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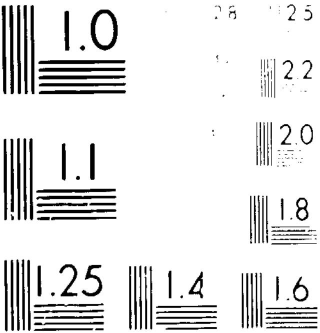
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RESTRICTED

20 October 1982
English

POLLUTION CERTIFICATION:
SI/BRA/81/802/11-01/32.1.5.

BRASIL.

Terminal Report

Prepared for the Government of Brasil
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme.

Based on the work of R.K. Chalmers *
Adviser on pollution certification

United Nations Industrial Development Organization,
Vienna

This report has not been cleared with the United Nations Development Organization which does not, therefore, necessarily share the views presented.

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ABBREVIATIONS

A. LOCAL

COPAM	-	Comissão de Política Ambiental de Minas Gerais The State Pollution Control Organization
CETEC	-	Fundação Centro Tecnológico de Minas Gerais Technical Centre, operating as a Company, with substantial service and laboratory facilities
CETESB	-	Companhia de Tecnologia de Saneamento Ambiental The technical centre for the State of São Paulo, and the Pollution Control Organization. A Company.
COPASA	-	Companhia de Saneamento de Minas Gerais S.A. The State's Sewerage and Sewage Treatment Company
COPEMA	-	The Environmental Pollution Section within the National Confederation of Industries
FEEMA	-	Fundação Estadual de Engenharia do Meio Ambiente, R.J. The Pollution Control Organization for the State of Rio de Janeiro. Wholly State Owned, with no other interests
SEMA	-	Secretaria Especial do Meio Ambiente The Federal Environmental Protection Department within the Ministry of the Interior, Brasilia.

B. TECHNICAL

US EPA	-	Environmental Protection Agency, USA
EPS	-	Environmental Protection Service, Environment Canada
EIA	-	Environmental Impact Assessment
EIS	-	Environmental Impact Statement
ER/V	-	Environmental Resources/Values
BOD(DBO)	-	Biochemical Oxygen Demand
COD(DCO)	-	Chemical Oxygen Demand
D.O. (O.D)	-	Dissolved Oxygen
P.V.	-	Permanganate Value, 4 hours
S.S.	-	Suspended Solids
B.P.T.	-	Best Practicable Technology
R.Q.O.	-	River Quality Objective
TLV	-	Threshold Limit Value
STEL	-	Short-term Exponsure Limit

C. EXCHANGE

1 Us Dollar = 210 cruzeiros(Cr$) at 1-10-82
179 cruzeiros (Cr$) at 25-07-82

ABSTRACT

Pollution control and certification is a developing art and science in Minas Gerais. The State Pollution Control Organization, COPAM is five years old, and requested technical assistance.

With 45,000 industries in a State larger than France, the task is a major one, and substantial expansion of the organization and control systems is required.

Starting from a sound base and a small but competent and enthusiastic technical staff, development is required of some technical aspects of pollution certification and control. Assistance was given, as recorded in this report, on quantifying emissions of pollutants, the derivation of control standards, approaches to assessing the effects of pollutants, assessment of applications for licences, factory inspections, air monitoring networks, minimizing industrial wastewater discharges, water quality surveys, solid toxic wastes, and environmental impact assessments.

The texts of ten discussion-seminars are annexed to the report, which includes 65 recommendations.

I - BACKGROUND

This mission arose from a request from the Government of Brazil for Special Industrial Services - a pollution certification expert to be attached to COPAM.

The purpose of the project was to contribute to maintaining stable environmental conditions and to prevent industrial pollution in the State of Minas Gerais. The job description is given in Annex 1.

Brazil is a very rapidly developing country. In the years from 1970 to 1982 it advanced from no aircraft production to being the 6 th largest producer in the world. It is the world's largest source of iron ore.

Federal pollution control is coordinated by SEMA, a department within the Ministry of the Interior. While there are Federal guidelines, which must be observed by all, on surface water quality, each State is largely autonomous in respect of its standards for and control of all forms of environmental pollution.
While the States of São Paulo and Rio de Janeiro have fairly well developed pollution control organizations, COPAM in Minas Gerais is of fairly recent origin (1977), and developing. Its technical staff are very well trained in the theory of pollution control, much of it based on USA technology, but lack practical experience in adapting this to local conditions or in assessing what is practical and possible in different industries in practice. Assistance was requested for this reason.

The mission lasted three months , and the expert was in Brazil from 25 July to 17 October 1982.

There had been no previous expert input in this field. The nearest related project is the current UNIDO project US/BRA/80/166: "Assistance in the establishment and operation of a pilot and demonstration plant for tannery effluents treatment,at Estancia Velha". An environmental impact study at a Steel works was made in 1974.

II- INTRODUCTION

The inland State of Minas Gerais is larger than France. It covers 587.000 square kilometers, contains 45.000 industries, 722 municipalities, 13,4 m. population, 5 significant river basins, many smaller streams and lakes, and its capital Belo Horizonte is a city of 2.2 M.people.

COPAM, the State pollution control organisation, is a young developing structure, staffed by notably well-trained and enthusiastic engineers, scientists, lawyers and administrators; grossly overloaded with work, and much too small in technical staff for the job it has to do. That job covers conservation, ecology, reforestation, air and water pollution standards and control, solid wastes, Noise.

It includes the responsibility for licensing industries for construction and operation, and monitoring ("Fiscalizing") them for compliance with the standards and requirements that it sets for all kinds of pollution control. The technical staff of COPAM of the start of this mission numbered 10, and by the end of the mission 17.
It will need a total staff of at least 70 people.

Against that background certain items in the job description for this mission could not be concluded.
It was impossible, for example, to "Report on all significant sources of pollution under various conditions", or to "Enumerate the sources and types of pollutants..." except in general terms. This is because of (a) the lack of much of the relevant basic data, and(b) the sheer size of the task. It is estimated that, for a comprehensive inventory, the collection, collation and interpretation of the data will require at least 3 Man-years rather than 3 months.

What was done therefore, with the agreement of the counterpart staff, was to summarise the existing relevant information and practices, and develop and recommend the actions required and the methodology for their extension, completion and use. Pilot visits were made to industries, as well as visits to official or semi-official organizations. The approach to the assessment of industrial submissions was illustrated.

Particular attention has been given to the development of controls applied to industry, and the need to make them relevant necessary, just, and economically attainable - as well as adequate - has been emphasized.
Methods for minimizing industrial effluent discharges at their sources have been described in detail, since they can reduce the size of a pollution problem many times, but are seldom practised in Brazil.

The training of counterpart staff was requested to bridge the gap between theory and practice, and was covered in some depth and completed by ten Discussion - Seminars. Because the counterpart staff had many other commitments and sustained discussion was difficult, the texts for these Seminars was constructed during the mission and supplied. They are reproduced, including their supporting appendices which total 75 pages, in the Annexes to this Report.

The Report contains.57 Specific recomendations and 8 general.

This was a happy mission and, within the constraints noted above, wholly successful.

During this mission some support was given to the developing UNDP Project, BRA/82/010: "Prevention of, control of and Combat Against Marine Pollution in Brazil, with which there are close similarities so far as UNIDO inputs are concerned.

III- COPAM STRUCTURE AND OPERATIONS

3.1. COPAM was established in 1977 as a Commisssion to deal with the political and policy aspects of environmental control in the State of Minas Gerais.
At that time all executive functions were vested in CETEC , and all practical and field work was done by them.
CETEC also works for industries.

In 1980 it was determined that the executive work should be done at COPAM, with service support to it provided by CETEC.

During this mission, on 28 september 1982, COPAM was formed into a "Superintendence" with direct executive responsibility for all aspects of pollution control in the State. It is envisaged that all laboratory analyses and possibly monitoring (sampling) factory visits - as opposed to "Fiscalizing" inspection visits for assessing compliance with licence conditions - will be sub-contracted, probably to CETEC and the Engineering School of the Federal University.

Some support from other State organizations is also possible.

The present structure of COPAM is shown in figure 1.

3.2. COPAM has strong administrative control, excellent legal services, and a structure capable of development into an effective organization of any desired size. All significant environmental interests are represented on its governing body, the Plenário.

Its deficiencies lie in its technical and support administrative services, upon which all of its practical work ultimately depend. They are too few, too small, too busy. It has some difficulty therefore in:

(a) listing details of all industries with significant discharges
(b) extending effective control to all such industries
(c) providing a comprehensive regular monitoring and fiscalizing service
(d) having time to review its control standards in the light of developing experience
(e) assessing the correctness of arguments put to it by some industries in which it has limited experience.

(f) collection, collation and interpretation of basic data on environmental pollution across the State.

(g) developing planning information.

While some of these activities can be (and have been) sub-contracted, it seems highly desirable to retain its basic planning licensing, fiscalizing and support services as an in-house operation, free from any commercial interest. As shown in Annex,4"Organization for an Expanding Fiscal (Monitoring) Programme", these operations alone call for a total staff of at least. 60 people, approached in a Pro - gramme of phased growth.

3.3. RECOMMENDATIONS

3.3.1. Expand the technical services in a programme of phased growth.

3.3.2. Establish a small section of specialists, which can be based on the existing staff, capable of providing an in-house consultancy service on industrial proceses, standards, and treatment to the operational licensing and monitoring services.

