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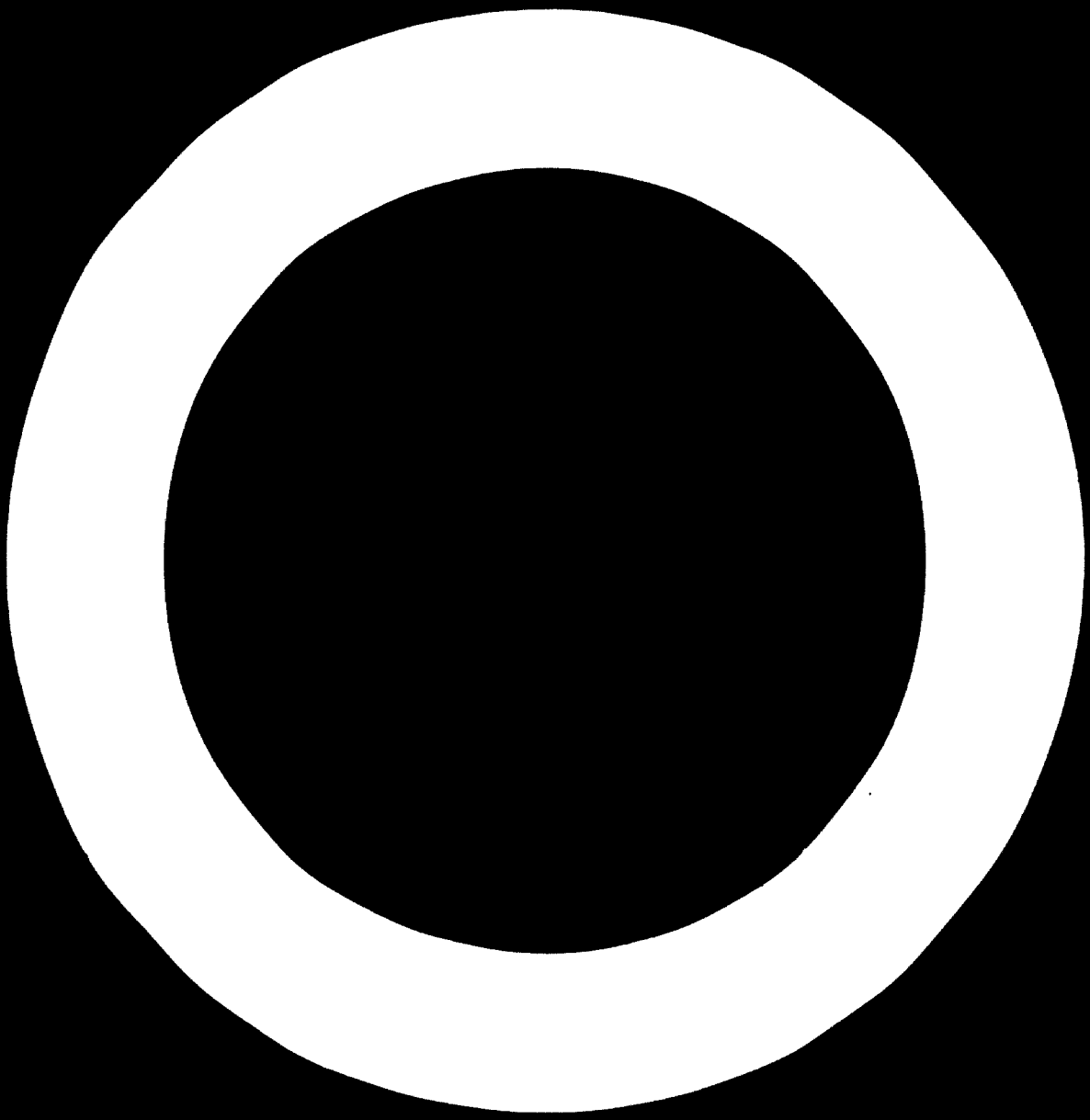

United Nations Development Programme

SELECTION OF ALUMINIUM-RELATED INDUSTRIES FOR LOCATION AT PUERTO MADRYN ARGENTINA

DP/ARG/73/007

Technical report: Environmental contamination and control of a primary aluminium smelter

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

Based on the work of Henry C. Wohlers, consultant on environmental affairs

United Nations Industrial Development Organization
Vienna, 1975

Explanatory notes

A full stop (.) is used to indicate decimals.

A comma (,) is used to distinguish thousands and millions.

A slash (/) indicates a field-season covering part of two consecutive years, e.g., 1974/75.

Use of a hyphen (-) between years, e.g., 1974-1975, signifies the full period involved, including the beginning and end years.

References to "dollars" ($) indicate United States dollars, unless otherwise stated.

The following exchange rates are used in the conversion of the country currency to United States dollars:

Country	Currency	Exchange rate per US dollar in	
		October 1974	April 1975
Argentina	New Peso ($a)	9.93	15.05

The following abbreviations are used in this report:

CFI	Consejo Federal de Inversiones
CNP	Centro Nacional Patagónico
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency (United States)
NEPA	National Environmental Policy Act (United States)

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SUMMARY

In this report an environmental control plan is presented that could be used by the Province of Chubut or nationally in Argentina. The methodology could be applied by administrative procedures without the passage of new legislation.

The environmental control plan, or a modification of it, might be put into force before new industries are given construction permits and before plans for industrial parks within the Province of Chubut are finalized.

Results of preliminary ambient-air sampling for fluoride in the environs of Aluar confirm the forecast of potential fluoride damage to the ecology/environment of the area. Unless fluoride controls are immediately installed at Aluar, fluoride-sensitive vegetation at Puerto Madryn will be destroyed. The same fate is anticipated for fluoride-sensitive native Patagonian flora; the effects on fauna in the area remain unknown.

Continued support of the United Nations Industrial Development Organization (UNIDO) could minimize detrimental short-term and long-term environmental effects within the Province of Chubut and in Argentina.

INTRODUCTION

The assignment of an expert in environmental contamination was part of the larger project "Selection of Aluminium-related Industries for Location at Puerto Madryn" (DP/ARG/73/...), which was requested by the Government of Argentina on 14 March 1973, approved by the United Nations Development Programme (UNDP) on 15 June 1973 and by the United Nations Industrial Development Organization (UNIDO) as executing agency on 17 June 1973. The Consejo Federal de Inversiones (CFI), an Argentine organization acting in conjunction with the provincial governments, was the co-ordinator of the project.

The expert was engaged by UNIDO for a period of six months. He was expected to accomplish the following tasks:

(a) To assist in evaluating the environmental contamination caused by aluminium production at Puerto Madryn;

(b) To advise on setting up appropriate monitoring and control systems to abate environmental contamination;

(c) To recommend measures that could be undertaken by the national authorities to reduce the effects of industrial pollution on the human environment;

(d) To organize and conduct training of national staff responsible for industrial pollution control;

(e) To formulate requirements for further United Nations technical assistance in the field of industrial pollution control, should it be necessary.

The complete assignment was to be covered in two periods from August through October 1974 and March through April 1975.

A report of the first phase of the project was issued in December 1974 (UNIDO/ITD.317). This report dealt almost exclusively with the potential fluoride contamination from the newly constructed primary aluminium smelter at Puerto Madryn. The consultant concluded that uncontrolled fluoride emissions from Alumar (Aluminio Argentina S.A.I.C.), amounting to 15 tons total fluorides per day, were a serious potential environmental hazard for the Puerto Madryn region. The dry alumina process, which could be profitable in the long-term, was suggested for fluoride emission control.

In addition, an alternative research programme was described to document fluoride effects in the region. Examples of United States fluoride regulations to control emissions from aluminium smelters were presented. Finally,

types of environmental problems that must be faced and resolved by the Government were listed, and the National Environmental Policy Act (NEPA) of 1969 (United States of America) was mentioned as a means of controlling the total environmental effects of any new industry or governmental project.

The objective of the present mission was to give talks and seminars based on the contents and recommendations of the interim report. On his arrival in Buenos Aires, the consultant learned that copies of the interim report had not been distributed and no arrangements had been undertaken for the presentation of talks or seminars on fluoride problems.

During the consultant's second visit, therefore, it was agreed that he evaluate the total environmental control problem for the Province of Chubut in addition to the fluoride problem at Puerto Madryn. Visits to Comodoro Rivadavia and Puerto Madryn were planned and completed. This report is concerned first with a methodology by which a governmental body could control the total environment within the country's boundries. Environmental problems relating to industrial growth and fluorides are then discussed. A chronological report of the mission is given in annex IV.

I. FINDINGS

A. An environmental control plan for the Province of Chubut

The Province of Chubut is located in the southern part of Argentina, bounded on the north by the Province of Rio Negro and on the south by the Province of Santa Cruz. Most of the Province is semi-arid, devoted principally to sheep raising and wool production. A major crude-oil production area is located around the city of General Rivadavia in the south-eastern portion of the Province and a textile industry has been developed in the north-east at Trelew.

As part of plans to develop new industries within the Province, a primary aluminium smelter, Aluar, was constructed 1.5 to 4 km north of Puerto Madryn (see figure I). The smelter is of the prebake, discontinuous-cell anode type and side-worked. The planned initial aluminium production is 140,000 tons per year (400 cells) with potential expansion to 210,000 tons (600 cells). Although full production was expected in 1975, hydroelectric power from Futaleufú has been delayed; in April 1975, 46 cells were operating using in-plant power. No pollution control devices have been installed at the cells, the cell houses, or the anode plant.

The earlier interim report of the expert contained suggestions for the control of fluoride emissions through three approaches: (a) voluntary action by Aluar in installing corrective equipment; (b) a research programme to determine the fluoride effects in the vicinity of Puerto Madryn; or (c) regulations (laws) to control the emission of fluorides. The scope of this final report is broadened to encompass not only the control of industrial growth and attendant problems for the Province but also the total environment. An important consideration for the Government of the Province of Chubut is that the methodology for total environmental control may be applied by administrative procedures without the passage of new legislation. While new laws to implement the methodology undoubtedly will be required in the future, they are not believed to be mandatory at present. The methods might also be considered for adoption by the Government of Argentina.

1. Development of environmental laws

Countries that now control environmental problems have taken a series of steps. For example, fluoride emissions were recognized as an environmental problem in the United States in about 1950 following an outbreak of lawsuits claiming damage to cattle and crops from fluoride-emitting industries. There ensued a period of about 10 years while research projects were undertaken to determine the fluoride concentrations which damaged cattle and crops, the extent of the damage, the engineering methods to reduce fluoride emissions from industrial plants, and a host of ancillary factors including sampling and analysis for low concentrations of fluorides. During the next five years or so states within which serious fluoride problems existed enacted legislation to control fluoride emissions. At present, the Federal Government is in the process of formulating national legislation to control fluoride emissions. Thus, the time between the onset of an environmental hazard to the adoption by a state of control legislation covered approximately 15 years, and for similar action to be taken by the Federal Government, the period was 25 years.

Not all environmental legislation in the United States evolved over such a long period, although the process of law to be just to all parties is time-consuming. The period for environmental legislation may now be considerably shortened as a result of intensive research on such matters in almost all countries.

In addition to environmental laws relating to specific pollutants, the United States in 1969 passed important and comprehensive legislation in the National Environmental Policy Act (NEPA).[1/] The methodology suggested here for the control of environmental problems in the Province of Chubut (or nationally for Argentina) is based on this Act.

