Chapter 5 Local Emission Standards of Thermal Power Plants

5.1 Preface

The JICA Team proposes in this chapter, the methodology to establish local emission standards of new or extended thermal power plants and applies it to the 3 model areas: the City of Buenos Aires, San Nicolas and Lujan de Cuyo. The imaginary new or extended plans of the future power plants (Refer to Chapter S8 of the Support Volume) are used for the application in the 3 areas. Based on the results, also described are several political and technical matters that require attention in applying the methodology in line with the present laws and regulations for air pollution control in Argentina.

5.2 Methodology for Establishing Local Emission Standards of Thermal Power Plants

5.2.1 Backgrounds

1) Legal System

The National Constitution amended in 1994 stipulates that for environmental legislation, the Nation establishes the minimum environmental rules and the provinces make their supplements.

The Secretary of Energy has the right to set the standards of emissions to atmospheric air from thermal power plants that participate in the National Wholesale Electric Market, according to the Electric Law stipulated in 1992 (#09).

Provinces and municipalities have the rights to establish the standards of emissions from stationary sources in their respective regions, based on the Air Preservation Law (#11).

2) Existences of Stationary Source Emission Standards

A National

The Secretary of Energy and Mines has established the emission standards for thermal power plants that participate in the National Wholesale Electric Market as in Table 4.4.1 of Chapter 4 in the Support Volume. The JICA Team could not find emission standards of other stationary sources stipulated by a National organization.

B Provinces and Municipalities

The JICA Team could not find provincial emission standards. The JICA Team found only emission guidelines (not the standards) for new industrial facilities in the Province of Buenos Aires. Both of the City of Buenos Aires and the Province of Mendoza have neither standard nor guideline. It is probably difficult to find the one in other provinces.

The City of Lujan de Cuyo has stipulated emission standards for combustion and industrial facilities. Its standards for SOx and PM are less stringent than those stipulated by the Secretary of Energy and Mines. For NOx, there are conditional variations between the National and local standards (See Table 4.3.11 & 12 of Chapter 4).

3) Ambient Air Monitoring

No official agency in the three model areas was monitoring air qualities automatically and continuously. The Division of Sanitary and Environmental Control, Government of Mendoza, has been monitoring at 25 sites in the greater Mendoza area with manual samplers. In the past, the City of Buenos Aires had intermittently monitored air qualities in the city. However, the operation was discontinued.

From these observations, the JICA Team supposes that there are few local governments monitoring air qualities continuously with automatic analyzers.

The National Agency of Meteorological Services is observing meteorology at many sites and publishing data. The JICA Team could not find local officials doing the same.

4) Source Inventory

The JICA Team was unable to find any official agency, local or national, in the model areas that collects and up-dates inventories of stationary and mobile emission sources, their magnitudes and kinds of operations, and their emission amounts. There may be no such inventory in Argentina.

5) Movements of Provincial Governments

The City and the Province of Buenos Aires are planning to install an automatic and continuous network of air quality monitoring and meteorology observation in the Metropolitan area with the assistance of the World Bank.

Also, the City of Buenos Aires is drafting a Clean Air Law to prepare source inventories and stipulate local stationary emission standards.

6) Environmental Impact Assessment

There is no General EIA National Law in Argentina. However, there are EIA provisions at Ministry or Secretary levels related with their mandated projects. The City of Buenos Aires and 15 of the 23 Provinces have the EIA system.

5.2.2 Basic Conditions

A proposed method for the establishment of local emission standards by the agency in the

National Organization has been developed under the background given above and the following conditions.

- Local emission standards are the average allowable emission levels based on their local average pollution levels and meteorological conditions.
- The method should be applicable to any local area in the whole country.
- The national emission standards must be observed primarily in the local areas.
- The national emission standards are based on generally available technologies, and the local standards are equal to or more stringent than the national ones because the local standards are based on preservation of local environmental conditions.
- The national and local air quality standards are the basis for the establishment of local emission standards.
- Emissions from sources other than power plants have to be recognized in the establishment of the power plant emission standards.
- In the course of the establishment of these standards, political judgments by national or local officials must be reserved.
- A safety factor has to be introduced in the establishment of the standards to give margins of uncertainty.
- The ENRE Manual (#8) must be regarded in the establishment of standards.
- Existing statistics on air quality, meteorology, socio-economy are available for the establishment of standards.
- The target pollutants are SOx, NOx and PM.

The Provinces, in turn, are requested to monitor air quality and meteorology and develop source inventories, and if necessary, are to revise their local emission standards set by the national authority.

The observation of the local emission standards by individual power plants does not always guarantee achievement of the valid air quality standards. To achieve the air quality standards in an area where air quality is or is expected to be above the standards, special measures are needed, such as introduction of emission reduction facilities to existing plants, reduction of generation capacity, etc.

5.2.3 Methodology for Establishment of Local Emission Standards

From the above backgrounds and conditions, the methodology for establishment of local emission standards was developed as follows. Fig.5.2.1 shows the procedure.

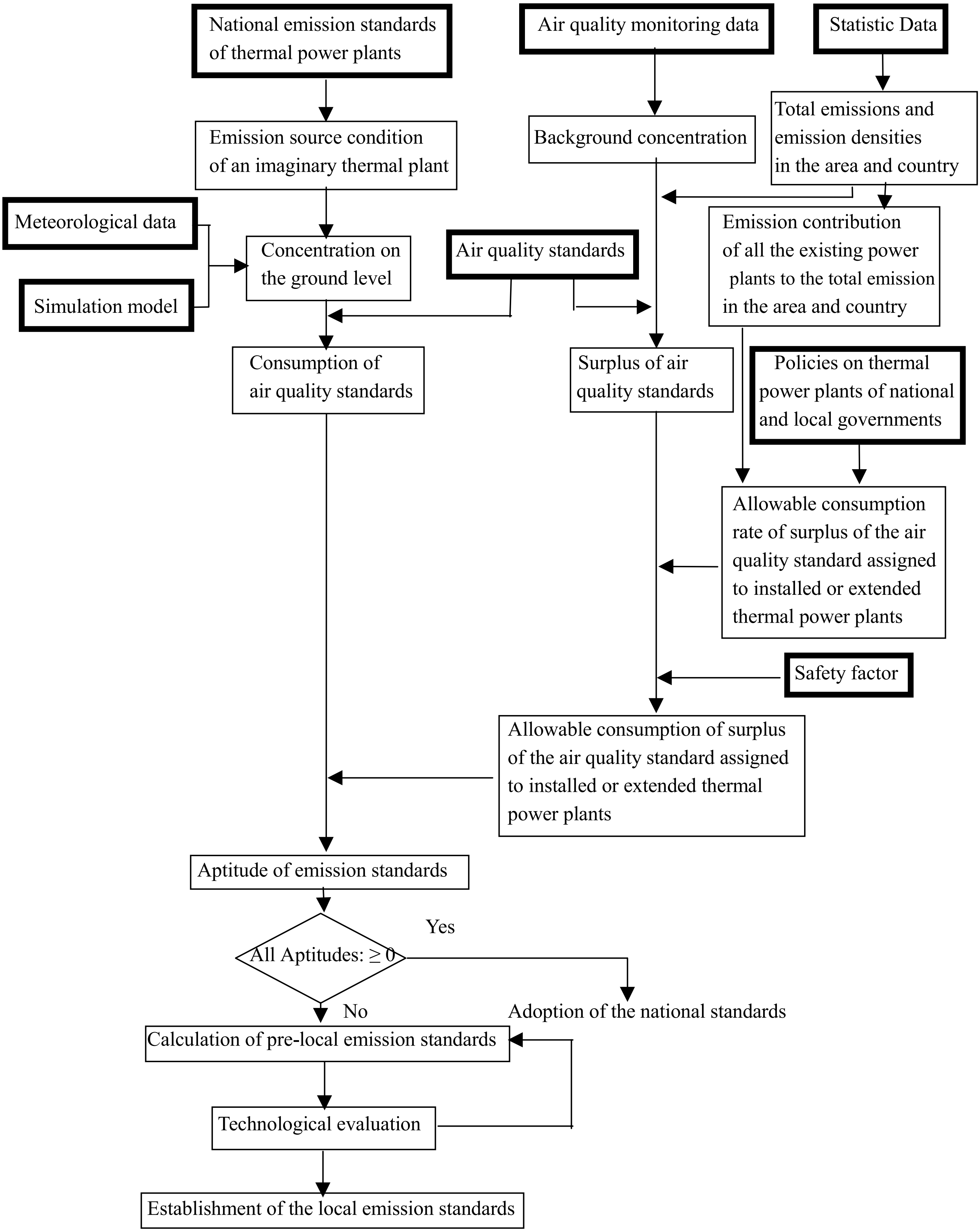

Figure 5.2.1 Flowchart of Local Emission Standards Establishment

1) Local Characters

A Classification of Local Areas

The local areas are, in general, classified into urban (motor vehicles), industrial (industries), rural (agriculture), or a combination of these classes based on the types of the air pollutant sources as shown in Table 5.2.1. Major sources of air pollution are motor vehicles in the urban areas and naturally industries in the industrial areas.