3.3.3. Include minimizing industrial effluent discharges and approaches to low waste technology in the specialist services.

3.3.4. Separate licensing operations from monitoring(and possibly fiscalizing) services, which will call for a full-time staff - already beginning.

3.3.5. Develop the fiscalizing and monitoring system along the lines recommended in Annex 4; including the planning of the data recording system for future transfer to a com - puter facility.

3.3.6. Modify some of the prescibed effluent control standards , some of which are inadequate, and some of which are un-necessarily detrimental to industry, as recommended in Annex.2.

3.3.7. Do not apply river discharge standards but the more relaxed sewer discharge standard to industrial effluents

that will be certain to be connected to sewer networks within a reasonble time - 5 years.
This is of major importance to industry. (See Annex 2).
If necessary seek a change in the law for this purpose

3.3.8. Establish a system of regular liason with FEEMA, CETESB, and SEMA in order to:

(a) coordinate pollution control requirements and standards, especially near State boundaries, and
(b) exchange information and library facilities.

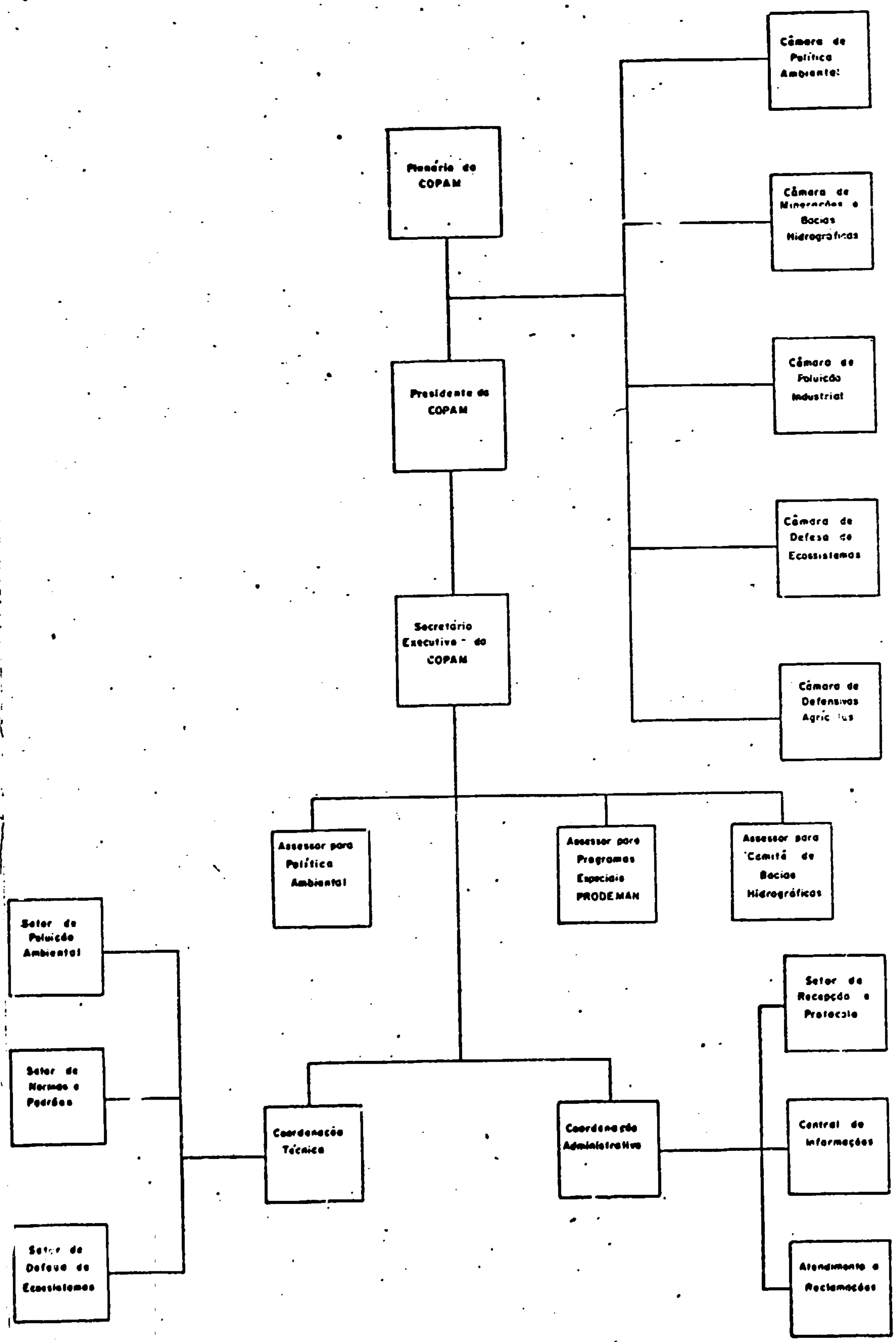
3.3.9. Expand the wholy inadequate local library at COPAM. Appoint a librarian.

3.3.10. Establish a regular further training programme for COPAM technical staff, using internal, national and international expertise.

3.3.11. Establish coordinating research and development commitees with the major polluting industries, as recommended in Annex 10 "Wider Aspects of Pollution Control". That Annex also contains suggestions for study groups and other matters for later development.

FIGURE 1

ESTRUTURA ATUAL DA COPAM



IV. THE SIZE OF THE PROBLEM

With 45.000 industries in the State, of which 11.629 have been listed as having some discharge of pollutants it is easy to see that pollution control is a major task.

Existing data is inadequate. It would be grossly misleading, for example, to assume that metal processing industries are not polluting because they contribute little or no BOD to waters in their discharges.

As data collection proceeds it will probably be found that the total number of factories with potentially polluting discharges is rather larger than 11.629. Of this total, by comparison with other areas, some 50% will probably be assessed as relatively insignificant, and may be subject to almost automatic licensing. Of the remainder, all are likely to require some attention, and between 2.500 and 5.000 to require regular surveillance.

For licensing and fiscalizing alone, the implications of such numbers are shown in Annex 4 , "Monitoring of Industrial Effluent Discharges".

Taking into account all the other interests of COPAM, the conclusion is inescapable that, unless it were to remain a purely, policy making body, a fairly dramatic expansion of its present structure must occur.

V. QUANTIFYING EMISSIONS OF POLLUTANTS

5.1. Some estimates have been made of the total potential emission of some industrial pollutants in the State of Minas Gerais. These were for the purpose of identifying critical areas for priority action, and are therefore generalized.

This information is summarized in tables 1 and 2 which show the distribution of 17 classes of industries within the micro-regions of the State, and the estimated total emissions of particulate matter and sulphur oxides to the atmosphere from each class. Some very limited information is also given on the estimated Biochemical Oxygen Demand (BOD) in aqueous discharges from some of the classes.

It should be noted that:

5.1.1. These estimates assume the absence of any pollution abatement measures.

5.1.2. While useful for identifying critical areas, and for giving possible background levels against which future improvements can be measured, they do not show the size of the problem in a particular location or at a particular factory.

5.1.3. This is because the sizes of factories vary, the extent and efficiency of pollution control measures vary, and the concentrations of factories within different locations vary.

5.1.4. The information needs to be refined, therefore, to show:

5.1.4.1. Data for specific industries. Cement, mining and ore crushing, for instance, are presumably included together under the heading, "Transformation of non-metallic mineral products". Similarly, iron, steel, aluminium and zinc appear to be classified together under "Metallurgical".

5.1.4.2. Data for individual industries in specific locations.

5.1.5. The information needs to be extended to cover many more specific pollutants: suspended solids, toxic metals, ammonia, phenols, cyanides, and individual organic chemicals in liquid effluents wherever these or other parameters are relevant; sulphides, nitrogen oxides, ammonia, solvents, etc, in air discharges wherever these or other parameters are relevant.

5.2. The forward programme should then be:

5.2.1. Preparation of a detailed list of significant factories, showing their location, size, number of employees, annual production, working hours, water comsumption, and any pollution abatement measures practised. A start has been made on the preparation of lists in two areas: Belo Horizonte and Paraiba do Sul Basin.

5.2.2. For air emissions, forecasts of the discharge each factory, (a) existing and (b) after introduction of pollution control measures. These can be derived from fairly well-established emission factors for specific industries, examples of which are given in table 3.

5.2.2.1. Monitoring of actual results and comparison with standards prescribed, and determination of ambient air concentrations under prevailing and abnormal wind and weather conditions.

5.2.2.2. Establishment of a phased programme of improvements to meet the ultimate goals. The pragmatic approach of CETESB in São Paulo is a useful guide.

5.3. For aqueous effluents, predicting discharge emissions is complicated by the enormous influence of economy measures that may or may not be practised within the industry. These, together with the extent of water re-use of recycle, the degree of effluent pre-treatment prior to discharge, and the containment or recovery of contaminants have to be assessed.

Annex 6, "Minimizing Industrial Wastewater Discharges", includes detailed figures for water consumption and discharge with and without economy measures, and examples of the control of the discharge of contaminants.

Many assessments have been made of pollution loads associated with production units in many industries. One of the most useful is that used by the Government of the Netherlands, from which the following is an abstract relating to the food industry.

