Table 3-3-10 POLLUTANTS EFFLUENT FROM PETROLEUM AND CHEMICAL INDUSTRY

(1/5)

No.	Product	Capacity (ton/year)	Company	Location	Commercement	Steam (Ton/Product)	Electric (KWH/T)	Fuel (MMBtu/T)
129	1st Stage Ethylen (1*Etapa Etileno)	245,000	PETROQUIMICA	Bahia Blanca(Bs.As.)	1981			
93	ABS y SAN		MONSANTO ARG.	Zarate(Bs.As.)	1969	0.39	710.00	0.00
6	Acetates (Acetatos)	12,500	ATANOR S.A.	Baradero (Bs.As.)	1977			
17	Acetic Acid (Acido Acetico)	14,500	ATANOR S.A.	Rio Tercero (Cordoba)	1973	3.76	20.00	0.00
7	Acetic Anhydride (Anhidrido Acetico)	2,500	ATANOR S.A.	Baradero (Bs.As.)	1977	0.60	450.00	0.00
32	Acetone (Acetona)	17,000	CARBOCLOR S.A.	Campana (Bs.As.)	1968	2.71	190.00	0.00
2	Alquil-Phenols (Alquilfenoles)	800,000	ACO S.A.	Pto.Gral.San Martin (Sta.Fe)	1972			
127	Ammonia (Amoniaco)	70,000	PETROSUR S.A.	Campana(Bs.As.)	1963			
49	Ammonia (Amoniaco)	17,000	DIRECCION GENERAL DE FABRICAC. MILITARES	Rio Tercero (Cordoba)	1951			
73	Ammonia (Amoniaco)	3,000	ELECTROCLOR	Cap. Bermudez (Santa Fe)	1960	-	14.00	4.0x106kcal
107	Ammonia (Amoniaco)	70,000	PETROSUR S.A.	Campana(Bs.As.)	1963			
	Total:	160,000				0.00	2,240,000.00	
160	Ammonium Sulphate (Sulfato de Amonio)		SOMISA	San Nicolas(Bs.As.)	1959	0.15	20.00	-
124	Aromatics (Aromaticos)	Expansion 10,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1992			
48	BTX	27,000	DIRECCION GENERAL DE FABRICAC. MILITARES	Campana (Bs.As.)	1951			
100	BTX	150,000	PASA PETROQUIMICA ARGENTINA	San Lorenzo(Santa Fe)	1965	1.05	40.00	6.47
	Total:	177,000				185,850.00	7,080,000.00	1,145,190.00
109	Benzene (Benceno)	70,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1974			
25	Benzoic Acid (Acido Benzoico)	1,800	BRAVE ENERG. S.A.	San Miquel del Monte (Bs.As)	1961			
106	Bisphenol (Bifenilo(95%))	1,500	PASA PETROQUIMICA ARGENTINA	San Lorenzo(Santa Fe)	1990	7.40	340.00	0.46
103	Butadiene (Butadieno)	37,000	PASA PETROQUIMICA ARGENTINA	San Lorenzo(Santa Fe)	1965	2.63	30.00	0.00
119	Buteno 1	25,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1990			
134	C4 Mix (Mezcla C4)	34,700	BAHIA BLANCA	Bahia Blanca(Bs.As.)	1986			
26	Carbon Black (Negro de Humo)	47,000	CABOT ARGENTINA S.A.	Campana (Bs.As.)	1964	-2.65	100.00	22.52
143	Carbon Dioxide (Anhidrido Carbonico)	7,000	PETROQUIMICA RIO III	Rio III(Cordoba)	1981			
63	Carbon Sulfide (Sulfuro de Carbono)	14,000	DUPERIAL	San Lorenzo (Santa Fe)	1964			
71	Carbon Tetra.(Tetraclorruro de Carbono)	10,000	ELECTROCLOR	Cap. Bermudez (Santa Fe)	1960	2.61	152.00	-
81	Carbonato de Sodio	50,000	INDUCLOR	Bahia Blanca (Bs.As.)	1986			
57	Carpet Yarn (Hilado Para Alfombra)	2,300	DUCILO S.A.	Berazategui (Bs.As.)	1955			
90	Caustic Soda (Soda Caustica)	4,000	KHEGART S.A.	Chacras de Coria (Mendoza)	1960			
141	Caustic Soda (Soda Caustica)	17,000	PETROQUIMICA RIO III	Rio III(Cordoba)	1981			
80	Caustic Soda (Soda Caustica)	100,000	INDUCLOR	Bahia Blanca (Bs.As.)	1986	4.50	2,500.00	
	Total:	121,000				544,500.00	302,500,000.00	0.00
79	Chlorine (Cloro)	90,000	INDUCLOR	Bahia Blanca (Bs.As.)	1986	0.47	290.00	0.00
74	Chlorine (Cloro)	43,500	ELECTROCLOR	Cap. Bermudez (Santa Fe)	1966			
19	Chlorine (Cloro)	12,000	ATANOR S.A.	Rio Tercero (Cordoba)	1987			
	Total:	145,500				68,385.00	42,195,000.00	0.00
86	Chlorine Soda (Cloro-soda)	44,000	INDUPA S.A.	Cinco Saltos (Rio Negro)	1962			
27	Creosote, Phenololls, Anthracene (Creosota, Aceites Fenolados, Antraceno)	30,000	CARBOQUIMICA ARG. S.A.	San Nicolas (Bs.As.)	1974			
164	Cumen (No Opera) (Cumeno(not in operation))	46,000		Ensenada(Bs.As.)	1978			
113	Cycloexane (Ciclohexano)	45,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1974	0.44	70.00	2.85
36	Diiso Butyl Cetone (Diisobutilcetona)	150	CARBOCLOR S.A.	Campana (Bs.As.)	1968			
24	Dispersions (Dispersiones)	2,500	BASF S.A.	Gral. Lagos (Santa Fe)	1971			
37	Eterisopropilico	2,400	CARBOCLOR S.A.	Campana (Bs.As.)	1968			
76	Ethane (Etano)	330,000	GAS DEL ESTADO	Gral. Cerri (Bs.As.)	1981	0.00	70.00	7.60
105	Ethyl-Benzene (Etilbenceno)	66,000	PASA PETROQUIMICA ARGENTINA	San Lorenzo(Santa Fe)	1990	0.28	85.00	9.53

(2/5)

No.	Product	Capacity (ton/year)	Company	Location	Commercement	Utility Consumption Steam (Ton/Product)	Electric (KWH/T)	Fuel (MMBtu/T)
132	Ethylene (Etileno)	65,000	BAHIA BLANCA	Bahia Blanca(Bs.As.)	1986	-0.08	60.00	0.00
104	Ethylene (Etileno)	24,000	PASA PETROQUIMICA ARGENTINA	San Lorenzo(Santa Fe)	1965	1.84	40.00	-8.04
88	Ethylene (Etileno)	16,000	IPAKO S.A.	Ensenada (Bs.As.)	1962	1.30	40.00	1.20
59	Ethylene (Etileno)	15,000	DUPERIAL	San Lorenzo (Santa Fe)	1964	1.06	40.00	9.49
	Total:	120,000				123,600.00	5,400,000.00	79,500.00
60	Expansion to Ethylene (Ampliacion de Etileno)	7,000	DUPERIAL	San Lorenzo (Santa Fe)	1989			
131	Expansion to: (Ampliacion en:)							
5	Expend Polystyrene (Poliestireno Expandible)	1,200	AISLANTES DE CUYO S.A.	Godoy Cruz (Mendoza)	1973			
23	Expendible Polystyrene (Poliestireno Expand)	6,600	BASF S.A.	Gral. Lagos (Santa Fe)	1971			
155	Extension Formol (Ampliacion Formol)	14,000	RESNFOR-METANOL	Reconquista(Sta.Fe)	1984			
15	Formaldehyde (Formaldehido)	18,000	ATANOR S.A.	Munro (Bs.As.)	1950			
39	Formaldehyde (Formaldehido)	22,000	COMPANIA CASCO S.A.	Pilar (Bs.As.)	1968	-0.30	40.00	0.00
	Total:	40,000				-12,000.00	1,600,000.00	0.00
154	Formol (Formol)	17,000	RESNFOR-METANOL	Reconquista(Sta.Fe)	1976			
11	Fumaric Acid (Acido Fumarico)	800	ATANOR S.A.	Llavallol (Bs.As.)	1972			
95	Glyphosate Weedkillers (Glifosato(herbicida))	8,500,000	MONSANTO ARG.	Zarate(Bs.As.)	1987			
126	H.D.Polyethylene (Polietileno a.d.)	62,000	PETROPOL S.M.	Bahia Blanca(Bs.As.)	1986	0.67	600.00	0.00
162	Hard DDB (DDB)	10,000	Y.P.F.	Ensenada(Bs.As.)	1978	1.05	150.00	15.67
115	Hevy Aromatics (Aromaticos Pesados)	2,600	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1974			
91	Hydrochloric Acid (Acido Clorhidrico)	9,600	KHEGART S.A.	Chacras de Coria (Mendoza)	1960	-	10.00	-
142	Hydrochloric Acid (Acido Clorhidrico)	50,000	PETROQUIMICA RIO III	Rio III(Cordoba)	1981			
	Total:	59,600				0.00	595,000.00	0.00
18	Hydrogen Peroxid (Agua Oxigenada)	4,000	ATANOR S.A.	Rio Tercero (Cordoba)	1971	7.50	1,800.00	0.00
148	L.D.Lineal Polyethylene (Polietileno Lineal b.d.)	120,000	POLISUR	Puerto Galvan(B.Blanca)	1981	0.00	600.00	0.00
55	Industrial Nylon (Nylon Industrial)	11,500	DUCILO S.A.	Berazategui (Bs.As.)	1965	4.00	390.00	0.90
30	Isopropanol	48,000	CARBOCLOR S.A.	Campana (Bs.As.)	1968	4.62	90.00	4.17
61	L.D.Polyethylene (Polistileno b.d.)	20,000	DUPERIAL	San Lorenzo (Santa Fe)	1964			
116	L.P.G.	45,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1981			
166	Lineal Parafins (Parafinas lineales)	40,000		Ensenada(Bs.As.)	1978	0.00	140.00	8.59
163	Lineal-Alquil-Benzene (ABL Alquil-Benceno-Lineal)	30,000		Ensenada(Bs.As.)	1978	4.25	70.00	0.00
77	Liquid Gas (Gas Licuado)	300,000	GAS DEL ESTADO	Gral. Cerri (Bs.As.)	1981			
82	M.C.V.	30,000	INDUPA S.A.	Cinco Saltos (Rio Negro)	1962			
70	M.V.C.	30,500	ELECTROCLOR	Cap. Bermudez (Santa Fe)	1960	1.39	220.00	4.78
118	MTBE	40,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1990	0.80	20.00	0.00
97	Maleic Anh. (Anhidrido Maleico)	Ampliacion an	MALEIC S.A.					
	Maleic Anh. (Anhidrido Maleico)	10,000	MALEIC S.A.	Ensenada(Bs.As.)	1990			
96	Maleic Anh. (Anhidrido Maleico)	10,000	MALEIC S.A.	Ensenada(Bs.As.)	1981	-3.70	1,330.00	0.00
	Total:	20,000				-74,000.00	26,600,000.00	0.00
120	Methanol (Metanol)	25,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1990	0.01	70.00	0.00
135	Methane (Metanol)	108,500	BAHIA BLANCA	Bahia Blanca(Bs.As.)	1986			
38	Methanol (Metanol)	21,000	COMPANIA CASCO S.A.	Pilar (Bs.As.)	1965			
156	Methanol (Metanol)	50,000	RESNFOR-METANOL	Pto.San Martin(Bs.As.)	1990			
	Total:	204,500				2,045.00	14,315,000.00	0.00
33	Methyl Ethyl Cetone (Metil Etilcetona)	7,000	CARBOCLOR S.A.	Campana (Bs.As.)	1968	11.00	550.00	0.48x106kcal
35	Methyl Isobutyl Carbinol (Metilisobutilcarbinol)	2,000	CARBOCLOR S.A.	Campana (Bs.As.)	1968			
34	Methyl Isobutyl Cetone (Metilisobutilicetona)	7,600	CARBOCLOR S.A.	Campana (Bs.As.)	1968	7.50	400.00	0.00
114	Mixed Xylene (Xilenos Mezcla)	5,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1974			

No.	Product	Capacity (ton/year)	Company	Location	Commencement	Utility Consumption Steam (Ton/Product)	Electric (KWH/T)	Fuel (MMBtu/T)
29	Naphthalene (Naftalina)	5,000	CARBOQUIMICA ARG. S.A.	San Nicolas (Bs.As.)	1974	1.36	42.00	
53	Nitrate of Ammonium (Nitrato de Amonio)	8,300	DIRECCION GENERAL DE FABRICACIONES MILITARES	Rio Tercero (Cordoba)	1980			
50	Nitric Acid (Acido Nitrico)	39,000	DIRECCION GENERAL DE FABRICACIONES MILITARES	Rio Tercero (Cordoba)	1980	0.04	32.00	
101	Nitrile Rubber (Caucho nitrilo)	2,000	PASA PETROQUIMICA ARGENTINA	San Lorenzo(Santa Fe)	1975			
159	Nylon Yarn (Hilado de Nylon)	4,500	SNIAFA S.A.	Bernandez(Bs.As.)	1959			
111	O-xylene (O-xileno)	20,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1974	0.00	160.00	18.43
121	Oxo-Alcoholes	35,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1990			
112	P-xylene (P-xileno)	40,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1974	0.00	160.00	18.43
1	P.T. Butyl Phenol (P.T. Butil Fenol)	1,000	ACO S.A.	Ensenada (Bs.As.)	1981			
83	P.V.C.	32,000	INDUPA S.A.	Cinco Saltos (Rio Negro)	1962			
69	P.V.C.	30,000	ELECTROCLOR	Cap. Bermudez (Santa Fe)	1960	0.84	200.00	0.00
85	P.V.C.	58,500	INDUPA S.A.	Bahia Blanca (Bs.As.)	1986			
	Total:	120,500				101,220.00	24,100,000.00	0.00
122	PET (Polietilenterstalato)		PETROQUIMICA GENERAL MOSCONI			0.01	90.00	3.41
123	(P.E.T.)			Ensenada(Bs.As.)	1992			
	—Bottle Degree (Grado Otella)	5,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1992			
	—Textile Degree (Grado Textil)	12,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1992	1.68	250.00	5.56
28	Petroleum Asphalt (Brea)	30,000	CARBOQUIMICA ARG. S.A.	San Nicolas (Bs.As.)	1974			
43	Phenolic Molding Power (Polvo Moldeo Fenolico)	2,500	COMPANIA CASCO S.A.	Quilmes (Bs.As.)	1967			
16	Phenolic Resins (Resinas Fenolicas)	2,500	ATANOR S.A.	Munro (Bs.As.)	1962	1.40	28.00	0.00
42	Phenolic Resins (Resinas Fenolicas)	2,000	COMPANIA CASCO S.A.	Quilmes (Bs.As.)	1967			
	Total:	4,500				6,300.00	126,000.00	0.00
4	Phenolic anti-oxidizer-B.H.T. (Antioxidante Fenolico B.H.T.)	3,000	ACO S.A.	Ensenada (Bs.As.)	1991			
62	Phtalic Anhydride (Anhidrido Ftalico)	12,400	DUPERIAL	San Lorenzo (Santa Fe)	1964			
12	Phtalic Anhydride (Anhidrido Ftalico)	16,000	ATANOR S.A.	Llavallol (Bs.As.)	1954	-3.78	140.00	0.00
13	Phtalic Anhydride (Plastificantes Ftalicos)	18,000	ATANOR S.A.	Llavallol (Bs.As.)	1954	-3.78	140.00	0.00
	Total:	46,400				-175,392.00	6,496,000.00	0.00
158	Polyacetate Vinil & Copolymers (Poliacetato de Vinilo y Copolimeros)	4,000	SIPAK S.A.	Capital Federal	1966			
146	Polybutenes and Poly-isobutyines (Polibutenos y Pollisobutenos)	9,000	POLIBUTENOS ARG.	Ensenada(Bs.As.)	1981	9.52	3,330.00	0.00
161	Polyester (Poliester)	6,000	SUDAMTEX	Azul(Bs.As.)	1963			
157	Polyester (Poliester)	2,500	RHODIA ARGENTINA	Quilmes(Bs.As.)	1972			
125	Polyester Monomer (DMT) (Monomeros Poliester(DMT))	45,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1992	1.26	500.00	4.99
149	Polyethylene i.d. (Polietileno b.d.)	90,000	POLISUR	Bahia Blanca(Bs.As.)	1981	0.40	1,600.00	0.00
89	Polyethylene b.d. (Polietileno)	15,000	IPAKO S.A.	Ensenada (Bs.As.)	1962			
64	Polyols (Polioles)	2,000	DUPERIAL	San Lorenzo (Santa Fe)	1976			
47	Polyols (Polioles)	25,344	(ex-Dow Quimica S.A.)	Puerto San Martin (Bs.As.)	1982			
	Total:	27,344						
139	Polypropylene (Polipropileno)	40,000	PETROQUIMICA CUYO	Lujan de Cuyo(Mendoza)	1988			
137	Polypropylene (Polipropileno)	40,000	PETROQUIMICA CUYO	Lujan de Cuyo(Mendoza)	1988	1.20	590.00	0.00
136	Polypropylene (Polipropileno)	100,000	PETROKEN	Ensenada(Bs.As.)	1991			
138	Polypropylene (Polipropileno)	100,000	PETROKEN	Ensenada(Bs.As.)	1991			
	Total:	280,000				336,000.00	165,200,000.00	0.00

No.	Product	Capacity (ton/year)	Company	Location	Commencement	Utility Consumption Steam (Ton/Product)	Electric (KWH/T)	Fuel (MMBtu/T)
94	Polystyrene (Poliestireno)	38,000	MONSANTO ARG.	Zarate(Bs.As.)	1986			
87	Polystyrene (Poliestireno)	2,500	INDUSTRIAS PLASTICAS SALADILLO S.A.	La Plata (Bs.As.)	1972			
98	Polystyrene (Poliestireno)	5,200	NEO PLOAX	Lomas de Zamora(Bs.As.)	1972			
147	Polystyrene (Poliestireno)	5,000	POLIESTIRENOS ARG.	Del Viso(Bs.As.)				
153	Polystyrene (Poliestireno)	3,500	RESIGUM	Garin(Bs.As.)	n.d.			
78	Polystyrene (Poliestireno)	41,500	IATA	Allen (Rio Negro)	s/d.	0.00	110.00	1.08
145	Polystyrenes (Poliestirenos)	4,700	PLASTICA BERNABO	Moreno(Bs.As.)	1962			
144	Polystyrenes (Poliestirenos)	7,500	PLAST	Sarandi(Bs.As.)	1969			
	Total:	108,000				0.00	11,880,000.00	116,640.00
58	Polyurethanic Yarn (Hilado Poliuretanico)	400	DUCILO S.A.	Mercedes (Bs.As.)	1978			
130	Propylene (Propileno)	20,000	BAHIA BLANCA	Bahia Blanca(Bs.As.)	1981			
133	Propylene (Propileno)	75,000	BAHIA BLANCA	Bahia Blanca(Bs.As.)	1986			
	Total:	95,000						
165	Propylene Tetramer (Tetramero Propileno)	20,000		Ensenada(Bs.As.)	1978	6.30	890.00	0.00
117	Pyrolisis Gasoline (Nafta de Pirolisis)							
	-Benzene (Benceno)	17,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1982	1.53	20.00	0.00
	-Normal Hexane (Normal Hexano)	30,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1984			
	-Xylene (Xileno)	1,300	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1982			
152	SAN	1,500	RESIGUM	Garin(Bs.As.)	n.d.			
46	SBR Latices (Latices SBR)	10,000	INDOQUIM S.A.	Puerto San Martin (Bs.As.)	1969	3.00	500.00	0.00
102	SBR Rubber (Caucho SBR)	53,000	PASA PETROQUIMICA ARGENTINA	San Lorenzo(Santa Fe)	1965	3.00	500.00	0.00
31	Secondary Butanol (Butanol secundario)	10,000	CARBOCLOR S.A.	Campana (Bs.As.)	1968	2.21	40.00	0.00
75	Soda	47,800	ELECTROCLOR (Ex-CELULOSA)	Cap. Bermudez (Santa Fe)	1966			
20	Sodium Hydroxide (Soda Caustica)	16,200	ATANOR S.A.	Rio Tercero (Cordoba)	1987			
8	Sorbinol	2,000	ATANOR S.A.	Baradero (Bs.As.)	1977			
99	Styrene (Estireno)	80,000	PASA PETROQUIMICA ARGENTINA	San Lorenzo(Santa Fe)	1965	1.17	30.00	8.01
3	Sulph. Aromatics (Aromaticos Sultonados)	900	ACO S.A.	Pto.Gral.San Martin (Sta.Fe)	1975			
66	Sulphuric Acid (Acido Sulfurico (Ex-Petrosur))	33,000	DUPERIAL	Campana (Bs.As.)	1985	1.00	100.00	-
65	Sulphuric Acid (Acido Sulfurico)	83,000	DUPERIAL	San Lorenzo (Santa Fe)	1962			
10	Sulphuric Acid (Acido Sulfurico)	68,000	ATANOR S.A.	Dock Sud (Bs.As.)	1979			
51	Sulphuric Acid (Acido Sulfurico)	36,000	DIRECCION GENERAL DE FABRICACIONES MILITARES	Rio Tercero (Cordoba)	1959			
52	Sulphuric Acid (Acido Sulfurico)	33,000	DIRECCION GENERAL DE FABRICACIONES MILITARES	Berisso (La Plata)	1951			
	Total:	253,000				253,000.00	25,300,000.00	0.00
140	T.D.I.	17,500	PETROQUIMICA RIO III	Rio III(Cordoba)	1981	3.29	670.00	20.80
67	Tartaric Acid (Acido Tartarico)	3,500	DUPERIAL	Palmira (Mendoza)	1940			
54	Textile Nylon (Nylon Textil)	3,000	DUCILO S.A.	Berazategui (Bs.As.)	1955			
56	Textile Nylon (Nylon Textil)	6,000	DUCILO S.A.	Mercedes (Bs.As.)	1970	2.45	100.00	7.30
	Total:	9,000				22,050.00	900,000.00	65,700.00
45	Thermoplastic Compounds (Compuestos Termoplasticos)	15,000	COOPLIMEROS ESTIRENICOS	San Luis	1987			
110	Toluene (Tolueno)	20,000	PETROQUIMICA GENERAL MOSCONI	Ensenada(Bs.As.)	1974			
9	Triacetina	600	ATANOR S.A.	Baradero (Bs.As.)	1977			
72	Trichloroethylene (Tricloroetileno)	6,000	ELECTROCLOR	Cap. Bermudez (Santa Fe)	1960			
84	Trichloroethylene (Tricloroetileno)	5,000	INDUPA S.A.	Cinco Saltos (Rio Negro)	1965			
	Total:	11,000						

