66.15	189.03	78.65
03/18/97	43.31	113.56	46.33
03/20/97	77.52	133.82	75.78
03/24/97	76.31	207.13	47.70
03/26/97	198.71	284.99	88.62

Data Distribution (1/96-3/97)

(No. of Data)

μ g/m^3	V.Moema	Capivari	S.Bernado
≦149	52	59	60
150 - 239	5	14	1
≧240	0	3	0
All	57	76	61

CHARQUEADAS

Date	Arranca Toco	Jacui
01/09/96	75	
01/10/96		60
01/12/96	74	38
01/18/96		12
01/24/96	64	22
02/06/96	47	
02/08/96		33
02/11/96	26	
02/18/96	27	13
02/23/96	87	41
02/29/96	28	
04/05/96	36	19
04/11/96		24
04/17/96	53	47
04/23/96	133	59
05/07/96		54
05/11/96	129	52
05/18/96	109	33
05/23/96		26
05/29/96		37
07/04/96	64	19
07/10/96		11
07/16/96	84	26
07/21/96	79	
07/24/96	121	
07/30/96		32
08/01/96	112	
08/07/96	40	
08/08/96		
08/09/96	50	
08/13/96	126	
08/15/96	55	
08/20/96		
08/23/96	103	
08/27/96	8	
08/29/96	67	
09/03/96	20	
09/05/96	84	
09/10/96	60	
09/12/96	86	
09/17/96	41	
09/19/96	119	
09/24/96	34	
09/25/96		
09/27/96	24	
10/01/96	63	
10/03/96	44	
10/08/96	139	
10/11/96	75	
10/15/96	42	

DEPREC
16
31
79
3
7
25
14
4
27
14

Date	Arranca Toco
10/17/96	81
10/22/96	10
10/24/96	25
10/29/96	61
10/31/96	52
11/05/96	118
11/07/96	67
11/12/96	
11/13/96	69
11/19/96	60
11/21/96	78
11/26/96	86
11/29/96	193
12/03/96	102
12/04/96	
12/06/96	80
12/10/96	139
12/17/96	30
12/19/96	47
12/24/96	
12/27/96	41
12/31/96	60
01/03/97	68
01/07/97	93
01/09/97	35
01/14/97	53
01/16/97	39
01/21/97	52
01/23/97	41
01/28/97	99
02/14/97	67
02/18/97	46
02/20/97	54
02/22/97	44
02/25/97	59
02/27/97	
02/28/97	32
03/04/97	
03/06/97	39
03/07/97	74
03/12/97	60
03/15/97	43
03/18/97	60
03/20/97	58
03/25/97	

DEPREC
4
37
46
31
33
19
63
23
19
15
44
44
32
41
30
10
20
25
45

CHARQUEADAS - continued

Date	Arranca Toco	Jacui
03/02/96		26
03/06/96	40	25
03/12/96	144	54
03/18/96	64	33
03/24/96	84	135
03/30/96	38	
04/29/96	94	28
06/04/96	71	
06/10/96	152	
06/16/96	46	
06/22/96	49	
06/28/96	13	20

Data Distribution

(No. of Data)

μ g/m^3	Arranca Toco 3/96-2/97	Jacui 1/96-7/96	DEPREC 8/96-3/97
≦149	86	27	29
150 - 239	2	0	0
≧240	0	0	0
All	88	27	29

Data Distribution

(1/96-9/96) & (12/96-2/97)

(No. of Data)

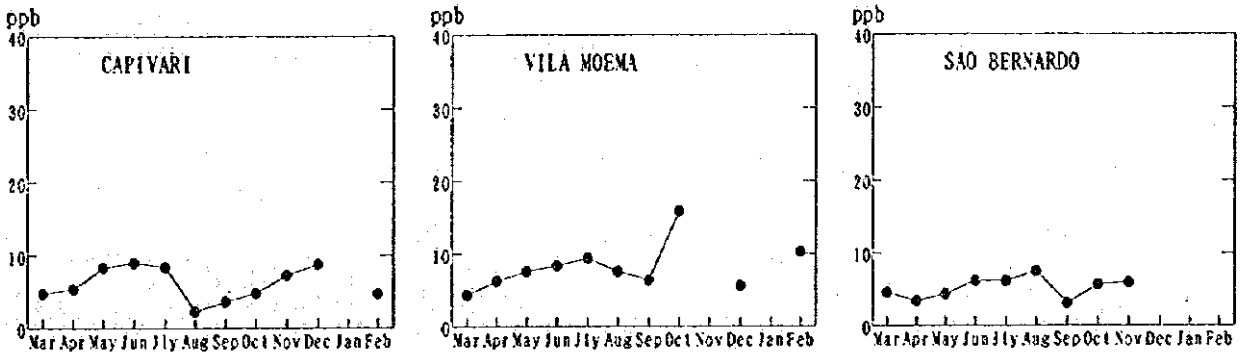
μ g/m^3	Candiota III
≦149	54
150 - 239	0
≧240	0
All	54

