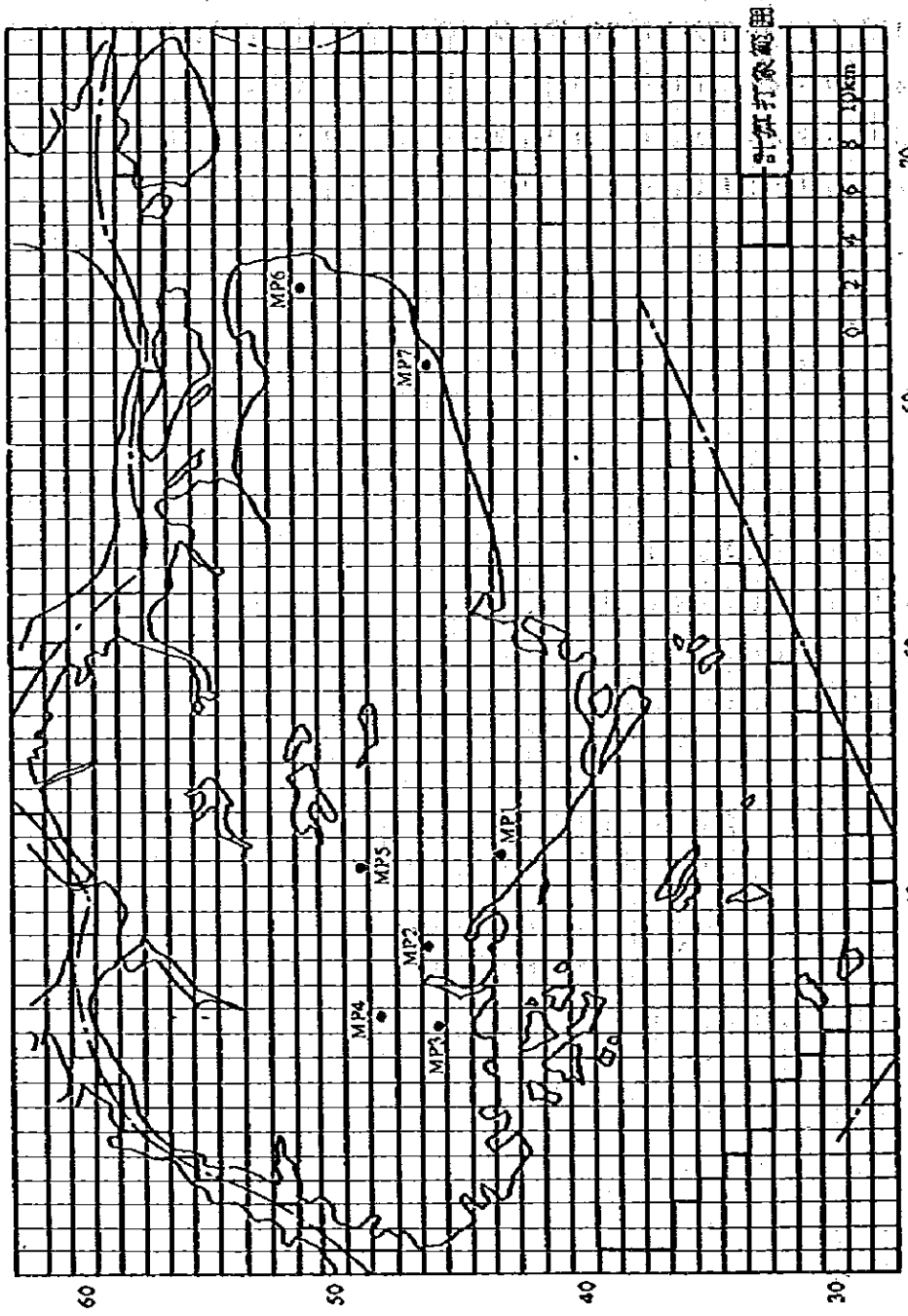
第2章　SO_2予測シミュレーションの結果

第1章で述べたSO_2予測シミュレーションモデルを用いて，第Ⅲ編で推定した現状（1981年次）及び将来（1990年次）のSO_2排出量が排出された場合の現状及び将来のSO_2環境濃度を予測した。その結果を以下に示す。なお，予測地点は，ＭＰ１～ＭＰ７の測定点及び対象地域を1km×1kmに区分したメッシュの中心点である。そのメッシュ区分と計算対象範囲は図Ⅴ－2－1に示すとおりである。



図Ⅴ－２－１　メッシュ区分と計測対象範囲

2－1　測定点の予測結果

各測定点におけるSO_2環境濃度の年平均値の予測結果を表Ⅴ－2－1に示す。これをみると，1981年次では6.7 ppb～23.2 ppbであったのが，1990年次では9.5 ppb～39.9 ppbとなり，2.8 ppb～16.7 ppb増加している。1981年次における各測定点の寄与率をみると，固定発生源（工場・事業場）が29～74％，船舶が6～11％，バックグランドが19～64％となっている。なお，バックグランドの意味については前章（1－2－6）を参照されたい。濃度の低いMP6，MP7を除いたMP1～MP5における1981年次の寄与率は，固定発生源が64～74％，船舶が6～9％，バックグランドが19～29％となっている。これらの寄与率は1990年次においても大きな変化はみられない。

予測濃度の最も高いMP3についてみると，SO_2環境濃度の予測値は1981年次の23.2 ppbから1990年次では39.9 ppbに増加している。MP3における固定発生源の寄与率は1981年次で74％，1990年次で80％を占めている。

表Ⅴ－2－1　測定局におけるSO_2濃度の予測結果（年平均値）

測定局	対象年次	（参考）実測濃度（ppb）	予測濃度（ppb）	固定発生源（工場・事業場）（ppb）	寄与率（％）	船舶（ppb）	寄与率（％）	バックグランド（ppb）	寄与率（％）
MP1) N.U.S	1981	14.2	15.9	10.10	64	1.46	9	4.3	27
	1990	－	21.6	13.66	63	2.23	10	5.7	26
MP2) J.T.C.HALL	1981	14.6	16.7	11.21	67	1.14	7	4.3	26
	1990	－	24.7	17.30	70	1.74	7	5.7	23
MP3) S.I.U.	1981	26.2	23.2	17.26	74	1.61	7	4.3	19
	1990	－	39.9	31.85	80	2.38	6	5.7	14
MP4) BOON LAY APARTMENT	1981	19.4	21.4	15.88	74	1.18	6	4.3	20
	1990	－	33.9	26.50	78	1.73	5	5.7	17
MP5) BUKIT TIMAH FIRE STATION	1981	17.6	14.9	9.70	65	0.94	6	4.3	29
	1990	－	20.7	13.61	66	1.42	7	5.7	27
MP6) CHANGI AIRPORT	1981	6.7	6.7	1.97	29	0.43	6	4.3	64
	1990	－	9.5	3.18	33	0.66	7	5.7	60
MP7) BEDOK POLICE STATION	1981	8.4	8.1	2.99	37	0.79	10	4.3	53
	1990	－	11.5	4.58	40	1.26	11	5.7	49

次に，S系モンスーン（4月～10月）とN系モンスーン（11月～3月）の平均濃度の予測結果を表V－2－2，表V－2－3に示す。S系モンスーンにおける予測濃度についてみると，1981年次では7.0～28.9 ppbであったのが，1990年次では10.0～48.2 ppbへと3.0～20.3 ppb増加している。発生源別の寄与率は年平均値の場合とほぼ同様である。

N系モンスーンにおける予測濃度についてみると，1981年次では6.3～16.5 ppbであったのが，1990年次では8.8～28.2 ppbへと2.5～11.7 ppb増加している。発生源別の寄与率をみると，S系モンスーンに比較し極めて小さくなっている。これは，第N編でみたようにS系モンスーンにおける卓越風向がNE系であるのに対し，N系モンスーンの卓越風向はSE系であることによっている。N系モンスーンの濃度はS系モンスーンに比較し低くなっているのもこの卓越風向の差異によるものである。

表Ⅴ－２－２　測定局におけるSO_2濃度の予測結果（Ｓ系モンスーン平均値）

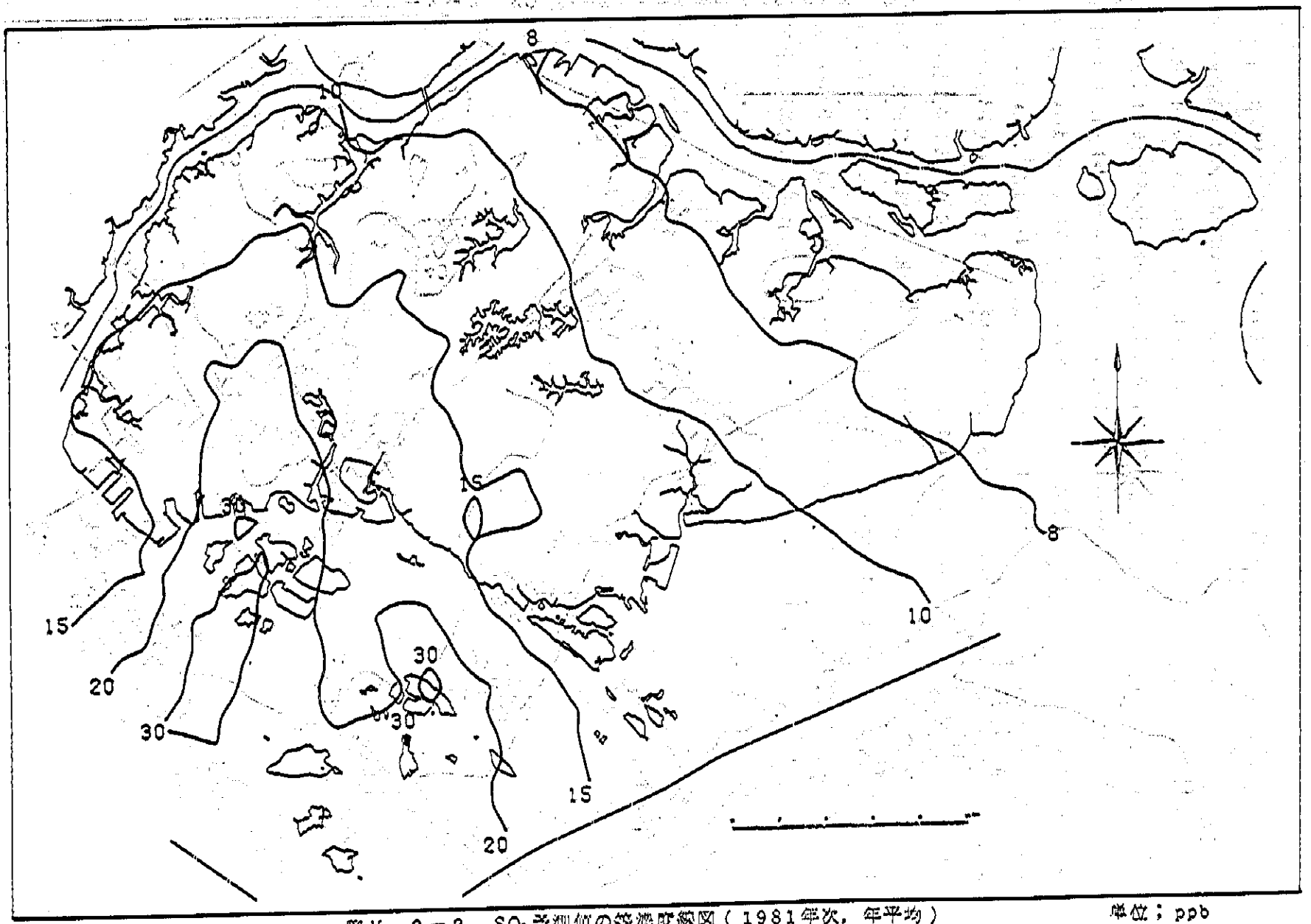
測定局	対象年次	実測濃度 (ppb)	予測濃度 (ppb)	固定発生源（工場・事業場） (ppb)	寄与率 (%)	船舶 (ppb)	寄与率 (%)	バックグランド (ppb)	寄与率 (%)
MP1) N.U.S	1981	13.1	18.3	11.78	64	2.23	12	4.3	24
	1990	—	24.2	15.05	62	3.43	14	5.7	24
MP2) J.T.C.HALL	1981	14.1	18.1	11.98	66	1.79	10	4.3	24
	1990	—	26.6	18.18	68	2.74	10	5.7	21
MP3) S.T.U.	1981	28.0	27.9	21.00	75	2.55	9	4.3	15
	1990	—	48.2	38.68	80	3.88	8	5.7	12
MP4) BOON LAY APARTMENT	1981	22.3	28.9	22.76	79	1.89	7	4.3	15
	1990	—	45.5	37.01	81	2.79	6	5.7	13
MP5) BUKIT TIHAH FIRE STATION	1981	17.9	15.7	9.88	63	1.50	10	4.3	27
	1990	—	22.4	14.43	64	2.27	10	5.7	26
MP6) CHANGI AIRPORT	1981	6.8	7.0	2.11	30	0.61	9	4.3	61
	1990	—	10.0	3.42	34	0.93	9	5.7	57
MP7) BEDOK PORICE STATION	1981	9.3	8.3	2.94	36	1.04	13	4.3	52
	1990	—	11.8	4.45	38	1.65	14	5.7	48

表Ⅴ－２－３　測定局におけるSO_2濃度の予測結果（Ｎ系モンスーン平均値）

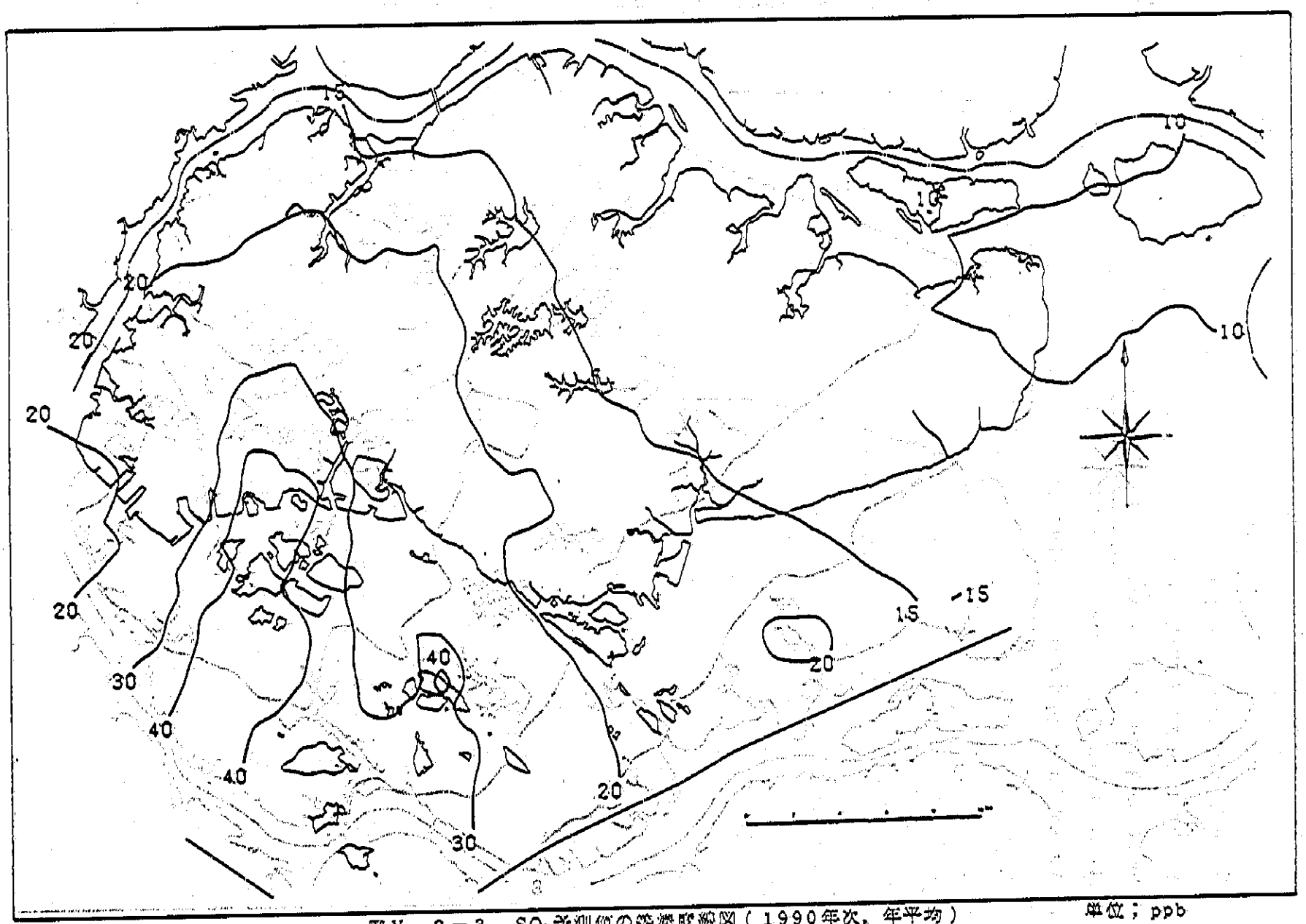
測定局	対象年次	実測濃度 (ppb)	予測濃度 (ppb)	固定発生源（工場・事業場） (ppb)	寄与率 (%)	船舶 (ppb)	寄与率 (%)	バックグランド (ppb)	寄与率 (%)
MP1) N.U.S.	1981	15.8	12.4	7.72	62	0.36	3	4.3	35
	1990	—	17.9	11.71	65	0.53	3	5.7	32
MP2) J.T.C.HALL	1981	15.0	14.7	10.12	69	0.23	2	4.3	29
	1990	—	22.1	16.07	73	0.33	1	5.7	26
MP3) S.I.U.	1981	23.7	16.5	11.94	72	0.27	2	4.3	26
	1990	—	28.2	22.16	79	0.37	1	5.7	20
MP4) BOON LAY APARTMENT	1981	15.0	10.6	6.12	58	0.17	2	4.3	41
	1990	—	17.5	11.59	66	0.24	1	5.7	33
MP5) BUKIT TIHAH FIRE STAITION	1981	17.2	13.9	9.44	68	0.15	1	4.3	31
	1990	—	18.4	12.46	68	0.21	1	5.7	31
MP6) CHANGI AIRPORT	1981	6.6	6.3	1.78	28	0.18	3	4.3	69
	1990	—	8.8	2.84	32	0.28	3	5.7	65
MP7) BEDOK POLICE STATION	1981	7.2	7.8	3.07	39	0.43	6	4.3	55
	1990	—	11.2	4.77	43	0.72	6	5.7	51

2－2　メッシュ点の予測結果

1981年次及び1990年次における対象地域のSO_2環境濃度の年平均値の予測濃度分布を図V－2－2，図V－2－3に示す。予測濃度にはバックグランド濃度として1981年次で4.3 ppb，1990年次で5.7 ppbが加算されている。濃度分布のパターンは1981年次，1990年次ともほぼ同様であり，Jurong地区，Suthern Islands及びBukum島に高濃度域がみられる。1981年次において２０ppb以上であった範囲は，1990年次では３０ppb以上となっており，約１０ppb程度の増加がみられる。