2. The National Environmental Policy Act of the United States

The National Environmental Policy Act requires that for any project for government funding or licensing an Environmental Impact Statement (EIS) must be prepared that answers adequately fundamental environmental questions of purpose:

1/ United States Public Law 91-190, S.1075 (1 January 1970).

(a) Do we need it?

(b) What happens if we don't build it?

(c) What are the effects, including physical, social, economic, political and aesthetic?

(d) How do we minimize negative effects and optimize positive ones?

(e) How do we design the project to make it serve its function most effectively and contribute to other community needs?

This national law has been so favourably received in the United States that more than one half of the individual states now require an impact statement to be filed with their public funds and licensing authority. Many municipalities and towns have similar requirements.

The EIS must include:

(a) A description of the proposed action, including information and technical data sufficient to permit a careful assessment of environmental effects by review agencies;

(b) A consideration of the probable impact of the proposed action on the environment, including its effects on ecological systems;

(c) A description of any probable adverse environmental effects that cannot be avoided;

(d) An analysis of studies of appropriate alternatives to the recommended courses of action. The analysis must be sufficient to accompany the EIS through the present review process and not foreclose options that might have less detrimental effects;

(e) A concern for the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term beneficial uses of the environment, on the assumption that each generation is trustee of the environment for succeeding generations;

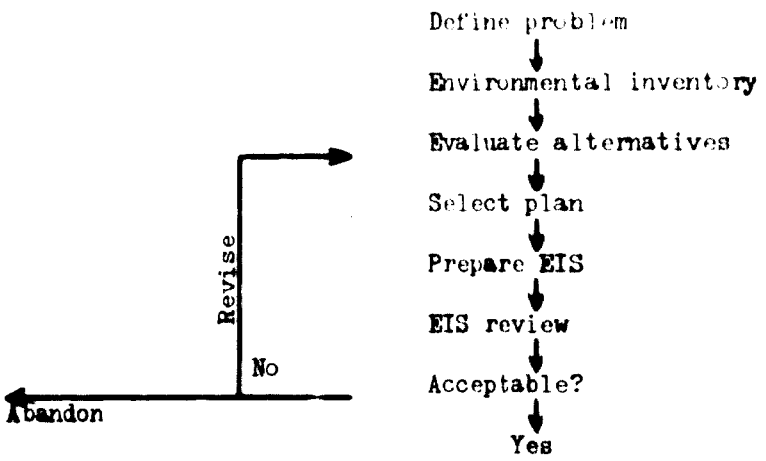
(f) The use of a systematic interdisciplinary approach to the assessment which will ensure the integrated use of the natural and social sciences and the environmental design arts in planning and decision-making.

The legal responsibility for the preparation of the EIS rests with a specific governmental agency, although most agencies require the submission of an EIS from contracting or industrial organizations. A public hearing on the matter is usually held. After a careful agency review, the Council on Environmental Quality is responsible for final approval or denial. Guidelines for EIS preparation have been published by the federal Government, the governments of states, and various federal agencies.[2/]

2/ Preparation of Environmental Impact Statements: Interim Regulations, Federal Register, vol. 38, No. 11 (17 January 1973), Part II, p. 1696-1712.

The sequence for environmental planning is shown in figure I. The sequence includes an evaluation of all the environmental aspects in the early stages of the study. On completion of an environmental inventory, it is possible to evaluate alternatives to the proposed project so that the most environmentally sound plan may be used in preparing the EIS. The review process may be modified to accommodate specific governmental agencies.

Figure I. Environmental planning sequence



The system for preparing an EIS is to compose two check-lists that are general enough to use as a reference covering the range of actions and effects of the project on the environment. The matrix thus completed clearly identifies the significant environmental effects and their relative importance as evaluated by the originator of the EIS and the project. The major aspects of the proposed project - construction and operational activities - are listed across the top of the matrix. All relevant aspects of the environment are enumerated down the left side of the matrix. In completing a matrix, two aspects of each action that may affect the environment are evaluated: the magnitude, extent or scale of its impact on specific sectors of the environment and the importance of its effect on the environmental factor in the specific instance under analysis. For example, for a project to reduce air pollution, a "magnitude" could be the mass-emission rate of pollutants from a cement plant and the "importance" would be the effect of the emissions on the environs.[3/]

3/ A Procedure for Evaluating Environmental Impact, Geological Survey Circular 645 (Washington, D.C., U.S. Department of the Interior, 1971).

The advantages of the National Environmental Policy Act are:

(a) First, an initial project review by an interdisciplinary group of scientists and engineers often reveals unknown environmental hazards not uncovered by the usual engineering approach. If these hazards are identified initially, connexions may be made benefitting the industry, the public, and the environment;

(b) Secondly, the ecology of the area must be determined while the project is in the planning stage in order to relate short-term objectives with second-, third-, and higher-order environmental consequences. In many cases, a project will be dropped because the benefits of the short-term objectives are grossly outweighed by the disadvantages of second-, third- and higher-order adverse consequences;

(c) Thirdly, the need for factual data for preparing an EIS necessitates gathering pertinent information on present and future environmental problems. As additional data becomes available, engineering plans may be modified to take into account this new information;

(d) Fourthly, the EIS serves as a bridge between industry, the government and the public. If rapport is established immediately, the project plans may be modified for the best use of public and natural resources. Further, this communication will minimize the need for costly and time-consuming legal actions.

The disadvantages of the National Environmental Policy Act are:

(a) First, precise guidelines for the preparation of an EIS have not been adequately formalized beyond draft rules and guidelines. This matter has largely been corrected but some confusion still exists, particularly when dealing with different governmental agencies;

(b) Secondly, the work of preparing an EIS is costly in terms of time and money. In many cases the number of pages of an EIS has ranged from 1,000 to 10,000; the preparation costs have varied from $US 250,000 for a new fossil-fuel power plant to $US 1 million or more for a controversial nuclear power plant. The need to prepare an EIS for review by governmental agencies has reportedly delayed projects by as much as two years;

(c) Thirdly, it is virtually impossible to prepare a perfect EIS. In many cases factual data on which to base an EIS are difficult or impossible to obtain and subjective evaluations must be made.

3. Application of principles of the National Environmental Policy Act for the Province of Chubut

Increased industrial activities in the Province of Chubut will attract more people and tradesmen. With more industry, commerce and people, the environment will be degraded, making the Province less desirable for most people. The Province, however, can control the environmental impact of increased industrialisation for the mutual advantage of the public and of industry.

A satisfactory environment needs to be defined by the Province. The consultant describes the environment as the total effects, singly and in

combination, of all conditions and things on man and his well-being. Such a definition goes far beyond air, water and land pollution for it includes, of necessity, all factors that affect the well-being of man. The short-term gains and the long-term consequences of such factors must be weighed in balance. New industry brings more money into a community, but this added money must be balanced against pollution, the need for more housing and a host of governmental services such as fire and police departments, schools, hospitals, transportation, energy etc. For the short term, it is difficult to justify pollution control in the Province, except for hazardous materials, because of the natural dusts from vehicles moving on unpaved streets and wind-blown dusts from the semi-arid areas outside the towns. While some industrial pollution can be tolerated on a short-term basis, the long-term effects must also be evaluated. With limited governmental funds, careful planning is required to decide which areas should be developed for optimum short-term gains versus long-term consequences. Once a general area has been selected for development, it is important to evaluate again environmental factors before designating specific areas for certain industries.

The standard approach to environmental control would be to enact legislation to minimize the undesirable effects and to maximize the benefits to the public and industry. Unfortunately, this approach is considered too time-consuming in view of the planned rapid influx of industry into the Province.

As an alternative to this standard approach, it is suggested that the principles of the National Environmental Policy Act form the basis of environmental control, but rather than passing a similar law, the Province of Chubut could establish an administrative procedure whereby industry coming into the region must prepare an adequate EIS. Authority to accept an EIS and to grant a licence to construct could be given to an appropriate provincial agency. The EIS would be prepared by the organization wishing to locate within the Province, but with guidance from a governmental agency. For the construction of highways sewage plants, governmental buildings, airports, high tension lines etc., the responsible provincial agency could prepare the EIS. With an adequately prepared EIS, provincial officials would have the necessary information to evaluate environmental problems before making final decisions.

Guidelines for the Province of Chubut. The suggestions offered here to guide provincial officials for the preparation of an EIS are modelled on the guidelines of the National Environmental Policy Act. Each of the suggestions must be carefully examined in the light of its adaptability to local conditions. If the Province of Chubut accepts the use of the EIS for environmental control purposes, it might be well if it made contacts with the Environmental Protection Agency (EPA) and the Council on Environmental Quality of the United States for assistance, including papers, reports, guidelines and impact statements in addition to those reports already supplied to the Province of Chubut by the Consultant.

Areas of examination in a provincial Environmental Impact Statement. As the environment is considered to be the sum of all conditions and things affecting the well-being of man, many areas must be examined in preparing an adequate EIS. Such areas of examination should include: earth, air, water, flora, fauna, noise, demographic characteristics, land use, transportation/circulation, local services, energy, utilities, human health, aesthetics, recreation and archeological/historical factors. A list of specific questions to be considered for each area of examination is given in annex I, section A.4/

Actions requiring Environmental Impact Statements. As a general rule, industrial and governmental activities that require government licence or funding must prepare an EIS. Governmental projects must also complete an EIS.

Naturally, not all actions requiring a government licence seriously affect the environment. Governments usually list actions requiring the preparation of an EIS and exempt those not requiring an EIS. Examples of both categories, specified by the State of Washington, are listed in annex I, sections B and C.

Draft of an Environmental Impact Statement. Perhaps the most important aspect of an EIS is the written report. As the draft EIS will be acted upon by a provincial agency, it is critical to list what is expected in the report. An example of the organization of a draft EIS is given in annex I, section D.

4/ Sections of annex I were slightly modified from: "Draft guidelines to implement the State Environmental Policy Act of 1971" (Lacey, Washington, Council on Environmental Policy, December 1974).

B. Industrial parks in the Province of Chubut

Plans for the expansion of existing industry and the influx of new industry into the Province have generally been based on the development of industrial parks. Once an area has been designated as an industrial park, detailed plans are made for specific industries to be located within that area. The development of industrial parks is the joint responsibility of the Province of Chubut and the Government of Argentina. The Government provides a large part of the capital funds needed by industry to locate within the specific areas. The Province of Chubut is responsible for environmental control.

