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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Contract No: 89/153 and
its Amendment No 1.

FINAL REPORT

FOR THE PERIOD 17. 11. 1989. TO 30. 11. 1993.
ON
PROJECT NO: DP/IND/88/015

JAWAHARLAL NEHRU ALUMINIUM RESEARCH DEVELOPMENT AND DESIGN CENTRE
in
NAGPUR, INDIA

Substantive officer: T. Grof, UNIDO

By
T. Kalman
Team leader
ALUTERV-FKI Ltd.,

November, 1993.

FINAL REPORT

JAWAHARLAL NEHRU ALUMINIUM RESEARCH DEVELOPMENT AND DESIGN CENTRE

in

NAGPUR, INDIA

November 17, 1989 - November 30, 1993

Project No: DP/IND/88/015
Contract No: 89/153 and it's Amendment No 1.

This report comprises this title page, 8 pages of text and 5 Annexes (I through V.)

ALUTERV-FKI Ltd.
Budapest, Hungary
November, 1993.

EXECUTIVE SUMMARY

CONTRACT

between
United Nations Industrial Development Organisation and

ALUTERV-FKI Ltd.
for the provision of services relating to the

JAWAHARLAL NEHRU ALUMINIUM RESEARCH DEVELOPMENT AND DESIGN CENTRE,
NAGPUR, INDIA

Project Number: DP/IND/88/015
Contract Number: 89/153 and its amendment No.1.

Immediate Objective:

To assist the government of India in setting up a functioning Aluminium Research Development and Design Centre which will develop the capability of carrying out its main functions on behalf of and in co-operation with the bauxite processing/alumina production and aluminium smelter industries in the country.

Special objectives:

To assist the establishment of the Aluminium Research Development and Design Centre consisting of

- Alumina Production Research Department
- Aluminium Electrolysis Department
- Analytical Research Department
- General Services, computer and Process Control Department

Duration:

As in the original contract: 17 Nov. 1989 - 17 Nov. 1992
and its amendment No. 1: 17 Nov. 1989 - 30 Nov. 1993

Conclusions:

In accordance with the scope of the contracting services of the subject contract and its amendment No. 1 (Annex 1) the international subcontractor (ISC) has accomplished the following services/activities detailed in five progress and one interim reports.

The main issues of the above are:

1. A team of ISC experts reviewed and assisted the finalisation of detailed Centre design inciuding:

   - The determination of main functions of the various laboratories along with their space and staff requirements.

   - The proposals for the establishment of large scale alumina laboratory and experimental electrolysis cells.

   - Data supply to MECON, for the design of alumina pilot plant at Korba.

   - The proposal to form a process engineering group.

   - The formulation of Research and Development programs for the Centre.

   - Data supply to MECON experts for the designing of buildings.

2. The ISC has provided/submitted the required/agreed test and analytical procedures The list of them is in Annex 2.

3. The ISC has completed his obligation with respect to providing criteria for the selection and assisting in identification and specification of imported equipment for both UNIDO and JNARDDC.

4. The ISC has provided assistance and guidance for the centre in the preparation of techno-economic evaluation of preinvestment studies, carbon material testing and information services.

5. In the framework of the subject Contract and its Amendment No. 1, the ISC has already carried out thirteen (13) man-months of field work contracted. The site works are enlisted in Annex 3. However, due to the delay in accomplishing of buildings a one month expertise in carbon laboratory is being carried out at the time of report writing.

6. The reports prepared by, or assisted/guided by the ISC expert during the project time are summarized in Annex 4.

Recommendations:

Aiming at maintaining and upgrading the results achieved during the project implementation to date, it would be crucially important:

- to further upgrade the technical and scientific capabilities of the Centre
- to maintain/widen relations with international organisations both in the field of institutional co-operation and personal relationships;
- to ensure the further possibilities of expertise in order to assist in preparing/carrying out important, high level Research and Development projects which along with a well selected fellowship/study tour program can significantly contribute to upgrading of the technical and scientific level of the Centre.