図Ⅴ－2－2　SO_2予測値の等濃度線図（1981年次，年平均）　　単位；ppb

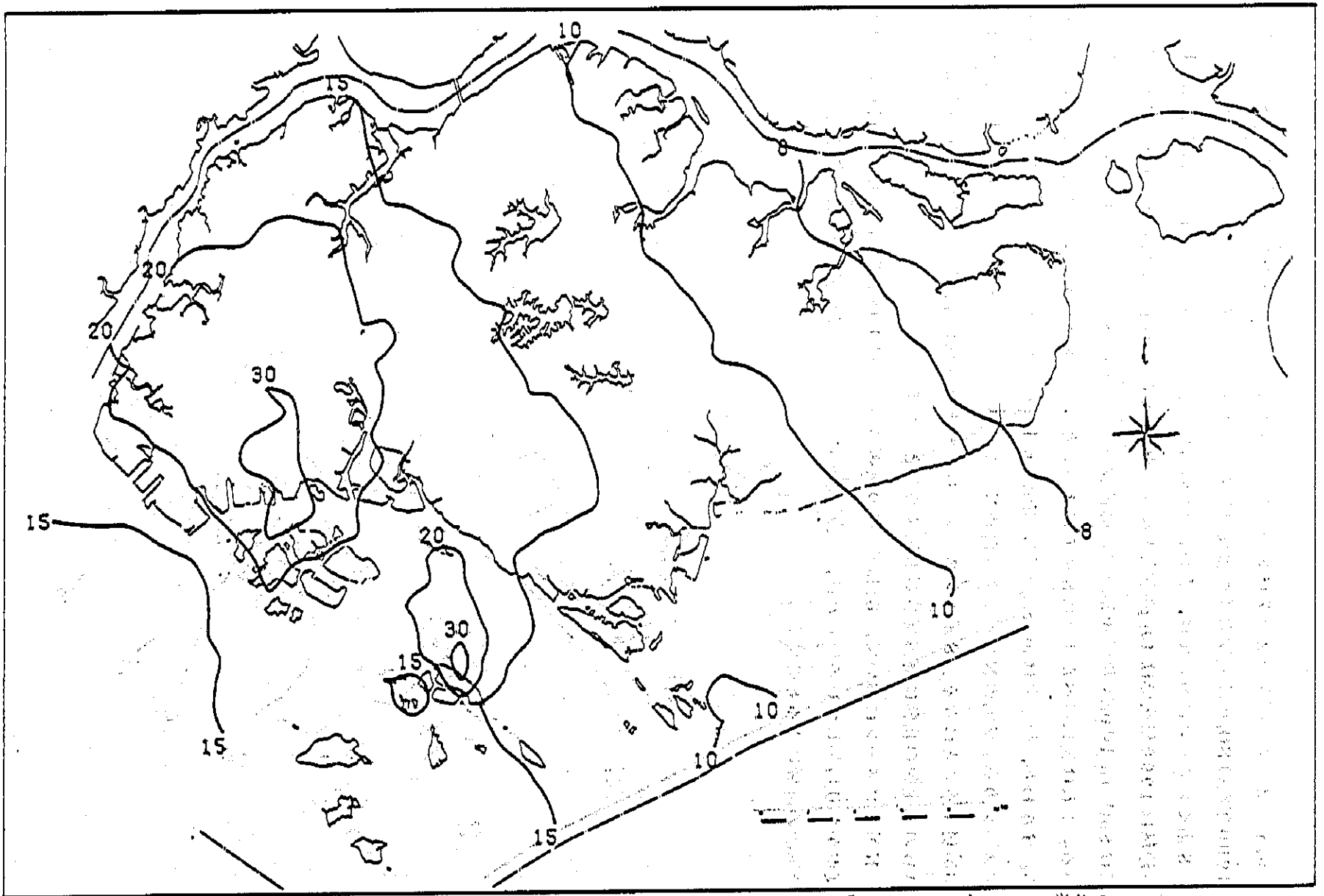


図Ⅴ－2－3　SO_2予測値の等濃度線図（1990年次，年平均）　　単位；ppb

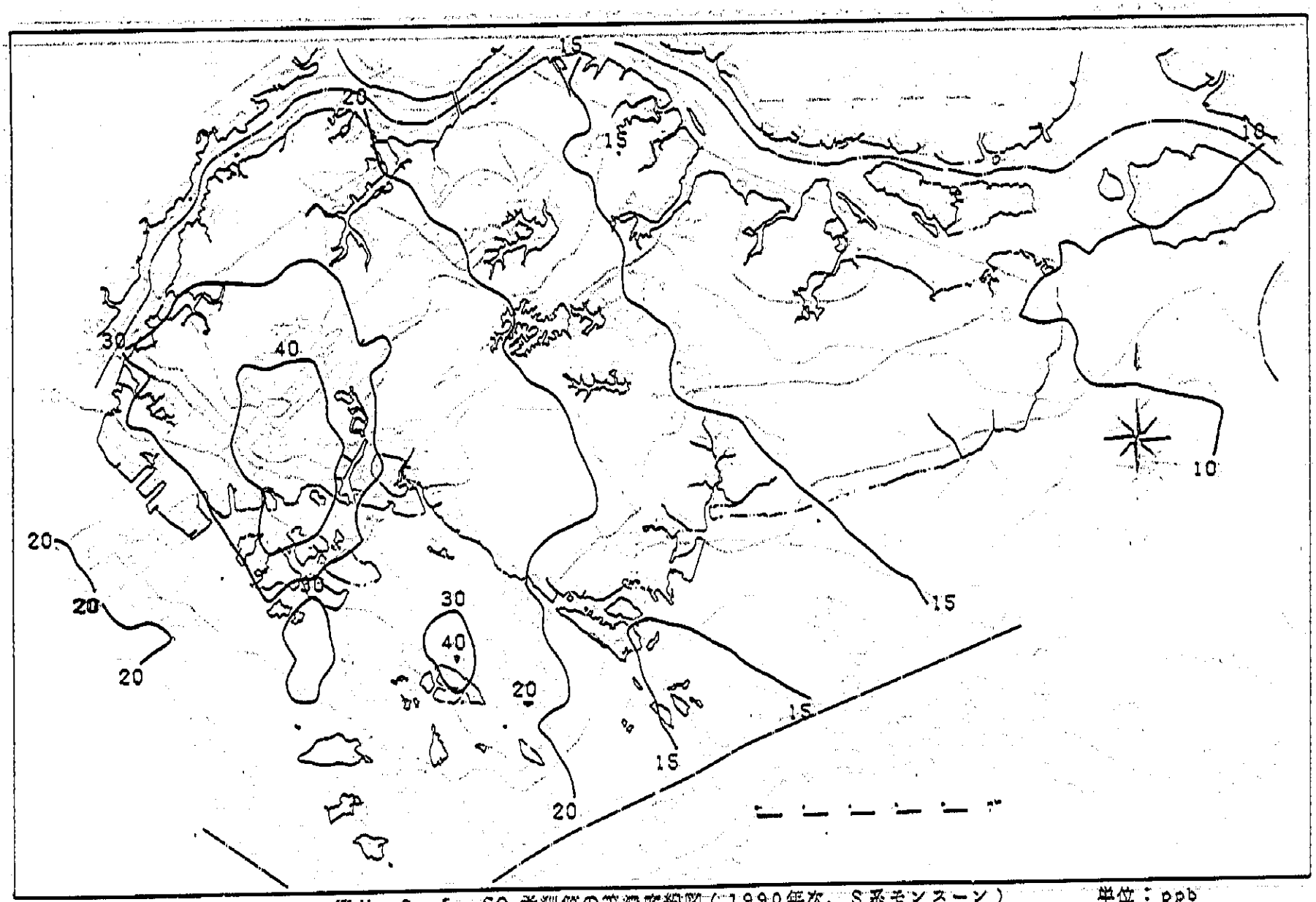
図Ⅴ－２－４～図Ⅴ－２－７はＳ系モンスーン及びＮ系モンスーンにおける1981年次と1990年次のSO_2環境濃度の予測濃度分布を示したものである。

Ｓ系モンスーンにおいては，Jurong地区に高濃度域がみられ，1981年次に30ppb以上である地域は1990年次では40ppb以上となっており，その範囲も拡大している。Ｎ系モンスーンにおいてはSuthern Islands及びBukum島に高濃度域がみられ，Ｓ系モンスーンとは大きく異なっている。これは先に述べたようにＳ系モンスーンとＮ系モンスーンの卓越風向の差異によっている。すなわち，発生源はJurong地区，Suthen Island及びBukum島に集中しており，Ｎ系モンスーンの卓越風向がＮＥ系であるためＮ系モンスーンではこれらの発生源の南側に高濃度域が出現することになる。Ｓ系モンスーンではこれとは反対に卓越風向がＳＥ系であるため，これらの発生源の北側に高濃度域が出現することになる。

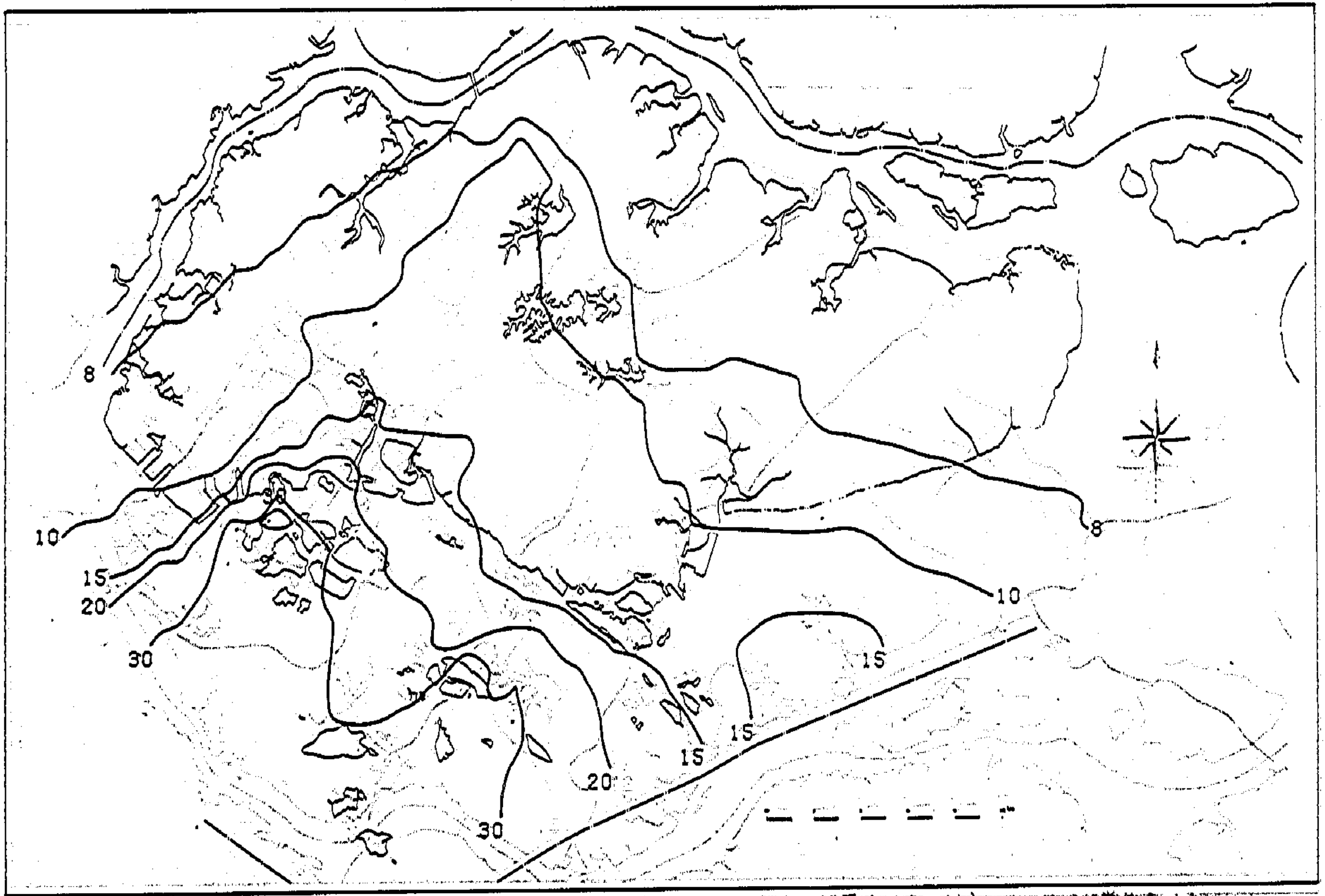
Ｎ系モンスーンにおいて，Bedok地区の東南の海上では1981年次に比較し1990年次は濃度がかなり増加している。これは，Tekong島に立地が計画されている一貫製鉄所及び石炭火力発電所の影響によるものである。



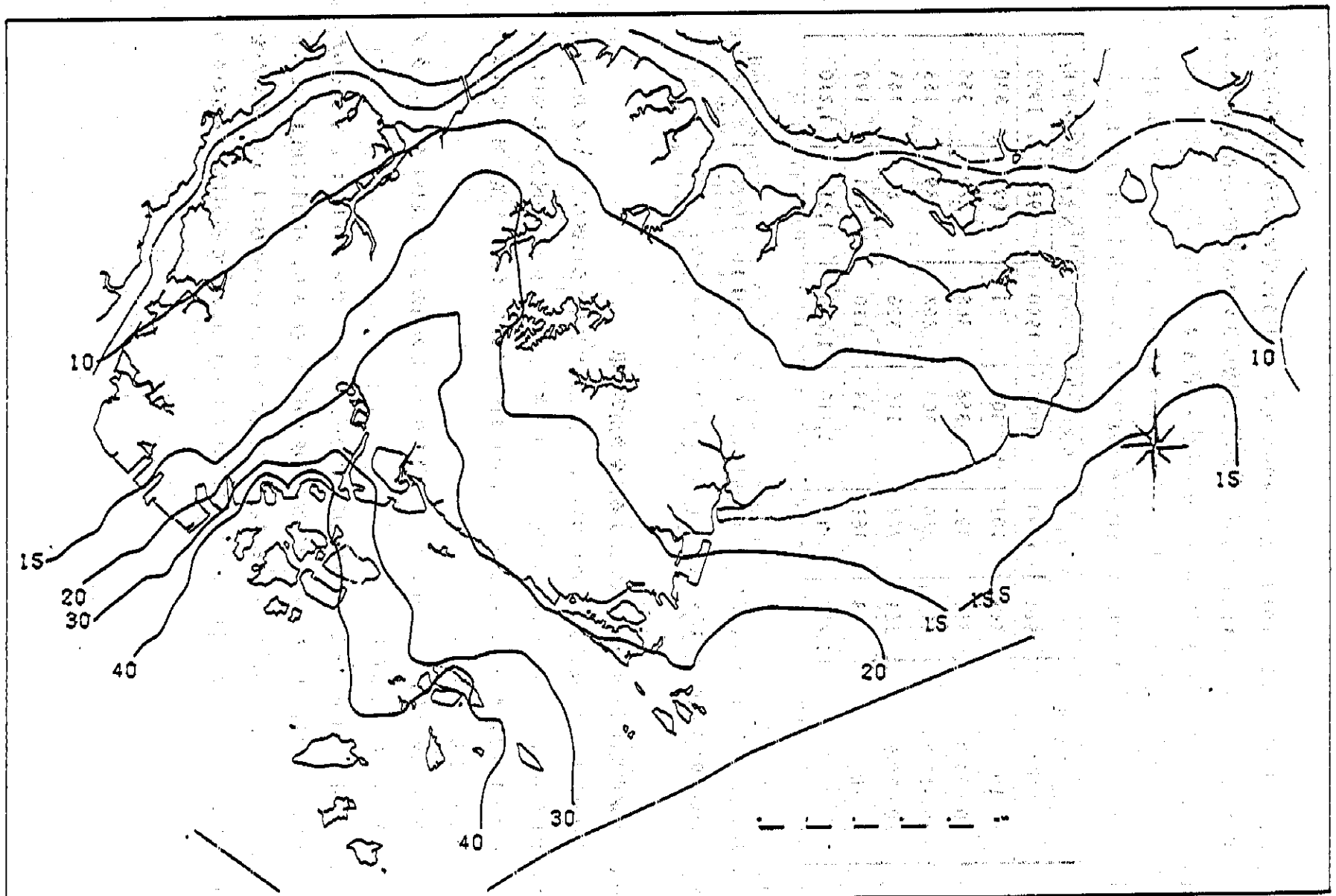
図Ⅴ－2－4　SO_2予測値の等濃度線図（1981年次，S系モンスーン）　　単位；ppb



図Ⅴ－2－5　SO_2予測値の等濃度線図（1990年次，S系モンスーン）　　単位：ppb



図－V－2－6　SO_2予測値の等濃度線図（1981年次，N系モンスーン）　単位；ppb



図Ⅴ－2－7　SO_2予測値の等濃度線図（1990年次，N系モンスーン）　　単位；ppb

次に，全体の環境濃度が1981年次と1990年次でどのように変化したかを概括的にみるため，各メッシュ点（全部で1210メッシュ）の濃度を濃度ランクで分類し，各濃度ランクに属するメッシュの数を求めた。その結果を表Ⅴ－2－4に示す。

表Ⅴ－2－4　SO_2予測濃度ランク別メッシュ数

濃度ランク (ppb)	年平均		S系モンスーン平均		N系モンスーン平均	
	1981	1990	1981	1990	1981	1990
10	467	103	409	84	694	330
10 - 14.9	368	397	368	368	229	355
15 - 19.9	196	280	304	262	89	183
20 - 29.9	161	262	116	386	84	143
30	18	168	13	110	114	199
合　計	1,210	1,210	1,210	1,210	1,210	1,210

この表で，年平均についてみると30 ppb以上のメッシュ数は1981年次で18メッシュであったのが1990年次では168メッシュに増加していることがわかる。

2－3　測定点及びピーク濃度地点における発生源別寄与率

測定点及びピーク濃度メッシュ点において，各発生源がどのように寄与しているのかを明らかにするために，各発生源別の寄与濃度とその寄与率を求めた。発生源の区分としては，各事業所（全61社），給鉛及びバックグランドの64区分である。但し，作業に当っては次の2種類の方法でとりまとめた。

① 各事業所のうち，寄与濃度の大きい上位10社とその他の事業所及び給鉛，バックグランドのように区分した表。

② 主要事業所10社とその他の事業所及び給鉛，バックグランドのようにとりまとめた表。

なお，主要事業所10社の内訳は一貫製鉄所1社，発電所5社，石油製精所4社である。

上記の①の表は，ある地点における環境濃度は主にどの発生源の寄与によっているのかを知るのに役立つ。②の表は着目している発生源の寄与は各地点においてどの程度であるかを知るのに役立つ。

(1) 測定点における寄与率

表Ⅴ－2－5(1)～(4)は，各測定点における各事業所の年平均値の寄与濃度のうち上位１０社を選んで，その寄与濃度と寄与率を示したものである。1990年次において最も濃度の高いＭＰ３についてみると，第１位がSeneko Power Stationの4.544 ppb，第２位がThe Chemical Car-Polation of Singapore Pte LTD.の3.933 ppbとなっている。これらの上位１０社の合計は23,108 ppbとなり全体の５８％を占めている。

また，表Ⅴ－2－6(1)～(4)，表Ⅴ－2－7(1)～(4)は各々Ｓ系モンスーン及びＮ系モンスーンにおける上位１０社の寄与濃度と寄与率を示したものである。

表Ⅴ－2－8は，主要事業所１０社の年平均値の寄与濃度と寄与率を示したものである。これをみるとSeneko Power Stationの寄与濃度はいずれの測定局においても大きな値を占めていることがわかる。Tekon Integrated Steel Millの寄与濃度についてみると，約0.2 ppb～0.3 ppbとなっており，その立地計画地点の関係でＭＰ６，ＭＰ７で高くなっている。Tekon Power Stationの寄与濃度は約0.05 ppb～0.1 ppbとなっている。また，Seraya Power Stationの寄与濃度は約0.3 ppb～2.3 ppbとなっておりＭＰ４に対する寄与が最も高く，寄与率では6.7％を占めている。

Ｓ系モンスーン及びＮ系モンスーンにおける寄与率は表Ⅴ－2－9，表Ⅴ－2－10に示した。

表Ⅴ－２－５(1)　測定点における高濃度上位１０社の寄与濃度（年平均）

MP1　N.U.S.

１９８１年次			１９９０年次		
工場・事業所名	寄与濃度（ppb）	寄与率（%）	工場・事業所名	寄与濃度（ppb）	寄与率（%）
SHELL COMPANIES IN SINGAPORE	2.799	17.65	SHELL COMPANIES IN SINGAPORE	2.799	12.96
SENOKO POWER STATION	1.826	11.52	SENOKO POWER STATION	2.773	12.86
PASIR PANJANG POWER STATION	1.580	9.96	PASIR PANJANG POWER STATION	1.580	7.31
JURONG POWER STATION	1.508	9.51	JURONG POWER STATION	1.508	6.98
ESSO SINGAPORE PTE LTD	0.680	4.29	ESSO SINGAPORE PTE LTD	0.680	3.15
SINGAPORE REFINING CO PTE LTD	0.380	2.40	NATIONAL IRON & STEEL MILLS LTD	0.531	2.46
MOBIL OIL SINGAPORE PTE LTD	0.300	1.89	SUMITOMO KAGAKU PTE LTD	0.405	1.87
NATIONAL IRON & STEEL MILLS LTD	0.213	1.35	SINGAPORE REFINING CO PTE LTD	0.380	1.76
SUGAR INDUSTRY OF SINGAPORE LTD	0.150	0.95	SUGAR INDUSTRY OF SINGAPORE LTD	0.374	1.73
RCD BRICKWORKS TILE WORKS	0.150	0.94	SERAYA POWER STATION	0.341	1.58
- REMAINING FACTORIES -	0.511	3.21	- REMAINING FACTORIES -	2.289	10.62
------- VESSELS -------	1.460	9.21	------- VESSELS -------	2.232	10.33
----- BACK GROUND -----	4.300	27.12	----- BACK GROUND -----	5.700	26.39
-------- TOTAL --------	15.857	100.00	-------- TOTAL --------	21.597	100.00

MP2　J.T.C. HALL

１９８１年次			１９９０年次		
工場・事業所名	寄与濃度（ppb）	寄与率（%）	工場・事業所名	寄与濃度（ppb）	寄与率（%）
SENOKO POWER STATION	3.093	18.57	SENOKO POWER STATION	4.679	18.91
PASIR PANJANG POWER STATION	1.795	10.78	PASIR PANJANG POWER STATION	1.795	7.25
SHELL COMPANIES IN SINGAPORE	1.714	10.29	SHELL COMPANIES IN SINGAPORE	1.714	6.93
ESSO SINGAPORE PTE LTD	1.156	6.94	SERAYA POWER STATION	1.217	4.92
JURONG POWER STATION	0.884	5.30	ESSO SINGAPORE PTE LTD	1.156	4.67
SINGAPORE REFINING CO PTE LTD	0.744	4.47	JURONG POWER STATION	0.884	3.57
RCD BRICKWORKS TILE WORKS	0.333	2.00	SINGAPORE REFINING CO PTE LTD	0.744	3.01
MOBIL OIL SINGAPORE PTE LTD	0.277	1.67	SIME DARBY OLEOCHEMICALS LTD	0.658	2.66
NATIONAL IRON & STEEL MILLS LTD	0.210	1.26	RCD BRICKWORKS TILE WORKS	0.652	2.63
SIME DARBY OLEOCHEMICALS LTD	0.193	1.16	SUMITOMO KAGAKU PTE LTD	0.649	2.62
- REMAINING FACTORIES -	0.812	4.87	- REMAINING FACTORIES -	3.159	12.76
------- VESSELS -------	1.144	6.87	------- VESSELS -------	1.742	7.04
----- BACK GROUND -----	4.300	25.82	----- BACK GROUND -----	5.700	23.03
-------- TOTAL --------	16.655	100.00	-------- TOTAL --------	24.749	100.00

表Ⅴ－２－５(2) 測定点における高濃度上位１０社の寄与濃度（年平均）

MP3 S.I.U.