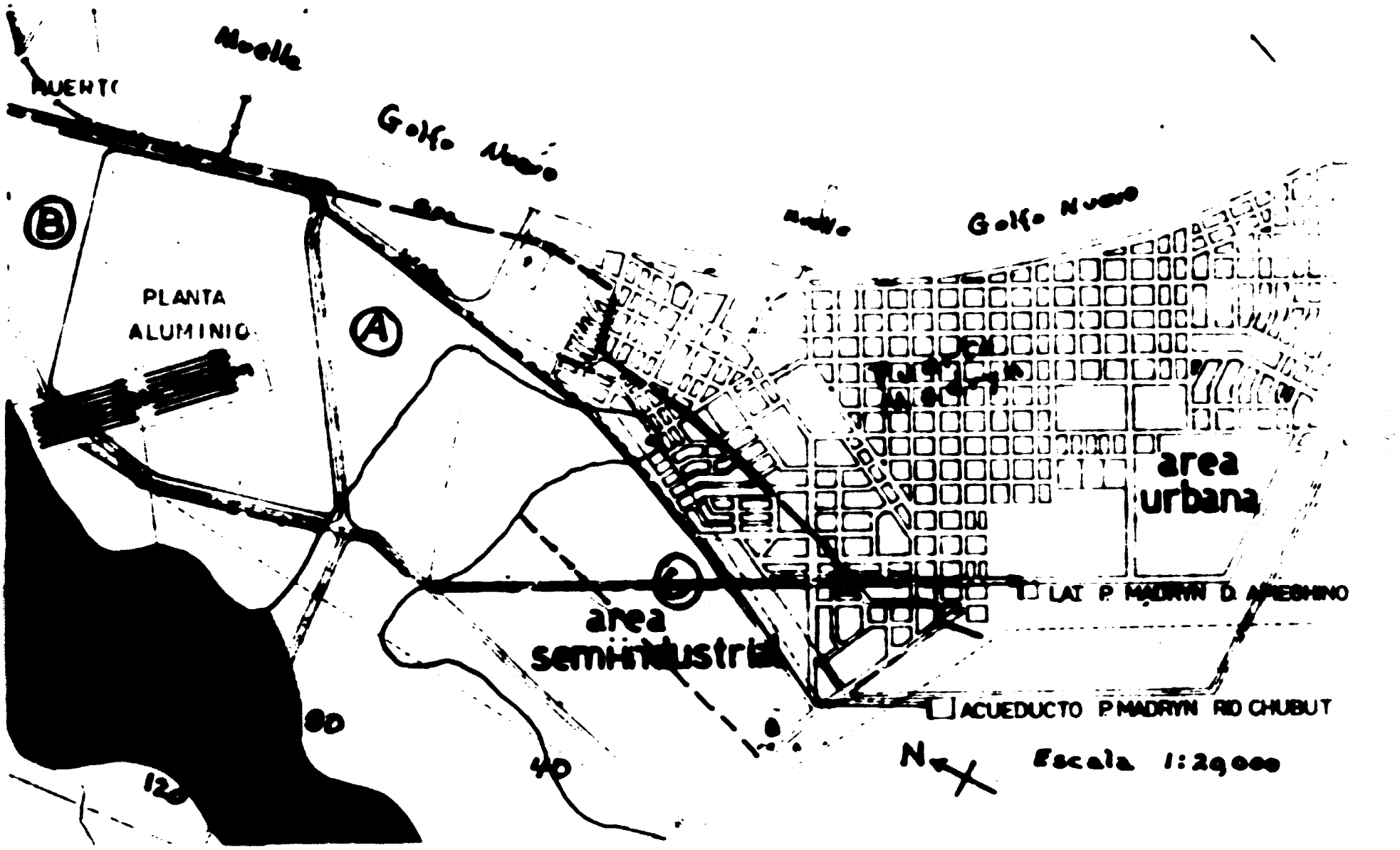
One industrial park has been located at Trelew to produce fibres from synthetic materials. Two industrial parks are being developed for Puerto Madryn and Comodoro Rivadavia; only these two projects will be reviewed for their environmental aspects.[5/]

It was obvious to the consultant that the total environmental problems of industrial parks and new industry had not been sufficiently emphasized by the Province of Chubut. It is suggested that steps be taken immediately to evaluate the industrial development plans according to the proposed methodology of this report for total environmental control by the Province of Chubut. Industrial locations must be related to meteorology and the impact of air, water and land pollution upon the environs. Each industrial project report submitted to the Province for initial approval should review adequately the effects of the new plant on the total environment (see annex I for details). In this way, the Province of Chubut will be able to evaluate both the short-term gains and the long-term benefits of the project.

1. Industrial park at Puerto Madryn

The spatial relationship between urban Puerto Madryn, Aluar (Planta Aluminio) and the locations allotted for future industrial growth is shown in the figure. It will be noted that the aluminium smelter is 1-1/2 to 4 km north of the town. An escarpment, 40 metres high, separates Aluar from Puerto Madryn. The sizes of the allowed areas for industrial expansion are: site A, approximately 40 ha; site B, approximately 1,000 to 2,000 ha; site C, approximately 60 ha.

5/ A detailed report on industrial parks and their functions is being prepared by a UNIDO expert, G. Percival.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At present eight industrial plants are planned for construction in the industrial areas; operational details now available are shown in annex II. Two of the plants will require molten aluminium metal - a rolling mill and a wire rod plant; these will be located close to the smelter, at either sites A or B (see figure II). The remainder of the planned units may be located in area C, which is designated as "semi-industrial": an extrusion plant, an anodizing plant, a cable plant, a window plant, a refractory brick plant and, possibly, a fluoride chemical plant; no final site decisions have been made for these plants.

In the intial site planning, insufficient attention was given to environmental control of air, noise, water, land, housing, or social necessities. In the same manner the aluminium smelter was constructed without sufficient forethought being given to the effects of fluorides on the environs. Before construction of the plants begins, the plans should be re-evaluated as to the effects of the operations on the total environment (see annex I).

It is of critical importance that the planning for the semi-industrial area northwest of Puerto Madryn (figure II, site C) be re-evaluated in terms of the methodology proposed in this report. The site location is such that westerly winds will blow air pollutants directly over a part of the town. Industrial noise is another factor that must be considered since the town borders the area. The semi-industrial area is visible from the homes on the edge of the town. Transportation of workers and products will add to the noise and pollution of the western section of Puerto Madryn. The questions should be considered whether to use site C for housing or recreation and whether to locate light and heavy industry in sites A and B.

Admittedly, it would be simpler in the short-term for workers to travel to and from work if the semi-industrial area were located in site C. For the long-term considerations, including that for building a heavy industrial complex at site B, would it not be better to locate all industry away from the town (sites A and B), and to consider future transportation problems now? A trolley, bus or short electric train could be planned to carry workers from the south-eastern edge of the town to the outskirts of the industrial area; costs of the operation could be assessed on the basis of the costs of transport per worker to the constructed plants.

7. Comodoro Rivadavia

Comodoro Rivadavia, with 100,000 inhabitants, is the largest city within the Province of Chubut. The city is located on the ocean edge at the south-eastern tip of the Province. Hills surround the city to the west, preventing extensive future growth in that direction; flat land for expansion lies to the north and south. From the flat coastal region, the land rises to about 700 metres within 10 km inland. Prevailing winds are westerly and reasonably strong.

The major product of the area is crude oil petroleum which is shipped from a number of points in the Comodoro region to La Plata (Buenos Aires) for processing. In 1972 the crude oil production amounted to slightly more than 3 million tons and it is expected that it will reach 10 million tons by 1985.

Along the main road south of Comodoro Rivadavia, semi-industrial plants have been built to produce a variety of products. These light commercial establishments did not appear to be a major air pollution problem at the time of the consultant's brief visit.

North of the city are two heavy industrial installations - a cement plant and a zinc reduction plant. The cement plant produces about 60,000 tons per year, for consumption in the southern provinces of Argentina. The plant is approximately 40-50 years old and is without air pollution or occupational health controls. The plant is 8 km north of the city and with the prevailing westerly winds, the dust plume was over the ocean during the consultant's visit. A dyeing plant is expanding operations directly west of the cement plant.

A zinc plant producing elemental metal (12,000 tons per year) is located about 8 km from the city. Air and water pollution control at this plant is good since a loss of the product means a loss of profits. However, occupational health problems may exist for workers inside the plant. There is the possibility that the plant may expand its operations in the near furure. By a slight process change, the zinc plant could produce sulphuric acid if this chemical is needed for the manufacture of fluorides for the aluminium smelter at Puerto Madryn.

The traffic within the city is reasonably heavy, although the car movement is good because of planned one-way streets. Unfortunately, only the main roads are paved, and vehicular dust from the unpaved roads blows over the entire city. Wind-blown desert dust adds to this nuisance and potential health hazard.

So far as is known, the sewage flows untreated through one or two outlets to the ocean. Solid wastes are reclaimed for paper and bottles and the residue is dumped on open land; burning occurs periodically.

Initial development of the industrial park north of the town has been completed and services (electricity, gas, water and telephone) have been brought to the area. No plant construction in the industrial park has begun. Tentative planning for the installation of plants envisages a foundry, a nuts and bolts factory, a tannery and perhaps a petrochemical operation (see annex III).

As noted in the planning for the industrial park at Puerto Madryn, each industrial project report for Comodoro Rivadavia should be reviewed with regard to its effects on the total environment. Industrial health problems should also be considered in the environmental assessment. Because of the high levels of wind-blown dusts, pollution control, except for hazardous substances, may not be important for the short-term consequences. Odours from the proposed fish plant should be evaluated as to their effect on the nearby village. The lack of sewage-treatment plants and adequate solid waste disposal in major towns and cities within the Province should also be given careful consideration.

C. The dilemma of Aluar

The uncontrolled fluoride emissions at Aluar are the most immediate critical environmental pollution problem to be resolved by the Province of Chubut. This problem was adequately covered by the consultant's interim report, which for certain reasons had not been distributed to the Province of Chubut. Hence, no action has been taken on the control of fluoride emissions by the Province.

Fluoride investigations by Centro Nacional Patagónico (CNP) have been initiated. Similar investigations by Aluar have been continued as well as research work on fluoride emission control. Impromptu meetings were held on the fluoride emission problems.

In preparation for a continuing investigation of fluoride emission-control problems from aluminium smelters, the consultant visited similar installations in the Pacific Northwest of the United States. Contacts were made with

universities in the area for possible graduate study visits on environmental problems by Argentine scientists or engineers.

4. Visits to aluminium smelters and universities in the Pacific Northwest of the United States

Smelter visits. Prior to visiting Argentina, the consultant visited four aluminium smelters in the Pacific Northwest of the United States; details of the visits are given in annex IV.

It was the opinion of industrial environmentalists at these plants that all American smelters eventually will control fluoride emissions with the dry alumina process - either with injection or fluidized-bed systems. In this control process, emitted fluorides are captured or sorbed by alumina and the formed aluminium fluoride is returned to the electrolytic cells. While the dry alumina control process did have operational problems, no insurmountable difficulties were encountered.

Advantages claimed for the dry alumina process for the control of fluorides included:

(a) The system installed as primary control equipment on the cells is sufficiently efficient for fluoride removal to meet state air-quality standards (< 0.5 g F/m^3) and the proposed federal emission standard of 1 kg total fluorides per ton aluminium produced;

(b) No water pollution problems are encountered since no water is used in the dry control process; water pollution problems are generally unavoidable if a scrubbing system is used for the control of fluorides. Further, the dry alumina process has a major advantage in areas where there is a shortage of water (e.g. Puerto Madryn);

(c) The reuse of the collected aluminium fluoride in the cells means that there is essentially no need to purchase or manufacture fluorides. At times, purchased fluorides have been in short supply and one company nearly had to reduce its production of aluminium because of the shortage of cryolite or aluminium fluoride;

(d) The dry alumina process for the control of fluorides is expected to show a long-term profit. Concrete evidence on this point was not obtained; agreement was not universal on the profitability of the process. It is believed that the question of profitability depends on cost-accounting practices, cost of purchased fluorides, interest rates and tax rebates. (In the United States a plant that installs pollution-abatement equipment is given specific tax advantages.)

