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APRIL 1989

POLLUTION CONTROL RESEARCH INSTITUTE

DP/IND/83/008

REPUBLIC OF INDIA

Mission Report*to: HARDWAR, INDIA

January - March 1989

Prepared for the Government of India

by the United Nations Industrial Development Organization

acting as executing agency for the United Nations Development Programme

Based on the work of Mr. Asit K. Biswas

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INTRODUCTION

Since only 9 months are now left before the completion of the project, it is an appropriate time to take stock of the developments so far and also to assess the strengths and weaknesses of the project. This is especially relevant since a second phase of the PCRI is now being proposed. It should be noted that since I took over as the CTA last August, the present mission of 2½ months gave me the first real opportunity to assess the project comprehensively. The earlier two brief visits in my role as the CTA were primarily used to assist PCRI to organize the International Conference on Environmental Impact Analysis, for Developing Countries, which turned out to be an outstanding success. A report on the current status of the Institute is shown in Annex I. Annex II shows the proposed areas of concentration.

OVERALL ASSESSMENT

My general overall assessment is that PCRI has made considerable progress since last summer. The knowledge-base of the Institute is better, the capacity to take on projects has increased, technical reports are better written since the inception of the Institute, and the staff are more confident of their ability. While these are unquestionably positive developments, much more needs to be done if PCRI is to be made a centre of excellence in the country.

Undoubtedly, the most important event for PCRI during the past year was the organization of the International Conference on Environmental Impact Assessment for Developing Countries, held in New Delhi, 28 November - 2 December, 1988. Co-sponsored by the various United Nations Agencies and other international scientific organizations, the Conference was attended by over 300 people from 26 countries. For an institution that had never even arranged a national seminar, it is indeed very remarkable that a truly outstanding international conference was organized. The convening of this very successful conference has gone a long way to establish the visibility and credibility of the Institute. It is now highly likely that PCRI will receive many projects on EIA, primarily because of the success of the Conference. What is now needed is to recruit a suitable commercial officer in consultation with the Head of PCRI to market this expertise.

STRENGTHS AND WEAKNESSES

At its present point of development, PCRI has many strengths and weaknesses. Among its many strengths are the following:

1. Its setting below the Sivalik foothills, and its park-like environment has provided it with an excellent atmosphere for research and development work.

2. The Institute has considerable scope for expansion, both in terms of staff and space.

3. Many of the equipments available are state-of-the-art, and similar facilities are not currently available in India or the other parts of South Asia.

4. If the second phase of the UNDP project is properly executed, PCRI can obtain some of the world's best environmental specialists to develop its expertise in its areas of concentration.

5. Work in pollution control and environmental management is likely to experience explosive growth in India during the next 10 to 15 years, and possibly for a longer period. If the PCRI develops the necessary expertise and experience, it could get a significant percentage of this work.

6. There is no similar institute like the PCRI in India or in South Asia. It thus has the potential of being transformed into a centre of excellence in the region.

7. Many of the young staff members are very bright. They have the potential to become good national or even international experts.

8. The fact that the PCRI is part of BHEL, a major public sector profit-making organization, gives the Institute certain unique advantages.

Among its major weaknesses are the following:

1. The first Project Document was poorly formulated. It should have been revised at least 3 to 3½ years ago. A significant percentage of the UNDP funds have not been optimally used, either in terms of equipments or experts.

2. The Institute was planned as a general all-purpose pollution control research institute. It is impossible for any institute to specialize in all aspects of air, water, noise, soil and solid waste

pollution from all types of industry. Accordingly, PCRI must concentrate on a few select areas.

3. Virtually all the persons initially involved with the establishment of PCRI in BHEL or the Executing Agency are no longer involved. The institutional memory is now inadequate.

4. The Institute currently lacks key personnel in the following areas: suitably qualified and experienced technical experts in pollution control and environmental management, librarian, accountant and commercial development officer. These points were raised in the 1988 TPR, but no action has been taken so far.

5. Some of the unsuitable and undesirable staff members must be transferred from PCRI for its long-term development. These problems have not been resolved for more than a year.

6. The absence of even core scientific books and technical journals in the library continues to be a very serious constraint. It is having adverse impact on the development of PCRI.

7. PCRI is now generally viewed in India as a BHEL Institute and not a national Institute. Accordingly, the regulatory authorities like the Department of Environment are not extending to it the same trust as given to other national institutes. Thus, studies and measurements carried out by PCRI are sometimes being questioned.

8. Some staff members are a little concerned about career growth prospects within PCRI. Some thought needs to be given on how to attract and keep good staff members.

FACTORS TO BE NOTED

Within this overall context, the following factors should be noted.

1. Role and status of PCRI - It appears that many people now expect PCRI to be a completely commercial organization, which will not only earn its entire operating expenses, but also hopefully make some profit. For the future of PCRI, this point should be resolved clearly once for all.

The Project Document explicitly stipulated that PCRI is a R&D institution, with a "Consulting Cell". This does not mean it would be a fully commercial institution, that would more than earn its total upkeep. R&D institutes, except in very rare instances and due to some very special circumstances, do not earn their upkeep. As PCRI was

constituted, it would be highly unrealistic to expect it to earn all its operating expenses. Once PCRI is fully developed, it may be possible for it to generate at most 30 to 40 percent of its operating expenses; certainly no more. There should be no misunderstanding on its role in the future.

Equally, PCRI must be given some flexibility in its rate structure so that it is competitive with its other competitors. Otherwise its further development is likely to be slow.

2. Head of PCRI - For the establishment of any research institute, the choice of the first Head is crucial. Unfortunately, at present very little can be done to undo the problems created by the Institute management during the early years. Since 70 to 80 percent of the equipments were ordered during this period, and have now been received, these problems cannot be resolved optimally.

The second TPR. which was held at New Delhi, and was chaired by the CMD of BHEL, clearly recommended that the "National Project Director needs to be given more delegation of powers than at present in order to handle different administrative and procedural matters more realistically".

This recommendation was the most important one made by that TPR for PCRI's long-term development. Although there has been some improvements, this recommendation has not been fully implemented over a period of two years. The reporting structure of PCRI within BHEL should also be reviewed so that decision-making could be faster.

3. Role of CTA - One of the main reasons as to why the project is unlikely to fulfil its many objectives fully is the role of the CTA. From November 1984 to August 1988, the CTA has spent an average of only 10 working days every year at the Institute. This is an unacceptable record. Equally, the CTA is being currently used only as an expert. For example, the CTA does not receive report of any expert to review the quality of the recommendations or their relative priorities in order to determine how they fit in within the overall scheme. Without such prioritization and proper integration, ad-hoc decisions have been taken and will continue to be taken. Basically, under the present practice, the CTA reviews and advises only during his visits to PCRI. Between the long intervening periods between two missions, there is no real involvement of the CTA. This practice must

be changed, at least during the second phase so that the CTA is kept continually informed of important developments between missions by mail, telex or fax. He should be consulted on important decisions before they are taken.

4. Staffing - Staff recruitment process has been much slower than expected. The Institute urgently requires two senior technical persons on pollution control and environmental management. One of these two new persons should be put in charge of overall research management, who should report directly to the Head.

A trained and experienced Librarian should have been recruited at least three years ago. The idea of getting a person from any BHEL plant, and give him three months or so training on library science, and then call him a Librarian is a non-starter.

Equally, an accountant should have been hired at least three years ago. PCRI cannot function properly without an accountant.

An officer is also urgently required for project and/or commercial development. Without such an officer, it will take much longer time to obtain adequate number of R&D work and consultancies.

Pollution control and environmental management is a comparatively new area. As PCRI staff are trained, their "market value" will increase. Thus, BHEL must consider adopting a more flexible policy, if they wish their trained staff to stay at PCRI.

5. Experts - The calibre of experts visiting PCRI has undergone significant improvement since last summer. There is still, however, further scope for improvement. Proposal for expert missions for the balance of the project duration is shown in Annex III.

One serious problem that still continues is the duration of expert visits. A mission of less than one month leaves much to be desired. It takes one week for experts to travel to and from the home base to Delhi, administrative work at Delhi, travel Delhi-Hardwar-Delhi, and debriefing - when necessary - at Vienna. Thus, a SSA for one month means at most a 3 weeks' stay at PCRI. Accordingly, unless exceptional circumstances warrant it, no SSA for less than five weeks be issued, out of which at least 4 weeks should be spent at Hardwar.

For the second phase, the expert visits should be considered in blocks of 6 to 8 weeks. However, for the real world-class experts to visit PCRI some conditions have to be satisfied: otherwise they simply will not come. The three most important conditions for this to happen are the following:

(i) The expert visits must be finalized at least 4 months before the missions. This does not mean only a telex from the Executing Agency and/or PCRI. A SSA must be issued well in advance. Equally, if an expert is to visit PCRI twice a year, it would be desirable to issue one SSA covering both the visits so that there is no misunderstanding from any side later.

(ii) The Executing Agency must provide competitive SSAs. Currently, the fees for top environmental experts recruited by UNDP (OPS) or UN DTCD are 80 percent higher than UNIDO's. The first CTA left only for this reason. It will continue to be a difficult process to attract top international experts, unless the Executing Agency modifies its current policy.

6. Library - The present status of the Library at PCRI, and the absence of an experienced Librarian, are major constraints to the Institute's development. Without a certain number of essential books and journals, at leeast in the proposed areas of concentration, PCRI will never succeed in achieving its objectives. The development of the Library should be considered to be a priority item. Books and journals given to PCRI are shown in Annex IV.

7. Work programme, and staff and resource accountability - Now that PCRI is getting itself properly organized, a system has to be developed in terms of staff and resources accountability for both existing and proposed programmes. A work programme should now be prepared for the medium term, say, the next 2-3 years.