1981年次 工場・事業所名	寄与濃度(ppb)	寄与率(%)	1990年次 工場・事業所名	寄与濃度(ppb)	寄与率(%)
SENOKO POWER STATION	3.002	12.96	SENOKO POWER STATION	4.544	11.38
ESSO SINGAPORE PTE LTD	2.601	11.23	THE CHEMICAL CORPN OF SINGAPORE PTE LTD	3.933	9.85
SINGAPORE REFINING CO PTE LTD	2.381	10.28	ESSO SINGAPORE PTE LTD	2.601	6.51
SHELL COMPANIES IN SINGAPORE	1.621	7.00	NATIONAL IRON & STEEL MILLS LTD	2.518	6.30
PASIR PANJANG POWER STATION	1.252	5.41	SINGAPORE REFINING CO PTE LTD	2.381	5.96
THE CHEMICAL CORPN OF SINGAPORE PTE LTD	1.156	4.99	SHELL COMPANIES IN SINGAPORE	1.621	4.06
NATIONAL IRON & STEEL MILLS LTD	1.011	4.36	SUGAR INDUSTRY OF SINGAPORE LTD	1.556	3.90
SUGAR INDUSTRY OF SINGAPORE LTD	0.625	2.70	DRAGON POLY-FOAM INDS (S) PTE LTD	1.377	3.45
MOBIL OIL SINGAPORE PTE LTD	0.535	2.31	SUMITOMO KAGAKU PTE LTD	1.324	3.31
HUME INDS (S) LTD	0.426	1.84	PASIR PANJANG POWER STATION	1.252	3.14
- REMAINING FACTORIES -	2.642	11.41	- REMAINING FACTORIES -	8.739	21.89
------- VESSELS -------	1.610	6.95	------- VESSELS -------	2.382	5.97
----- BACK GROUND -----	4.300	18.56	----- BACK GROUND -----	5.700	14.28
------- TOTAL -------	23.162	100.00	------- TOTAL -------	39.928	100.00

MP4 BOON LAY APARTMENT

1981年次 工場・事業所名	寄与濃度(ppb)	寄与率(%)	1990年次 工場・事業所名	寄与濃度(ppb)	寄与率(%)
JURONG POWER STATION	4.463	20.89	JURONG POWER STATION	4.463	13.15
SENOKO POWER STATION	1.725	8.08	SENOKO POWER STATION	3.347	9.86
ESSO SINGAPORE PTE LTD	1.692	7.92	SERAYA POWER STATION	2.273	6.70
PASIR PANJANG POWER STATION	1.621	7.59	DRAGON POLY-FOAM INDS (S) PTE LTD	1.709	5.04
SINGAPORE REFINING CO PTE LTD	1.432	6.71	ESSO SINGAPORE PTE LTD	1.692	4.99
SHELL COMPANIES IN SINGAPORE	1.394	6.53	PASIR PANJANG POWER STATION	1.621	4.78
SUGAR INDUSTRY OF SINGAPORE LTD	0.615	2.88	SUGAR INDUSTRY OF SINGAPORE LTD	1.532	4.51
MOBIL OIL SINGAPORE PTE LTD	0.589	2.76	SINGAPORE RSFINING CO PTE LTD	1.432	4.22
NATIONAL IRON & STEEL MILLS LTD	0.490	2.29	SHELL COMPANIES IN SINGAPORE	1.394	4.11
THE CHEMICAL CORPN OF SINGAPORE PTE LTD	0.190	0.89	NATIONAL IRON & STEEL MILLS LTD	1.221	3.60
- REMAINING FACTORIES -	1.665	7.80	- REMAINING FACTORIES -	5.812	17.15
------- VESSELS -------	1.182	5.53	------- VESSELS -------	1.734	5.11
----- BACK GROUND -----	4.300	20.13	----- BACK GROUND -----	5.700	16.80
------- TOTAL -------	21.358	100.00	------- TOTAL -------	33.930	100.00

表Ⅴ－2－5(3)　測定点における高濃度上位１０社の寄与濃度（年平均）

MP5　BUKIT TIMAH FIRE ST.

１９８１年次			１９９０年次		
工場・事業所名	寄与濃度（ppb）	寄与率（%）	工場・事業所名	寄与濃度（ppb）	寄与率（%）
SENOKO POWER STATION	3.165	21.19	SENOKO POWER STATION	4.091	19.73
PASIR PANJANG POWER STATION	1.872	12.54	PASIR PANJANG POWER STATION	1.872	9.03
SHELL COMPANIES IN SINGAPORE	1.532	10.26	SHELL COMPANIES IN SINGAPORE	1.532	7.39
JURONG POWER STATION	1.185	7.93	SERAYA POWER STATION	1.426	6.88
ESSO SINGAPORE PTE LTD	0.719	4.82	JURONG POWER STATION	1.185	5.71
SINGAPORE REFINING CO PTE LTD	0.444	2.97	ESSO SINGAPORE PTE LTD	0.719	3.47
MOBIL OIL SINGAPORE PTE LTD	0.188	1.26	SINGAPORE REFINING CO PTE LTD	0.444	2.14
SUGAR INDUSTRY OF SINGAPORE LTD	0.122	0.82	SUMITOMO KAGAKU PTE LTD	0.311	1.50
NATIONAL IRON & STEEL MILLS LTD	0.118	0.79	SUGAR INDUSTRY OF SINGAPORE LTD	0.303	1.46
RCO BRICKWORKS TILE WORKS	0.085	0.57	NATIONAL IRON & STEEL MILLS LTD	0.294	1.42
- REMAINING FACTORIES -	0.266	1.78	- REMAINING FACTORIES -	1.440	6.95
------- VESSELS -------	0.938	6.28	------- VESSELS -------	1.417	6.83
----- BACK GROUND -----	4.300	28.79	----- BACK GROUND -----	5.700	27.48
------- TOTAL -------	14.934	100.00	------- TOTAL -------	20.734	100.00

MP6　CHANGI AIRPORT

１９８１年次			１９９０年次		
工場・事業所名	寄与濃度（ppb）	寄与率（%）	工場・事業所名	寄与濃度（ppb）	寄与率（%）
SENOKO POWER STATION	0.508	7.58	SENOKO POWER STATION	0.769	8.06
JURONG POWER STATION	0.471	7.02	JURONG POWER STATION	0.471	4.94
PASIR PANJANG POWER STATION	0.303	4.52	TEKONG INTEGRATED STEEL MILL	0.309	3.24
SHELL COMPANIES IN SINGAPORE	0.229	3.42	PASIR PANJANG POWER STATION	0.303	3.18
ESSO SINGAPORE PTE LTD	0.160	2.38	SERAYA POWER STATION	0.277	2.90
SINGAPORE REFINING CO PTE LTD	0.091	1.35	SHELL COMPANIES IN SINGAPORE	0.229	2.40
MOBIL OIL SINGAPORE PTE LTD	0.086	1.28	ESSO SINGAPORE PTE LTD	0.160	1.67
NATIONAL IRON & STEEL MILLS LTD	0.029	0.44	TEKONG POWER STATION	0.108	1.14
SUGAR INDUSTRY OF SINGAPORE LTD	0.018	0.27	SINGAPORE REFINING CO PTE LTD	0.091	0.95
HORIZON PAPER INDS PTE LTD	0.012	0.18	MOBIL OIL SINGAPORE PTE LTD	0.081	0.85
- REMAINING FACTORIES -	0.068	1.00	- REMAINING FACTORIES -	0.383	4.02
------- VESSELS -------	0.435	6.48	------- VESSELS -------	0.659	6.90
----- BACK GROUND -----	4.300	64.08	----- BACK GROUND -----	5.700	59.75
------- TOTAL -------	6.710	100.00	------- TOTAL -------	9.540	100.00

表V－2－5(4) 測定点における高濃度上位10社の寄与濃度（年平均）

MP7 BEDOK POLICE STATION

1981年次			1990年次		
工場・事業所名	寄与濃度 (ppb)	寄与率 (%)	工場・事業所名	寄与濃度 (ppb)	寄与率 (%)
JURONG POWER STATION	0.852	10.54	SENOKO POWER STATION	1.047	9.07
SENOKO POWER STATION	0.689	8.52	JURONG POWER STATION	0.852	7.38
PASIR PANJANG POWER STATION	0.386	4.77	SERAYA POWER STATION	0.436	3.77
ESSO SINGAPORE PTE LTD	0.308	3.81	PASIR PANJANG POWER STATION	0.386	3.34
SHELL COMPANIES IN SINGAPORE	0.286	3.54	TEKONG INTEGRATED STEEL MILL	0.328	2.84
SINGAPORE REFINING CO PTE LTD	0.178	2.21	ESSO SINGAPORE PTE LTD	0.308	2.67
MOBIL OIL SINGAPORE PTE LTD	0.104	1.29	SHELL COMPANIES IN SINGAPORE	0.286	2.47
NATIONAL IRON & STEEL MILLS LTD	0.056	0.69	SINGAPORE REFINING CO PTE LTD	0.178	1.54
SUGAR INDUSTRY OF SINGAPORE LTD	0.036	0.44	NATIONAL IRON & STEEL MILLS LTD	0.139	1.20
HORIZON PAPER INDS PTE LTD	0.014	0.17	TEKONG POWER STATION	0.104	0.90
- REMAINING FACTORIES -	0.081	1.03	- REMAINING FACTORIES -	0.516	4.49
------VESSELS------	0.789	9.77	------VESSELS------	1.264	10.95
----- BACK GROUND -----	4.300	53.22	----- BACK GROUND -----	5.700	49.38
------- TOTAL -------	8.079	100.00	------- TOTAL -------	11.544	100.00

表Ⅴ－2－6(1)　測定点における高濃度上位１０社の寄与濃度（Ｓ系モンスーン平均）

MP1　N.U.S.

1981年次			1990年次		
工場・事業所名	寄与濃度(ppb)	寄与率(%)	工場・事業所名	寄与濃度(ppb)	寄与率(%)
SHELL COMPANIES IN SINGAPORE	4.409	24.08	SHELL COMPANIES IN SINGAPORE	4.409	18.24
PASIR PANJANG POWER STATION	2.607	14.24	PASIR PANJANG POWER STATION	2.607	10.78
JURONG POWER STATION	1.274	6.96	SENOKO POWER STATION	1.429	5.91
SENOKO POWER STATION	0.932	5.09	JURONG POWER STATION	1.274	5.27
ESSO SINGAPORE PTE LTD	0.820	4.48	ESSO SINGAPORE PTE LTD	0.820	3.39
SINGAPORE REFINING CO PTE LTD	0.448	2.45	NATIONAL IRON & STEEL MILLS LTD	0.538	2.23
MOBIL OIL SINGAPORE PTE LTD	0.281	1.53	SUMITOMO KAGAKU PTE LTD	0.475	1.97
NATIONAL IRON & STEEL MILLS LTD	0.216	1.18	SINGAPORE REFINING CO PTE LTD	0.448	1.85
SUGAR INDUSTRY OF SINGAPORE LTD	0.151	0.83	SERAYA POWER STATION	0.409	1.69
RCD BRICKWORKS TILE WORKS	0.148	0.81	SUGAR INDUSTRY OF SINGAPORE LTD	0.377	1.56
- REMAINING FACTORIES -	0.487	2.66	- REMAINING FACTORIES -	2.261	9.34
------- VESSELS -------	2.233	12.20	------- VESSELS -------	3.431	14.19
----- BACK GROUND -----	4.300	23.49	----- BACK GROUND -----	5.700	23.58
-------- TOTAL --------	18.306	100.00	-------- TOTAL --------	24.178	100.00

MP2　J.T.C. HALL

1981年次			1990年次		
工場・事業所名	寄与濃度(ppb)	寄与率(%)	工場・事業所名	寄与濃度(ppb)	寄与率(%)
PASIR PANJANG POWER STATION	2.965	16.41	PASIR PANJANG POWER STATION	2.965	11.14
SHELL COMPANIES IN SINGAPORE	2.802	15.51	SHELL COMPANIES IN SINGAPORE	2.802	10.53
ESSO SINGAPORE PTE LTD	1.545	8.55	SERAYA POWER STATION	1.860	6.99
JURONG POWER STATION	1.055	5.84	ESSO SINGAPORE PTE LTD	1.545	5.80
SINGAPORE REFINING CO PTE LTD	0.997	5.52	JURONG POWER STATION	1.055	3.96
SENOKO POWER STATION	0.586	3.24	SINGAPORE REFINING CO PTE LTD	0.997	3.74
MOBIL OIL SINGAPORE PTE LTD	0.319	1.77	SIME DARBY OLEOCHEMICALS LTD	0.990	3.72
SIME DARBY OLEOCHEMICALS LTD	0.291	1.61	SUMITOMO KAGAKU PTE LTD	0.943	3.54
NATIONAL IRON & STEEL MILLS LTD	0.249	1.38	SENOKO POWER STATION	0.890	3.34
RCD BRICKWORKS TILE WORKS	0.241	1.33	NATIONAL IRON & STEEL MILLS LTD	0.619	2.33
- REMAINING FACTORIES -	0.930	5.14	- REMAINING FACTORIES -	3.515	13.21
------- VESSELS -------	1.798	9.90	------- VESSELS -------	2.738	10.29
----- BACK GROUND -----	4.300	23.80	----- BACK GROUND -----	5.700	21.41
-------- TOTAL --------	18.068	100.00	-------- TOTAL --------	26.619	100.00

表V－2－6(2)　測定点における高濃度上位10社の寄与濃度（S系モンスーン平均）

MP3　S.I.U.

1981年次 工場・事業所名	寄与濃度(ppb)	寄与率(%)	1990年次 工場・事業所名	寄与濃度(ppb)	寄与率(%)
ESSO SINGAPORE PTE LTD	3.968	14.24	THE CHEMICAL CORPN OF SINGAPORE PTE LTD	6.518	13.55
SINGAPORE REFINING CO PTE LTD	3.744	13.44	ESSO SINGAPORE PTE LTD	3.968	8.25
SHELL COMPANIES IN SINGAPORE	2.649	9.51	SINGAPORE REFINING CO PTE LTD	3.744	7.77
PASIR PANJANG POWER STATION	2.051	7.36	NATIONAL IRON & STEEL MILLS LTD	3.411	7.08
THE CHEMICAL CORPN OF SINGAPORE PTE LTD	1.915	6.88	SHELL COMPANIES IN SINGAPORE	2.649	5.50
NATIONAL IRON & STEEL MILLS LTD	1.369	4.92	SUGAR INDUSTRY OF SINGAPORE LTD	2.509	5.21
SUGAR INDUSTRY OF SINGAPORE LTD	1.007	3.62	SUMITOMO KAGAKU PTE LTD	2.061	4.28
HUME INDS (S) LTD	0.693	2.49	PASIR PANJANG POWER STATION	2.051	4.26
SENOKO POWER STATION	0.631	2.27	SERAYA POWER STATION	2.046	4.25
MOBIL OIL SINGAPORE PTE LTD	0.619	2.22	HUME INDS (S) LTD	1.727	3.58
- REMAINING FACTORIES -	2.358	8.44	- REMAINING FACTORIES -	7.997	16.59
------ VESSELS ------	2.555	9.17	------ VESSELS ------	3.803	7.89
----- BACK GROUND -----	4.300	15.44	----- BACK GROUND -----	5.700	11.83
------- TOTAL -------	27.859	100.00	------- TOTAL -------	48.184	100.00

MP4　BOON LAY APARTMENT

1981年次 工場・事業所名	寄与濃度(ppb)	寄与率(%)	1990年次 工場・事業所名	寄与濃度(ppb)	寄与率(%)
JURONG POWER STATION	7.181	24.81	JURONG POWER STATION	7.181	15.78
PASIR PANJANG POWER STATION	2.679	9.25	SERAYA POWER STATION	3.604	7.92
ESSO SINGAPORE PTE LTD	2.571	8.88	DRAGON POLY-FOAM INDS (S) PTE LTD	2.692	5.92
SHELL COMPANIES IN SINGAPORE	2.274	7.86	PASIR PANJANG POWER STATION	2.679	5.89
SINGAPORE REFINING CO PTE LTD	2.252	7.78	ESSO SINGAPORE PTE LTD	2.571	5.65
SUGAR INDUSTRY OF SINGAPORE LTD	0.968	3.34	SUGAR INDUSTRY OF SINGAPORE LTD	2.410	5.30
MOBIL OIL SINGAPORE PTE LTD	0.780	2.70	SHELL COMPANIES IN SINGAPORE	2.274	5.00
NATIONAL IRON & STEEL MILLS LTD	0.731	2.52	SINGAPORE REFINING CO PTE LTD	2.252	4.95
SENOKO POWER STATION	0.544	1.88	NATIONAL IRON & STEEL MILLS LTD	1.820	4.00
THE CHEMICAL CORPN OF SINGAPORE PTE LTD	0.311	1.07	SUMITOMO KAGAKU PTE LTD	1.405	3.09
- REMAINING FACTORIES -	2.465	8.52	- REMAINING FACTORIES -	8.126	17.85
------ VESSELS ------	1.892	6.54	------ VESSELS ------	2.786	6.12
----- BACK GROUND -----	4.300	14.85	----- BACK GROUND -----	5.700	12.53
------- TOTAL -------	28.948	100.00	------- TOTAL -------	45.500	100.00

表Ⅴ－2－6(3)　測定点における高濃度上位10社の寄与濃度（S系モンスーン平均）

MP5　BUKIT TIMAH FIRE ST.