(5/5)

No.	Product	Capacity (ton/year)	Company	Location	Commercement	Utility Consumption Steam (Ton/Product)	Electric (KWH/T)	Fuel (MMBtu/T)
108	Urea	104,000	PETROSUR S.A.	Campana(Bs.As.)	1963	2.00	160.00	-
128	Urea	104,000	PETROSUR S.A.	Campana(Bs.As.)	1963			
	Total:	208,000				416,000.00	33,280,000.00	0.00
14	Ureic Glues (Colas Ureicas)	8,300	ATANOR S.A.	Munro (Bs.As.)	1962	0.30	30.00	0.00
44	Ureic Molding Power (Polvo Moldeo Ureico)	1,500	COMPANIA CASCO S.A.	Quilmes (Bs.As.)	1967			
41	Ureic Resin (Resinas Ureicas)	25,000	COMPANIA CASCO S.A.	Quilmes (Bs.As.)	1967			
150	Vinyl Polyacetate & Copolymers (Poliacetato de Vinilo y Copolimeros)	15,000	QUIMICA HOECHST	Liavallol(Bs.As.)	1965			
151	Vinyl Polyacetate & Copolymers (Poliacetato de Vinilo y Copolimeros)	5,000	REFINERIAS DE MAIZ	Baradero(Bs.As.)	1966			
	Total:	20,000						
40	Vinyl Resins (Resinas Vinilicas)	3,000	COMPANIA CASCO S.A.	Pilar (Bs.As.)	1967			
92	Vinylchlorine Monomer (Cloruro de Vinilo Monomero)	130,000	MONOMEROS VINILICOS	Bahia Blanca (Bs.As.)	1986	0.10	20.00	0.00
21	Weedkillers (3.5-Dinitro Herbicida)	2,000	ATANOR S.A.	Rio Tercero (Cordoba)	1987			
68	Weedkillers (Herbicidas)	2,000	DUPERIAL	Fighiera (Santa Fe)	1984			
22	Weedkillers Atrazine (Atrazina Herbicida)	4,000	ATANOR S.A.	San Nicolas	1987			
	Total:	8,000						
	Grand Total :	14,440,294				3,284,578	1,110,530,000	8,999,860

Under the above conditions discharge of atmospheric pollutants from the chemical industry in Argentina was summarized as shown in Table 3-3-11:

Table 3-3-11 DISCHARGE OF CHEMICAL INDUSTRY POLLUTANT

	SOx (Ton/Y)	NOx (Ton/Y)	Dust (Ton/Y)
Case-1	1135	739	-
Case-2	3728	1176	-
Case-3	6195	2161	-

Contitions for Cases 1,2 and 3 are given below.

	Steam generating boiler	Power(on-site generator)	Fuel(heavy oil/ natural gas)
Case-1	25% heavy oil boiler	20%	0/3
Case-2	50% heavy oil boiler	40%	1/2
Case-3	100% heavy oil boiler	70%	2/1

In addition to the list of the chemical industry shown in Table 3-3-10 above, there are plans for construction projects given in Table 3-3-12, but no details are available now. Assuming that these construction projects become operational, they would add the following pollutants to the value of Table 3-3-11

So far, the atmospheric pollutants discharged from chemical industry in Argentina have been discussed. The chemical industry of the country currently is in a position of increased low-priced imports from foreign countries, not to mention sluggish global market conditions. As far as this sort of situation continues to exist, it should be unlikely to see discharge of atmospheric pollutants go up in volume, but, at the same time, it will be difficult to further reduce the discharge from an objective viewpoint.

Table 3-3-12 PETROCHEMICAL PLANTS UNDER CONSTRUCTION AND PROJECTED

(Plantas petroquimicas en construccion y Proyectadas)

(1/2)

Product	Capacity (tons/year)		Company	Location	Present Condition	Estimated Invest (US$10(x6))	Operating Year
Acetic Acid (Acido Acetico)		35,000	PETROQUIMICA HUARPES POLIBUTENOS ARG. RESINFOR-METANOL	Pto. San Martin (Santa Fe)	Projected (Proyecto)	34.0	n.d.
Acrylic-Nitrile (Acrilo-Nitrilo)		140,000	PASA PETROQUIMICA ARGENTINA	San Lorenzo (Santa Fe)	Under study (En estudio)		1995
Ammonia (Amoniaco)		66,000	INDUPE	Bahia Blanca (Bs. As.)	Projected (Proyecto)	39.0	n.d.
Ammonia (Amoniaco)		150,000	PETROQUIMICA HUARPES POLIBUTENOS ARG. RESINFOR-METANOL	Plaza Huincul (Neuquen)	In execution (En ejecucion)	74.0	1992
Total:		216,000					
Butadiene (Butadieno)		25,000	PETROQUIMICA	Bahia Blanca (Bs. As.)	Projected (Proyecto)		n.d.
Butanes (Butanos)		94,000	DOW QUIMICA/PEREZ COMPANC	Loma La Lata (Neuquen)	Projected (Proyecto)		1993
Butene (N. Buteno)		10,000	CARBOCLOR	Baradero (Bs. As.)	Projected (Proyecto)		
Cumene (Cumeno)		50,000	PASA PETROQUIMICA ARGENTINA	Ensenada (Bs. As.)	In execution (En ejecucion)		1995
Diammonium Phosphate & Fertilizers (Fosfato Diamonico y Tertilizantes)		220,000	INDUPE	Bahia Blanca (Bs. As.)	Projected (Proyecto)	39.0	n.d.
Ethylbenzene (Etilbenceno)	Expansion to (Ampliacion)	150,000	PASA PETROQUIMICA ARGENTINA	Ensenada (Bs. As.)	In execution (En ejecucion)		1995
Ethylene (Etileno)		150,000	DOW QUIMICA	Loma La Lata (Neuquen)	Projected (Proyecto)	191.0	1995
Ethylene (Etileno)		10,000	DUPERIAL	San Lorenzo (Santa Fe)	Construct (Construccion)	10.0	1992
Ethylene (Etileno)		200,000	PETROQUIMICA	Bahia Blanca (Bs. As.)	Projected (Proyecto)		n.d.
Ethylene (Etileno)		15,000	PETROQUIMICA CUYO	Lujan de Cuyo (Mendoza)	Construction (Construccion)		
Ethylene (Etileno)	Expansion to (Ampliacion)	40,000	PASA PETROQUIMICA ARGENTINA	Ensenada (Bs. As.)	In execution (En ejecucion)	120.0	1995
Total:		415,000					
Formic Acid (Acido Formico)		1,300	SPC	San Luis	Projected (Proyecto)	n.d.	n.d.
Gas Separating Plan (Planta Separadora de Gases)		300,000	DOW QUIMICA/PEREZ COMPANC	Loma La Lata (Neuquen)	Projected (Proyecto)	110.5	n.d.
Gasoline (Gasolina)		90,000	PETROQUIMICA	Bahia Blanca (Bs. As.)	Projected (Proyecto)		n.d.
Gasolines (Gasolinas)		78,000	DOW QUIMICA/PEREZ COMPANC	Loma La Lata (Neuquen)	Projected (Proyecto)	730.5	1993
h.d. & i.d. Polyethylene (Polietileno a.d. y b.d.)		145,000	DOW QUIMICA	Loma La Lata (Neuquen)	Projected (Proyecto)	115.0	1995
h.d. Polyethylene (Polietilene a.d.)	Expansion to (Ampliacion)	180,000	PETROPOL	Bahia Blanca (Bs. As.)	Projected (Proyecto)	12.1	n.d.
Hydrogen Peroxide (Agua Oxigenada)		5,000	ATANOR S.A.M./CIA. QUIMICA	Rio TTercero (Cordoba)	Construct (Construccion)	20.0	1992
Isobutylene (Isobutileno)		40,000	PETROQUIMICA HUARPES POLIBUTENOS ARG. RESINFOR-METANOL	Ensenada (Prv. Bs. As.)	Construction (Construccion)	25.0	1992
L.P.G.		22,000	PETROQUIMICA CUYO	Lujan de Cuyo (Mendoza)	Construction (Construccion)	48.0	1992
M.T.B.E.		21,700	CARBOCLOR	Campana (Bs. As.)	Projected (Proyecto)	8.0	1995
M.T.B.E.		200,000	ASTRA EVANGELISTA B. ROGGIO, CARBOCLOR	Bahia Blanca (Bs. As.)	Projected (Proyecto)	130.0	n.d.
Total:		221,700					
Methanol (Metanol)		75,000	ASTRA EVANGELISTA B. ROGGIO, CARBOCLOR	Bahia Blanca (Bs. As.)	Projected (Proyecto)		
Methanol (Metanol)	Expansion to (Ampliacion)	100,000	PETROQUIMICA HUARPES POLIBUTENOS ARG. RESINFOR-METANOL	Pto. San Martin (Santa Fe)	Construction (Construccion)	42.0	1992
Methanol (Metanol)		680,000	PETROQUIMICA AUSTRAL	Tierra del Fuego	Projected (Proyecto)	270.0	n.d.
Total:		855,000					
Methyl-Isobutyl-Cetone (Metil-Isobutil-Cetona)		1,800	CARBOCLOR	Campana (Bs. As.)	Projected (Proyecto)	1.0	1995
Mix C4 (Mezcla C4)		17,300	PETROQUIMICA	Bahia Blanca (Bs. As.)	Projected (Proyecto)		n.d.
Olefines (Olefinas)		30,000	PETROQUIMICA CUYO	Lujan de Cuyo (Mendoza)	Construction (Construccion)		
P.V.C.		41,500	ELECTROCLOR	Bahia Blanca (Bs. As.)	Construct (Construccion)	67.0	1992
P.V.C.	Expansion to (Ampliacion)	30,000	ATANOR S.A.	Bahia Blanca (Bs. As.)	Projected (Proyecto)	17.2	n.d.
P.V.C.	Expansion to (Ampliacion)	20,000	INDUPA	Bahia Blanca (Bs. As.)	Projected (Proyecto)	16.5	n.d.
Total:		91,500					

(2/2)

Product	Capacity (tons/year)	Company	Location	Present Condition	Estimated Invest(US$10x6)	Operating Year
Paracresol	2,000	ACO	Ensenada (Bs.As.)	Projected (Proyecto)	6.5	n.d.
Polypropylene	Expansion from 40,000 to 70,000	PETROQUIMICA CUYO	Lujan de Cuyo (Mendoza)	Construction (Construccion)		
(Polipropileno)	Ampliacion de 40,000 a 70,000	PETROQUIMICA CUYO				
Polypropylene (Polipropileno)	150,000	DOW QUIMICA/PEREZ COMPANC	Loma La Lata (Neuquen)	Projected (Proyecto)		1993
Total:	Expansion from 190,000 to 220,000					
Polystyrene and Copolymer (Poliestireno y Copolimeros)	40,000	PASA PETROQUIMICA ARGENTINA	San Lorenzo (Santa Fe)	Under study (En estudio)	250.0	1995
Propylene (Propileno	70,000	CARBOCLOR	Campana (Bs.As.)	Projected (Proyecto)	21.4	1995
Propylene (Propileno)	14,000	PETROQUIMICA CUYO	Lujan de Cuyo (Mendoza)	Construction (Construccion)		
Propylene (Propileno)	160,000	DOW QUIMICA/PEREZ COMPANC	Loma La Lata (Neuquen)	Projected (Proyecto)		1993
Propylene (Propileno)	66,000	PETROQUIMICA	Bahia Blanca (Bs.As.)	Projected (Proyecto)	350.0	n.d.
Propylene (Propilenos)	24,000	PASA PETROQUIMICA ARGENTINA	Ensenada (Bs.As.)	In execution (En ejecucion)		1995
Total:	334,000					
Propylene-Glycol (Propilenglicoles)	10,000	DOW QUIMICA	San Lorenzo (Santa Fe)	Projected (Proyecto)	n.d.	n.d.
Soda Solvay	200,000	ALPAT	San Antonio Oeste (Bs.As.)	Construct (Construccion)	350.0	1992
Styrene (Estireno)	Expansion to (Ampliacion) 140,000	PASA PETROQUIMICA ARGENTINA	Ensenada (Bs.As.)	In execution (En ejecucion)		1995
Urea Tormaldehyde(Urea Formaldehideo)	50,000	PETROQUIMICA HUARPES POLIBUTENOS ARG.RESINFOR-METANOL	Pto.San Martin (Santa Fe)	Projected (Proyecto)	8.0	n.d.
Vinyl Chloryde (Clorure de Vinilo)	Expansion to (Ampliacion) 70,000	MONOMEROS VINILICOS	Bahia Blanca (Bs.As.)	Projected (Proyecto)	20.0	n.d.
Grand Total:	4,289,600 (+190,000 to 220,000)					

(3) Estimates of emission of atmospheric pollutants from the cement industry

The Argentine cement industry has suffered oversupply of its product. Shown in Table 3-3-13 are changes from year to year, and it Table 3-3-14 names of manufactures, the number of plants and their capacities.

1) Consumption of power and fuel per unit of production

Shown in Table 3-3-15 is fuel consumption per unit of production for cement, and in Table 3-3-16 power consumption per unit of production (KWH/ton) for each manufacturing method.

2) Atmospheric pollutants discharged from cement manufacturing process

Since the raw materials are exposed to burnt gas in the kiln and pre-heater, in which SO_2 is absorbed as a result of reaction of alkali (Na, K) and CaO contained in the SO_2 out of its process is not taken into consideration.

The discharge coefficients of NO_2 are set as follows:

For burning : 50 kg-NO_2/ton-oil
For drying : 35 kg-NO_2/ton-oil

While dust contained in the flue gas out of the kiln is heavy at 10 to 170 g/Nm_3, the following assumptions were made, because often in Argentina dust removers similar to cyclones seems to be in use:

Kiln : 0.6 g/Nm_3
Dryer : 0.8 g/Nm_3
Boiler: 0.3 g/Nm_3

Based on the above emission coefficients, emission amount volume of pollutants was obtained, which is shown in Table 3-3-17.

Table 3-3-13 THE ARGENTINE CEMENT INDUSTRY
- thousand tons -

Heading	1985	1986	1987	1988	1989	1990	1991	1992*
Capacity	11,960	11,960	11,960	11,960	12,050	11,500	11,500	11,500
Production	4,630	5,554	6,302	6,030	4,449	3,673.8	4,399.1	5,114.6
Deliveries to markets	4,573	5,539	6,291	6,013	4,439	3,580	4,385.9	5,062.1
Population (millions)	30.0	30.4	30.8	31.3	31.7	32.3	32.6	33.1
(KILOS)								
Consumption per inhabitant	152	182	204	192	140	111	135	153

(*) Provisional figures at the period end

Source: Portland Cement Manufactures Association.

Table 3-3-14 STRUCTURE OF THE ARGENTINE CEMENT INDUSTRY

Company	Number of Plants	Installed Capacity	% of Total
Loma Negra CIASA	9	6,304	54.8
Juan Minetti S.A.	3	1,841	16.0
Corp. Cementera Arg.S.IA.(Corcemar)	2	1,975	17.2
Cementos Avellaneda S.A.	1	950	8.3
Petroquimica Comodoro Rivadavia S.A.	1	300	2.6
Cementos EL Gigante S.A.	1	130	1.1
TOTAL	17	11,500	100.0

Source: Portland Cement Manufacurers Association and own estimate.

Table 3-3-15 FUEL CONSUMPTION PER UNIT OF PRODUCTION (heavy oil, class C (l/t))

Category	Dry process					Wet process	
	With boiler	Repol	With suspension pre-heater	Shaft	Raw lime	Without filter	With filter and boiler
Baking	152	90	86	90	52	137	168
Drying	5	6	2	6	1	0	1
Total	157	96	88	96	53	137	169

Table 3-3-16 POWER CONSUMPTION PER UNIT OF PRODUCTION FOR EACH PRODUCTION METHOD (KWH/t)

Category	Dry process				Wet process	
	With suspension pre-heater	Repol	With boiler	Shaft	Without filter	With filter and boiler
Raw Materials	47	48	47	33	40	40
Baking	30	25	20	22	26	26
Finishing	48	48	45	43	50	50
Total	125	121	112	98	116	116
After heat power generation			130			115

(4) Discharge of atmospheric pollutants from mobile sources

GDP of the transport sector in Argentina for the year 1992 accounts for 9% of the country, and its breakdown is as follow:

Land transport : 74.8%
Water transport : 7.3%
Air transport : 8.4%
Other transport : 9.5%

For consideration of automobiles, which are the main mobile sources of atmospheric pollution, the number of automobiles owned, produced, imported and sold in Argentina in the last 30 years or so since 1960 is given in Table 3-3-18. Automobiles owned, as shown in Table 3-3-19, consist of 4,300 thousand passenger cars, 1,450 thousand trucks and 65 thousand cars for business purposes.

While Argentina's automobile industry has a long history, every 5-6 persons own one car, demonstrating more extensive use of cars than an international standard. The industry consists of 3 US-European affiliates (<1>SEVEL: FIAT and PEUGEOT, <2>RENAULT, <3>AUTOLATINA: VOLKSWAGEN and FORD) making passenger cars and small commercial cars; Ibeco, Scania and Mercedes Benz making large commercial cars; and two indigenous companies assembling buses. The government ad imposed restrictions on the industry including a total ban on importing assembled cars before 1989, when the current administration came into power liberalizing import by removing the import ban, introducing international tender procedures within the total quantitative limit and by drastically quantitative limit and by drastically lowering import duties on assembled cars.

Table 3-3-20 shows indicators of passenger transporting vehicles in urban areas.

Order of magnitude of emissions of environmental pollutants from automobile sector's was calculated as shown in the following table.

Table 3-3-17 ESTIMATES OF EMISSION OF POLLUTANTS FROM AUTOMOBILE SECTOR

	Passenger	Truck	Bus	Sub total
Numbers	4315160	1454520	65320	107994
Gasoline				
Allowable limit of NOx (Japan)(g/km)	0.25	0.84	0.84	
California quality standard (g/km)	0.62			
EEC Regulation (g/m)	0.97*1			
NOx (g/km)	2.78	3.53		
Fuel consumption rate (ml/km)	111	24.2		
NOx (kg/kl)	25	4.4		
LPG Auto				
NOx (g/km)	3.72			
Fuel Consumption (ml/km)				
NOx (kg/kl)				
NOx (kg/ton)	18.1			
Diesel Car (g/km)				
Allowable limit of NOx (g/km)	0.72	0.84	0.84	
California quality standard (g/km)				
EEC Regulation (g/m)	0.97*1			
NOx (kg/ton)		27.9	24.7	
PM (g/km)		0.34	0.34	
Average driving distance (km/mth)	600			
Commercial use (km/mth)	6000	6000	8000	
NOx Emission (ton/yr)	14758	87969	5267	
NOx Emission total (ton/yr)				

*1 including HC

(5) Atmospheric pollutants discharged from the paper and pulp sectors

The paper and pulp industry in Argentina is highly oligopolistic and major five companies occupy 50% share in virtually all the paper areas and 75% in the paperboard and pulp areas.

Given in Table 3-3-3(6)-1 is production, import, export and consumption in the Argentina paper and pulp industry.