Netherlands - Surface Water Pollution Act, 1970: Pollution units are based on population equivalents (pe), and have been established for many industries. They show a wide variation according to type of industry, equipment, and primarily to the attention paid by management and workers to "good housekeeping" practices. Examples are:

Type	Unit	Coefficient
Brewery	1,000 Kg beer	1.2
Chocolate, Sweets	Employee	2.5
Distilleries	Employee	0.5
Vegetable Canning	1,000 Kg carrots, turnips	1.6
	1,000 Kg peas	0.3
Yeast and Alcohol	1,000 Kg molasses	8.4
Lemonade and Bottling	1,000 litre product	0.2
Slaughterhouses, Pigs	1,000 Kg finished product	0.6
Farms	1 cow (total)	10

Type	Unit	Coefficient
Farms	1 cow (urine only)	3
Fish canning	1,000 Kg fish	1.7
Fish meal	1,000 Kg fish	3.0
Dairy	1,000 Kg milk received	0.09
	1,000 Kg cheese	3

$$1 \text{ pe} = \frac{\text{grams COD} + 4.57 \text{ grams N}}{180}$$

TABELA 1

Síntese das participações percentuais de cada gênero industrial no conjunto das indústrias da microrregião

MICRORREGIÃO	TOTAL DE INDÚSTRIAS	% relativo ao total do Estado	PARTICIPAÇÃO RELATIVA DO GÊNERO INDUSTRIAL (%)																
			Produtos alimentares	Trans. prod. min. não metálicos	Metalurgia	Madeira	Bebidas	Mobiliário	Têxtil	Mat. de transporte	Couros, peles e prod. similares	Química	Material elétrico	Borracha	Perf. sabões e velas	Prod. matérias plásticas	Papel e papelão	Prod. farm. e veterinários	Fumo
157. Sanfranciscana de Januária	88	0,6	22	53	1,1	14	3,4	-	-	-	6,8	-	-	-	-	-	-	-	-
158. Serra Geral de Minas	40	0,3	25	15	-	13	38	-	10	-	-	-	-	-	-	-	-	-	-
160. Chapadões do Paracatu	206	1,4	36	21	6,3	31	-	0,5	-	3,4	1,0	0,5	0,5	-	-	-	-	-	-
161. Alto Médio São Francisco	45	0,3	27	53	8,9	8,9	-	-	-	2,2	-	-	-	-	-	-	-	-	-
159. Alto Rio Pardo	35	0,2	14	40	-	5,7	29	-	-	-	11	-	-	-	-	-	-	-	-
162. Montes Claros	227	1,6	30	21	9,2	13	5,3	3,5	0,4	4,8	7,1	1,7	0,9	1,3	0,4	-	0,4	0,4	-
163. Mineradora do Alto Jequitinhonha	2	0,0	50	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
164. Pastoril de Pedra Azul	81	0,6	23	14	3,7	9,9	26	-	-	1,3	20	-	-	-	-	-	-	-	-
165. Pastoril de Almenara	71	0,5	32	27	11	13	8,5	-	-	-	8,5	-	-	-	-	-	-	-	-
167. Mineradora de Diamantina	66	0,5	35	15	7,6	7,6	27	-	6,1	-	1,5	-	-	-	-	-	-	-	-
168. Teófilo Otoni	126	0,9	26	14	5,6	14	28	3,9	-	2,4	2,4	0,8	-	2,4	-	-	-	0,8	-
169. Pastoril de Nanuque	86	0,6	36	23	2,3	20	4,7	1,1	1,1	1,1	7,0	1,1	-	2,3	-	-	-	-	-
166. Médio Rio das Velhas	129	0,9	30	32	7,5	9,3	12	1,5	5,4	-	1,5	-	0,8	0,8	-	-	-	-	-
171. Alto Paranaíba	211	1,4	42	30	4,7	11	1,9	1,9	0,4	2,4	0,4	3,3	0,5	0,4	0,4	-	-	-	-
172. Mata da Corda	280	1,9	33	31	7,1	19	1,5	1,5	-	1,8	3,2	0,3	0,4	0,7	-	-	-	0,3	-
173. Três Marias	111	0,8	28	42	3,6	14	3,6	0,9	0,9	2,7	-	2,7	-	-	0,9	-	-	-	-
170. Uberlândia	748	5,1	43	15	10,0	7,9	1,6	8,6	1,4	4,9	0,6	1,7	1,1	1,5	0,8	0,4	0,3	0,3	-
177. Pontal do Triângulo Mineiro	273	1,9	36	49	1,1	9,5	0,4	1,4	-	2,2	0,7	-	-	-	-	-	-	-	-
178. Uberaba	388	2,7	39	41	7,4	3,4	1,0	4,4	1,5	2,6	1,5	1,3	1,3	1,0	0,8	1,0	1,0	-	0,3
174. Bacia do Suaçuí	155	1,1	36	42	2,0	7,1	12	0,7	-	-	-	-	-	-	-	-	-	-	-
175. Governador Valadares	198	1,4	42	15	10	10	4,0	4,0	-	4,5	3,6	1,0	1,0	1,5	-	1,5	1,0	0,5	-
176. Mantena	69	0,5	44	25	2,9	16	7,2	-	-	5,3	-	-	-	-	-	-	-	-	-
184. Mata de Caratinga	130	0,9	44	32	2,3	3,8	7,0	1,5	0,8	3,1	1,5	-	0,8	-	-	-	-	0,8	-
185. Bacia do Manhuaçu	181	1,2	36	23	4,4	24	7,2	0,5	-	2,2	2,2	0,5	-	-	-	-	-	-	-
188. Mata de Ponte Nova	196	1,3	53	14	9,2	4,6	16	1,0	1,0	-	-	0,5	0,5	-	-	-	0,5	-	-
189. Vertente Ocidental do Caparaó	279	1,9	52	23	1,8	7,5	5,0	1,1	0,7	1,1	0,4	0,4	0,7	0,4	0,8	0,4	-	-	-
192. Mata de Viçosa	157	1,1	51	18	1,2	8,9	14	0,6	-	-	-	-	3,2	-	0,6	-	0,6	-	-
193. Mata de Muriaé	317	2,2	47	13	3,4	14	7,3	3,2	3,2	4,7	1,3	0,3	0,3	0,9	0,6	0,3	-	0,6	-
196. Mata de Ubá	287	2,0	40	23	4,5	7,3	7,3	1,4	0,4	1,0	1,8	1,0	0,3	0,7	-	1,0	-	0,4	1,4
201. Mata de Cataguases	306	2,1	51	16	3,3	12	3,3	1,9	4,0	0,6	-	1,3	-	0,4	-	0,4	2,9	0,4	0,4
179. Planalto de Araxá	183	1,3	40	25	8,8	14	1,6	4,4	-	2,7	0,5	1,1	-	1,1	0,5	-	-	-	-
180. Alto São Francisco	425	2,9	41	28	7,0	15	2,4	0,9	0,9	0,3	0,8	2,4	0,5	0,5	0,3	-	-	-	-
190. Furnas	987	6,8	49	29	4,9	8,2	1,0	1,7	1,2	0,7	1,3	1,5	0,4	0,5	0,1	0,1	0,1	0,1	-
191. Formiga	564	3,9	37	31	7,5	14	4,0	0,7	0,3	1,2	1,6	2,0	-	0,7	0,2	-	-	-	-
194. Mogiana Mineira	340	2,3	54	21	4,7	8,2	1,5	1,2	0,9	1,2	2,7	0,3	0,3	0,5	-	-	-	-	-
197. Planalto de Poços de Caldas	308	2,1	30	28	11	10	12	2,6	0,4	1,6	-	1,0	1,3	1,0	1,6	-	-	-	-
198. Planalto Mineiro	868	6,0	45	30	4,9	9,9	3,4	1,2	2,5	0,4	0,3	1,1	0,1	0,3	0,3	0,1	0,3	0,1	-
199. Alto Rio Grande	294	2,0	60	26	3,4	6,8	0,4	1,4	0,6	-	-	-	0,7	0,6	-	-	-	0,4	-
202. Alto Mantiqueira	464	3,2	49	27	6,7	9,7	1,5	1,7	0,9	1,1	-	0,2	1,5	0,2	0,2	0,2	0,4	-	-
181. Calcários de Sete Lagoas	199	1,4	33	3	18	7,5	3,0	2,5	5,0	2,0	2,5	-	1,5	1,5	1,0	-	-	-	-
183. Siderúrgica	369	2,5	30	30	16	8,7	1,9	7,6	-	1,6	0,3	2,7	-	1,1	-	0,3	-	-	-
186. Divinópolis	611	4,2	21	34	22	5,6	2,6	3,3	3,1	2,0	1,8	0,5	1,5	2,1	0,2	0,4	-	-	0,4
187. Espinhaço Meridional	283	1,9	30	39	21	7,4	6,3	5,7	3,9	0,7	1,1	1,4	2,1	0,4	-	-	-	-	-
195. Campos da Mantiqueira	415	2,9	32	36	8,9	9,4	3,2	2,1	3,9	0,7	6,0	1,7	0,5	1,2	-	-	-	0,3	-
200. Juiz de Fora	782	5,4	[illegible]	19	9,6	7,7	3,1	3,9	17	0,7	0,5	1,8	1,5	0,7	[illegible]	[illegible]	[illegible]	1,3	[illegible]
182. Belo Horizonte	[illegible]	13,6	25	17	[illegible]	[illegible]	1,1	10	2,1	[illegible]	1,4	[illegible]	2,7	1,4	[illegible]	1,4	[illegible]	1,6	0,1
Estado	14.561	100,0	33	25	9,8	9,4	3,9	3,6	2,3	1,9	1,5	1,2	1,1	0,8	0,4	0,4	0,3	0,2	0,1