1981年次			1990年次		
工場・事業所名	寄与濃度 (ppb)	寄与率 (%)	工場・事業所名	寄与濃度 (ppb)	寄与率 (%)
PASIR PANJANG POWER STATION	3.071	19.58	PASIR PANJANG POWER STATION	3.071	13.71
SHELL COMPANIES IN SINGAPORE	2.420	15.43	SHELL COMPANIES IN SINGAPORE	2.420	10.80
JURONG POWER STATION	1.408	8.98	SERAYA POWER STATION	2.168	9.68
ESSO SINGAPORE PTE LTD	0.953	6.08	JURONG POWER STATION	1.408	6.28
SINGAPORE REFINING CO PTE LTD	0.587	3.74	ESSO SINGAPORE PTE LTD	0.953	4.25
SENOKO POWER STATION	0.499	3.18	SENOKO POWER STATION	0.867	3.87
MOBIL OIL SINGAPORE PTE LTD	0.219	1.40	SINGAPORE REFINING CO PTE LTD	0.587	2.62
SUGAR INDUSTRY OF SINGAPORE LTD	0.160	1.02	SUMITOMO KAGAKU PTE LTD	0.405	1.81
NATIONAL IRON & STEEL MILLS LTD	0.142	0.90	SUGAR INDUSTRY OF SINGAPORE LTD	0.399	1.78
RCD BRICKWORKS TILE WORKS	0.085	0.54	TEKONG INTEGRATED STEEL MILL	0.369	1.65
- REMAINING FACTORIES -	0.338	2.17	- REMAINING FACTORIES -	1.786	7.97
------ VESSELS ------	1.497	9.55	------ VESSELS ------	2.272	10.14
----- BACK GROUND -----	4.300	27.43	----- BACK GROUND -----	5.700	25.44
------ TOTAL ------	15.679	100.00	------ TOTAL ------	22.405	100.00

MP6　CHANGI AIRPORT

1981年次			1990年次		
工場・事業所名	寄与濃度 (ppb)	寄与率 (%)	工場・事業所名	寄与濃度 (ppb)	寄与率 (%)
JURONG POWER STATION	0.576	8.19	JURONG POWER STATION	0.576	5.73
PASIR PANJANG POWER STATION	0.372	5.29	SENOKO POWER STATION	0.527	5.24
SENOKO POWER STATION	0.346	4.93	TEKONG INTEGRATED STEEL MILL	0.374	3.72
SHELL COMPANIES IN SINGAPORE	0.282	4.01	PASIR PANJANG POWER STATION	0.372	3.70
ESSO SINGAPORE PTE LTD	0.199	2.83	SERAYA POWER STATION	0.329	3.27
SINGAPORE REFINING CO PTE LTD	0.110	1.57	SHELL COMPANIES IN SINGAPORE	0.232	2.30
MOBIL OIL SINGAPORE PTE LTD	0.086	1.23	ESSO SINGAPORE PTE LTD	0.199	1.98
NATIONAL IRON & STEEL MILLS LTD	0.036	0.52	TEKONG POWER STATION	0.130	1.29
SUGAR INDUSTRY OF SINGAPORE LTD	0.022	0.32	SINGAPORE REFINING CO PTE LTD	0.110	1.10
HORIZON PAPER INDS PTE LTD	0.012	0.17	NATIONAL IRON & STEEL MILLS LTD	0.091	0.90
- REMAINING FACTORIES -	0.073	1.03	- REMAINING FACTORIES -	0.433	4.34
------ VESSELS ------	0.612	8.71	------ VESSELS ------	0.926	9.21
----- BACK GROUND -----	4.300	61.20	----- BACK GROUND -----	5.700	56.72
------ TOTAL ------	7.026	100.00	------ TOTAL ------	10.049	100.00

表V－2－6(4) 測定点における高濃度上位10社の寄与濃度（S系モンスーン平均）

MP7 : BEDOK POLICE STATION

1981年次			1990年次		
工場・事業所名	寄与濃度 (ppb)	寄与率 (%)	工場・事業所名	寄与濃度 (ppb)	寄与率 (%)
JURONG POWER STATION	0.842	10.16	JURONG POWER STATION	0.843	7.13
SENOKO POWER STATION	0.491	5.93	SENOKO POWER STATION	0.753	6.38
PASIR PANJANG POWER STATION	0.470	5.68	PASIR PANJANG POWER STATION	0.670	5.68
SHELL COMPANIES IN SINGAPORE	0.349	4.22	SERAYA POWER STATION	0.417	3.53
ESSO SINGAPORE PTE LTD	0.310	3.74	SHELL COMPANIES IN SINGAPORE	0.349	2.96
SINGAPORE REFINING CO PTE LTD	0.180	2.18	TEKONG INTEGRATED STEEL MILL	0.329	2.79
MOBIL OIL SINGAPORE PTE LTD	0.101	1.22	ESSO SINGAPORE PTE LTD	0.310	2.62
NATIONAL IRON & STEEL MILLS LTD	0.057	0.69	SINGAPORE REFINING CO PTE LTD	0.180	1.53
SUGAR INDUSTRY OF SINGAPORE LTD	0.036	0.44	NATIONAL IRON & STEEL MILLS LTD	0.142	1.20
HORIZON PAPER INDS PTE LTD	0.014	0.17	TEKONG POWER STATION	0.103	0.88
- REMAINING FACTORIES -	0.088	1.05	- REMAINING FACTORIES -	2.034	4.60
------- VESSELS -------	1.044	12.60	------- VESSELS -------	1.650	13.99
------ BACK GROUND ------	4.300	51.92	------ BACK GROUND ------	5.700	48.33
-------- TOTAL --------	8.282	100.00	-------- TOTAL --------	11.794	100.00

表Ｖ－２－７(1)　測定点における高濃度上位１０社の寄与濃度（Ｎ系モンスーン平均）

MP1　N.U.S.

１９８１年次			１９９０年次		
工場・事業所名	寄与濃度(ppb)	寄与率(%)	工場・事業所名	寄与濃度(ppb)	寄与率(%)
SENOKO POWER STATION	3.093	24.97	SENOKO POWER STATION	4.689	26.14
JURONG POWER STATION	1.838	14.84	JURONG POWER STATION	1.838	10.25
SHELL COMPANIES IN SINGAPORE	0.517	4.17	NATIONAL IRON & STEEL MILLS LTD	0.522	2.91
ESSO SINGAPORE PTE LTD	0.481	3.88	SHELL COMPANIES IN SINGAPORE	0.517	2.88
MOBIL OIL SINGAPORE PTE LTD	0.328	2.65	ESSO SINGAPORE PTE LTD	0.481	2.68
SINGAPORE REFINING CO PTE LTD	0.285	2.30	SUGAR INDUSTRY OF SINGAPORE LTD	0.370	2.06
NATIONAL IRON & STEEL MILLS LTD	0.210	1.69	SUMITOMO KAGAKU PTE LTD	0.304	1.70
RCD BRICKWORKS TILE WORKS	0.151	1.22	MOBIL OIL SINGAPORE PTE LTD	0.297	1.66
SUGAR INDUSTRY OF SINGAPORE LTD	0.148	1.20	RCD BRICKWORKS TILE WORKS	0.296	1.65
PASIR PANJANG POWER STATION	0.123	0.99	SIME DARBY OLEOCHEMICALS LTD	0.295	1.65
- REMAINING FACTORIES -	0.549	4.44	- REMAINING FACTORIES -	2.099	11.63
------- VESSELS -------	0.364	2.94	------- VESSELS -------	0.532	2.97
----- BACK GROUND -----	4.300	34.71	----- BACK GROUND -----	5.700	31.77
-------- TOTAL --------	12.387	100.00	-------- TOTAL --------	17.940	100.00

MP2　J.T.C. HALL

１９８１年次			１９９０年次		
工場・事業所名	寄与濃度(ppb)	寄与率(%)	工場・事業所名	寄与濃度(ppb)	寄与率(%)
SENOKO POWER STATION	6.646	45.35	SENOKO POWER STATION	10.048	45.47
JURONG POWER STATION	0.641	4.37	RCD BRICKWORKS TILE WORKS	0.908	4.11
ESSO SINGAPORE PTE LTD	0.605	4.13	JURONG POWER STATION	0.641	2.90
RCD BRICKWORKS TILE WORKS	0.464	3.17	ESSO SINGAPORE PTE LTD	0.605	2.74
SINGAPORE REFINING CO PTE LTD	0.386	2.64	SINGAPORE REFINING CO PTE LTD	0.386	1.75
MOBIL OIL SINGAPORE PTE LTD	0.218	1.49	NATIONAL IRON & STEEL MILLS LTD	0.385	1.74
SHELL COMPANIES IN SINGAPORE	0.173	1.18	SUGAR INDUSTRY OF SINGAPORE LTD	0.341	1.65
NATIONAL IRON & STEEL MILLS LTD	0.155	1.05	SERAYA POWER STATION	0.305	1.38
SUGAR INDUSTRY OF SINGAPORE LTD	0.145	0.99	DRAGON POLY-FOAM INDS (S) PTE LTD	0.242	1.09
PASIR PANJANG POWER STATION	0.137	0.94	SUMITOMO KAGAKU PTE LTD	0.232	1.05
- REMAINING FACTORIES -	0.551	3.77	- REMAINING FACTORIES -	1.958	8.86
------- VESSELS -------	0.232	1.58	------- VESSELS -------	0.329	1.49
----- BACK GROUND -----	4.300	29.34	----- BACK GROUND -----	5.700	25.79
-------- TOTAL --------	14.653	100.00	-------- TOTAL --------	22.100	100.00

表Ⅴ－２－７(2)　測定点における高濃度上位１０社の寄与濃度（Ｎ系モンスーン平均）

MP3　N.U.S.					
１９８１年次			１９９０年次		
工場・事業所名	寄与濃度（ppb）	寄与率（%）	工場・事業所名	寄与濃度（ppb）	寄与率（%）
SENOKO POWER STATION	6.361	38.54	SENOKO POWER STATION	9.622	34.09
ESSO SINGAPORE PTE LTD	0.665	4.03	DRAGON POLY-FOAM INDS (S) PTE LTD	2.720	9.64
NATIONAL IRON & STEEL MILLS LTD	0.502	3.04	NATIONAL IRON & STEEL MILLS LTD	1.251	4.43
HERCULES RUBBER & CHAMICAL INDS PTE LTD	0.463	2.80	BEECHAN (MFG) SINGAPORE PTE LTD	0.762	2.70
MAXIM DYEING & FINISHING FTY PTE LTD	0.454	2.75	HERCULES RUBBER & CHAMICAL INDS PTE LTD	0.714	2.53
SINGAPORE REFINING CO PTE LTD	0.450	2.72	BROADWAY ENTERPRISES PTE LTD	0.705	2.50
MOBIL OIL SINGAPORE PTE LTD	0.415	2.51	MAXIM DYEING & FINISHING FTY PTE LTD	0.695	2.46
BROADWAY ENTERPRISES PTE LTD	0.311	1.88	ESSO SINGAPORE PTE LTD	0.665	2.36
DRAGON POLY-FOAM INDS (S) PTE LTD	0.296	1.79	RCD BRICKWORKS TILE WORKS	0.486	1.72
HONGKONG DYEING & WEAVING (S) LTD	0.252	1.53	SINGAPORE REFINING CO PTE LTD	0.450	1.59
- REMAINING FACTORIES -	1.768	10.72	- REMAINING FACTORIES -	4.090	14.48
------- VESSELS -------	0.270	1.64	------- VESSELS -------	0.368	1.31
----- BACK GROUND -----	4.300	26.05	----- BACK GROUND -----	5.700	20.19
-------- TOTAL --------	16.507	100.00	-------- TOTAL --------	28.228	100.00

MP4　BOON LAY APARTMENT					
１９８１年次			１９９０年次		
工場・事業所名	寄与濃度（ppb）	寄与率（%）	工場・事業所名	寄与濃度（ppb）	寄与率（%）
SENOKO POWER STATION	3.399	32.06	SENOKO POWER STATION	6.873	39.19
JURONG POWER STATION	0.610	5.76	JURONG POWER STATION	0.610	3.48
ESSO SINGAPORE PTE LTD	0.446	4.20	ESSO SINGAPORE PTE LTD	0.446	2.54
MOBIL OIL SINGAPORE PTE LTD	0.318	2.99	SERAYA POWER STATION	0.386	2.20
SINGAPORE REFINING CO PTE LTD	0.270	2.55	NATIONAL IRON & STEEL MILLS LTD	0.371	2.11
NATIONAL IRON & STEEL MILLS LTD	0.149	1.40	DRAGON POLY-FOAM INDS (S) PTE LTD	0.316	1.80
SHELL COMPANIES IN SINGAPORE	0.146	1.38	SUGAR INDUSTRY OF SINGAPORE LTD	0.287	1.63
PASIR PANJANG POWER STATION	0.123	1.16	MOBIL OIL SINGAPORE PTE LTD	0.285	1.61
SUGAR INDUSTRY OF SINGAPORE LTD	0.115	1.08	SINGAPORE REFINING CO PTE LTD	0.270	1.54
RCD BRICKWORKS TILE WORKS	0.069	0.65	BROADWAY ENTERPRISES PTE LTD	0.189	1.08
- REMAINING FACTORIES -	0.482	4.56	- REMAINING FACTORIES -	1.561	8.92
------- VESSELS -------	0.175	1.65	------- VESSELS -------	0.243	1.39
----- BACK GROUND -----	4.300	40.56	----- BACK GROUND -----	5.700	32.51
-------- TOTAL --------	10.602	100.00	-------- TOTAL --------	17.534	100.00

表Ⅴ－２－７(3)　測定点における高濃度上位１０社の寄与濃度（Ｎ系モンスーン平均）

MP5　BUKIT TIMAH FIRE ST.

１９８１年次			１９９０年次		
工場・事業所名	寄与濃度(ppb)	寄与率(%)	工場・事業所名	寄与濃度(ppb)	寄与率(%)
SENOKO POWER STATION	6.944	50.03	SENOKO POWER STATION	8.659	47.14
JURONG POWER STATION	0.868	6.25	JURONG POWER STATION	0.868	4.72
ESSO SINGAPORE PTE LTD	0.388	2.79	ESSO SINGAPORE PTE LTD	0.388	2.11
SHELL COMPANIES IN SINGAPORE	0.273	1.97	SERAYA POWER STATION	0.375	2.04
SINGAPORE REFINING CO PTE LTD	0.242	1.74	SHELL COMPANIES IN SINGAPORE	0.273	1.48
PASIR PANJANG POWER STATION	0.174	1.26	SINGAPORE REFINING CO PTE LTD	0.242	1.32
MOBIL OIL SINGAPORE PTE LTD	0.144	1.04	NATIONAL IRON & STEEL MILLS LTD	0.209	1.14
NATIONAL IRON & STEEL MILLS LTD	0.084	0.61	SUMITOMO KAGAKU PTE LTD	0.177	0.96
RCD BRICKWORKS TILE WORKS	0.084	0.60	PASIR PANJANG POWER STATION	0.174	0.95
SUGAR INDUSTRY OF SINGAPORE LTD	0.067	0.48	SUGAR INDUSTRY OF SINGAPORE LTD	0.167	0.91
- REMAINING FACTORIES -	0.164	1.19	- REMAINING FACTORIES -	0.928	5.07
------- VESSELS -------	0.147	1.06	------- VESSELS -------	0.206	1.12
----- BACK GROUND -----	4.300	30.98	----- BACK GROUND -----	5.700	31.04
-------- TOTAL --------	13.879	100.00	-------- TOTAL --------	18.366	100.00

MP6　CHANGI AIRPORT

１９８１年次			１９９０年次		
工場・事業所名	寄与濃度(ppb)	寄与率(%)	工場・事業所名	寄与濃度(ppb)	寄与率(%)
SENOKO POWER STATION	0.738	11.79	SENOKO POWER STATION	1.112	12.61
JURONG POWER STATION	0.323	5.15	JURONG POWER STATION	0.323	3.66
PASIR PANJANG POWER STATION	0.206	3.28	TEKONG INTEGRATED STEEL MILL	0.218	2.47
SHELL COMPANIES IN SINGAPORE	0.155	2.47	PASIR PANJANG POWER STATION	0.206	2.33
ESSO SINGAPORE PTE LTD	0.105	1.67	SERAYA POWER STATION	0.203	2.30
MOBIL OIL SINGAPORE PTE LTD	0.086	1.37	SHELL COMPANIES IN SINGAPORE	0.155	1.76
SINGAPORE REFINING CO PTE LTD	0.063	1.00	ESSO SINGAPORE PTE LTD	0.105	1.19
NATIONAL IRON & STEEL MILLS LTD	0.019	0.31	MOBIL OIL SINGAPORE PTE LTD	0.078	0.88
SUGAR INDUSTRY OF SINGAPORE LTD	0.013	0.20	TEKONG POWER STATION	0.078	0.88
HORIZON PAPER INDS PTE LTD	0.011	0.18	SINGAPORE REFINING CO PTE LTD	0.063	0.71
- REMAINING FACTORIES -	0.060	0.98	- REMAINING FACTORIES -	0.297	3.40
------- VESSELS -------	0.184	2.94	------- VESSELS -------	0.280	3.17
----- BACK GROUND -----	4.300	68.66	----- BACK GROUND -----	5.700	64.64
-------- TOTAL --------	6.263	100.00	-------- TOTAL --------	8.818	100.00

表Ⅴ－２－７(4)　測定点における高濃度上位１０社の寄与濃度（Ｎ系モンスーン平均）

MP7　BEDOK POLICE STATION

1981年次			1990年次		
工場・事業所名	寄与濃度 (ppb)	寄与率 (%)	工場・事業所名	寄与濃度 (ppb)	寄与率 (%)
SENOKO POWER STATION	0.969	12.43	SENOKO POWER STATION	1.464	13.08
JURONG POWER STATION	0.866	11.11	JURONG POWER STATION	0.866	7.74
ESSO SINGAPORE PTE LTD	0.306	3.92	SERAYA POWER STATION	0.462	4.13
PASIR PANJANG POWER STATION	0.266	3.41	TEKONG INTEGRATED STEEL MILL	0.327	2.92
SHELL COMPANIES IN SINGAPORE	0.196	2.51	ESSO SINGAPORE PTE LTD	0.306	2.73
SINGAPORE REFINING CO PTE LTD	0.175	2.25	PASIR PANJANG POWER STATION	0.266	2.37
MOBIL OIL SINGAPORE PTE LTD	0.109	1.40	SHELL COMPANIES IN SINGAPORE	0.196	1.75
NATIONAL IRON & STEEL MILLS LTD	0.054	0.70	SINGAPORE REFINING CO PTE LTD	0.175	1.57
SUGAR INDUSTRY OF SINGAPORE LTD	0.035	0.45	NATIONAL IRON & STEEL MILLS LTD	0.135	1.21
HORIZON PAPER INDS PTE LTD	0.013	0.17	TEKONG POWER STATION	0.105	0.94
- REMAINING FACTORIES -	0.076	0.98	- REMAINING FACTORIES -	0.470	4.21
------- VESSELS -------	0.428	5.49	------- VESSELS -------	0.717	6.41
------ BACK GROUND ------	4.300	55.18	------ BACK GROUND ------	5.700	50.94
------- TOTAL -------	7.792	100.00	------- TOTAL -------	11.184	100.00

表Ⅴ－２－８　測定点における主要事業所の寄与濃度（年平均）

事業所名	(1) N.U.S.				(2) J.T.C. HALL			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.204	0.95	—	—	0.192	0.78
SENOKO POWER STATION	1.826	11.52	2.776	12.86	3.053	16.57	4.679	18.91
JURONG POWER STATION	1.502	9.51	1.506	6.98	0.653	5.30	0.884	3.57
PASIR PANJANG POWER STATION	1.530	9.96	1.580	7.31	1.295	10.78	1.795	7.25
SERAYA POWER STATION	—	—	0.341	1.58	—	—	1.217	4.92
TEKONG POWER STATION	—	—	0.063	0.29	—	—	0.059	0.24
SHELL COMPANIES IN SINGAPORE	2.799	17.65	2.799	12.96	1.714	10.49	1.714	6.93
ESSO SINGAPORE PTE LTD	0.680	4.29	0.680	3.15	1.155	8.94	1.156	4.67
SINGAPORE REFINING CO PTE LTD	0.350	2.40	0.360	1.76	0.744	4.47	0.744	3.01
MOBIL OIL SINGAPORE PTE LTD.	0.300	1.89	0.284	1.31	0.277	1.67	0.263	1.06
-- REMAINING FACTORIES --	1.024	6.45	3.048	14.13	1.548	9.29	4.604	18.59
------- VESSELS -------	1.460	9.21	2.232	10.33	1.144	6.87	1.742	7.04
----- BACK GROUND -----	4.300	27.13	5.700	26.39	4.300	25.85	5.700	23.03
-------- TOTAL --------	15.857	100.00	21.597	100.00	16.355	100.00	24.749	100.00

事業所名	(3) S.I.U.				(4) BOON LAY APARTMENT			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.177	0.44	—	—	0.233	0.89
SENOKO POWER STATION	3.003	12.96	4.544	11.38	1.725	8.05	3.347	9.66
JURONG POWER STATION	0.104	0.45	0.104	0.26	4.453	20.33	4.453	13.15
PASIR PANJANG POWER STATION	1.252	5.41	1.252	3.14	1.621	7.53	1.621	4.78
SERAYA POWER STATION	—	—	1.243	3.11	—	—	2.273	6.70
TEKONG POWER STATION	—	—	0.054	0.14	—	—	0.071	0.21
SHELL COMPANIES IN SINGAPORE	1.621	7.00	1.621	4.06	1.394	6.53	1.394	4.11
ESSO SINGAPORE PTE LTD	2.601	11.23	2.601	6.51	1.652	7.72	1.652	4.99
SINGAPORE REFINING CO PTE LTD	2.381	10.28	2.381	5.96	1.430	6.71	1.432	4.22
MOBIL OIL SINGAPORE PTE LTD.	0.535	2.31	0.505	1.27	0.559	2.26	0.559	1.64
-- REMAINING FACTORIES --	5.754	24.65	17.364	43.48	2.980	13.83	9.412	27.74
------- VESSELS -------	1.510	6.95	2.382	5.97	1.152	5.53	1.734	5.11
----- BACK GROUND -----	4.300	18.53	5.700	14.28	4.300	20.13	5.700	16.80
-------- TOTAL --------	23.162	100.00	39.928	100.00	21.358	100.00	33.930	100.00