Table 3-3-18 RESISTERED AUTOMOTIVES AND DEMAND/SUPPLY

		Registered Total	Production	Import	Sales
Passenger use	1960	473,517 (23)	40,144	3,251	39,844
	1965	914,578 (41)	133,734	503	134,675
	1970	1,481,947 (62)	167,000	211	165,933
	1975	2,310,820 (89)	185,162	165	174,583
	1980	3,112,065 (110)	218,640	39,668	215,177
	1984	3,759,323 (126)	137,206	11	135,163
	1985	3,878,249 (128)	113,788	221	121,203
	1986	4,036,511 (131)	137,889	2,053	134,269
	1987	4,136,120 (133)	166,153	996	163,790
	1988	4,070,569 (129)	135,776	3,166	142,397
	1989	4,088,000 (128)	107,597	5,134	118,043
	1990	4,186,440 (129)	86,937	1,797	83,336
	1991	-	114,113	-	117,425
Commercial use	1960	392,019 (19)	49,194	1,856	47,878
	1965	573,370 (25)	60,802	604	56,022
	1970	787,470 (33)	52,599	337	54,813
	1975	985,575 (38)	54,874	291	52,248
	1980	1,216,828 (43)	63,153	28,693	59,881
	1984	1,547,982 (52)	30,117	427	29,896
	1985	1,409,339 (46)	23,887	489	24,321
	1986	1,458,669 (47)	32,601	280	31,306
	1987	1,492,633 (48)	27,162	107	27,467
	1988	1,471,510 (47)	28,384	71	21,754
	1989	1,512,000 (47)	20,226	880	16,713
	1990	1,493,560 (46)	12,702	785	12,577
	1991	-	24,845	-	24,955
Total	1960	865,536 (42)	89,338	5,107	87,722
	1965	1,487,948 (66)	194,536	1,107	190,697
	1970	2,269,417 (96)	219,599	548	220,746
	1975	3,296,395 (127)	240,036	456	226,831
	1980	4,328,893 (153)	281,793	68,361	275,058
	1984	5,168,662 (173)	167,323	438	165,059
	1985	5,310,269 (175)	137,675	710	145,524
	1986	5,495,180 (179)	170,490	2,333	165,575
	1987	5,618,753 (180)	193,315	1,103	191,257
	1988	5,542,079 (176)	164,160	3,237	164,151
	1989	5,600,000 (175)	127,823	6,014	134,756
	1990	5,680,000 (176)	99,639	2,582	95,913
	1991	-	138,958	-	142,380

Table 3-3-19 REGISTERED AUTOMOTIVES

- Development over last decade -

Year	Total	Private Cars	Trucks	Passengers
1980	4,328,893	3,112,065	1,169,705	47,123
1981	4,611,797	3,319,243	1,240,764	51,790
1982	4,873,936	3,516,728	1,302,546	54,662
1983	4,996,791	3,620,194	1,321,501	55,096
1984	5,168,662	3,759,323	1,352,581	56,758
1985	5,310,344	3,878,721	1,373,800	57,823
1986	5,496,576	4,037,541	1,399,496	59,539
1987	5,620,558	4,137,042	1,422,421	61,095
1988	5,565,530	4,090,638	1,414,025	60,867
1989	5,742,350	4,256,954	1,421,226	64,170
1990	5,777,000	4,288,498	1,423,981	64,521
1991 (e)	5,835,000	4,315,160	1,454,520	65,320

(e) Estimate
Source: Auto Manuf. Association

Table 3-3-20 URBAN PASSENGER TRANSPORT

Heading	1984	1985	1986	1987	1988	1989	1990	1991	1992
Passenger Transport-thousand	2,182.8	2,171.6	2,209.1	2,172.7	2,115.1	1,988.6	2,102.1	2,089.4	2,140.5
Kms. (million)	838.5	803.5	786.3	770.1	802.8	786.8	810.3	818.1	838.2
Rotation Index (pass/kg)	2.6	2.7	2.8	2.8	2.6	2.5	2.6	2.6	2.6
Average Distance (km)	5.9	5.9	6.0	6.0	5.9	5.9	5.9	5.9	5.9
Number of Lines	148	148	148	147	148	146	144	143	143
Number of Companies	127	127	127	126	127	125	123	118	118
Number of Vehicles	9,923	9,410	9,572	9,587	9,658	9,730	9,803	9,877	9,956
Average P/Vehicle (km)	84,501	85,388	82,146	80,328	83,123	80,863	82,658	82,859	84,186
Average use (year)	4.8	5.6	6.0	6.1	6.1	6.4	6.5	6.9	5.9

Source: Motor Transport Undersecreatariat

Table 3-3-21 ARGENTINE CELLULOSE - PAPER INDUSTRY

- 1,000 ton -

		1985	1986	1987	1988	1989	1990	1991	1992
1. Cellulos Pulp									
Mechanical	P.	21.3	20.3	20.0	13.7	5.0	5.9	4.5	5.0
	M.	7.9	11.7	6.5	6.7	3.0	3.4	5.8	7.0
	X.	-	-	-	-	-	-	-	-
	C.A.	29.2	32.2	28.0	20.4	8.0	9.3	10.3	12.0
Chemical and Semi chemical	P.	654.4	731.2	743.2	706.7	687.0	678.3	659.8	754.4
	M.	23.6	23.0	28.5	28.6	16.0	13.6	28.2	30.0
	X.	80.0	68.7	64.5	68.7	63.0	117.7	69.7	106.8
	C.A.	598.0	685.5	707.2	666.4	640.0	574.2	618.3	647.6
Total	P.	675.7	751.5	763.2	720.4	692.0	684.2	664.3	759.4
	M.	31.5	34.7	35.0	35.3	19.0	17.0	34.0	37.0
	X.	80.0	68.7	64.5	68.7	63.0	117.7	69.7	106.8
	C.A.	627.2	717.7	735.2	686.8	648.0	583.5	628.6	659.6
2. Paper and Bristol boards									
Newsprint	P.	200.0	214.5	221.0	224.6	220.0	208.0	201.5	203.1
	M.	12.0	32.0	55.0	24.0	9.0	8.3	24.0	84.0
	X.	10.0	5.6	5.0	20.0	43.0	63.7	9.6	9.7
	C.A.	202.0	240.9	271.0	226.6	186.0	152.6	215.9	277.4
Other papers, Cardboards and Bristol boards	P.	699.0	798.8	770.4	737.9	701.0	740.5	762.3	831.9
	M.	19.0	17.0	48.0	41.0	14.0	33.7	169.0	176.0
	X.	4.0	3.6	14.0	45.0	47.0	7.5	21.6	4.3
	C.A.	714.0	812.2	804.4	733.9	668.0	702.7	909.7	1,003.6
Total	P.	899.0	1,013.3	991.4	962.5	921.0	948.5	963.8	1,035.0
	M.	31.0	49.0	103.0	65.0	23.0	42.0	193.0	260.0
	X.	14.0	9.2	19.0	65.0	90.0	71.2	31.2	14.0
	C.A.	916.0	1,053.1	1,075.4	960.5	854.0	855.3	1,125.6	1,281.0

P.: Production M.: Imports X.: Exports C.A.: Apparent Consumption
Source: Association of Cellulose and Paper Manufacturers.
*) Provisional figures and own research.

With regard to atmospheric pollutants discharged from paper and pulp plants, there are problems with waste water like white water from non-bleaching washers and condensed water from evaporators. Air pollution concerns offensive odors from various sorts of process equipment and waste gas from recovery furnace of steam-generating heavy oil boilers and burning black liquid.

Discharge volume of these gases is given in Table 3-3-22.

Table 3-3-22 DISCHARGE COEFFICIENT AT PAPER AND PULP PLANTS

Waste gas Volume				SO_2 Conc.	SO_2 (ton/y)	NO_2(ton/y)	Dust(ton/y)
Black liquid recovery furnace 15,000Nm³/ton				1.5-3.0kg/ton 50-80ppm			4,037
Heavy oil boiler 27,000Nm³/ton 30kg-heavy oil/ton				100ppm	13,843	280	
Boiler heavy oil		N	70				
		L	65 ℓ			577	
Steam (heavy oil)	Pulp. process	M	400				
		L	300				
	Machine process	M	200				
		L	200			4,440	
Electricity (kwh)	Pulp. process	M	550				
		L	500				
	Machine process	M	100				
		L	100			439	
Total					13,843	5,736	4,037

3.3.4 Overall Assessment of Emission

(1) Estimated Amount of Pollutants from majour subsector

Estimation of Total Environmental Pollutants in Argentine Republic

	SOx	NOx	Dust
Electricity	38079	71693	
Steel Plants	11564	8157	88062
Petrochemicals	3728	1176	
Cement		84950	17900
Paper and Pulp	13843	5736	4037
Automobile		107994	
Total	67214	279706	109999

	Environment Index	NOx	SOx
Gross GDP (million US$)	93260		
Gross Population (mill.)	32.61		
GDP per Cap (US$/head)	2860		
Primary Energy consumption (thousand toe)	34196		
Primary Energy consumption per head (kg-oe/head)	1049		
Energy Consumption per GDP (toe/GDP)	367		
Emission (Ton/yr)		279706	67214
Emission per head (kg/head)		8.6	2.1
Emission per GDP (g/US$)		3	0.72
NOx cal (1000 Ton/yr)1/,2/	302		342
Emission per head (kg/head)	9		10
Emission per GDP (g/US$)	3		4

(2) Relationship between Population, GDP and Consumption of Primary Energy

Table 3-3-23 shows world's energy consumption per capita annual average growth rate of the year. The 1987 per capita energy consumption of the world was 1680 kg-oe,and those in Asia, Africa, Middle East and Latin America were lower than this figure. As for regional records, developing countries consumed 636 kg-oe, the planning economy countries 1646 kg-oe, and to OECD countries 5060 kg-oe per capita in 1987.

Chart 3-3A shows GDP per capita and energy consumption per capita of the major regions, demonstrating GDP and energy consumption per capita are positively correlated.
Chart3-3B shows GDP per capita of energy consumption per GDP dollar of the world, demonstrating GDP per capita and energy consumption per GDP dollar are negatively correlated perhaps partly due to energy conservation efforts made since the second oil crisis.
As Table 3-3-23 shows, Argentina belongs to the world average group in terms of energy consumption per capita and matches the Middle East group in terms of energy consumption per GDP dollar, possibly due to underestimated GDP or energy conservation pursued more effectively than is thought.
Table 3-3-24 lists OECD countries social and economic indi cators as well as SOx/NOx Emission in relation to these indicators.

(3) Relation between GDP and SOx Emission

Chart 3-3C shows the relationship between GDP and SOx emis sion. The SOx emission per capita of Argentina is 2.1kg (Japan 6.7, USA 83.2, Canada 144.7, Germany 15.7) and the SOx emission per GDP dollar is 0.72g (Japan 0.5, USA 4.6, Canada 8.5, Germany 1.5), which are rather low.

(4) Relationship between NOx Emission and GDP

Chart 3-3D shows the relationship between GDP and NOx emission, and Chart 3-3E shows that between GDP per capita and NOx emission per GDP dollar.
The NOx emission per capita of Argentina is 8.6kg (Japan 9.5, USA 79.5, Canada 74.6, Germany 36.3) and that per GDP dollar is 3g (Japan 0.7, USA 4.4, Canada 4.4 Germany 3.5), which are more comparable to the worldwide volume than SOx.

Table 3-3-23 POPULATION, ENERGY CONSUMPTION OF OECD COUNTRIES

Country	Population (1000)	Area (1000 km2)	Consumption of Energy (MTOE/MTEP)	GDP (billion of US$) 1989	Electricity Garanted (TWh)	Consumption of Energy by GDP (TOE/1000 $US)	SOx (1000tons)	NOx (1000tons)	Energy (kg-oe/ Capita)	GDP/人	Energy (toe/ MilUS$)	SOx (g-SOx/ US$)	NOx (g-NOx/ US$)	SOx (kg/ Capita)	NOx (kg/ Capita)
Canada	26.248	9,976.1	164.06	449.2	499.4	0.46	3,800	1,959	6,250.4	17,114	365	8.5	4.4	144.77	74.63
USA	248.777	9,372.6	1,392.71	4,547.0	2,954.1	0.38	20,700	19,800	5,598.2	18,277	306	4.6	4.4	83.21	79.59
Japan	123.116	377.8	288.51	1,714.2	791.2	0.21	835	1,176	2,343.4	13,923	168	0.5	0.7	6.78	9.55
Australia	16.807	7,686.9	57.47	213.1	147.1	0.30			3,419.4	12,676	270	0	0	0	0
N.Zealand	3.343	268.7	9.23	33.8	28.7	0.24			2,761.0	10,114	273	0	0	0	0
Austria	7.624	83.9	20.27	90.5	49.3	0.26	121	213	2,658.7	11,868	224	1.3	2.4	15.87	27.94
Belgium	9.938	30.5	33.80	119.7	66.8	0.34	414	297	3,401.1	12,043	282	3.5	2.5	41.66	29.89
Denmark	5.132	43.1	13.42	66.3	22.8	0.27	242	249	2,615.0	12,927	202	3.6	3.8	47.16	48.52
Finland	4.964	338.0	22.69	66.1	53.7	0.40	302	276	4,570.9	13,306	344	4.6	4.2	60.84	55.6
France	56.160	549.0	142.60	725.2	403.0	0.24	1,223	1,656	2,539.2	12,912	197	1.7	2.3	21.78	29.49
Germany	78.665	356.9	190.88	822.9	438.4	0.28	1,237	2,859	2,426.5	10,461	232	1.5	3.5	15.72	36.34
Greece	10.033	132.0	14.83	64.5	34.2	0.21			1,478.1	6,430	230	0	0	0	0
Iceland	253	103.0	1.08	3.6	4.5	0.29			4,268.8	14,111	303	0	0	0	0
Ireland	3.515	70.3	7.44	28.0	13.5	0.30	174	115	2,116.6	7,963	266	6.2	4.1	49.5	32.72
Italy	57.525	301.2	118.15	708.5	207.3	0.18	2,006	1,705	2,053.9	12,317	167	2.8	2.4	34.87	29.64
Luxembourg	378	2.6	3.24	5.7	0.6	0.79	12	22	8,571.4	15,185	564	2.1	3.8	31.75	58.2
Netherlands	14.849	40.8	50.95	180.3	73.1	0.33	259	585	3,431.2	12,144	283	1.4	3.2	17.44	39.4
Norway	4.227	324.2	17.88	61.6	116.7	0.34	67	225	4,230.0	14,561	290	1.1	3.7	15.85	53.23
Portugal	10.337	92.4	12.17	63.9	25.7	0.17	205	122	1,177.3	6,180	191	3.2	1.9	19.83	11.8
Spain	38.888	504.8	58.75	355.6	145.6	0.18	-	826	1,510.7	9,144	165	0	2.3	0	21.24
Sweden	8.493	450.0	33.18	116.7	143.7	0.36	213	396	3,906.7	13,742	284	1.8	3.4	25.08	46.63
Switzerland	6.723	41.3	19.73	105.4	53.8	0.20	74	194	2,934.7	15,680	187	0.7	1.8	11.01	28.86
Turkey	55.255	780.6	39.11	219.3	52.0	0.19	25	2,642	707.8	3,969	178	0.1	12	0.45	47.81
UK	57.236	244.8	147.95	727.2	310.7	0.24	3,813	480	2,584.9	12,705	203	5.2	0.7	66.62	8.39
Yugoslavia	23.800	255.8	25.04	0.0	86.3		1,600	21,700	1,052.1	0	ERR	ERR	ERR	67.23	911.76
N. America	275.025	19,348.8	1,556.77	4,996.0	3,453.6	0.39	24,200	12,600	5,660.5	18,166	312	4.8	2.5	87.99	45.81
Australia	20.150	7,955.5	66.71	246.8	175.9	0.29	-	10,900	3,310.7	12,250	270	0	44.2	0	540.94
OECD	430.195	4,489.3	948.12	4,530.8	2,215.7	0.25	-	36,200	2,203.9	10,532	209	0	8	0	84.15
EEC	342.656	2,368.4	794.19	3,866.9	1,741.8	0.24	-		2,317.7	11,285	205	0	0	0	0
OECD	848.486	32,171.4	2,860.11	11,488.0	6,636.3	0.30			3,370.8	13,539	249	0	0	0	0
World	5,292,200	133,824.7	5,566.40		11,403.3									0	0

Table 3-3-24

	Emission Factor		Kg/Ton Fuel		Emission x 103kg/Year		
SOx	S Content	EM-Fact	Power Fuel	Other Fuel	SOx Power	SOx Other	
Fuel Oil	1%	20.0	1583.0	2062.0	31660.0	41240.0	
Gas Oil	0.2%	4.0	392.0	6913.0	1568.0	27652.0	
Coal	1%	19.5		168.0		3276.0	
Steel	Coke S 9kg	1.5		2500.0		3750.0	
Cement	Coal fuel	0.6		5000.0		3000.0	
					33228.0	78918.0	112146.0

NOx			Fuel		NOx Power	NOx Other	
Fuel Oil	Power Plant	7.2	1583.0		11397.6		
Fuel Oil	General	5.9	2239.0			13210.1	
Gas Oil	Power Use	27.0	392.0		10584.0		
Gas	Power Use	5.2	5518.0		28693.6		
Gas	General	2.6	10522.0			27357.2	
Gasoline	Vehicle	31.2	4055.0			126516.0	
Diesel	Vehicle	32.0	4220.0			135040.0	
Steel		4.0	2500.0			10000.0	
					50675.2	312123.3	362798.5

Particul			Power Fuel	Other Fuel	S.P. Power	S.P. Other	
Fuel Oil		4.5	1583.0	2062.0	7123.5	9279.0	
Gas Oil	Engine	4.0	392.0	2693.0	1568.0	6272.0	
Gas	0.06	0.1	5518.0	10522.0	331.1	19.9	
Gasoline	Nil						
Diesel	Vehicle	4.0		4220.0		16880.0	
					9022.6	32450.9	41473.5

