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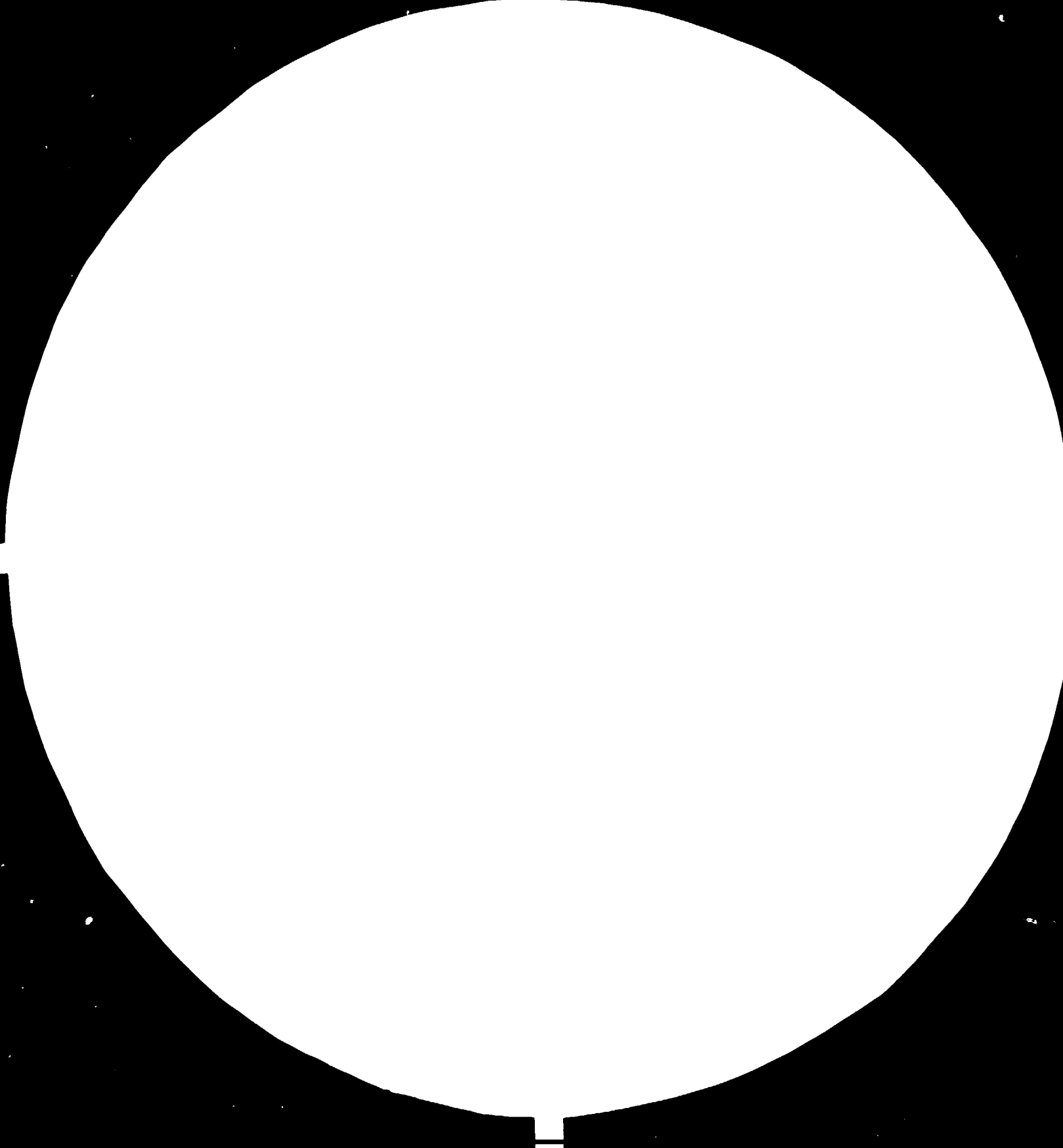
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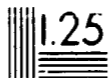
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STANDARDIZATION, QUALITY CONTROL AND QUALITY CERTIFICATION

