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(2) INDIA : APPROPRIATE AUTOMATION PROMOTION PROGRAMME .

DP/IND/82/034

INDIA

TECHNICAL REPORT



REVIEW OF THE APPROPRIATE AUTOMATION PROMOTION PROGRAMME
AND RELATED AUTOMATION DEVELOPMENT ACTIVITIES IN INDIA

Prepared by
Theodore J. Williams
Consultant, UNIDO

Based on a Visit to India
September 6-14, 1986

SUMMARY

The author visited India on September 6-14, 1986 at the invitation of the Department of Electronics of the Government of India (with the concurrence and support of the UNDP Staff in New Delhi and UNIDO) to take part in the International Seminar and Exhibition on Distributed Control held on September 10-12, 1986 in New Delhi. The undersigned presented one of the two Theme Addresses and a second technical paper at the Seminar.

He also visited the offices of the Steel Authority of India (SAIL) to discuss the results of the Summer Educational Program set up for participants in the INCOS Project (Integrated Control Systems for Steel Plants) of SAIL. Proposals were also discussed for a continuation of this educational program for 1987 and beyond.

OBJECTIVE

The major purpose of this visit to India on September 6-14, 1986 was to take part in the International Seminar and Exhibition on Distributed Control sponsored by the Department of Electronics of the Government of India and organized by its Appropriate Automation Promotion Programme. It was held on September 10-12, 1986 at the Pragati Maidan Exhibition Grounds in New Delhi. The author presented one of the two

Theme Addresses at the Seminar. The second was presented by Dr. N. Seshagiri, Additional Secretary of the Department of Electronics. The author also presented the first paper of the regular technical sessions. A copy of the Seminar Programme is presented in Appendix I.

The opportunity was also taken during this mission to visit the offices of the Steel Authority of India, Ltd. (SAIL) in New Delhi, which company is involved in the INCOS (Integrated Control System for Steel Plant) Project under the Appropriate Automation Promotion Programme (AAPP) sponsored through the Department of Electronics by UNIDO and UNDP for India. This visit was for the purpose of reviewing the results of the Summer Educational Program carried out by Purdue University for SAIL during the summer of 1986. A total of 27 engineers from SAIL, the Department of Electronics, and MECON (Metallurgical and Engineering Consultants (India) Limited) were trained in advanced control techniques, computer applications, mathematical modelling and simulation techniques to fit them for positions of importance in the INCOS Project. SAIL officials were very enthusiastic concerning the results of this first program and plan to continue it in 1987 and subsequent years. A copy of the outline of the educational program presented is enclosed as Appendix II. A list of the students who attended the Summer 1986 program is also included as Appendix III.

SAIL is still negotiating with French and United States companies for the position of Engineering Consultant Manager to the INCOS Project as it will be implemented at the Bhilai Steel Plant. This negotiation has been continuing for about nine months but is now in the final stages. Settlement of the identity of the Engineering Contractor company is vital for the INCOS Project to proceed. The difficulty has been one of getting the potential contractors to quote the same services in order to give the proposals a thorough and fair evaluation.

FINDINGS AND CONCLUSIONS

The International Seminar and Exhibition on Distributed Control was a very successful conference with approximately four hundred attendees from all parts of India and all types of industries. The exhibition, while small by western standards, contained several important exhibits of the latest state-of-the-art equipment in the field of distributed digital control systems with demonstrations and hands-on instructions in the use of the actual equipment. It had an enthusiastic attendance.

In addition to the author, papers were presented at this seminar by Drs. Thomas P. Stout and Irving Lefkowitz from the United States, by Dr. K. Mori of Japan, and by Professor D. Popovic of West Germany. The remaining twelve papers were

of Indian origin. They were well prepared and presented and of excellent technical quality.

This and similar programs on related topics should be presented regularly, not only in New Delhi but throughout India at each of its major cities.