Chart 3-3A RELATIONSHIP BETWEEN GDP PER CAPITA AND ENERGY CONSUMPTION PER GDP

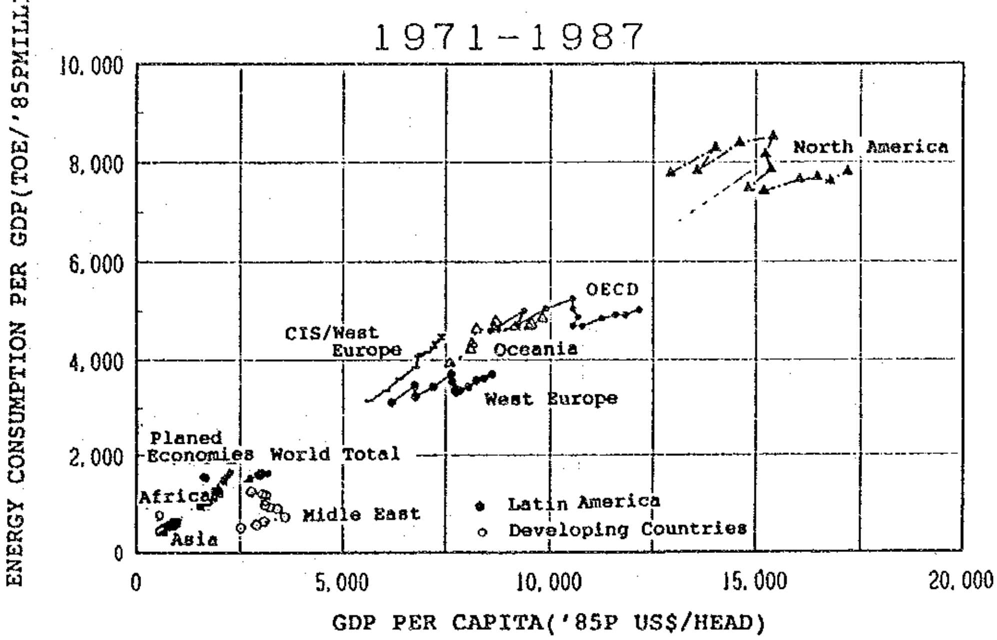


Chart 3-3B RELATIONSHIP BETWEEN GDP PER CAPITA AND ENERGY CONSUMPTION FOR REGION OF THE WORLD

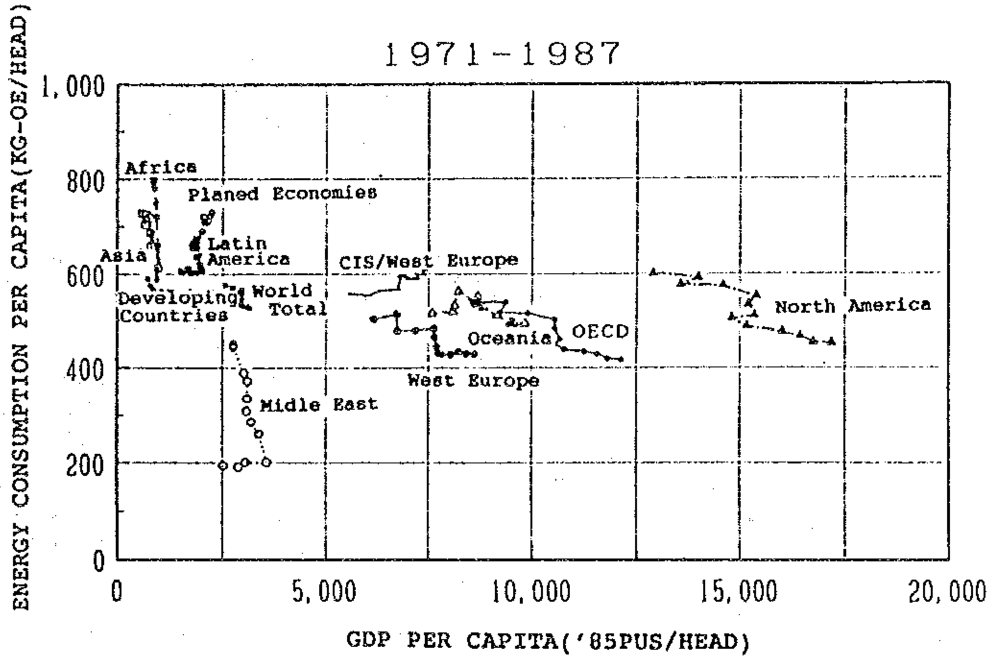


Chart 3-3C RELATIONSHIP BETWEEN GDP AND SOx EMISSION

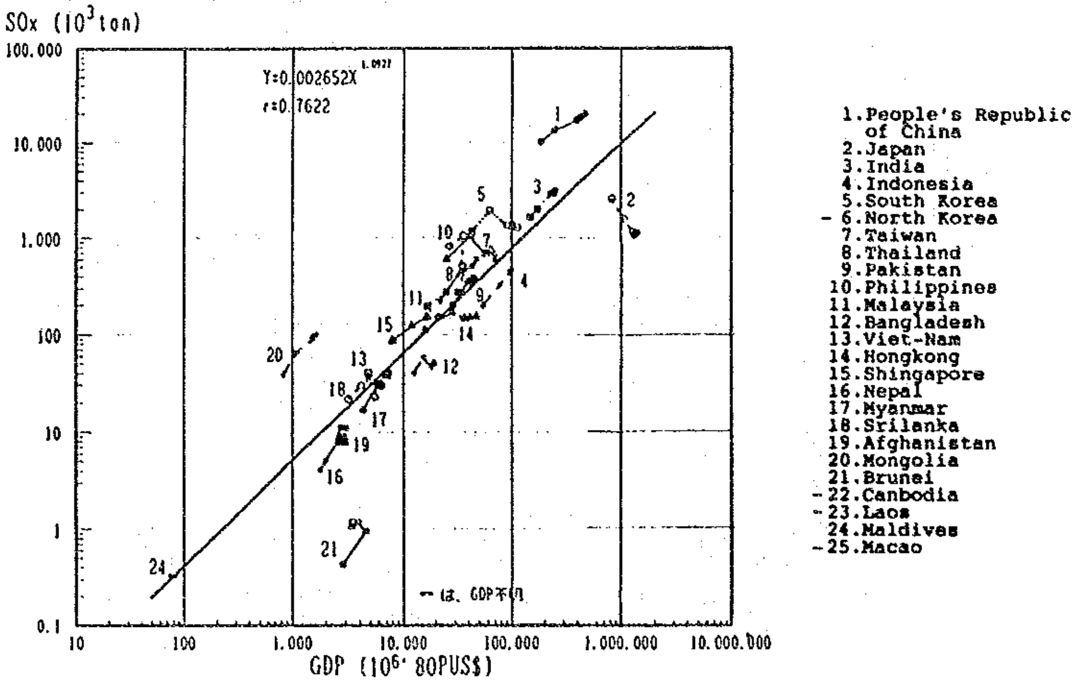


Chart 3-3D RELATIONSHIP BETWEEN GDP AND NOx EMISSION

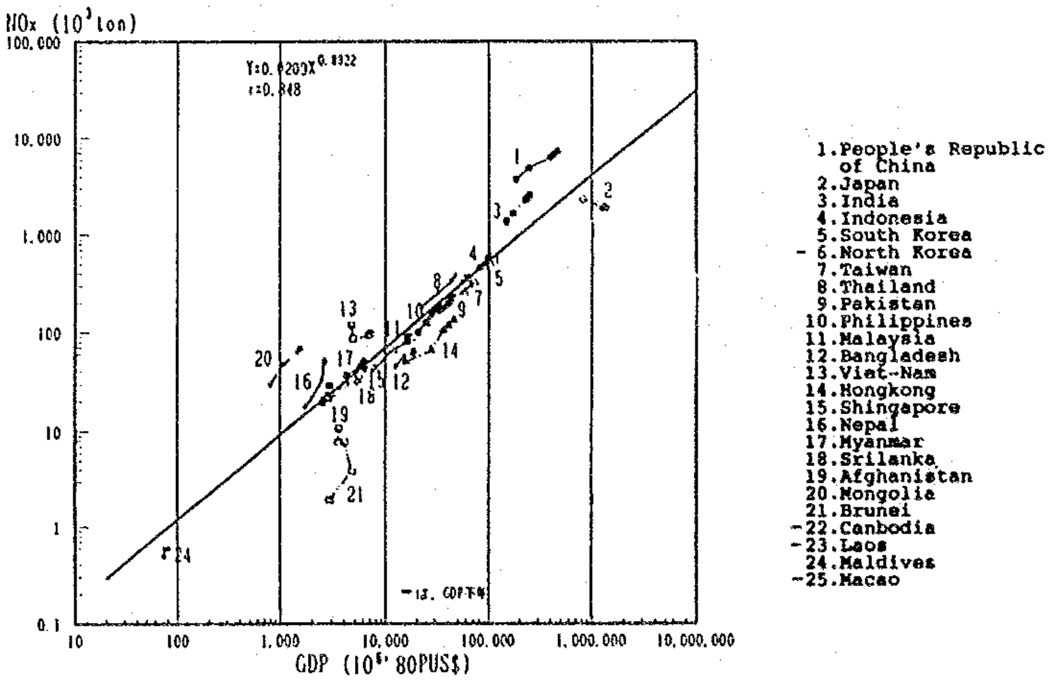
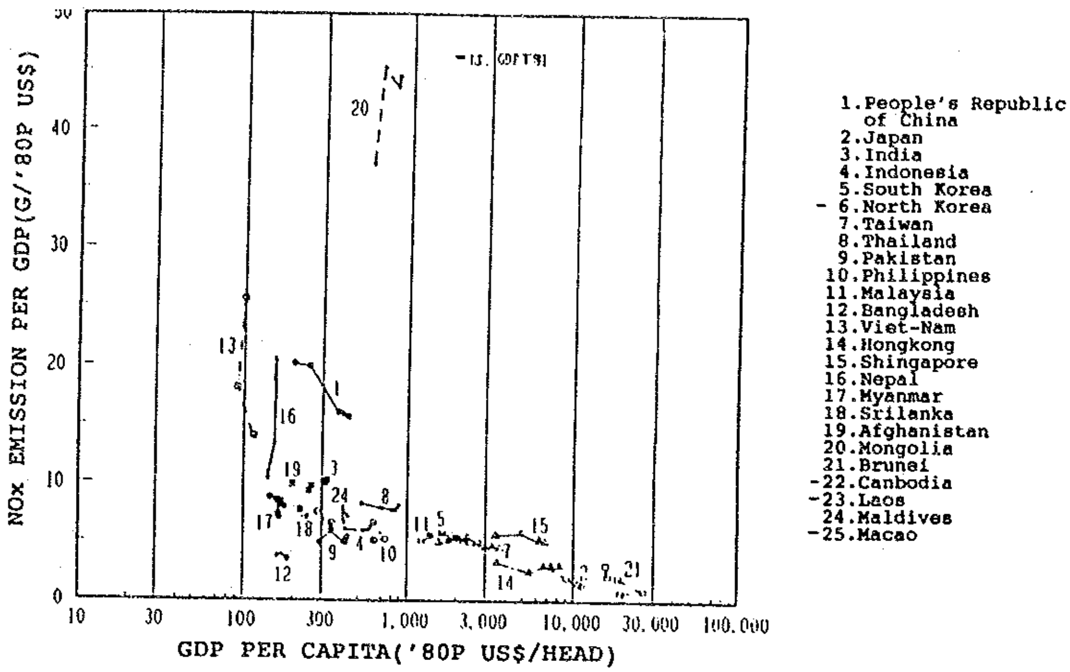


Chart 3-3E RELATIONSHIP BETWEEN GDP AND NOx EMISSION PER GDP



Chapter 4 AIR POLLUTION CONTROL MEASURE FOR THERMAL POWER PLANT

Chapter 4 Air Pollution Control Measure for Thermal Power Plant

4.1 Scheme of Master Plan Related to Air Pollution control

As the air pollution preventive mesures for thermal power plants in Argentine, various subjects that need consideration of related parties are suggested as shown below as a typical plan.

These subjects are classified into two; the subjects to be examined by administrative organs and the subjects to be examined by power companies. Since nationwide air pollution preventive plans and countermeasures including sectors other than power sectors in Argentina will be implemented gradually in future, it is necessary to have adequate coordination between these plans and countermeasures and the general plan of power sectors. Therefore, it is necessary to select these subjects conforming to the progress of current air pollution preventive measures. The detailed contents are described in Section 4.2.

4.1.1 Role of Administrative Organs to Control Air Pollution

The role for which the administration should play is shown in Figure 4-1-1 by setting a target to grasp the emission conditions of air pollution materials caused by the thermal power plants, together with schedule a long plan related to the air pollution control finally while estimating the future trend, and to scheme the maintenance of atmospheric environment in the surrounding of thermal power plants.

4.1.2 Role of Power Companies Related to Control Air Pollution

To maintain the atmospheric environment of adjecent area according to the nature of air pollution materials emitted from the possessed thermal power plants, the private sector thermal power companies shall observe the various restrictions imposed from the administration, also shall perform the high quality operation, maintenance, and control of facilities. It is also necessary to scheme the sufficient coordination with the local governments concerned and the adjecent power companies under the leading of administration.

These actions are useful for improvement of efficiency of thermal power plants and for protection of accidents before hand, consequently the power companies will receive the great merits. Figure 4-1-2 shows the roles that the power companies should play to control air pollution.

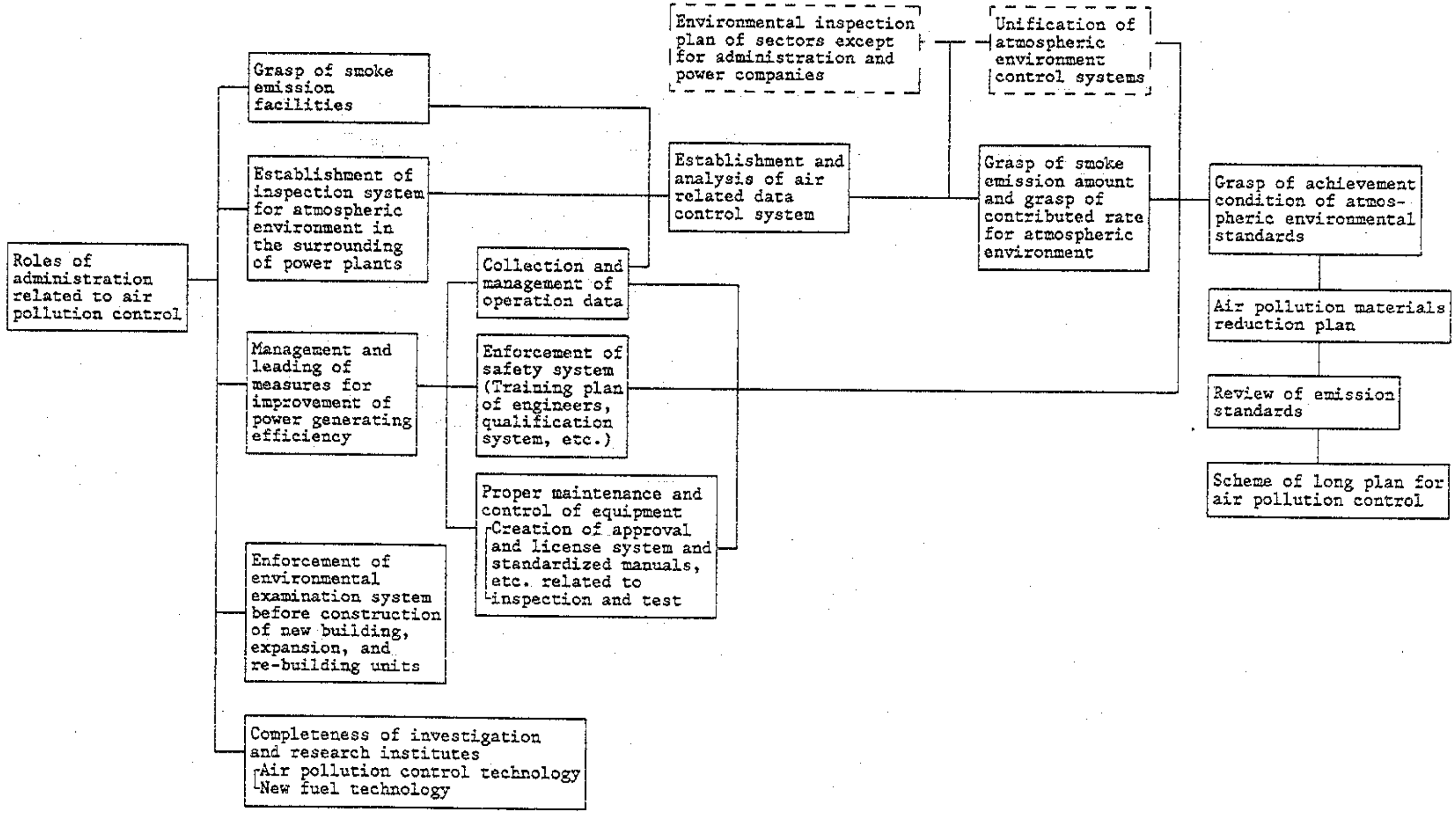


Figure 4-1-1 ROLES OF ADMINISTRATION TO CONTROL AIR POLLUTION

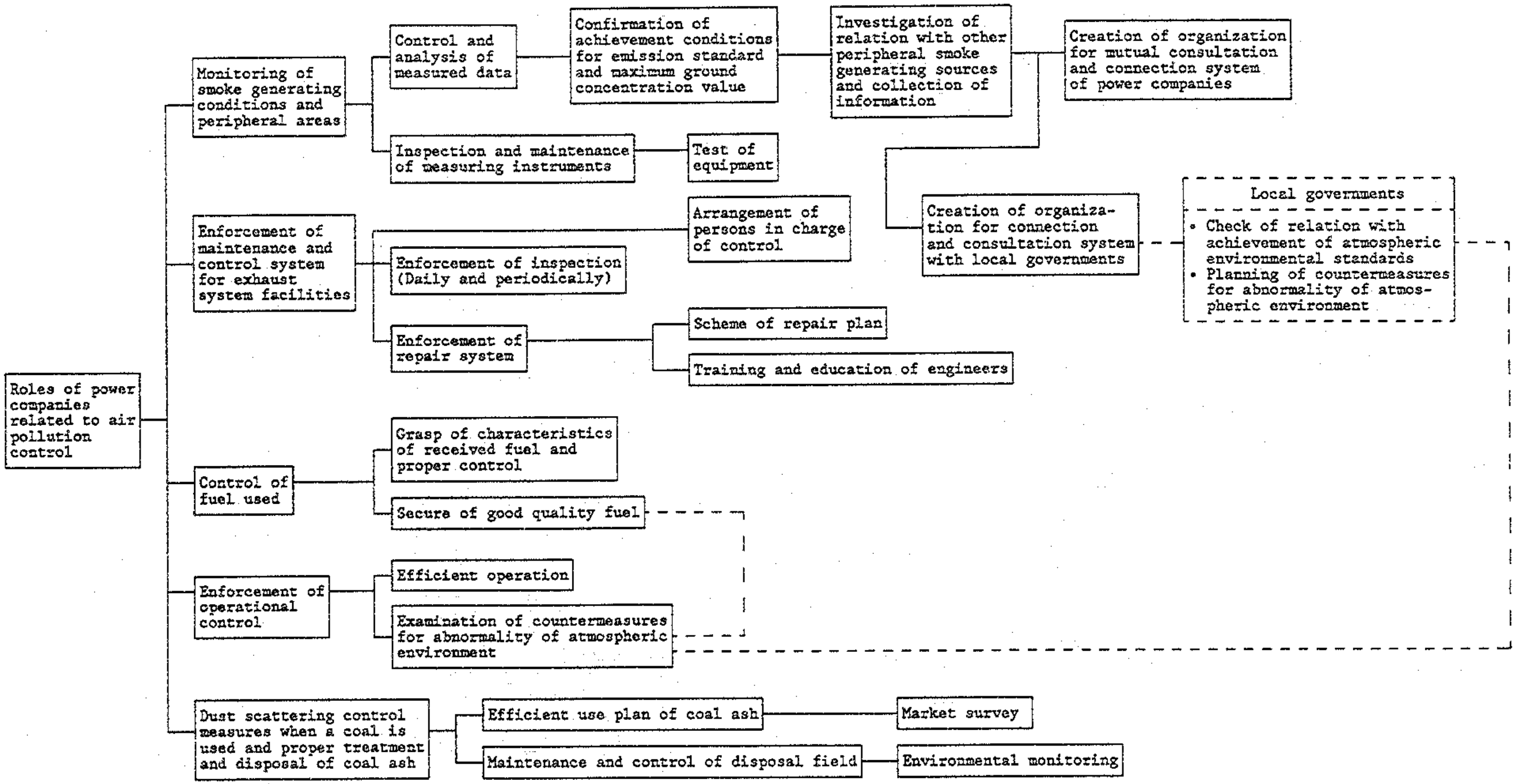


Figure 4-1-2 ROLES OF POWER COMPANIES TO CONTROL AIR POLLUTION

4.2 Government Role to Control Air Pollution

Suggested below are the subjects to be considered by the government and public organs to protect the atmospheric environments in the adjecent area of thermal power plants in future.

4.2.1 Management for Existing Power Generation Facilities

(1) Observation of flue gas generating facilities

According to the current statistical documents, though the outline of operational conditions such as equipment capacity and power generating amount by each power station is publicated, avairable of data related to various emission sources, which are the base of air pollution control plan, is not sufficient.
Therefore, for the flue gas generating facilities related to power generation, SE shall establish the report system for the administrative organs, who are in charge of operational management to grasp the contents of the flue gas rapidly from the power companies. These reports will become the basic data to supervise thermal power plants to control air pollution.
Such examination procedure on the individual facility report are recommended to be carried out of the some national organization and also data and information system based from the facility report need to be promoted for control of air pollution. In future, it is also necessary to organize systems and operations which can be applied to the fields other than power sectors as well as the province managed power companies.
Examples of report items are shown below:

- Constitution of flue gas generating facility
  Heating surface area (m^2)

Combustion ability of fuel (Heavy oil conversion lit/h)
The construction drawing of facility should be attached

- Usage of flue gas emission facility
  Hours and days used
  Types and component rate of fuel used
  (Ash, sulfur, nitrogen, and other harmful matters)
  Fuel used per day
  Calorific value of fuel
  Rate of mixed combustion
  Emission gas amount (Nm^3/h)
  ...... Max. and average value by wet or dry
  Temperature of emission gas (°C)
  Oxygen concentration in emission gas (%)
  Concentration of flue gas
  (Dust: g/Nm^3, SO_X: ppm, NO_X: ppm,
  Other harmful matters: mg/Nm^3)
  Smoke amount

- Treatment method of flue gas
  Kinds, types, names of flue gas treatment facilities
  Treatment ability of flue gas
  (For harmful matters, each concentration, or amount and collection efficiency before and after treatment)
  Actual height of emission port (m)
  Corrected height of emission port
  (Effective stack height) (m)
  Emission velocity (m/s)

The schematic diagram with construction drawing and approximate sizes of the flue gas treatment facility should be attached.

(2) Establishment of atmospheric environmental inspection system in the adjecent area of thermal power plants

1) Installation of atmospheric environmental measuring stations

in the adjacent area of power plants

To inspect the atmospheric environments adjecent area of thermal power plants and to analyze the measured data of exhaust gas in each power station, described later, it is necessary to construct measuring stations to grasp the contribution of the flue gas exhausted from the thermal power plants to the atmospheric environment.

(a) Considerations in arrangement of measuring stations

Before the installation of measuring stations of atmospheric environments, it is necessary to consider such condition as population distribution in each area, degree and variation conditions of air pollution, characteristics of weather, geographical features and distribution conditions of generation sources.
Also, it is desirable to assess the future conditions of atmospheric environmental contamination by areawise and select places with geographical characteristics that are useful to grasp the air pollution conditions together with the various conditions mentioned above.

(b) Classification of areas for inspection of "atmospheric environments" in Argentine

When the atmospheric environments are to be monitored, there are cases in which inspection systems are located areawise in addition to the conditions in item (a) above.
We consider it is proper to locate the atmospheric environmental measuring networks depend on each local characteristic practically by dividing the whole country of Argentine into nine blocks as shown in Figure 4-2-1 by considering the natural conditions such as geographical features and weather.

For your reference, populations and electric energy of power generation by each area are shown in Table 4-2-1.

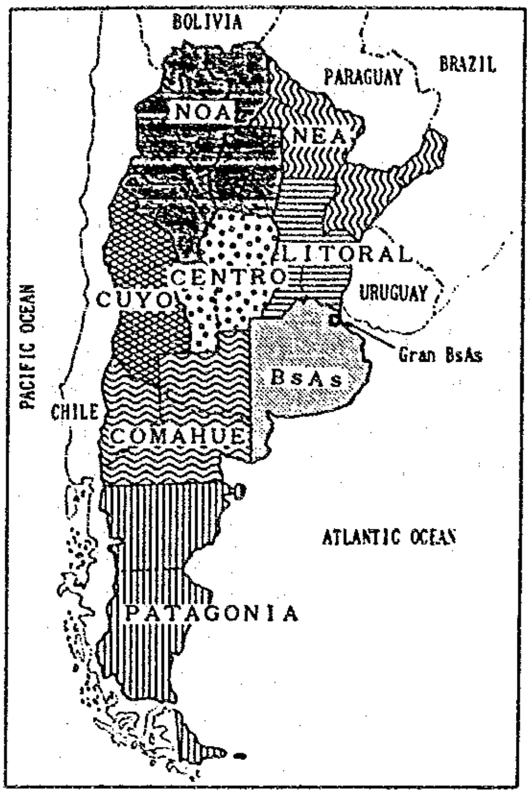


Figure 4-2-1
BLOCKS FOR THE ATMOSPHERIC ENVIRONMENT MEASURING NETWORK

Table 4-2-1
Polulations (1991) and electric energy of power generation (1992) by area each

Block	Population	Electric energy of power generation (GWh)
NOA	3,681,611	2,131
NEA	2,827,368	413
Litral	3,820,158	859
Centro	3,050,510	1,903
Cuyo	1,943,978	1,098
Gran BsAs	10,911,400	9,695
BsAs	4,631,897	8,057
Comahue	1,155,764	446
Patagonia	585,874	1,088
Total	32,608,560	25,690

(c) Installation priorities of measurement stations for atmospheric environment of adjecent area of thermal power station

For locating measurement stations for inspection atmospheric environment in the country, it is considered that a comprehesive study which covers the plan of future national inspection system, the basic policy in relation to inspection of emission from moving sources and stationary sources, future siting of large industrial facilities, must be conducted.

It is necessary to select the areas to be monitored with the consideration of the stationary sources such as large scale thermal power plants and the population density in the area together with the actual results of inspection of atmospheric environment. Districts listed below are considered as the area to be monitered at first place as there are many power plants which may have appreciable impact to the atmospheric environment in the area.