Table 5.2.1 Classification of Local Areas and Their Major Sources

Area Classification	Major air pollutant sources
Urban areas	Motor vehicles, thermal power plants, buildings, residences
Industrial (including mining) areas	Industries (mining), motor vehicles and thermal power plants
Rural areas	Thermal power plants, open burning
Urban and industrial areas	Motor vehicles, industries and thermal power plants
Rural areas with industrial parks	Industries and thermal power plants

B Emission Amounts and Emission Densities

The degree of air pollution in a local area depends on the total amounts of pollutants emitted in the area, namely the emission densities. The local emission density is the quotient of the total pollutant amounts divided by the local surface area. The national emission density can be obtained by following to the same procedure.

Emissions of SOx, and NOx can be estimated by following to methods given in the IPCC guidelines. The guidelines do not give the estimation method of PM emissions. However, principally it is similar to the methods for SOx, and NOx.

2) Imaginary Power Plant

A power plant is imagined to be installed in a local area in order to establish emission standards of a new power plant in the local area. If it has been announced or is predicted (from the demands of electricity) that a new power plant will be installed in the local area, then the imaginary plant should be the announced or the predict one. If there is no such plan of future installation, the imaginary plant may have the average capacity and facilities of plants in Argentina. Operational patterns of the imaginary plant can be the similar to the existing plants. If there is no power plant in the area, the average pattern of all the power plants in Argentina can be used.

3) Air Dispersion Simulation Model

The ISCST3 Model is to simulate diffusions of pollutants emitted from stacks of the imaginary plant.

4) Meteorological Data

The data measured at a meteorological observatory of the National Meteorology Services are used for the simulation. If there are other suitable local data, they can be used instead.

5) Impact Concentrations at Ground Level

The impact concentrations of pollutants at ground level are calculated based on the ENRE manual.

6) Consumption of Air Quality Standards by the Imaginary Power Plant

The imaginary thermal power plant will emit pollutants, which will reduce the remaining difference between the valid air quality standards and the current air qualities, in other words, consume the valid air quality standards.

Generally, environmental air quality standards specify several upper limit concentrations of each pollutant with corresponding evaluation times (20 minutes, 1 hour, 3 hours, 1 year, etc.).

Cs(t) is defined as the consumption of the valid air quality standards, corresponding to the evaluation time (t) of the valid air quality standard in the area. In case the evaluation time (t) is less than 1 hour, Cs(t) can be calculated by the following equation (#8).

$$Cs(t) = Cs(60)\ (t / 60)^{-0.20}$$

7) Background Concentration

A Monitored Air Quality Data

Where there is a set of reliable air quality data measurements in the local area, the data can be used to establish local emission standards. The measured data has to be converted to the local average background concentration (Back(t)) by changing the original data to meet the evaluation time (t) of the valid air quality standards.

In case there is a piece of data not suitable to be changed to Back(t) corresponding to the evaluation time (t), the equation given in Item **6)** above or other equations recognized in the world, or the typical Larsen model equation should be applied to estimate Back(t).

B Background Concentration from Other Similar Area

For an area where is no appropriate or reliable set of monitored air quality data available, the following method may be applicable.

Select a similar area that is in the same area classification as the area of interest and has equal magnitude of pollutant densities with a set of monitored air quality data. Estimate the background concentration of the area of interest from the set of data of the similar area. For example, the background data of the area of interest can be estimated by proportioning its pollution density with that of the selected area.

When there are several similar areas to choose from, the similarity of meteorology and topography should be considered before selection.

8) Surplus Portion of Air Quality Standard

The surplus portion of the air quality standard (Rs(t), corresponding to the evaluation time (t), is calculated from the applied valid air quality standard (As(t)) and Back(t) by the following equation.

$$Rs(t) = As(t) - Back(t)$$

9) Allowable Consumption Rate by Future Thermal Power Plants

A Current Contribution by Existing Thermal Power Plants to Total Emissions

In addition to thermal power plants, there are other emission sources in an area. Room should be allowed for the installation or extension of these sources.

The current emission contribution of all the existing power plants to the total emissions in the area (Ctl) is calculated from the emissions of all existing thermal power plants (Ctel) and the total emission from all the sources in the area (Tel). (Tel) is mentioned in Article 5.2.3 Item 1) B of this Chapter.

$$Ctl = Ctel / Tel$$

Likewise, the current emission contribution of all the existing power plants to the total emission in Argentina (Ctn) is calculated from the total emissions of the existing thermal power plants (Ctn) and the total emissions from all the sources in the country (Ten).

$$Ctn = Cten / Ten$$

B Determination of Allowable Consumption Rate by Future Power Plants

The allowable consumption rate of the surplus portion of the air quality standard assigned to new or extended installation of thermal power plants (Esca) may be determined by related policies of the national and local governments in consideration of Ctl, Ctn, etc.

10) Safety factors

Safety factors (Sf) should be placed in consideration of uncertainties involved in establishment of the emission standards. The Sf should be more than 1.

11) Allowable Consumption by Future Thermal Power Plants

The allowable consumption of the surplus portion of the air quality standard assigned to new or extended thermal power plants (Rsca (t)) corresponding to (t) is calculated from Rs(t), Esca and Sf.

$$Rsca(t) = Rs(t) \times Esca / Sf$$

12) Aptitude of Emission Standard

The aptitude of the emission standard (Aes(t)) corresponding to (t) is calculated from Rsca(t) and Cs(t) by the following equation.

$$Aes(t) = Rsca(t) - Cs(t)$$

13) Judgment on Aptitude of Emission Standard

In case all the Aes(t)s of all evaluation times are equal to or above 0, the current National Emission Standards can be adopted as the standards of the concerned area. In case where one or more than one of aptitudes are negative, the local emission standards different from the national ones should be established.

14) Pre-local Emission Standard

For each evaluation time (t), where Aes(t) is negative, the required emission (Res(t)) is calculated by the following equation.

$$Res(t) = Efn \times Rsca(t) / Cs(t) \qquad \text{for all ts: } Aes(t) < 0$$

Subsequently, the pre-local emission standard (Efl) is determined to be the minimum of all the Res(t)s.

$$Efl = Mini\ (Res(t)s)$$

15) Determination of Local Emission Standard

The above pre-local emission standard should be evaluated for whether the standard is achievable with currently available technologies. If it is, the pre-standard is determined to be the local emission standard. If it is not, the pre-local emission standard should be softened as necessary to establish the technically achievable local emission standard.

5.3 Investigation of Local Emission Standards in Model Area

5.3.1 Outline of Local Emission Standard Investigation

The method of local emission standard establishment given in Section 5.2 is applied in three model areas for investigation of the method.

The investigation process is outlined below, using an example shown in Table 5.3.1. The details of the processes are described in Section 5.3.2 and afterward in this Section 5.3.