Staff should be made accountable for both the quantity and quality of their work. Their performances should be evaluated objectively and the incentives given in terms of promotion, foreign training, and participation at scientific and technical meetings should be dependent on their performance appraisal.

8. Second Phase - While there is now good reasons for cautious optimism for the future of PCRI, it can achieve its potential only if the second phase of the UNDP assistance is approved. Both Project Formulation Framework (PFF) and the detailed Project Document were prepared during the present mission. These are attached herewith as Annexes V and VI.

There is considerable urgency to have the PFF approved by BHEL, and then by the appropriate government ministries so that the project can be included in the next country programme. Ideally this should be done by the end of March 1989. I discussed this issue with the Secretary of Department of Public Enterprises, Director (Technical) of BHEL, and Deputy Resident Representative of UNDP, all of whom now have copies of the PFF. Their initial reaction has been most positive. In addition, the second phase of PCRI was discussed with the Secretary, Department of the Environment, who has also agreed to support it. While initial groundwork was completed during the mission, some follow-up work may be necessary.

9. Bilateral Aids - PCRI should explor bilateral aids. During my stay, First Secretary of the British High Commission was invited to Hardwar. As a direct result of this visit, PCRI was awarded two training fellowships, each for a maximum of one year in U.K. Equally, a Project Proposal is now with the British Council in London to support three travelling training courses in India to be organized by PCRI with the British Council assistance. A part of this proposal includes a book presentation programme. I am currently exploring with the British Council about the possibility of a technology transfer project for total pollution control from thermal power stations through CEGB.

Initial contacts have now been made with SIDA and JICA for further bilateral assistance.

10. Training - The impact of earlier training programmes arranged has been minimal since it involved short visits of 1-3 weeks in one place and then moving in to another. For training to be effective, trainees should not go to more than 2 places. The duration of the training period should be increased from 2 to 3 months.

Training facilities should be given only to staff members who work, and thus make a positive contribution to PCRI. So far because staff has been recruited at a much slower rate than foreseen in the project document, all professional staff members have viewed training as a matter of right. This practice should be discontinued. A person should be sent for training for the second time, if this will help the Institute most. This would also be an incentive for staff members to work efficiently. In this regard, the decision to send 2 staff members, who have already been trained once under the UNDP-UNIDO project, to UK for a further period of 6-7 months under the British Council fellowships, is a step in the right direction.

11. Advisory Council and Governing Council - While both the Councils were visualized in the Project Document, none were constituted. The Advisory Council has now been constituted, and invitation letters have gone out to the members. The first meeting of this Council will take place in the near future. Details are given in Annex VII.

The Governing Council remains still to be constituted. Such a Council is necessary in order that people outside view PCRI as a national institute, which will increase its credibility. This issue was discussed with the Secretary, Department of Public Enterprises. During the meeting, it was agreed that the Joint Secretary from this Department would chair the Governing Council, which would soon be constituted.

12. BHEL facilities - For world class environmental experts to come to PCRI for 4-8 week periods, in addition to the requirements mentioned earlier, two facilities need to be upgraded.

First, it is proposed that two suites be specially constructed for PCRI experts for long-term stay at the Trishul Guest House. The suites must be properly designed and suitable for working during week-ends and evenings. PCRI must be in control of these suites: otherwise these would be monopolized by the so-called VIPs and PCRI experts would have no access to them. Furthermore, before they are constructed, the plan for the suites should be discussed with the CTA to ensure that they match the requirements of the visiting experts. This was discussed at various levels of BHEL management, and the response has been positive.

Second, PCRI must have STD facilities with a fax within its premises. Currentiy experts are completely cut off from the outside world in terms of telecommunication. Furthermore, as a national institute, PCRI must have its own telecommunication facilities. This needs urgent attention. Again the general response of the BHEL management at Delhi has been positive.

Both these two issues would need some further follow-up actions.

A. K. Biswas
March 4, 1989

FUTURE DIRECTION OF PCRI IN TERMS OF AREAS OF CONCENTRATION

PAPER FOR DISCUSSION AT TPR

INTRODUCTION :

According to the Project Document the immediate objectives of the Pollution Control Research Institute are to:-

"i) develop industrial pollution technologies and equipments with respect to air,water, noise and solid wastes;

ii) develop practical methods for recovery and re-use of industrial wastes;

iii) evolve processes and control procedures for minimising pollution generation;

iv) advise industry on how to introduce and maintain pollution control levels and technical standards and scientifc knowledge on pollution control technologies;"

The Project Document further states that "activities will cover, inter-alia:

i) installation and commissioning of equipment for providing facilities to carry out applied research to develop technologies for treatment of air, water, noise and solid pollutants;

ii) carrying out investigations and preparation of reports giving suggestions for corrective measures/improvements in respect of :

(a) emissions and electrostatic precipitator of a thermal power station;

(b) effluents of a pharmaceutical plant;

(c) noise prediction and control methodologies in the equipment/processes in a few select industries;

iii) establishment of a consultancy cell to advise industry on pollution problems;

(iv) setting up of a data bank of scientific, economic and sociological aspects of pollution with facilities for dissemination of available informations;

(v) compilation of international standards on pollution control technologies and norms;

(vi) maintaining regular contact with industry to promote application of efficient pollution control devices and measures and establishing linkages with international bodies engaged in similar activities to obtain up-to-date information on technologies developed elsewhere for application in industries in India."

The above information is taken from pages 3 to 4 of the Project Document. It should be noted that there are some errors and inconsistencies in the above objectives and activities, but they are simply reproduced above from the Project Document for convenience. Furthermore, later on in the Project Document a fifth objective was added. This is to "serve as a reservoir of technical and scientific knowledge on pollution control technologies."

It was expected that all these objectives will be achieved within a limited period of only 3 years.

PRESENT STATUS

The Institute has basically developed along the objectives stipulated, and has unquestionably fulfilled parts of each objective, though the degrees of fulfillment of each objectives very considerably This is, however to be expected since no

pollution control research institute anywhere in the world can specialize in all the aspects of air, water and noise pollution and solid wastes management, as well as be knowledgable in every aspect of pollution control technologies, processes, and equipments for all types of industry. In addition, the Institute is expected to know at least by direct implication, the specific and overall impacts of industrial pollution on the biota. Consideringthe facts that there are too many different types of industry, different process are often used within any single type of industry, and that technological changes are occuring very rapidly all over the world, it is clearly impossible for any one institute to be aware of only the significant changes let alone be full knowledgeable on all aspects. An Institute of this generalized type can only at best aspire to become be the "jack of all trades but master of none." Clearly PCRI was originally assigned an impossible task.

Furthermore, the complexities of all the subject areas are now such that no one individual can be a real expert on say, all different aspects of air pollution control technologies from all different types of industry. Hence, a critical mass of experts and supporting staff is necessary in each area of specialization.

On the basis of the past performance of the Institute, and on the specialist advice received from the Chief Technical Advisor, other pollution control experts and the Department of the Environment, it is evident that PCRI cannot be "all things to all men." It must focus its attention to a few select core areas, wherein specialist expertise in pollution control can be developed. In other words, PCRI must immediately decide on areas of concentration and then focus its attention to these areas.

AREAS OF CONCENTRATION

Since it is evident that PCRI must focus its activities on specific areas, the two most important questions which then arise are what should be these few select areas of concentration and on what basis should these areas be selected.

In view of the vast number of potential areas available for consideration, the selection of areas of concentration needs careful scrutiny. Criteria can be used to decide on the areas in which PCRI should specialize. Among these important criteria are the following:-

1. Areas where PCRI has already developed some expertise, and this expertise has now generally been recognized externally;

2. Areas where PCRI's presence within its parent organization, BHEL, gives it certain special advantages;

3. Areas where up-to-date sophisticated instruments already available in PCRI give it a special advantage over its compeitiors;

4. Areas where no or inadequate expertise on pollution control exists in India at present;

5. Areas where PCRI can develop special pollution control niches in India;

6. Areas where PCRI is likely to get substantial number of projects as contracts;

7. Areas where the geographical location of PCRI may give it some special advantages; and

8. Areas where competition for work is less from other potential competitors.

On the basis of the above criteria, and discussions within PCRI, BHEL, visiting experts, appropriate UNIDO and UNDP officials and senior government officials in the area of pollution control in New Delhi, following areas are recommended as areas of concentration.

1. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) - PCRI has already developed considerable expertise on EIA. The recently held International Conference on EIA in New Delhi has been unanimously acknowledged to be a great success. This has not only increased the visibility of PCRI but also has projected its image externally as an Institute with considerable expertise and experience on EIA. Furthermore, as EIA is being made mandatory for all public sector projects and important private sector industrial development projects, both the scope and demand for this type of work at present in India are good. The demand will most likely increase manifold in the future. By all accounts, the importance of EIA and subsequent follow-up monitoring studies is expected to increase by leaps and bounds during the next 2 to 5 years in India as well as in South Asia.

2. SPECIALIZATION IN POLLUTION CONTROL TECHNOLOGY IN SELECTED INDUSTRY- It is proposed that pollution control from THERMAL POWER STATIONS should be one of the most important areas of concentration for PCRI. BHEL is now the main supplier of generators, turbines and electrostatic precipitators in India, and thus has considerable interest in thermal power stations. Equally, increase in the number of such power stations and/or to their capacities, will be significant over the next 5 to 10 years. All these new power stations, or their expansion of existing ones, needed to be cleared on environmental grounds. PCRI should develop control technology for pollution control for

thermal power stations. PCRI should be able to get a significant percentage of these studies, provided it can establish its reputation in this area quickly and its charges are competitive. In this regard, commercial support from the parent organization would be most helpful.

Equally PCRI can play an important role to improve the design of the electrostatic precipitators manufactured by BHEL by monitoring and reviewing their current performances during the EIA studies undertaken, and then by providing this feedback to the appropriate BHEL division.