Disadvantages claimed for the dry alumina process included:

(a) A loss in aluminium purity - two points for iron (0.02 per cent), one point for silica (0.01 per cent) and a raise in the nickel content from 0.005

[illegible] per cent. Although the loss in purity has not affected the sales price of aluminium, some companies operate one or two lines with fresh alumina instead of recycled aluminium fluoride;

(b) An increase in the dustiness of the recycled material has been noted and has been resolved by taking extra care in the handling of recovered aluminium fluoride;

(c) Some plant operators believe that the holding of the cells has somehow affected the heat transfer or distribution, requiring closer control of cell temperature;

(d) The injection system can be installed quicker and at less cost than the fluidized-bed system; bag life with the injection system may be shorter than with the fluidized-bed. A system for the bag house could prevent this problem and at the same time reduce the particulate loading to the bag house;

(e) The dry system on the anode plant has operational problems with caking and sticking in the bags. A scrubber followed by a wet electrostatic precipitator might be a better alternative for the anode plant; recovered products could be clarified, calcined to remove carbon and reused in the cells.

The dry alumina process for the recovery of fluorides from aluminium plants has been used successfully in all plants where the process has been installed. From discussions with plant-operating personnel in the Pacific Northwest and elsewhere in the United States, it appears that there are companies throughout the world that could install the dry alumina process at Aluar on a turn-key basis.

The question of the profitability of the dry alumina process has not been completely resolved. The fact that industrial personnel have not condemned the dry system because of costs would support the conclusion that it offers a possibility of long-term profit.

Visits at universities. Two universities in the State of Washington were visited to determine if Argentine scientists or engineers could take graduate courses in environmental studies.

Professor E. Robinson of Washington State University (Pullman, Washington) and Professor A.T. Rossano of the University of Washington (Seattle, Washington) were most willing to accept qualified students for graduate study. University catalogues were given to CFI. The universities complement one another. Washington State University emphasizes pollution problems involving agriculture and cattle and is located in a small town of approximately 20,000 inhabitants. The University of Washington emphasizes pollution problems of industrial operations and health-related matters and is located in a major city of about one

million inhabitants. Visits to primary aluminium industries in the area could also be arranged for the students.

Ideally, if it could be arranged, a visiting Argentine scientist could spend six months at each university. In the United States, universities start a new term in September and the year ends in late May or early June.

5. Proposed United States standards for aluminium smelters

As deleterious effects of fluorides on both animals and vegetation have been extensively documented, the Government of the United States has proposed the following standards for primary aluminium smelters:6/

(a) Total fluorides. Not more than 1 kg of total fluorides per metric ton of aluminium (or aluminium equivalent) produced from the primary aluminium reduction plant, including the carbon anode bake plant;

(b) Visible emissions. Standards would be less than 10 per cent opacity from the potroom and less than 20 per cent opacity from the anode bake plant. An over-all control efficiency of 95 to 97 per cent of fluorides generated in the potroom would be required to meet the above standard; the proposed standard for fluorides would also result in efficient control of both particulates and organics.

Primary aluminium smelters can meet the proposed standard by using either the dry or wet systems (high-efficiency wet scrubber followed by a wet electrostatic precipitator). For tightly hooded prebake cells, the proposed standard can be met by a good primary control system for effluent gases collected from the reduction cells. Under these conditions, no secondary control devices should be required on potroom vents. The dry alumina process (fluidized-bed or the injection system) was considered one of the most attractive control systems.

Calculated control costs by the Environmental Protection Agency for primary aluminium plants are summarized in table 1.

6/ United States Environmental Protection Agency, Office of Air Quality Planning and Standards and Research, Background Information for Standards of Performance: Primary Aluminium Industry, Vol. 1: Proposed Standards and Vol. 2: Test Data Summary (Triangle Park, North Carolina, October 1974).

Table 1. Summary of control costs for aluminium plants

Costs	Prebake (reduction cells plus anode plant)	Vertical stud Soderberg	Horizontal stud Soderberg
Capital cost, dollars/ton	65-79	95-117	1.93
Annual cost, cents/lb	0.45-0.74	1.14-1.93	2.32

By contrast, data on the Alcoa process record a $US 1.80 profit per ton of aluminium produced.[7]

3. Results of ambient-air monitoring for fluorides at Puerto Madryn

Preliminary and incomplete results of ambient-air monitoring in the vicinity of Puerto Madryn are presented in table 2.[8] With eight or less cells operating at Aluar, the fluoride concentration measured by the bubbler technique (NaOH) at the Centro National Patagónico (CNP) reached 0.5 $\mu g/m^3$; with from 8 to 15 cells operating, fluoride concentrations reached 2.6 $\mu g/m^3$. A maximum concentration of 73.4 $\mu g/m^3$ was measured at a distance of 300 metres from Aluar, and of 59.7 $\mu g/m^3$ at a distance of 1,000 metres. These results are "spot" samples and not long-time average concentrations. Later sampling data exist but were not available.

It must be emphasized that the results given in table 2 were obtained with a maximum of 15 cells operating out of a potential 600, or 2.5 per cent of full capacity. Assuming air concentrations to vary directly with production, the concentrations in table 2 should be multiplied by at least a factor of 40. If 0.5 $\mu g/m^3$ of gaseous fluorides over a five-week or longer period will damage sensitive vegetation, this fluoride level could be exceeded by a factor approximating 200 within the town of Puerto Madryn: $\frac{2.6\ \mu g/m^3 \times 40}{0.5\ \mu g/m^3} = 208$
Under these conditions, there is no doubt that all fluoride-sensitive cultivated

7/ C. C. Cook, G. R. Swany and J. W. Colpitts, "Operating experience with the Alcoa 398 Process for Fluoride Recovery", Journal of Air Pollution Control Association, vol. 21 (1971), p. 479-483.

8/ Ing. Lidia Saigg de Chialva, Ministerio de Economia Servieros y Obras, Públicos de la Provincia del Chubut, Rawson.

Table 2. Results of air sampling for fluorides at Puerto Madryn

Date	Number of cells operating at Aluar	Sampling location	Prevailing winds	Wind speed (km/h)	Sampling time (h)	Soluble fluoride concentration ($\mu g/m^3$)
2 July 1973 to 18 October 1974	0–8	CNP	Variable	Variable	24–50	0.0–0.1 ±0.1
21 October 1974	8	CNP	WSW	...	25	0.5
10 December 1974	8	CNP	N	27	16	2.6 ±0.5
1 January 1975	15 (estimated)	CNP	W	13–23	15	2.2 ±0.4
12 December 1974	8	300 m W Aluar	E	12	11	14.9 ±0.5
14 December 1974	9 or 10	300 m S Aluar	N	24	20	73.1 ±5.9
15 December 1975	10 or 11	300 m W Aluar	Variable	2–11	19	20.5 ±1.4
16 December 1974	10	4–600 m E Aluar	E	14	17	13.3 ±1.3
17 December 1974	11	4–600 m W Aluar	S	11	15	5.8 ±0.7
19 December 1974	12	4–600 m N Aluar	S	11	15	16.9 ±1.3
2 December 1974	8	1 000 m Aluar	WSW	25	11	3.2 ±1.3
4 December 1974	8	1 000 m E Aluar	ESE	2–20	15	3.7 ±0.5
14 December 1974	9 or 10	1 000 m W Aluar	N(var.)	4–11	20	59.5 ±1.4
18 December 1974	11	1 000 m W Aluar	ENE	22	15	5.0 ±0.7

and native vegetation at Puerto Madryn and surrounding Aluar would be destroyed.

Although information on fauna in the area is not yet available, some inferences may be drawn from a recent fluoride investigation in Garrison, Montana (United States of America).[9] Deer mice (rodents), which live less than a year with a home range of 100 x 100 metres, were caught with snaptraps and live traps and both femurs were dissected out and analysed for fluorides. Within one-half mile of the phosphate fertilizer plant, the femurs analysed contained almost 3,000 ppm F compared with about 250 ppm F beyond two miles from the plant; forage values ranged from 100 to 10 ppm F. Although a detailed study of deer mice population was not undertaken in the Garrison study, research has shown that cattle have suffered from fluorosis when the fluoride bone levels have exceeded the normal by a factor of 5 to 10.

It is anticipated that the fluoride levels in the bones of native animals in the vicinity of Aluar will show even greater fluoride differences between contaminated and background regions; Aluar will emit much greater quantities of fluorides than the inadequately controlled fertilizer plant at Garrison Montana.

4. An Environmental Impact Statement needed from Aluar

Because preliminary information on the fluoride air levels in the vicinity of Aluar confirmed the forecasted potential damage to sensitive vegetation at Puerto Madryn and in the environs of Aluar, it is highly recommended that the Province of Chubut request Aluar to complete an EIS. There is no doubt about the fate of hundreds of pine trees, sensitive fruit trees and vegetable gardens at Puerto Madryn. More critical is the fate of the flora and fauna of the native Patagonian region surrounding Aluar, with the distinct possibility of a "domino effect".

The EIS prepared by Aluar should contain an evaluation of the complete range of environmental questions as outlined in this report. Further, the EIS should evaluate the full range of contaminants from the smelter, most of which are shown in tables 3 and 4.[10]

9/ R. Kay, "An inquiry into the distribution of fluoride in the environment of Garrison, Montana", Fluoride, vol. 7 (1974), p. 7-20.

10/ "Environmental, health, and human ecologic considerations in economic development projects" (Washington, D.C., World Bank, May 1974).

Table 1. Primary airborne contaminants - aluminium smelters

Airborne	Principal use or source of emission	Health effects
Asbestos	Insulation, coverings, lagging materials	Fibrosis of lungs; potential lung cancer
Coal tar, pitch, volatiles	Electrode binder, potrooms, anode plant, pot relining	Photochemical skin burns; possible lung cancer
Fluorides - gaseous and particulates	Cryolite plant, potrooms, pot repair, solid fluxes	Acute: nose bleed, vomiting, respiratory irritation Chronic: increased bone density; aggravated bronchitis and asthma
Noise	Air plenums, pneumatic tools, ball mills; fans saws; power production	Hearing loss
Heat	Potrooms, casting	Weakness, irritability, muscle cramps; cardiovascular strain

D. Future UNIDO assistance in the field of environmental protection

The two reports prepared by this consultant have emphasised: (a) potential environmental hazards from uncontrolled fluoride emissions at Aluar; and (b) the need for a complete environmental evaluation before approval of industrial park locations or approval of specific industries within the Province of Chubut. It is suggested that UNIDO assistance should be continued in the future to solidify the environmental efforts of the Province.

It is suggested further that an environmental expert make an annual visit to Argentina for the next three years to assist the Province of Chubut in environmental affairs. If specific and agreed-upon items of environmental concern were prepared by the Province prior to each visit, one month a year would suffice. During the forthcoming visits the environmental consultant might make contact with as many official agencies and non-governmental groups as possible having an interest in the environment of the Province of Chubut and of Argentina. Assistance in this broadening of the environmental effort could be given by UNDP, the Province of Chubut and CFI.