The AAPP of the Department of Electronics of the Government of India has been sponsored by UNIDO and the UNDP for India since May of 1982. Its contract is due to expire in May 1987 unless extended. It is my understanding that the Department of Electronics plans to submit a proposal for such an extension.

The AAPP has had a profound effect upon the concept of and acceptance of automation by Indian industry. Its several projects and its many conferences (like the International Seminar and Exhibition on Distributed Control) have reached many Indian engineers and managers and helped convince them of the value of automation for their company and their industry.

By far the most important accomplishment of the AAPP has been the establishment of the INCOS Project and its acceptance by SAIL. This program, which is initially funded at 204 crores of rupees and will get much larger before completion will automate each of the major steel mills of SAIL beginning with the Bhilai Plant. It has captured the attention not only of all Indian industry but the steel and process control industries of the world as well. This

project alone has already changed the face of automation in India by the attention it has focused on this technology.

It is very strongly recommended that the AAPP program be extended for a period of two years with the following additional funding provisions:

1. Training for Indian engineering personnel abroad to the extent of 50 man months total, i.e., eight personnel at 3 man months each per year.
2. Provision to invite additional experts from abroad to the extent of 20 man months total for the two years.
3. A limited but well defined hardware/software system such as a LISP Machine to initiate projects in the artificial intelligence/expert systems research area and their specific applications in industry. Cost of the system would be about \$200,000.00 US.

The above described project, in addition to all presently sanctioned funds, would allow the AAPP to be sure that INCOS and its other projects are all on a sound footing before its conclusion.

Support of the AAPP by the United Nations is of immeasurable help to the Indian Government in its automation

efforts since it allows them to access foreign experts and foreign facilities with a minimum of formalities and of hesitation on the part of the donors of the experts and/or expertise as compared to the Indian Government requesting these services on its own. This has been especially evident in the INCOS project where so much has been achieved in the very short time of less than two years. The presence of the United Nations as a partner and sponsor sanctioned much of the INCOS discussions in the minds of foreign companies and individuals.

It is thus very important that the UN sponsorship continue for the immediate future until the INCOS Project and other AAPP projects are well on their way to completion. The two year period mentioned above appears sufficient for this at this time.

RECOMMENDATIONS

Based on the above observations the following recommendations are made to help the UNIDO and UNDP staffs in their continuing evaluation of the AAPP programme and its accomplishments.

1. The current contract of UNIDO with the Department of Electronics of the Government of India for the sponsorship of the AAPP is due to expire in May

1987. It is understood that a proposal for renewal will be made in the near future. It is very strongly recommended that this proposal be accepted and that the AAPP be continued for the immediate future. This acceptance should include the provisions for additional training and for the initiation of research in artificial intelligence/expert systems listed earlier in this report.

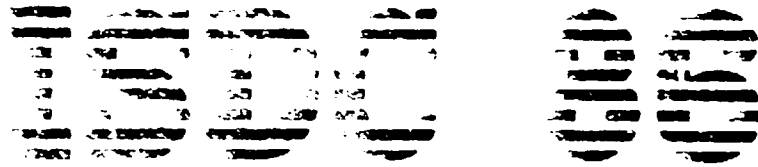
2. The INCOS Project is the crown jewel of the program of the AAPP. It should continue to be included in any future extension of the AAPP project. While the proportion of UN funds involved in INCOS is small, UN sponsorship through AAPP provides several important advantages for INCOS.

- a. The AAPP project provides funds and contacts by which foreign experts with experience and expertise in steel industry projects can be induced to come to India to help AAPP and INCOS. UN sponsorship provides the extra credibility necessary to get these individuals to come to India to offer their services.

- b. As just noted UN sponsorship provides considerable additional credibility for foreign computer system equipment and services vendors to want to get involved in the INCOS Project. This has been very evident in past contacts and will continue as long as UN sponsorship continues or as soon as the INCOS Project is accepted internationally in its own right.