Table 5.3.1 An Example of Local Emission Standard Investigation

NO_x Emission Standard	Natural Gas	100	mg/m^3_N
	Gas Oil	100	mg/m^3_N
	Mixture	100	mg/m^3_N
Power Plant Share in NO_x Emission		0.272	(Fraction)
Annual Air Quality Standard of NO_x		100	$\mu g/m^3$

Sites	Present Conc. ug/m^3	Present P.P. ug/m^3	Surplus Conc. ug/m^3	P.P. Share ug/m^3	Phased Out P.P. ug/m^3	P.P. Total ug/m^3	P.P. Expansion ug/m^3	Judge	Recommended Emission Standard mg/m^3_N
(1)	19.2	0.1	80.8	22.0	0.0	22.0	13.5	○	
(2)	18.4	0.1	81.6	22.2	0.0	22.2	6.9	○	
(3)	18.7	1.3	81.3	22.1	0.3	22.4	20.2	○	
(4)	8.1	1.3	91.9	25.0	0.3	25.3	17.5	○	
(5)	19.1	1.2	80.9	22.0	0.2	22.2	12.3	○	
(6)	15.4	0.6	84.6	23.0	0.2	23.2	9.6	○	
(7)	16.6	0.5	83.4	22.7	0.1	22.8	6.6	○	
(8)	39.9	0.1	60.1	16.4	0.0	16.4	18.8	×	87.2
(9)	40.9	0.1	59.1	16.1	0.0	16.1	15.4	○	
(10)	36.2	0.5	63.8	17.4	0.1	17.5	9.0	○	
	Area Avg.	Same Location	Surplus	P.P.	Same Location		Area Max.		
Area Location	23.3	3.4 (16km,10km)	76.7	20.9	0.8 (16km,10km)	21.7	36.7 (16km,10km)	×	59.1

Conc.: Concentration, P.P.: Power Plant

a. The present emission standard for combined cycle with natural gas and gas oil mixture is $100mg/m^3N$, and the annual air quality standard in Buenos Aires is $100ug/m^3$.

b. The simple measurement results are regarded as the present annual average concentrations, and the averages of the stations as the local annual concentration. The present concentration shown here includes present power plant contribution. For example, the present concentration of the Site (1) is $19.2ug/m^3$ and $0.1ug/m^3$ is the contribution from power plants. Therefore, the surplus to the annual air quality standard, $100ug/m^3$, is $80.8ug/m^3$.

c. 27.2% of total NO_x emission amount in Buenos Aires city area comes from the power plants. Thus, 27.2% of the total surplus to the air quality standard, 22.0 ug/m^3, is assigned to the surplus of the power plants.

d. In the Buenos Aires city area, 1239MW units of the power plants are assumed to be phased out and 3200MW units expanded by the year 2020 (Support Volume Chapter S8). The surplus by the phased-out units will be added to the surplus of the present power plants to obtain the total surplus of power plant.

e. Finally, if the contribution by the expansion does not exceed this total surplus, the present emission standard is adequate (Judgment: ○). For an example at the Site (8), the contribution by the expansion, 16.4ug/m^3, exceeds the surplus, 18.8 μ g/m^3 (Judgment: ×). In this case, the present emission standard, 100ug/m^3, is changed as,

$$100ug/m^3 \times 16.4(ug/m^3)/18.8(ug/m^3)=87.2ug/m^3.$$

The details of the method during the process of the emission standard establishment and the results of the investigation on the emission standards are explained below.

5.3.2 Air Quality Standards, Emission Standards and Present Concentration

1) Air Quality Standards

The annual air quality standards for each pollutant in each area are shown in Table 5.3.2 (cf. Chapter 4). In case of no standard for annual average, annual standards are derived with conversion factors of the USEPA (#192) etc.

Table 5.3.2 Annual Air Quality Standards

Pollutants	Buenos Aires	San Nicolas	Lujan de Cuyo
NO_x	100 [a)]	100 [a)]	74 [b)]
SO_2	80 [a)]	80 [a)]	229 [c)]
SPM	50 [a)]	50 [a)]	72 [d)]

Unit : ug/m^3

Note:

a) Air Quality Standards of Buenos Aires Province
b) National Standard of Annual Average = (924ug/m^3) x 0.08 (Annual/Hourly Conversion Factor of the US-EPA) = 74ug/m^3
c) National Standard of Annual Average = (2857ug/m^3) x 0.08 (Annual/Hourly Conversion Factor of the US-EPA) = 229ug/m^3
d) National Standard of Monthly Average = (150ug/m^3) x 0.482 (Annual/Monthly Conversion Factor derived from the conversion factors of the US-EPA for some averaging times by regression equation) = 72ug/m^3

2) Emission Standard

Expanded power plants in the future will be combined cycle systems with natural gas as a main fuel, and the their present emission standards are shown in Table 5.3.3 (cf. Chapter 4).

Table 5.3.3 Present Emission Standard of Combined Cycle

Turbine Type	Fuel	Pollutant	Unit	Emission Standard
Combined Cycle	Natural Gas	NO_x	mg/m^3_N	100
		SO_2	mg/m^3_N	-
		PM	mg/m^3_N	6
	Liquid Fuel	NO_x	mg/m^3_N	100
		Sulphur Content	(%)	0.5
		PM	mg/m^3_N	20
	Mixture	NO_x	mg/m^3_N	Heat-Weighted Average of Mixed Fuels
		SO_2	mg/m^3_N	
		PM	mg/m^3_N	

3) Present Concentration

The present pollutant concentrations including the contributions from the power plants are estimated with the simple air quality measurements in the summer and the winter (Support Report Volume S5). Actually, the average concentrations during the summer and the winter periods are regarded as the annual averages. Furthermore, TSP concentrations were measured in the simple measurements and the results are converted to the SPM concentrations by multiplying the factor (=0.55, #275) by the US-EPA. The present pollutant concentrations in each area are shown from Table 5.3.4 to Table 5.3.6.

Table 5.3.4 Present Pollutant Concentrations in Buenos Aires

Site	NO_x	SO_2	SPM
(1)EMERGENCIAS SANITARIAS	19.2	112.5	46.9
(2)HOSPITAL ALEMAN	18.4	95.6	31.7
(3)RAPALLINI	18.7	105.9	30.1
(4)INAP	8.1	89.6	35.6
(5)CASA MARILLA	19.1	101.9	37.6
(6)METRO GAS	15.4	87.2	35.6
(7)GARRAHAN	16.6	92.9	36.2
(8)JARDIN JAPONES	39.9	98.0	48.9
(9)BIBLIOTECA NATIONAL	40.9	147.5	29.5
(10)AGUAS ARGENTINAS	36.2	124.1	31.8
Area Average	23.3	105.5	36.4

Unit：ug/m^3

Table 5.3.5 Present Pollutant Concentration in San Nicolas

Site	NO_x	SO_2	SPM
(1)UTN	8.7	38.5	40.2
(2)HOTEL RIO	9.3	49.2	53.1
(3)TANQUE	9.3	38.0	50.4
(4)TRANSIBA	8.7	48.0	42.5
(5)B° FAMILY	7.6	43.0	87.2
(6)AERO CLUB	8.2	35.4	61.2
(7)CASA DE MINA	9.5	36.7	49.6
(8)METALURGICA FLOGG	8.7	46.6	63.6
(9)CENTRAL TERMICA	5.7	32.4	46.8
(10)ESTABLECIMIENTO METALURGICO UNIVERSAL	12.3	41.4	44.7
Area Average	8.8	40.9	53.9

Unit：ug/m^3

Table 5.3.6 Present Pollutant Concentration in Lujan de Cuyo

Site	NO_x	SO_2	SPM
(1)ZONA FRANCA	13.3	65.3	58.7
(2)ACSA	13.1	65.6	119.3
(3)CTM	13.4	50.8	87.4
(4)ALMACEN	14.6	49.4	73.4
(5)MISTA	13.8	59.1	78.3
(6)CHIPOLETTI	13.3	45.3	70.1
(7)VISTALBA	13.9	48.5	79.0
(8)YPF GAS STATION	13.7	54.2	70.6
(9)CASA UHGO	12.2	47.2	86.1
Area Average	13.5	53.9	80.3

Unit:ug/m^3

5.3.3 Power Plant Share in Total Pollutant Emission Amount of The Area

The power plant shares in total pollutant emission amounts are calculated with fuel consumption in each area. The calculations are conducted in Buenos Aires province except Buenos Aires city, for San Nicolas area and in Mendoza province for Lujan de Cuyo area according to the categories of the statistical information. If possible, the statistical information in the precise target area is desirable.

1) Fuel Consumption of Power Plant

The fuel consumption in the power plants in each area is shown in Table 5.3.7 (cf. Chapter 3, Table 3.2.4). The consumption in Buenos Aires province, except for the city area, is obtained by correcting the consumption of San Nicolas power plant with the ratio of the electricity capacities.

Table 5.3.7 Fuel Consumption of Power Plant

Fuel	Unit	Buenos Aires City	Buenos Aires Province except BA City	Mendoza Province
Natural Gas	1000 m^3	2,409,329	1,214,214	541,390
Gas Oil	ton	8,707	0	248
Fuel Oil	ton	488,107	58,270	36,515
Coal	ton	0	473,675	0

Note) Nuevo Puerto, Puerto Nuevo, Lujan de Cuyo: 1999, Others: 2000
Fuel Consumption in BA Province was estimated with the rated capacities

2) Natural Gas Consumption in Each Area

The natural gas consumption in each area is shown in Table 5.3.8 (cf. S2-A4 in Support Volume). The consumption of the industrial sector is obtained by subtracting the consumption of the power plants from large consumer I and F in the original material. CNG consumption is regarded as included in the automobile sector and residential consumer and general consumer P in the original is categorized as other sector.