Table 4. 3 Major airborne contaminants - aluminium smelters

Airborne contaminant	Principal use or source of emission	Health effects
Alumina	Potrooms, materials handling areas	Lung overload, no fibrosis
Ammonia	Spent pot relinings; cryolite recovery and pot repair	Irritation of respiratory tract and mucuous membrane
Beryllium	Metal alloying	Fibrosis of lung
Cadmium oxide fume	Silver soldering and brazing	Severe respiratory irritation; kidney degeneration
Carbon dioxide	Potrooms, anode pits	Asphyxiation
Carbon monoxide	Potrooms, furnaces; combustion engines	Asphyxiation; disturbed consciousness
Chlorine, chlorides	Fluxing in casting furnaces	Irritation of respiratory tract, mucuous membrane
Coke and calcined coal	Anode plant, potrooms, materials handling	Lung overload
Lead	Metal alloying solders	Colic; nerve damage
Manganese	Metal alloying	Lung overload; nerve damage
Mercury	Rectifiers; laboratories	Brain damage
Nitrogen dioxide	Welding; calcining	Respiratory irritation
Nuisance dust	Materials handling in entire plant	Lung overload
Oil mist particulate	Rod mill lubricants; sawing aluminium	Oil pneumonia; oil dermatitis
Ozone	Welding fume	Respiratory irritant
Sodium hydroxide mist	Cryolite plant	Respiratory irritant
Welding fume	Welding operations	Respiratory irritation; metal-fume fever
Radiation	Medical x-ray units	Genetic damage; bone marrow depression, skin burns
Sulphur dioxide	Impurity in petroleum coke	Respiratory irritation
Vibration	Hand tools; jack-hammers; mobile equipment	Neurovascular changes in fingers

Finally, the question of training technical personnel must be considered. For the short-term solution, UNIDO consultants could assist in training Argentine scientists and engineers. It would also be highly desirable to send one or more scientists or engineers abroad for graduate training in environmental studies. In addition to graduate study, one or more senior officials of the Province of Chubut and Argentina could benefit from a three months' tour of the United States under the auspices of the Environmental Protection Agency. For the long-term, UNIDO assistance could be used to expand courses in Sanitary Engineering at the University of Buenos Aires to include a wider variety of environmental subjects.

II. RECOMMENDATIONS

1. The uncontrolled fluoride emissions from the primary aluminium smelter at Puerto Madryn will cause serious damage to flora and fauna in the environs of Aluar. It is earnestly recommended that immediate steps be taken to control the fluoride emissions from this pollution source.

2. In the near future many new industries will come to the Province of Chubut. It is recommended that the Province plan how much industry and what types are in the best interests of local inhabitants and of Argentina.

3. With large increases in industry, commerce and population, the environment will be degraded unless government controls detrimental effects. The Province of Chubut should form a strong environmental control group as soon as practical.

4. The environment is the sum of all conditions and things affecting man. A methodology of environmental evaluation similar to that described here should be introduced by the Province of Chubut.

5. Experienced men and women will be needed to form and operate an environmental control section within the Province of Chubut. Funds should be made available to send one or more Argentine scientists or engineers abroad, as soon as possible, for graduate-level environmental training.

6. Finally, it is believed that the Government of Argentina is just now beginning to appreciate present and future environmental problems. The joint project of the Government of Argentina and of UNIDO should continue for a number of years. Further, UNIDO could consider a new programme to assist the Government of Argentina on total environmental problems.

Annex I

GUIDELINES FOR THE PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS (EIS)

A. Areas of examination for provincial EIS

1. **Earth**

(a) Would the proposal result in unstable conditions or in any substantial changes in geological substructure?

(b) Would the proposal result in any substantial disruptions, displacements or overcovering of the soils?

(c) Would the proposal result in any substantial change in topography or ground-surface relief features?

(d) Would the proposal result in the destruction, covering, or modification of any unique geologic or physical features?

(e) Would the proposal result in any significant increase in wind or water erosion of soils, either on or off the site?

(f) Would the proposal result in notable changes in deposition or erosion of beach sands, or in changes in siltation, deposition, or erosion which may modify the channel of a river or stream?

2. **Air**

(a) Would the proposal involve substantial air emissions, or result in deterioration of ambient air quality?

(b) Would the proposal substantially alter air temperature, or result in any change in climate, either locally or regionally?

3. **Water**

(a) Would the proposal result in any notable changes in currents, or the course or direction of surface water movement in either marine or fresh waters?

(b) Would the proposal result in any substantial changes in absorption rates or the amount of surface water run-off?

(c) Would the proposal result in any significant alterations to the course or flow of flood waters?

(d) Would the proposal result in a significant increase or decrease in the amount of surface water in any watercourse?

(e) Would the proposal result in substantial discharge to surface waters, or in any significant alteration of surface water quality, including temperature?

(f) Would the proposal result in any notable alteration of the direction or rate of flow of ground waters?

(g) Would the proposal result in any notable increase or decrease in the quantity of ground waters, either through direct additions or withdrawals or through interception of an aquifer by cuts or excavations?

(a) Would the proposal result in any notable deterioration in groundwater quality, either through direct injection, or through the seepage of nitrate, phosphates, detergents, waterborne virus or bacteria, or other contaminants into the ground water?

(b) Would the proposal substantially reduce the amount of water otherwise available for public water supplies?

4. Flora

(a) Would the proposal result in a significant reduction in the numbers of any species of flora (including trees, shrubs, grass, crops, microflora, and aquatic plants)?

(b) Would the proposal result in the elimination of notable numbers of any unique, rare or endangered species of flora?

(c) Would the proposal result in the introduction of new species of flora into an area, or create a barrier to the normal replenishment of existing species?

5. Fauna

(a) Would the proposal result in a significant reduction in the numbers of any species of fauna (birds, land animals including reptiles, fish and shellfish, benthic organisms, insects, microfauna)?

(b) Would the proposal result in the elimination of notable numbers of any unique, rare or endangered species of fauna?

(c) Would the proposal result in the introduction of new species of fauna into an area, or create a significant barrier to the migration or movement of fauna?

6. Noise

Would the proposal produce objectionable noise levels?

7. Demographic characteristics

Would the proposal significantly alter the location of the human population of an area?

8. Land use

Would the proposal result in the alteration of the present or planned land use of a substantial area?

9. Transportation/circulation

(a) Would the proposal result in the generation of substantial additional vehicular movement?

(b) Would the proposal result in a significant impact upon existing transportation systems?

(e) Would the proposal result in significant alterations to present patterns of circulation or movement of people and/or goods?

(f) Would the proposal result in substantial alterations to water or air traffic?

10. Local services

(a) Would the proposal result in a need for substantial new fire protection?

(b) Would the proposal result in a need for substantial new police protection?

(c) Would the proposal result in a need for substantial educational services, or would it have a significant adverse effect on any existing school?

(d) Would the proposal result in a need for new park facilities not included in the proposal, or would it have a significant adverse effect on any existing park?

(e) Would the proposal result in a need for substantially increased maintenance of existing public facilities?

(f) Would the proposal result in a need for substantial new governmental services (libraries, animal-control, social and health services etc.)?

11. Energy

(a) Would the proposal result in the use of substantial amounts of fuel or energy?

(b) Would the proposal result in a significant impact upon existing sources of energy, or require the development of new sources of energy?

12. Utilities

(a) Would the proposal result in a need for substantial alterations to existing power or natural-gas utility systems?

(b) Would the proposal result in a need for substantial alterations to existing communications systems?

(c) Would the proposal result in a need for substantial alterations to existing water-supply systems?

(d) Would the proposal result in a need for substantial alterations to existing sewer systems, or in substantial numbers of new septic tanks?

(e) Would the proposal result in a need for substantial alterations to existing storm-water drainage or sewer systems?

(f) Would the proposal result in the generation of a substantial amount of solid waste?

13. Human health

Would the proposal result in the creation of any health hazard or potential health hazard (excluding mental health and the hazard of injury-producing accidents)?

'5. Aesthetics

Would the proposal result in the destruction of any scenic vista or view or natural area open to the public, and would it create an aesthetically offensive site?

'6. Recreation

Would the proposal result in a significant adverse impact upon the quality and quantity of existing recreational opportunities (hunting, fishing, boating, swimming, camping, hiking, picnicking etc.)?

'7. Archeological/Historical

Would the proposal result in a notable alteration of a presently unique archeological or historical site?

B. Actions requiring EIS

Proposals for the actions listed below shall always constitute proposals for major actions significantly affecting the quality of the environment:

1. Any change in existing land use or authorizations for use covering 40 or more acres, any part of which lies within the limits of a city or town, or any part of which lies within a shoreline of state-wide significance.

2. Any change in existing land use or authorizations for use covering 640 or more acres outside 1 above.

3. Roadway construction of a four-or-more lane, divided highway with at least partial control of access of five route miles or more in length.

4. Construction of any new airport (except emergency landing fields).

5. Construction of any new metallic mineral-processing or metal-extraction facility.

6. Construction of any new pulp and/or paper mill.

7. Construction of any new oil refinery, or an expansion of an existing refinery that shall increase capacity by 10,000 barrels per day or more.

8. Construction of any new thermal power plant.

9. Construction of any new commercial or industrial facility at which 1,000 or more people will be employed, or which encompasses square feet or more.

10. Construction of a new or additional residential development that includes 100 or more dwelling units in an unsewered area or 500 or more dwelling units in a sewered area.

11. Construction of any new boat moorage facility designed to hold 150 or more boats.

12. Construction of any new port facility designed to serve vessels of over deadweight tons.

13. Adoption or amendment of any comprehensive plan or land-use ordinance which establishes a new zone or changes existing zoning designations for 640 or more acres.

14. Construction of a pipeline greater than six inches in diameter and 50 miles in length used for the transportation of crude petroleum or petroleum fuels or oil or derivatives thereof, or for the transportation of synthetic or natural gas under pressure.

15. Construction on a single site of facilities that are designed for, or capable of, storing a total of one million or more gallons of any liquid fuel.

16. Any new or additional impoundment of water creating a water surface in excess of 40 acres.

17. Construction of a sanitary landfill for an excess of 100,000 cubic yards per year of waste fill.

18. Construction or opening of a facility for mining gravel or other non-metallic minerals which will involve more than 80 acres.

19. Preparation of a 10-year pre-sale development plan for sustainable timber harvest for state-owned lands or land managed by the Department of Natural Resources.

20. The creation of a new port district or expansion of the boundaries of any existing port district in excess of acres.

. Categorical exemptions for EIS preparation

Proposals for undertakings of the types listed herein are determined not to require preparation of an EIS because they will not significantly affect the quality of the environment, and are exempted from compliance with the procedural requirements of EIS preparation.

. Repair, maintenance or minor alteration of existing facilities

The repair, maintenance or minor alteration of existing private or public structures, utility, telephone and transit facilities or mechanical equipment, involving no material expansions or changes of use beyond that previously existing. If the previous use had been discontinued for a period of five years or more prior to the present proposal, this exemption shall not apply.

. Minor new construction

The following types of minor new construction shall be exempt except when undertaken wholly or in part on lands covered by water:

(a) The construction of a single family residence, duplex or small apartment of four dwelling units or less;

(b) The construction of a barn, loafing shed, or similar agricultural structure, excluding feedlots;

(c) The construction of an office, commercial, recreational, service or storage building designed for an occupant load of 25 persons or less, and with less than 2,500 square feet of floor area;

(d) The construction of bus stops, shelters, access facilities and pullout lanes for taxicabs and transit, and the construction of loading zones;

(e) The construction and/or installation of commercial signs, and signs and signals for all public purposes;

(f) The construction or installation of minor road and street improvements such as channelization and elimination of sight restrictions at intersections, street lighting, guardrail and barricade installation, installation of catch basins and culverts, and reconstruction of existing road bed (existing curb to curb in urban locations), including minor widening of shoulders and additional right of way, but not including the addition of a lane;

(g) The installation of hydrological measuring devices;

(h) The construction of a parking lot designed for 30 cars or less;

(i) The demolition of any existing building (not including other man-made structures which are not building);

(j) Any landfill or excavation of 500 cubic yards or less;

(k) Electric line extensions and services at distribution voltages;

(l) The installation, repair, maintenance, and inspection of all underground communication lines or public right of way;

(m) Construction of utilities to serve any building or facility exempted by this subsection;

(n) Accessory structures to any building or facility exempted by this subsection, including garages, carports, patios, fences, septic tanks and recreational facilities;

(o) County/cities may at their option designate areas within their jurisdiction which are environmentally sensitive areas and within which the exemptions of this subsection shall not apply. Environmentally sensitive areas should be those within which one or more of the actions listed within this subsection could have a significant adverse environmental impact, including but not limited to areas with unstable soils, steep slopes, unusual or unique flora or fauna, or which lie within flood plains. The location and extent of all environmentally sensitive areas shall be clearly indicated on a map.