3. AAPP personnel should be encouraged to present other seminars and conferences like the International Seminar and Exhibition on Distributed Control not only in New Delhi but also in other important industrial centers of India.

APPENDIX I



INTERNATIONAL SEMINAR & EXHIBITION
ON
DISTRIBUTED CONTROL

10-12 SEPTEMBER, 1986

NEW DELHI
INDIA

P R O G R A M M E

Organised by

Government of India
Appropriate Automation Promotion Programme
Department of Electronics
New Delhi
India

APPENDIX I (Cont.)

10 SEPTEMBER 1986

Time	Programme	
10:00-11:30	INAUGURATION OF SEMINAR & EXHIBITION	Shri Shivraj V. Patil Hon'ble Minister of State for Science & Technology INDIA
12:00-13:45	THEMES SESSION	
	1. "Distributed, Digital- Computer Based, Industrial Control Systems in the Western World & Japan— A Status Report"	Prof. T.J. Williams Purdue University, USA
	2. "DDC—A Developing Country Perspective"	Dr. N. Seshagiri Additional Secretary, Department of Electronics, INDIA
13:45-14:30	LUNCH	
14:30-17:30	SESSION - I : STEEL INDUSTRY Chairman	Shri V. Krishnamurthy, Chairman, Steel Authority of India Ltd., INDIA
	Coordinator	Shri G.S. Varadan Department of Electronics, INDIA
	1. "Use of On-line Process Models in DDC"	Prof. T.J. Williams Purdue University, USA
	2. "Integrated Control System for Bhilai Steel Plant"	Shri N. Subrahmanyam, R.K. Saigal, Bhilai Steel Plant & G.S. Varadan, Department of Electronics, INDIA
	3. "Distributed Control System in Japanese Steel Industries"	Dr. K. Mori Kobe Steel, JAPAN.

APPENDIX I (Cont.)

11 SEPTEMBER 1986

09:00-12:00

SESSION-II: POWER INDUSTRY

Chairman

Dr. Tata Rao, Chairman, Andhra Pradesh State Electricity Board, INDIA

Coordinator

Shri M.S. Vasudeva, Department of Electronics, INDIA

1. "Advanced Control for Industrial Utility Systems"

Prof. Thomas P. Stout, Profimatics Inc., USA

2. "DDC Architecture for a Thermal Power Plant"

Shri P. Purakayastha, DESEIN, INDIA

3. "An Overview of Applications of DDC Systems for Thermal Power Plants"

Shri V.S. Dorai, B.H. Bhate, T. Ullal, Tata Electric Company, INDIA

12:00-13:30

SESSION-III: CEMENT INDUSTRY

Chairman

Shri A.V. Rijhsinghani, Director (Projects) Cement Corporation of India Ltd., INDIA

Coordinator

Shri A.K. Chopra, Department Electronics, INDIA

1. "Automation and DDC in Cement Industry"

Shri S.K. Sahani, Cement Corporation of India Ltd., INDIA

2. Plant Automations through DDC System"

Shri S.V. Nagaraja, Madras Cements, INDIA

13:30-14:15

LUNCH

14:15-17:30

SESSION-IV: CHEMICALS, FERTILIZERS & REFINERIES

Chairman

Dr. S. Varadarajan, Chief Consultant, Planning Commission, INDIA

Coordinator

Shri M.R. Rajagopalan, Department of Electronics, INDIA

1. "Integrated Control of Industrial Systems"

Prof. I. Lefkowitz, Case Western Reserve University, USA

2. "Distributed Digital Control Systems in the Fertilizer Industry"

Shri C.D. Amudachari, Shri K.P. Sharma, Projects & Development India Ltd., INDIA

3. "Experience of DDC at Madras Refineries Ltd."

Shri B.V. Gopalkrishna, Madras Refineries INDIA

APPENDIX I (Contd.)