事業所名	(5) BUKIT TIMAH FIRE ST.				(6) CHANGI AIRPORT			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.275	1.33	—	—	0.309	3.24
SENOKO POWER STATION	3.165	21.19	4.091	19.73	0.508	7.58	0.759	8.04
JURONG POWER STATION	1.185	7.93	1.185	5.71	0.471	7.02	0.471	4.94
PASIR PANJANG POWER STATION	1.872	12.53	1.872	9.03	0.303	4.52	0.303	3.18
SERAYA POWER STATION	—	—	1.426	6.88	—	—	0.277	2.90
TEKONG POWER STATION	—	—	0.084	0.41	—	—	0.108	1.14
SHELL COMPANIES IN SINGAPORE	1.532	10.26	1.532	7.39	0.229	3.42	0.229	2.40
ESSO SINGAPORE PTE LTD	0.719	4.82	0.719	3.47	0.160	2.39	0.160	1.67
SINGAPORE REFINING CO PTE LTD	0.444	2.97	0.444	2.14	0.091	1.35	0.091	0.95
MOBIL OIL SINGAPORE PTE LTD.	0.185	1.24	0.181	0.87	0.063	1.25	0.061	0.65
-- REMAINING FACTORIES --	0.591	3.96	1.608	8.72	0.127	1.89	0.383	4.02
------- VESSELS -------	0.933	6.26	1.417	6.83	0.435	6.48	0.659	6.90
----- BACK GROUND -----	4.300	28.79	5.700	27.48	4.300	64.08	5.700	59.78
-------- TOTAL --------	14.934	100.00	20.734	100.00	6.710	100.00	9.549	100.00

事業所名	(7) BEDOK POLICE STATION			
	1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.328	2.84
SENOKO POWER STATION	0.859	8.52	1.047	9.07
JURONG POWER STATION	0.652	10.54	0.852	7.38
PASIR PANJANG POWER STATION	0.368	4.77	0.388	3.36
SERAYA POWER STATION	—	—	0.438	3.79
TEKONG POWER STATION	—	—	0.104	0.90
SHELL COMPANIES IN SINGAPORE	0.286	3.54	0.286	2.47
ESSO SINGAPORE PTE LTD	0.308	3.81	0.308	2.67
SINGAPORE REFINING CO PTE LTD	0.178	2.21	0.176	1.54
MOBIL OIL SINGAPORE PTE LTD.	0.104	1.29	0.100	0.87
-- REMAINING FACTORIES --	0.187	2.33	0.555	4.82
------- VESSELS -------	0.789	9.77	1.264	10.95
----- BACK GROUND -----	4.300	53.23	5.700	49.38
-------- TOTAL --------	8.079	100.00	11.544	100.00

（表Ⅴ－2－9　測定点における主要事業所の寄与濃度（S系モンスーン平均）

事業所名	(1) N.U.S.				(2) J.T.C. HALL			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.250	1.04	—	—	0.235	0.88
SENOKO POWER STATION	0.932	5.09	1.429	5.91	0.556	3.24	0.859	3.34
JURONG POWER STATION	1.274	6.96	1.274	5.27	1.055	5.84	1.055	3.96
PASIR PANJANG POWER STATION	2.607	14.24	2.607	10.78	2.965	16.41	2.965	11.14
SERAYA POWER STATION	—	—	0.409	1.69	—	—	1.660	6.99
TEKONG POWER STATION	—	—	0.076	0.31	—	—	0.072	0.27
SHELL COMPANIES IN SINGAPORE	4.409	24.08	4.409	18.24	2.602	15.51	2.602	10.53
ESSO SINGAPORE PTE LTD	0.820	4.48	0.820	3.39	1.545	8.55	1.545	5.80
SINGAPORE REFINING CO PTE LTD	0.448	2.45	0.445	1.85	0.997	5.52	0.997	3.74
MOBIL OIL SINGAPORE PTE LTD	0.281	1.53	0.274	1.13	0.319	1.77	0.310	1.17
-- REMAINING FACTORIES --	1.002	5.48	3.051	12.62	1.711	9.48	5.450	20.48
------- VESSELS -------	2.233	12.20	3.431	14.19	1.788	9.90	2.233	10.29
----- BACK GROUND -----	4.300	23.49	5.700	23.58	4.300	23.80	5.700	21.41
-------- TOTAL --------	18.306	100.00	24.178	100.00	18.068	100.00	26.619	100.00

事業所名	(3) S.I.U.				(4) BOON LAY APARTMENT			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.217	0.45	—	—	0.317	0.70
SENOKO POWER STATION	0.631	2.27	0.960	1.99	0.544	1.68	0.655	1.69
JURONG POWER STATION	0.127	0.46	0.127	0.26	7.181	24.81	7.181	15.76
PASIR PANJANG POWER STATION	2.051	7.36	2.051	4.26	2.677	9.25	2.675	5.87
SERAYA POWER STATION	—	—	2.048	4.25	—	—	3.614	7.93
TEKONG POWER STATION	—	—	0.065	0.14	—	—	0.096	0.21
SHELL COMPANIES IN SINGAPORE	2.649	9.51	2.649	5.50	2.274	7.85	2.274	5.00
ESSO SINGAPORE PTE LTD	3.965	14.24	3.968	8.23	2.571	8.88	2.571	5.65
SINGAPORE REFINING CO PTE LTD	3.744	13.44	3.744	7.77	2.252	7.78	2.252	4.95
MOBIL OIL SINGAPORE PTE LTD	0.619	2.22	0.608	1.26	0.780	2.70	0.753	1.65
-- REMAINING FACTORIES --	7.215	25.89	22.245	46.17	4.478	15.45	14.423	31.71
------- VESSELS -------	2.555	9.17	3.603	7.69	1.892	6.54	2.765	6.12
----- BACK GROUND -----	4.300	15.44	5.700	11.83	4.300	14.85	5.700	12.53
-------- TOTAL --------	27.859	100.00	48.184	100.00	28.946	100.00	45.500	100.00

事業所名	(5) BUKIT TIMAH FIRE ST.				(6) CHANGI AIRPORT			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.369	1.65	—	—	0.378	3.72
SENOKO POWER STATION	0.499	3.18	0.857	3.87	0.346	4.93	0.527	5.24
JURONG POWER STATION	1.408	8.98	1.408	6.29	0.576	8.19	0.576	5.73
PASIR PANJANG POWER STATION	3.071	19.58	3.071	13.71	0.372	5.29	0.373	3.70
SERAYA POWER STATION	—	—	2.168	9.68	—	—	0.329	3.27
TEKONG POWER STATION	—	—	0.112	0.50	—	—	0.130	1.29
SHELL COMPANIES IN SINGAPORE	2.420	15.43	2.420	10.80	0.282	4.01	0.283	2.80
ESSO SINGAPORE PTE LTD	0.953	6.08	0.953	4.25	0.199	2.83	0.199	1.98
SINGAPORE REFINING CO PTE LTD	0.587	3.74	0.587	2.62	0.110	1.57	0.110	1.10
MOBIL OIL SINGAPORE P.E LTD	0.219	1.40	0.216	0.97	0.085	1.23	0.061	0.64
-- REMAINING FACTORIES --	0.725	4.63	2.262	10.07	0.143	2.04	0.440	4.40
------- VESSELS -------	1.497	9.55	2.277	10.14	0.612	8.71	0.925	9.21
----- BACK GROUND -----	4.300	27.43	5.700	25.44	4.300	61.20	5.700	56.72
-------- TOTAL --------	15.677	100.00	22.405	100.00	7.026	100.00	10.047	100.00

事業所名	(1) BEDOK POLICE STATION			
	1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.329	2.79
SENOKO POWER STATION	0.491	5.93	0.753	6.38
JURONG POWER STATION	0.842	10.16	0.842	7.13
PASIR PANJANG POWER STATION	0.470	5.68	0.470	3.99
SERAYA POWER STATION	—	—	0.417	3.53
TEKONG POWER STATION	—	—	0.103	0.88
SHELL COMPANIES IN SINGAPORE	0.349	4.22	0.349	2.96
ESSO SINGAPORE PTE LTD	0.310	3.74	0.310	2.62
SINGAPORE REFINING CO PTE LTD	0.180	2.18	0.180	1.53
MOBIL OIL SINGAPORE PTE LTD	0.101	1.22	0.100	0.85
-- REMAINING FACTORIES --	0.195	2.35	0.591	5.02
------- VESSELS -------	1.034	12.48	1.650	13.99
----- BACK GROUND -----	4.300	51.92	5.700	48.33
-------- TOTAL --------	8.282	100.00	11.794	100.00

表Ⅴ－２－１０　測定点における主要事業所の寄与濃度（Ｎ系モンスーン平均）

事業所名	(1) N.U.S.				(2) J.T.C. HALL			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.139	0.78	—	—	0.130	0.59
SENOKO POWER STATION	3.073	24.97	4.689	26.14	6.644	45.35	10.048	45.47
JURONG POWER STATION	1.835	14.84	1.838	10.25	0.641	4.37	0.641	2.90
PASIR PANJANG POWER STATION	0.123	0.99	0.123	0.69	0.137	0.94	0.137	0.62
SERAYA POWER STATION	—	—	0.245	1.37	—	—	0.306	1.38
TEKONG POWER STATION	—	—	0.044	0.24	—	—	0.041	0.19
SHELL COMPANIES IN SINGAPORE	0.517	4.19	0.517	2.88	0.173	1.18	0.173	0.78
ESSO SINGAPORE PTE LTD	0.461	3.38	0.481	2.68	0.405	4.13	0.605	2.74
SINGAPORE REFINING CO PTE LTD	0.285	2.30	0.285	1.59	0.385	2.64	0.385	1.75
MOBIL OIL SINGAPORE PTE LTD.	0.328	2.65	0.297	1.66	0.216	1.49	0.196	0.89
-- REMAINING FACTORIES --	1.058	8.55	3.050	16.98	1.315	8.95	3.409	15.41
------- VESSELS -------	0.361	2.93	0.532	2.97	0.232	1.58	0.329	1.49
----- BACK GROUND -----	4.300	34.71	5.700	31.77	4.300	29.34	5.700	25.79
-------- TOTAL --------	12.357	00.00	17.940	100.00	14.653	100.00	22.100	100.00

事業所名	(3) S.I.U.				(4) BOON LAY APARTMENT			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.120	0.42	—	—	0.114	0.65
SENOKO POWER STATION	6.361	38.54	9.622	34.05	3.399	32.06	6.872	39.19
JURONG POWER STATION	0.071	0.43	0.071	0.25	0.610	5.76	0.610	3.48
PASIR PANJANG POWER STATION	0.120	0.73	0.120	0.43	0.123	1.16	0.123	0.70
SERAYA POWER STATION	—	—	0.105	0.37	—	—	0.388	2.20
TEKONG POWER STATION	—	—	0.038	0.13	—	—	0.037	0.21
SHELL COMPANIES IN SINGAPORE	0.164	1.00	0.164	0.58	0.148	1.35	0.148	0.84
ESSO SINGAPORE PTE LTD	0.665	4.03	0.665	2.36	0.448	4.20	0.448	2.54
SINGAPORE REFINING CO PTE LTD	0.456	2.76	0.450	1.59	0.270	2.55	0.270	1.54
MOBIL OIL SINGAPORE PTE LTD.	0.415	2.51	0.361	1.28	0.318	2.99	0.283	1.61
-- REMAINING FACTORIES --	3.691	22.35	10.444	37.00	0.815	7.69	2.305	13.14
------- VESSELS -------	0.270	1.64	0.368	1.31	0.178	1.68	0.243	1.39
----- BACK GROUND -----	4.300	26.05	5.700	20.19	4.300	40.58	5.700	32.51
-------- TOTAL --------	16.507	00.00	28.226	00.00	10.602	00.00	17.534	100.00

事業所名	(5) BUKIT TIMAH FIRE ST.				(6) CHANGI AIRPORT			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.141	0.77	—	—	0.218	2.47
SENOKO POWER STATION	6.944	50.03	8.659	47.16	0.733	11.79	1.112	12.61
JURONG POWER STATION	0.885	6.25	0.868	4.72	0.323	5.15	0.323	3.65
PASIR PANJANG POWER STATION	0.174	1.26	0.174	0.95	0.203	3.28	0.203	2.33
SERAYA POWER STATION	—	—	0.375	2.04	—	—	0.203	2.30
TEKONG POWER STATION	—	—	0.045	0.25	—	—	0.028	0.65
SHELL COMPANIES IN SINGAPORE	0.273	1.97	0.273	1.48	0.155	2.47	0.155	1.76
ESSO SINGAPORE PTE LTD	0.353	2.79	0.380	2.11	0.105	1.67	0.105	1.19
SINGAPORE REFINING CO PTE LTD	0.243	1.74	0.243	1.32	0.063	1.00	0.063	0.71
MOBIL OIL SINGAPORE PTE LTD.	0.144	1.04	0.131	0.71	0.085	1.37	0.078	0.88
-- REMAINING FACTORIES --	0.399	2.88	1.164	6.35	0.103	1.67	0.297	3.40
------- VESSELS -------	0.147	1.05	0.206	1.12	0.164	2.64	0.280	3.17
----- BACK GROUND -----	4.300	30.98	5.700	31.04	4.300	69.66	5.700	64.64
-------- TOTAL --------	13.877	00.00	18.356	00.00	6.233	00.00	8.818	00.00

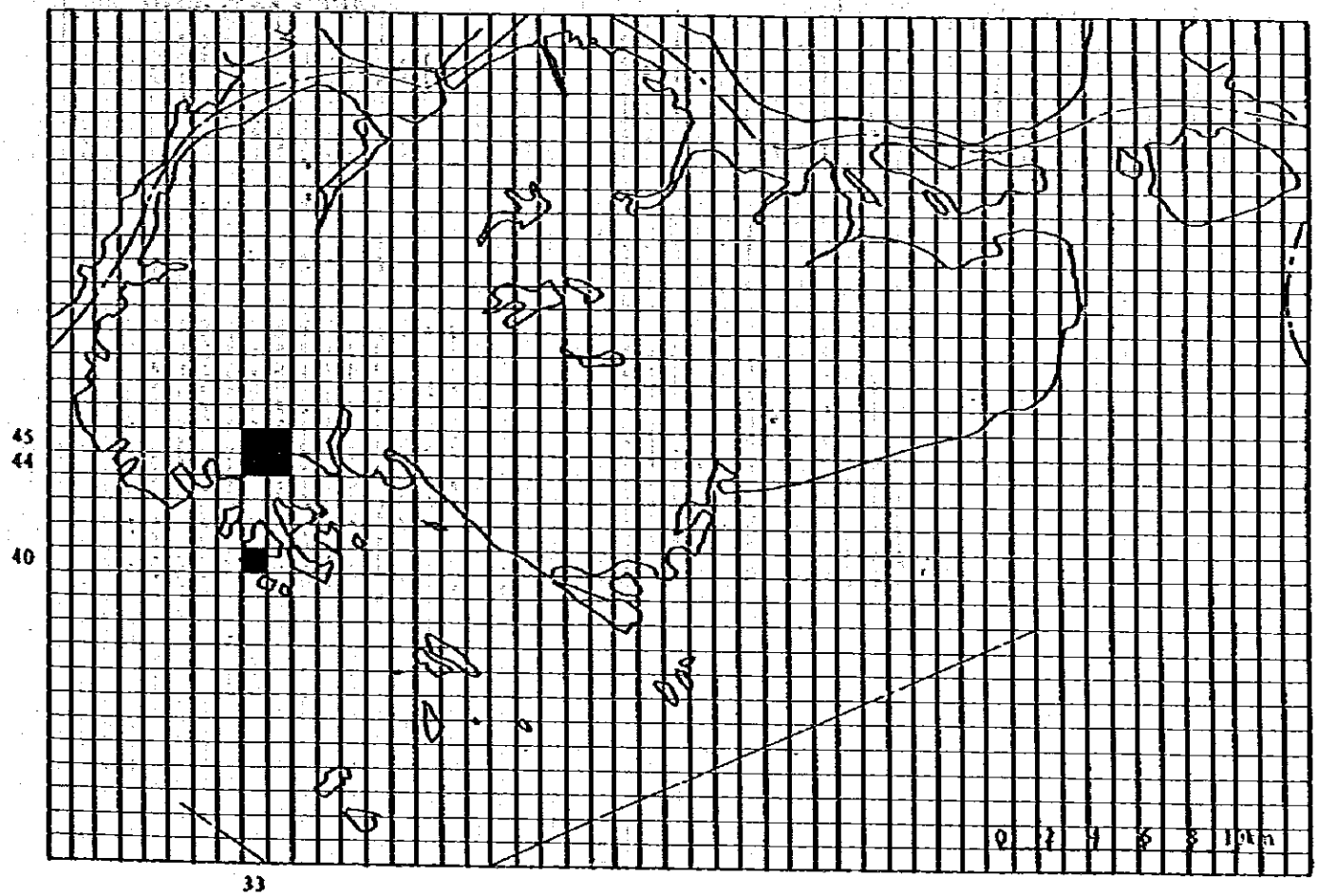
事業所名	(7) BEDOK POLICE STATION			
	1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.327	2.92
SENOKO POWER STATION	0.969	12.42	1.464	13.08
JURONG POWER STATION	0.868	11.11	0.868	7.74
PASIR PANJANG POWER STATION	0.268	3.41	0.268	2.37
SERAYA POWER STATION	—	—	0.468	4.13
TEKONG POWER STATION	—	—	0.105	0.94
SHELL COMPANIES IN SINGAPORE	0.196	2.51	0.196	1.75
ESSO SINGAPORE PTE LTD	0.306	3.92	0.306	2.73
SINGAPORE REFINING CO PTE LTD	0.178	2.28	0.178	1.57
MOBIL OIL SINGAPORE PTE LTD.	0.109	1.40	0.100	0.89
-- REMAINING FACTORIES --	0.178	2.28	0.508	4.53
------- VESSELS -------	0.425	5.45	0.717	6.41
----- BACK GROUND -----	3.300	55.18	5.700	50.94
-------- TOTAL --------	7.793	00.00	11.189	100.00

(2) ピーク濃度地点における寄与率

ピーク濃度地点として，計算メッシュ点のうち，年平均濃度の最も高い地点を，シンガポール本島より4地点，その他の島より1地点選び，その地点における寄与率を求めた。選出した5地点は表Ⅴ－2－11及び図Ⅴ－2－8に示すとおりである。

表Ⅴ－2－11　ピーク濃度地点とSO_2の年平均濃度

メッシュコード	平均年		S系モンスーン平均		N系モンスーン平均	
	1981年次	1990年次	1981年次	1990年次	1981年次	1990年次
33 - 40	42.3	56.6	20.7	32.0	73.0	91.6
33 - 44	27.1	44.0	29.0	40.6	24.3	48.7
34 - 44	28.2	43.5	33.1	46.3	21.3	39.5
33 - 45	25.4	43.2	32.6	52.5	15.2	30.0
34 - 45	24.8	40.7	31.3	49.3	15.5	28.5



図Ⅴ－2－8　寄与率を求めたピーク濃度地点

表Ⅴ－２－１２～表Ⅴ－２－１４は，年間及びＳ系モンスーン・Ｎ系モンスーンにおける寄与濃度と寄与率を示したものであり，各事業所のうち，寄与濃度の高い上位１０社が記載されている。１９９０年の年平均値が最も高い３３－４０のメッシュではESSO Singapore Private Limitedの寄与がとびぬけて大きく15.749ppb，27.8％の寄与率を占めている。これは，同社の低い煙突の影響によるものと考えられる。シンガポール本島におけるピーク濃度地点は３３－４４であり，この地点に対する寄与濃度の第１位はNational IRON & Steel Mills LTD.の7.167ppbであり寄与率は16.3％を占めている。

次に，主要事業所１０社についての寄与濃度と寄与率を表Ⅴ－２－１５～表Ⅴ－２－１７に示す。これによると，測定点の場合と同様Seneko Power Stationがいずれの地点においても高い濃度を示している。