3. **Water rights**

Proposals for the following appropriations of water shall be exempt, the exemption covering not only the permit to appropriate water, but also any hydraulics permit, shoreline permit or building permit required for a normal diversion or intake structure, or well and pumphouse reasonably necessary to accomplish the appropriation, but not covering any actions relating to construction of a distribution system:

(a) Appropriations of 50 cu ft/sec or less for irrigation purposes, when done without a government grant or loan;

(b) Appropriations of 1 cu ft/sec or less for any purpose.

4. **Judicial activity**

The following shall be exempt:

(a) All actions of the judicial branch;

(b) Any quasi-judicial action of any agency, provided that such action consists of the review of a prior administrative decision. Contested cases or other hearing processes conducted prior to the first administrative decision on a proposal are not exempt.

5. **Enforcement and inspections**

The following enforcement and inspection activities shall be exempt:

(a) All actions, including administrative orders and penalties, undertaken to enforce a statute, regulation, ordinance or prior decision. No licence shall be considered exempt by virtue of this subsection; nor shall the adoption of any ordinance or regulation be considered exempt by virtue of this subsection;

(b) All inspections conducted by an agency of either private or public property for any purpose;

(c) Police patrol and traffic law enforcement except where such involves any physical construction activity;

(d) Any action undertaken by an agency to abate a nuisance or to abate, remove or otherwise cure any hazard to public health or safety; provided, that open burning shall be exempted under this subsection, nor shall the application of any pesticide or chemical, except to disperse oil spills. No licence shall be considered exempt by virtue of this subsection; nor shall the adoption of any ordinance or regulation be considered exempt by virtue of this subsection;

(e) Any suspension or revocation of a licence for any purpose.

6. Business and other regulatory licences

The following business and other regulatory licences are exempt:

(a) All licenses to undertake an occupation, trade or profession;

(b) Licences to operate amusement devices and entertainment carnivals, lances, music machines and theatres, but not including licences required for construction of any of the above;

(c) Licences for solicitation or door-to-door sales, private security services, and taxicabs and other vehicles for hire;

(d) Licences for massage parlours, second-hand dealers, pawnbrokers and close-out sales;

(e) Licences for the sale or display of fireworks;

(f) Licences for food services, sales or distribution;

(g) Animal control licences;

(h) The renewal or reissuance of any licence regulating any present activity or structure, so long as the structure or activity in question will continue in a manner unchanged from what had been done before, and that the substantive terms of the licence will remain the same as in the prior licence. In the event that a change in the location or nature of the activity or structure is contemplated, or a change in the terms of the licence is contemplated, the proposal for the purpose of this chapter shall consist only of the contemplated change;

(i) All licences required solely for revenue purposes.

7. Legislative actions

The following shall be exempt:

(a) All actions of the state legislature; provided, that this subsection shall not be construed to exempt the proposing of legislation by any agency;

(b) All budgetary requests and requests for appropriation except capital budget requests or submittals.

8. General administration, operation and personnel

The following types of action concerning an agency's general administration, operation and personnel shall be exempt:

(a) The procurement of general supplies and services previously authorized, or necessitated by previously approved functions or programmes;

(b) The assessment and collection of taxes;

(c) The adoption of all budgets, except capital budget items;

(d) The review and payment of vouchers and claims;

(e) All personnel actions, including hiring, terminations, appointments, promotions, allocations of positions, or expansions or reductions in force;

(f) All agency organization, reorganization, internal operational planning or co-ordination of plans or functions.

9. Review and comment actions

Any activity where one agency reviews or comments upon the actions of another agency or another department within an agency shall be exempt, provided, that the exemption shall not apply where the reviewing agency exercises a substantive decision over the proposal, where the failure to review or comment would veto or modify the proposal, or where the comment amounts to a new proposal for legislation or action.

10. Purchase or sale of real property

The following real property transactions by an agency shall be exempt:

(a) The purchase or acquisition of any right to real property by an agency;

(b) The sale, lease or exchange of any interest in real property by an agency to or with another agency or instrumentality of the federal government;

(c) The sale or transfer of any real property by an agency (except street vacations) to a private individual or entity; provided, that such sale or transfer does not have the effect of terminating an existing public use of the property or of removing such property from a natural preserve. The lease of real property by an agency to a private individual or entity shall not be exempt.

11. Minor land-use decisions

The following land-use decisions shall be exempt:

(a) The approval of short plats or subdivisions;

(b) Variances based on special circumstances applicable to subject property such as size, slope, topography, location or surrounding and not resulting in any change in land use or density;

(c) Classification of land for current use taxation.

12. Procedural actions

The proposal or adoption of legislation, rules, regulations, resolutions or ordinances, or of any plan or programme relating solely to governmental procedures, and containing no substantive standards respecting use or modification of the physical environment shall be exempt.

13. Acceptance of filings

The acceptance by an agency of any document or thing required or authorized by law to be filed with the agency and for which the agency has no discretionary power to refuse acceptance shall be exempt. No licence shall be considered exempt by virtue of this subsection.

14. Burning permits

The issuance, revocation or suspension of permits for open burning shall be exempt. The adoption of plans, programmes, objectives or regulations by any agency incorporating general standards respecting the issuance of burning permits shall not be exempt.

15. Water-quality certifications

The granting or denial of water-quality certifications.

D. Organization of a draft EIS

1. The draft EIS shall be organized as set forth in subsections 2, 3 and 4 below.

2. Each draft EIS shall begin with a title page, followed by a distribution list, summary and description of the proposed project. Organization variation is not permitted for these portions of the draft EIS.

3. The organization of the content of the remainder of the EIS may be varied, at the option of the lead agency. (For example, the remainder of the draft EIS might be organized by areas of the environment impacted, or by various subsections of a project or programme, or the discussion of the impacts of alternatives might be integrated with the impacts of the proposed action etc.)

4. In the event that a lead agency does elect to vary the organisational format of the draft EIS, pursuant to subsection 3 above, the substantive

information required to be discussed under each of these sections must nevertheless be set forth in the organizational format which is utilized.

6. The following sections set forth the required contents of a project draft EIS:

a. Title page

The following information shall be succinctly set forth at the beginning of the draft EIS:

(a) Project sponsor and a brief (one or two sentences) description of the nature of the project and its location;

(b) Lead agency, responsible official, and the name and address of a contact person to whom comments, information and questions may be sent;

(c) Authors and principal contributors to the draft EIS, including titles and disciplines represented, and the nature or subject area of their contributions;

(d) List of all licences which the project will require;

(e) Location of EIS background data;

(f) Cost to the public for a copy of the document but no more than actual reproduction cost;

(g) Date of issue of the draft EIS;

(h) Date by which comments must be received to be incorporated into final EIS (30 days after distribution).

7. Distribution list

The draft EIS shall include a list of the names and addresses of all agencies, federal agencies, organizations and persons to whom the draft EIS will be sent upon publication.

8. Summary of the contents of the draft EIS

Each project draft EIS shall contain a summary of its contents. The summary is intended as an aid to the decision makers involved in the proposal. The lead agency should bear in mind that agencies other than the lead agency will be utilizing the EIS as an aid in decision making, so jurisdictional parochialism should be avoided in the summary as well as in the statement itself. Except for the description of the project, the summary shall include only the conclusions reached in the EIS with respect to the various subject areas. In the event no conclusion can be reached, the reason for uncertainty together with the more likely possibilities should be succinctly stated. In most cases it is expected that the summary will run two to five pages, but it shall not be more than ten

pages. The summary shall include the following:

(a) A brief description of the proposed project, including the purpose or objectives which are sought by the project sponsor;

(b) The direct and secondary adverse impacts upon the physical environment which may result from the project as proposed;

(c) The alternatives considered, together with any variation in impacts which may result from each alternative;

(d) Measures which may be effectuated by the applicant, lead agency, or other agency with jurisdiction to mitigate or eliminate adverse impacts which may result from the proposal;

(e) Any remaining adverse impacts which cannot be mitigated.

9. Description of the proposed project

The draft EIS for a project shall include a description of the total project being proposed, including but not limited to, the following:

(a) The project name, sponsor and principals involved;

(b) The location of the project, including a legal description and further identification (usually a map) sufficient to enable a layman to understand its location;

(c) Reference to the file numbers of any other agencies involved, so that they will be able to identify the project location with precision;

(d) If the project involves phased construction over a period of time, the timing of each construction phase should be identified; and if it is anticipated that later phases of the proposal will require future environmental analyses, these should be identified;

(e) A description of the major physical and engineering aspects of the proposal. This description should be tailored to the environmental impacts later discussed, with those physical aspects of the proposal causing the greater impacts being given the more detailed description. Inclusion of detailed engineering drawings and technical data should normally be avoided. Material of this nature should be retained in agency files and supplied to consulting agencies upon request;

(f) A brief description of existing land-use plans, policies and regulations applicable to the project location, and whether the proposal is consistent with them.

Within the general guidelines of this subsection, the lead agency has discretion to determine the content and level of detail appropriate to adequately describe a given project.

10. Existing environmental conditions

This section shall present a general picture of the existing environment, covering in general those areas of the physical environment. The level of

detail used in presenting the existing environment should be proportionate to the impact the proposal will have. Areas of the physical environment which will not be affected need only be mentioned generally, or not at all. Inventories of the species of flora and fauna present on the site should be avoided; rather, emphasis should be placed upon those species which may be significantly affected. Such information shall be brief, non-technical, easily understood, and provide the necessary background for understanding the project impacts.

11. The environmental impact of the proposed action

Any area of the physical environment which may be significantly affected by the proposal shall be discussed. Impacts which are potential, but not certain, shall be discussed within reason. Those which will not be affected shall be marked "N/A" (not applicable). Direct and secondary impacts of the total proposal, including cumulative and growth-inducing impacts, shall be examined. The possibility that effects upon different areas of the environment will interrelate to form significant impacts should not be overlooked. This section shall discuss beneficial as well as adverse environmental impacts.

12. The realtionship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity

This section shall attempt to identify the long-term beneficial uses of the environment (including those by future generations) which may be foreclosed by this project, and relate and/or compare these with the uses of the environment (both long- and short-term) resulting from the proposal in question. Some brief discussion of broad social policies and goals may be helpful to make this section meaningful.

13. Irreversible or irretrievable commitments of resources

This section shall identify any natural resources, including energy, which are committed by the proposal, either permanently or over a long term. Natural resources committed include the lost opportunities to make other uses of the resources in question, and this section may be integrated with the discussion in subsection 12 hereof. There is no requirement that this section include a discussion of socio-economic resources committed, such as labour, money etc.

15. Adverse impacts which may be mitigated

This section shall include a description of reasonable alterations to the project which may result in avoiding or mitigating any adverse impacts upon the physical environment associated therewith. Each such alteration shall be evaluated in terms of its effect upon the physical environment, and its practicality (including economic practicality) of application.

16. Alternatives to the proposed action

This section shall contain a description and objective evaluation of any reasonable alternative action which could feasibly attain the objective of the proposal. The alternative of "no action" shall be included and evaluated. The adverse environmental effects of each alternative shall be identified, together with any reasons why each alternative was rejected. The analysis should be sufficiently detailed to permit a comparative evaluation of each alternative and the proposed action.