12 SEPTEMBER 1986

09:00-11:30

SESSION - V : TECHNOLOGY TRENDS & NEW APPLICATION AREAS

- | | |
|---|--|
| Chairman | Prof. V. Rajaraman
Indian Institute of Science, INDIA |
| Coordinator | Shri G.S. Varadan
Department of Electronics, INDIA |
| 1. "Concepts in Data Transmission in DDC" | Prof. D. Popovic
University of Bremen FRG |
| 2. "Artificial Intelligence Applications in Process Control." | Dr. V.P. Bhatkar, Director, Electronics Research & Development Centre, INDIA |
| 3. "Automation in Textile Industries" | Dr. T. Radhakrishnan, Ahmedabad Textile Industry Research Association, Shri H.S. Mazumdar, Physical Research Laboratory, INDIA |
| 4. "Some Aspects of Control in the Textile Industry." | Prof. P. Grosberg, C. Iype and I. Porat, University of Leeds, U.K. |
| 5. "Computers and Process Control-Standardisation Efforts." | N. Srinivasan
Indian Standards Institution, INDIA |

11:30-11:45

TEA

11:45-13:30

POSTER SESSION

- | | |
|-------------|---|
| Chairman | Dr. G.N. Acharya, Director, Central Electronics Engineering Research Institute, INDIA |
| Coordinator | Shri M.R. Rajagopalan,
Department of Electronics, INDIA |

14:30-17:00

PANEL DISCUSSION

- | | |
|----------|--|
| | "An Approach To Industrial Automation - Role of New Technologies & DDC" |
| Chairman | Shri V. Krishnamurthy, Chairman, Steel Authority, of India Ltd. |
| Panel: | <ol style="list-style-type: none">1. Dr. N. Seshagiri, Department of Electronics, INDIA2. Shri K.R. Sangameswaran, Bhilai Steel Plant, INDIA3. Shri M.L. Shishoo, National Thermal Power Corporation, INDIA4. Shri K.R. Paramesvar, Indian Standards Institution, INDIA5. Dr. G.N. Acharya, Central Electronics Engineering Research Institute, INDIA6. Prof. V.S. Rajamani, Indian Institute of Technology, INDIA7. Prof. D. Popovic, University of Bremen, FRG |

APPENDIX II (Cont.)

WORK STATEMENT

HIERARCHICAL COMPUTER CONTROL FOR THE
STEEL INDUSTRY

Purdue University, through its Schools of Engineering, proposes to present the second year of the summer educational program on the above topic developed for the Steel Authority of India (Limited). This program will be updated based on information learned from presentation of the first program in Summer 1986.

The educational program will consist of five major graduate-level courses and a computer system short course as outlined in Table I. These courses will be presented during the thirteen week period from May 15-August 14, 1987. The class schedule of Table II and Figure 1 will be used. This educational program can continue to be repeated in succeeding summer periods if desired by the Government of India.

While all courses presented will be of graduate level (post graduate) quality this will be a certificate program instead of a degree program since the usual academic requirements for student selection, thesis assignment, etc., will not be available to the Purdue University faculty.

Included in this proposal for the second year of the above educational program will be an abbreviated developmental period to allow the Purdue University faculty

APPENDIX II (Cont.)

to modify the necessary course materials to take advantage of factors in student's backgrounds, etc., learned from the 1986 program.

This program will be under the overall direction of the Purdue Laboratory for Applied Industrial Control of the Schools of Engineering and of the Continuing Education Administration of Purdue University with the cooperation of the individual Schools of Engineering of the University.

APPENDIX II (Cont.)

TABLE I

DESCRIPTION OF THE GRADUATE-LEVEL COURSES
TO BE PRESENTED BY PURDUE UNIVERSITY AS PART OF
THE INSTRUCTIONAL PROGRAM ON
HIERARCHICAL COMPUTER CONTROL FOR THE STEEL INDUSTRY

A. Course Number 1. Production Scheduling and Production Optimization in the Steel Industry

This course will cover the topics of plant production scheduling and production optimization as carried out in the upper levels of a hierarchical computer control system. The findings of the Purdue University study on Systems Engineering of Hierarchical Computer Control Systems for Large Industrial Steel Manufacturing Complexes will form the basis for much of this course. Also covered will be the requirements for plant data bases and the modelling of overall production systems as used in production scheduling studies.