CANDIOTA

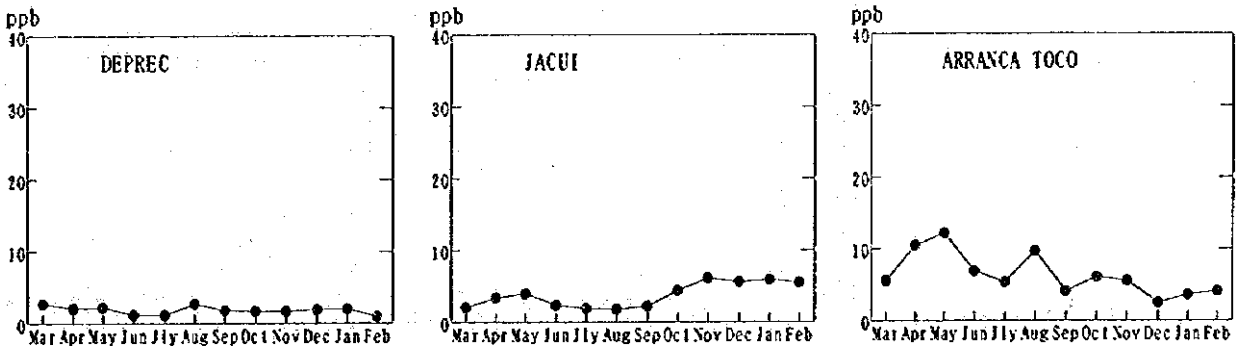
Date	CandiotaIII
01/06/96	48.30
01/12/96	16.23
01/18/96	79.11
01/24/96	21.44
01/30/96	20.81
02/05/96	64.30
02/11/96	15.81
02/17/96	39.13
02/23/96	45.51
02/29/96	109.46
03/12/96	42.11
03/18/96	16.26
03/24/96	20.54
03/30/96	11.43
04/11/96	24.79
04/17/96	15.53
04/23/96	17.83
04/29/96	14.04
05/05/96	26.90
05/11/96	28.04
05/17/96	17.20
05/23/96	50.39
05/29/96	21.03
06/04/96	13.88
06/10/96	31.39
06/16/96	10.72
06/22/96	14.05
06/28/96	8.69
07/04/96	42.58
07/10/96	5.12
07/16/96	17.88
07/22/96	16.54
07/28/96	31.71
08/03/96	67.64
08/09/96	11.00
08/15/96	17.60
08/21/96	33.20
08/27/96	25.39
09/02/96	12.60
09/08/96	2.10
09/14/96	16.77
09/20/96	58.27
09/26/96	6.82
12/13/96	34.25
12/19/96	38.40
01/06/97	30.60
01/12/97	27.37
01/18/97	22.02
01/24/97	19.31
01/30/97	21.85
02/05/97	8.91
02/11/97	54.08
02/17/97	13.02
02/23/97	13.23