All these can only be achieved by a prolonged UNDP/UNIDO assistance, therefore the implementation of one to three years continued support of post project phase is recommended to be considered by both the United Nations and Government of India

General:

During the visit of the ISC team leader at the Centre, Nagpur, the obligations of the ISC contract were reviewed and evaluated by the National Project Director Dr. T. R. Ramachandran, chief Technical Advisor, UNIDO Dr. J. Zambo and Dr. T. Kalman based on which the full completion of ISC contract can be stated. (Annex 5).

INTRODUCTION

The Final Report was prepared in connection with Contract between the United Nations Industrial Development Organisation and the ALUTERV-FKI Ltd., for the provision of services relating to the Jawaharlal Nehru Aluminium Research Development and Design Centre, Nagpur, India.

Project No: DP/IND/89/015
Contract No: 89/153 and it's Amendment No 1.

The aim of the subject contract was to assist the government of India in setting up a functioning Aluminium Research Development and Design Centre which will develop the capability of carrying out its main functions on behalf of and in co-operation with the bauxite processing/alumina production and aluminium smelter industries in the country.

According to the original contract the project was scheduled to be completed by 17. 11. 1992. however, due to the delay in accomplishing of buildings, the duration of contract had to be extended by one year. The conditions of this extension are in the Amendment No.1. to the original contract.

In the framework of the subject contract the ALUTERV-FKI Ltd., as the International Subcontractor (ISC) had to provide the following services:

1. To provide specialised technical assistance en the conceptual and detailed Centre and pilot plant designs.
2. To review, consult and assist in finalisation of Centre design.
3. To provide and submit test and analytical procedures required in for the Centre.
4. To provide supervision and guidance for the research, development activities of the Centre.
5. To provide criteria for selection and to assist in identification and specification of the specialised imported equipment.
6. To assist in preparation of the Centre Training Programme.

During the visit of T. Kalman ISC team leader at the Centre, Nagpur the ISC obligations contracted were reviewed/evaluated together with the project management based on which the full completion of ISC Contract was established.

ACTIVITIES UNDERTAKEN BY ISC

1st year (1990)

1. Seven ISC experts visited at the Centre between 22 Jan. - 3. Feb., 1990. for 2.5 MM field work. Main issues of this visit were:

   - finalisation of detailed Centre design;
   - data supply to MECON, the domestic contractor, for the design of alumina pilot plant at Korba;
   - proposal to form a process engineering group;
   - formulation of R & D programmes for the Centre;
   - preparation of revised list of equipment to be imported (UNDP/UNIDO input as well as Government one);
   - data supply to MECON experts for the designing of the Centre's buildings.

2. Preparation and submission of detailed and general specifications for equipment to be procured through UNIDO.

3. Additional data supply to MECON for the designing of the equipment location between 16 to 20 July, 1990) three of ISC experts (T. Kalman, J. Horvath and I. Sajo) visited UNIDO, Vienna for the evaluation of quotations and selection of suppliers.

4. Questions raised by MECON were sorted and through letters and telexes.

5. The first technological procedure relating to the Predesilication of Bauxites was prepared and submitted to JNARDDC.

Second year (1991)

1. Continuation of technical evaluation of the quotations of equipment and selection of suppliers. (Two of ISC experts - T. Kalman and J. Horvath - paid a one day visit at UNIDO, Vienna on 31 January, 1991).

2. Preparation/submission of additional technical information on pending equipment for UNIDO, Vienna.

3. Specification of preparatory work to be completed at the site before the mobile van is put into operation.

4. Preparation and submission of the test procedures and analytical methods for the Centre, Nagpur.

Third year (1992)

1. Two of ISC experts, Dr. K. Solymar and Mr. J. Steiner, visited at the Centre, Nagpur between 04. 04. 1992 to 02. 05. 1992.
   The main tasks of the ISC experts were.