IN THE IRON AND STEEL INDUSTRY

BRAZIL

Final Report

Prepared by
Dr. B. N. Singh
UNIDO Expert on
Statistical Quality Control

1. INTRODUCTION

- 1.1. As iron and steel are essential basic raw materials for the extensive all round development of Brazil, the national plans of Brazil had laid great stress on the development of iron and steel industry.
- 1.2. The UNIDO Project BRA/75/003 had been started in 1977 with a view to assisting the National Institute of Metrology, Standardization and Industrial Quality (INMETRO) and the Government in the development of standards, quality control and quality certification of iron and steel, thereby leading to proper utilization of these basic raw materials.
- 1.3. The Expert on Statistical Quality Control had been appointed in March 1982 with a view to assisting the Project in development of quality control and was, according to the Job Description, expected to:
- (1) Assist in the development of national standards in the field of quality control;
 - (2) Design sampling clauses in product standards;
 - (3) Promote statistical quality control concepts in the iron and steel industry;
 - (4) Establish and implement training programmes for the above.
- 1.4. After his arrival in Rio de Janeiro, the Expert had prepared a Preliminary Report (01/628/82) setting out the work plan on the basis of his job description and his discussions with the Project Manager for the development of quality

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control. The work plan as given in 1.4.1 covered three important facets of work, namely standardization, training and technical assistance to industry.

1.4.1. Work Plan

1. Assessment of the status of standardization in the field of quality control in Brazil.
2. Review of the existing ABNT standards on quality control and identification of priorities for preparation of quality control standards needed in the country.
3. Preparation of draft standards on priority subjects.
4. Review of the statistical concepts and sampling plans in the metal standards .
5. Review of the structure of the existing technical commissions and sub-committees and suggestions for their reorganization.
6. Participation in meetings of technical commissions and sub-committees.
7. Promotion of Brazilian participation in ISO work.
8. Training of INMETRO personnel.
9. Training and technical assistance to industry in statistical quality control.

2. INTERIM REPORT

2.1. The plan of work as set out in the aforesaid Preliminary Report had been reviewed and an Interim Report (17/709/82) prepared at the end of nine months.

3. WORK ACCOMPLISHED

3.1. Status of national standardization in quality control

3.1.1. The status of national standardization in quality control had been examined. It was found that Associação Brasileira de Normas Técnicas (ABNT) had published only seven standards on sampling inspection (05/638/82). However, these standards are concerned with only one aspect of sampling inspection, namely, of ascertaining the conformity of the products to specifications, thereby either accepting or rejecting a lot. The other aspect, namely, of estimating the average quality of a lot of products or of a process manufacturing the products has not been considered.

3.1.2. Besides, sampling inspection is only one part of quality control. It is also highly important and imperative to apply quality control during production so as to prevent the manufacture of defective products, thereby ensuring production at most satisfactory and economic levels.

3.1.3. It is also important to lay down methods for evolving satisfactory and realistic specifications and tolerances based on manufacturing capabilities of the industries .

3.1.6. Accordingly, the priorities for the preparation of Brazilian standards on quality control had been identified.

3.2. Preparation of basic draft standards

3.2.1. The following basic draft standards on quality control on priority subjects have been prepared:

(a) Control chart method for controlling quality during production - Part I Control Charts for variables.

(b) Control chart method for controlling quality during production - Part II Control charts for attributes and count of defects.

(c) Method for statistical determination of specification limits and tolerances.

(d) Guide on precision of test methods.

(e) Methods for determination of sample size to estimate the average quality of a lot or manufacturing process.

3.2.2. These standards, when properly processed and published, would greatly help the industries in proper and quicker adoption and development of quality control.

3.3. Sampling methods in metal standards

3.3.1. ABNT had issued up to 31 July 1982 360 standards on different kinds of metals and metal products. Out of these standards, 179 or about 50 percent

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are specifications. These specifications prescribe the requirements for the quality of various products.

- 3.3.2. The sampling plans and statistical concepts in various metal standards had been examined, an analysis made and comments given with regard to the weaknesses of these sampling plans (16/708/82). It has been suggested that the sampling methods in various metal specifications have to be considerably improved in accordance with the statistical requirements and practical considerations so as to provide the necessary quality assurance and economy.
- 3.3.3. In case of similar and important products like steel pipes, tubes and fittings, separate standards on sampling may be prepared so as to facilitate a more comprehensive, quick and effective review and processing of the sampling methods.
- 3.3.4. In case of separate standards on sampling, certain guidelines for process control may also be given so as to reduce the quality fluctuations and the number of tests required, thereby making the inspection and testing more economical. Such an approach would also greatly help in promoting wide-spread and rapid adoption of quality control by the industries concerned.
- 3.3.5. With this end in view, the Draft Standard on Methods for sampling of steel pipes, tubes and fittings has been prepared (11/660/82), which would serve as a guide for preparation of more such standards on sampling of different types of metal products.