In addition to thermal power stations, it is proposed that PCRI should specialize in FOUNDRY AND METAL-COATING areas. Most of the BHEL plants have foundries and metal-coating shops. Expertise in pollution control technology for these two areas can be developed by initially working within the BHEL factories, in Hardwar as well as elsewhere. Most public sector manufacturing industries also have foundries and metal-coating shops, which could thus be PCRI's potential clients. Furthermore, no group in India has developed expertise in pollution control technologies in these two industry. It should be noted that in the original Project Document, foundry was mentioned in one place as an possible area of interest.

There are many other areas where PCRI can develop pollution control expertise, but once the areas of concentration are agreed upon, the temptation to diversify to different areas should be strongly resisted. Unquestionably, even at a proposed annual full strength of 121 man-years, PCRI can realistically develop critical mass of experts only in a few select areas. Accordingly, unless exceptional circumstances justify it,

acceptance of a project in a new area should be strongly discouraged.

3.SPECIAL AREAS- At this stage these areas cannot be identified precisely, except in a conceptual fashion.

On the basis of work that will be carried out at PCRI in the above-mentioned areas of concentration, it is highly likely that PCRI will develop some new POLLUTION CONTROL EQUIPMENTS, which should have market potential. If appropriate and economically feasible, these could be manufactured by BHEL. Another possibility could be that these equipments could be manufactured through sub-contracting or by others on a royalty basis, so as to make these equipments economically justifiable. Currently some R & D work is being carried out at PCRI on high volume samplers for air pollution measurements. However, what type of equipments that could be considered finally for manufacturing cannot be identified precisely at present. At a certain stage, some market surveys may have to be carried out to determine the sales potential of equipments being considered for manufacturing.

The second special area could be those where expertise currently do not exist in India, but where with limited manpower(say 2 to 3 experts) and primarily external funding support, PCRI can be acknowledged to be the premier institution of its kind in the country,and possibly in South Asia.A possible example could be the impact of the greenhouse effect on India as a whole. Currently no one is studying the impact of increases in CO2 levels from the combustion of fossil fuels in India, and their potential impacts on the country in terms of climatic changes. Yet these impacts could be most significant in many parts of India. Globally this is now considered to be one of the

most serious long-term environmental problems, but paradoxically no group is working seriously on this issue in India at present. Funds can be obtained for this type of study from the Department of Environment, CSIR, DST and / or UNEP.

Another possibility could be to study the impact of lead from motor vehicle emissions and other sources on biota. This is an area where the Secretary of the Department of the Environment would like some assistance from PCRI. An experimental study in the Hardwar area could be initiated out with external financial support.

Thirdly, PCRI in collaboration with other organizations can undertake some specific projects. For example, one possibility could be an in-depth study of air pollution in a major city like Delhi which could be undertaken with the Central Board of Pollution Control and with external funding. However, before any special project is undertaken, it should be ensured that such a new activity do not have adverse impact on the agreed areas of concentration.

All these types of special projects should be for specific durations and primarily funded by external sources. These projects should be self-financing. Man-power necessary and new equipments required should be paid from the external support.

CONCLUDING REMARKS

Finally, unless it is decided that PCRI should have specific areas of concentration, its chances of being recognized as the

leading pollution control research institution in India is not very good. By focussing on a few select areas and by developing expertise principally in those areas, PCRI has the potential of not only being the best Institution of its kind in India but also in South Asia. Its success could encourage UNDP to establish similar pollution control research institutions in other developing countries.

PLAN FOR UNDP/UNIDO EXPERTS, 1989

Post No.	Title	Total (m/m)	Completed till 12/88 (m/m)	Balance (m/m)	Expert	Proposed Period	m/m
11-01	CTA	12.03	7.8	4.5	A.K. Biswas	Jan-March April-Nov.	2.5 2.0
11-02	Water Pollution Control	4.8	3.8	1.0	from CEGB	October	1.0
11-03	Air Pollution Control	7.0	5.5	1.5	from CEGB	October	1.5
11-04	Solid Waste Management	6.4	5.4	1.0	To be nominated	July or earlier	1.0
11-05	Noise and its control	2.8	1.8	1.0	To be nominated	June	1.0
11-06	Red./Contrl of Pollut. from Boiler	5.0	3.0	2.0	*S.C.Wallin	May October	1.0 1.0
11-07	Advanced E.P. Tech.	1.0	-	1.0	To be nominated	May	1.0
11-08	Water Disbn. System	2.0	2.0	-	-	-	-
11-10	Math.Modelling	7.9	5.9	2.0	*K.Fedra	Oct-Nov	2.0
11-11	Wet Scrubber Tech	1.0	-	1.0	To be nominated	July or earlier	1.0
11-12	Env. Chemistry	1.0	-	1.0	H. Mayer or S. Jorgensen	September	1.0
11-13	Ecological Protection	3.0	2.0	1.0	* P. Wanner	September	1.0
11-60	Unspecified Consultants	7.2	7.2	0.0	-	-	0.0
	Total	61.4	44.4	17.0			17.0

*Return visit

S.B.C. 4/3/89

(S.B.C.AGARWALA)
HEAD (PCRI)

(A.K.BISWAS) 4/3/89
CTA

ANNEX IV

BOOKS AND JOURNALS PRESENTED TO PCRI LIBRARY

1. Sustainable Development: Constraints and Opportunities, by M.K. Tolba, Butterworths, London

2. Global Environmental Issues, by E. El-Hinnawi & M. Hashmi, Butterworths, London

3. Environmental Education and Training, by Desh Bandhu, Indian Environment Society, New Delhi

4. Evolving Environmental Perceptions, by M.K. Tolba, Butterworths, London

5. Proceedings, National Symposium on Aquaculture Productivity, New Delhi

6. Tamilnadu Water Resources Act, including arrangements for Water Pollution Control, draft, Madras

7. Soil and Water Conservation, by V.V. Dhruva Narayana, Central Soil and Water Conservation Research Institute (CSWCRI), Dehradun

8. Hazardous Wastes Management, by S. Maltezou, A.K. Biswas and H. Sutter, Cassell Tycooly, London

9. Treatment and Reuse of Wastewater, by A.K. Biswas and A. Arar, Butterworths, London

10. Soil Conservation, Prospects and Challenges, by A.S. Mishra, CSWCRI, Dehradun

11. Sahastradhara Mine Area Rehabilitation Research Project, CSWCRI, Dehradun

12. Soil and Water Conservation in Low Rainfall Regions, by V.S. Patnaik, CSWCRI, Dehradun

13. Energy Storage Systems in Developing Countries, by Y. ElMahgary, Butterworths, London

14. Land Use Policy, Vol. 5, No. 4, October 1988

15. Resources Policy, Vol. 14, No. 3, September 1988

16. Ecological Modelling, Vol. 42, No. 2, August 1988

17. Ecological Modelling, Vol. 42, No. 314, September 1988

18. Ecological Modelling, Vol. 43, No. 5, October 1988

19. Environment International, Vol. 14, No. 1, 1988

20. Agriculture, Ecosystems and Environment, Vol. 21, No. 5, 1988

21. GeoJournal, Vol. 17, No. 2, October 1988

22. GeoJournal, Vol. 17, No. 3, October 1988

23. Civil Engineering, August 1988

24. Energy Policy, Vol. 15, No. 5, October 1988

25. Regulated Rivers, Vol. 2, No. 4, October 1988

26. Bulletin, International Commission on Irrigation and Drainage, Vol. 17, No. 1, January 1989

27. Water Resources Development, Vol. 4, No. 9, December 1988

28. Soil and Water Conservation Newsletter, December 1988

29. Time, Special Issue on Environment, January 1, 1989

Fictions

30. Patriot Games, by Tom Clancy

31. Whirlwind, by James Clavell

32. The Haj, by Leon Uris

33. Falcon Flies, by Wilbur Smith

34. The Icarus Agenda, by Robert Ludlum

35. Mortal Friends, by James Carrell

ANNEX V

Dr. A.K. Biswas
February 28, 1989

UNITED NATIONS DEVELOPMENT PROGRAMME

PROJECT OF THE GOVERNMENT OF THE REPUBLIC ON INDIA

Project Formulation Framework

Title : Strengthening of the Pollution Control Research Institute, BHEL, Hardwar 249403, U.P., India

Estimated Duration : 4 years

Estimated UNDP contribution : $ 2,904,000

Estimated Government Input : Rs. 28,600,000

Estimated Starting Date : January 1990

A. Development problem(s) to be addressed by proposed project

1. At sectoral or sub-sectoral level
   ([illegible] level)

	Causes	Evidence
Inadequate environmental protection	1. Lack of appropriate institutions to provide appropriate solutions, including development of new technologies and methodologies for environmental protection	(a) Conventional measures, which can be considered inadequate by contemporary standards of environmental protection, continue to be used.
		(b) Technologies already developed outside the country for industrial pollution control are [illegible] unavailable at present
	2. Importance of environmental protection [illegible] recognized in the recent past.	2. Increasing environmental pollution in terms of air, water, soil, solid wastes and [illegible]

2. At [illegible] level
   ([illegible] level)

	Causes	Evidence
a) Insufficient [illegible] in the country to give proper advice on pollution control and environmental management.	1. Lack of experienced and trained manpower	1. Difficulty of finding trained people for recruitment.
	2. Emphasis on environmental management is of comparatively recent origin.	2. No structured education and training programme available.
	3. Industry and other sectors [illegible] fully aware of the importance of proper environmental management.	3. Pollution control measures [illegible]

1) Widespread environmental degradation due to various developmental activities.	1) Skepticism of the financial and other benefits of pollution control at senior decision-making levels.	1) Reluctance to use funds for pollution control activities.
	2) Lack of positive and disincentives for pollution control.	2) Increasing effluent discharges to the environment.
	3) Inadequate compliance of pollution control regulations.	3) Not enough trained enforcement officials available.
	4) Reluctance of people to change old alternatives.	4) Existence of sewer systems designed more than 10 - 20 years ago.
2. Inefficient application of available technology.	1) While the information on environmental control technology, e.g. is available outside the country it is not not available readily within.	1) Difficulty or even the near impossibility to get information on clear terms eg. within the country.
	2) Lack of appropriate pollution control equipments and instruments.	2) Inadequate manufacturing of concerned equipments and instruments in the country.