For private projects which are proposed for a specific site, the alternatives considered shall be limited to the "no action" alternative plus other reasonable alternative means of achieving the objective of the proposal on the same site (which may include only alterations for mitigation under subsection 14 hereof).

16. Unavoidable adverse impacts

This section should identify those impacts discussed in subsection 11 hereof which are adverse but cannot be mitigated or avoided by modifications to the project. For any impact discussed in subsection 11 hereof which is determined to be non-adverse, the reason for this conclusion should be clearly stated.

17. Social, economic and cultural issues

Every draft EIS shall contain a section labelled "Social, Economic, and Cultural Issues" within which those problems and issues not pertaining to any area of the environment, but which are relevant to the proposal shall be identified. This section shall be limited to a brief identification of potential social, economic or cultural problems or issues, and no detailed discussion of any such issue is required (nor is it allowed for any impact statement prepared for a private project). So long as a section labelled "Social, Economic, and Cultural Issues" is present in the statement, no EIS shall be deemed inadequate because of the failure to list any particular issue.

Annex II

PLANNED INDUSTRIAL INSTALLATIONS IN THE VICINITY OF THE ALUMINIUM SMELTER AT PUERTO MADRYN

Present plans for an industrial park at Puerto Madryn include largely those operations directly related to the production of primary aluminium. A list of these operations follows, along with a process description and some factual information concerning plant capacity and operating conditions.

1. Rolling mill

Molten aluminium metal is alloyed as needed, treated with chlorine and nitrogen to remove hydrogen, and placed in a gas-fired holding furnace. From the holding furnace, the metal stream flows via a launder into the strip caster; the solidified strip is coiled.

From this point, various products and/or sheets require different steps of heat treatment, surface levelling, surface profiling, and cutting to the finished unit.

Plant capacity:

20,000 tons product/year

Fuels:

Purchased electricity (126,000,000 kWh/year)
Natural gas (7,500,000 m^3/year)

Raw materials:

Molten aluminium
Alloying chemicals
Chlorine
Nitrogen
Water
Rolling oil (kerosene type)

Pollution control:

Water recirculation unit
Rolling-oil recovery system

2. Wire rod plant

Molten aluminium is alloyed with manganese or silicon, as required; chlorine and nitrogen are added to dehydrogenate the molten metal. The metal is placed in a gas-heated holding furnace from which the liquid metal is poured onto a rotating and grooved water-cooled wheel. The emerging bar is forced through pinch rolls to form a wire rod of the desired size. Large flows of an emulsion type lubricant are used to cool and lubricate the rod as it passes through the pinch mill.

Plant capacity

25,000 tons/year

Fuels:

Purchased electricity (2,600,000 kWh/year)
Natural gas (1,300,000 m^3/year)

Raw materials:

Molten aluminium
Chlorine
Nitrogen
Emulsion type lubricant
Water (8,000 m^3/year)

Pollution control:

Recirculation unit to reuse the emulsion type lubricant
Recirculation of cooling water

3. Extrusion plant

Aluminium billets are heated to a temperature just above the extrusion point in an induction furnace (450°-500°C). The heated billet is moved to the cylinder (container) and a hydraulicram forces the "fluid" aluminium through a die of the desired shape. The extrusion from the die is air- or water-quenched and then detwisted. The correctly formed extrusion is then cut into desired lengths; some extrusions need a low-temperature ageing treatment (160°C).

Plant capacity:

3,000 tons extrusions/year

Fuels:

Purchased electricity (4,700,000 kWh/year)
Natural gas (408,000 m^3/year)

Raw materials:

Aluminium billets
Water

Pollution control:

None

4. Anodizing plant

The aluminium article to be anodized is initially either polished finished (mechanically) or etched finished (immersion in alkaline cleaner at 60°-70°C) The "finished" article is cleaned or etched in warm 5-10% (wgt.) caustic soda, neutralized in 20% (vol.)nitric acid, and water rinsed. The aluminium article is then used as the anode in a cell bath containing sulphuric acid (8-10% vol.) at a current density of 1.5 A/dm^2.

The film so produced is porous and hence can absorb dyestuff by immersion. The final step consists of "sealing" the anodized or anodized and dyed article in a tank of boiling water.

Plant capacity:

400 dm^2 of anodising/h (600-750 tons/year)

Fuels:

Purchased electricity
Gas-fired boiler for steam (2,500 kg steam/h at 15 p.s.i.)

Raw materials:

Aluminium extrusions
Water
Caustic soda
Sulphuric acid
Nitric acid
Organic and inorganic chemicals, including dyes

Pollution control:

Bag collectors on mechanical polishers
Fume control on caustic and acid dip tanks

• Cable plant

Aluminium wire rod is led into a wire-drawing machine which reduces the rod to the desired wire thickness. A small quantity of high viscosity lubricant is added to the die during the drawing operation. The aluminium wire is wound on spools and woven into the desired cable size.

Plant capacity:

2,000 tons/year

Fuels:

Purchased electricity

Natural gas (heating only)

Raw materials:

Wire rod

Lubricant

Pollution control:

None

6. Window plant

Aluminium extrusions will be cut to size and otherwise modified for assembly into complete windows.

Plant capacity:

12,000 windows/year

Fuels:

Purchased electricity

Natural gas (heating only)

Raw materials:

Aluminium extrusions

Screws, nuts and bolts

Window glass

Pollution control:

None

7. **Refractory brick plant**

Specific clay materials are ground, classified to size, and stored in hoppers. The proper materials are blended with water and moulded to the required brick size. The "green" bricks are then dried, fired and cooled.

Plant capacity: 5,000 tons/year

Low refractory bricks: 2,700 tons/year
Moderate refractory bricks: 700 tons/year
High refractory bricks: 500 tons/year
Super refractory bricks: 400 tons/year
High alumina bricks: 400 tons/year

Fuels:

Purchased electricity (3'4,000 kWh/year)
Natural gas (1,000,000 m^3/year)

Raw materials:

Various clays
Inorganic chemicals
Water

Pollution control:

None

8. **Fluoride installations**

No firm plans have been completed for construction and operation of chemical plants involving fluorides. Tentative plans call for the production of 9,000 tons/year of cryolite, 6,000 tons/year aluminium fluoride, and 11,000 tons/year of hydrofluoric acid (unknown strength). These plants may not be required if Aluar installs the dry alumina process to recover emitted fluorides.

Pollution controls:

None noted.

Annex III

PLANNED INDUSTRIAL INSTALLATIONS IN THE VICINITY OF COMODORO RIVADAVIA

Production of crude oil in the Comodoro Rivadavia region amounted to 3 million cubic metres (8.4 million tons) in 1972 with an expected growth to 10 million tons in 1985. As the crude oil is processed in the La Plata region of Buenos Aires, attempts have been made to develop industrial operations in the Comodoro Rivadavia region which are not directly related to petroleum.

An industrial park area of over five million square metres has been set aside. Present plans call for immediate development of a portion of this large area (686,000 m^2). Completed industrial plans will be reviewed here. Only the foundry may be located in the proposed industrial park, about eight kilometres north of the city.

1. Cement plant

Cementaceous raw material will be milled dry and fed directly to the kilns. The formed clinker will be milled and mixed with various additives for desired cement properties.

Probable location will be 8-10 kilometres north of the city.

Plant capacity:

1,000 tons/day clinker
350,000 tons/year cement

Fuels:

Purchased electricity (42,000,000 kWh/year)
Natural gas (30,700,000 m^3/year)

Raw materials:

Limestone
Siliceous material
(If insufficient raw material is found nearby, the plant may be located some 170 km north)

Water:

140,000 m^3/year

Pollution control:

Electrostatic precipitator on the kilns

Bag collectors on all grinding equipment (cyclones will serve as pre-filters)

2. Foundry operations

Cast iron will be produced in a standard cupola. Steel will be produced in an electric resistance furnace.

The liquid metals will be poured into moulds to produce the units (valves, unions, plumbing hardware etc.) which will be cleaned by sand blasting and grinding and then machined. Brass and bronze fittings may also be made at a later time.

About 95% of the moulding sand will be reprocessed.

Probable location will be close to the proposed cement plant.

Plant capacity:

700 tons/year cast iron
600 tons/year steel

Fuels:

Purchased electricity (4,650,000 kWh/year)
Natural gas (3,000,000 m^3/year)
Coke (72 tons/year)

Raw materials:

Ferrous materials
Moulding sand (360 tons/year)
Water (73,000 m^3/year)

Pollution control:

No controls considered as yet.

3. Fish plant

Ocean fish will be processed and the frozen or canned products will be exported. Fish meal will be produced.

An existing building on the north edge of the city may be the first installation. The main operation is planned for a small port about 20 kilometres north of Comodoro Rivadavia.

Plant capacity:

5,000 tons/year fish products

5,000 tons/year fish meal

Fuels:

Purchased electricity (690,000 kWh/year)

Natural gas (900,000 m^3/year)

Raw materials:

Ocean fish (10,000 tons/year)

Water (62,000 m^3/year)

Pollution control:

None

Annex IV

PRINCIPAL VISITS PAID BY CONSULTANT

4 March 1975

Discussion with Joseph Bryne, Environmental Manager, and Stanley Passwell, Environmental Control Engineer, Martin Marietta Aluminium, Inc. (90,000 tons/year, vertical-stud Sodeberg) at The Dalles, Oregon. The control facilities at the plant included a scrubber and wet electrostatic precipitator as primary collectors on the cells and a water-spray system as a secondary collector on the cell houses. The collection system meets Oregon State fluoride air-quality regulations; recently, some water-pollution problems have been encountered. The following other points were developed:

(a) The dry alumina system is most helpful in minimizing purchase of fluorides, which have been in short supply;

(b) The profitability of the dry alumina system depends, in part, on methods of cost accounting, interest rates and tax rebates;

(c) The purity of the aluminium with the dry alumina system is reported to have dropped three grade points because of impurity build-up (iron, silica, carbon etc.);

(d) Some plants use fresh alumina on some lines and recycled aluminium fluoride on other lines to maintain better purity;

(e) The anticipated United States standards for fluoride emissions may be increased from 1 kg TF/ton aluminium for new plants to 1½ kg TF/ton aluminium for existing smelters;

(f) The cost of "adequate" control of fluoride emissions approximates 5% of plant capital costs for new installations and 10% for retrofit.

5 March

Discussion with Lloyd H. McKay, retired Plant Manager of The Dalles smelter. Mr. McKay worked with Aluar SAIC as a volunteer executive from the International Executive Service Corps of New York City. It was the opinion of Mr. McKay, who visited Puerto Madryn, that the plant design was good. He was most concerned that poor operating conditions would increase fluoride emissions (by as much as 50%). Mr. McKay also remarked that wind-blown dusts (silica) at Puerto Madryn might decrease aluminium purity. He opted for a dry-control system because of the potential water pollution problem.

March 6

Completed discussions with Mr. Bryne of Martin Marietta. Mr. Bryne knew of no aluminium smelter which did not have, at one time or other, fluoride lawsuits. Mr. Bryne considered that ambient air quality standards for fluorides should be the prime goal for control agencies and industry but that emission standards were easier to apply and to administer. Drove to Pullman, Washington.

March 7

Discussion with Professor R. Robinson and others about the possibility of Argentine scientists or engineers attending Washington State University for graduate studies in air pollution topics. Dean Leon Luck, Civil Engineering Department, stated that the University would welcome such students.