- San Nicolas city in BsAs district
- San Miguel de Tucuman in NOA district and Salta city and San Salvador de Jujuy
- Rosario city in Litoral district

Since most of the thermal power plants to be developed by 2010 will be located in the Comahue district and the NOA district, it is expected these districts will become important areas to be covered by the general atmospheric environmental measuring networks depending on the relation between the heavily populated areas and the locations of the new power plants.

For other district, it is suggested to determine the priority of locating the inspection station after performing actual inspection of the environment by temporal facility and have a program of emission control by the power plant and other industrial facilities in the area.

2) Establishment of inspection system

(a) Arrangement of measurement stations to monitor the influence of emission from stationaly sources to atmospheric environment

- Positions and numbers of stations to be installed

In principle, it is desirable to install at least three stations in the surrounding of the place, where yearly maximum ground concentration will be observed according to the result of assessment for a long-term diffusion of pollutant, and the place where maximum ground concentration will be observed according to the result of assessment of a short-term (Value in 1 hour and 24 hours) diffusion of pollutant.

When the exact positions are selected, it is necessary to consider the weather conditions (appearance frequency, etc.), such as wind direction, and wind velocity, etc. and locational relation with large scale exhaust sources in the adjecent area such as power plants and other sources.

(b) Measuring methods and items of the inspection station

- Measuring methods
  Present methods:

<u>Observation by mobile stations</u>
Under the conditions where many thermal power plants to be monitored are dispersed locally, sporadic inspection of approx. one month shall be taken in the time with seasonal characteristics (for example, rainy season, dry season, or every three months), in accordance with a mobile system.

Observation by fixed stations

Select the suitable three places or more as theinspection points for the objective thermal power plants conforming to the observed result by mobile stations and install the fixed stations in these places to perform inspection.

- Measuring items
  - SO_x
  - NO_x
  - Suspended particulate matter
  - Dust
  - Wind direction, wind velocity, temperature, humidity

(c) Collection and management of measured data

When the fixed station with automatic instruments is installed, record the data every hour, in principle. As collection methods of measured data, the following methods are considered:

1) The periodic patrol (for example, once/week) by person in charge
2) Install the inspection center at appropriate place to perform telemetering (regular inspection)

For the present, collect the measured data every week according to the patrol program together with regular maintenance and inspection of the facilities. Therefore, it is recommended that such appropriate party will implement the above mentioned work under SE.

The collected data by the trusted party is to be sent to the public organ, which use such data for environment control directly and also it manage and analyze the data. After general processing is completed, the public organ sends the data to an organization under SE regularly, for example, once a month.

In future, when many inspection stations are installed locally, install the inspection center to integrate data management therein by the regular inspection system using the data transmission circuit. It is desirable to examine and determine the construction of this regular inspection system by the examination committee consisting of the persons in charge of air control of administrative organs, experts of public weather observation organs, experts of universities and research institutes, and engineers of related industries, etc., centering around an organization under SE and/or SE itself.

(3) Measures for improvement of power generaton efficiency

To reduce environmental influence caused by the dust emitted from thermal power plants, it is important to improve the general efficiency of power generation by an effective operation of existing equipment, in particular, fuel system equipment.
Therefore, it is necessary to maintain the proper performance of equipments of thermal power plants, and therefore daily inspection, periodic inspection, and repair works for whole plant including boiler, turbine, and exhaust gas system are extremely important.

1) Establishment of periodic inspection system

In Argentina, since manufacturers of equipment of the power plant are different by each power generating unit, and there are many old equipment, furthermore, the unit capacity is relatively small so that, it is extremely difficult to scheme unification of operational procedures.

Therefore, an organization under SE is recommended to establish a periodic inspection program for main equipments such as boiler and turbine including the preparation of standard manual on daily inspection and maintenance of equipment to each power generating company.

The periodic inspection shall be performed for the following items by combining them suitably corresponding to each equipment:

<1> Inspection of equipments based on the data obtained at overhauling

<2> Working and adjustment tests of equipments

<3> Inspection of records

Check of following records.

- The records related to overhauling and inspection of each portion
- The records related to working test for safety valves, emergency stop devices, etc.
- The records related to the safety for maintenance diary, operational record, accidental record, repair record, etc.
- The records related to start and stop
- The record related to water quality control
- Other required records

For the contents of these inspections, determine the inspection contents conforming to the standardized operation record, and it is necessary to make the inspection items and the contents minutely in accordance with the operation hours, and the number of start/stop times within the inspection period (in principle, year unit.), and in accordance with the accumulated operated hours (for example, 80000 hours) from the start of operation.

It is recommended that SE should take positive leadership to introduce comprehensive inspection program to every power plants. For example, it is desirable that SE shall organize the examination committee for periodic inspection system consisting of universities, research institutes, maintenance engineers and engineers of manufacturers of equipment.

Besides above, for examination of standardization of inspection system, the new organization including people of experience or academic standing is necessary.

2) Establishment of Test System

When the periodic inspection system described above is implemented concretely, some time the welding repair work will be necessary for main equipments.
Also, check procedures for testing the welding at the end of repair will be necessary.
When the periodic inspection is standardized, then the standardization of the test system according to the recommendation of public organ should be established.

(a) Welding test

The equipment which is to be under the application of welding test are pressure vessels such as boiler, superheater, reheater, economizer, heat exchanger, etc., and pressure bearing portions such as main piping (for example, the tube whose outer diameter is 150 m/m or more), etc.

The test items of welding portion are normaly visual inspection, radiographic test and liquid penetrant test (PT test) of welding portion.

For the machinery whose operation history is longer (for example, accumulated running hours of 80000 hours or more and the number of accumulated stop and start times of 2500 or more), the magnetic particle test (MT test) targeting the fatigue vulnerable portion shall be performed.

The party to perform such the test shall have the technical level of higher than standard, for example, it should have qualified persons of ASME (American Society of Mechanical Engineers) approval test. It is desirable that the public institution which has the appropriate technique level and the sufficient ability of reliable judgement organize a council including those with academic experience at universities and institutions, engineers of manufacturers and maintenance engineer, where a test system or a qualification of testing party can be established.

(b) Test before use

When the periodic inspection with overhauling is completed, the following various tests shall be performed in the presence of inspectors who are authorized by a public supervision organ, namely, ENRE, to check the inspected contents comprehensively from the viewpoint of functional performance, and the machinery is put back to the regular running after receiving the judgment of acceptance from the inspector.
The main test items are shown below. However, for the witnessed test items required the presence of inspector, select major items from the followings.
The remained items shall be performed by the engineer of the power plant according to assessment of periodic inspection records.

- Pressure-proof test
  Perform the welding test and the device test before applying the pressure-proof test adding the hydraulic pressure or pneumatic pressure, and the leak test.

- System test
  Check whether the system of equipment functions properly or not conforming to the purpose by the power generation unit each.

  The representative items are shown below:
  - Interlock test
  - System running test
  - Alarm test
  - Sequence working test

- No-load test
  When the power generation unit is started, perform the

vibration adjustment of turbine generator, check of over-speed stop device of turbine, and valve switching test under no-load condition to check each function.

- Dynamic response test
  The main items are shown below:
  - Output variation test
  - Load dump test
    (Perform the tests by 30%, 50%, 75%, and 100% load each)
  - Heat balance test
  - Continuous full load test

3) Maintenance and Control of Measuring Instruments for Atmospheric Environment and Exhaust Gas, and Manuals Related to Testing of Measuring Instrument

The measuring instruments for exhaust gas, which are designed for the regular continuous measuring instrument, is to obtain the normal measured values while maintaining the precision and performance for 20 hours/day, 600 hours/month, and 7500 hours/year.

Therefore, it is recommended that an organization under SE will create the standardized manuals for control system, maintenance and inspection, performance test, and test system of inspection measuring instruments on surrounding of power plants and various measuring instruments whose installation is obliged in each power station. For the atomospheric environment inspection instruments, these manuals will be used as an execution procedure of an organization of the government (because SE is not responsible for the supervision of concentration of pollutants around a stack) including trusted party of maintenance and control. For the exhaust gas measuring instruments in each power station, these manuals will be used as reference when the detailed execution plan is prepared in each power station by the engineers of power station (power generating company).
The main items to be written in these manuals are shown below:

<1> Maintenance and control system
Arrangement of technical staffs
Education and training
Facilities, equipments
(Technical data of facilities and equipments which are required for storage, inspection, repair, etc. of measuring instruments)
Device control, ledger control

<2> Maintenance and control of measuring instruments
Maintenance and inspection plan
(daily adjustment, daily inspection, periodic inspection, emergency inspection.)
Calibration of scale
Performance test
Repair
Necessity of measuring instrument to be replaced
Service life of measuring instruments
(including handling of equipment for test)

<3> Contractor management
Definition of contracted work
Qualification and selection of contractor to be adopted
Supervision of work of the contraction

<4> Execution of contracted work
Organization
Arrangement of engineers
Equipments
Reference materials
Management of ledgers

<5> Safety control

<6> Management of measured data (including the data related to the running condition of power station.)

*: For creation of manuals, it is desirable that an organization under SE organizes the manual examination committee consisting of persons in charge of atmospheric environment control of administrative organ, engineers of manufacturers of measuring instruments, and representatives of power generation companies, to improve the quality of work.

4) Reinforcement of Maintenance System

To reduce the influence to the atmospheric environment of adjacent area due to the air pollutants emitted from the thermal power plants as much as possible, it is necessary to improve the operation efficiency as written above, however, it is also important to maintain the stabilized running condition simultaneously.
Therefore, establishment of the policy on the improvement of operating condition of the power plant is important in order to strengthen the maintenance system of facilities in each power station (power generating company).

<1> Grasp of running conditions of thermal power plants (regularly, and at the time of emergency)

It is recommended that an organization under SE will understand how the thermal power plants (power generating companies) make effort to reduce the influence to the atmospheric environment through maintaining the daily running conditions at best, or what kind of correspondence they will carry out at the time of emergency.
Therefore, it is necessary to set up reporting system that define the obligation of power generating companies of reporting periodically (for example, once/month) for running conditions, or reporting immediately for emergencies caused by accidents, failure, etc. (for example, immediately for prompt report, and within 10 days for detailed report including countermeasures and treatments, etc.) to SE.

- Periodic report for running conditions
  Emission source data and power generating conditions
  Fuel used conditions

- Reports for accidents and failure

For accidents and failure, it is necessary to clarify the definition beforehand.

As examples, the accident means the case where the generator unit trips and restart becomes unable at once due to the equipment damage or the external accidents in the power station, and the failure means the case to be difficult to maintain the normal running condition even the power generation does not stop.
When such status is occured, the power generating company must present the report having the contents which include causes of problem, countermeasures, inspection and maintenance records, and other data which is useful for prevention of recurrence of accidents or failure.

Therefore, it is recommended that an organization under SE will prepare a guideline for reporting procedure including these definitions, together with making the coding as much as possible so that these report contents are liable to be utilized as the statistical documents.

<2> Enactment of qualification system required for improvement of operational maintenance

To scheme the improvement of operational maintenance and control in thermal power plants, it must be obliged to assign the qualified persons to each power station or power generating company corresponding to the scale and content of each facility.

<u>The qualification of such persons is described in the following</u>
For each qualification, SE shall enact the rules related to systemization of responsibility, authority, right of approval, or approval of test by the qualified person.
The qualification system examination committee including representatives of universities, research institutes and power generating companies under SE

shall be formed to prepare the procedures and related evaluation criteria to appoint qualified persons.

<u>Main qualifications</u>
Electrical qualified engineer with license
Qualified engineer with license in relation to boiler and turbine technology
Manager in charge of pollution control with appropriate carrier. (Water quality, air, and others.)
Qualified engineer with license for pollution control
Operational environment management engineer with appropriate carrier.

(4) Outlook of emission standards

In the present thermal power plants in Argentine, there are may units of relatively small capacity or old units. However, almost all these existing stations are considered to continue operation till about 2010.

On the other hand, in future, it is expected that the power plants of large scale (300 MW level) with combined cycle process targeting a better generation efficiency will be increased.

Although the regulation to limit dust emission form the thermal power plants is already exists, the large scale dust emitting facilities of other industries whose emission standards are not enacted at present, the emission standards for such industrial facilities will be enacted in turn.

Therefore, for the current emission standards, though SE has enacted by fuel type, regulate the emission of SO_x and soot and dust, in addition, in future, it is prospected to enacts addition of standard for NO_x. It is also considered as nessesary to to set the emission standard depending on the capacity of exhaust gas quantity (Nm^3/h) by each stack of power plants or to distinct the standards depend on the nature power generating system, for example, steam turbine, internal combustion engine, gas turbine etc. must be considered.

For review of standard figures, it is also necessary to specify the residual oxygen concentration in flue gas of power generating system each and by fuel type each for NO_x and dust.

The residual oxygen concentration means a percentage of oxygen concentration remained in the flue gas just after combustion, and the oxygen concentration of gas introduced to the combustion facility is shown by "On", and the residual oxygen concentration according to the actual measurement is shown by "Os", and these concentration is used to standardize the measurement values of NO_x or soot and flue gas. When the oxygen concentration in air is assumed 21%, obtain the ratio between 21-On and 21-Os, and the measurement value of NO_x or soot and flue gas is adjusted by multiplying by this ratio.

$$C = \frac{21 - On}{21 - Os} \cdot Cs$$

For the Japanese "Air Pollution Protection Law", the standard residual oxygen concentration applies to 4 - 6% for boilers of steam power generation system, 16% for the gas turbine, and 13% for the diesel engine.

When new emission standard is considered in particular, it is necessary to consider the difference of background of atmospheric environmental pollution, namely, the transition of social activity and economic activity in the area or future trend by each area, and for that emission standards, reviewing the ranking of allowable emission shall be considered by each area simultaneously. The bases to be considered to review the standard are shown below.

(a) The power station operating at present and the power station to be installed newly shall be distinguished.
(b) Classification considering the current conditions for

population crowded area and depopulated area, industry concentrated area and other areas, etc. shall be performed.

(c) Ranking shall be performed depending on the exhaust gas quantity.

(d) Classification by the fuel type shall be performed.

(e) Each classification shall be performed depending on the types, namely, steam, internal combustion force, G.T. and composite type.

(f) The power plants whose yearly duty cycle is extremely low and other power plants shall be classified.

Therefore, to examine these conditions, it is desirable that SE should establish an advisory board to review the emission standards constanlly, which consists of the central and province government organs, research institutes of universities, and depending on the case, experts of manufacturers for boiler and gas turbine, etc., under the adjustment committee installed at present.

The advisory board must always be informed the economical activities of each region and technical innovation in combusion engineering. To assess the influence on environment, it will have to foresee the changes of dust amount that may be caused by a future review of emission standard. Therefore, the advisory board must be organized with a long-term perception.

4.2.2 Management of Newly Constructed/Expanded Power Generation Units

In future, the management policy for the existing power generation plants described in 4.2.1 will also be applied to newly constructed/expanded or replacing power plants and units. However, the following items shall be added.

(1) Establishment of approval and license system

1) Establishment of prior environmental influence assessment system

As described above, regulations by S.E.E. 149/90 define comprehensive measures to protect the environment step by step from planning to operation of the conventional thermal power plants.

However, most of future thermal power plants will have complex generation system. In such case, the fuel will be natural gas, and the most of case object power generation unit shall be the gas turbine generator.

Therefore, the present environment assessment system at the planning stage will require some review.

When a large-scale thermal power station is constructed or operated, it is necessary to conform to the environment control requirement of the local government. In addition, the impact on environment caused by the thermal power station must be the least possible to obtain understanding and cooperation from the residents in the area. For this reason, details of the plan must be opened to the public as the "Environment Impact Statement" (EIS).

In the developed country and some of the developing

countries, though their conditions are different from those in Argentina, it is becoming more difficult to obtain consensus from the residents in the area where to construct large scale thermal power plants, and this tendency threatens the stable power supply in some cases.
Therefore, it is desirable to start the review of the system for implementation of power plant as early as possible.

The power companies shall be responsible to select the locations of future thermal power plants. Therefore, it is desirable that SE/ENRE should form a committee among related government agencies and representatives of the power companies, including consultants when necessary, to examine the procedures to be followed by the power company at the time of new plant construction.

Following are some examples of prior environmental assessment pracedures, which is adopted in several countries.

(a) Advanced method of environmental assessment

i) Initial stage

The power companies who are planning the construction of thermal power plants shall examine whether all activities locating at the locations of construction of thermal power station generate any impact to the environments or not at the stage of planning.

It is desirable to determine a exception list for the development project in each region which define the nature of the project, which will be excempted from formal environment assessment procedures. That list is indicates the nature of the project, the size of project etc which are exempted.
However, in general the thermal power plants do not meet the requirement of this exception list.

When the locations do not correspond to the exception list, perform the comprehensive assessment (Environmental Assessment: abbreviation EA), and as a result of this assessment, if the impact to the environment is considered small, create the report, which all related matter is written, shall be published. When this report is approved, the next step can be started.

ii) Preparation of environmental impact assessment sheet (EIS)

When it is judged that the impact is not little, perform the preliminary examination of impact to environment (Scoping) conforming to the implementation plan.
Based on this result, the power companies prepare the draft report of environmental impact assessment (Draft EIS). In this paper, the examined results for impact of original scheme to the environments or that of alternatives shemes are included.
The Draft EIS is published for a specific term (for example, 45 days). For this Draft EIS, the general citizens or administrative organs concerned present the opinion.
In this published term, the power companies open the explanatory conference or the public hearing to explain the plan to the citizens to scheme the well-known.
The power companies examine the opinion presented to the Draft EIS, and prepare the final environmental impact assessment sheet (Final EIS), then make public the Final FIS for a specific term (For example 30 days) to obtain the opinion again. In such way, the final decision (Record of Decision), whether the project is accepted or not, is performed after the completion of opening.

(b) Predictive evaluation for atmospheric environmental impact in environmental impact assessment statement (EIS)

In this EIS, for locations of thermal power plants, the impacts which affect the natural environments and social environment, countermeasures, and evaluation are written concretely in each step of planning, construction, and operation.

In this EIS, the items related to the atmospheric environments are shown below.

i) Preliminary examination (Scoping)

In this subject, the items which should be adopted are as follows:

- Fuel plan
  Classification of domestic and importation, characteristics of fuel, yearly quantity consumed, storage quantity
- Flue gas treatment system
- Items related to the stack
- Current condition of atmospheric environments
  Levels of dust, SO_x, NO_x within 20 - 30 km radius in the adjecent area of power station
- Weather data
  Air temperature, rainfall amount, wind direction, wind velocity, atmospheric stability, etc.
- For thermal power plants of coal
  Coal ash generated quantity, disposal method, disposal site plan, etc.

ii) EIS (Draft EIS and Final EIS)

- Predictive evaluation for construction

Generation of dust according to the operational vehicles and equipments mainly for the land reclamation work or construction, and estimate of impact to the air, required counter measures and its evaluation

- Estimate for operation
  Estimate of max. ground concentration of contaminants (dust, SO_x, NO_x) mainly contained in the soot and flue gas (short-term and long-term) and estimate of impact to environments, required counter measures and its evaluation
  (For thermal power plants of coal, estimate of impact to the atmospheric environments of adjecent area for disposal ash, required counter measures and its evaluation are included.)
- Inspection of atmospheric environments
  Inspection of soot and flue gas in the emission source, and atmospheric environment inspection plan

2) Approval of installation of new facility

Establishment of the procedures related to preliminary examination and approval for the installation of new facility, which include the submission of report with the following contents presented by the power companies to the authority controling the power generation units of newly construction/expansion. The report include contents of design, fuel plan used, management plan and past achievement, fund plan, engineering ability, etc.

(2) Establishment of inspection system for equipments

1) Establishment of inspection system according to the government regulation or the alternative standard accepted by the government office in relation to the boiler, turbine, etc., under construction (when installation of equipments is completed)

2) Establishment of witnessed inspection system according to the government regulation for the safety of facilities after the work is completed (before start of commercial operation)

4.2.3 Establishment of the institure for reasearch and development of technology

(1) Establishment of research institutes related to air pollution control technique

In future, it is desirable to establish a research institution under the control of SE concerning air pollution control where emphasizing NO_X control technology, in particular, for the combined cycle process with large scale gas turbine which is considered to become the core of new construction or expansion plan of thermal power plants.

(2) Establishment of investigation and research organs related to fuels for power generation

It is desirable to establish the examination and research organs related to the long-term demand plan of fuels for power generation, necessity of introduction of new fuels, etc. under the control of SE.
In particular, the fuel used for the complex type power generation system which is expected to become the main force of thermal power plants in future, is the domestic natural gas, In order to secure the long-term stabilized economic supply, it is necessary to scheme the coordination between the long-term use plan of natural gas for power generation and use in other sectors and the production plan of natural gas.

(3) Research cooperation with adjecent countries

From the viewpoint of resional environment preservation, it is considered necessary to establish the research organs among the countries in the region, related to preservation of atmospheric environment including prevention of global warming (green house effect), whose geographical features and weather conditions are similar (Uruguay, Brazil, Bolivia, Paraguay, etc.), and in that case, as the agency representing Argentina, SE is considered suitable.

4.2.4 Required government role in relation to financing arrangement for improving the atmospheric environment control of the thermal power plants

Presently privatization of the thermal power plants under the control of federal government has almost completed, and the privatization of hydro-power plants are being proceeded.

In order to meet the increasing demand of electricity in the country the construction of a few hydro-power plants are still continuing under the public finance.

However, the finance of government to energy sector is being rapidly reduced. According to the latest government plan, the government investment for energy sector will be 1,308 million current peso in 1995 (1993 is 2,414 million).

It is expected that the privatized electricity generation company will make necessary financing arrangement for continuation of on going hydro-power plant project to replace the finance from the government.

However, as it is already observed the construction of additional capacity of power generation from now on will heavily oriented to natural gas base thermal power plant as far as the existing conditions surrounding the electricity sector of country are maintained.

General speaking the investment required to built the same size of power plant by the hydraulic system, the investment will be more than two times and the time required to complete the construction work will be also more than two times of the case of combined cycle natural gas base plant.