- 3.4. Creation of new technical committees
- 3.4.1. Committee on Quality Control and Industrial Statistics - At present there is no specific committee to properly process the quality control standards (see 3.2.1.) prepared by the Expert or to deal with the work of Technical Committee 69 Application of statistical methods (ISO/TC 69) of the International Organization for Standardization (ISO). Besides, ABNT is a participating (P) member of only TC 69 and only one of its 6 subcommittees.
- 3.4.1.1. Hence a proposal has been made that ABNT should immediately set up a new committee on Quality Control and Industrial Statistics to deal with the ISO/TC 69 work as also to properly and expeditiously process the quality control and statistical standards (21/720/83). Besides, the new committee can also advise the other ABNT committees in matters concerning the application of statistical methods in standardization. It has also been suggested that Brazil should also become P - member of the five other subcommittees of ISO/TC 69. As a result, Brazil would not only be kept informed of the progress of their work but it can also actively participate and contribute to the furtherance of their work.
- 3.4.2. Subcommittee on Sampling Methods under CB1 (Comitê Brasileiro de Mineração e Metalurgia). It has also been suggested that a new subcommittee on sampling methods should be set up under CB1 to prepare and process the sampling standards on products covered by CB1 (see also 3.3.2 to 3.3.5.)

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Besides, this subcommittee would also be competent to advise other committees and technical commissions of CB-1 with regard to statistical matters in general and sampling methods in particular.

3.5. Technical Assistance in Quality Control

3.5.1. Assistance to Companhia Siderurgica Nacional (CSN), Volta Redonda - During his visits to CSN, the Expert found that the variations were rather large and that the scraps and other non-conformities were on the higher side. Accordingly, he gave talks to the engineers and technologists of CSN on control charts, process capability and modified control charts explaining as to how quality control can be applied during production so as to prevent the manufacture of defective products. He had also visited certain departments and had discussions with their chiefs and other officers. He gave his guidelines for improving their quality and reducing their rejections and scraps by installing appropriate types of control charts for different processes at different stages of production and taking corrective measures when necessary. It was further suggested to put the control charts on the computers also with a proper coordination and feed back system. Thus, in CSN, quality control will work both on the processes and the computers to their great benefit.

3.5.1.1. Mention may be made here of the problem of excessive amount of overcoating of zinc in the Steel Finishing and Galvanizing Department of CSN. As a result of the suggestions and quality

improvement, CSN would be saving about 7% of zinc in its consumption of zinc. This would amount to a saving of about 227 million cruzeiros per year. In terms of dollars, the savings would be about 0.9 million dollars per year (20/713/83).

3.5.2. Assistance to Fundação Tecnológico de Minas Gerais (CETEC), Belo Horizonte - During his visit to CETEC at their request, the Expert found that CETEC had problems of both quality control and standardization including precision of test methods. He had a number of round table meetings with the various departmental heads and their officers. They had put forward their problems and difficulties and sought his guidelines which he duly gave to their satisfaction. The Director of CETEC had said that he would duly implement the various suggestions and guidelines which would greatly improve the quality control and other functions of CETEC as also their technical assistance to industries.

3.5.2.1. It may be mentioned that the CETEC request for assistance had arisen as a result of the enthusiasm and interest generated in the Belo Horizonte SQC training programme (see 3.6.2) in which their officers had participated.

3.6. Training Programmes in Quality Control

3.6.1. QC Training Programme for INMETRO Personnel - The Expert had conducted a comprehensive quality control training programme for the

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benefit of INMETRO personnel with a view to providing to them detailed training in principles and techniques of quality control with particular emphasis on standardization. 15 engineers and technologists had participated in the training programme (see also Appendix A). The programme would help them in writing more rational and realistic standards based on the manufacturing capabilities in the country as also in evolving more sound and economic sampling plans suited to individual product specifications. It would also create a nucleus of quality control personnel who can assist in the organization of quality control activities in the country. The Programme outline is given in Appendix B.