Table 5.3.8 Natural Gas Consumption by Sector

Sector	Buenos Aires City	Buenos Aires Province	Mendoza Province
Power Plant	2,409,329	1,214,214	541,390
Industry	766,878	3,448,428	390,008
Automobile	285,473	776,916	101,713
Other	1,701,816	4,257,272	402,197
Total	5,163,496	9,696,830	1,435,308

Unit: 1000m^3

3) Petroleum Consumption in Each Area

Petroleum consumption in each area is shown in Table 5.3.9 (cf. Chapter 2). After subtracting the consumption of the power plant from the total petroleum consumption in each area of the original material, all diesel oil consumption is regarded as automobile sector and all fuel oil as industrial sector. Fuel consumption of Buenos Aires city and Mendoza provinces has negative values after subtracting the power plant consumption from the total. These subtracted values are regarded as zero.

Table 5.3.9 Petroleum Consumption by Sector

Sector	Fuel	Buenos Aires City	Buenos Aires Province	Mendoza Province
Power Plant	Gas Oil	8,707	0	248
	Fuel Oil	488,107	58,270	36,515
Industry	Fuel Oil	55,645	156,929	0
Automobile	Diesel	600,161	3,668,336	359,065
	Gasoline	394,872	1,333,017	112,796

Unit: ton

4) Summary of Fuel Consumption in Each Area

Fuel consumption in each area is summarized in Table 5.3.10.

Table 5.3.10 Fuel Consumption in Each Area

Sector	Fuel	Buenos Aires city	Buenos Aires Province	Mendoza province
Power Plant	Natural Gas	2,409,329	1,214,214	541,390
	Gas Oil	8,707	0	248
	Fuel Oil	488,107	58,270	36,515
	Coal	0	473,675	0
Industry	Natural Gas	766,878	3,448,428	390,008
	Fuel Oil	55,645	156,929	0
Automobile	Natural Gas	285,473	776,916	101,713
	Diesel Oil	600,161	3,668,336	359,065
	Gasoline	394,872	1,333,017	112,796
Other	Natural Gas	1,701,816	4,257,272	402,197

Unit: $1000m^3$(Natural Gas), ton(Other Fuels)

5) Pollutant Emission Amount in Each Area

Based on the fuel consumption by sectors in Item 4) above, NO_x and SO_x emission amounts are calculated by the IPCC Guideline method (#285), and the share of the power plant in the total pollutant emission amount is estimated. Heat (TJ) is calculated by multiplying fuel consumption and net calorific value. The NO_x emission amount is obtained by multiplying the heat value and NO_x emission factor (Kg/TJ). SO_x emission amount is calculated by multiplying fuel consumption in weight, sulfur content, and SO_2/sulfur conversion factor (=2). Share for PM is assumed as the same as the one for SO_2 in Section 5.3.4.

Finally, the shares of the power plants for NO_x emission and SO_x amounts are respectively 27.2% and 56.7% for Buenos Aires City, 4.8% and 22.0% for Buenos Aires Province, and 13.3% and 18.1% for Mendoza Province (from Table 5.3.11 to Table 5.3.13). These shares should not be taken as directly proportional to the apportionment of the power plants to air quality deterioration in the model areas. Flue gases are emitted from power plants under conditions (such as emission release height, and relatively high values of temperatures and volume rates) that favor pollutants to disperse. Therefore, the contribution of the power plants in the ambient air concentrations of NO_x, SO_2 and PM is much lower than their shares in emission amounts. This can be appreciated from Table 5.3.17 to Table 5.3.25.

Adding to the features of the figures above, more precise estimations of the shares of pollutant emissions from all stationary and mobile sources are highly recommended with more precise and time-matched data.

Table 5.3.11 Power Plant Share in Pollutant Emission Amount (Buenos Aires City)

Sector	Fuel Type	Fuel Consumption ton[1)]	Net Calorific Value kcal/kg[2)]	NO_x Emission Factor kg/TJ[3)]	NO_x Emission Amount ton	Sulphur Content Weight %	SO_x Emission Amount [4)] ton
Power Plant	Natural Gas	2,409,329	8330	150	12,604.1	0.0	0.0
	Gas Oil	8,707	10280	200	75.0	0.2	34.8
	Fuel Oil	488,107	9840	200	4,021.8	0.5	4,881.1
	Coal	0	6123	300	0.0	0.5	0.0
Sub-total 1					16,700.9		4,915.9
Industry	Natural Gas	766,878	8330	150	4,011.8	0.0	0.0
	Fuel Oil	55,645	9840	200	0.0	0.5	556.5
Automobile	Natural Gas	285,473	8330	600	5,973.7	0.0	0.0
	Diesel Oil	600,161	10280	800	20,664.9	0.2	2,400.6
	Gasoline	394,872	11106	600	11,016.6	0.1	789.7
Other	Natural Gas	1,701,816	8330	50	2,967.6	0.0	0.0
Sub-total 2					44,634.6		3,746.8
Share of P.P.					0.272		0.567

1)Natural Gas : $1000m^3$

2)Natural Gas : $kcal/m^3$

3)1cal＝4.1868J

4)In case of SO_x emission amount calculation, density of $0.7257kg/m^3$ is used

Table 5.3.12 Power Plant Share in Pollutant Emission Amount (Buenos Aires Province)

Sector	Fuel Type	Fuel Consumption ton[1)]	Net Calorific Value kcal/kg[2)]	NO_x Emission Factor kg/TJ[3)]	NO_x Emission Amount ton	Sulphur Content Weight %	SO_x Emission Amount [4)] ton
Power Plant	Natural Gas	1,214,214	8330	150	6,352.0	0.0	0.0
	Gas Oil	0	10280	200	0.0	0.2	0.0
	Fuel Oil	58,270	9840	200	480.1	0.5	582.7
	Coal	473,675	6123	300	3,642.9	0.5	4,736.8
Sub-total 1					10,475.0		5,319.5
Industry	Natural Gas	3,448,428	8330	150	18,040.0	0.0	0.0
	Fuel Oil	156,929	9840	200	1,293.0	0.5	1,569.3
Automobile	Natural Gas	776,916	8330	600	16,257.4	0.0	0.0
	Diesel Oil	3,668,336	10280	800	126,309.0	0.2	14,673.3
	Gasoline	1,333,017	11106	600	37,190.0	0.1	2,666.0
Other	Natural Gas	4,257,272	8330	50	7,423.8	0.0	0.0
Sub-total 2					206,513.3		18,908.7
Share of P.P.					0.048		0.220

1)Natural Gas: $1000m^3$

2)Natural Gas: $kcal/m^3$

3)1cal＝4.1868J

4)In case of SO_x emission amount calculation, density of $0.7257kg/m^3$ is used

Table 5.3.13 Power Plant Share in Pollutant Emission Amount (Mendoza Province)

Sector	Fuel Type	Fuel Consumption ton[1)]	Net Calorific Value Kcal/kg[2)]	NO_x Emission Factor kg/TJ[3)]	NO_x Emission Amount ton	Sulphur Content Weight %	SO_x Emission Amount [4)] ton
Power Plant	Natural Gas	541,390	8330	150	2,832.2	0.0	0.0
	Gas Oil	248	10280	200	2.1	0.2	1.0
	Fuel Oil	36,515	9840	200	300.9	0.5	365.2
	Coal	0	6123	300	0.0	0.5	0.0
Sub-total 1					3,135.2		366.1
Industry	Natural Gas	390,008	8330	150	2,040.3	0.0	0.0
	Fuel Oil	0	9840	200	0.0	0.5	0.0
Automobile	Natural Gas	101,713	8330	600	2,128.4	0.0	0.0
	Diesel Oil	359,065	10280	800	12,363.4	0.2	1,436.3
	Gasoline	112,796	11106	600	3,146.9	0.1	225.6
Other	Natural Gas	402,197	8330	50	701.3	0.0	0.0
Sub-total 2					20,380.3		1,661.9
Share of P.P.					0.133		0.181

1)Natural Gas : $1000m^3$

2)Natural Gas : $kcal/m^3$

3)1cal＝4.1868J

4)In case of SO_x emission amount calculation, density of $0.7257kg/m^3$ is used

6) Future Electricity Supply Plan

The future electricity supply plan in the target areas by the year 2020 are predicted as in Table 5.3.14 (cf. Support Report Chapter S8).