Fonte: [illegible]

TABLE 1

TABLE 2. ESTIMATES OF TOTAL EMISSIONS OF POLLUTANTS

INDUSTRY	Nos.	AIR. Particulate Matter: Average Emission, Kg/d/factory	AIR. Particulate Matter: Total Emission, Kg/d.	AIR. Oxides of Sulphur: Average Emission, Kg/d/factory	AIR. Oxides of Sulphur: Total Emission, Kg/d.	WATER. BOD.: Average Emission, Kg/d/factory	WATER. BOD.: Total Emission, Kg/d.
1. Food products	3.734	40,2	150.000	27	99.000	22.000	83 x 10^6
2. Non-metallic minerals	3.031	2.100	6.450.000	63	190.000	-	-
3. Metallugircal	1.269	1.300	1.600.000	23	29.000	-	-
4. Wood	622	0,029	18	0,0043	2,7	-	-
5. Drinks	869	3,8	3.300	4,8	4.200	2.900	25 x 10^6
6. Mechanical	720	2,5	1.800	22	16.000	-	-
7. Textiles	192	27	5.200	89	17.000	400	76.000
8. Transport materials	64	0,15	9,6	7,3	470	-	-
9. Leather	266	0,2	53	8,3	2.200	56	15.000
10. Chemicals	217	4,6	990	38	8.200	4,6	1.000
11. Electrical materials	240	0,039	9,3	0,21	50	-	-
12. Rubber	160	0,061	9,7	0,19	30	-	-
13. Soap and candles	47	6.000	230	1,6	73	2,1	100
14. Plastics	12	0,010	0,12	0,36	4,3	-	-
15. Paper and cardboard	35	6.000	210.000	2.200	76.000	2.800	99.000
16. Pharmaceutical	117	0,34	40	0,80	94	-	-
17. Tobacco	34	-	-	-	-	-	-
TOTALS	11.629		8,4 x 10^6		0,44 x 10^6		86 x 10^6

TABLE 3 - EXAMPLE OF KNOWN EMISSIONS FROM INDUSTRIES

PARTICULATE MATTER

-Lbs per Ton-

	Without Control	With Control
1. Cement:		
Wet process, kilns	167	10 (new plant 0,3-USA)
Grinders, dryers, etc.	25	1,5
Dry process, kilns	167	10
Grinders, dryers, etc.	67	4
2. Rock Crushing	17	3,4
3. Sand and Gravel	0,1	-
4. Iron:		
Ore Crushing	2	2
Materials handling	10	1
Sintering	42	4,2
Blast Furnace	130	1,3
5. Steel Furnaces:		
Open Hearth	17	0,5
Basic Oxygen	40	0,4
Electric arc	10	0,1
6. Coal Combustion:		
Industrial Boilers		
Pulverized	170	26
Stoker	133	20
Cyclone	31	6
7. Fuel Oil (Industrial)	18	18 (units: lbs./mil. scf.)

	-Lbs per Ton-	
	Without Control	With Control
8. Magnesite	250	50
9. Aluminium:		
Grinding bauxite	6	1,2
Calcining hydroxide	200	20
H.S.Soderberg Cells	144	86
V.S.Soderberg Cells	84	30
Pre-bake	63	23
Materials handling	10	1
10.Zinc:		
Ore Crushing	2	2
Roasting- Fluid Bed	2.000	40
Ropp multi-hearth	333	50
Sintering	180	9
Materials handling	7	1
11.Sulphuric acid:		
Chamber	5	5
Contact	2	0,1
Spent acid concentrators	30	2
12.Coffee Roasting:		
Indirect fired	0,8 - 4,0	0,2 - 1,0
Direct fired	3 - 5	1,2
Stoner, cooler cleaner, and handling	0,5 - 0,8	0,1 - 0,3

This table, calculated from figures published by Sax ("Industrial Pollution" Van Nostrand Reinhold, 1974) is given only as an example of the derivation of emissions to be expected.

From the factors in this table, with or without control of emissions, the total emissions can be calculated from the production throughput of a) individual factories and b) the total for the State. Some annual production figures from the State of Minas Gerais are:

PRODUCT	YEAR	TONS
Cement	1981	7.622.000
Steel	1981	4.691.000
Iron Ore	1980	139.344.000
Aluminium	1981	148.000
Sulphuric Acid	1981	920.000 (capacity)
Phosphoric Acid	1981	259.000 (capacity)

Similar lists of emission factors are available for many parameters, and reference should be made to standard reference books like Sax, and particularly the US. EPA Guidelines which have been published for the pollutant emissions from many industrial processes.

In applying "with control" factors care is necessary to use those applicable to the controls actually used, which may or may not be the "Best available technology".

VI- STANDARDS

A- Aqueous Discharges

6.1. This subject is considered in detail in Annex 2 "Standards for waters and Effluents".

The existing system of control by Standards is potentially excellent. The recommendations in this report should be seen as suggestions for its fine tuning, and for minimizing some problems that can be forseen.

6.2. Unless it is decided to require the application of BPT to all effluent discharges, regardless of the consequential costs, it is highly undesirable to apply the COPAM effluent standards as a single set of figures applicable to all cases in the State. In order to meet the Federal RQO standards at all times, such a standard must be based upon the lowest probable flow-perhaps the once in 10 year low-in the smallest receiving river or stream. In all other cases, and at all normal flows, the river standards would be met with a huge factory of safety.

6.3. The suggestion is therefore developed that the COPAM effluent standards should be capable of variation to meet local discharge circumstances, and always designed to ensure that the RQO requirements of the receiving river are met. This has the advantage of telling industry clearly what is expected of it, of eliminating some contradictory requirements, and of requiring compliance monitoring at one point only, the effluent discharge, instead of the two- including the river - which are implied by the present system.

6.4. There is also a need to specify in licences the volume and rate of effluent discharge, in order to prevent one industry taking up the whole receiving capacity of a river when others need a facility to make discharges, or of overloading a river by discharging the whole of its permitted daily load in one or two hours. Some refinement of the COPAM effluent conditions is also indicated to prohibit totally the discharge of some unacceptably hazardous materials not yet listed, to define some rather vague terms such as "cyanide" and to correct one two dubious existing figures.

6.5. Since it is COPAM policy to encourage (or require) industrial effluent discharges into sewer metworks when facilities for domestic sewage treatment become available - as is projected in several cases - account should be taken of this in framing effluent standards. Standards for discharges to domestic sewers will certainly be less stringent than those for direct discharges to rivers, and a phased introduction of tightening standards for river discharges is recommended.

Indeed even for permanent discharges to rivers a phased application of standards is desirable for existing industries, since time is inevitably required for them to obtain assessments, designs, tenders, installation and commissioning of suitable pretreament plants and/or containment measures. It may well be counter-productive, inducing a dis-respect for the law, to prescribe standards when they can not be met.

6.6. The importance of a programme of domestic sewage treatment running in parallel with industrial pollution abatement cannot be over-emphasized. Industrial effluent treatment alone is unlikely in render all the rivers clean, or to remove the major sources of potential disease.

6.7. 2 sets of standards are applied by COPAM:

The mandatory Federal standards for river quality; and the COPAM standards for the quality of effluent discharges. Similar standards are adopted by FEEMA, Rio de Janeiro. These 2 sets of standards are not directly inter-related, as the following table shows.

6.8. QUALITY STANDARDS (COPAM)

1. <u>In mg/l except for PH</u>

	(A) CLASS 2 WATERS	(B) EFFLUENTS	(B/A)
DBO_5	5	60	12
pH	6-9	6,5-8,5	-

NH_3	0,05	-	
As	0,1	0,2	2
Ba	1	5	5
Cd	0,01	0,1	10
Cr	0,05	$0Cr^6$ $1Cr^3$	20
CN	0,2	0,2	1
Cu	1	0,5	0,5
Pb	0,1	0,1	1
Sn	2	4	2
Phenols	0,001	0,2	200
F	1,4	10	7
Hg	0,002	0,01	5
Se	0,01	0,02	2
Zn	5	1	0,2

Note: i) the ratio (B/A) indicates the minimum dilution required for an effluent at the prescribed limit(B) to reach the river water standard (A)

ii) the wide variation in this ratio shows the lack of connection between the 2 sets of standards

iii) the effluent standards of 0,5 mg/l Cu and 1 mg/l Zn are clearly incorrect. Higher figures are permitted in the river water.

6. 9. Application of both sets of standards, as they are, for Fiscal purposes is therefore:

a) illogical
b) wasteful of resources - requiring extra treatment to meet the COPAM effluent standards in some cases where the Federal river water standards do not require this.
c) wasteful of effort - since monitoring control is implied at 2 points: the effluent discharge, and the river below it.

6.10. In theory, the prescribed standards apply now to all industrial effluent discharges in the State of Minas Gerais. In practice this is unattainable since time is required for the procurement and installation of treatment plants at existing industries.