表Ⅴ－2－15　高濃度地点における主要事業所の寄与濃度（年平均）

事業所名	メッシュコード 33－40				メッシュコード 33－44			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.166	0.29	—	—	0.170	0.39
SENOKO POWER STATION	2.616	6.66	4.261	7.52	2.178	8.04	3.663	8.35
JURONG POWER STATION	5.935	14.02	5.935	10.48	0.135	0.50	0.135	0.31
PASIR PANJANG POWER STATION	0.587	1.39	0.587	1.04	1.235	4.56	1.235	2.81
SERAYA POWER STATION	—	—	0.079	0.14	—	—	0.338	0.77
TEKONG POWER STATION	—	—	0.051	0.09	—	—	0.052	0.12
SHELL COMPANIES IN SINGAPORE	1.286	3.04	1.286	2.27	1.662	6.13	1.662	3.78
ESSO SINGAPORE PTE LTD	15.749	37.22	15.749	27.81	5.464	20.17	5.464	12.43
SINGAPORE REFINING CO PTE LTD	2.272	5.37	2.272	4.01	2.405	8.87	2.405	5.47
MOBIL OIL SINGAPORE PTE LTD.	0.654	1.55	0.571	1.01	0.633	2.34	0.501	1.14
-- REMAINING FACTORIES --	4.782	11.29	15.055	26.59	4.927	25.56	19.282	44.96
------- VESSELS -------	3.934	9.30	4.915	8.68	2.158	7.96	2.640	6.44
----- BACK GROUND -----	4.300	10.16	5.700	10.07	4.300	15.87	5.700	12.96
-------- TOTAL --------	42.317	100.00	56.627	100.00	27.095	100.00	43.966	100.00

事業所名	メッシュコード 34－44				メッシュコード 33－45			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.173	0.40	—	—	0.170	0.39
SENOKO POWER STATION	2.945	10.43	4.458	10.26	1.621	6.39	3.140	7.26
JURONG POWER STATION	0.104	0.37	0.104	0.24	0.117	0.46	0.117	0.27
PASIR PANJANG POWER STATION	1.254	4.44	1.254	2.88	1.227	4.84	1.227	2.84
SERAYA POWER STATION	—	—	0.253	0.58	—	—	0.429	0.99
TEKONG POWER STATION	—	—	0.053	0.12	—	—	0.053	0.12
SHELL COMPANIES IN SINGAPORE	1.727	6.12	1.727	3.97	1.595	6.29	1.595	3.69
ESSO SINGAPORE PTE LTD	5.672	20.09	5.672	13.04	4.422	17.43	4.422	10.23
SINGAPORE REFINING CO PTE LTD	4.146	14.68	4.146	9.53	1.916	7.55	1.916	4.43
MOBIL OIL SINGAPORE PTE LTD.	0.550	1.95	0.471	1.08	1.111	4.38	1.006	2.33
-- REMAINING FACTORIES --	5.350	19.04	16.458	37.91	7.240	28.55	20.551	48.49
------- VESSELS -------	2.162	7.65	2.925	6.67	1.815	7.16	2.472	5.77
----- BACK GROUND -----	4.300	15.23	5.700	13.11	4.300	16.95	5.700	13.19
-------- TOTAL --------	28.241	100.00	43.493	100.00	25.354	100.00	43.216	100.00

事業所名	メッシュコード 34－45			
	1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.174	0.43
SENOKO POWER STATION	2.213	8.94	3.740	9.19
JURONG POWER STATION	0.101	0.41	0.101	0.25
PASIR PANJANG POWER STATION	1.247	5.04	1.247	3.06
SERAYA POWER STATION	—	—	1.141	2.80
TEKONG POWER STATION	—	—	0.054	0.13
SHELL COMPANIES IN SINGAPORE	1.651	6.67	1.651	4.06
ESSO SINGAPORE PTE LTD	4.431	17.90	4.431	10.89
SINGAPORE REFINING CO PTE LTD	2.896	11.70	2.896	7.12
MOBIL OIL SINGAPORE PTE LTD.	0.625	2.52	0.545	1.34
-- REMAINING FACTORIES --	5.555	22.45	16.505	40.58
------- VESSELS -------	1.734	7.00	2.500	6.14
----- BACK GROUND -----	4.300	17.37	5.700	14.01
-------- TOTAL --------	24.753	100.00	40.657	100.00

表Ⅴ－２－１６　高濃度地点における主要事業所の寄与濃度（Ｓ系モンスーン平均）

事業所名	メッシュコード 33 － 40				メッシュコード 33 － 44			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.204	0.64	—	—	0.208	0.51
SENOKO POWER STATION	0.727	3.52	1.111	3.47	0.638	2.19	0.990	2.44
JURONG POWER STATION	0.427	2.07	0.427	1.34	0.133	0.46	0.133	0.33
PASIR PANJANG POWER STATION	0.844	4.09	0.844	2.64	2.024	6.97	2.024	4.99
SERAYA POWER STATION	—	—	0.092	0.29	—	—	0.540	1.33
TEKONG POWER STATION	—	—	0.062	0.19	—	—	0.063	0.16
SHELL COMPANIES IN SINGAPORE	2.086	10.10	2.086	6.53	2.741	9.44	2.741	6.76
ESSO SINGAPORE PTE LTD	3.900	18.89	3.900	12.20	8.738	30.09	8.738	21.54
SINGAPORE REFINING CO PTE LTD	0.897	4.34	0.897	2.80	3.916	13.49	3.916	9.65
MOBIL OIL SINGAPORE PTE LTD	0.426	2.06	0.378	1.18	0.288	0.99	0.248	0.61
-- REMAINING FACTORIES --	3.135	15.18	11.254	35.20	2.696	9.28	10.824	26.67
------- VESSELS -------	3.909	18.93	5.016	15.69	3.364	11.58	4.449	10.96
----- BACK GROUND -----	4.300	20.82	5.700	17.83	4.300	14.81	5.700	14.05
-------- TOTAL --------	20.651	100.00	31.972	100.00	29.036	100.00	40.574	100.00

事業所名	メッシュコード 34 － 44				メッシュコード 33 － 45			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.213	0.46	—	—	0.209	0.40
SENOKO POWER STATION	0.665	2.01	1.013	2.19	0.557	1.71	0.902	1.72
JURONG POWER STATION	0.122	0.37	0.122	0.26	0.134	0.42	0.136	0.26
PASIR PANJANG POWER STATION	2.054	6.20	2.054	4.43	2.011	6.18	2.011	3.83
SERAYA POWER STATION	—	—	0.396	0.85	—	—	0.691	1.31
TEKONG POWER STATION	—	—	0.065	0.14	—	—	0.064	0.12
SHELL COMPANIES IN SINGAPORE	2.849	8.60	2.849	6.15	2.631	8.08	2.631	5.01
ESSO SINGAPORE PTE LTD	9.000	27.17	9.000	19.45	6.967	21.46	6.937	13.36
SINGAPORE REFINING CO PTE LTD	6.543	19.76	6.543	14.12	3.119	9.58	3.119	5.94
MOBIL OIL SINGAPORE PTE LTD.	0.338	1.02	0.314	0.68	1.345	4.14	1.259	2.38
-- REMAINING FACTORIES --	3.670	11.69	13.376	28.83	8.588	26.37	24.853	47.31
------- VESSELS -------	3.377	10.20	4.659	10.12	2.850	8.65	3.975	7.57
----- BACK GROUND -----	4.300	12.98	5.700	12.30	4.300	13.21	5.700	10.85
-------- TOTAL --------	33.118	100.00	46.334	100.00	32.555	100.00	52.525	100.00

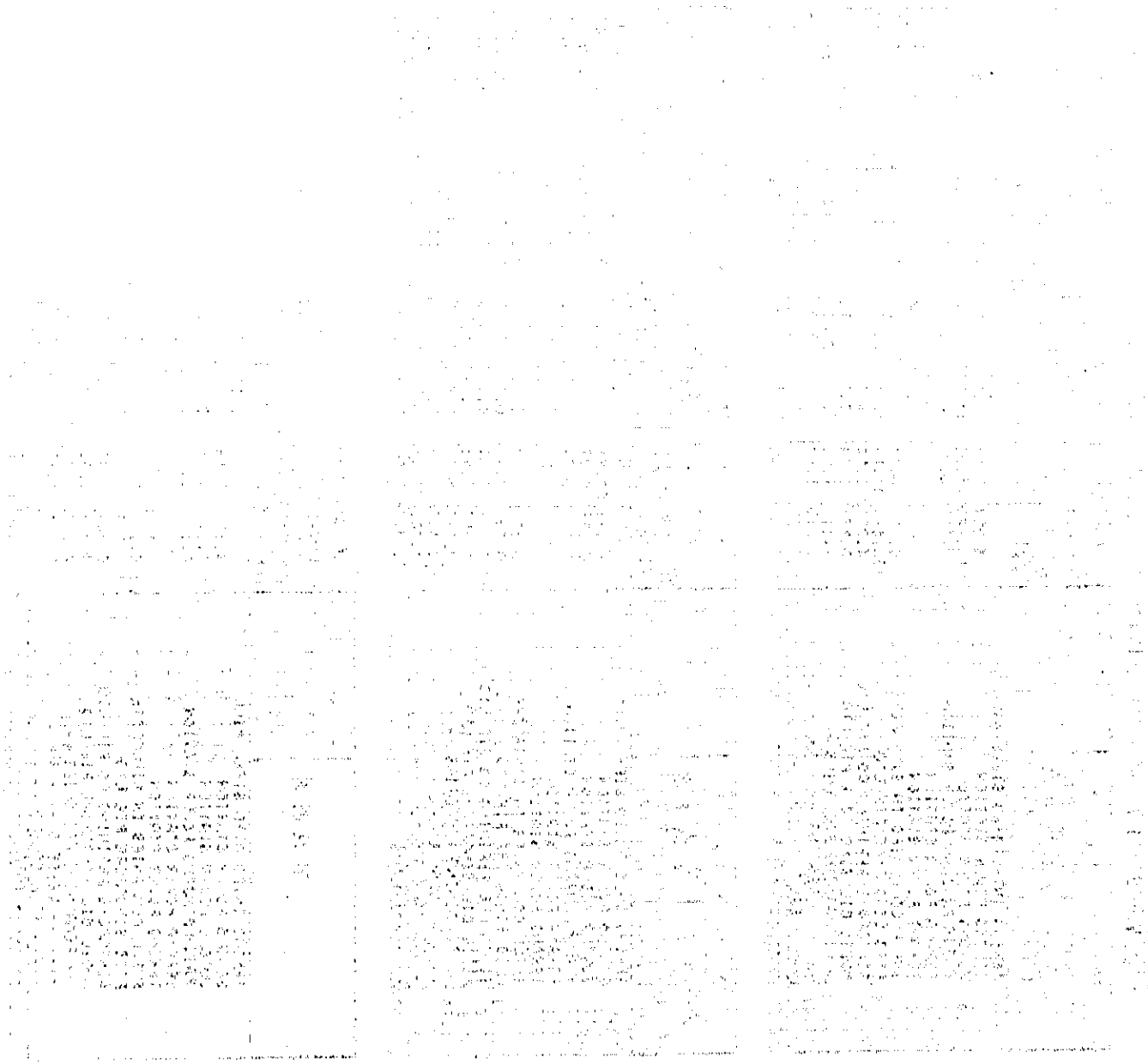
事業所名	メッシュコード 34 － 45			
	1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.214	0.45
SENOKO POWER STATION	0.619	1.96	0.959	1.94
JURONG POWER STATION	0.122	0.39	1.222	0.25
PASIR PANJANG POWER STATION	2.043	6.53	2.043	4.14
SERAYA POWER STATION	—	—	1.879	3.81
TEKONG POWER STATION	—	—	0.065	0.13
SHELL COMPANIES IN SINGAPORE	2.724	8.71	2.724	5.53
ESSO SINGAPORE PTE LTD	7.001	22.38	7.001	14.20
SINGAPORE REFINING CO PTE LTD	4.559	14.57	4.559	9.25
MOBIL OIL SINGAPORE PTE LTD.	0.702	2.24	0.621	1.26
-- REMAINING FACTORIES --	6.478	20.70	18.341	37.21
------- VESSELS -------	2.741	8.76	3.913	8.07
----- BACK GROUND -----	4.300	13.74	5.700	11.56
-------- TOTAL --------	31.289	100.00	49.305	100.00

表Ⅴ－２－１７　高濃度地点における主要事業所の寄与濃度（Ｎ系モンスーン平均）

事業所名	メッシュコード 33 － 40				メッシュコード 33 － 44			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.112	0.12	—	—	0.115	0.23
SENOKO POWER STATION	5.774	7.91	8.724	9.53	4.364	17.92	7.498	15.37
JURONG POWER STATION	13.740	18.82	13.749	15.01	0.137	0.56	0.137	0.28
PASIR PANJANG POWER STATION	0.223	0.31	0.223	0.24	0.118	0.48	0.116	0.24
SERAYA POWER STATION	—	—	0.050	0.07	—	—	0.051	0.10
TEKONG POWER STATION	—	—	0.035	0.04	—	—	0.035	0.07
SHELL COMPANIES IN SINGAPORE	0.153	0.21	0.153	0.17	0.132	0.54	0.132	0.27
ESSO SINGAPORE PTE LTD	32.542	44.57	32.542	35.54	0.824	3.38	0.824	1.69
SINGAPORE REFINING CO PTE LTD	4.222	5.78	4.222	4.61	0.263	1.08	0.263	0.54
MOBIL OIL SINGAPORE PTE LTD	0.976	1.34	0.844	0.92	1.124	4.62	0.860	1.76
-- REMAINING FACTORIES --	7.117	9.73	20.440	22.32	12.639	51.94	32.481	66.61
------- VESSELS -------	3.975	5.44	4.772	5.21	0.444	1.82	0.557	1.15
----- BACK GROUND -----	4.300	5.89	5.700	6.22	4.300	17.66	5.700	11.69
-------- TOTAL --------	73.022	100.00	91.567	100.00	24.345	100.00	48.774	100.00

事業所名	メッシュコード 34 － 44				メッシュコード 33 － 45			
	1981年次		1990年次		1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.117	0.30	—	—	0.115	0.35
SENOKO POWER STATION	6.178	28.96	9.340	23.67	3.130	20.63	6.312	21.02
JURONG POWER STATION	0.079	0.37	0.079	0.20	0.070	0.53	0.090	0.30
PASIR PANJANG POWER STATION	0.121	0.57	0.121	0.31	0.117	0.77	0.117	0.39
SERAYA POWER STATION	—	—	0.048	0.12	—	—	0.057	0.19
TEKONG POWER STATION	—	—	0.037	0.09	—	—	0.036	0.12
SHELL COMPANIES IN SINGAPORE	0.137	0.64	0.137	0.35	0.127	0.83	0.127	0.42
ESSO SINGAPORE PTE LTD	0.957	4.49	0.957	2.42	0.757	5.19	0.737	2.52
SINGAPORE REFINING CO PTE LTD	0.749	3.51	0.749	1.90	0.211	1.39	0.211	0.70
MOBIL OIL SINGAPORE PTE LTD	0.650	3.98	0.693	1.76	0.776	5.11	0.653	2.19
-- REMAINING FACTORIES --	7.520	35.26	20.898	52.93	5.350	35.13	15.415	51.35
------- VESSELS -------	0.439	2.06	0.594	1.51	0.308	2.02	0.371	1.30
----- BACK GROUND -----	4.300	20.16	5.700	14.44	4.300	28.34	5.700	18.99
-------- TOTAL --------	21.330	100.00	39.463	100.00	15.174	100.00	30.019	100.00

事業所名	メッシュコード 34 － 45			
	1981年次		1990年次	
	寄与濃度 (ppb)	寄与率 (%)	寄与濃度 (ppb)	寄与率 (%)
TEKONG INTEGRATED STEEL MILL	—	—	0.118	0.41
SENOKO POWER STATION	4.471	28.88	7.631	26.72
JURONG POWER STATION	0.071	0.46	0.071	0.25
PASIR PANJANG POWER STATION	0.120	0.77	0.120	0.42
SERAYA POWER STATION	—	—	0.095	0.33
TEKONG POWER STATION	—	—	0.037	0.13
SHELL COMPANIES IN SINGAPORE	0.131	0.85	0.131	0.46
ESSO SINGAPORE PTE LTD	0.769	5.09	0.769	2.77
SINGAPORE REFINING CO PTE LTD	0.539	3.45	0.537	1.89
MOBIL OIL SINGAPORE PTE LTD	0.516	3.33	0.439	1.54
-- REMAINING FACTORIES --	4.249	27.42	12.347	43.37
------- VESSELS -------	0.308	1.98	0.405	1.43
----- BACK GROUND -----	4.300	27.76	5.700	20.02
-------- TOTAL --------	15.492	100.00	28.473	100.00



ANNEX

SCOPE OF WORK

FOR

THE STUDY OF ENVIRONMENTAL EFFECTS

OF COAL FIRING POWER STATIONS

AND INTEGRATED STEEL MILL

DECEMBER 1980

This Scope of Work is agreed by the following two authorities concerned;

The Jurong Town Corporation,
Government of the Republic of Singapore.

Japan International Cooperation Agency,
the Official Agency responsible for the implementation of technical cooperation programmes of the Government of Japan.

To confirm the aforementioned, the Scope of Work is herewith attached and signed by the responsible personnel of the said authorities concerned.

Date: 19th December 1980

Issued at: Singapore

For the Jurong Town Corporation, Government of the Republic of Singapore.

YING YAK HANG
PRINCIPAL DIRECTOR (TECHNICAL)
JURONG TOWN CORPORATION
GOVERNMENT OF THE REPUBLIC OF SINGAPORE

For Japan International Cooperation Agency, the Government of Japan.

菊島一郎

ICHIRO KIKUSHIMA
LEADER OF THE JAPANESE PRELIMINARY SURVEY TEAM
DEPUTY DIRECTOR
ENVIRONMENTAL PROTECTION GUIDANCE DIVISION
INDUSTRIAL LOCATION & ENVIRONMENTAL PROTECTION BUREAU
MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY

IN THE PRESENCE OF:-

LIM SAK LAN
SENIOR DIRECTOR, ENGINEERING
JURONG TOWN CORPORATION

御手洗章弘

AKIHIRO MITARI
HEAD, INDUSTRY DIVISION
MINING & INDUSTRIAL PLANNING AND SURVEY DEPARTMENT
JAPAN INTERNATIONAL COOPERATION AGENCY

1. Introduction

In response to the request of the Government of the Republic of Singapore, the Government of Japan has agreed to extend the technical assistance to conduct the study on the environmental effects of coal firing power stations and the integrated steel mill which will be sited in the new industrial estates of the Republic of Singapore, which assistance is given in accordance with the laws and regulations in force in Japan.

The study will be carried out through The Japan International Cooperation Agency (hereinafter referred to as JICA), which is the official agency responsible for the implementation of technical cooperation programmes of the Government of Japan, in close cooperation with the Government of the Republic of Singapore and authorities concerned.

2. Objectives

The objectives of the study are:-

(1) To conduct the field survey in terms of air and water qualities within and at surrounding areas of Pulau Seraya, Jurong, Pulau Tekong, where the proposed coal firing power stations and the integrated steel mill are to be sited.

(2) To conduct the simulation study by computers based on the data obtained from the above said field survey and to assess the estimated pollution loads when these plants are in operation.

3. Scope of the study

3-1 Survey Areas

(A) Pulau Seraya, the proposed site of the coal firing power station and its surrounding areas.

(B) Pulau Tekong, the proposed site of the coal firing power stetion and the integrated steel mill, and its surrounding areas.

(C) Other areas mutually agreed to be surveyed.

3-2 Survey Plan

(A) Air Quality Survey

i) Long Term Measurement

a) Sulphur dioxide (SO_2) concentration

b) Wind directions and velocity at ground surface

c) Net radiation

d) Temperature

Notes: Period of measurement = 1 year

ii) Short Term Measurement

a) Vertical profile of wind directions and velocity

Notes: Period of measurement - two days each at two stations.

iii) Simulation - Simulation of sulfur dioxide (SO_2)

(B) Water Quality Survey

i) Measurement

a) Current directions and velocity

b) Chemical Oxygen Demand (COD)

c) Water temperature and salinity

Notes: Period of measurement - 2 weeks per measuring point for the above (a), once per measuring point for the above (b) and (c), and 1.5 months in total including preparation works.

ii) Simulation - Simulation of COD and temperature

4. Time Schedule

As shown in ANNEX 1 (Subject to change)

5. Report

5-1 Interim Report

i) 30 copies

ii) The interim report will be submitted in English to the Government of the Republic of Singapore within 5 months after the completion of the simulation for water quality survey.

iii) The interim report will contain the results of the water quality survey and refer to the progress of air quality survey.

iv) The Government of the Republic of Singapore will provide the comments to JICA through the Embassy of Japan within 1 month after receipt of the interim report.

5-2 Draft Final Report

i) 30 copies

ii) The draft final report will be submitted in English within 4 months after the completion of the simulation for air quality survey.

iii) The Government of the Republic of Singapore will provide the comments to JICA through the Embassy of Japan within 1 month after receipt of the draft final report.