Table 5.3.14 Future Electricity Supply Plan

Year	Unit[1]	Buenos Aires City		Buenos Aires Province		Mendoza Province	
		Capacity	Increase/ Decrease	Capacity	Increase/ Decrease	Capacity	Increase/ Decrease
2001	TV	2149		650		164	
	CC	1976		830		364	
	Total	4125		1480		528	
2020	TV	910	-1239	350	-300	164	0
	CC	5176	3200	2430	1600	1564	1200
	Total	6086	1961	2780	1300	1728	1200

1)TV : Steam Turbine, CC : Combined Cycle　　Unit : MW

Negative values in the table mean phasing-out of old power generation units. For example, 1239MW of steam turbines will be phased out and 3200MW of combined cycles will be newly constructed.

7) Imaginary Power Plant

Combined cycles with 3200, 1600, and 1200 MW capacities are necessary to satisfy the future demands shown in Table 5.3.14 in each area. The pollutant source specifications of the imaginary combined cycle unit with 400 MW are set on the operational data of Units 8, 9, and 10 of the Costanera power plant. By assuming that several new units are necessary for the demands in each area to be constructed, air dispersion simulations are conducted. The operational data of the Costanera power plant are shown in Table 5.3.15 (cf. Chapter 3, Table 3.2.4).

Table 5.3.15 Operational Data of Costanera Power Plant

Rated Capacity	MW	850
NG Consumption	1000 m^3	945,346
NG Calorie	kcal/m^3	8,330
NG Heat	Tcal	7,874.7
Gas oil Consumption	ton	7,696
Gas oil Calorie	kcal/kg	10,280
Gas oil Heat	Tcal	79.1
Energy Input	kcal	7,953.8
Generated Electricity	MWh	4,994,275
Electricity Calorie	kcal/kwh	860
Energy Output	Tcal	4,295.1
Efficiency		0.540
Utility Ratio		0.671

The specifications of the imaginary power plant based on the operational data of the Costanera power plant are shown in Table 5.3.16.

Table 5.3.16 Specifications of Imaginary Power Plant

Rated Capacity	MW	400	Assumed Value
Operational Ratio	Fraction	1.000	ditto
Operational Load	Fraction	0.700	ditto
Utility Ratio	Fraction	0.700	ditto
Electricity Generation	MWh	2,452,800	Calculated Value
Electricity Calorie	kcal/kw	860	Actual Data
Energy Output	Tcal	2,109.4	Calculated Value
Efficiency	Fraction	0.500	Assumed Value
Energy Input	Tcal	4,218.8	Calculated Value
NG(Natural Gas) Heat Ratio	Fraction	0.99	Assumed Value
GO(Gas Oil) Heat Ratio	Fraction	0.01	ditto
NG Heat	Tcal	4,176.6	Calculated Value
GO Heat	Tcal	42.2	ditto
NG Calorie	kcal/m^3	8,330	Actual Data
GO Calorie	kcal/kg	10,280	ditto
NG Annual Consumption	1000 m^3	501,396	Calculated Value
GO Consumption	ton	4,104	ditto
NG Hourly Consumption	m^3/h	57,237.0	ditto
GO Hourly Consumption	kg/h	468.5	ditto
Wet Gas Factor for NG	m^3_N/m^3_N	28.0	Assumed Value
Wet Gas Factor for Gas Oil	m^3_N/kg	28.0	ditto
Wet Gas Rate in m3N	m^3_N/h	1,615,752.8	Calculated Value
Stack Gas Temperature	K	363.15	Assumed Value
Wet Gas Rate	m^3/h	2,148,126.1	Calculated Value
Stack Diameter	M	7.0	Assumed Value
Stack Area Size	m^2	38.5	Calculated Value
Stack Gas Velocity	m/s	15.5	ditto
Dry Gas Factor for NG	m^3_N/m^3_N	26.3	Assumed Value
Dry Gas Factor for GO	m^3_N/kg	26.3	ditto
Dry Gas Rate by NG in m^3_N	m^3_N/h	1,505,332.4	Calculated Value
Dry Gas Rate by GO in m^3_N	m^3_N/h	12321.1	ditto
Dry Gas Rate in m^3_N	m^3_N/h	1,517,653.5	ditto
SO_2 Emission Standard for NG	mg/m^3_N	0.0	Actual Data
SO_2 Emission Standard for GO	% in Fuel	0.5	ditto
Hourly SO_2 Emission Standard by GO	mg/h	4,684,824.9	Calculated Value
SO_2 Emission Standard for GO in Conc.	mg/m^3_N	380.2	ditto
SO_2 Emission Standard for NG & GO	mg/m^3_N	3.8	ditto
SO_2 Emission Rate	g/s	1.60	ditto
NO_x Emission Standard for NG	mg/m^3_N	100	Actual Data
NO_x Emission Standard for GO	mg/m^3_N	100	ditto
NO_x Emission Standard for NG&GO	mg/m^3_N	100	Calculated Value
NO_x Emission Rate	g/s	42.16	ditto
PM Emission Standard for NG	mg/m^3_N	6	Actual Data
PM Emission Standard for GO	mg/m^3_N	20	ditto
PM Emission Standard for NG&GO	mg/m^3_N	6.14	Calculated Value
PM Emission Rate	g/s	2.59	ditto

Pollutant emission rate is calculated under the condition of present emission standard.

The locations of the stacks of newly constructed units are assumed to be at the same positions as the phased-out units in Buenos Aires area, and assumed in the vacant place of the San Nicolas power plant.

On the other hand, the contributions from the present and the phased-out power plant units are calculated on the operational data of each target year (Support Report Chapter S7).

5.3.4 Result of Emission Standard Investigation

The results of emission standard investigations of NO_x, SO_2, and PM in the three model areas using the method described in Section 5.3.1 are shown in Table 5.3.17 to Table 5.3.25.

The results show that the present NO_x and PM emission standards in Buenos Aires are adequate until 2020. Present SO_2 concentrations have already exceeded the air quality standards and the standards could not be satisfied even if the concentration improvement by phased-out units is considered, although the main cause of the high concentrations are not the power plants. Accordingly, expansion of the power plant is not allowable even if the strictest emission standard is installed.

Meanwhile, the example of the investigation given in Table 5.3.1 assumes three times greater expansion in Buenos Aires than the plan in Table 5.3.14 to explain the correction of emission standard.

In San Nicolas, the current emission standards of NO_x and SO_2 are adequate until 2020. For PM emission standards, the present concentrations at most of the monitored sites exceed the air quality standards, with exception of 4 sites having the lower present concentrations than the air quality standard. Therefore, although it is not necessary to make the present standard stricter, the expansion of the power plant seems not acceptable because of local characteristics featured by other emission sources.

In Lujan de Cuyo, the current emission standards of NO_x and SO_2 are adequate until 2020. On the contrary, the situation of the present PM concentrations is similar to the case of San Nicolas. At most of the sites the monitored concentrations exceed the air quality standards, with exception of 3 sites. The expansion of power plant causing the increase of SPM concentrations in Lujan de Cuyo seems not acceptable.