Drove to Mead, Washington, to tour the Mead Works of the Kaiser Aluminium and Chemical Corporation (220,000 tons/year prebaked anodes - centre worked; 8 pot-lines of 142 cells, 24 anodes/cell) with C.H. Folkrod, Environmental Manager. The plant was initially built in 1942. Control equipment consists of a bed of alumina with a bag house to collect the solids. The anode plant has the same type equipment designed by Kaiser Engineers. The plant meets the Washington State fluoride requirements without secondary controls. As the operation is a "centre-work", the crust is broken and solids are added mechanically without disturbing the cell closures.

The control system was retrofitted in September 1974 at a cost of $US 17 million. The plant is still experiencing minor difficulties from the new installation. The drop in aluminium purity has not been serious. It was estimated that the recovered fluoride values would pay for the operating costs plus "something left over". No major difficulties have been experienced in the operation of the dry alumina control system. Some increased dustiness has been noticed while adding recycled solids to the cells. Mr. Folkrod was uncertain as to the life of the bags on the control system (one bag house per line; 768 bags per unit). It was the opinion of Mr. Folkrod that all aluminium smelters are going to the dry alumina control system.

10 March

Discussion with J. A. Tompson, Northwest Environmental Manager of Alcoa's aluminium smelter at Wenatchee. The plant is a prebake unit with primary controls on both the cells and anode plant (dry alumina fluidized-bed, 210,000 tons per year; 5 pot-lines, centre-work; at present 2 lines on dry system and 3 lines on scrubbers plus precipitator). Estimated costs to retrofit three lines in the near future are $US 17 million.

No difficulties have been encountered with the dry alumina system at the cells but problems of bag caking must be resolved at the anode plant. The cell covers are simple aluminium shields which are hand removed when replacing anodes. Solid feed is automatically added to the centre of the cell. The drop in aluminium purity has not affected sales price. Increased dustiness of the recovered fluoride has been noted. Air flow through the cells approximates 3,000 cu ft/min with increased flows when the cell shields are removed.

All vegetation samples are leached with a caustic and an acid solution; fluoride is determined on the neutralized and chelated solution with a fluoride electrode (BTI method). Research Appliance Company's dual fluoride tape samplers are used to measure air concentrations. Stack solids are fused, dissolved and analysed directly with the fluoride electrode. About six men handle the fluoride environmental problems at the plant. Calcium formate papers have been used to determine gaseous fluoride levels and concentrations.

11 March

Toured the Intalco Aluminium Corporation's smelter at Ferndale with R.A. Gustafson, Property and Environmental Manager. The plant has both a primary (dry alumina injection) and a secondary (water spray) system at the cell houses; the anode plant has a wet scrubber followed by a wet electrostatic precipitator (now being installed).[a/]

The dry alumina injection system was chosen over the fluidized-bed because of a lower cost and a quicker installation time. In about 1970, the retrofit installation (Alcan - 2 lines and Pratt-Daniels - 1 line) cost $US 15 million. In 1974, the recovered fluoride from the bag house collectors was valued at $US 3 million.

There has been a drop in aluminium purity (iron 2 points and silica 1 point) but the decreased purity has not affected sales. Also the nickel content of the aluminium increased from 0.005 to 0.02 per cent.

The entire cell side hooding is raised to feed solids and to change anodes. Metallic aluminium is withdrawn from a door in the centre of the side cover. It is felt that the hooding has somehow affected the cell's heat transfer or heat distribution to some extent. Approximately 3,000 cu ft/m air are drawn through the cells to the primary control system. The increased dustiness of

a/ 270,000 tons per year; 3 pot-lines with 240 cells/line; low current density cells (4.2 A); side-work operation.

[illegible] exceeded for [illegible] off-site operations. Air samples surrounding the plant have not exceeded 0.4 mg/m^3 (12 hour sample) since the dry injection system was instituted. A water-distillation unit, automated by Technicon, is the basis for analysis of all low fluoride containing samples. The sodium arsenate tube method is used to sample the atmosphere for gaseous fluorides.

The environmental programme (air and water control) is handled by eight employees plus consultants, when needed.

12 March

Visited Professor A.T. Rossano of the University of Washington in Seattle. The University would be pleased to accept graduate students from Argentina for air pollution studies. In subsequent discussions, it was determined that the cost data for aluminium smelters developed by the Environmental Protection Agency was extrapolated based upon retrofit costs. The EPA cost data were highly dependent upon cost-accounting practices. Paul Boyes of EPA, who developed portions of the cost data, was involved in the discussions. William Hamilton of EPA could be contacted for detailed cost data on aluminium smelters.

Drove to Olympia, Washington, to discuss control problems of aluminium smelters in the State of Washington with Dr. R.L. Stockman (retired) and and Henry Droege of the Department of Ecology. No precise cost data were available but it was again stated that cost-accounting practices, tax rebates and interest charges influenced the cost data calculations. The RAC dual tape sampler was accepted as a monitoring instrument. The caustic-acid leach was also accepted as a part of the analytical procedure for particular fluorides. It was also remarked that scaling problems had developed with the dry alumina injection system, which reduced bag life; a cyclone prior to the bag house might minimize this problem.

14 March

Visit to Kaiser Aluminium and Chemical Corporation in Oakland was not completed. A discussion was held with Dr. Jack Schoegman, Director of Environmental Science, who reported a cold air effect producing markings to pine trees similar to that of fluorides. A. P. Garcfa, Head of Marketing Sales, felt that the dry alumina control process could have a long-term payoff. Kaiser could design and install a dry alumina system for Puerto Madryn if so requested.

17 March (Buenos Aires)

Informal project discussions were held with Messrs. A. E. Volpe, A. W. Brace, J. Rêvora, C. A. Ruscelli and Geoffrey Percival (Industrial Park Consultant).

18-24 March

Initiation of planning procedures for project and review of proposed industrial plants to be established at Puerto Madryn. With Ing. O. R. Sala of CFI reviewed planned installations for an industrial park in Comodoro Rivadavia.

Possible plants include: fish products for export, cement plant (35[illegible], [illegible] tons/year), tannery, iron and bronze foundry, plumbing fixtures, poultry feed, nuts-bolts, and a boat repair shop. The installation is planned for an area some 8-20 km from Comodoro Rivadavia, which has a population approximating 10[illegible].

1 April

With a group of 10 to 12 persons (UNIDO, UNDP, CFI, and Province of Chubut) toured the environs of Comodoro Rivadavia - sites of the proposed industrial park and fish-packing plant, cement plant, zinc plant, light industry south of the city and a living area on the hills southwest of the city.

2-8 April

Reviewed status of planned industrial installations with personnel of UNIDO, UNDP, CFI and Province of Chubut. Travelled from Comodoro Rivadavia to Trelew. Examined industrial park areas with representatives of UNIDO, CFI and Province of Chubut.

9 April

Discussions with Dr. Barros of Centro Nacional Patagónico (CNP). Meteorological measurements show that calm winds may bring Aluar emissions into Puerto Madryn. Preliminary ambient air measurements by CNP and Aluar, with up to 46 cells in operation, show the following fluoride concentrations:

Centre of town: 2-4 g/m^3

North edge of town: up to 40 g/m^3

300 and 1,000 s from Aluar: up to 70 g/m^3

Sampling periods ranged from 12 to 50 hours

Sampling and analytical problems were discussed with Dr. Barros and Sr. Cejas.

[illegible] with Dr. [illegible], [illegible] Development [illegible]. It was mentioned that [illegible] present [illegible] and that additional [illegible] the [illegible] forty-[illegible] are now in [illegible].

Agri.

Audited a meeting discussing aspects of industrial parks. Brief meeting with Sra. Chaiva to discuss fluoride and environmental problems.

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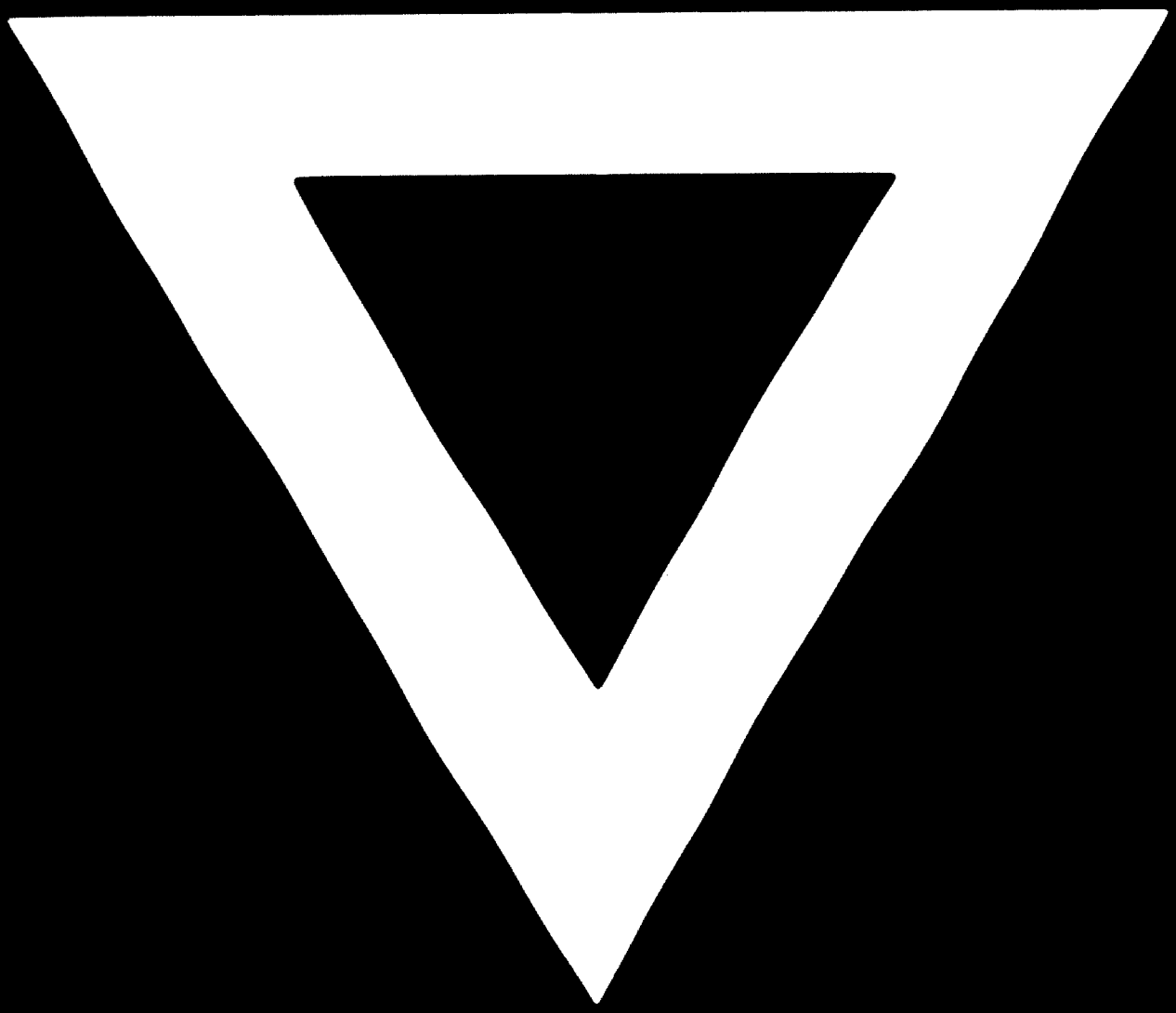

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