B. Concerned parties/target beneficiaries

1. Who has identified the development problem and how has it come to the attention of UNDP ?

This project is the second phase of an earlier UNDP project (IND/83/OC°/B101137) on the establishment of Pollution Control Research Institute (PCRI) at Hardwar, U.P. Initiated in November 1984, with a UNDP contribution of $ 2.857 million, the project was expected to (1) develop industrial pollution control technologies and equipments with respect to air, water, noise and solid wastes, (2) develop practical methods for recovery and reuse of industrial wastes, (3) evolve processes and control procedures for minimizing pollution generation, (4) advise industry on how to introduce and maintain pollution control levels and technical standards and scientific knowledge on pollution control technologies, (5) serve as a reservoir of technical and scientific knowledge on pollution control technologies. As to be expected with such an ambitious project, only part of all these five objectives were fulfilled.

Furthermore, in the last tripartiate review, it was agreed that PCRI should become a centre of excellence in South Asia in certain selected areas of pollution control and environmental management. These areas of concentration were agreed upon after an intensive series of discussions with UN Experts, senior Government of India officials and BHEL staff. The areas identified and agreed to be taken up during the proposed second phase of the project are environmental impact assessment, total pollution control from thermal power stations, foundries and metal cutting shops and on very few selected special topics.

2. What particular group or groups are intended to benefit from the solution of the development problem identified at item A.2 (i.e. target beneficiaries) ?

Among many beneficiaries, the main ones are likely to be the following :

i) By reducing industrial pollution in the areas of concentration, the project will significantly help those segments of population who are directly affected by pollution caused by such industrial activities. Since poor people are mostly located in and around the industrial areas, in the final analysis, they would be one of the principal beneficiaries of the project.

ii) By providing technology for reuse and recycling of waste products, the project would contribute simultaneously to both resource conservation and pollution reduction, or even elimination, and thus enable the country to maintain its resource base for long-term sustainable development.

iii) Provide the country with reliable and up-to-date information system and data base on pollution control technologies and environmental management methodologies which do not exist in India at present. This would greatly benefit the country's research and development efforts by providing essential information on the subject.

iv) Central and State Governments would benefit directly by receiving advice on how best to control industrial pollution cost-effectively, and this will contribute to quicker environmental clearence of industrial projects for implementation. This would substantially increase the overall

benefits to industry, and by proxy to the country, by considerably reducing time delays and cost overruns, which otherwise may have occurred.

v) National and international organizations would benefit directly since they would be able to use the facilities of PCRI to train people and solve problems from South Asia in specific areas of industrial pollution control and environmental management. Since it would not be essential to send people to be trained in advanced industrialized countries, the cost of training per trainee would be significantly less. This would mean more people could be trained in the country for the same amount of funds. The cost of resolution of technical problems would be equally less.

vi) The project would benefit India and other South Asian countries by the development of indigenous pollution control technology as well as pollution monitoring equipments. It is expected that some of the equipments identified and developed by the project would be manufactured in India for use nationally as well as for export to neighbouring countries.

C. Pre-project and end of project status

1. The present or pre-project situation

With the rapid industrialization and urbanization of the country, environmental problems have also increased in recent years. While individual environmental impacts of specific projects or activities may be tolerable and within permissible limits, their combined impacts in many areas are now far exceeding the assimilative capacity of the environment. For example, according to the latest reports of the World Health Organization and the United Nations Environment Programme, major

Indian cities like Delhi and Calcutta are now included among the 20 most polluted urban centres of the world in terms of air pollution. Long-term health impacts of such high and sustained levels of air pollution on the urban population now must be substantial. The social and economic costs of such adverse impacts, while they are yet to be accurately calculated, are already quite significant. Not only can such existing adverse environmental impacts cannot be tolerated, but also every attempt must be made to ensure that the presently unacceptable levels of pollution do not increase further due to the inevitable increase in pollution and the consequent intensification of various human activities.

Currently the overall expertise on pollution control and environmental management in India is very limited. The country must rapidly catch up with the technologies that are already available to reduce or even eliminate various forms of environmental pollution, not only from industry but also from many other sources. Regular monitoring and analysis of levels of air, water, soil, solid waste and noise pollution in critical areas are urgently needed. Many of the equipments necessary for monitoring and analysis are now not manufactured in India, and thus are not easily available. Currently adequate expertise within the country to carry out environmental impact assessments for complex projects simply does not exist. Nor is much experience available on reliably predicting the impacts of various levels and types of pollution on human and animal health, and other forms of biota. If the expectations of the Seventh Five-year Plan in the area of environment and ecology are to be realized, much more needs to be done. The strengthening of the Pollution Control Research Institute is expected to go a long way

to develop the necessary knowledge, expertise and experience that are urgently required, and also to provide the necessary means through the availability of up-to-date pollution control equipments and technologies to resolve the pollution control and environmental management problems of India.

Pollution Control Research Institute is a part of the Bharat Heavy Electricals Limited (BHEL), a major public sector undertaking. During the first phase of the project, it was established as a general purpose industrial pollution control institute, with major emphasis on equipments for various types of pollution monitoring. BHEL, the parent organization, is the largest producer of electrostatic precipitators in the country to control air pollution from thermal power stations. While basic industrial environmental management techniques are now currently available within PCRI, what is urgently needed is further institutional strengthening so that it can develop up-to-date specialized expertise on pollution control and environmental management in a few select areas of concentration.

2. The situation expected at the end of the proposed project:

Currently comprehensive and up-to-date pollution control technologies for most industry is either not known or not easily available in India. Equally, knowledge and experience are somewhat limited on how to design new industrial projects which minimizes all forms of environmental degradation - air, water, solid waste and noise pollution, and land use - and in the process encourage reuse and recycling of wastes so that they end up as being useful products having no disposal requirements. Information on clean or non-waste technologies are also not readily available.

Furthermore, considering the fact that the general concern on environmental issues in India is of relatively recent origin, it is not surprising that much work has not been done on the impacts of industrial pollution on human and animal health as well as on the biota. Furthermore, expertise on risk-impact analysis due to sudden, accidential releases of pollutants to the environment, as happened in Bhopal and in many other areas of India, is rather limited.

It is expected that by the end of this proposed institutional strengthening project, PCRI will develop adequate expertise, information base and full knowledge of cost-effective alternatives available to reduce industraial pollution control from few select types of industry, starting from minimization of waste generation to how best to manage all forms of industrial wastes that are produced during the production processes. It is expected that the Institute will also develop the necessary expertise to forecast impacts in terms of dose-response relationships of the waste discharges on the human health and the environment. It would thus be able to analyse various industrial projects as to how best to reduce levels of waste discharges economically so as to have minimal adverse impacts on the environment. Only when such expertise on the cause-and effect relationships is available, society can have the knowledge-base to decide scientifically and rationally what levels of pollution may be acceptable for the long-term sustainable development of the country.

D. Special Considerations

1. Identification of special considerations

The project merits several special considerations. First, it would directly address to pollution control and environmental

management problems, and thus would contribute significantly to the sustainable development process of the country. Second, it would facilitate good technical co-operation between developing countries by providing appropriate training facilities on pollution control and environmental management to professionals from India and other developing countries, by providing technical knowhow and consultancy services and by the presence of an up-to-date information base which could be used not only by PCRI staff but also other professionals. Third, PCRI is already interacting with NGOs and the private secotr. For example, one major environmental NGO is already represented in the Institute's Advisory Council. Equally, PCRI has worked closely with major international scientific and technical NGOs like International Association for Clean Technology, International Water Resources Association and International Society for Ecological Modelling. The Institute is already directly assisting the private sector as well as the public sector to resolve their industrial pollution control problems and overall environmental management planning.

2. Identification of negative impacts

The project will have no negative impact on the environment or any specific sector of the population.

E. Other donors, programmes active in the same subsector

Except for the first phase of the establishment of the Pollution Control Research Institute, there is no other similar project that is in operation in the country at present.

E. Development objectives and its relation to country programme

The main development objective of the project is to ensure that the environment and development objectives of the country

are satisfied simulataneously. By ensuring that the environmental management factors are properly considered, it is likely that the unacceptable and unanticipated side-effects of economic growth could be minimized. Air, water, solid wastes and noise pollution levels would be reduced significantly; land use parctices could be enhanced and environmental management practices could be improved. These development objectives have been explicity recognized in all recent national Five Year Plans.

G. Major elements

Immediate Objective -

The project has one major immediate objective. This is to upgrade the present capacity of the Pollution Control Research Institute in order that it can carry out effective research and development projects on pollution control from industrial and other sources, provide expert advice on environmental management to public and private sectors as well as to international organizations, and serve as one of the principal repository of information and knowledge on different aspects of pollution control and environmental management in the country, and in South Asia.