Appendix 4-7 Monthly Change of SO_2

Jorge Lacerda Power Plant



Charqueadas Power Plant



Candiota Power Plant

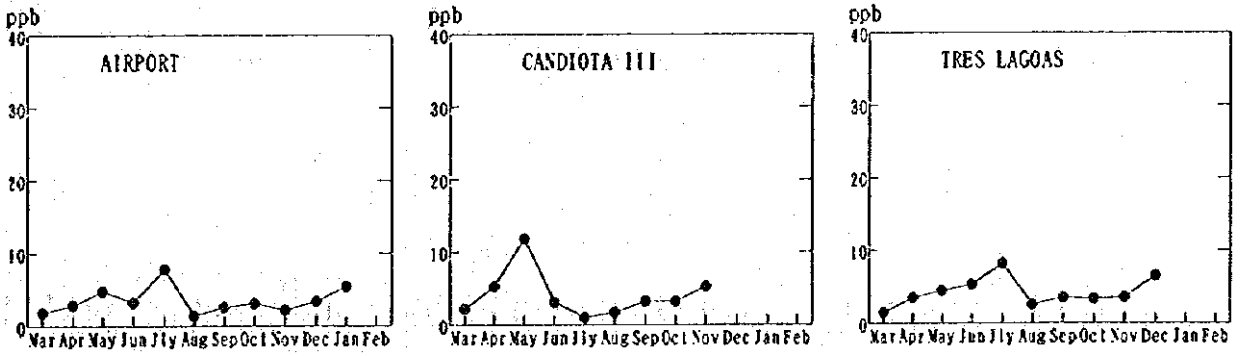


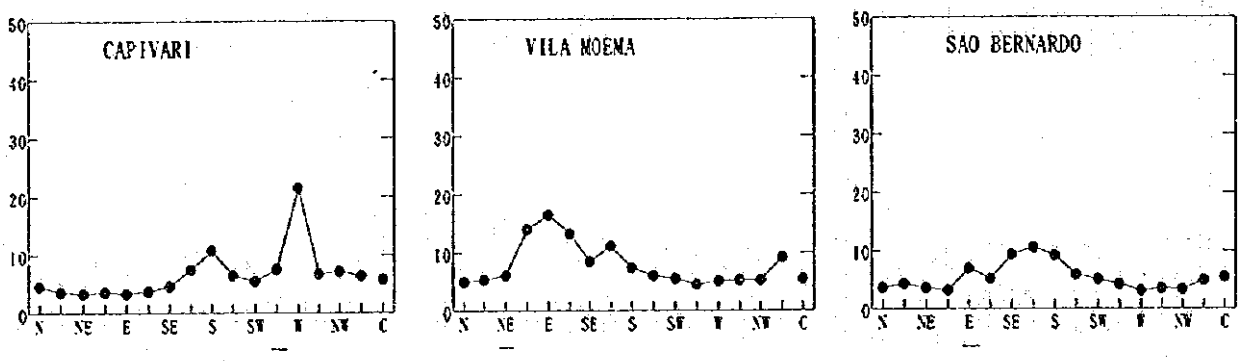
Fig. Monthly Change of Sulfur Dioxide

Year 1996 Mar to 1997 Feb

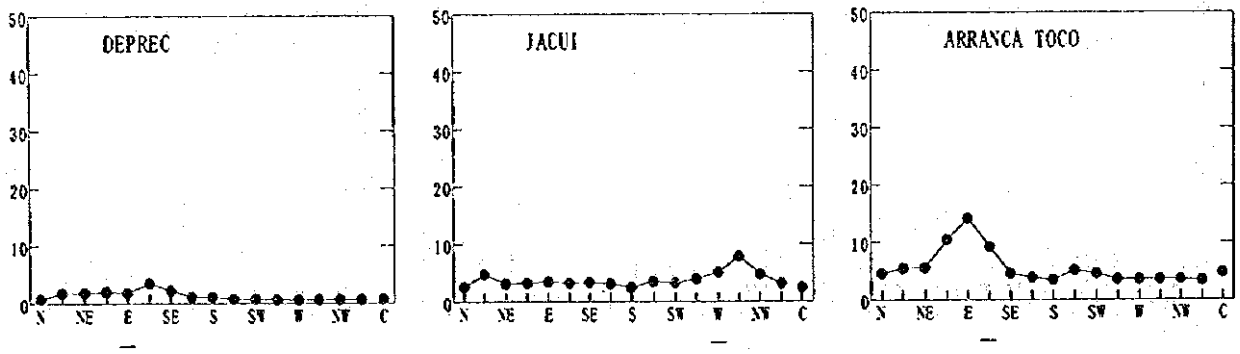
*SO_2: 1ppb=2.60$\mu g/m^3$ at 25°C

Appendix 4-8 Average Concentration by Wind Directions (SO_2 & NO_x)