The course will be presented by Professors Colin L. Moodie and Joseph J. Talavage of the School of Industrial Engineering of Purdue University.

APPENDIX II (Cont.)

B. Course Number 2, Advanced Process Control

This course will use the major IBM Process Control Simulation Laboratory in the School of Chemical Engineering at Purdue University. This will allow the simulation of the operation of modern distributed computer control systems with advanced control topics included.

Professor Henry C. Lim of the School of Chemical Engineering of Purdue University will present this course.

C. Course Number 3, Microprocessors and Communications Systems for Process Control

This course will make the students familiar with the use and capabilities of microprocessors as used in modern, distributed computer control systems. Likewise the use of such devices as part of recent bit-serial, data-highway systems will be covered. A major topic will be the developing industry standards in this area and their applicability to overall plant-wide control. The knowledge required of the development manager of such a system will be emphasized.

APPENDIX II (Cont)

This course will be presented by Professor Frederic J. Mowle of the School of Electrical Engineering of Purdue University

D. Course Number 4, Mathematical Modelling and Simulation of Steel Industry Processes

This course will cover the development of plant process mathematical models, both first principle and empirical. The use of plant data in model derivation, model parameter determination, and model proof testing will be covered. Model sensitivity analysis and its use in the reduction of required model complexity will be treated.

A major part of this course will be the use of the above models as part of a process simulation based control system and their use in helping develop other process control systems.

Professor Theodore J. Williams, Director, Purdue Laboratory for Applied Industrial Control, Purdue University, will present this course.

APPENDIX II (Cont.)

E. Course Number 5, State-of-the-Art of Advanced Control and Optimization in Industrial Plants

A series of full-day seminars on state-of-the-art advances in steel industry process control topics and the latest control equipment available for such tasks. These seminars will be presented by industrial speakers from a wide variety of user and vendor companies in the steel plant process control field.

The seminars will be under the overall direction of Professor Theodore J. Williams, Director, Purdue Laboratory for Applied Industrial Control, Purdue University.

F. Course Number 6, An Introduction to Purdue's Computer Systems

A short course presented early in the program to bring course participants up-to-speed quickly in the use of Purdue University's computer system and the FORTRAN language used here.

This course will be presented by members of the Computer Science Department, School of Science, Purdue University.

APPENDIX II (Cont)

TABLE II

PROPOSED CLASS SCHEDULE - 1987 SESSION
THE INSTRUCTIONAL PROGRAM ON
HIERARCHICAL COMPUTER CONTROL FOR THE STEEL INDUSTRY

The Instructional Program will be presented over the thirteen week period of May 15-August 17, 1987. It will be organized into two, six-week sessions (May 15-June 26 and July 6-August 14) with a one week break in between. The class schedule of Figure 1 will be used with Courses 3 and 4 being presented during the first period on Mondays, Tuesdays, Thursdays, and Fridays. Courses 2 and 3 will be presented similarly during the second period. Course Number 5 will be presented as an all-day seminar each Wednesday during the overall instructional period.

The computer systems short course will be presented as an evening course early in the program.

The break period from June 27 to July 5 will be devoted to a technical excursion trip to allow the students to visit important commercial and governmental companies and installations of the computer control field. Such an excursion will give the students a much needed break from the rigors of the classroom schedule of the first half of the program and, in addition, add valuable technical knowledge and experience to their backgrounds.