Outputs	Activities	Responsible party for the activity
1.1 In selected areas of concentration develop a well thought out functional programme on R&D activities on pollution control and environmental management through human resources development.	1.1.1 Identification and purchase of equipments, both from within and outside India	P C R I Executing Agency
	1.1.2 Review equipments available and take essential steps to keep them functional on a long term basis	P C R I Executing Agency
	1.1.3 Bring in acknowledge international experts to advise PCRI	P C R I Executing Agency
	1.1.4 Arrange short and medium-term training of PCRI staff and study tours of senior staff.	Executing Agency PCRI
1.2 Provide comprehensive and effective advice to [illegible] central and state government and national and international organisations [illegible]	1.2.1 Carry out site specific environmental impact [illegible] to facilitate environmental clearance by regulatory agencies.	P C R I with assistance from expert
	1.2.2 [illegible] different [illegible] and proposed projects to recommend cost-effective [illegible]	
	1.2.3 [illegible] state and central governments and national organisations, non-governmental organisations on short-and long-term impacts of human activities on the environment.	
1.3 Develop [illegible] cost - effective pollution control technology [illegible] equipment.	1.3.1 Identify and prioritise areas where new or modified pollution control technology and equipments are required	P C R I
	1.3.2 Develop pollution control technology and determine their effectiveness through laboratory or pilot scale investigations	P C R I with assistance from expert.

	1.3.3 Develop new pollution control equipments for indigenous manufacture	P C R I with assistance from experts.
1.4 Increase environmental and technological knowledge-base in the country.	1.4.1 Dessemination knowledge developed through training courses and workshops, and publication of reports and articles.	P C R I
	1.4.2 Publication of technical manuals and environmental guidelines	P C R I
1.5 Establish a functional library and information system for up-to-date pollution control and environmental management literature and data	1.5.1 Identify, order and catalogue books, journals and reports in areas of conservation	P C R I Executing Agency
	1.5.2 Take necessary steps for recognition of PCRI as a depository library for relevant national and international institutions.	P C R I Executing Agency
	1.5.3 Develop computerised environmental information system	P C R I with assistance from experts.

H. Project Strategy

1. Who are the people and/or institutions who would benefit in the first instance from the proposed outputs, and activities of the project ?

Engineers and scientists from the Pollution Control Research Institute, planners and decision-makers on pollution control and environmental management.

2. The target beneficiaries and the direct recepients of the project are not likely to be the same. Describe how the benefit proposed to be delivered to the direct recipients will lead to the benefit intended for target beneficiaries.

The Project aims to introduce efficient cost-effective pollution control technology and environmental management in the areas of concentration in India in particular and in South Asia in general. It is expected that advantages occurring to the direct beneficiaries would lead to the general adoption of the technologies and methods. The direct target beneficiaries will include thermal power stations, foundries and other selected areas of concentration who will have access to technology to control total pollution. In addition, various regulatory agencies would benefit from reliable and objective environmental impact studies. The ultimate beneficiaries will be those people who work and live in and around various projects where pollution control technologies would be implemented through direct or indirect assistance from PCRI.

The project is the second phase of the earlier project on the establishment of the Pollution Control Research Institute. It would be implemented through Bharat Heavy Electricals Limited (BHEL), a public sector undertaking. Most of the required institutional infrastructure, including building and laboratory

facilities, are already in place. Some 60 full-time professionals and support staff are already in position. The Executing Agency could be, in alphabetical order, UN DTCT, UNDP (OPE) or UNIDO.

Full-fledged facilities for the Institute would be available for the second phase of the project. Additional professional and support staff would be recruited. The Institute will have a staff strength of 121 by the end of the project.

An eminent CTA would be recruited for guiding the project. Well known international experts would be identified and invited to advise and guide PCRI on its R&D programmes. Counterpart professionals would be sent abroad for training in appropriate technologies and disciplines. The PCRI Advisory Council would continue to meet and guide its overall programme.

4. Identify any alternative project strategies and/or implementation arrangements which have been considered, and why they have been rejected in favour of the one chosen ?

The implementation strategy was finalized on the basis of the results obtained and experience gained during the first phase of the project.

I. Host Country Commitment

1. Describe the indications which show the Government or other host country institution concerned will provide the counterpart support necessary for the project's successful operation and to sustain its results.

Much of the institutional infrastructure, including buildings, laboratories, already exist. The balance, like two suites for visiting UN experts at the Trishul Guest House, which would be totally at the disposal of PCRI, would be constructed promptly. Currently 60 full-time professional and support staff are already at PCRI. This would be increased to 121 by the end of the project. The counterpart agency would make available to the Institute at least one new car and a new van for its work. Some new indigeneous equipments necessary would be purchased during this phase. Full details of counterpart countribution would be provided in the project Document that would be made available by the Government of India.

2. Describe any legal arrangements necessary to assure that staff trained by the project will remain in their posts for a fixed period after their training.

It is mandatory for staff members trained abroad to execute a legal bond to serve at PCRI for a period of 3 years, when the training period is 3 months or less, and 5 years when the training period is more than 3 months.

J. Risks

List all those significant risks which could seriously delay or prevent the achievement by the project of its outputs and objectives.

Description of risk	Estimated likelyhood
1. Factors which may at the outset cause major delays or prevent achievement of the project's outputs and objectives.	None
2. Factors which could over time cause major delays or prevent achievement	

of the project's outputs and objectives.

3. Lack of interest of high level BHEL management because of their overwhelming interest in production, could have an adverse impact on the project.	Low
4. Improper choice of international experts and backstopping officers by the Executing Agency.	Low

K. Inputs

1. Skeleton budget

	National inputs (Indian Rs.)	External inputs (US $)
Personnel	14,500,000	909,000
Sub-contracts (Civil Construction)	1,000,000	-
Training	800,000	500,000
Equipments (including Library & information system)	6,000,000	1,450,000
Miscellaneous	1,300,000	45,000
TOTAL	23,600,000	2,904,000

2. Comment on any proposed inputs which may raise policy issues on which headquarters guidance is sought.

None

Person primarily responsible for this formulation network ..... Asit K. Biswas .....

Name : Asit K. Biswas
Title : Chief Technical Advisor, PCFI and President International Society for Ecological Modelling.

of the project's outputs and objectives.

3. Lack of interest of high level BHEL management because of their overwhelming interest in production, could have an adverse impact on the project.	Low
4. Improper choice of international experts and backstopping officers by the Executing Agency.	Low

K. Inputs

1. Skeleton budget

	National inputs (Indian Rs.)	External inputs (US $)
Personnel	19,500,000	909,000
Sub-contracts (Civil Construction)	1,000,000	-
Training	800,000	500,000
Equipments (including Library & information system)	6,000,000	1,450,000
Miscellaneous	1,300,000	45,000
TOTAL	28,600,000	2,904,000

2. Comment on any proposed inputs which may raise policy issues on which headquarters guidance is sought.

Date

Person primarily responsible for this formulation network ..... Asit K. Biswas .....

Name : Asit K. Biswas
Title : Chief Technical Advisor, PCRI and President International Society for Ecological Modelling.

ANNEX VI (UNIDO)

A.E.Biswas

January 1989

UNITED NATIONS DEVELOPMENT PROGRAMME

PROJECT OF THE GOVERNMENT OF THE REPUBLIC OF INDIA

TITLE: Strengthening of the Pollution Control Research Institute, BHEL , Ranipur, Hardwar 249403, India.

Project Number:

Duration: 4 years

Host Country Implementing Agency : Bharat Heavy Electricals Limited(BHEL), New Delhi, through Department of Public Enterprises, Ministry of Industry.

Executing Agency : UNDP (OPS), DTCD or UNIDO

Tentative UNDP Costs: $ 2,904,000

Estimated total Project Costs:

Estimated Starting Date : January 1990.

A. CONTEXT

1. Description of subsector

Even though [illegible] early recognized in the Indian constitution, environmental protection was not considered to be a priority [illegible] years after the independence of the country. During this period environmental considerations were seldom explicity considered and properly integreted in India's development plans, programmes and projects.

This situation started to change in the beginning of the early Seventies. The preparatory work for the United Nations Conference on the Human Environment, held in Stockholm, Sweden, in June 1972, highlighted the importance of the environmental issue in most developing countries. The late Indian Prime Minister Mrs. Indira Gandhi lead the Indian delegation to the Stockholm Conference, where she made seminal contributions to its deliberations. Her forceful arguements, which linked poverty directly to environmental degradation were clearly recognized by the Stockholm Conference, and were adequately reflected in the Conference recommendations.

The various senior Ministers of the Government of India have often said that poverty is one of the major factors contributing to environmental pollution. Accordingly, it can be confirmed that rapid development with an emphasis on the removal of poverty is the central objective of the government plan, and this objective is as much an environmental as a development goal. It is further recognized that there are many alternative ways to alleviate poverty, and the country should select those options which would maximize the environmental benefits and simultaneously minimize the environmental degradation.

[illegible] the poorest [illegible] of the population who bear the [illegible] share of the adverse environmental impacts due to desertification, deforestation, soil erosion, and air and water pollution. The poor are thus the direct victims of industrial and other forms of environmental pollution. Their lifestyles are very intimately linked to the soil and water resources, and their poverty, illiteracy and malnutrition ensure that they constitute the segment of the society that is most susceptible to environmental pollution, including diseases associated with such high and sustained levels of pollution. The Government of India has accordingly recognised in recent years that pollution control safeguards and environmental protection measures are essential ingredients for poverty alleviation programmes.

2. Host Country Strategy -

India's Fourth Five Year Plan (1969-74) clearly outlined the importance of environmental considerations in the following words:

"It is an obligation of each generation to maintain the productive capacity of land, air, water and wildlife in a manner which leaves its successors some choice in creation of a healthy environment. A physical environment is a dyanmic, complex and inter-connected system in which any action in one part affects others. There is also the inter-dependence of living things and their relationships with land, air and water. Planning for harmonious development recognised this unity of nature and man. Such planning is possible only on the basis of a comprehensive appraisal of environmental issues, particularly economic and

ecological."

The importance of an integrated approach to [illegible] management was stressed in the Sixth Five Year Plan (1980-85). Proposals were initiated on how best to ameliorate the environmental pollution problems that already existed, and also how to build up adequate knowledge and capability to prevent or mitigate those that would arise in the future.