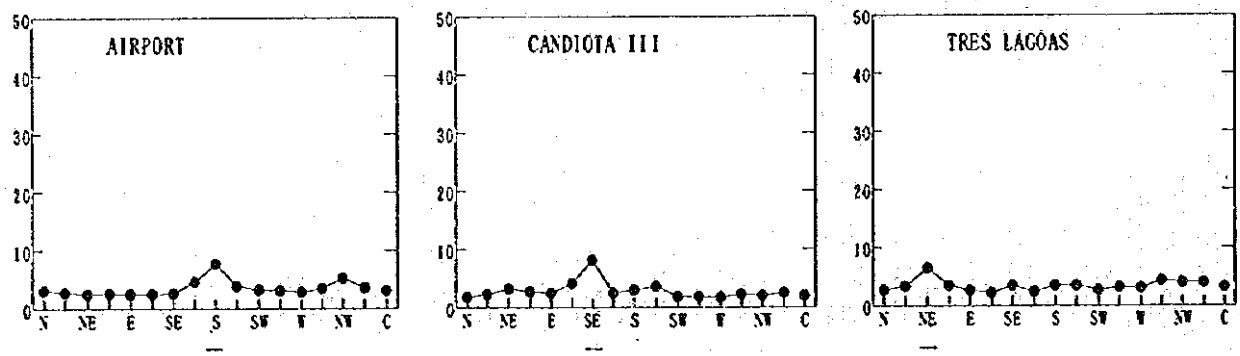
Jorge Lacerda Power Plant



Charqueadas Power Plant



Candiota Power Plant



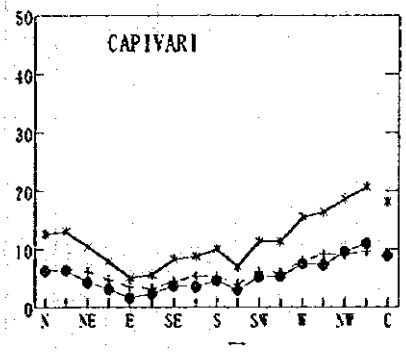
—: Upwind directions of power plants

Fig. Average Concentration by Wind Directions (Sulfur Dioxides)

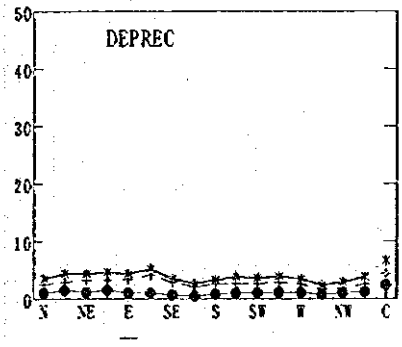
Year 1996 Mar to 1997 Feb

Jorge Lacerda Power Plant

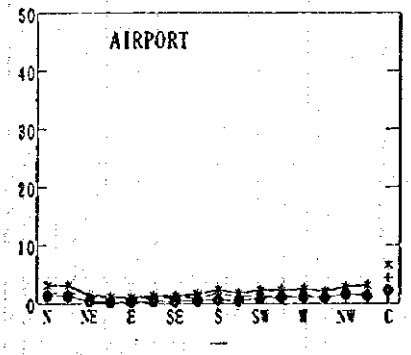
●—● NO : ppb　　+--+ NO_2 : ppb　　×—× NOx : ppb



Charqueadas Power Plant



Candiota Power Plant



—: Upwind directions of power plants

Fig. Average Concentration by Wind Directions (Nitrogen Oxides)

Year 1996 Mar to 1997 Feb

Appendix 4-9A

Airborne SO_2 and NO_2 by Simple Method

Jorge Lacerda (1)