Table 5.3.17 Result of Emission Standard Investigation (Buenos Aires/NO_x)

NO_x Emission Standard		Natural Gas	100	mg/m^3_N				
		Gas Oil	100	mg/m^3_N				
		Mixture	100	mg/m^3_N				
Power Plant Share in NO_x Emission			0.272	(Fraction)*	*More Precise Estimation is Highly Recommended			
Annual Air Quality Standard of NO_x			100	$\mu g/m^3$				
Sites	Present Conc. ug/m^3	Present P.P. ug/m^3	Surplus Conc. ug/m^3	P.P. Share ug/m^3	Phased Out P.P. ug/m^3	P.P. Total ug/m^3	P.P. Expansion ug/m^3	Judge
(1)	19.2	2.8	80.8	22.0	1.9	23.9	4.5	○
(2)	18.4	1.5	81.6	22.2	0.9	23.1	2.3	○
(3)	18.7	4.1	81.3	22.1	1.4	23.5	6.7	○
(4)	8.1	3.7	91.9	25.0	1.0	26.0	5.8	○
(5)	19.1	2.7	80.9	22.0	0.5	22.5	4.1	○
(6)	15.4	1.8	84.6	23.0	0.6	23.6	3.2	○
(7)	16.6	1.6	83.4	22.7	0.4	23.1	2.2	○
(8)	39.9	3.8	60.1	16.4	2.7	19.1	6.3	○
(9)	40.9	3.0	59.1	16.1	2.3	18.4	5.1	○
(10)	36.2	1.8	63.8	17.4	0.7	18.1	3.0	○
	Area Avg.	Same Location	Surplus	P.P.	Same Location		Area Max.	
Area Location	23.3	7.5 (16km,10km)	76.7	20.9	1.6 (16km,10km)	22.5	12.2 (16km,10km)	○

Table 5.3.18 Result of Emission Standard Investigation (Buenos Aires/SO_2)

SO_2 Emission Standard		Natural Gas	0	mg/m^3_N				
		Gas Oil	380.2	mg/m^3_N				
		Mixture	3.8	mg/m^3_N				
Power Plant Share in SO_2 Emission			0.567	(Fraction)*	*More Precise Estimation is Highly Recommended			
Annual Air Quality Standard of SO_2			80	$\mu g/m^3$				
Sites	Present Conc. ug/m^3	Present P.P. ug/m^3	Surplus Conc. ug/m^3	P.P. Share ug/m^3	Phased Out P.P. ug/m^3	P.P. Total ug/m^3	P.P. Expansion ug/m^3	Judge
(1)	112.5	4.209	-32.5	-18.4	3.600	-14.8	0.171	－
(2)	95.6	2.097	-15.6	-8.8	1.765	-7.1	0.087	－
(3)	105.9	2.550	-25.9	-14.7	2.366	-12.3	0.256	－
(4)	89.6	2.047	-9.6	-5.4	1.773	-3.7	0.221	－
(5)	101.9	0.819	-21.9	-12.4	0.724	-11.7	0.156	－
(6)	87.2	1.130	-7.2	-4.1	0.982	-3.1	0.121	－
(7)	92.9	0.728	-12.9	-7.3	0.632	-6.7	0.083	－
(8)	98.0	5.729	-18.0	-10.2	4.978	-5.2	0.237	－
(9)	147.5	4.650	-67.5	-38.3	4.260	-34.0	0.195	－
(10)	124.1	1.534	-44.1	-25.0	1.373	-23.6	0.113	－
	Area Avg.	Same Location	Surplus	P.P.	Same Location		Area Max.	
Area Location	105.5	2.615 (16km,10km)	-25.5	-14.5	2.417 (16km,10km)	-12.1	0.464 (16km,10km)	－

Table 5.3.19 Result of Emission Standard Investigation (Buenos Aires/PM)

PM Emission Standard		Natural Gas	6	mg/m^3_N				
		Gas Oil	20	mg/m^3_N				
		Mixture	6.14	mg/m^3_N				
Power Plant Share in PM Emission			0.567	(Fraction)*	*More Precise Estimation is Highly Recommended			
Annual Air Quality Standard of SPM			50	$\mu g/m^3$				
Sites	Present Conc. ug/m^3	Present P.P. ug/m^3	Surplus Conc. ug/m^3	P.P. Share ug/m^3	Phased Out P.P. ug/m^3	P.P. Total ug/m^3	P.P. Expansion ug/m^3	Judge
(1)	46.9	0.09	3.1	1.8	0.07	1.8	0.28	○
(2)	31.7	0.05	18.3	10.4	0.03	10.4	0.14	○
(3)	30.1	0.07	19.9	11.3	0.06	11.3	0.41	○
(4)	35.6	0.06	14.4	8.2	0.05	8.2	0.36	○
(5)	37.6	0.03	12.4	7.0	0.02	7.0	0.25	○
(6)	35.6	0.03	14.4	8.1	0.03	8.2	0.20	○
(7)	36.2	0.02	13.8	7.9	0.02	7.9	0.13	○
(8)	48.9	0.12	1.1	0.6	0.09	0.7	0.38	○
(9)	29.5	0.09	20.5	11.6	0.08	11.7	0.32	○
(10)	31.8	0.03	18.2	10.3	0.03	10.3	0.18	○
	Area Avg.	Same Location	Surplus	P.P.	Same Location		Area Max.	
Area Location	36.4	0.10 (16km,10km)	13.6	7.7	0.08 (16km,10km)	7.8	0.75 (16km,10km)	○

Table 5.3.20 Result of Emission Standard Investigation (San Nicolas/NO_x)

NO_x Emission Standard		Natural Gas	100	mg/m^3_N				
		Gas Oil	100	mg/m^3_N				
		Mixture	100	mg/m^3_N				
Power Plant Share in NO_x Emission			0.048	(Fraction)*	*More Precise Estimation is Highly Recommended			
Annual Air Quality Standard of NO_x			100	$\mu g/m^3$				
Sites	Present Conc. ug/m^3	Present P.P. ug/m^3	Surplus Conc. ug/m^3	P.P. Share ug/m^3	Phased Out P.P. ug/m^3	P.P. Total ug/m^3	P.P. Expansion ug/m^3	Judge
(1)	8.7	0.24	91.3	4.4	0.07	4.5	0.79	○
(2)	9.3	0.31	90.7	4.4	0.07	4.5	1.10	○
(3)	9.3	0.30	90.7	4.4	0.08	4.5	1.02	○
(4)	8.7	0.55	91.3	4.4	0.14	4.5	1.82	○
(5)	7.6	0.47	92.4	4.5	0.12	4.6	1.25	○
(6)	8.2	0.50	91.8	4.4	0.11	4.5	1.67	○
(7)	9.5	0.47	90.5	4.4	0.13	4.5	1.31	○
(8)	8.7	0.20	91.3	4.4	0.05	4.5	0.45	○
(9)	5.7	-	-	-	-	-	-	-
(10)	12.3	0.09	87.7	4.2	0.02	4.3	0.26	○
	Area Avg.	Same Location	Surplus	P.P.	Same Location		Area Max.	
Area Location	8.8	0.51 (21km,35km)	91.2	4.4	0.11 (21km,35km)	4.5	1.85 (21km,35km)	○

Table 5.3.21 Result of Emission Standard Investigation (San Nicolas/SO_2)

SO_2 Emission Standard		Natural Gas	0	mg/m^3_N				
		Gas Oil	380.2	mg/m^3_N				
		Mixture	3.8	mg/m^3_N				
Power Plant Share in SO_2 Emission			0.220	(Fraction)*	*More Precise Estimation is Highly Recommended			
Annual Air Quality Standard of SO_2			80	$\mu g/m^3$				
Sites	Present Conc. ug/m^3	Present P.P. ug/m^3	Surplus Conc. ug/m^3	P.P. Share ug/m^3	Phased Out P.P. ug/m^3	P.P. Total ug/m^3	P.P. Expansion ug/m^3	Judge
(1)	38.5	0.3	41.5	9.1	0.01	9.1	0.03	○
(2)	49.2	0.5	30.8	6.8	0.01	6.8	0.04	○
(3)	38.0	0.5	42.0	9.2	0.01	9.2	0.04	○
(4)	48.0	0.8	32.0	7.0	0.03	7.1	0.07	○
(5)	43.0	0.7	37.0	8.1	0.03	8.2	0.05	○
(6)	35.4	0.8	44.6	9.8	0.04	9.8	0.06	○
(7)	36.7	0.7	43.3	9.5	0.05	9.6	0.05	○
(8)	46.6	0.7	33.4	7.3	0.02	7.4	0.02	○
(9)	32.4	-	-	-	-	-		
(10)	41.4	0.1	38.6	8.5	0.01	8.5	0.01	○
	Area Avg.	Same Location	Surplus	P.P.	Same Location		Area Max.	
Area Location	40.9	0.8 (21km,35km)	39.1	8.6	0.02 (21km,35km)	8.6	0.07 (21km,35km)	○

Table 5.3.22 Result of Emission Standard Investigation (San Nicolas/PM)