The Seventh Five Year Plan (1985-90) contains an independent chapter on the "Environment and Ecology" and gives considerable emphasis to the concept of "sustainable development". It says clearly: "If the gains in productivity are to be maintained, resources must also continue to be available over time. This requires that, while providing for current needs the resource base be so managed as to enable sustainable development." It has also been explicity recognised that environmental planning should specifically address to the class of problems that arise as unintended side-effects of the very attempts at development. These relate to mismanagement of natural resources, large scale deforestation, the unplanned discharges of residues and wastes, the handling of toxic elements, and indiscriminate construction and expansion of settlements.

3. Prior or Ongoing Assistance -

Pollution Control Research Institute was initially established under a UNDP project. The total UNDP contribution was $ 2.857 million. The Institute is the first of its kind in any developing country, and specializes in pollution control and environmental management.

4. Institutional Framework for the Subsector-

In 1972, the Government of India initiated the beginning of

an institutional [illegible], to review India's environmental problems. A National Committee on Environmental Planning and Co-ordination was [illegible] [illegible] the year to [illegible] India's environmental problems and then to advise the Government on how those issues could be [illegible] resolved.

The overall interest in environmental issues, and th awareness of the general public on the importance o environmental protection has increased continuously an significantly since 1972. Many environmental legislations [illegible] been adopted since that time on a number of issues [illegible] [illegible] the environmental management process and [illegible] provid legislative and regulatory frameworks for [illegible].

In 1980, a full fledged Department of the Environment wa established. The importance attached to the environment was suc that the late Prime Minister Mrs. Gandhi held that portfoli herself until her untimely death in late 1984.

Many of the states have now environmental ministries. Eac state also has a Pollution Control Board, and the Centra Pollution Control Board co-ordinates their activities directly o indirectly. Also, all new public sector projects, or expansio of existing ones, currently require environmental impac assessment reports. These reports are reviewed by the Departmen of the Environment. Before project implementation can start these have to be explicity cleared on environmental grounds.

B. **PROJECT JUSTIFICATION**

1. Problems to be addressed; the present situation -

With the rapid industrialization and urbanization of th country, environmental problems have also increased in recen

[illegible] While individual environmental impacts of specific projects or activities may be tolerable and within prescribed limits, their combined impacts in many areas are now far exceeding the assimilative capacity of the environment. For example, according to the latest reports of the World Health Organization, and the United Nations Environment Programme, cities like Delhi and Calcutta are now included among the 20 most polluted cities of the world in terms of air pollution. Long-term health impacts of such high and sustained levels of air pollution on the urban population now must be substantial. The social and economic costs of such adverse impacts, while they are yet to be accurately calculated, are already quite significant. Not only must such resulting adverse environmental impacts be tolerated, but also every attempt must be made to ensure that the presently unacceptable levels of pollution do not increase further due to the inevitable increase in population and the consequent intensification of various human activities.

Currently the overall expertise available on pollution control and environmental management in India is very limited. The country must rapidly catch up with the technologies that are already available to reduce or even eliminate all forms of environmental pollution, not only from industry but also from many other sources. Regular monitoring and analysis of levels of air, water, soil and noise pollution in critical areas are urgently needed. Many of the equipments necessary for monitoring and analysis are now not manufactured in India, and thus are not easily available. Currently adequate expertise within the country to carry out environmental impact assessments for complex projects simply does not exist. Nor is much experience available

on reliably predicting the impacts of various levels and types of pollution on human and animal health, and other aspects of the If the expectations of the Seventh Five-Year Plan in the environment and ecology are to be realized, much more needs to be done. The strengthening of the Pollution Control Research Institute is expected to go a long way to develop the necessary knowledge, expertise and experience that are urgently required and also to provide the necessary means through the availability of up-to-date pollution control equipments and technologies to resolve the pollution control and environmental problems of India.

Pollution Control Research Institute (PCRI) was established with UNDP assistance (Ind/81/009/31/01/37) in November 1984. The Institute, located in Hardwar, U.P., is a part of the Bharat Heavy Electricals Limited (BHEL), a major public sector undertaking. During the first phase of the project, it was established as a general purpose industrial pollution control Institute, with major emphasis on equipments for various types of pollution monitoring. BHEL, the parent organization, is the largest producer of electrostatic precipitators to control air pollution from thermal power stations. While basic industrial pollution control technologies and general expertise of environmental management are now currently available within PCRI what is urgently needed is further institutional strengthening so that PCRI can develop up-to-date specialized expertise of pollution control and environmental management in a selective few areas of concentration.

2. <u>Expected end of project situation</u>- Currently comprehensive and up-to-date pollution control technologies for

most industry is neither not known or not easily available in India. Equally, knowledge and experience are not available on how to design new industrial projects which minimize all forms of environmental degradation - air, water, solid waste and noise pollution, and land use - and in the process encourage maximum recycling of waste products so that they end up as being useful products having no disposal requirements. Information on clean or non-waste technologies are also not readily available.

Furthermore, considering the fact that the general knowledge on environmental issues in India is of relatively recent origin it is not surprising that much work has not been done on the impacts of industrial pollution on human and animal health as well as the biota. Furthermore, expertise on risk-impact analysis due to sudden, accidential releases of pollutants, as has happened in Bhopal, and in other areas to the environment is rather limited.

It is expected that by the end of this proposed institutional strengthening project, PCRI will develop adequate expertise, information base and full knowledge of cost effective alternatives available to reduce industrial pollution control from few select types of industry, starting from minimization of waste generation to how best to manage all forms of industrial wastes that have to be generated during the production processes. It is expected that the Institute will also develop the necessary expertise to forecast impacts in terms of dose-response relationships of the waste discharges on the human health and the environment. It would thus be able to analyse various industrial projects as to how best to reduce levels of waste discharges economically so as to have minimal adverse impacts on the

environment. Only when such expertise in the [illegible] relationship is available, society can make the knowledge [illegible] decide scientifically and rationally what levels of pollution [illegible] be acceptable for the long-term sustainable development of [illegible] country.

2. Target Beneficiaries- There will be many beneficiaries from the strengthening of the counterpart institution. Among th main beneficiaries would be the following:

i) By reducing industrial pollution [illegible] concentration, the project will significantly help those segment of population who are directly affected by pollution caused b such industrial activities. Since poor people are mostly located in and around the industrial areas, in the final analysi they would be one of the principal beneficiaries of the project

ii) By providing technology for reuse and recycling of waste products, the project would contribute simultaneously to both resource conservation and pollution reduction, or even elimination, and thus enable the country to maintain its resource base for long-term sustainable development.

iii) Provide the country with reliable and up-to-date information system and data base on pollution control technologies and environmental management methodologies which do not exist in India at present. This would greatly benefit the country's research and devlopment efforts by providing essential information on the subject.

iv) Central and State Governments would benefit directly by receiving advice on how best to control industrial pollution

cost-effectively, and this will contribute to [illegible] environmental clearances of industrial projects [illegible] implementation. This would substantially increase the overall benefits to industry, and by proxy to the country, by considerably reducing time delays and cost overruns, which otherwise may have occurred.

v) National and international organizations would benefi directly since they would be able to use the facilities of PCR to train people and solve problems from South Asia in specifi areas of industrial pollution control and environmenta management. Since it will not be essential to send people to b trained in advanced industrialized countries, the cost o training per trainee would be significantly less. This woul mean more people could be trained in the country for the sam amount of funds. The cost of resolution of technical problem would be equally less.

vi) The project would benefit India and other South Asia countries by the development of indigenous pollution contro technology as well as pollution monitoring equipments. It i expected that some of the equipments identified and developed b the project would be manufactured in India for use nationally a well as for export to neighbouring countries.

4. <u>Project Strategy</u>- As the Administrator of UNDP observe during his last visit to PCRI, currently no similar institut exists in India or for that matter in any other developin country that specializes in industrial pollution control an environmental management, a topic that now requires priorit

attention. Thus, increasingly sophisticated technologies, equipments and expertise are necessary to assess and control industrial pollution in the country.

Under the earlier assistance from UNDP, PCRI has managed to develop general expertise and acquired some equipments for industrial pollution measurements. What is now being envisaged under this new project is to transform the Institute to a "centre of excellence" on the subject, which would substantially benefit both India and other South Asian countries. Since PCRI is the only Institute of its kind in the South Asian region, which has the potential of being made into a centre of excellence, for environmental pollution control, strategically it makes very good sense to increase its capability. This would not only be the most cost-effective solution but also could be implemented much quicker than any other possible alternative.

5. Reasons for external assistance from UNDP- In order to transform PCRI to a major centre of pollution control and environmental management in the region, it is essential to obtain some external funds for bringing international experts who could spend significant periods of time at PCRI to transfer knowledge and to give "hands on" experience to the staff, to obtain some equipments which are not currently available in India but are essential for its future evelopment, to train some staff members abroad in specific areas of pollution control and environmental management that currently do not exist in the country and to develop an up-to-date library and information system.

The Executing Agency for this project could be UNDP-OPS UNDTCD or UNIDO. Each of these agencies has certain advantages

and disadvantages. The final choice should be on the basis of the Agency that is most flexible and would have long-term commitment to PCRI's development.

6. Special Considerations- The project merits several special considerations. First, it would directly address to pollution control and environmental management, and thus would contribute significantly to the sustainable development of the country. Second, it would facilitate good technical co-operation between developing countries by providing appropriate training facilities on pollution control and environmental management to professionals from India and other developing countries, by providing technical knowhow and consultancy services and by the presence of an up-to-date information base which could be used not only by PCRI staff but also by other professionals. Third, PCRI is already interacting with NGOs and the private sector. For example, one major environmental NGO is already represented in the Institute's Advisory Council. Equally, PCRI has worked closely with major international scientific and technical NGOs like International Association for Clean Technology, International Water Resources Association and International Society for Ecological Modelling. The Institute is already directly assisting the private sector as well as the public sector to resolve their industrial pollution control problems and overall environmental management planning.