6.11. The standards prescribed are maxima, to be observed at all times. No attempt has been made to allow for the inevitable variations in effluent quality by the statistical applicatons of standards - e.g. on a 95 percentile basis, when 95% of the samples would be expected to comply.

THE RECOMMENDATIONS IN ANNEX 2 INCLUDE THE FOLLOWING

6.12. Provide for a phased introduction of increasingly stringent standards for effluent discharges to rivers. Suitable standards are suggested in the following page-section 6.13

These standards are generally directly related to the Federal water quality standards. They assume a minimun of 10 x dilution in the receiving waters, and the 1984 standards are based generally on 20 x the Federal water quality standards, and the 1986 standards on 5 x. There are one or two exceptions, notably in the case of DBO5 (Which is biodegradable), and cyanide (which is particulatly harmful to fish, and is capable of complete treatment) and in zinc. The 1986 standards broadly reflect best practicable technology in conventional effluent treatment.

It should be made clear that these standards assume a minimum of 10 x dilution of the effluent discharge in the receiving waters, and that for any lesser dilution the standards will be proportionately tightened. On this basis the 1986 Standards would allow one discharger to take up half the available absorptive capacity of the river (assuming an unpolluted water up-stream of his discharge), and some modifications of the standards might be required in the case of multiple local discharges of industrial effluent.

6.13. Quality standards for effluent discharges to rivers:

	A. From 1-1-1984	B.From 1-1-1986
PH Value	6,5 - 8,5	6,5 - 8,5
	Milligrams per litre	
DBO_5	100	50
DCO	200	100
NH_3 (N)	1	0,25
Ag.	0,4	0,1
As.	2	0,5
Ba.	20	5
Cd.	0,2	0,05
Cr^6	1	0,2
Cr^3	4	1
CN (Cyanides liberating HCN on acidification)	2	0,5
Cu	20	5
Pb	2	0,5
Sn	40	10
Monohydric Phenols	0,02	0,01
F.	28	10
Hg	0,04	0,01
Se	0,2	0,05
Zn	50	10
Total toxic metais excluding Zn Sn :	20	10

Other parameters - as in the present COPAM standards. In these standards limits for metallic compounds are expressed in terms of the metal.

An example of the phased introduction of standards, as applied in Malaysia to Palm oil processing effluents, is given in Annex2.The financial penalty for not reaching the standard immediately should be noted. This principle could be followed, if desired, as an inducement towards reaching the ultimate (1986) standards.

6.14. In cases where ultimate discharge of the industrial effluent to a sewage treatment works is expected, apply now as interim standards those which will apply to the discharge to the sewers.

These standars will vary somewhat from industry to industry- Guideline standards for 18 industries, which have beem recommended by the author and accepted as reasonable an attainable in other countries are given in Annex, together with the justifications for them. These can only be guidelines: more stringent standards may be required in cases where the flow of domestic sewage is low; to safeguard the quality of water discharged from storm sewage overflows; or where the quality of the sludge from the domestic sewage treatment is dominating.

Once the sewer network becomes available it could be left to the industrialist to choose between continuing to discharge to the river, but at the ultimate (1986) conditions applying to river discharges, or to discharge to the sewage network, at its standards, on payment of the appropriate effluent acceptance charges.

6.15. Control, and specify in licences, the maximum daily volume in m^{3}/d, and the maximum rate of discharge in 1/sec. for all effluent discharges. This is essential.

B. AIR EMISSIONS

6.16. Air emissions differ from aqueous discharges in that:

(a) they have a direct effect on life in the area that they reach

(b) the dilution capacity of the receiving environment does not vary, as it does with the sizes of rivers receiving aqueous effluents

(c) the available control technology is more limited: essentially containment, Stack disperson, filtration, scrubbing with or without chemical treatment, precipitation, adsorption, incineration

(d) the results to be expected from such treatment are well established

(e) emission standards, related to volumes of discharges or to product throughput are universally applicable.

6.17. There is therefore a strong case for requiring the applicatio of the Best Practicable Technology to minimize discharges to the atmosphere.

Emission standards reflecting best practicable technology for large numbers of pollutants and for many industries have been established in many countries, and need not be repeated here. Reference should be made to standard textbooks, to standards promulgated by countries ranging from Australia to USSR, to the US EPA, and to international sources like the WHO Compendium of Industrial Discharge Standards (Geneva, 1982).

The basic approach to setting air emission standards is thus simple and direct, although the subject as a whole is highly complex.

6.18. It is easy to require application of best practicable tecnology by new industries and this should be done. Modifications to the standards are howerer required to take account of:

(a) a phased introduction of standards for existing industrias (as at São Paulo)

(b) Different requirements for critical areas (as in Japan)

(c) abnormal weather conditions
(d) Ambient air quality criteria
(e) The relative health significance of different pollutants
(f) Long term objectives
(g) Selection from various international standards of those appropriate to local circunstances.

6.19. It might be noted that in the U.K. "Best Praticable Means" is not defined quantitatively. Presumptive limits are issued as guidelines, and normally reflect BPT. This approach has the advantage of giving inspectors discretion to vary the limits for certain plants - as for instance in an area of high background pollution.

6.20. Ambient air quality criteria are less well - establishad than emission limits, although many are available - eg from US EPA. In cases of doubt it is reasonable to set ambient air concentration limits at 1/30 to 1/40 of the TLV-TWA: the time - Weighted average of the threshold limit value . The TLV is the average concentration in air below which a contaminant is normally harmless on occupational exposure. In USA, TLV's are published for about 500 industrial materials and revised annually by the American Conference of Governmental Industrial Hygienists (ACGIH).

6.21. With certain industrial chemicals regard must be had to hazards other than direct toxic effects. Table 6 summarises the TLV's together with the explosive levels for some compounds. Short term (15 minutes) exposure limits (STEL) are also indicated.

6.22. An example of the varying international discharge standards from which a selection may have to be made for local application is given in table 7, for steel manufacture.

TABLE 6 Threshold Limit Values and Explosive Levels for Various Compounds

Compound	Threshold Limit Values		Explosive Levels	
	TWA (ppm)	STEL (ppm)	LEL Volume %	UEL Volume %
Acetone	1,000	1,250	2.6	13
Ammonia	25	35	15	28
Amyl acetate	100	150	1	7.1
n-Butyl alcohol(s)	50(C)	50(C)	1.7	12
Diethylamine	25	25	1.8	10
Ethyl acetate	400	400	2.2	11
Ethyl alcohol	1,000	1,000	3.3	19
Ethyl ether	400	500	1.9	48
Formaldehyde	2(C)	2(C)	7	73
Hydrogen sulphide	10	15	4	44
Methyl alcohol(S)	200	250	6.7	36
Methyl chloride	100	125	10.7	17.4
Propylene oxide	100	150	2.8	37
Pyridine	5	10	1.8	12.4
Toluene (S)	100	150	1.2	7.1
Vinyl chloride	10	30(C)	4	21.7
Xylene(S)	100	150	1.1	6.4

(C) indicates ceiling value

(S) indicates that skin may be a significant route of entry

DISCHARGE STANDARDS

STEEL MANUFACTURE

		Particulate Matter	Notes
France:	with oxygen lancing -	0,12 mg/Nm^3	production restricted above this
Fed.Rep.Germany:	Blast furnaces -	20 mg/m^3	No restriction on S,
	If gases flared -	50 mg/m^3	If removed in slag.
	Steel making furnaces -	150 mg/m^3	CO must be used or dispersed.

Japan :		General emission standard, g/Nm^3	special areas
	Blast furnaces	0,10	0,05
	Converters, open hearth furnaces, sinter plants:		
	a) Emissions < 40.000 Nm^3/h	0,40	0,20
	> 40.000	0,30	0,20
	Electric steel furnaces:		
	a) Emissions < 40.000 Nm^3/h-	0,40	0,20
	b) > 40.000	0,20	0,10
Sweden:	Basic oxygen furnaces	0,30	Kg/ton.
(monthly averages)	Sinter plants, are, open-hearth	1,0	"
U.K	Blast furnaces -	0,46 g/m^3	
	oxygen process -	0,115 "	
	hot blast cupolas	0,115 "	
U.S.A.	Electric arc furnaces -	12 mg/Nm^3-	After de-dustin;
	oxygen steel making -	50 mg/Nm^3-	also, opacity less than 3%

VII- EFFECTS OF POLLUTANTS

7.1. There is insufficient data to quantify the effects of the pollutants discharged to the environment . of Minas Gerais on any systematic basis. This is because data collection has only started fairly recently, and some of it is irrelevant. Much of the available data on rivers, for example relates to their mineral or sanitary quality for public supply water, and not to industrial pollutants. And surveys for toxic metal contents, which were started, have been stopped within the last year or so, apparently on grounds of costs. A start has been made- notably by CETEC-in assessing the global discharge of some pollutants in the state, but there are few cases where the actual effect on the local receiving environment , which is what matters in practice, has been quantified.

7.2. Qualitatively, it is easy to see that there are some major problems. The photographs in the frontispiece to this report were taken by the expert on a Sunday afteroon after driving through the choking fumes on a public highway. They show the discharge from an aluminium factory which apparently is not convinced that it has a problem. It is in an area of exceptional amenity value.

And one has only to look at the many highly turbid rivers, to see the coated trees around some cement plants, to smell the air in Belo Horizonte, or to survey the open sewer which passes for a river in the centre of that city, to see that there are many cases of gross pollution.