- 3.6.1.1. In the training programme, the Expert had brought out and emphasized the integrated approach to quality control and standardization so as to achieve the requisite quality and economy by formulating realistic specifications. The integrated approach would give valuable guidance to the manufacturers and enable their production at the most satisfactory and economic levels. It would also furnish high quality assurance to the consumers and provide them with good quality and more economical products.
- 3.6.2. SQC Training Programme for industry - The Expert had also conducted a training programme in statistical quality control which had been organized by the Instituto Brasileiro de Qualidade Nuclear (IBQN) and Centro de Desenvolvimento de Tecnologia Nuclear (CDTN), Nuclebrás for the benefit of the industry

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at Belo Horizonte. A CDTN officer was the other member of the faculty. 15 participants from different sectors of industries had participated in the training programme (see also Appendix A). An evaluation test had been held at the end of the training programme. The Programme outline is given in Appendix C.

- 3.6.3. SQC Training Programme for IBQN personnel - The Expert had also conducted a training programme in statistical quality control for the benefit of the engineers and technologists of IBQN at Rio de Janeiro. 20 trainees had participated in the training programme (see also Appendix A). At the end of the programme, an evaluation test had been done. The programme outline was the same as given in Appendix C. It may be mentioned that the IBQN officers can also form the nucleus for training the people in the industries.
- 3.6.4. International Training Course on Standardization and Industrial Quality - The Expert had given lectures on quality control at the International Training Course on Standardization and Industrial Quality organized by UNIDO and INMETRO at Xerem from 18 October to 10 December 1982. 12 trainees from 11 countries had attended the training course (see also Appendix A). The topics covered by the Expert are given in Appendix D.
- 3.7. Meeting attended - The Expert had attended a meeting of the ABNT committee on metal

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containers and had given his suggestions for the improvement of the sampling procedure which were agreed to by the committee.

3.8. Seminars

- 3.8.1. Seminars were held and lectures given by the Expert at CSN, Volta Redonda, CETEC, Belo Horizonte and Aço Minas Gerais S.A. (Açominas), Belo Horizonte with a view to disseminating the knowledge and techniques of quality control and promoting its valid application in the industries (see also Appendix E).

4. CONCLUSIONS AND RECOMMENDATIONS

- 4.1. The Project BRA/75/003 has done excellent work in the promotion and development of standards in many areas. It has been rightly accorded recognition by UNIDO by ranking it as nº 1 among the successful UNIDO projects during the last 15 years.
- 4.2. National standardization in quality control has to be developed further. The draft standards on quality control already prepared by the Expert may be processed further by ABNT and developed into Brazilian standards. These standards would then greatly help the industries in proper and quicker adoption and development of quality control.
- 4.3. ABNT should immediately set up a new committee on quality control and industrial statistics. This committee can then process the draft

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quality control standards already prepared by the Expert and can also prepare more standards on the remaining subjects identified by the Expert.

- 4.4. The new ABNT committee on quality control and industrial statistics can also act as an adviser to the other ABNT committees in matters concerning the application of statistical methods in standardization. This committee can also look after the work of ISO/TC 69 and its subcommittees.
- 4.5. CB1 should set up a new subcommittee on sampling methods to review and improve the sampling plans in the metal standards.
- This subcommittee can also process the Draft Standard on methods for sampling of steel pipes, tubes and fittings as already prepared by the Expert. The subcommittee can also prepare more standards on sampling of other important metal products on similar lines.
- 4.6. The new subcommittee on sampling methods under CB1 can also advise other committees and technical commissions of CB1 with regard to statistical matters in general and sampling methods in particular.
- 4.7. Quality Control work has been initiated. However it has to be developed further to reach the take off stage. For this purpose more training programmes on quality control have to be conducted for the benefit of different sectors of industries. The engineers

and technologists trained in INMETRO and IBQN can form the nucleus for training the people in the industries.

- 4.8. INMETRO officers can help in the preparation of realistic specifications by following the integrated approach to quality control and standardization. For this purpose they can collect relevant data from the industries, statistically analyze them and evolve realistic specifications as mentioned earlier.
- 4.9. INMETRO officers can also try to introduce the statistical and quality control concepts in the standards and improve the sampling plans in the various non-metal specifications on the basis of the knowledge gained from the Quality Control Training Programme.
- 4.10. Technical assistance to industries in quality control can be given by the INMETRO and IBQN officers and others trained for this purpose.
- 4.11. More seminars on quality control may be organized for the benefit of different sectors of industries by INMETRO, IBQN, CETEC, CDTN and other concerned organizations. These seminars will greatly help in the propagation of the knowledge and principles of quality control and promoting its valid application in the industries.
- 4.12. A list of all the Documents prepared by the Expert is given in Appendix F.