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
09:00					
10:00					
11:00					
12:00					
01:00	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
02:00					
03:00					
04:00					

COURSE NUMBER 1 OR 2 (Monday 10:00-12:00, Tuesday 10:00-12:00)
 COURSE NUMBER 3 OR 4 (Monday 12:00-02:00, Tuesday 12:00-02:00)
 COURSE NUMBER 5 STATE-OF-THE-ART CONTROL AND IN INDUSTRIAL (Wednesday 09:00-12:00, Wednesday 02:00-04:00)
 COURSE NUMBER 1 OR 2 (Thursday 09:00-12:00, Thursday 02:00-04:00)
 COURSE NUMBER 3 OR 4 (Friday 09:00-12:00, Friday 02:00-04:00)

FIGURE 1

SCHEDULE OF PRESENTATION OF COURSES IN THE PROGRAM
HIERARCHICAL COMPUTER CONTROL FOR THE STEEL INDUSTRY

APPENDIX III

INCOS TRAINEES AT PURDUE

<u>NAME</u>	<u>OFFICE ADDRESS</u>	<u>RESIDENCE ADDRESS</u>
1. Mr. A. Balasubramanian	Dy. Mgr. (MM) Co. & BPP B.S.P., Bhilai, INDIA	1-B Street 4-B Sector -9 Bhilai - 490009 INDIA
2. Mr. N. B. Dhote	Dy. Mgr. 4th Floor Ispat Bhavan B.E.D.B. Bhilai, INDIA	2B/35/IX Bhilai 490006 INDIA
3. Mr. K. K. Singhal	- Dy. Mgr 507, Ispat Bhavan Automation and Computerisation B.S.P, Bhilai, INDIA	14-A, Street-4 Sector - 10 Bhilai, INDIA
4. Mr. Bipin Sharma	Dy. Mgr. INCOS (BEDB) R.N. 516, 5th Floor ISPAT, Bhavan B.S.P. Bhilai, INDIA	14D/4/10 Bhilai, INDIA
5. Mr. Santosh Singh	Dy. Mgr. INCOS Room No. 513 Ispat Bhavan B.S.P. Bhilai, INDIA	6B/71/VI Bhilai-Nager(M.P), 490006 INDIA
6. Mr. A. G. Vaidya	Dy. Mgr. (Inst.) R & C Lab. B.S.P. Bhilai Nagar, 490001 INDIA	2F, Street 54 Sector - 8 Bhilai, Nagar, 490006 INDIA

APPENDIX III (Cont.)

<u>NAME</u>	<u>OFFICE ADDRESS</u>	<u>RESIDENCE ADDRESS</u>
7. Mr. N. L. Puri	Asst. Mgr. c/o Supdt. Rail and Structural Mill (E) B.S.P., Bhilai, INDIA	4-C/Hospital Sector Bhilai, INDIA
8. Mr. K. Maruti Ram	Asst. Mgr. B.E.D.B. ISPAT Bhavan 4th Floor B.S.P. Bhilai, INDIA	75 Old M.O.M. Sector - 4 Bhilai, 490001 INDIA
9. Mr. A. P. Barnwal	Asst. Mgr. (E) Ore Handling Plant Bhilai Steel Plant Bhilai, INDIA	8 G/Russian Block Sector - 6 Bhilai, INDIA
10. Mr. A. K. Kundu	Development Technologist Tech. Dev. Dept. B.S. P. ^{Room # 540, Ispat Bhavan} Bhilai, (M.P.) INDIA	38, New M.O.H. Sector - 4 Bhilai, 490001 (M.P.) INDIA
11. Mr. V. Ravi	Asst. Mgr. Automation and Computerisation 507, Ispat Bhavan Bhilai Steel Plant Bhilai, INDIA	6Q Russian Block Street 38 Sector - 6 Bhilai, 490006 (M.P.) INDIA
12. Mr. A. B. Arnold	Asst. Mgr. Instrumentation Operator R & C Lab. B.S.P. Bhilai, INDIA	4B/24, Sector - 1 Bhilai, 490001 INDIA
13. Mr. C. Bhaskar	Management Trainee (Tech) 507, Automation and Computerisation Ispat Bhavan B.S.P. Bhilai, INDIA	3B, Street 35 Sector - 9 Bhilai, 490009 INDIA

APPENDIX III (Contd.)