To put that into context it is necessary to determine what really matters in the local circumstances, and to what extent. It is necessary to know if coated trees are really damaged, and if so how much; if ambient air concentrations at factory perimeters exceed safe levels for continous exposure to pollutants and by what factor of safety; if the recent major accidental discharge of metal sludges to the River Paraiba do Sul has left persistent deposits of toxic concentrations of cadmiun or zinc in the mud of that water supply river; and if, as seems probable, the discharges of domestic sewage to rivers pose the major health hazard, so that priorities can be set.

7.3. Those priorities must include industrial pollution abatement, where the practices range from those factories with an outstanding care for the environment-some steel and cement factories, and some Mines-to those with an almost total disregard for it. This range reflects some of the success of COPAM'S activities so far. But a great deal remains to be done, and it must be said that its controls so far have been applied to, and acted upon by the most receptive factories-a relatively easy task.

7.4. Thus there is an immediate need for quantifying the amounts of pollutants discharged and determining their effects from consideration of the meteorological data and river flow dilutions-data which does exist in some cases, and needs to be extended.

The actions required for this purpose and the methodology are discussed in the sections of this report dealing with quantifying emissions, the design of water quality sampling programmes, and monitoring.

VIII- ASSESSEMENT OF APPLICATIONS FOR LICENCES

8.1. Comprehensive information is required to be submitted to COPAM in applications for licences to operate with discharge of effluents.

When these are received the assessments made by COPAM technical staff is generally thorough. Indeed, it may be almost too thorough in some aspects of the engineering details, since COPAM is not - and must not - be expected to certify that a proposed treatment plant will work, for which it would then be assuming some responsibility. The object is to assess if the treatments proposed are correct in principle, and if the treatment plant operates correctly that the required effluent standards should then be met.

Some experience is perhaps required in abstracting and highlighting the salient points from a technical submission. The following example of an assessment by the expert of a submission made during the mission is given as an example of the approach.

It should be noted that in this summary of an assessment the origins of the basic data or factors used are given, and comments can be seen to justify the conclusions. A few suggestions, which are intended to be helpful and are based on practical experience are also included.

8.2. Dairy Wastes Treatment - Assessment

Notes on Process descriptions submitted by the Dairy

8.2.1. The background and theoretical figures on the composition of milk products, and milk effluents are from well-established published sources.

8.2.2. Pages 8 - 10

Quadro 6, p. 10 shows pH 3,10, which indicates some fermentation. Compare quadro 4, p.8.

8.2.3. Page 12

Flow = 4,62 l/sec = 400,000 l/d.
Compare p. 14: 400 - 600 m^3/d.

8.2.4. Page 13

Higher strengths than published figures are suggested to be due to less dilution than elsewhere.

But n.b. the flow is in the normal range for dairies: -

Milk Production (liquid milk) = 200,000 kg/d. = 200 tonnes
Flow = 400 - 600 m^3/d. - say 500
= 500 m^3/200 t. q milk
= 2,5 m^3/tonne of milk

Compare this with figures from:
France - 3,25 m^3/m^3 - Bebin, IAWPR Bangkok p. 482
Denmark - 1,5 m^3/m^3
Generally - 2 - 4 m^3/m^3 - Balabram + Ennes, 1973. DNOS Report, p. 12

8.2.5. Page 15

DBo = 7.810 kg/d.
= 13.100 mg/l.

Both of these figures are 8 x higher than one would normally expect: -

i) Expected load:

					kg DBo/t*		kg DBo/d
From 200.000 kg/ milk/d.	=	200	t/d	x	4,2	=	840
20.000 kg Conc.milk/d	=	20	t/d	x	7,6	=	152
1.000 kg Cheese/d	=	1	t/d	x	2,04	=	2
960 kg Yoghurt/d	=	1	t/d	x	2 (?)	=	2
2.000 kg Butter/d	=	2	t	x	0,85	=	2
					$kg\ DBo_5/d$	=	998

* Factors from Bebin, p. 482

ii) From a normal loss (without economy measures) of 2% of the milk treated, giving 2 ml effluent at 100.000 mg/l DBo per 100 ml milk treated

= 200.000 mg/l

≃ 2 kg DBo/t of milk treated

The figures given, at 8 x normal for dairies, indicate either very abnormal processes, or exceptionally high losses to effluent. Have the losses been quantified and minimized ?

8.2.6. Page 16

For milk wastes, in which the DBo is substantially from dissolved substances, it is potentially misleading to include the suspended solids in the derivation of Population Equivalent.
(Milk has a DBo of 100.000 mg/l with virtually no separable suspendend solids)

The real population equivalent is more likely to be about:

$$\sqrt[2]{P_1 \times P_2} \simeq 132.000$$

8.2.7. Page 20

i) The available dilution in the river is approx. 70 : 1, as stated

ii) The OD_e should be taken as effectively zero in a waste with 13.000 mg/l DBo

Milk wastes have a notably high initial oxygen demand. Treatment plants have been under-designed for aeration capacity as a result of ignoring this factor.

iii) Based only upon achieving a DBo of 5 mg/l in the river the DBo_e required for this is 356 mg/l

It is possibly unrealistic to include an OD requirement at the immediate point of discharge.

iv) With a DBo_e of 356 mg/l, the purification required is:

$$G = 1 - R = 1 - \frac{356}{12.739} = 1 - 0{,}028 = 0{,}97 = 97\%$$

97% purification is significantly easier to attain than 99%, although still very demanding.

8.2.8. Page 23

The treatment actually proposed is not indicated. Only the possible approaches are listed.

It is worth noting that the efficiency of DCo removal on treatment of dairy wastes with activated sludge, including pure oxygen supply is 88 ± 2% (Bebin, Prog. Wat. Tech. 8, 1976, 305)

In dairy wastes CoD : BoD = 1,5 to 1,6 (Bebin, Prog. Wat. Tech. p. 301 - 11)

If 97% + removal of DBo is required, some consideration might be given to the Lagoon/Cascade bioaerator system described by Balabram and Ennes. (Ministério do Interior, DNOS).

The strong tendency to fermentation and also smell nuisance from dairy wastes should be noted, and tank retention times kept low.

8.2.9. Pages 24 - 25

The references are general. Consultation of more specific references to dairy wastes treatment may be helpful. See, eg, copies of 3 Papers attached.

The Paper by Holder and Sewards, Australia, includes a table of characteristics of whey. (Prog. Wat. Tech., 8, 1976, 313 - 319).

8.2.10. The application should be re-submitted to deal with the points noted above.

IX. APPROACH TO FACTORY INSPECTIONS

9.1. Some persistence is necessary during factory inspections to obtain all the relevant environmental emission and discharge data, and its sources and control and results, and not merely information which the factory chooses to reveal.

The following notes on a visit made to a cement factory during this mission are given to illustrate the approach used by the expert, and the attention to detail that is required. After listing observations on the site, they include notes on further information required, recommendations, applicable standards, notes on some standards used internationally, and background information on the selection of points for ambient air monitoring, and on stack height standards for cement works.

NOTES ON A VISIT TO- CEMENT MANUFACTURERS,

12.08.82

9.2.1 . **PRODUCTION :**

1,1 m t/a,	4,500 t/d .	cement
	3,200 t/d .	clinker

9.2.2 . **INSPECTED**

a) Area generally
b) Kiln
c) Raw materials storage areas
d) Packing department
e) Automated control room

9.2.3 . **ENVIRONMENTAL OBSERVATIONS**

a) Wind fresh, gusting. Prevailing wind from S.W.

b) Town to S.E. Nearest houses 600m from kiln

c) All external areas of factory covered with cement dust- 2 to 3 cm. on roads

d) Adjacent hill, (owned by the factory but traversed by a road used by the public), about 50m. high: leaves of all trees coated with dust.

e) A few cattle in the immediate area - in very poor condition

f) Emission from kiln stack, after electrostatic precipitator: generally fairly clean - plume rises approx. 30m and disappears on lateral dispersion within 100m - well within factory perimeter. 2 sudden emissions of very heavy dust, each of duration 15", - twice in 15 minutes - reported to be associated with testing of the control instruments: temperature and voltage.

g) The major dust emissions are the wind- blown ones from i) raw materials, ii) Cement packing. Possibly also from the crushers- not operational during this visit.

h) Canalised river runs through the factory: gray, with very heavy load of Mineral Suspended Solids, much of which is from points upstream of the factory - upstream entry point inspected: flow approx. 18 cm/s, width 30 m. depth?

i) Much air pollution from burning of solid wastes, uncontrolled, on open ground, with heavy black, smelly smoke reaching over and beyond the adjacent hill side. Source inspected: a small open fire burning old rubber pipes.

j) 2 large cylindrical oil fuel tanks in very good bund, with concrete walls and earth base- large enough to hold all the contents of tank(required by Federal law)

9.2.4 . <u>FACTORY OPERATIONS :</u>

a) The crushers were not working because the water supply to the factory was interrupted - pipeline failure. Cement production was continuing from the stock of prepared raw materials in the hoppers.

b) The normal water supply is from underground wells:
process usage: 24 m^3/h - make-up
36 m^3/h - Kiln condensing tower
6 m^3/h - (chlorinated)-Domestic Supply

c) This water war previously treated by base-exchange softening. Connections from this plant still exist to drains, discharging to a hole in the ground, presumably leading to the river. Currently the water is treated with a sequestering agent (Drew Chemicals Dispersan) . When this supply fails (approx. 1 x 6 years) , as today, river water may be substituted. That water is treated by dissolved air flotation and sand filtration, with reject and back-wash water discharged to the river. The domestic sewage from the factory, untreated, discharges into the river upstream of this abstraction point, and this practice must be regarded as highly questionable on health grounds. Number of people on site- approx.350. There are plans to connect the factory domestic sewage to a future sewage network, but when is not known.