Further the impact to environment by the construction of hydraulic system is considered more difficult to be assessed than the case of thermal power plant.

These conditions make very difficult the private party to make investment for the construction of a large hydraulic power plant.

It is very possible that privatization of existing power plants could be realized without much difficulty, but the positive participation of private investor to a new hydraulic power plant project may be difficult without appropriate arrangement by the Government. As it is well awared by the international institutions, the promotion of energy supply from renewable energy sources is considered very important for sustaining growth of the economy over the entire world.

It is possible the Government of Argentine to obtain finance with good terms from the countries, who are having problem of reducing CO_2 emission to environment, to Argentine for her not to increase CO_2 emission to atmospheric environment even sustaining her development.

This type of arrangement is being considered seriously by the country concerned on the reduction of green house effect in the atmosphere of the glove.

When such low cost finance is relended to the private party by the Government, who will willing to invest for the construction of hydraulic power plant in stead of building the thermal power plant utilizing fossil fuel, the promotion of the construction of hydraulic power plant will be realized even under the market oriented economy mechanism.

The existing finance to large power plant project, such as the national energy fund etc can be utilized in the similar way as the above mentioned external fund when avairable.

Similarly the application of low cost finance should be considered for the project, which improve environment conditions of country very much.

The capacity increase of natural gas system to replace fuel oil consumption by the power plants during winter or a non-traditional fuel project which can replace fuel oil or coal demand for power plant and industries in future are the candidate projects for such government assistance.

4.3 Roles of Power Stations to Prevent Air Pollution

Measures to prevent air pollution caused by thermal power plants have been defined by the enforcement regulations (Resolution 154/93) as enactment of emission standards, concentration of contaminants in exhaust gas, and prevention of dust disperse, and power companies are conforming to these regulations.

At present, the total capacity of thermal power plants in Argentine is approximately 8000 MW, and they are expected to continue in operation as long as possible. Therefore, power plants are required to pay greater attention to the atmospheric environment and the exhaust gas emitted from the power plants. Power stations should also make efforts to improve their operation and maintenance to ensure and improve the efficiency of power generation, which will consequently protect the atmospheric environment.

In Argentine, laws and ordinances related to anti-pollution measures for environmental protection will be further refined and reinforced continuously. It is also expected that the public will desire the better environment.

This means that the facilities that may emit contaminants will be required to have more positive attitude to establish anti-pollution measures.

Roles and subjects of power companies to prevent air pollution have already been described in Figure 4.1.2, Item 4.1. However, it is natural that the attitudes to cope with problems differ depending on the conditions of each station or the environmental conditions of adjacent area.

Shown below are the items that may help power companies to improve their anti-pollution measures.

4.3.1 Identification of Flue Gas Generating Conditions and Monitoring of Atmospheric Environment

(1) Control and analysis of measured data

Power companies normally have more than one power station or power generating unit in the same area. In many cases, the unit capacity, power generating systems, fuels used, shapes of stack for these stations or units are different.

Therefore, to check the soot and flue gas generating condition, the inspection system must examine the exhaust gas emitted from each stack from the viewpoint of the control of whole power station, and depending on the case, the general inspection system including the adjacent power plants is necessary.

Therefore, always compare and examine the measured data of flue gas with the emission standard to check if the standard is achieved, and the general data control and analysis as the whole power station shall be performed simultaneously. And construction of organizations or systems to perform such serial data control is also necessary.

(2) Monitoring of atmospheric environments in the surrounding area

In the environmental impact statement which private power plants are obliged to present, estimated ground level concentration for long and short terms regarding SO_x, NO_x of flue gas are included, and it is necessary to check how the estimated value of max. concentration on the ground is and in what kind of correlation is exist between estimate and the actual measured value. Therefore, it is necessary to measure periodically the atmospheric environments in the surrounding area of power station.

For the present, it is desirable to perform the intermittent inspection by the mobile system at plural spots, and in future, to perform the continuous inspection by the plural fixed stations. In this case, it is effective if the inspection take into consideration the measurement conducted by the surrounding other power plants. Also, it is necessary to scheme the conformity with the general atmospheric environmental measuring stations which were already installed by the governmental atmospheric environmental control department or the local governments or whose installation is scheduled in future.

(3) Investigation related to other generation sources and exchange of information

As a result of inspection or inspection of atmospheric environments, if the abnormal value is detected, it is necessary to check whether the abnormal value is caused by the own power plants or not. In particular, when the large scale emission sources other than the power plants are present in the neighborhood of the power plants, it is necessary to grasp the mutual correlation.

Since the power company will have difficulty in treating this problem individually, it is considered that the administrative organs of central government or the local governments concerned shall treat this problem integrated way to perform the required administrative leading.

Therefore, the communication conference related to the atmospheric environmental control of areas including the local governments concerned and the enterprises concerned should be organized. When the power companies participate this organization, it is necessary to cope with locally or by the nationwide unified policy as power companies under the application of leading or advice by SE.

(4) Mutual communication conference system of power companies

As for the whole country of Argentine, the movement related to the atmospheric environmental protection gets strong in future is considered naturally, and the movement is already in the trend where the new atmospheric environmental standards by province or by city will be enacted, or review of existing standards will be performed, and arrangement of atmospheric environmental inspection networks are strengthened.

When such strengthening of regulations is conducted, the thermal power plants are positioned in the difficult situation because of they are the large scale emission sources, and it is anticipated that the inspection by the administration will be performed in future, or frequent presentation of measured data of exhaust gas will be required (depending on the case, the direct transmission system using the telemeter method is also considered).

For the atmospheric environmental standards enacted, the standard values required the emergency measures such as abnormal values or the warning values, etc. are determined besides the normal values.

Therefore, for these cases of emergency, the concrete instructions such as the reduction of power output corresponding to the degree of pollution or exchange to the clean fuels, etc.is given to control the atmospheric contaminants.

Against such serial administrative instruction, the power companies shall not respond individually, but it is considered to be necessary to respond by each area related to one local governments such as province, etc. if possible ation is to be taken, by based on the nationwide unified basic policy. In addition, it is anticipated that the power companies require the organization to scheme the cooperation, consultation, and unification of intention by each area and nationwide level not only for the atmospheric environmental related items, but also establishment of common policy as power sector company including the subject of common interest. It is desirable to promote the creation of such organizations rapidly under the guidance and advice from SE.

(5) Maintenance of atmospheric environment related measuring instruments

For the flue gas measuring instruments, atmospheric environmental measuring instruments and the data control related facilities, these data becomes the base to grasp the current condition of the atmospheric environment, and consequently, the data will become the basic documents of atmospheric environmental control including the review of future emission standards, so that the importance is high, therefore, maintenance and control of these instruments and facilities shall be performed so as to function properly all the time.

Therefore, the manuals related to the daily inspection, periodic inspection, and maintenance should be prepared, and the check system to ensure, that the inspection, maintenance and control conforming to the manuals, are performed properly shall be established.

Generally, the service lives of measuring instruments are 5 to 7 years, so that the test and calibration of measuring instruments shall be performed, as required, and it is also necessary to determine the condition of the old instrument reaches to the renewal time.

4.3.2 Maintenance and Control of Exhaust System Facilities and Strengthening of Operation and Control

As the measures required to maintain the normal operation to scheme proper functioning of the soot and flue gas generation facilities of thermal power plants, preparation of safety system in power plants and suitable daily inspection and periodic repair for instruments are mentioned in the preceding paragraph. In this paragraph, the other way of improving the operation of plan is described;

(1) Maintenance and strengthening of pollution preventive system

The thermal power generating companies shall establish the organization having a responsibility to protect the peripheral atmospheric environments of surrounding area in relation to the operation of the flue gas generation facilities.

Therefore, the unit manager shall have the responsibility to the sole pollution protection together with taking appointment of the general responsible person who stands on the top of execution for countermeasures of pollution, and it is necessary to nominate engineers who share the duties for execution of pollution preventive measures, for example, control of facilities, measurement of emitted materials, treatments for emergency or accidents, etc. or by the element of pollution, such as, air, drain, noise, vibration, etc. under the lower part.

These assignment scheme are changed by the scale or the type of thermal power plants, and, in principle, it is not always necessary to unify the detail of measures by power company each, however, since the thermal power plants have the strong characteristic of public enterprise, and have the social responsibility to supply the power steadily, it is desirable to assign the capable engineers having the following responsibility and authority in every powerstation, in principle, as the important measure for atmospheric contamination protection.

1) Responsible person for prevention of air pollution
He is a responsible person to scheme the air pollution protection of thermal power plants as whole, and the main duties are shown below:

(a) Inspection, maintenance and operation of running conditions of flue gas generation facilities
(b) Analysis and control of measured data of soot and flue gas emitted into the air
(c) According to the rule of the atmospheric environmental standards, when the atmospheric environments of surrounding area become an abnormal, this responsible person shall take the emergency actions instructed from

the local governments, etc.

2) Manager for air pollution prevention

To change the technical performance which is directly related to the air pollution prevention of thermal power plants, the manager for air pollution prevention shall be assigned under the authority of responsible person for air pollution prevention. The main duties of this manager are shown below:

(a) Arrangement and analysis of fuel data used
(b) Inspection of flue gas generating facilities
(c) Operation, inspection, repair and emergency treatments for accidents for generated flue gas treatment facilities
(d) Measurement, record of flue gas, and inspection and preparation of measuring instruments
(e) Emergency action in accordance with the operation procedures of atmospheric environmental standards (Reducing measures of quantity and concentration of flue gas, and execution of other required treatments)

(2) Inspection and maintenance of flue gas generating facilities and improvement of technical ability

The inspection and maintenance of equipments related to air pollution protection shall be performed for the operation of whole facilities of power plants, namely, the inspection and maintenance shall be performed generally as the daily inspection work or the periodic inspection work. It is obvious so as not to take attention only for flue gas generation facilities therefore, there are no description for the detail of inspection and maintenance work for every facility.

As the daily measures to prevent the impact to the environments due to the air pollution, it is most effective to improve the running efficiency as the whole power plants. As for the flue gas generation facilities, not only the inspection and maintenance for each facility in the interval from the inspection of characteristics of fuels to the stacks, but the work shall be performed keeping in mind how each facility relates to the running conditions of whole power generating plant.

Therefore, it is necessary to scheme the improvement of technical capability engineers. For each engineer including the responsible person related to the pollution protection mentioned in item (1), the internal qualification approval system, etc. shall be considered.

Since some of the thermal power generation units in Argentine have the equipments manufactured in 1930s, and manufacturers spread over the worldwide countries, therefore, arrangement and control of records keeping related to the history of each equipment, namely, the records of operation, repair, modification or accidents, are, of course, extremely importance to execute the maintenance properly and improve efficiency for equipments.

4.3.3 Control of Fuels Used

All fuels used for thermal power plants in Argentine are produced in the country, and the main fuel is natural gas. The fuels, including the naphtha or gas oil besides natural gas are called the good quality whose sulfur content is low, and for the qualitative control of fuels, it is considered there are not so much special things to be written, in particular.

However, to maintain and improve the running efficiency of power plants properly, it is required always to grasp the calorific values of fuels used, so that it is necessary to take attention for correlation between the fuel quantity consumed and the running condition of power generating equipment.

It is normal to perform the periodic chemical analysis for the receiving fuels, and even when the chemical analysis is entrusted to the outer organs, it may be necessity to perform the in-firm analysis as the cross check in the suitable term.

Assessment of the correlation between these chemical analytical data and the contaminants in the exhaust gas and analysis of the chemically analyzed data by combining with the various running data in the fuel systems make the basic information to check whether the proper operation is performed or not.

As the measure for controlling of abnormality in atmospheric environments, it is considered as effective measure to change type of fuels for reduction of contaminants in the exhaust gas, namely, to changeover to the fuels having more superior quality, so that, examination shall be made in advance of storing of fuels to now the quality of it for emergency countermeasures.

4.3.4 Measures for Coal Using

The preventive measures dust scattering in the thermal power plants with coal are written herein.

In Argentine, the power generating units which can burn coal are few at present, however, for the case when a plan to use coal in future occurs, the countermeasures to be considered beforehand are proposed as below.

(1) Measures for coal receiving facilities and storage facilities

For the facilities to unload the coal from the coal carrier and for the carrying facilities such as belt conveyer, etc., it is necessary to adopt the sealing design as much as possible as the dust proof measure.

In the coal yard, the storage facility, the dust scattering preventive net shall be installed in the periphery together with installation of spray equipment.

(2) Handling of coal ash

For handling of coal ash, since the transportation work to the silo or the ash disposal site is unavoidable, sealing of carrying system, such as sheetcover over the pallets of carrying vehicles are necessary, and if it is feasible technically and economically, the slurry transportation* using the pipe is also an effective measure.

*: The method to transport the coal ash suspended in a liquid (mainly water).

(3) Measures for disposal site of coal ash

Since the effluent from the coal ash disposal site is a strong alkali nature, the impact to the surrounding environments of surrounding area is possible. Therefore, the wastewater treatment facility, in particular, the neutralization equipment shall be installed, and inspection of water quality in the drain hole shall be performed to confirm that the effluent does not give the wrong impact to the environments of sarrounding area.

For the disposal site of coal ash, the dust scattering preventive measure from the disposal site is necessary, for example, installation of the spray facility to perform spray, cover the surface of disposed coal ash using the suitable sediment, etc.

(4) Effective use of coal ash

As the basic measures to reduce the various impacts to environment due to the coal ash, it is most effective way to control the quantity of coal ash as far as possible. Therefore, it is necessary to scheme the effective use of coal ash by way of study of the needs by the market survey, etc., and develop the research and technology to use the coal ash in the new fields.

4.4 Suggestions Concerning Systems and Organs to be realized to Prevent Air Pollution

In this chapter, various measures to be considered for prevention of air pollution have been discussed. Following are the summary of those measures recommended in the text.

4.4.1 Systems to Prevent Air Pollution

(1) Measures to be considered by the government

- Reporting of flue gas generating facilities
- Installation of atmospheric environmental measuring stations in the surrounding area of power plants
- Periodic inspection of power plants
- Test system after periodic inspections
- Maintenance and control of measuring instruments for atmospheric environment and exhaust gas, and creation of manuals related to test
- Reporting of running conditions of power plants
- Guideline for reporting of running conditions
- Placement of qualified persons
- Review and renewal of emission standard
- Specification of residual oxygen concentration
- Inspecting system for equipments

(2) Measures to be considered by power companies

- Control system of measured data concerning flue gas emission at power plants
- Monitoring of atmospheric environment in surrounding area of power plants
- Manuals regarding maintenance of atmosphere related measuring instruments
- Control of atmosphere related measuring instruments
- Pollution preventive system and qualification approval system of power companies
- Control of fuels used
- Measures for coal using

4.4.2 Organs Concerning Air Pollution Preventive Measures

(1) Measures to be considered by the government

- Committee for regular inspection system of atmospheric environment
- Committee for periodic inspection of power plants
- Committee for standardization of periodic inspection
- Organ to observe periodic inspection
- Council for qualification approval system for periodic inspection
- Committee for maintenance of measuring instruments for atmospheric environment and exhaust gas and creation of manuals related to test
- Committee for worker-qualifying system
- Advisory organ to review emission standard
- Committee for prior environment influence assessment system
- Research institution specialized in anti-air pollution techniques
- Investigation and research organ related to fuels of power station
- Common research institution with peripheral countries

(2) Measures to be considered by power companies

- Organ to manage measured data concerning flue gas emission at power plants
- Regional conference to control atmospheric environment
- Communication conference of power companies

4.5 Necessities of Improvement of Combustion Technology for Reduction of Pollutant Emission from Flue Gas

4.5.1 Outline of combustion technology

Most of thermal power plants in Argentina use natural gas as the fuel for 9 months of each year, and fuel oil for the remaining 3 months. Natural gas is essentially clean energy and exhaust gas after combustion contains few pollutants, excepting NOx, and SOx and dust are not likely to exceed emission standards. Thus, only NOx reduction measures are needed for the 9-month period during which natural gas is burned. On the other hand, the 3-month oil-burning period requires measures to reduce NOx, SOx, and sometimes dust in flue gas.

Clearly, it is uneconomical to install flue gas treatment facilities which are used for only 3 months, thus a true solution should be related to national energy policy. Particularly, if all thermal power plants and the natural gas supply enterprise are privatized, market force may allow the thermal powr plants to use natural gas throughout the year.

As the matter is out of scope of the present study, this section discusses improvement requirements to comply with the existing emission standards when existing thermal power plants continue to use natural gas for 9 months and fuel oil for remaining 3 months.

(1) SOx reduction measures

As for SO_2 reduction measures during the 3-month period, the SO_2 emission standard is 1,700mg/Nm^3, which is equivalent to flue gas produced by burning fuel oil with sulfur content of 1.1% or coal with the 0.7% sulfur content. Thus, to comply with existing emission standards, it is obviously economical to use fuel oil or coal of the above quality, rather than to install new SOx reduction facilities.

(2) Dust control measures

The existing dust emission standard in the case of oil burning is 140mg/Nm^3, which is equivalent to flue gas produced by burning fuel oil with the 0.94% sulfur content. According to EPA, the dust produced by burning of fuel oil increases in proportion to the content of sulfur contained in the fuel. Again, it is economical to use fuel oil which sulfur content is below the above level, rather than to install a new electrostatic precipitator (EP).

Using fuel oil of the 0.9% sulfur content will reduce dust concentration in flue gas to around 140mg/Nm^3 and SO_2 concentration to 1,500mg/Nm^3, which are within present emission standards.

In the case of coal firing, dust concentration at the boiler outlet reaches 10,000 - 30,000mg/Nm^3, which is reduced to 200 - 600mg/Nm^3 or less in flue gas after going through the EP.

(3) NOx reduction measures

At present, Argentina has no NOx emission standards for thermal power plants. Nevertheless, there is public recognition that NOx is a major factor in producing oxidants and serves as a detrimental pollutant to cause environmental pollution, particularly in urban areas. Thus, controlling NOx production to a minimum level contributes to environmental preservation and fuel saving, and the following improvements are recommended.

NOx produced from combustion of a fuel in a boiler are mostly nitrogen monoxide (NO) and nitrogen dioxide (NO_2), and generally, NO accounts for around 95% of NOx. NOx produced from combustion are divided into thermal NOx which is produced when nitrogen molecules in the air mixed with the fuel reacts with oxygen under high temperature, and fuel NOx which is produced when nitrogen compounds contained in the fuel are oxidized during combustion. Although varying with the type and method of combustion, thermal NOx accounts for 100% of all NOx produced from combustion of gas, 30% - 40% in the case of fuel oil or crude oil, and 10% - 20% in the case of coal. Thermal NOx can be reduced by lowering combustion temperature and oxygen concentration, and reducing the period of combustion gas staying in the high temperature range.

In particular, NOx can be reduced by 10% to 30% by reducing O_2 in the combustion gas by half (2% to 3%). This can be accomplished by reducing excess air for combustion. Careful control is required to prevent incomplete combustion accompanied by soot due to insufficient air supply. Table 4-5-1 shows reduction of NOx production through low excess air combustion.

In developing countries, O_2 in combustion gas is not measured and highly excess air is used to avoid incomplete combustion. As a result, NOx production amounts to [2] in Table 4-5-1. By controlling excess air to the minimum required level on the basis of accurate measurement of O_2 in the combustion gas, NOx can be reduced by 20% - 30%, with saving in fuel consumption by 5% - 10%.

Reduction of excess air also leads to the reduction of SO_3. SO_3 adversely affects the environment and corrodes equipment after a combustion furnace or boiler, such as air heaters and EPs. Since SO_3 cannot be fully removed through the wet type flue gas desulfurization process, control of excess air is considered as an important means to reduce it.

Table 4-5-1 REDUCTION OF NOx BY LOW EXCESS AIR COMBUSTION

(Unit: NOx ppm)

Fuel		Coal	Fuel Oil	Gas
N(%)		0.7-3	0.1-0.5	0
O2 Equivalent (%)		6	4	5
[1]	Standard Combustion	550-800	400-500	300-400
[2]	Air Excess Combustion	600-900	500-600	350-450
[3]	Low Oxygen Combustion	450-650	300-400	200-300

Note : NOx 1ppm is equivalent to $2mg/m^3$

As mentioned above, NOx can be reduced by 10% to 30% by controlling excess air during combustion to cut residual O_2 in combustion gas by half (to 2% - 3%), with 5% to 10% saving in fuel. This method requires, however, careful combustion control to prevent incomplete combustion due to the shortage of air, accompanied by soots, from occurring. Assuming that each power plant is equipped with an automated combustion control device, it can be used for low excess air combustion of the boiler. In addition to immediate effects of NOx reduction and fuel saving, the low excess air operation forms a basis of future NOx reduction measures and serves as an opportunity for plant workers to raise their awareness and learn necessary techniques. It should be noted, however, that the low excess air operation will increase dust concentration, which should be controlled below the respective emission standard.

NOx concentration at present is estimated at 600 - 900mg/Nm^3 for gas combustion, 800 - 1,200mg/Nm^3 for fuel oil combustion, and 1,100 - 1,800mg/Nm^3 for coal combustion. Through the low excess air combustion, these figures can be reduced to 400 - 600mg/Nm^3, 600 - 800mg/Nm^3, and 900 - 1,300mg/Nm^3, respectively.

(4) Summary

The above improvement proposals are summarized as follows:

1) Use of low-sulfur fuel
   To use fuel oil with sulfur content of 0.9% or less, or coal with the 0.7% or less sulfur content.

2) Low excess air operation

The major effect of the improvement measure is fuel saving due to low excess air combustion, which may compensate to a certain degree for a higher fuel cost of a low sulfur fuel. At the same time, introduction of the new operation will help raise awareness of plant workers and learn techniques related to energy conservation.

Also, NOx reduction will lead to the reduction of environmental impacts.