5. ACKNOWLEDGEMENT

- 5.1. The Expert wishes to express his sincere thanks to Dr. B.S. Krishnamachar for his constant advice and encouragement.
- 5.2. The Expert also wishes to thank INMETRO and other organizations as also the staff for their cooperation.

APPENDIX A
TRAINING PROGRAMMES CONDUCTED/LECTURES DELIVERED

Date	Place	Organized by	Subject	nº of participants	nº of hours
May-September 1982 and 3 Feb. 1983	Rio de Janeiro	INMETRO	Quality Control	15	43
25-29 October 1982	Belo Horizonte	IBQN and CDIN, Nuclebrás	Statistical Quality Control	15	18
22,25,29,30 Nov. and 1 Dec. 1982	Xerém	UNIDO and INMETRO	Quality Control	12	23 1/2
7-11 March 1983	Rio de Janeiro	IBQN	Quality Control	20	10

APPENDIX B

INMETRO PROGRAMME OUTLINE

1. Basic Quality Control Concepts
2. Basic Statistical Concepts
3. Specifications and Tolerances
4. Process Control
5. Acceptance Sampling
6. Organization of Quality Control
7. Integrated Approach to Quality Control and Standardization
8. Numerical Values

APPENDIX C

IBQN PROGRAMME OUTLINE

1. Basic Quality Control Concepts
2. Basic Statistical Concepts
3. Specifications and Tolerances
4. Process Control
5. Acceptance Sampling

APPENDIX D

QUALITY CONTROL TOPICS COVERED AT THE INTERNATIONAL
PROGRAMME

1. Basic Quality Control Concepts
2. Specifications and Tolerances
3. Acceptance Sampling
4. Design of Experiments

APPENDIX ESEMINARS CONDUCTED

<u>Date</u>	<u>Place</u>	<u>Organized by</u>	<u>Subject</u>	<u>nº of participants</u>	<u>nº of hours</u>
28.09.82	Volta Re- donda	CSN	Quality Control	15	3
02.12.82	Belo Hori- zonte	CETEC	Quality Control and Standard- ization	20	1
16.12.82 and 17.12.82	Belo Horizonte	AÇOMINAS	Quality Control	21	10

APPENDIX F

LIST OF DOCUMENTS

<u>Ref.</u>	<u>Date</u>	<u>Title</u>
01/628-82	12.04.82	Preliminary Report
02/629-82	22.04.82	Quality Control Training Programme for INMETRO Personnel - Objective and Outline
03/633-82	25.05.82	Quality Control Training Programme for INMETRO Personnel - Theme papers
04/637-82	30.06.82	List of Brazilian standards on Quality Control
05/638-82	30.06.82	Status of Standardization in Quality control in Brazil
06/650-82	23/09/82	Report on the visit to CSN
07/657-82	5/10/82	Report on the second visit to CSN
08/658-82	13/10/82	Report on the visit to CDTN, Nuclebrás - Belo Horizonte
09/659-82	6/10/82	Draft Standard - Control chart Method for Controlling Quality during Production - Part 1 Control charts for variables
10/660A-82	06/11/82	Report on the SQC Training course at Belo Horizonte

<u>Ref.</u>	<u>Date</u>	<u>Title</u>
11/660/82	11.11.82	Draft standard - Methods for sampling of steel pipes, tubes and fittings
12/661-82	12.12.82	Draft standard - Method for statistical determination of specification limits and tolerances.
13/669-82	07.12.82	Report on the visit to CETEC, Belo Horizonte.
14/706-82	22.12.82	Draft standard - Control chart method for controlling quality during production - Part II Control charts for attributes and count of defects
15/702-82	27.12.82	Report on the visit to Açominas, Belo Horizonte
16/708/82	27.12.82	Sampling Methods in metal standards in Brazil
17/709/82	27.12.82	Interim Report
18/710/83	06.01.83	Draft Standard - guide on precision of test methods
19/712/83	06.01.83	List of Codes of Practice
20/713/83	17/01/83	Report on the third visit to CSN, Volta Redonda

<u>Ref.</u>	<u>Date</u>	<u>Title</u>
21/720/83	04.02.83	Participation of Brazil in ISO /TC 69 work
22/737/83	03.03.83	Draft Standard - Methods for determination of sample size to estimate the average quality of a lot or manufacturing process.
23/738/83	14.03.83	Report on the quality control training course at IBQN, Rio de Janeiro.
24/747/83	04.04.83	This Report.