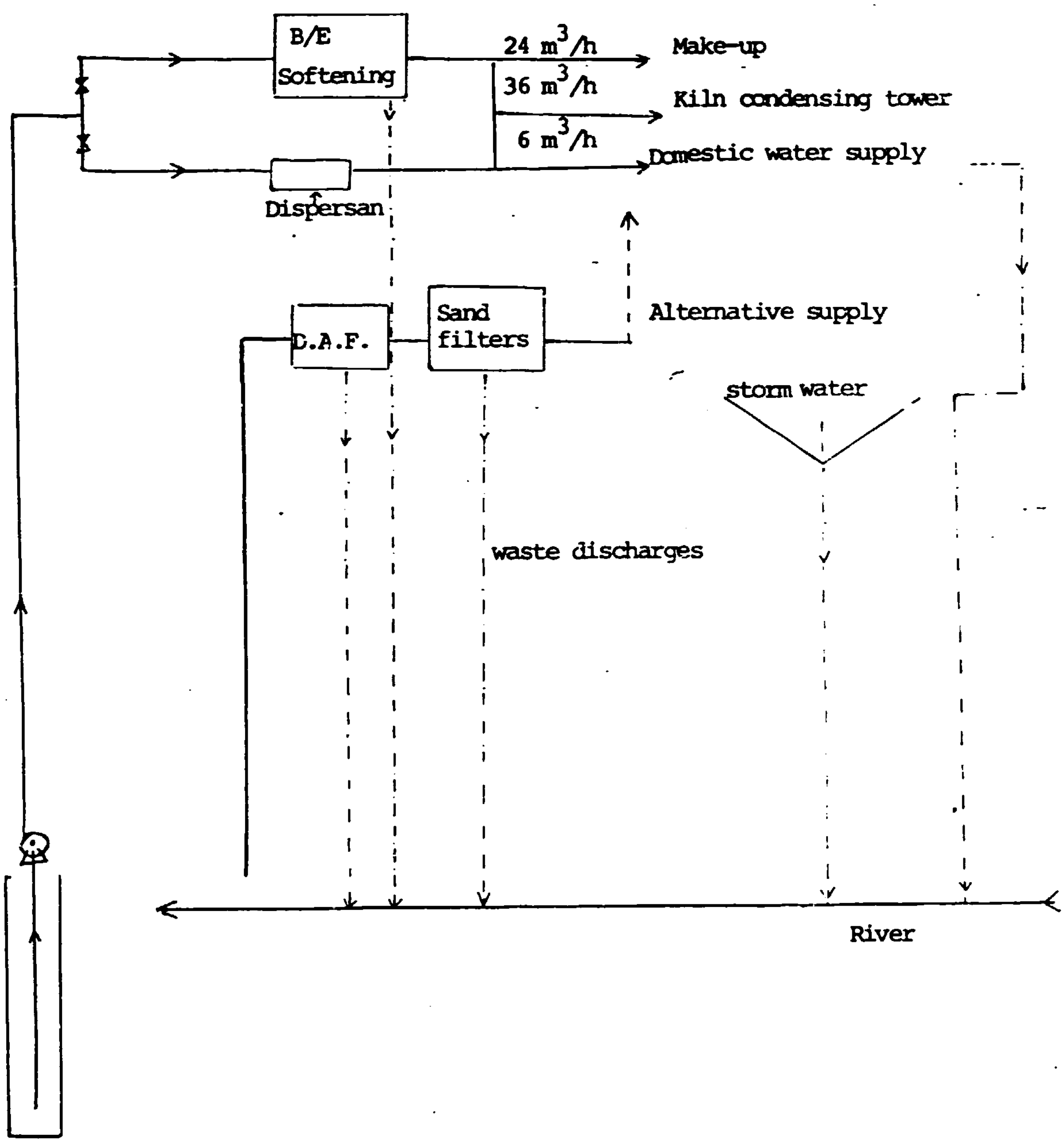
During this visit attempts were being made to clean out the river intake pump well, with the sludge being discharged back to the river. A full water distribution and drainage plan for the factory is required, but the system appears to be as shown dragrammatically on the following page.

d) Raw materials are stored in large stacks, some completely open. There was substantial windage dust from this area. There are storm drainage channels cut into the ground around and encircling the stacks - discharge to river. Average and maximum rainfall - ?

e) In the kiln feed area there is no automatic stop on the conveyor feed when the Mill (kiln) is stopped. This causes major overflows of dust to the floor beneath the conveyor. During this inspection these was such a pile, of perhaps $0.5m^3$, on the floor, and it was being shovelled back in to the system with much air-blown contamination. The frequency of this occurrence was" not known" : At this time was associated with water shortage.

f) In the transfer areas which were operational bag filters, where fitted, appeared to be effective.

g) The central control panel is excellent, and covers all production operations on a clear mimic diagram. It includs 18 chart-recorders, many of them multi-point recorders. Instruments show temperature and voltage in the electrostatic precipitator.


B/E
Softening
24 m3/h
Make-up
36 m3/h
Kiln condensing tower
6 m3/h
Domestic water supply
Dispersan
Alternative supply
D.A.F.
Sand
filters
storm water
waste discharges
River

h) In the cement packing area, the filling of bags is a very messy operation, with appreciable spillage, which is generally recycled. This is a source of some atmospheric contamination. There is much dust where bags are manually loaded into the filler, and the operators wear cloths over the back of their necks , but no face-masks, and this would appear to be a health hazard.

9.2.5 . COMMENTS

a). It is a pity that the excellent control panel does not include provision for automatic monitoring of the dust emissions- eg. from the Kiln .

b) The environmental control measures which have been adopted so far accord with good practice, viz: electrostatic precipitation at the kiln stack; and bag filters local to other point sources of air contamination.

c) There is no control of wind-blown dust from the main raw materials storage areas, and this is a source of distinct and visible contamination.

d) The factory operations appear to be carried out with a total disregard of water pollution potential. This seems to be on the basis that there are no programmed discharges of waste water. It should be noted, however, that:

i) There are connections from the water treatment plant to the drains.

ii) The factory is thick with cement dust and this, together with contributions from the storage areas, must discharge to the river in wet weather.

iii) Domestic waste waters from 350 people discharge directly into the river.

e) No monitoring of environmental contamination is carried out by the factory, either in the production areas or at its perimeter.

9.2.6. **INFORMATION REQUIRED:**

a) Meteorological reports
b) Kiln stack height and diameter
c) Kiln stack air flow rates
d) Rated capacity of the electrostatic precipitator
e) Fequency of change of bag filters.
f) Forecast expansion programme of the factory
g) History of any complaints from the area
h) Drainage plan of the factory

9.2.7. **RECOMMENDATIONS:**

a) The factory should be required to institute monitoring of the air for airborne contaminants at

i) The kiln stack
ii) The outside area adjacent to principal production units
iii) Its perimeter

Also to keep records,and for the kiln ideally (if possible) from automatic monitoring and recording

b) The factory should be required to route its storm water discharges to a holding basin, large enough to hold the first 24 hours flow of a maximum storm, for settlement prior to discharge to the river. For flows of greater duration than 24 hours, the basin may require to be by-passed.

c) The factory should be required to disconnect the connection to the drains from the water treatment plant- and any other source of industrial effluent discharge- or to route these drains to a holding basin of adequate size for the maximum expected discharge, prior to pre-treatment (if necessary) and controlled discharge to the river.

d) The factory should be required to connect its domestic waste water discharges to the municipal sewer network as soon as this is available.

e) The factory should be required to comply with reasonable standards for air quality:

i) For the kiln stack discharge:
The electrostatic precipitator manufacturers have "guaranteed" a discharge standard of 80g/Nm^3.
This is better than any known control standards applied anywhere , and it seens unreasonable to expect it to be met at all times. A reasonable standard for particulate solid matter might be 150g/Nm^3. This is approximately the standard adopted in France and in the Federal Republic of Germany, and is more strict than those in Sweden, . Japan, and U.K.

It should be noted that Canada and U.S.A, have limits proportional to the kiln through-put.

ii) For other cement.handling Operations:

250 mg/Nm^3 (The U.K. limits is 230)

iii) Ambient Air:
For air in the outside area of the factory, within its perimeter, the indicated standards required should be derived from a pilot monitoring exercise. It may well be found that the figures exceed 500 $\mu g/m^3$, possibly substantially at some points.

For the factory perimeter, however, especially at points near to houses, a general residential area standard should be the aim, and a figure of 80 µg/m^3 should be the aim, until and unless the early monitoring results show this to be unattainable.

These ambient air standards are expressed in units per m^3 of air. 80 µg/m^3 is the COPAM general standard, subject to a maximum of 240 µg/m^3 not more than once per annum.