PM Emission Standard		Natural Gas	6	mg/m^3_N				
		Gas Oil	20	mg/m^3_N				
		Mixture	6.14	mg/m^3_N				
Power Plant Share in PM Emission			0.220	(Fraction)*	*More Precise Estimation is Highly Recommended			
Annual Air Quality Standard of SPM			50	$\mu g/m^3$				
Sites	Present Conc. ug/m^3	Present P.P. ug/m^3	Surplus Conc. ug/m^3	P.P. Share ug/m^3	Phased Out P.P. ug/m^3	P.P. Total ug/m^3	P.P. Expansion ug/m^3	Judge
(1)	40.2	0.046	9.8	2.1	0.014	2.2	0.05	○
(2)	53.1	0.068	-3.1	-0.7	0.013	-0.7	0.07	—
(3)	50.4	0.067	-0.4	-0.1	0.014	-0.1	0.06	—
(4)	42.5	0.108	7.5	1.6	0.025	1.7	0.11	○
(5)	87.2	0.097	-37.2	-8.2	0.025	-8.1	0.08	—
(6)	61.2	0.103	-11.2	-2.5	0.026	-2.4	0.10	—
(7)	49.6	0.091	0.4	0.1	0.034	0.1	0.08	○
(8)	63.6	0.036	-13.6	-3.0	0.012	-3.0	0.03	—
(9)	46.8	-	-	-	-	-	-	
(10)	44.7	0.019	5.3	1.2	0.004	1.2	0.02	○
	Area Avg.	Same Location	Surplus	P.P.	Same Location		Area Max.	
Area Location	53.9	0.103 (21km,35km)	-3.9	-0.9	0.021 (21km,35km)	-0.8	0.11 (21km,35km)	—

Table 5.3.23 Result of Emission Standard Investigation (Lujan de Cuyo/NO_x)

NO_x Emission Standard		Natural Gas	100	mg/m^3_N				
		Gas Oil	100	mg/m^3_N				
		Mixture	100	mg/m^3_N				
Power Plant Share in NO_x Emission			0.133	(Fraction)*	*More Precise Estimation is Highly Recommended			
Annual Air Quality Standard of NO_x			74	$\mu g/m^3$				
Sites	Present Conc. ug/m^3	Present P.P. ug/m^3	Surplus Conc. ug/m^3	P.P. Share ug/m^3	Phased Out P.P. ug/m^3	P.P. Total ug/m^3	P.P. Expansion ug/m^3	Judge
(1)	13.3	1.33	60.7	8.1	0.00	8.1	1.21	○
(2)	13.1	0.43	60.9	8.1	0.00	8.1	0.06	○
(3)	13.4	-	-	-	-	-	-	
(4)	14.6	1.26	59.4	7.9	0.00	7.9	1.87	○
(5)	13.8	0.10	60.2	8.0	0.00	8.0	0.14	○
(6)	13.3	0.07	60.7	8.1	0.00	8.1	0.07	○
(7)	13.9	0.52	60.1	8.0	0.00	8.0	0.24	○
(8)	13.7	0.16	60.3	8.0	0.00	8.0	0.16	○
(9)	12.2	2.77	61.8	8.2	0.00	8.2	1.02	○
	Area Avg.	Same Location	Surplus	P.P.	Same Location		Area Max.	
Area Location	13.5	1.93 (13km,43km)	60.5	8.0	0.00	8.0	2.99 (13km,43km)	○

Table 5.3.24 Result of Emission Standard Investigation (Lujan de Cuyo/SO_2)

SO_2 Emission Standard		Natural Gas	0	mg/m^3_N				
		Gas Oil	380.2	mg/m^3_N				
		Mixture	3.8	mg/m^3_N				
Power Plant Share in SO_2 Emission			0.181	(Fraction)*	*More Precise Estimation is Highly Recommended			
Annual Air Quality Standard of SO_2			229	$\mu g/m^3$				
Sites	Present Conc. ug/m^3	Present P.P. ug/m^3	Surplus Conc. ug/m^3	P.P. Share ug/m^3	Phased Out P.P. ug/m^3	P.P. Total ug/m^3	P.P. Expansion ug/m^3	Judge
(1)	65.3	0.05	163.7	29.6	0.00	29.6	0.05	○
(2)	65.6	0.01	163.4	29.6	0.00	29.6	0.00	○
(3)	50.8	-	-	-	-	-	-	
(4)	49.4	0.05	179.6	32.5	0.00	32.5	0.07	○
(5)	59.1	0.00	169.9	30.8	0.00	30.8	0.01	○
(6)	45.3	0.00	183.7	33.2	0.00	33.2	0.00	○
(7)	48.5	0.02	180.5	32.7	0.00	32.7	0.01	○
(8)	54.2	0.00	174.8	31.6	0.00	31.6	0.01	○
(9)	47.2	0.08	181.8	32.9	0.00	32.9	0.04	○
	Area Avg.	Same Location	Surplus	P.P.	Same Location		Area Max.	
Area Location	53.9	0.05 (13km,43km)	175.1	31.7	0.00	31.7	0.11 (13km,43km)	○

Table 5.3.25 Result of Emission Standard Investigation (Lujan de Cuyo/PM)

PM Emission Standard	Natural Gas	6	mg/m^3_N	
	Gas Oil	20	mg/m^3_N	
	Mixture	6.14	mg/m^3_N	
Power Plant Share in PM Emission		0.181	(Fraction)*	*More Precise Estimation is Highly Recommended
Annual Air Quality Standard of SPM		72	$\mu g/m^3$	

Sites	Present Conc. ug/m^3	Present P.P. ug/m^3	Surplus Conc. ug/m^3	P.P. Share ug/m^3	Phased Out P.P. ug/m^3	P.P. Total ug/m^3	P.P. Expansion ug/m^3	Judge
(1)	58.7	0.0022	13.3	2.4	0.0	2.4	0.07	○
(2)	119.3	0.0002	-47.3	-8.6	0.0	-8.6	0.00	―
(3)	87.4	-	-	-	-	-	-	
(4)	73.4	0.0020	-1.4	-0.3	0.0	-0.3	0.11	―
(5)	78.3	0.0002	-6.3	-1.1	0.0	-1.1	0.01	―
(6)	70.1	0.0001	1.9	0.3	0.0	0.3	0.00	○
(7)	79.0	0.0005	-7.0	-1.3	0.0	-1.3	0.01	―
(8)	70.6	0.0001	1.4	0.3	0.0	0.3	0.01	○
(9)	86.1	0.0029	-14.1	-2.5	0.0	-2.5	0.06	―
	Area Avg.	Same Location	Surplus	P.P.	Same Location		Area Max.	
Area Location	80.3	0.0015 (13km,43km)	-8.3	-1.5	0.0	-1.5	0.18 (13km,43km)	―

5.4 Application Plan of Emission Standards for Thermal Power Plants

5.4.1 Applied Fields

There are 3 fields for which the methodology can be applied. The first is nationwide allocation of future thermal power plants in consideration of air quality. Here, the methodology is used as a tool for evaluation criteria. Although the natural gas firing combined cycle is the prevailing power generation system, currently used in Argentina, diversification of fuels for power generation is one of the major political themes. The methodology can be used as a measure to evaluate impact on the atmospheric environment of alternative strategic plans for allocation and diversification of fuels of thermal power plants in the country.

The second field is the environmental evaluation of expected projects. There are publicized projects for thermal power plants until 2010. The methodology can be used as a tool to evaluate these projects, namely, as a tool for preliminary EIA in the planning stage.

The third field is the establishment of local emission standards for new or extended thermal power plants. Emission standards are legally binding. Argentina has national emission standards for thermal power plants. However, there is no local standard. Several remarks are given below about establishing the local emission standards.

5.4.2 Differences between National and Local Emission Standards

There are 2 kinds of emission standards: national and local ones. The former should be observed by all the subjected persons or bodies under the national jurisdiction. While, only those who are in the local area should observe the latter. This is the first difference.

The second difference is in the their values. Usually, the local standards are more stringent than the corresponding national ones. This is because the national standards are not or are expected not to be appropriate to protect the local environment. As a result, more stringent standards are applied to the local area. The national emission standards are the minimum requirements. National and / or local authorities can apply more stringent standards to the specific local areas, if they judge it is necessary.

The third difference is in their basis. The national emission standards are based on technology. While, the local ones are based on the environment. Although the national ones contribute obviously to preserve the local environment, concrete individual problems on living environment arise in local areas. This is because usually people spend their life in a comparatively narrow and limited area. Here the local standards that can guarantee to preserve the local air quality are specially required. The national standards are based upon the average technology level and the local ones request higher technological levels.

5.4.3 Judgment of Necessity of Local Emission Standards

As mentioned earlier, Argentina has national emission standards for thermal power plants. There is no local standard in the 3 areas of the JICA Study, except for the general ones (#259-5) in Department of Lujan de Cuyo. It should be judged whether the national government has to establish local emission standards or not, prior to examining the framework of emission standards for thermal power plants in the country, namely national standards only or a combination of national and local standards. There are several items to be considered for the judgment as shown below.