7. Co-ordinating arrangements- PCRI is working closely with the Department of Environment and Forests, Ministry of Heavy Industry, Central and State Pollution Control Boards, State Electricity Boards, various United Nations agencies, private sector industry groups and undertakings and national and international

NGOs. Through these contacts, as well as formal and informal meetings, there is already considerable co-operation in the environmental sub-sector of the country. With the establishment of a functional Advisory Committee for PCRI, co-ordination and co-operation between major environmental and industrial pollution control organizations in India has been enhanced significantly. The Advisory Committee will continue to function during the institutional strengthening process and beyond.

8. Counterpart Support Agency- BHEL is one of the largest profitable public sector undertaking in India. It has made a commitment to the long-term future of the Pollution Control Research Institute, and has already made significant financial investments to make it functional. The financial capacity of BHEL to sustain the Institute during the proposed phase as well as after is beyond any doubt. The senior management of BHEL has taken considerable interest in the working of PCRI, and this is manifested by the fact that Director Technical of BHEL is chairing the Institute's Advisory Committee.

C. DEVELOPMENT OBJECTIVE

The main development objective of the project is to ensure that the environment and development objectives of the country are satisfied simultaneously. By ensuring that the environmental management factors are properly considered, it is likely that the unacceptable and unanticipated side-effects of economic growth could be minimized. Air, water, solid waste and noise pollution levels would be reduced significantly, land use practices could be enhanced and environmental management practices would be improved.

D. IMMEDIATE OBJECTIVES, OUTPUTS AND ACTIVITIES

1. Immediate objective - The project has one major immediate objective. This is to upgrade the present capacity of the Pollution Control Research Institute in order that it can carry out effective research and development projects on pollution control from industrial and other sources, provide expert advice on environmental management to public and private sectors as well as to international organizations, and serve as one of the principal repository of information and knowledge on different aspects of pollution control and environmental management in the country.

The project will have the following outputs :

1.1 Output 1

In the selected areas of concentration of PCRI, development of a well thought-out functional programme on R&D activities on pollution control and environmental management through human resource development.

1.1.1 Activity 1

Identification and purchase of equipment, from both outside and within India, to supplement the available equipments in order that good R&D work can be carried out at the Institute.

1.1.2 Activity 2

Review the equipment already available and determine how best to keep these equipments operational on a long-term basis, by ensuring non-operational equipments are functional through availability of spare parts, training of staff in how best to optimize the use of such equipments, long term service

contracts, existence of operating and service manuals in English, and developing a culture of preventive maintenance within the Institute.

1.1.3 Activity 3

Bring in experienced international experts and consultants to advise PCRI on how best to resolve specific pollution control and environmental management problems.

1.1.4 Activity 4

Arrange short-term and medium-term training of PCRI staff in appropriate subject areas both outside and inside the country.

1.1.5 Activity 5

Organize study tour of senior level staff members to see specific but advanced pollution control and environmental management techniques for possible use or adoption in the country, and to participate in major international technical meetings.

1.2 Output 2

Provide comprehensive and efficient advice to public and private sectors, central and state governments, and national and international organizations on pollution control and environmental management.

1.2.1 Activity 1

Carry out site specific environmental and technical studies on environmental impact assessment in order that projects [illegible] receive prompt environmental clearance from appropriate state and central agencies.

1.2.2 Activity 2

Investigate and monitor air, water, solid waste and noise pollution from existing or proposed projects to recommend cost-effective technological as well as environmental solutions for their reduction. This could include recommendations on alternative technologies, more and extensive use of clean and low-waste technology, and encouragement of waste recovery and reuse.

1.2.3 Activity 3

Advise state and central governments, international organizations and non-governmental organizations, on potential short-term and long-term impacts of human activities on the environment based on latest knowledge available. Such advice would be only knowledge-based, objective and impartial and not currently available in the country. Thus, governments and other appropriate bodies would be able to develop realistic policies based on such advice.

1.3 Output 3

Develop and/or adopt cost-effective pollution control technology and equipments that can be used in India and similar other developing countries.

1.3.1 Activity 1 - Identify, on the basis of R&D work carried out, the areas where new or modified pollution control technology are necessary and thus should be developed on a priority basis.

1.3.2 Activity 2 Develop pollution control technology, and determine their effectiveness through laboratory scale and/or pilot scale investigations. Once the technical problems are

resolved, and the alternatives developed are found to be economic, the Institute will promote their use through advisory services, manufacturing and/or other efforts.

1.3.3 Activity 3 - Develop new pollution measurement equipments or modify existing designs so that they could be indigenously manufactured in India.

1.4 Output 4

Increase the status of environmental and technological knowledge in the country in pollution control and environmental management.

1.4.1 Activity 1 - On the basis of knowledge gained and experiences obtained, provide dissemination of this information through periodic training courses and workshops on specific subjects, primarily in India but possibly in South Asia at the request of host governments and international organizations.

1.4.2 Activity 2 - Disseminate the knowledge available through internal reports, newsletters or journals, through technical books, articles in scholarly journals and presentation of papers at national or international conferences.

1.4.3 Activity 3 - Publish technical guidelines and training manuals of different aspects of pollution control and environmental management.

1.4.4 Activity 4 - Convene national and international conferences and seminars in important subject areas to facilitate technology transfer, knowledge dissemination and experience

exchange.

1.5 Output 5

Establish a functional library and information system for up-to-date pollution control and environmental management literature and data.

1.5.1 Activity 1 - Identify, order and catalogue relevant books, journals and reports in the areas of interest.

1.5.2 Activity 2 - Take necessary steps towards recognition of PCFI as a depository library for appropriate national and international organizations.

1.5.3 Activity 3 - Develop a computer-based environmental information system for use by both the PCFI staff members and other scientists in India.

E. INPUTS

UNIF inputs are required for:

1. experts to advise on various aspects of pollution control and environmental management;

2. provide training and fellowships to PCFI staff, and

3. obtaining necessary equipments including appropriate computers and computer software;

4. obtaining books, journals and other associated materials for the library and information system.

The total international staff requirements over the duration of the entire project is expected to be 84 man-months. This is shown in the budget estimates. The costs of expert visits include fees, travel expenses and daily subsistence allowance while on missions.

It is proposed that the Chief Technical Advisor (CTA) to the project will spend 6 months every year throughout the duration of recommendations, and then advise the NPD on the priority of the recommendations for implementation.

With respect to expert missions, the project would generally require good experts with working experience in developing countries and who are willing to make longer term commitments in terms of repeat missions to PCRI. The durations of expert missions to PCRI should be for one month or for longer periods. Any mission of less than 3 weeks should be discussed, and, if considered essential, must have the explict concurrence of both the NPD and the CTA. Unless for very exceptional circumstances, missions of 2 weeks or less by experts should not be considered.

Study tours and Fellowships - It is envisaged that a total of 100 man-months of study tours for senior staff members and fellowships for other engineers and scientists will be provided outside the country in important project areas. The total cost, which includes travel expenses, daily subsistence allowance and training costs by the host institutes, is estimated at $ 500,000.

Library and information system - The library and the information system of the Institute is very poorly developed at present, and even though it was expected to be a major output of the first phase of the project, poor project design and non-earmarking of funds have meant that this is the least fulfilled output of the first phase of the project. For the Institute to have the international potential envisaged by the present project, strengthening of the library and information system must receive priority attention. A total of $ 250,000 is proposed for

the strengthening of this area.

Equipments - There are two important aspects that would be considered in the project : First is the spare parts necessary to keep the equipments bought from outside India under the first phase operational. It is estimated that $ 400,000 will be needed for this purpose during the three year period 1990 - 1992.

Second aspects is the new equipments that are necessary in the priority areas of concentration of the Institute. It is proposed to purchase $ 700,000 worth of new equipments under the project. Details of the major equipments, including computers and software, are given in the Annexure.

Host Country Commitments

Following are the host country commitments -

i) Manpower

The project currently has 54 employees. It is proposed that by 1991, it will have a full strength of 111 employees.

The head of the Institute will be at the level of a General Manager. He would have two deputies reporting to him, one for Finance and Administration and the other for Research and Development. The deputy in charge of Research and Development must be a technically knowledgable individual in the area of pollution control and environmental management. The person would have some reputation in India in this field. The basic management structure of the Institute will be as follows:

The Institute will recruit on an urgent basis the following staff members:

- three experienced and technically competent

engineers/scientists, one of whom would be the Chief of the Research and Development Division, and the two others will be reporting directly to him;

- an instrumentation engineer, experienced and trained at maintaining and operating sophisticated and complex equipments;

- a trained librarian with experience in scientific libraries;

- an accounts officer; and

- a marketing officer.

ii) Equipments

Counterpart contributions will be used to purchase equipments necessary that are manufactured in India. This is shown in the Annex. For the indigenous equipments purchased earlier, the Institute would be responsible for their continued operation and maintenance.

iii) Infrastructure

In order to resolve the accommodation problem of CTA and visiting experts, the counterpart agency undertakes to build on an urgent basis, two suites at the Trishul Guest House, located within walking distance of the Institute. The suite for the CTA will consist of a bed room, living room bathroom and small kitchen. It will be furnished appropriately for long periods of stay, and for work during evenings and week-ends. Both the suites will be kept reserved for UNDP experts, and their allocation will rest exclusively with PCRI.

Part of the present Library will be partitioned and made into an air-conditioned reading room for use by the PCRI staff and visiting experts; and other appropriate professionals.