No.	NAME	29/02/96 to 07/03/96		07/03/96 to 14/03/96		01/04/96 to 02/05/96		02/05/96 to 03/06/96		03/06/96 to 03/07/96	
		SO_2 (μg)	NO_2 (μg)	SO_2 (μg)	NO_2 (μg)	SO_2 (μg)	NO_2 (μg)	SO_2 (μg)	NO_2 (μg)	SO_2 (μg)	NO_2 (μg)
1	Banhado da Estiva	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	3.1	< 1.0	4.8	< 1.0	4.8
2	Igreja de Sao Sebastiao	< 1.0	1.1	< 1.0	< 0.8	< 1.0	4.2	< 1.0	6.4	< 1.0	6.6
3	Campo dos Bandeirantes	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	1.4	< 1.0	2.2	< 1.0	2.3
4	Turist Hotal	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	0.9	< 1.0	1.7	< 1.0	2.2
5	Ribeirao da Pescaria Brava	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	1.2	< 1.0	2.5	< 1.0	3.6
6	Sao Bernardo*	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	2.8	< 1.0	3.2	< 1.0	2.8
7	Domingo Saviatto/Ceramica *	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	2.3	< 1.0	2.3	< 1.0	2.3
8	Pasto do Gado RFFSA *	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	3.3	< 1.0	4.6	1.2	4.5
9	Vila Moema*	< 1.0	< 0.8	< 1.0	0.8	< 1.0	4.1	< 1.0	6.2	1.2	5.2
10	Monte Castelo *	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	2.8	< 1.0	3.0	< 1.0	2.8
11	Escola Jose Botega*	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	3.4	< 1.0	1.8	< 1.0	2.6
12	Estrada Geral Treze de Maio	< 1.0	< 0.8	< 1.0	< 0.8	1.2	2.4	< 1.0	3.1	< 1.0	2.0
13	Colegio Gallotti*	< 1.0	0.9	< 1.0	1.4	1.4	6.0	2.2	1.9	2.2	6.3
14	Capivari*	< 1.0	< 0.8	< 1.0	< 0.8	1.4	3.9	< 1.0	6.7	< 1.0	5.4
15	Oficinas**	< 1.0	1.0	< 1.0	1.1	—***	—***	< 1.0	5.3	< 1.0	6.5
16	Ilhota Grande	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	1.1	< 1.0	6.3	1.2	1.6
17	Cachoeira Segunda	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	1.6	< 1.0	2.8	1.1	2.2
18	Escola Cristina Avila Wendhausen	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	2.2	< 1.0	2.7	1.0	2.6
19	Lactuba	< 1.0	< 0.8	< 1.0	< 0.8	< 1.0	1.2	< 1.0	1.8	< 1.0	2.0
20	Cabecudas	< 1.0	1.0	< 1.0	< 0.8	< 1.0	4.6	< 1.0	7.0	1.6	5.4

*: 28/02/96 to 06/03/96 06/03/96 to 13/03/96 ***: No Data

**: 01/03/96 to 08/03/96 08/03/96 to 15/03/96

Jorge Lacerda (2)

No.	NAME	03/07/96 to 05/08/96		05/08/96 to 03/09/96		03/09/96 to 02/10/96		02/10/96 to 06/11/96		06/11/96 to 09/12/96	
		SO_2 (μg)	NO_2 (μg)	SO_2 (μg)	NO_2 (μg)	SO_2 (μg)	NO_2 (μg)	SO_2 (μg)	NO_2 (μg)	SO_2 (μg)	NO_2 (μg)
1	Banhado da Estiva	-*	-*	< 1.0	< 0.8	-*	-*	< 1.0	3.2	< 1.0	2.8
2	Igreja de Sao Sebastiao	< 1.0	7.2	< 1.0	5.4	< 1.0	4.2	< 1.0	4.9	< 1.0	4.0
3	Campo dos Bandeirantes	< 1.0	3.8	< 1.0	2.6	< 1.0	1.2	< 1.0	1.8	< 1.0	2.2
4	Turist Hotal	< 1.0	3.0	< 1.0	1.8	< 1.0	1.0	< 1.0	1.4	< 1.0	1.0
5	Ribeirao da Pescaria Brava	< 1.0	2.7	1.2	1.5	< 1.0	1.5	1.5	2.5	< 1.0	1.4
6	Sao Bernardo	< 1.0	5.4	< 1.0	4.0	< 1.0	3.2	< 1.0	3.8	1.1	3.2
7	Domingo Saviatto/Ceramica	< 1.0	3.5	< 1.0	2.4	< 1.0	2.1	1.9	3.8	4.5	3.8
8	Pasto do Gado RFFSA	< 1.0	6.4	< 1.0	4.8	< 1.0	3.8	< 1.0	< 0.8	< 1.0	4.4
9	Vila Moema	< 1.0	8.0	< 1.0	5.6	< 1.0	4.4	< 1.0	5.5	< 1.0	4.1
10	Monte Castelo	< 1.0	5.0	< 1.0	4.0	< 1.0	2.8	< 1.0	3.7	< 1.0	3.4
11	Escola Jose Botega	1.5	4.6	< 1.0	4.9	< 1.0	3.2	< 1.0	4.0	1.6	4.4
12	Estrada Geral Treze de Maio	< 1.0	3.6	< 1.0	3.5	< 1.0	2.7	1.5	3.2	< 1.0	2.8
13	Colegio Galiotti	< 1.0	9.4	< 1.0	7.5	< 1.0	6.6	< 1.0	3.8	< 1.0	7.0
14	Capivari	< 1.0	6.8	< 1.0	4.5	< 1.0	3.7	< 1.0	3.7	< 1.0	3.1
15	Oficinas	< 1.0	7.8	< 1.0	7.3	< 1.0	6.9	< 1.0	6.7	< 1.0	6.6
16	Ilhota Grande	< 1.0	2.4	< 1.0	1.8	< 1.0	1.7	< 1.0	2.0	< 1.0	< 0.8
17	Cachoeira Segunda	< 1.0	3.4	< 1.0	2.1	< 1.0	2.2	< 1.0	2.6	2.5	2.7
18	Eacola Cristina Avila Wendhausen	< 1.0	4.1	< 1.0	2.4	< 1.0	2.1	< 1.0	2.3	< 1.0	2.0
19	Lactuba	< 1.0	2.7	< 1.0	2.6	< 1.0	1.3	1.7	1.5	< 1.0	1.3
20	Cabecudas	< 1.0	8.0	< 1.0	4.7	< 1.0	4.7	< 1.0	5.2	< 1.0	4.3