4.5.2 Major Combustion Parameters

(1) Relationship between Major Combustion Parameters and NOx Concentration

The principle of NOx formation was duly considered and relevant experimental data were obtained.
Figures 4-5(1) - 4-5(5) show how NOx concentration is related to air-fuel ratio, residence time, temperature, Fuel NOx conversion ratio, or N (nitrogen) content in fuel.
On the other hand, survey results on existing boilers were summarized. From the foregoing, the following conclusions are believed to have been confirmed.

1) Fuels and NOx concentration

Figure 4-5(6) shows the relationship of NOx concentration to the air-fuel ratios of various kinds of fuel.
The figure demonstrates that NOx concentration increases as air-fuel ratio goes up. The NOx concentration of kerosine remains close to that of city gas over the whole range of O2 concentration, although the former is slightly higher. The NOx concentration of LSA.A is generally higher than those of kerosine and city gas by 12-24 ppm. The cause is Fuel NOx. The mass fraction of N in LSA.A is about 0.01-0.02%, which corresponds to Fuel NOx concentrations of 12-24 ppm, if converted to NOx totally.
The broken line in Figure 4-5(6) shows the differences between the average NOx concentrations of LSA.A and the maximum Fuel NOx concentration of 24 ppm.

2) Examination of operating air-fuel ratio

The survey of existing boilers shows that those installed in more recent years have smaller operating air-fuel ratios. It is particularly clear with oil-pressure type, rotary type

and low pressure air burner type.
Also, boilers with such burner types as high pressure nozzle type, gas type and low NOx type are operated at somewhat low air-fuel ratios. Those of oil-pressure type, rotary type and low pressure air type are operated at an equivalent, and slightly higher, level of air-fuel ratio. Generally speaking, older boilers are more worn and deteriorated, and tend to be operated at excessive levels of air-fuel ratio in order to avoid imcomplete combustion and dust.

3) Boiler type and NOx concentration

Figure 4-5(7) shows survey results on small capacity boilers in reference to LSA.A and the three boiler types: water-tube, fire-tube type and sectional type. Boilers of large capacity are omitted intentionally, because they are usually well managed.
The NOx concentration is in the descending order of fire-tube water-tube sectional over the whole range of O2 concentration, although the differences are smaller than those of O2 concentration in the exhaust gas.

4) Loading of heat transfer area and NOx concentration

NOx concentration is said to rise as loading of heat transfer area increases, because temperature goes up in a combustion chamber, although residence time in the combustion chamber decreases. However, there is no correlation between Nox concentration in exhaust gas and loading of heat transfer area regardless of boiler type or burner type.

5) Burner type and NOx concentration

The O2 concentrations and average NOx concentrations in the exhaust gas of LSA.A are plotted against burner types in Figure 4-5(7). They are generally in the descending order of rotary type high pressure nozzle type oil-pressure type.

6) Examination of dust concentration

O_2 concentration in exhaust gas, boiler type, burner type and loading of heat transfer area were studied in relation to dust concentration, and only the O_2 concentration was found to affect dust concentration.
Figure 4-5(8) shows how the O_2 concentrations in exhaust gas are related with the average dust concentrations when LSA.A is used as fuel.
Decrease in operating air-fuel ratio generally brings about increased dust generation due to lowered O_2 concentration in a combustion zone. But Figure 4-5(8) shows that higher average dust concentrations are accompanied by higher concentrations of exhaust gas. It is believed from the survey results of existing boilers that older boilers are operated at higher operating air-fuel ratios in order to control dust generation under a permissible level, as their efficiency worsens due to the wearing of burner tips and the accumulation of carbon.

(2) Low-cost program for lowering NOx

It is presumed that NOx needs not to be removed from exhaust gas from burning facilities in the Argentine for the time being. Programs for lowering NOx are touched upon here, for it would be desirable to study their costs now before reaching a stage where they need to be examined for installation.
Table 4-5-2 shows programs for controlling and lowering NOx in existing plants.

Table 4-5-2 LOW COST NOX REDUCTION TECHNOLOGY

No.	Name	Method	Feature	Application	Reference	Note
(1)	Control of air fuel ratio	Lower the temperature of combustion zone	Least cost method combustion control system should be improved.	Boiler, Furnace and others. Applicable to most of combustion system	Fig 4-5(9)-(13)	* Potential of increasing particulate. * Narrowing turn down rate. * Computerlized control system caw minimize
(2)	Low NOx burner	Modification of burner, and adequate maintenance.			Fig 4-5(30)-(31)	In general (1), (2), (4), (5) are recommended
1	Accerate mixing and rapid flame cooling type	Reduce retention time. Lower the temperature of combustion zone	Energy efficiency improved.	Boiler	Fig 4-5(14)	Application only for boiler
2	Flame splitting type	Same as above	As above	Boiler. Industrial furnace	Fig 4-5(15)	Potential of CO, P.M. increase
3	Self circulation type	Lower the temperature of combustion zone.	Reduction of particulate matter.	as above	Fig 4-5(16)	Turn down rate narrow
4	Two stage combustion type	Low oxygen conc. Lower the temperature of combustion zone	Air preheat effective to NOx reduetion Reduction of fuel NOx formation is effective	Boiler, Furnace, Petroleum heater	Fig 4-5(17)(18)	Flame length increase (CO, P.M. Increase)
5	Thick and thin combustion type	as above	Reduction of fuel NOx formation effective	Boiler, Industrial furnace	Fig 4-5(19)-(20)	Same as above
6	Injection of steam or water	Lower the temperature of combustion zone	NOx and particulate matter be reduced	as above	Fig 4-5(21)	Energy efficient lower
(3)	Injection of water or steam	as above	as above	Boiler, Industrial furnace and other combustion facility	Fig 4-5(22)	Fuel NOx are not controled. Energy efficiency lower
(4)	Reculation of flue gas	as above	as above	Boiler, Industrial furnace	Fig 4-5(23)	Fuel NOx are not controled
(5)	Two stage combustion	Low oxygene conc. Lower the temperature of combustion zone	Effective to fuel NOx control, Least increase of NOx by air-preheating	Not applicable to the system which should not be exposed to reducing gas	Fig 4-5(24)	Computer control system is recommended. Potential of CO, P.M. increase
(6)	Thick and thin combustion	Lower the temperature of combustion zone	comparatively low cost	Not applicable to the system which require stable heat transfer	Fig 4-5(25)	Applicable only the case multiple burners are used
(7)	High quality fuel	Fuel free from nitrogen compound	Not only NOx but SOx, P.M. be decreased	Boiler, Industrial furnace and all other combustion facility	Fig 4-5(26)	Cost of operation increase
(8)	Reduction of heat load	Lower temperature of combustion zone. Slow mixing in furnce Lower pre-heat temperature of combustion air	P.M. will be reduced too. Furnace internal pressure is lowered. operation control easy	Boiler, Industrial furnace and all other combustion facility	Fig 4-5(27)-(29)	Actual capacity be less than design or large unit will be required

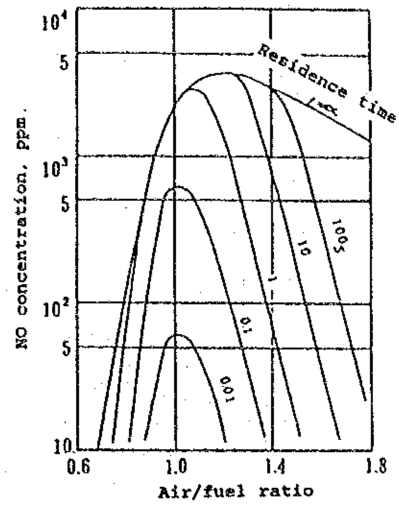


Figure 4-5(1)
RELATIONSHIP BETWEEN RESIDENCE TIME AND NOx REACTION

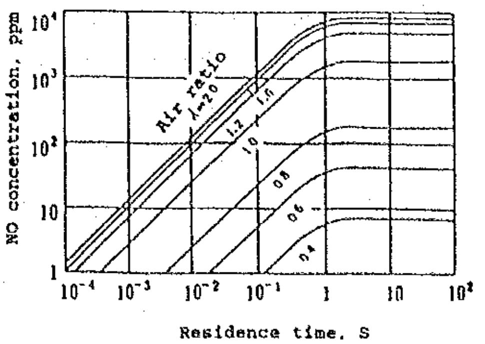


Figure 4-5(2)
RELATIONSHIP BETWEEN RESIDENCE TIME AND NOx REACTION (Impact of Air Ratio)

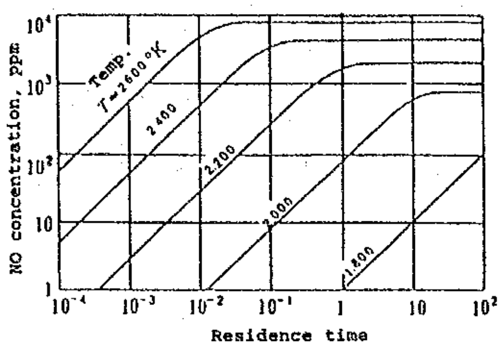


Figure 4-5(3)
RELATIONSHIP BETWEEN RESIDENCE TIME AND NOx REACTION (Impact of Temp.)

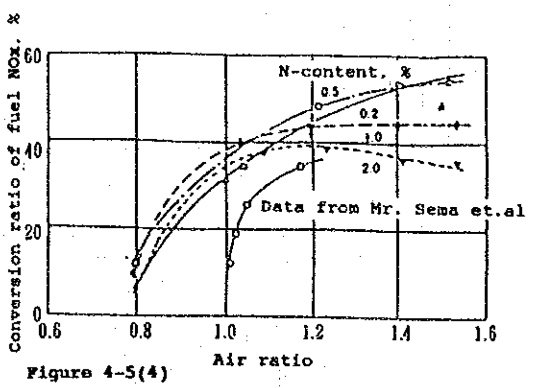


Figure 4-5(4)
RELATIONSHIP BETWEEN FUEL NOx CONVERSION RATIO AND AIR RATIO

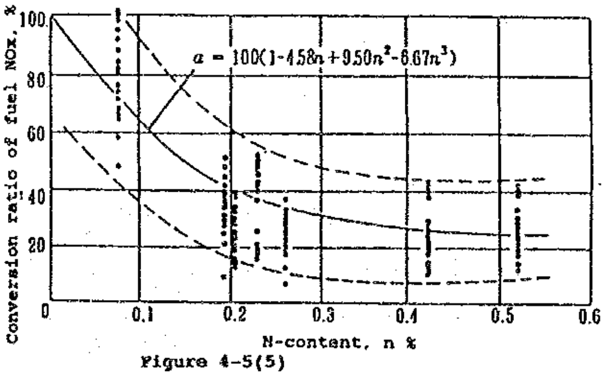


Figure 4-5(5)
RELATIONSHIP BETWEEN N-CONTENT AND FUEL NOx CONVERSION RATIO

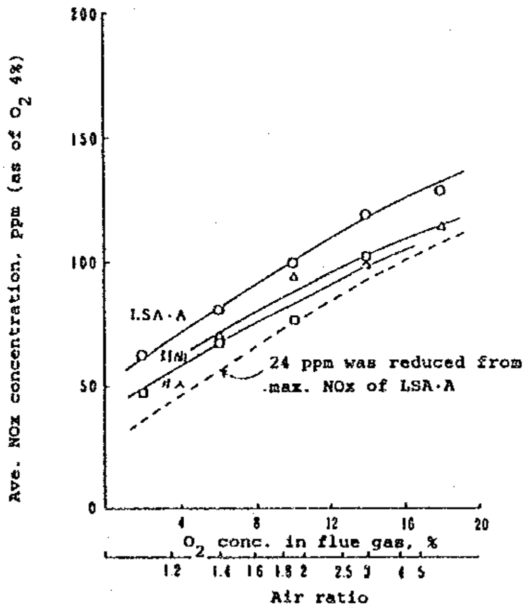
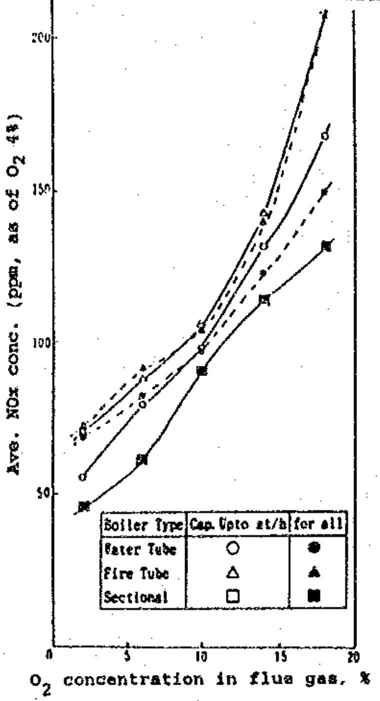


Figure 4-5(6) **INFLUENCE OF FUEL TYPE ON NOx CONCENTRATION**

Figure 4-5(7) INFLUENCE OF TYPE OF BOILER USING LSA-A OIL ON NOx EMISSION



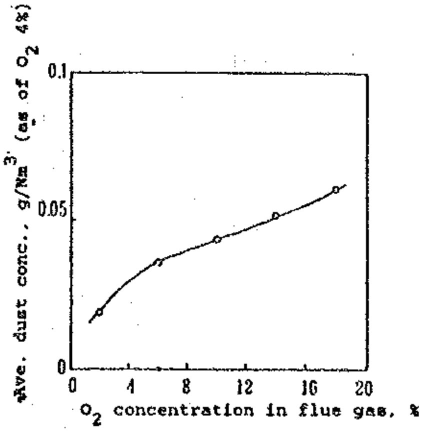


Figure 4-5(8)
RELATIONSHIP BETWEEN O2 CONCENTRATION IN FLUE GAS AND DUST CONCENTRATION
(Fuel: LSA-A)

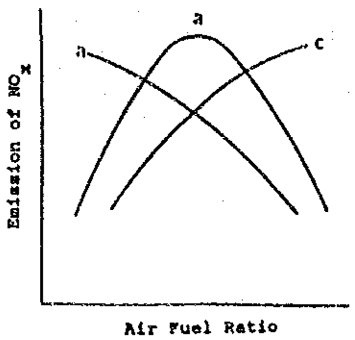


Figure 4-5(9) GENERAL RELATIONSHIP BETWEEN FUEL-AIR RATIO AND EMISSION OF NOx

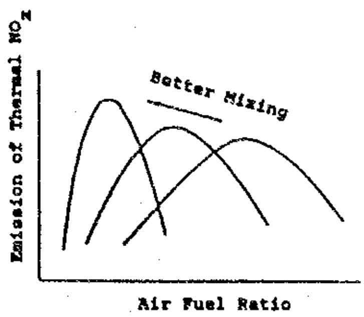


Figure 4-5(10) RELATIONSHIP BETWEEN FUEL-AIR RATIO AND EMISSION OF THERMAL-NOx

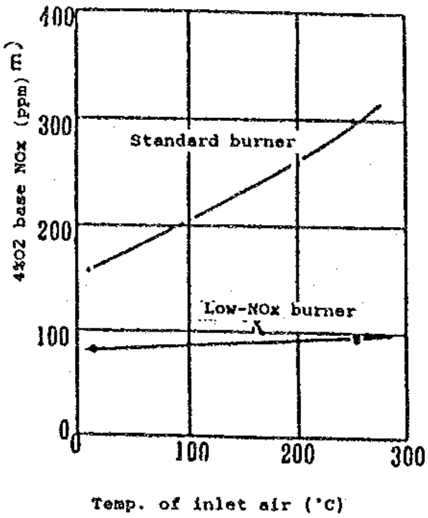


Figure 4-5(11) RELATIONSHIP BETWEEN NOx AND AIR TEMP. IN HEAVY OIL COMBUSTION

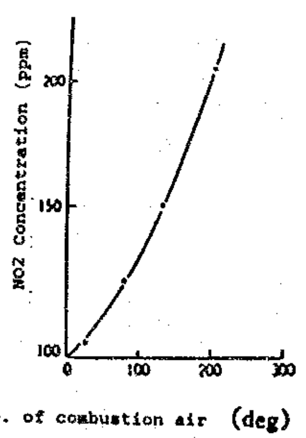


Figure 4-5(12) RELATIONSHIP BETWEEN NOx AND TEMP. OF AIR IN PROPANE GAS COMBUSTION
(Experimental Furnace
by Mr. Nagata et al.)

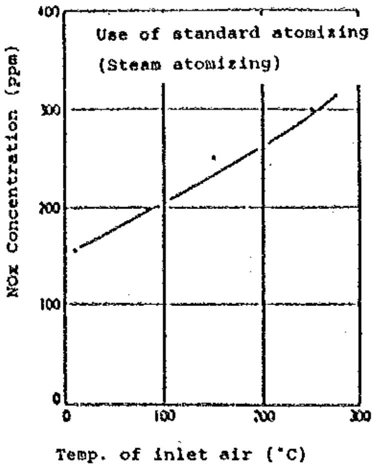


Figure 4-5(13) RELATIONSHIP BETWEEN NOx AND TEMP. OF AIR AT HEAVY OIL COMBUSTION
(Steam atomizing burner, 400 l/hr. testing boiler)

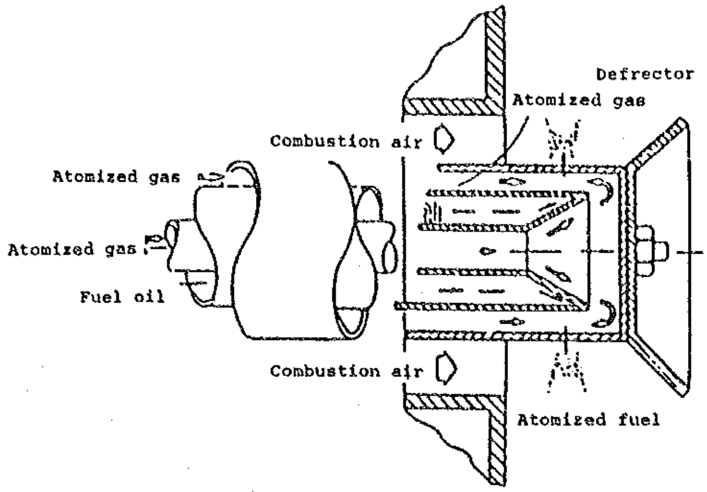


Figure 4-5(14) FORCED MIXING (THIN FILM VAPORIZATION) TYPE LOW-NOx BURNER

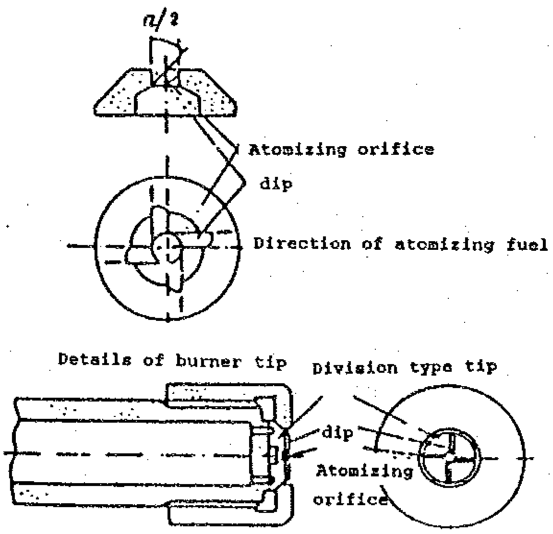


Figure 4-5(15) DIVISION FLAME TYPE LOW NOX BURNER
(Eddy winding oilpressure atomizing burner)