<u>NAME</u>	<u>OFFICE ADDRESS</u>	<u>RESIDENCE ADDRESS</u>
14. Mr. G. Bandhu	Management Trainee (Tech) 513, INCOS Ispat Bhavan B.S.P. Bhilai, INDIA	Room No. 90/3 Management Trainee Hostel B.S.P. Bhilai, INDIA
15. Mr. V-Vijay Kumar	Junior Manager Instrument Dept. B.S.P. Bhilai, INDIA	c/o Instrumentation Dept, R & C Lab Bhilai, 490001, INDIA
16. Mr. K. Sankarasubramanian	Junior Manager Room No. C-30 Computer Centre (EDP) Ispat Bhavan Bhilai, INDIA	112 Maroda Sector Bhilai, (MP) 490006 INDIA
17. Mr. K. S. Chandra	Manager CET, SAIL Express Building Bahadur Shah Zafar Marg New Delhi, 110002 INDIA	D-1st - 195 Lajpat Nagar - 1 New Delhi, 110024 INDIA
18. Mr. P. S. Mukharjee	Management Trainee (Tech) c/o V.S. Ramanadham B.T.I. B.S.P. Bhilai, INDIA	Hostel - 3 Sector - 3 Bhilai, 490001 INDIA
19. Mr. C. P. Rao	Management Trainee (Tech) 2nd Floor Indian Express Bldg. Bahadur Shah Zafar Marg New Delhi, INDIA	Room No. 76, Hostel - 3, Sector - 3 Bhilai, 490001, (M.P.) INDIA

APPENDIX III (CONT.)

<u>NAME</u>	<u>OFFICE ADDRESS</u>	<u>RESIDENCE ADDRESS</u>
20. Mr. S. C. Majumdar	Manager INCOS Rourkela Steel Plant Rourkela, INDIA	C/22. Sector - 3 Rourkela, 769002, INDIA
21. Mr. S. K. Chawda	Asst. Mgr. PCCD/INCOS Rourkela Steel Plant INDIA	H-71, Sector - 2 Rourkela, 769002, INDIA
22. Mr. M. K. Gupta	Asst. Mgr H.S.M. (E)/INCOS Rourkela Steel Plant Rourkela, INDIA	52, Hill View Sector - 4 Rourkela, 769002 INDIA
23. Mr. P. C. Chaturvedi	Dy. Mgr. Instrument (Opr) R & C Lab. Bldg. Bokaro Steel Plant B.S. City, Dhambad, INDIA	2108 Street - 12 Sector - IX B B-S, City Dhambad, INDIA
24. Mr. U. R. Vadavi	Dy. Mgr. SMS (Opr) B.S.L. B.S. City, Dhambad, INDIA	3212 Sector - XII C Bokaro Steel City Dhambad, INDIA
25. Mr. S. K. Roy	Electronics Comm. A.A.P.L. 4th Floor CGO Complex A. Block, Lodhi Rd. New Delhi, INDIA	G/102. DDA Flat Madan Gir New Delhi, 62, INDIA

APPENDIX III (Cont.)

<u>NAME</u>	<u>OFFICE ADDRESS</u>	<u>RESIDENCE ADDRESS</u>
26. Mr. Pardeep Chopra	Electronics Comm. A.A.P.L. 4th Floor CGO Complex A. Block, Lodhi Rd. New Delhi, INDIA	F - 154 Nanak Pura Moti Bagh New Delhi, INDIA
27. Mr. L. R. Singh	A.E.M. (System) MECON Ranchi, INDIA	Tripathi Colony Behind SBI Doranda Ranchi, 834002 INDIA