F. RISKS

Description of Risk	Estimated Likelihood
1. Factors which may at the outset cause major delays or prevent achievement of the project's outputs and objectives.	None
2. Factors which could over time cause major delays or prevent achievement of the project's outputs and objectives.	
i) Senior Management of BHEL, because of the overwhelming emphasis on production and due to personnel changes, may take little or no interest in PCRI. Lack of such high level interest would have an adverse impact on the institutional strengthening process. Both the MTD and the CTA must make a special effort to sustain the support of the top management. Thus, the choice of MTD and CTA would be absolutely crucial to the future success of the Institute.	Low
ii) Improper choice of international experts and backstopping officers by the Executing Agency. Since the number of good, experienced experts having developing country experience in this comparitively new area are somewhat limited, their selection and recruitment process must be planned properly in advance.	Low

G. PRIOR OBLIGATIONS AND PREREQUISITES

There are no prior obligations or prerequsities for this project.

H. PROJECT REVIEUS, REPORTING AND EVALUATION

(a) The project will be subject to tripartite review (joint review by representatives of the Government, Executing Agency and UNDP) at latest once every 12 months, the first such meeting to be held within the first 12 months of the start of full implementation. The National Project Co-ordinator and/or senior project officer of the United Nations Executing Agency shall prepare and submit to each tripartite review meeting a Project Performance Evaluation Report (PPER). Additional PPERs may be requested, if necessary, during the project.

(b) A project terminal report will be prepared for consideration at the terminal tripartite review meeting. It shall be prepared in draft sufficiently in advance to allow its circulation to local institutions, the Executing Agency and UNDP four months prior to the terminal tripartite review.

( ) The project shall be subject to evaluation in accordance with the policies and procedures established for this purpose by UNDP. The organization, terms of reference and timing will be decided after consultation between the parties to the project document, plus any associated United Nations agency.

I. LEGAL CONTEXT

1. This project document shall be the instrument referred to as such in Article I of the Standard Basic Assistance

Agreement between the Government of India and the United Nations Development Programme, signed by the parties on --------. The host country implementing agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the government co-operating agency described in that Agreement.

This project document shall be the instrument envisaged in the Supplemental Provisions to the Project Document, attached hereto. The host country implementing agency shall, for the purpose of the Supplemental Provisions to the Project Document, refer to the government co-operating agency described in the Supplemental Provisions.

2. The following types of revisions may be made to this project document with the signature of the UNDP resident representative only, provided he or she is assured that the other signatures of the project document have no objections to the proposed changes:

(a) Revisions in, or additions of, any of the annexes of the project;

(b) Revisions which do not involve significant changes in the immediate objectives, outputs or activities of a project, but are caused by the rearrangement of inputs already agreed to or by cost increase due to inflation; and

(c) Mandatory annual revisions which rephase the delivery of agreed project inputs or increased expert or other costs due to inflation or take into account agency expenditure flexibility.

PROJECT BUDGET COVERING UNDP CONTRIBUTIONS IN US DOLLARS

	TOTAL	1990	1991	1992
Fellowships	$500,000	$200,000	$200,000	$100,000
Equipments, including spareparts	$1,100,000	$450,000	$400,000	$250,000
Library & Information System	$350,000	$150,000	$150,000	$50,000
Experts	$909,000	$318,000	$333,000	$258,000
Miscellaenous	$45,000	$10,000	$25,000	$10,000
Total	$2,904,000	$1,128,000	$1,108,000	$668,000

Annexes

ANNEX I : Work Plan

To be provided after agreement on PFF.

ANNEX II : Schedule of Project Reviews, Reporting and Evaluation to be provided after agreement on PFF.

ANNEX III : Standard legal text for non-SBAA countries Not required.

ANNEX IV : Training Programme

To be provided after agreement on PFF.

ANNEX V : Equipment Requirements

To be provided after agreement on PFF. Primarily list already available. This will be shown to after UNIDO experts, and the list will then be finalized in consultation with CTA during his next visit.

PROJECT PERSONNEL	TOTAL m/m	TOTAL $	1990 m/m	1990 $	1991 m/m	1991 $	1992 m/m	1992 $
International professionals								
Chief Technical Advisor	18	216000	7	84000	6	72000	5	60000
Air Pollution Control	9	81000	4	36000	3	27000	2	18000
Water Pollution Control	6	54000	2	18000	2	18000	2	18000
Noise Pollution Control	3	27000	0	0	2	18000	1	9000
Hazardous Waste Management	3	27000	1	9000	1	9000	1	9000
Pollution Control Tech.& System Engg.	10	90000	4	36000	4	36000	2	18000
EIA Including Environmental Mgt	10	90000	3	27000	4	36000	3	27000
Mathematical Modelling	7	63000	3	27000	3	27000	1	9000
Pollution Monitoring & Control Instrumentation/equipments	11	99000	4	36000	4	36000	3	27000
Biotechnological Pollution Control	5	45000	2	18000	2	18000	1	9000
Ecosystems Analysis	3	27000	1	9000	1	9000	1	9000
Unspecified	10	90000	2	18000	3	27000	5	45000
Component Total	95	909000	33	318000	35	333000	27	258000

PROJECT BUDGET COVERING UNDP CONTRIBUTIONS IN US DOLLARS

	TOTAL	1990	1991	1992
Fellowships	$500,000	$200,000	$200,000	$100,000
Equipments, including spareparts	$1,100,000	$450,000	$400,000	$250,000
Library & Information System	$350,000	$150,000	$150,000	$50,000
Experts	$909,000	$318,000	$333,000	$258,000
Miscellaenous	$45,000	$10,000	$25,000	$10,000
Total	$2,904,000	$1,128,000	$1,108,000	$668,000

ANNEX VI

(1) Chief Technical Advisor

The Chief Technical Advisor will spend an average of six months each year during the life of the project. At least four months of this time each year will be spent at the Institute itself. Among his many duties will be to :

i) develop the strategy for the institutional strengthening;

ii) work out a medium-term work programme of the Institute;

iii) identify appropriate experts for missions to PCEI for recruitment by the Executing Agency;

iv) finalize suitable training programmes for the national staff in consultation with NID;

v) review equipment needs;

vi) select research and development projects;

vii) discuss the present activities and future development plans with the senior BHEL management, Government of India officials, and potential bilateral and multilateral donors and clients;

viii) review the mission reports of the international experts deputed to the Institute, and advise the NID on the validity as well as relative priorities of their recommendations;

ix) advise Institute staff on various technical aspects of pollution control and environmental management;

x) assist in the finalization of the terminal report and in project evaluation..

Qualifications and Experience -

Must have a doctorate degree in engineering, with extensive experience in pollution control and environmental management in both developed and developing countries. An international reputation on pollution control research will be an asset. Must have good contacts with bilateral and multilateral organizations to further promote the interests of the Institute. Must have excellent command of English.

2. Air Pollution Control Experts

Duties will include:

(i) review of the existing facilities available in the air pollution laboratory, and make recommendations for their improvement;

(ii) develop a realistic research and development programme on different aspects of air pollution on a priority basis,

(iii) provide information on air pollution control technologies, legislations and institutions;

(iv) assist in identifying and developing air pollution measurement equipments that could be manufactured indigenously;

(v) assist in the preparation of air pollution control project,

(vi) provide information on the impacts of various levels of air pollution on human health and biota; and

(vii) recommend training programme of PCRI staff abroad.

Qualifications and Experiences

Must have a degree in engineering with at least 10 years' of experience in air pollution control technologies. Doctorate degree will be desirable. Must be familiar with latest air pollution measurement techniques and equipments. Research and development experience on different aspects of air pollution will be an asset. Good working knowledge of English essential.

(3) Water Pollution Control Experts

Duties will include:

(i) review of the existing facilities available in the water pollution laboratory, and make recommendations for improvement;

(ii) develop a viable water pollution research and development programme that is in line with the Institute's aims and priorities;

(iii) provide specific data and information on various aspects of water pollution control technologies, equipments, and other associated aspects;

(iv) assist in identifying and designing water pollution control equipments for possible manufacturing in India.

(v) assist in developing specific water pollution control projects.

(vi) provide information on water quality criteria, and

impact of various types of water pollution on human health and biota; and

(vii) recommend suitable training programme for PCRI staff abroad.

Qualifications and Experiences

Must have a degree in engineering or in an appropriate water pollution control subject, and at least 10 years' of experience in water pollution control techniques and wastewater treatment technologies. A doctorate degree in water pollution will be desirable. Research and development experience on different aspects of water pollution will be an asset. Good working knowledge of English is essential.

4. Noise Pollution Control Experts

Duties will include :

(i) review the existing facilities available in the noise pollution research laboratory, and make recommendations on more effective use of equipments;

(ii) assist in developing a viable noise pollution control research and development that is in line with the Institute's primary objectives;

(iii) provide lectures and training to the appropriate Institute staff on different aspects of noise measurement and control;

(iv) assit in developing specific noise pollution control projects;

(v) provide information on noise control regulations and their implementation.

(vi) recommend suitable training programme for PCRI staff abroad

Qualifications and Experiences

Must have a degree in physics or engineering with at least 10 years' experience in noise pollution control. Doctorate degree will be preferred. Must be familiar with latest noise pollution control technologies and equipments, and noise regulations. Research and development experience on noise control will be an asset. Good working knowledge of English essential.

5 **Hazardous Waste Management Experts**

Duties will include :

(i) provide specific data and information on different ways of managing hazardous wastes;

(ii) Give lectures and training to appropriate PCRI staff in the area of hazardous wastes management ;

(iii) assist in the design and operation of a pilot scale incinerator for hazardous wastes disposal;

(iv) propose suitable training programmes for PCRI staff abroad.

Qualifications and Experiences

Must have a degree in engineering and at least 10 years' experience in hazardous wastes management, especially in the area of incinerator design and operation. Research and development experience in the subject area desirable. Good working knowledge of English is essential.