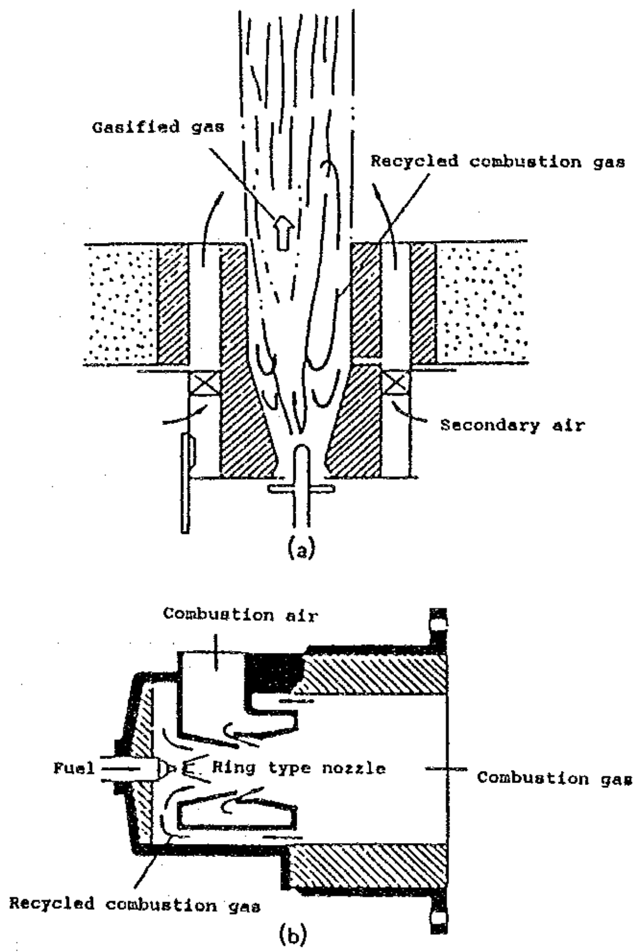


Figure 4-5(16) SELF RECYCLE TYPE LOW NOx BURNER

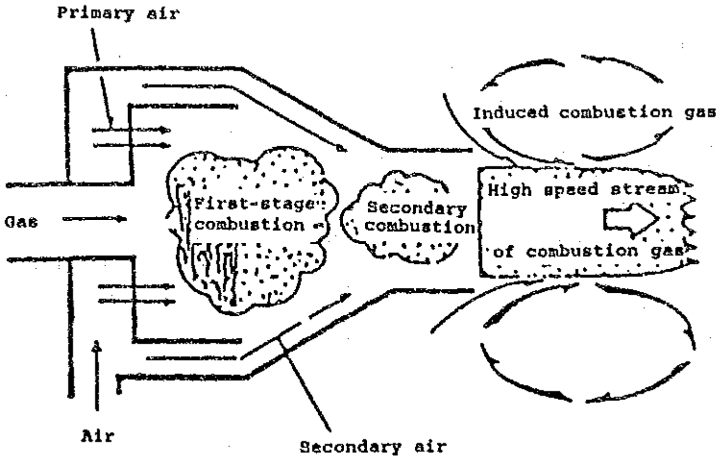


Figure 4-5(17) TWO STAGE COMBUSTION TYPE LOW-NOx BURNER

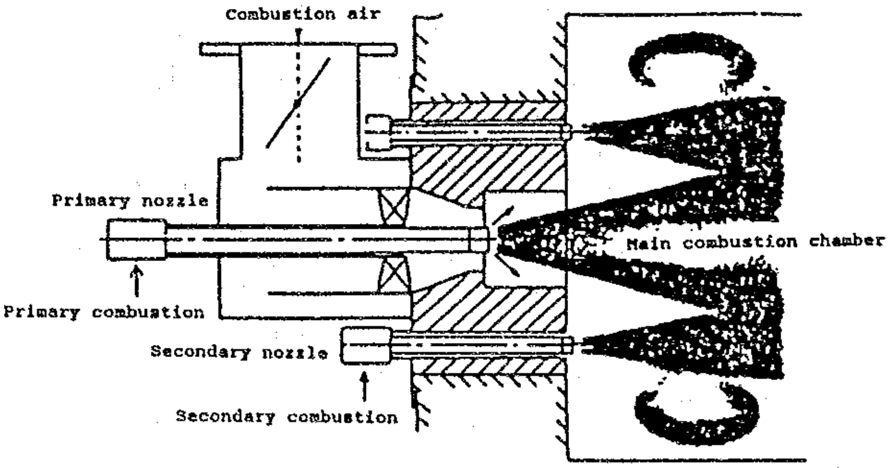


Figure 4-5(18) REVERSE TWO STAGE COMBUSTION TYPE LOW-NOx BURNER

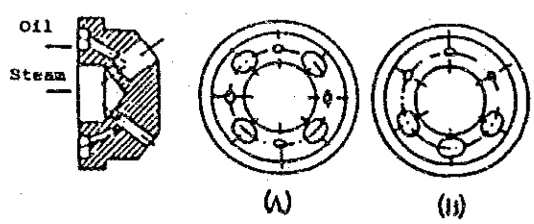


Figure 4-5(19) EXAMPLE OF DISTRIBUTION OF ATOMIZING ORIFICE OF SELF-BIAS ATOMIZING TYPE LOW-NOx BURNER

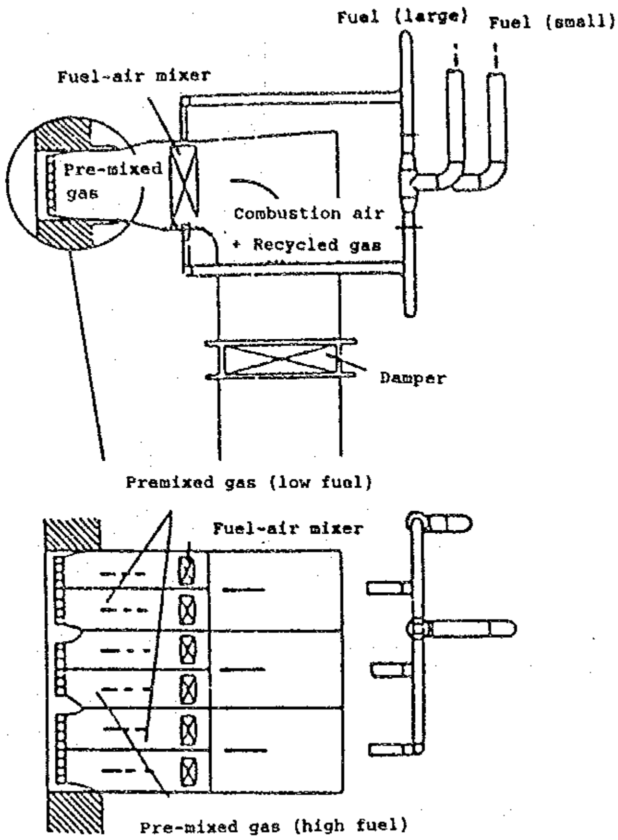


Figure 4-5(20) HIGH/LOW COMBUSTION GAS TYPE LOW-NOx BURNER

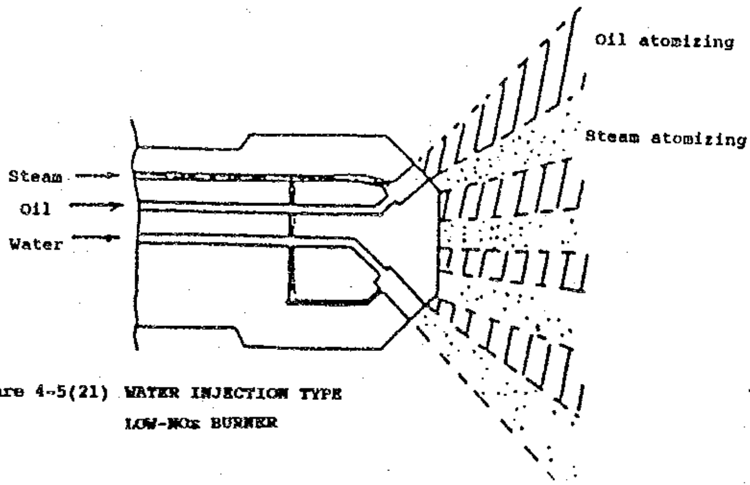
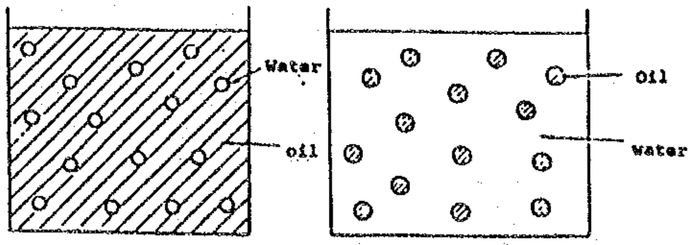


Figure 4-5(21) WATER INJECTION TYPE LOW-NOx BURNER



Water droplet in oil (W/O type)   Oil droplet in water

Figure 4-5(22) TYPE OF EMULSION

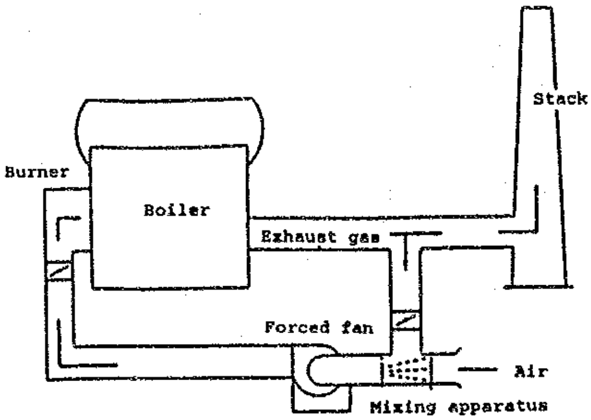
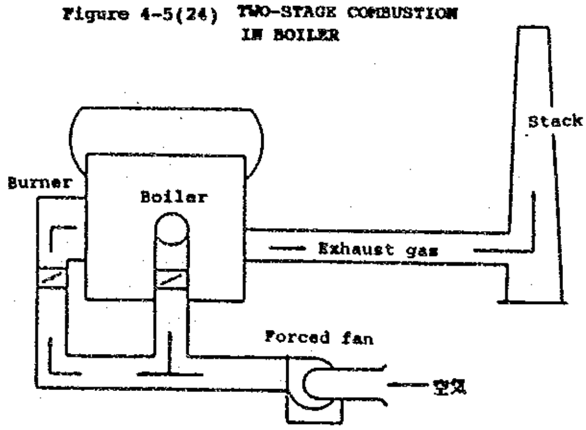


Figure 4-5(23) EXHAUST GAS RECYCLE (MIXING INDUCTION OF AIR-EXHAUST GAS BY FDF)

Figure 4-5(24) TWO-STAGE COMBUSTION IN BOILER



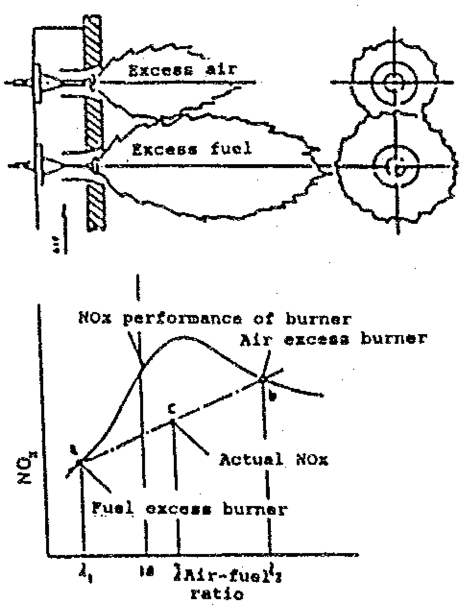


Figure 4-5(25) PRINCIPLE OF HIGH/LOW COMBUSTION

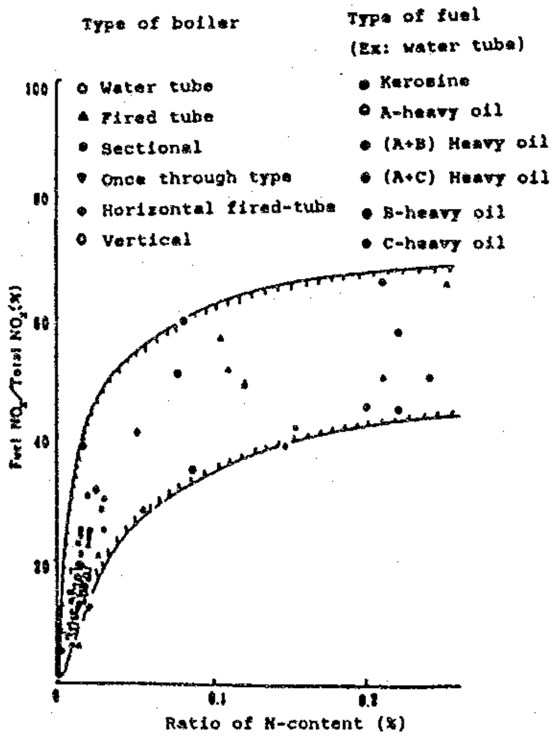


Figure 4-5(26) RELATIONSHIP BETWEEN RATIO OF FUEL-NOx IN THE TOTAL NOx AND N-CONTENT

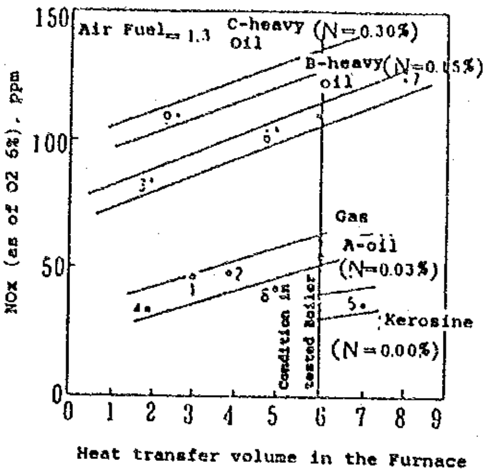


Figure 4-5(27) CONCENTRATION OF NOx DEPENDING ON HEAT TRANSFER VOLUME

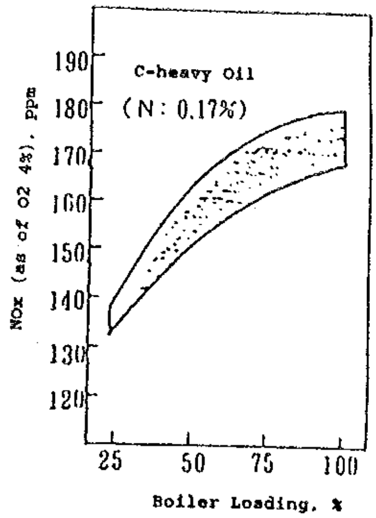


Figure 4-5(28) DECREASING NOx UNDER LOW-LOADING OF BOILER

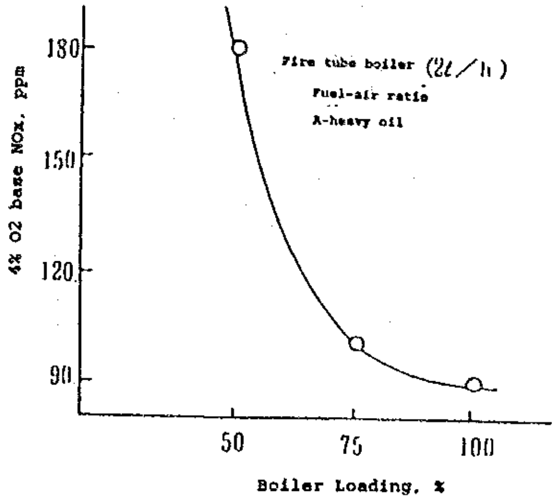


Figure 4-5(29) RELATIONSHIP BETWEEN NOx CONCENTRATION AND LOAD

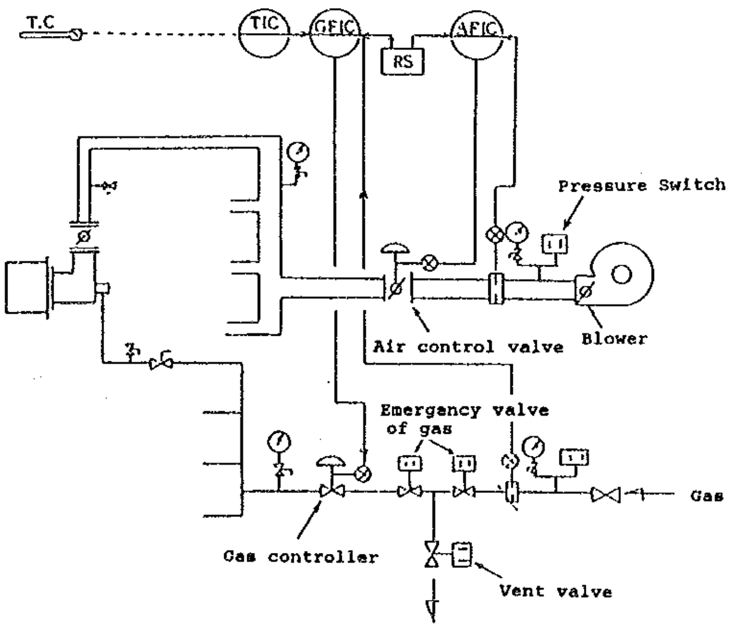


Figure 4-5(30) FLOW SHEET FOR LOW-NOx BURNER

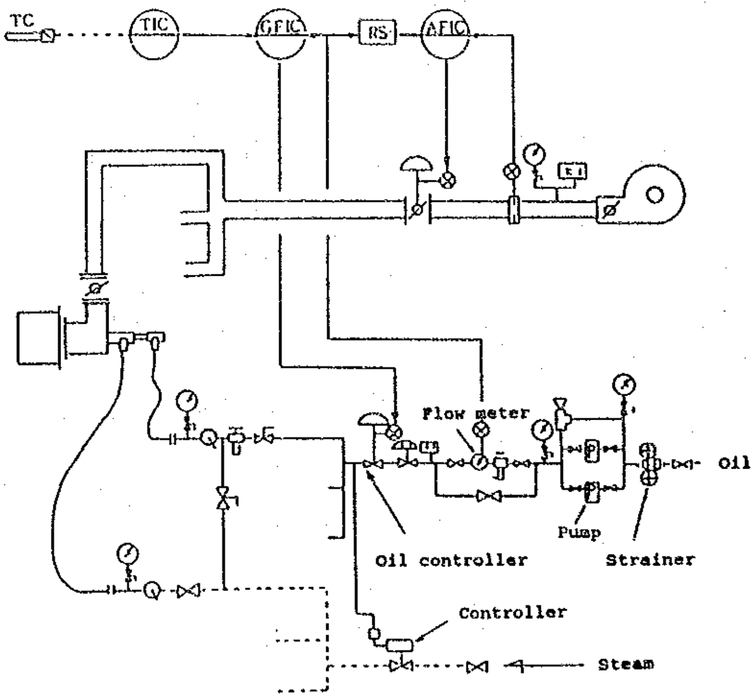


Figure 4-5(31) FLOW SHEET FOR LOW-NOx OIL BURNER

Chapter 5 BASIC DESIGN OF FLUE GAS MONITORING SYSTEM

Chapter 5 Basic design of flue gas monitoring system

5.1 Basic concept

Thermal power stations in Argentina are now legally bound to regularly measure and report SOx, NOx and dust. Although, by using the results, SE has a good grasp at all times through ENRE of environmental pollutants discharged from thermal power stations, the team has studied set-up of regional monitoring stations as one of the survey proposals which is to monitor environmental pollutants from thermal power stations.

The set-up of the regional monitoring stations, naturally, is not to be carried out by SE alone, but through the joint efforts of the Ministry of Environment of Argentina. Ministry of Economics and Foreign Trade, as well as State governments and city governments. It is, therefore, very significant for SE to proceed with its implementation as a pioneering demonstration plant as SE administers organizations discharging high level environmental pollutants.

While it is advisable to set up regional monitoring stations in 13 regions of SE's administrative district, three sites will be chosen as a first step. In other words, a central monitoring station will be put in place and regional monitoring stations will be established initially in three regions.

5.2 Components of project

The project is made up of the following elements:

(a) Regional monitoring stations (three sites)

The purpose of these stations is to monitor soot in the regions concerned. This part of the project consists of the following facilities for close technical cooperation with thermal power stations in the region as well as measurement of atmospheric concentration of pollutants and collection of meteorological data.

- building of measuring stations
- Service facilities
- Plumbing for gas
- Instruments for meteorological observation
- Tools for chemical analyses
- Various monitoring gauges
- Processing equipment for data observed and measured
- Mobile observation vehicles

(b) Central monitoring station

The central monitoring station has two functions; namely, technical supports intended to reduce environmental pollutants from thermal power stations and monitoring of pollutants discharged from all the thermal power stations in Argentina. It is equipped with the following:

- Buildings as a measuring station and room for its staff
- Instruments for soot monitoring and atmospheric pollutants observation
- Instruments for meteorological observation
- Processing equipment for data observed and measured and desk publishing apparatus
- Library
- Printing equipment
- Major research and development equipment

(c) Personnel development plan

For the purpose of reducing environmental pollutants from thermal power stations and improving measurement techniques in line with SE's plan, overseas and domestic training will be conducted for staff of SE and thermal power stations and technical cooperation with overseas organizations will be considered.

5.3 Contents of project

(a) Establishing organization for project implementation

For the above activities to be implemented, the current SE's activities need to be re-constructed both organizationally and technically. The central monitos supervised by SE need to monitor environmental pollution in regions caused by local thermal power stations in collaboration with state and municipal authorities. Shown in figure 1 are its systematic cooperative relationships among the project implementation bodies.

(b) Locations of regional monitoring stations

Eventually, in accordance with SE's administrative districts and meteorological segments, some six sites are considered to be appropriate at an intermediate grouping level, but in phase 1 three sites are suggested.

(c) Activities of central monitoring station

a) Public roles for improving an environmental regulation system and techniques

- Observation of environmental pollutant discharge from thermal power stations and study of its contributing rates
- Accumulation of technologies regarding measurement methods of soot and atmospheric pollutant concentration
- Review and re-arrangement of environment regulations
- Provision of environmental assessment, especially, a diffusion calculation system
- Promotion of bilateral and multilateral cooperation in R&D

b) Assistance to individual power stations

- Cruising measurement service for power stations
- Technical diagnostic service for power stations
- Assistance regarding analysis instruments and supply of back-up equipments and spare parts
- Training of technical personnel at thermal power stations

(c) Activities of regional monitoring stations

- Continuous measurement of atmospheric pollutants in the regions
- Observation of meteorological data
- Cruising measurement service in the regions
- Monitoring of soot and warning in case of emergency
- Construction of cooperative system with State governments involved
- Training of State government personnel
- Assessment of environmental impact of thermal power stations in the region

5.4 Equipment plan

Shown in Table 4- is an outline of equipment needed for implementation of the above plan, in Diagram 4 the concept of the regional monitoring system, and in Diagram 4 , a map of their installations respectively.

5.5 Estimate of project cost

Given in Table 4 is the estimated project cost. The financial plan for this project appears feasible in the light of its general purpose, as the project may be able to obtain financing of multinational financial institutions like the World Band and Inter-American Development Bank or bilateral institutions like the Export-Import Bank of Japan. Overseas Economic Cooperation Fund of Japan, JICA, USAID and GTZ, as long as the project objectives and impelementating responsibilities are clearly defined.

Conversion or construction of buildings as monitoring stations incurring heat and light expenses and personnel should be paid by the Argentine government.

Given in Table 4 is the number of staff necessary for implementation of this project. These people should be easily provided from among people currently employed by SE and its related organizations.

5.6 Implementation schedule (draft)

The implementation schedule for this project is shown in Diagram 4. When the financial improvement plans of the Argentine government are considered, grants or loans by bilateral or multi-lateral aids are desirable as mentioned earlier, and, therefore, the key is the coordination for its funding plant and cooperation with funding countries.

As the procurement schedule for the project is based on a five-month delivery training of project personnel, preparation of schedules design and modeling of the monitoring station building may constitute a bottleneck as well.