Other kinds of standards have sometimes been used for deposited particulate matter from ambient air, expressed in weight of deposited matter/area/unit time. An example is given in Appendix 1, showing the 1967 St. Louis, USA standards for industrial, residential, commercial and open space areas. The figure of an allowable 130 tons/square mile/annum for residential areas corresponds closely to the COPAM general standards for settling solids, of 5 g/m^2/30 days for commercial and residential areas.

It should be noted, however, that a standard based upon collected settling solids would be difficult to monitor for cement dust, owing to some solubility and interaction of cement particles with water which also will be collected at times of rain.

The U.S.A. Federal standard is now 75 µg/m^3 - annual geometric mean, with a 1 day/a maximum of 260-and these are more practical units for this.

9.2.8. BACKGROUND INFORMATION :

Attached in appendix 1 x 2 are notes which may be helpful on:

a) Selection of points for ambient air monitoring
b) St.Louis standards for Particulate Emission Densities
c) Stack heights standards for Cement works. (U.K.)

AMBIENT AIR MONITORING PERIMETER

CONSIDER

1) Meteorology
2) One or more monitors in direction of prevailing wind
3) At least one at the pt. of maximum plume impact
4) One or more adjacent to nearby town
5) One or more near important agricultural crops or forests.

LLOWABLE AND EXISTING PARTICULATE EMISSION DENSITIES - ST. LOUIS 1967

Land use	area miles^2	%total	existing emission density tons/mi^2/a	Allowable emission density tons/mi^2/a	additional reduction needed %
ndustry	36	9.1	1.890	600	68.2
esidential	153	38.8	170	130	22.3
Commercial	23	5.8	255	175	31.6
pen space	182	46.3	35	100	0
Central Urban rea	394	100.0	269	1?5	39.8

Source - Interstate Air Pollution Study, Phase II Project Report, VIII A.
Proposal for an Air Resource Mannagement Program
U.S. Department of Health, Education and welfare
Public Health Service, May 1967, p. 19

APPENDIX 2

STACK HEIGHT STANDARD FOR CEMENT WORKS - U.K.

Clinker Throughput Tons/h	Chimney Height (feet) wet Process	semi-dry Process	dry Process
30 and less	200	200	200
60	280	260	240
90	340	310	280
120	390	350	210
240	500	460	415
360	550	500	450

For intermediate throughputs interpolate on smooth curve through points in the table

Source: "Notes on the Best Practicable Means for cement works emissions", Appendix V, Alkali etc. Works Annual Report by the Chief Inspector, London, 1966

X. SUMMARY OF FINDINGS AN RECOMMENDATIONS

10.1. Findings

While the basic structure and operation of COPAM is excellent, a substantial expansion of its operations and of its technical services is required. Being under-staffed and over worked, it has not had time to give the attention that is required to:

(a) Quantifying emissions of pollutants
(b) Extending control to all significant industries
(c) Refinement of prescribed standards
(d) The design of air monitoring networks
(e) Minimizing industrial effluent discharges
(f) Water quality surveys.
(g) Correlating the possible with the praticable in control of industrial effluents.

COPAM is short of practical experience in the control of some industrial effluents, and has no experience in practical approaches to minimizing discharges at their sources. It would benefit from the establishment of a small team of experts to give an in-house consultancy service to its operating staff. Its library facilities are inadequate. Systematic coordination with the activities of other Brasilian Control Agencies would be helpful, as would practical collaboration with specific industries on particular problems. Necessary suggestions have been made on further training, and for future attention to the wider aspects of pollution control. There is in Brazil a good nucleus of engineers with a very good theoretical training. But, as emphasized by some industries, there is a distinct shortage of experienced practical engineers.

10.2. RECOMMENDATIONS

10.2.1. FOR THE GOVERNMENT

A. Amend the law on pollution control to allow for

(i) A phased attainment of ultimate standards required, and

(ii) The application of sewer discharge standards, rather than river discharge standards, to industrial effluents that will be connected to sewers within a reasonable time- say 5 years.

B. Review pollution control requirements in relation to river basins.

C. Coordinate the activities of state pollution control authorities at and near inter-state boundaries.

10.2.2. FOR UNIDO:

A. Complete the present mission, as projected in SI/BRA/81/802/11-02, with a practical examination of the possibilities for improvements in waste treatment techniques and standards.

B. Examine the possible need for assistance to COPAM in optimizing air monitoring networks and river quality surveys.

C. Coordinate the industrial pollution aspects of the UNDP Marine Pollution in Brazil project, BRA/82/010, with the results of missions like the present one, with which there are some close similarities

D. Consider a mission for Brasil to deal with low waste technology and minimizing industrial effluent discharges.

E. Arrange an open seminar aimed at correlating the interests of control authorities and industrialists, with contributions from Government agencies, Industry, Consultants, and UNIDO.

10.2.3. FOR COPAM:

- Take the actions recommended in this report, viz:
On COPAM operations, 12 recommendations. Section 3.3.
On monitoring, 12 recommendations, Annex (4)
On standards, 12 recommendations , Annex (2)
On quantifying emissions, 5 recommendations, Section 5.2.
On industry, 5 recommendations, Annex (5)
On solid wastes, 4 recommendations, Annex (9)
On wider aspects of pollution control, 7 recommendations, Annex (10).

10.2.4. FOR UNIVERSITIES:

Include some training on environmental protection, including industrial pollution control, in courses for all engineers.

XI SUMMARY OF DISCUSSION SEMINARS

11.1. STANDARDS FOR WATERS AND EFFLUENTS

Derivation of standards- BPT and RQO approaches- the need for flexibility to meet local discharge circumstances- inconsistencies in the present standards- control of volume and rate of discharges-defects in the present system- recommendations-standards for discharges to rivers and to sewers.

11.2. DESIGN OF WATER QUALITY SAMPLING PROGRAMMES

Objectives- identifying sampling sites- time and frequency of sampling- flow rates- statistical evaluation of numbers of samples required- analytical requirements- an approach to lake water sampling- effects of storm water discharges- non-point discharges- river quality maps-biological surveys.

11.3. MONITORING OF INDUSTRIAL EFFLUENT DISCHARGES

Objectives- size of the programme required-organization-Los Angeles control structure, system and staffing-comparison with COPAM requirements-recommendations.

11.4. IS POLLUTION CONTROL FAIR TO INDUSTRY?

Background- effects of standards imposed- how far to go in effluent pre-treatment-how industry can help itself-what control authorities can do- making it fairer.

11.5. MINIMIZING INDUSTRIAL WASTEWATER DISCHARGES

Cost-benefits-reducing water requirements-critical examination of the need for water-examples of water savings-re-use and recycle of water-eliminating the need for settlement-modifications to production processes-treatment within process lines-effluent system planning-treatment plant simplification-practical approaches-methods for reducing amounts of contaminants discharged-water quality required for industrial process-examples from practical experience.

11.6. AIR MONITORING NETWORKS

Background-network design-statistical methods-modelling methods-practical guidelines on network density-preliminary work for network design-development of an air pollution monitoring programme.

11.7. ENVIRONMENTAL IMPACT ASSESSMENTS

Background-general considerations-actions which may cause environmental impact- summary of an actual assessment-methodology-suggested format for organization of environmental impact statement report-guidelines for impact studies of: industries in general; agro-industries; mining; nuclear power.

11.8. DISPOSAL OF SOLID TOXIC WASTES

Background-disposal methods-hazards requiring control-what is toxic-calculation of toxicity-substances requiring attention- control of disposal to land-selected data on hazardous wastes possible constituents-hydrogeological guidelines for selection of landfill sites-road transport of hazardous wastes-road tanker labelling regulations.

11.9. WIDER ASPECTS OF POLLUTION CONTROL

Finer points of effluent reduction and control-application of developing world wide knowledge and technology-recommendations to a water research commission for research and development on industrial effluent discharges-task groups for industrial wastes management, air and water quality protection, intractable wastes, etc.- study groups for health aspects, trends in legislation-coordinating research and development committees, including specific industries- seminars-study tour-open seminar correlating interests of control authorities and industrialists.

11.10 COPAM STRUCTURE AND OPERATIONS

In the main body of this report, section 3.

XII. LIST OF VISITS

1. CETEC
2. BRITISH CONSUL
3. STATE FEDERATION OF INDUSTRIES
4. CETESB, SÃO PAULO
5. FEEMA, RIO DE JANEIRO
6. NATIONAL CONFEDERATION OF INDUSTRIES, RIO DE JANEIRO
7. SEMA, BRASÍLIA
8. UNDP, BRASÍLIA
9. IRON ORE MINE
10. CEMENT FACTORY
11. A HOSPITAL - POLLUTION COMPLAINT INVESTIGATION
12. ALUMINIUM FACTORY, POÇOS DE CALDAS
13. URANIUM MINE AND FACTORY, POÇOS DE CALDAS
14. FERTILIZER FACTORY, POÇOS DE CALDAS
15. SYNTHETIC FIBRES FACTORY, POÇOS DE CALDAS
16. RIVER ABSTRACTION POINTS, POÇOS DE CALDAS
17. MUNICIPALITY, POÇOS DE CALDAS
18. STEEL FACTORY
19. SARAMENHA - AIR POLLUTION PHOTOGRAPHS

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2. CETEC

3. CETESB

4. FEEMA

5. SEMA

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7. FEDERAÇÃO DAS INDÚSTRIAS DO ESTADO DE MINAS GERAIS

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