5-3 Final Report

i) 50 copies together with 50 copies of abstracts.

ii) The final report will be submitted in English within 2 months after receipt of the comments of the draft final report.

6. Contribution of the Government of the Republic of Singapore

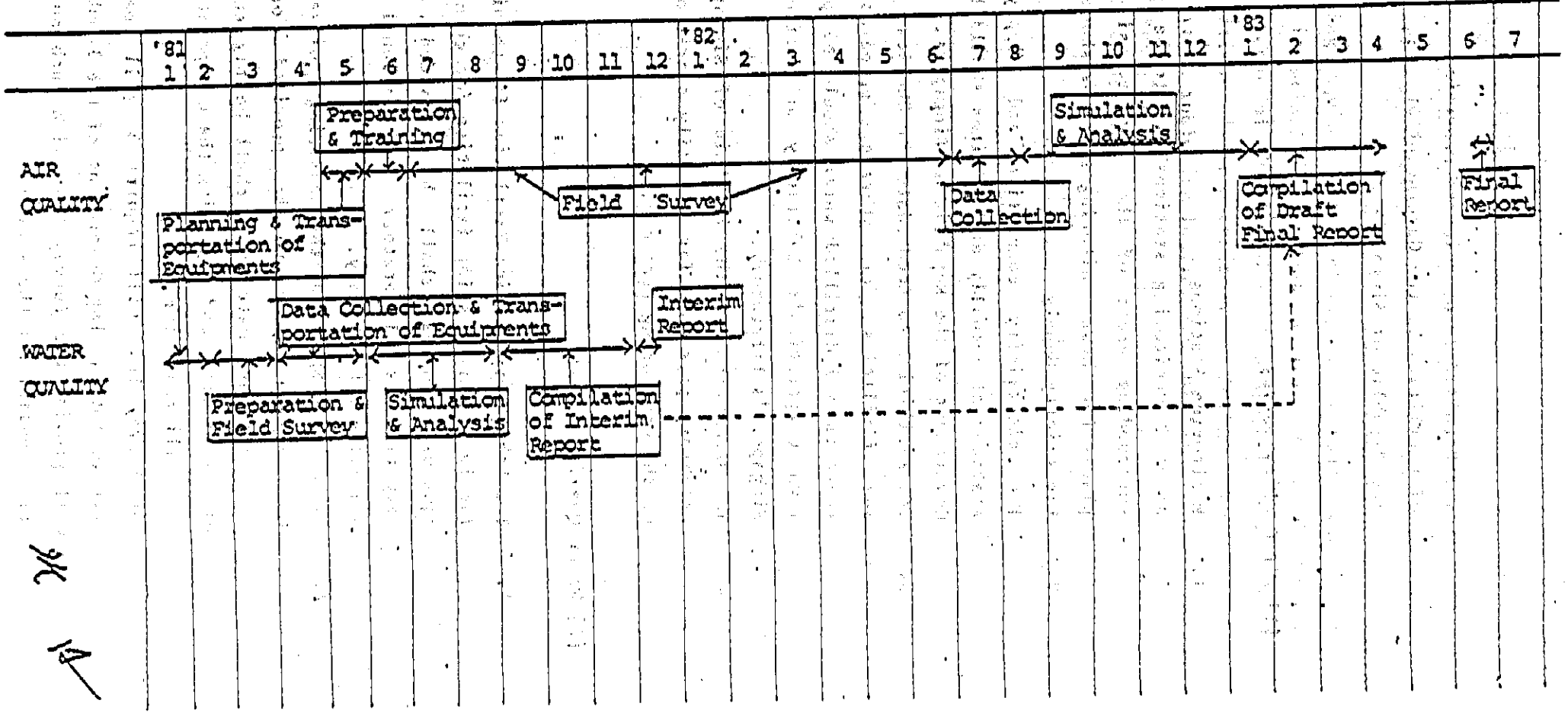
1. The Government of the Republic of Singapore will assign a qualified counterpart to be responsible for liaison and cooperation with the team conducting the survey. (hereinafter referred to as Survey Team)
2. The Government of the Republic of Singapore will provide the Survey Team with the necessary and available information and data.
3. The Government of the Republic of Singapore will make arrangements for the Survey Team to visit the authorities concerned.
4. The Government of the Republic of Singapore will provide the Survey Team with an office, sites for monitoring stations, laboratory testing facilities, storage space, temporary site office, transportation and boats as are necessary for the survey (ANNEX II)
5. The Government of the Republic of Singapore will exempt the Survey Team from taxes and duties on machinery, equipments and materials brought in Singapore by the Survey Team.
6. The Government of the Republic of Singapore will exempt the members of the Survey Team from any tax, including import and export duties imposed on the members' personal effects.
7. The Government of the Republic of Singapore will make an effort to ensure the securities of machinery, equipments and materials brought in Singapore by the Survey Team.

7. Contribution of the Government of Japan

1. The Government of Japan, through JICA, will provide a Survey Team who will conduct the field survey and simulation according to the Time Schedule (ANNEX I)
2. The Government of Japan will conduct during the stay of the Survey Team in the Republic of Singapore the training course for the Singapore counterparts to further their skills in operating and maintaining the necessary measuring machinery and equipments for the period of the field survey.

ANNEX I

TIME SCHEDULE FOR THE STUDY OF ENVIRONMENTAL EFFECTS OF COAL FIRING POWER STATION AND INTEGRATED STEEL MILL IN THE REPUBLIC OF SINGAPORE



The Detailed Information on Provision of Facilities by the Government of The Republic of Singapore

(1) Air Quality Survey

1. Monitoring Stations
   About 7 monitoring stations are to be established in the surrounding areas of the proposed sites. The land or places for these monitoring stations should be provided.
2. Electricity Supply
   The electricity connection and supply for monitoring stations at mutually agreed sites should be provided by the Government of the Republic of Singapore.
3. The Facilities to Accomodate the Chemical Reagents
   The facilities for storage, preparation of chemical reagents and distilled water should be provided at Jurong Town Corporation's Laboratory or National University of Singapore's Laboratory.
4. The Government of the Republic of Singapore will provide necessary personnel for the daily operation and maintenance of the monitoring stations.

(2) Water Quality Survey

1. The Laboratory Testing Facilities for Chemical Analysis
   The laboratory testing facilities for chemical analysis of aqueous samples shall be provided at Jurong Town Corporation's Laboratory or National University of Singapore's Laboratory.
2. The Storage Space for the Measuring Equipments and Materials
   The storage space to be provided for the measuring equipments and materials shall be big enough for opening of the packages and adjusting the equipments.
3. The Small Boats for Survey
   The Survey Team will require 3 small boats for about 20 days in total. The Government of the Republic of Singapore will provide the Survey Team with such number of boats as are necessary for the survey.

(3) Handling of Measuring Equipments

All the measuring equipments necessary to conduct the field survey will be, in principle, brought in and out by the Survey Team. The Government of the Republic of Singapore is requested to provide facilities and arrangement on the followings:-

(a) Custom clearance including loading and unloading

(b) Inland transportation

(c) Packing and unpacking

MINUTES OF MEETINGS

FOR

THE STUDY OF ENVIRONMENTAL EFFECTS

OF COAL FIRING POWER STATIONS

AND INTEGRATED STEEL MILL

DECEMBER 1980

MINUTES OF MEETINGS

FOR

THE STUDY OF ENVIRONMENTAL EFFECTS OF COAL FIRING POWER STATIONS AND INTEGRATED STEEL MILL

19TH DECEMBER 1980

CONFIRMED BY:

YING YUK HANG
PRINCIPAL DIRECTOR (TECHNICAL)
JURONG TOWN CORPORATION
GOVERNMENT OF THE REPUBLIC OF
SINGAPORE

菊島一郎

ICHIRO KIKUSHIMA
LEADER OF THE JAPANESE
PRELIMINARY SURVEY TEAM
DEPUTY DIRECTOR
ENVIRONMENTAL PROTECTION
GUIDANCE DIVISION
INDUSTRIAL LOCATION & ENVIRONMENTAL
PROTECTION BUREAU
MINISTRY OF INTERNATIONAL TRADE AND
INDUSTRY

MINUTES OF MEETINGS

The Japanese Preliminary Survey Team and the Singapore Counterpart had discussion on the Environment Effects of the Coal Firing Power Stations and Integrated Steel Mill and the following were mutually agreed upon.

Data of the Proposed Coal Firing Power Stations and the Integrated Steel Mill

(A) Coal Firing Power Station

i) The Japanese side requested for information on the proposed coal firing power station.

ii) After discussion with the Singapore side which included P.U.B., the assumptions given in Appendix A were agreed upon.

iii) It was indicated that one coal firing power station will be on Pulau Seraya and one on Pulau Tekong. (See Appendix D)

(B) Integrated Steel Mill

i) The Singapore side indicated that the proposed steel mill will use about eight million tons of iron ore per year and producing about one million tons of steel product by the direct reduction process using coal.

ii) The Japanese side requested for technical information similar to those in Appendix A.

iii) The Singapore side replied that it is not in a position to provide, except that the location will be in Pulau Tekong (See Appendix D). However, it will try to obtain the information requested by the Japanese side at the earliest possible date.

iv) It was mutually agreed that this matter will be further discussed and resolved when the next water quality survey team visits Singapore.

(C) Data on Emission Sources (Present & Future 1990)

(a) Air Quality

i) The Japanese side requested for emission data both present and future and suggested that if such data is not available then a survey be carried out to obtain the same.

ii) The Singapore side agreed to carry out such survey.

iii) The Japanese side indicated that these data should be made available by June 1982.

iv) The Singapore side agreed to the above.

(b) Water Quality

i) The Japanese side requested for effluent data present and future including industries located on the southern islands and suggested if such data is not available then a survey be carried out to obtain the same.

ii) The Singapore side agreed to carry out such survey.

iii) The Japanese side indicated that these data should be made available by May 1981.

iv) The Singapore side agreed to the above.

(c) Malaysian Development Plan (North of Straits of Johore)

i) The Japanese side requested information regarding industrial development plan immediately north of the Straits of Johore.

ii) The Singapore side replied that it is not in a position to do so.

iii) It was mutually agreed that effects of the Malaysian developments shall not be considered.

(D) Monitoring Points

Based on survey carried out by Japanese Preliminary Survey Team, the following monitoring points were agreed upon.

(a) Air Quality

i) SO_2, wind direction, wind velocity - 7 points

ii) Net radiation - 1 point

iii) Vertical distribution of temperature - 1 point

iv) Pilot balloon observation - 2 points

(b) Water Quality

i) Current direction, current velocity - 10 points (around the two proposed sites

ii) Water temperature, salinity, COD observation. - 30 points (around the two proposed sites

(c) Clearance from Competent Authorities

The Singapore side will arrange and obtain necessary clearance from the competent authorities to conduct the above surveys.

(E) Simulation Methods

i) The Japanese side stated that for SO_2 diffusion calculation, Plume Puff model will be adopted and predict a yearly concentration of SO_2.

ii) As for water temperature and COD diffusion calculation, FEM (Finite Element Method) will be adopted.

iii) The Singapore side agreed to the above methods.

(F) Evaluation on the Environmental Effects and Impacts

i) The Japanese side enquired about the environmental ambient standards of SO_2 and COD.

ii) The Singapore side replied that it has only the emission standard but not the ambient standard.

iii) The Japanese side stated that it will predict the levels of SO_2 and COD from the coal firing power stations and integrated steel mill.

iv) The Japanese side stated that it will also be able to predict the total levels of SO_2 and COD in the year 1990 if adequate datas on the emission are collected from the survey referred in para C.

v) It was mutually agreed that if no ambient standard is indicated by the Singapore side, the Japanese side will not be in a position to comment on the levels of SO_2 and COD and in any case further evaluation will have to be carried by the Singapore side.

(G) Maintenance of monitoring stations

i) The Japanese side requested the Singapore side to provide the necessary personnel for the daily operation and maintenance of the monitoring stations as indicated in Appendix 'B'.

ii) Singapore side agreed to provide the personnel required.

(H) Survey Schedule

i) The Japanese side mentioned that the schedule may need to be altered. Such alteration will be mutually discussed and agreed upon.

ii) The Singapore side agreed to the above.

5(I) Contributions

i) The Japanese side requested that land and sea transport for future survey team and equipments and their local counterparts be provided in accordance with schedule in Appendix 'C'.

ii) The Singapore side agreed to provide the same.

iii) At the commencement of the survey, the Japanese side will arrange for all the equipments to be delivered to Jurong Town Hall. The Singapore side will arrange for the transportation of the equipments from the Jurong Town Hall to the various monitoring stations and will be responsible for the setting up of the stations.

iv) On completion of survey, the Singapore side will arrange for transportation of all equipments from the monitoring stations back to Jurong Town Hall and the Japanese side will arrange to collect the same from Jurong Town Hall.

(J) Datas/Reports

i) The Singapore side requested that information supplied to the Japanese side shall be treated as confidential materials. Similarly the results and report of the study are to be treated also as confidential.

ii) The Japanese side agreed to the above.

Assumption on Coal Firing Power Station

Generated Output	350 MW x 2
Fuel	Coal Calorific Value 7,000 Kcal/kg Sulphur 1% (wt%) Consumption 154 x 10^4 t/year (operation rate 70%)
Stack	Gas Volume 182 x 10^4 Nm^3/h Gas Temperature 150°C (without desulfurization of flue gas) Gas Discharge Velocity 30 m/s Height 200m
Cooling Sea Water	Amount 29.4 m^3/s Temperature difference 7°C
Effulent	Volume 1,200 m^3/d COD 160 mg/l

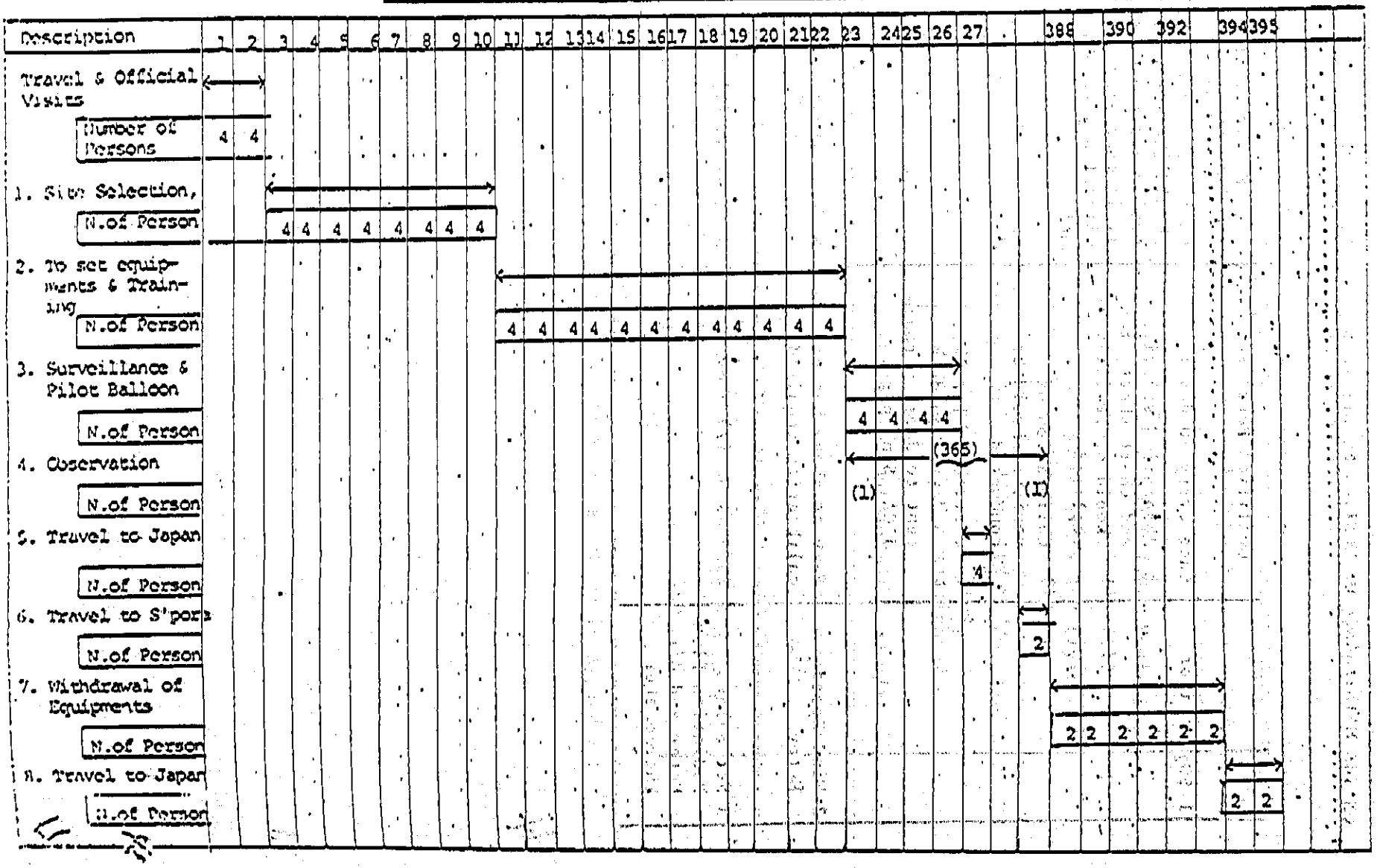
NOTE:
The sites of stacks and outlets are as shown in Appendix D

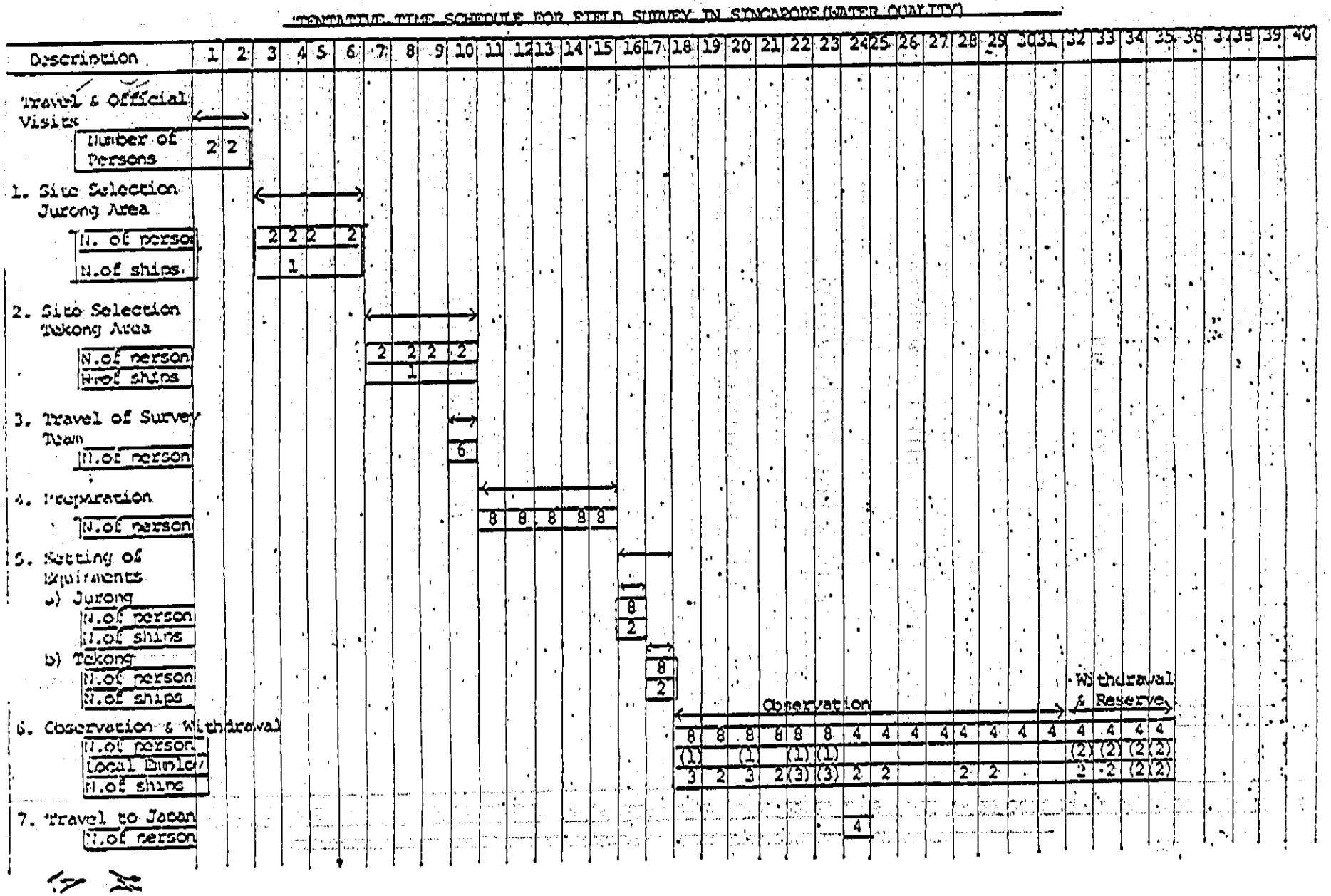
ON THE MAINTENANCE OF MONITORING STATIONS

	Qualified Persons	Regular Persons
1 SO_2 Monitor	Once every 20 days:- a Absorption solution and chart sheet, ink should be refilled or replaced b Calibration of monitor should be conducted c Chart data for last 20 days should be sent to Japan through JICA, Singapore	Once per everyday he should check the monitoring station whether it is operating properly without any trouble or not
2 Wind Speed Meter	Same as above but no calibration required	Same as above
3 Net Solar Radiation Flux Meter and Air Thermometer	Same as No (2) above	Same as No (1) and (2) above