The first one is the existence of environmental impact assessment system (EIA system). As is widely known, EIA provides materials to decide whether to approve the implementation of the project or not from its impacts on the environment.

Currently, Argentina has no national comprehensive EIA law targeting various projects. However, the Resolution of the Secretariat of Energy No. 149/90 (#1) imposes EIA on thermal power plants to be newly or extendedly installed. The 15 provinces and the City of Buenos Aires have their own general EIA system. They impose EIA on thermal power plants as well.

Generally, the impact of a thermal power plant on air quality is evaluated by comparing the sum of its impact concentration and the background concentration with the air quality standard, in EIA on environmental air. In case problems are expected to arise, the entrepreneur has to take appropriate measures to counteract them.

EIA system is a powerful tool to prevent environmental deterioration before it happens. In such a situation where a entrepreneur of a thermal power plant has a legal obligation to conduct a EIA study, it is a crucial issue whether the national government should establish the local emission standards or not.

Besides, if local emission standards have to be established, the existence of monitored air quality data and source inventory data in the area concerned is a prerequisite. In Argentina where air quality monitoring has rarely been conducted, development of air quality monitoring (to give reliable background concentration) and the source inventories (to estimate reasonable emissions from other sources) are indispensable in order to establish reasonable local emission standards of thermal power plants. The establishment of local emission standards requests substantial efforts and costs.

Moreover, the major air pollutant emitted from combined cycles, the prevailing power generation system now in Argentina, is NOx, though it does not emit so much NOx in comparison with other generation systems. As a result, NOx is the target pollutant for further emission regulation. The area with high concentration of NOx is the Buenos Aires metropolitan area, where the Argentina Pollution Management Project has been conducted with the assistance of the World Bank. Although the project is reportedly suspended now, an air quality monitoring network is planned in the metropolitan area. The City of Buenos Aires has a plan of establishing local emission standards on stationary sources.

The national policy on local emission standards of thermal power plants should be decided with due considerations as mentioned above.

The JICA Team recommends the Secretary of Energy and Mines (Secretary of Energy) and ENRE to apply the methodology to EIA in planning stage of installation and extension of thermal power plants.

5.4.4 Establishment of Comprehensive Emission Standards

There is no nationally comprehensive emission standards covering various stationary sources in Argentina. While the Secretary of Energy has revised the emission standards of thermal power plants three times in 1993, 1995 and 2001.

As long as the national economy continues to expand, total national air pollution loads will increase, which will lead to higher background concentrations everywhere, including around power plants and subsequently to further revision of emission standards of power plants (#144).

In spite of the fact above, the establishment of comprehensive emission standards covering various combustion and industrial facilities is a prerequisite for further revision of the emission standards of thermal power plants or establishment of their local emission standards.

The polluter-pays-principle is a principle stipulated in the National Constitution of Argentina. Air polluters must share their fair burden for the protection of atmospheric environment. It is questionable to impose the burden only on the power generators. The Secretary of Energy and ENRE are in a position to control and supervise thermal power plants, and at the same time in a position to protect them. Comprehensive national emission standards for stationary sources are necessary to make polluters share the burden of environmental protection. Such standards are indispensable for reasonable allocation of resources in the country.

The JICA Team visited large-scale industries in the 3 model areas, most of which conduct environmental management voluntarily. Several industries have measured their flue gases. They pay much attention to the environment. They seem to accept emission regulations such as emission standards.

ENRE should propose that the Ministry of Social Development and Environment to establish emission standards for air polluting facilities (other than power plants) over a given scale. The targeted industries are obliged to observe the standards, and to conduct flue gas measurement and report the results.

Flue gases should be measured based on a uniform national rule. ENRE should propose that the Ministry of Social Development and Environment prepare guidelines and manuals for flue gas measurement, maintenance of the analyzers, and data processing and analysis.

The Secretary of Energy and Mines and ENRE have much experience and knowledge about establishment of emission standards and flue gas measurements. They can contribute much to developing the above standards, guidelines and manuals.

5.4.5 Ambient Air Monitoring

Establishment of local emission standards requires monitoring of air quality to know the level of concentrations, its compliance with the air quality standards and changes over several years. Therefore, automatic and continuous air quality monitoring should be a choice. Meteorological data are required to know local air pollution mechanism and hence, meteorology (wind direction and speed, temperature, etc.) should be observed at least at one of the air quality monitoring stations.

Air pollution is a result of dispersion of air pollutants from various kinds of stationary and mobile sources. Consequently there are many polluters. Though several industries are monitoring ambient air voluntarily, it is questionable to impose the monitoring on specific polluters.

It is local governments (provinces or municipalities) who are responsible for the monitoring and management of their atmosphere. The Secretary of Energy and ENRE should propose, through the national cabinet, that local governments carry out automatic continuous monitoring in their jurisdictions.

It is a duty of local governments to monitor their atmosphere. However, it should be conducted based on a uniform rule. The Ministry of Social Development and Environment should prepare guidelines and manuals for the selection of monitoring sites for air quality and meteorology, measuring methods, maintenance of the equipment, data processing and analysis.

5.4.6 Development of Source Inventory

To monitor and manage local atmosphere, development of source inventories as well as continuation of air quality monitoring is necessary to know the state of the local air pollution and its pollution mechanism. Though development of source inventories is assigned to local governments, they should be made based on a uniform rule. The Ministry of Social Development and Environment should prepare uniform guidelines and manuals to develop source inventories.

5.4.7 Technical Notes on Methodology for Establishing Local Emission Standards

The following are the technical supplements to put into practice the methodology for establishing local emission standards of thermal power plants.

1) Characteristics of Emission Standards

Generally speaking, emission standards regulate not amounts of emissions but emission concentration. The emission concentration is a timeless expression and may possibly correspond to a span of one year in character. Accordingly, air quality corresponding to the emission standards should be the annual average value.

2) Local Air Pollutant Emission

Total air pollutant loads of SOx, NOx and PM in a local area can be calculated based on the IPCC Guidelines for Greenhouse Gas Inventories. There are two types of approaches: top-down and bottom-up. The bottom-up approach is preferable, which requires development of source inventories.

3) Imaginary Thermal Power Plant

The energy forecast reports by the Secretariat of Energy and Mines (#144 and 255) list name, rated capacity and start year of the thermal power plants to be newly or extendedly installed until 2010. If power plants in the target area are found in the list, the capacity of the imaginary plant could be set based on these reports.

4) Meteorology

As a general rule, the meteorological data observed at meteorological observatories of the National Meteorology Services should be used. However, in case the target area is a long way from any of the observatories, the observed data may not represent the meteorology of the area. Therefore, observation of meteorology (especially the wind direction and speed) at the representative site in the area is desirable.

5) Impact Concentration

In case it is difficult to assume a suitable hourly operational pattern of the imaginary power plant throughout a year, only the impact concentration in annual average is calculated.

6) Air Quality Standards

There are 2 kinds of air quality standards: national and local ones. In case the target area has its own local standards, both standards should be observed.

Generally, air quality standards specify several upper limit concentrations for each pollutant corresponding to several evaluation times. As shown in Item **1)**, the air quality corresponding to emission standards is the annual average. Therefore, if the annual average is assigned to the standard, it can be used directly for emission evaluation. Otherwise, the following steps can be applied to assign the annual average value for the evaluation. First, convert the standard value of each evaluation time into a corresponding annual average by using the Larsen equation (Refer to Chapter S5 in the Support Volume). Then, select the lowest value among the annual averages corresponding to the evaluation times as the unified measure.

Here, the impact concentration, surplus portion of air quality standard, and allowable consumption by the future thermal power plant are all expressed in annual average values.

7) Consumption of Air Quality Standards by Imaginary Power Plant

If the impact concentration calculated is the annual average, the consumption of air quality standards by the imaginary power plant is the maximum annual concentration of the impact concentration.

8) Background Concentration

Among the impact concentrations, annual average concentration is the least requirement. Therefore, the air quality monitoring data has to be able to produce the reliable annual averages.

9) Allowable Consumption Rate by Future Thermal Power Plants

Particulate matter (PM) is originated from natural sources as well as artificial ones. Although dispersion mechanism of particulate is complicated, it is more similar to SOx than NOx in its generation mechanism. Accordingly, the allowable consumption rate of PM should be determined based on that of SOx.

Policies to be considered in determining the allowable consumption rates by future thermal power plants involve local and national environmental policies, national policies on power sector, and local policies on their economy and development. National and local regulations for air pollution control and their effects should also be taken into consideration.