* No Data

Jorge Lacerda (3)

No.	NAME	09/12/96 to 06/01/97		06/01/97 to 04/02/97		04/02/97 to 06/03/97		06/03/97 to 07/04/97			
		SO_2 (μg)	NO_2 (μg)	SO_2 (μg)	NO_2 (μg)	SO_2 (μg)	NO_2 (μg)	SO_2 (μg)	NO_2 (μg)		
1	Banhado da Estiva	< 1.0	2.8	< 1.0	2.1	-*	-*	1.7	3.7		
2	Igreja de Sao Sebastiao	< 1.0	4.8	< 1.0	3.8	< 1.0	3.1	< 1.0	3.8		
3	Campo dos Bandeirantes	2.3	2.0	< 1.0	1.9	< 1.0	2.3	< 1.0	1.7		
4	Turist Hotal	1.5	2.4	< 1.0	1.7	1.1	1.4	< 1.0	1.7		
5	Ribeirao da Pescaria Brava	< 1.0	1.3	1.2	1.6	< 1.0	3.3	< 1.0	1.4		
6	Sao Bernardo	< 1.0	3.1	< 1.0	3.1	< 1.0	3.0	< 1.0	3.6		
7	Domingo Saviatto/Ceramica	< 1.0	3.4	< 1.0	2.4	< 1.0	2.6	1.9	2.4		
8	Pasto do Gado RFFSA	< 1.0	3.2	2.0	3.2	< 1.0	3.9	1.2	4.1		
9	Vila Moema	3.8	4.1	< 1.0	3.3	< 1.0	3.7	< 1.0	4.1		
10	Monte Castelo	1.7	3.0	< 1.0	2.6	< 1.0	3.1	< 1.0	2.1		
11	Escola Jose Botega	2.0	2.9	< 1.0	3.0	< 1.0	3.0	< 1.0	2.7		
12	Estrada Geral Treze de Maio	< 1.0	1.9	< 1.0	2.3	< 1.0	2.4	< 1.0	2.5		
13	Colegio Gallotti	< 1.0	5.1	< 1.0	4.8	< 1.0	5.7	< 1.0	6.0		
14	Capivari	< 1.0	3.7	< 1.0	2.6	1.1	3.2	< 1.0	4.3		
15	Oficinas	-*	-*	< 1.0	5.3	< 1.0	5.2	< 1.0	5.4		
16	Ilhota Grande	1.5	4.0	< 1.0	1.2	< 1.0	4.3	< 1.0	1.7		
17	Cachoeira Segunda	1.1	2.4	< 1.0	2.0	< 1.0	2.2	< 1.0	2.1		
18	Escola Cristina Avila Wendhausen	< 1.0	1.7	< 1.0	2.0	< 1.0	2.1	< 1.0	1.8		
19	Lactuba	< 1.0	1.6	< 1.0	1.5	< 1.0	1.5	1.6	1.4		
20	Cabecudas	2.8	4.0	< 1.0	3.8	< 1.0	3.9	< 1.0	5.1		

* No Data