APPENDIX C

TIME SCHEDULE FOR FIELD SURVEY IN SINGAPORE (AIR QUALITY)




TENTATIVE TIME SCHEDULE FOR FIELD SURVEY IN SINGAPORE (WATER QUALITY)
Description
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Travel & Official Visits
Number of Persons
2 2
1. Site Selection Jurong Area
N. of person
2 2 2 2
N.of ships.
1
2. Site Selection Tekong Area
N.of person
2 2 2 2
N.of ships
1
3. Travel of Survey Team
N.of person
6
4. Preparation
N.of person
8 8 8 8 8
5. Setting of Equipments
a) Jurong
N.of person
8
N.of ships
2
b) Tekong
N.of person
8
N.of ships
2
6. Observation & Withdrawal
Observation
Withdrawal & Reserve
N.of person
8 8 8 8 8 8 4 4 4 4 4 4 4 4 4 4 4 4 4
Local Binlo/
(1) (1) (1) (1) (2) (2) (2) (2)
N.of ships
3 2 3 2 (3) (3) 2 2 2 2 2 2 (2) (2)
7. Travel to Japan
N.of person
4

TENTATIVE TIME SCHEDULE FOR FIELD SURVEY IN SINGAPORE (WATER QUALITY)

Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1). Packing of Equipments N.of person																																				4	4	4	4	
2). Travel to Japan N.of person																																								4

MINUTES OF MEETINGS

FOR

THE STUDY OF ENVIRONMENTAL EFFECTS

OF COAL FIRING POWER STATIONS

AND INTEGRATED STEEL MILL

FEBRUARY 1981

MINUTES OF MEETINGS

FOR

THE STUDY OF ENVIRONMENTAL EFFECTS

OF COAL FIRING POWER STATIONS

AND INTEGRATED STEEL MILL

21ST FEBRUARY 1981

Confirmed by:

YING YOK HANG
PRINCIPAL DIRECTOR (TECHNICAL)
JURONG TOWN CORPORATION
GOVERNMENT OF THE REPULIC OF
SINGAPORE

友田正敏

MASATOSHI TOMODA
ENVIRONMENTAL PROTECTION GUIDANCE
DIVISION
INDUSTRIAL LOCATION & ENVIRONMENTAL
PROTECTION BUREAU
MINISTRY OF INTERNATIONAL TRADE AND
INDUSTRY
FOR JAPAN INTERNATIONAL COOPERATION
AGENCY

Minutes of Meeting

The Japanese Survey Team and the Singapore Counterpart had discussion on the Environmental Effect of the Coal Firing Power Stations and Integrated Steel Mill and the following were mutually agreed upon.

Data of the Proposed Coal Firing Power Stations and the Integrated Steel Mill

(A) Coal Firing Power Station

(i) The Japanese Side worked out a revised set of assumptions on the proposed coal firing power stations.

(ii) After discussion with the Singapore Side which included the P.U.B., the assumptions given in Appendix 'A' were agreed upon.

(iii) These assumptions will supercede those contained in Appendix 'A' of Minutes of Meetings dated 19th December 1980.

(B) Intergrated Steel Mill

(i) The Japanese Side shoved a set of draft assumptions on the proposed integrated steel mill, studied and calculated based on the data provided by the Singapore side.

(ii) After discussion with the Singapore Side, which included E.D.B., the assumptions given in Appendix 'B' were agreed upon.

(iii) These assumptions will be adopted for the purpose of the study.

(iv) The location of the stacks and effluent points are as indicated on the plan (Appendix 'C') attached.

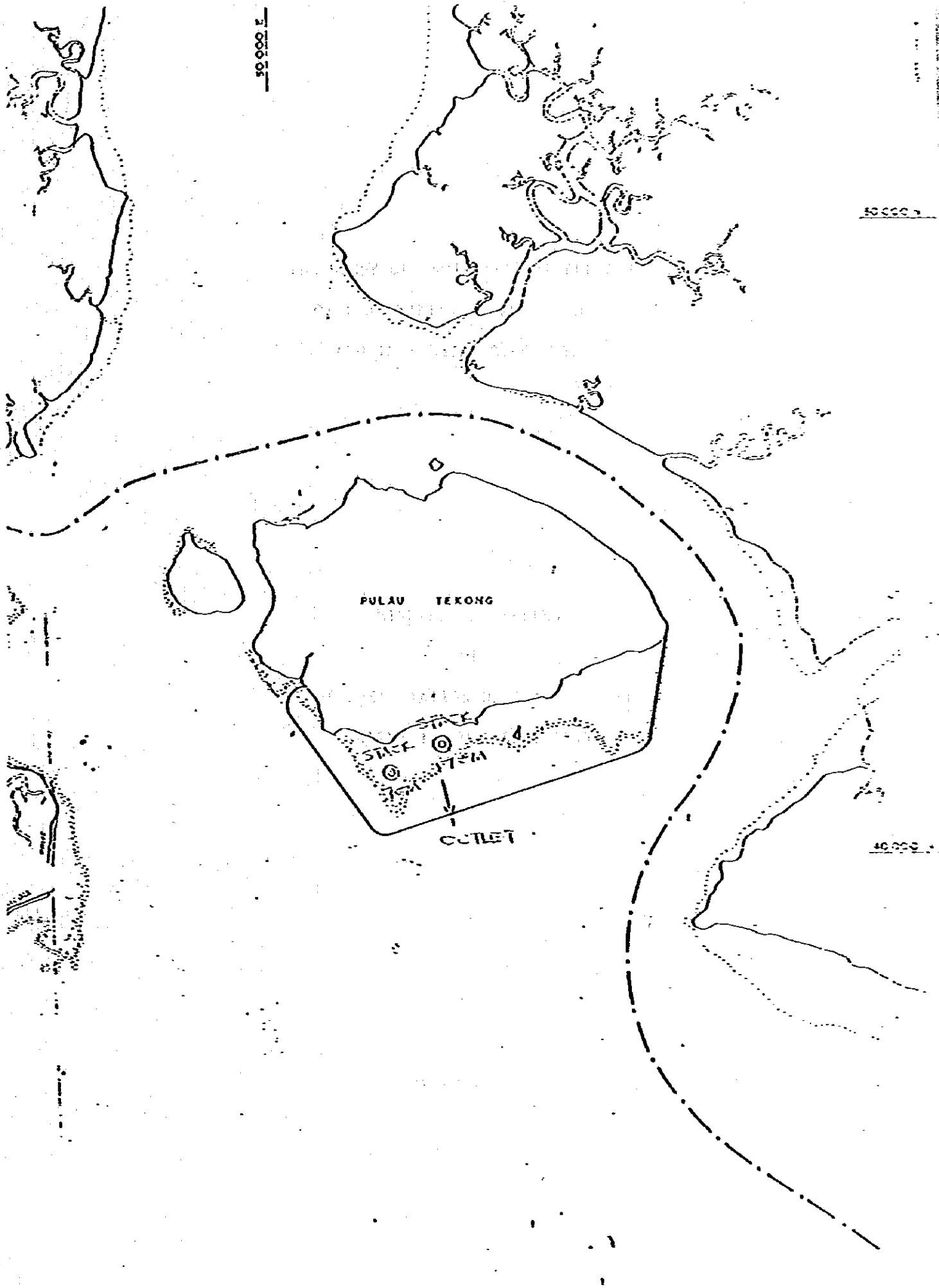
eeeee

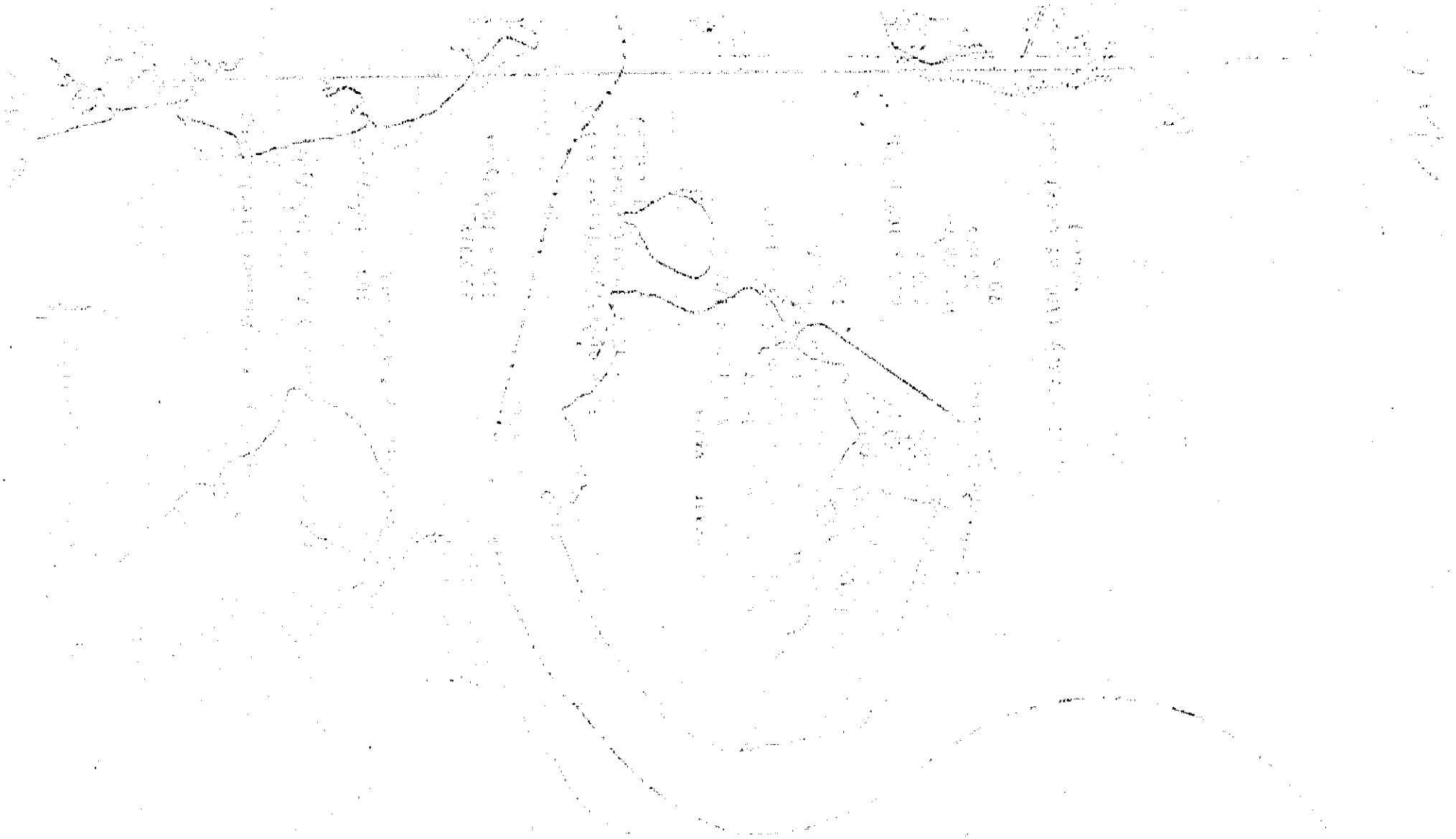
Assumption on Coal Firing Power Stations

Location	P. Seraya	P. Tekong
General Capacity	750 MW (250 MW x 3)	700 MW (350 MW x 2)
Fuel Calorific Value Sulfur Consumption	Coal 27 MJ/kg 1% (wt) 1.7 Mt/year	Coal 27 MJ/kg 1% (wt) 1.6 Mt/year
Stack Height Gas Temperature Gas Volume Gas Discharge Velocity	 183 m 150°c 2,650,000 Nm^3/h 25 m/s (without flue gas desulfurization)	 183 m 150 °c 2,470,000 Nm^3/h 25 m/s (without flue gas desulfurization)
Cooling Sea Water Volume Temperature Difference	 110,000 m^3/h 8.3°c	 100,000 m^3/h 8.3°c
Effluent Volume (COD) Mn	 1,500 m^3/d 50 mg/l	 1,500 m^3/d 50 mg/l
	(Boiler air heater washing effluent, after neutralisation & mixing with water treatment plant effluent)	

Assumption on Integrated Steel Mill

Location	Pulau Tekong
Production Process	Grate Kiln and Electric Arc Furnace Steelmaking
Ore Feed	Lump Ore (Fe 62.6%, S 0.018%) 800 x 10^4t/year
Product	Bar and Wire Rod 100 x 10^4t/year Balance (reduced iron) for Export
Reductant	Coal (S 1%wt) Calorific Value 30 MJ/kg Consumption 336 x 10^4t/year (Operation rate 83%)
Fuel	Heavy Oil (S 3%wt) Consumption 431 x 10^3kl/year(Grate Kiln) 357 x 10^2kl/year(Reheating Furnace)
Stack	Grate Kiln Process Gas Volume 5 x 10^6 Nm^3/h Gas Temperature 100°c (without desulfurization of flue gas) SO_2 Volume 3,500 Nm^3/h Gas Discharge Velocity 30 m/s Height 170 m Reheating Furnace Gas Volume 6.3 x 10^4 Nm^3/h Gas Temperature 500°c SO_2 Volume 100 Nm^3/h Gas Discharge Velocity 30 m/s Height 70 m
Effluent	Volume 9,300 m^3/day (10% of total used water) (COD) Mn 7 ppm


PULAU TEKONG
STACK
STACK
SYSTEM
OUTLET



THE STUDY OF ENVIRONMENTAL EFFECTS OF COAL FIRING POWER STATIONS AND INTEGRATED STEEL MILL

MINUTES OF MEETING OF THE PRESENTATION OF DRAFT REPORT VOLUME 1 - WATER QUALITY

FEBRUARY 1982

MINUTES OF MEETING

The Japanese study team for the Water Quality Survey of the Study of Environmental Effects of Coal Firing Power Stations and Integrated Steel Mill in the Republic of Singapore (Hereinafter referred to as "The Team"), sent by the Japan International Cooperation Agency (Hereinafter referred to as "JICA"), presented to the Singapore authorities a report entitled "DRAFT REPORT ON ENVIRONMENTAL EFFECTS OF COAL FIRING POWER STATIONS AND INTEGRATED STEEL MILL IN THE REPUBLIC OF SINGAPORE VOLUME 1 - WATER QUALITY".

The following is a summary of the meetings and discussions:

1 Schedule of Meetings and Participants

The schedule of meetings and participants are listed in Annexes 1 & 2.

2 Presentation of the Draft Report

2.1 The Team presented the Draft Report which has been prepared based on the objectives, the scope of work, and information described in the following record of discussions:

- Scope of Work dated 19 December 1980
- Minutes of Meeting dated 21 February 1981

The presentation was made by highlighting the features of the study and results.

2.2 The Singapore authorities and the Team exchanged views on the Draft Report.

1 The Singapore authorities expressed satisfaction and appreciation for the dedication, efforts and hard work put in to complete the study.

2 A preliminary review of the Draft Report indicates that the contents of the Report are objective.

4 The Singapore authorities expressed the intention of making questions in order to clarify the contents of the Draft Report, if necessary

- The Team replied to the Singapore authorities that such questions should be made to JICA's office in Singapore by 28 February 1982. The answers will be made in written form outside the final report.

3 Final Report of Volume 1 - Water Quality

The Draft Report of Volume 1 - Water Quality will be considered as final.

The Final Report of Volume 1 - Water Quality will be subbitted to the Singapore authorities by the end of Arpil 1982.

YING YOK HANG
PRINCIPAL DIRECTOR (TECHNICAL)
JURONG TOWN CORPORATION
FOR GOVERNMENT OF REPUBLIC OF SINGAPORE

鈴木洋一

YOICHI SUZUKI
LEADER OF THE JAPANESE
WATER QUALITY SURVEY TEAM
FOR JAPAN INTERNATIONAL
CO-OPERATION AGENCY

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ENVIRONMENTAL STUDY
WATER QUALITY SURVEY

Presentation of Draft Report

Venue: VIP Lounge, Jurong Town Hall, Singapore

Time: 9.00 am - 10.00 am

Date: 4 February 1982

Member Lists

Japanese Report Team

Mr Yoichi Suzuki	-	IPCAJ, Leader, Water Quality Survey Team
Mr Kihachi Inagaki	-	IPCAJ, Co-ordinator
Mr Kisaburo Nakata	-	MITI
Mr Masaya Konno	-	MITI

Singapore Counterpart (JTC)

Mr Tang I Fang	-	Chairman
Mr Francis Mak	-	General Manager
Mr Ying Yok Hang	-	Principal Director (Technical)
Mr Lim Sak Lan	-	Senior Director (SME)
Mr Tan Suan Yong	-	Senior Principal Civil Engineer
Mr Hee Ah Mui	-	Senior Civil Engineer

ENVIRONMENTAL STUDY
WATER QUALITY SURVEY

Technical Session for The Discussion on
The Draft Water Quality Survey Report

Venue: Jurong Town Hall, Singapore

Time: 9.30 am - 12.00 noon

Date: 5 February 1982

Member Lists

Japanese Report Team

Mr Yoichi Suzuki	-	IPCAJ, Leader, Water Quality Survey Team
Mr Kihachi Inagaki	-	IPCAJ, Co-ordinator
Mr Kisaburo Nakata	-	MITI
Mr Masaya Konno	-	MITI

Japanese Embassy

Mr Tokio Katayama	-	1st Secretary, Commercial Attache

Singapore Team

Mr Lim Sak Lan	-	Jurong Town Corporation
Mr Tan Suan Yong	-	Jurong Town Corporation
Mr Hee Ah Mui	-	Jurong Town Corporation
Mr Ng Hwee Choon	-	Jurong Town Corporation
Mr Chiang Kok Meng	-	Ministry of the Environment
Mr Foong Chee Leong	-	Ministry of the Environment
Mr Jasbir Singh	-	Port of Singapore Authority
Mr Yang Keng Kun	-	Port of Singapore Authority
Mr Wong Seng Chee	-	Port of Singapore Authority
Mr Joseph Hui	-	Anti-Pollution Unit
Dr Tay Joo Hwa	-	National University of Singapore
Dr Ng Wun Jern	-	National University of Singapore

MINUTES OF MEETING

FOR

THE STUDY OF ENVIRONMENTAL EFFECTS

OF COAL FIRING POWER STATIONS

AND

INTEGRATED STEEL MILL

23 JULY 1982

CONFIRMED BY

YING YOK HANG
PRINCIPAL DIRECTOR (TECHNICAL)
JURONG TOWN CORPORATION
ON BEHALF OF
THE GOVERNMENT OF
THE REPUBLIC OF SINGAPORE

稲垣喜八

KIHACHI INAGAKI
TEAM LEADER
JAPANESE SURVEY TEAM
ON BEHALF OF
JAPAN INTERNATIONAL COOPERATION AGENCY

The Japanese Survey Team and the Singapore Counterpart had held discussions with the Relevant Authorities on future and present emission sources data for the purpose of setting up conditions and input data pertaining to the study on the environmental effects of coal firing power stations and integrated steel mill, and the following were mutually agreed upon -

1 For facilities commissioned before 1975, they are permitted to continue the use of the present quality of fuel; and
For facilities commissioned after 1975, they are required to use fuel which contains less than 2% of sulphur, with the exception of PUB's Senoko Power Station.

2 Besides the present three existing power stations, the following power stations are expected to be in operation -

a Senoko Power Station Phase III

Expected Date of Operation	Capacity	Sulphur Content of Fuel	Stack Diameter
i June 1983	1 x 250 MW	2.8%	4.30m
ii Dec 1983	1 x 250 MW	2.8%	4.30m

b Seraya Power Station Phase I

	Expected Date of Operation	Capacity	Sulphur Content of Fuel	Stack Diameter
i	1987	2 x 250 MW	2%	4.30m
ii	1988	1 x 250 MW	2%	4.30m

3 The projection of growth of industries will be based on information and data provided by EDB earlier, except that the petroleum refining industries will maintain the present level of production until 1990.

JICA