   - To deliver lectures on selected topics interesting and relevant to the personnel of the Centre and the alumina refineries

   - To participate in the alumina plant visit at KORBA/BALCO; DAMANJODI/NALCO and RENUKOOT/HINDALCO and the technical discussions organised by the Centre.

   These obligations above were fully attained and documented by the two write ups below:

   - Mission Report
   - Workshop Notes on Alumina Production

2. Between 16 July to 7 August, 1992 Ms. E. Molnar visited at the Centre in order to assist in the Centre's scientists to get acquainted with the practical use of the mathematical model of calculating the material and heat balance of the Bayer alumina plant.

3. For a period of six weeks, ISC expert Mr. I. Sajo also visited at the Centre to demonstrating the use of XRD software and helping the Centre's scientists in the calibration and use of XRD and XRF equipment.

4. 13 reports on methology and procedures prepared in the framework of the contract between ISC and VAMI and one additionally requested ISC's method for the determination of fluorine content in bauxite and aluminate liquor were submitted to JNARDDC.

Fourth year (1993)

The general conditions of ISC obligations are determined by the Amendment No. 1. to Contract 89/153 according to which the ISC has to provide:

1. Expertise in information services - In order to establish a functional information Centre at JNARDDC, Dr. E. Hidvegi spent 0.75 month at the Centre during which period she assisted/guided in the preparation of a programme for the establishment of information services.
   This programme was handed over to the Centre.

2. Expertise in carbon material testing - Due to delay in completion of the buildings this activity was started on 19 November only and is scheduled to be completed by Dr. J. Horvath in December 1993.

3. Expertise in techno-economic evaluation of pre-investment studies - For the completion of this activity three of ISC experts Mr. L. Varga; Ms. E. Molnar and Mr. A. Molnar visited JNARDDC for durations of 2; 1.75 and 0.75 months respectively. They assisted/guided in the preparation of pre-investment studies for BALCO, HINDALCO and NALCO alumina refineries. The manuscripts of these studies are scheduled to be ready by November 19, 1993.

4. Preparation of and final reports - the ISC team leader Dr. T. Kalman arrived at JNARDDC, Nagpur for a 0.5 month mission in order to discuss/evaluate the completion of ISC obligations fixed in the Terms of Reference of the subject Contract and it's Amendment No. 1. with the project management Dr. T. R. Ramachandran, Director, JNARDDC and Dr. J. Zambo, CTA, UNIDO.
The main findings of the discussion are:

- In the framework of the contract ISC has accomplished the obligations stipulated in the terms of reference of the subject contract and the first amendment to it.

- The ISC carried out 13 man-months of field work in fulfilment of the stipulations in the contract.

- The executive summary of the final report was prepared in agreement with the project management.

(More details on the four years activity can be found in the Annex 3 and the Progress and Interim Reports).

25th November, 1993.

Dr. T. Kalman
Team leader
ISC

V. Iliev/uk
21 July 1989

TERMS OF REFERENCE FOR INTERNATIONAL SUBCONTRACTOR

PROJECT DP/IND/88/015

"JAWAHARLAL NEHRU ALUMINIUM RESEARCH, DEVELOPEMNT AND DESIGN CENTRE, NAGPUR, INDIA"

A. GENERAL BACKGROUND INFORMATION

The Indian aluminium industry looks back to a history of 44 years. The first aluminium smelter (in Alupuram, Kerala) was put into operation in 1943. At present there are five alumina plants in operation and six aluminium smelters with an overall capacity of about 660,000 and 362,000 tonnes per year, respectively. These facilities belong to five aluminium companies, namely, Bharat Aluminium Company Ltd. (BALCO), Hindustan Aluminium Corporation Ltd. (HINDALCO), the Indian Aluminium Company Ltd. (INDAL), the Madras Aluminium Company Ltd. (MALCO) and the National Aluminium Company Ltd. (NAICO).

During the past years, India became one of the leading countries in the world having substantial bauxite resources, after the discovery of large deposits in the Eastern Coast in the early 1970ies. The total bauxite reserves of India are estimated to be of the order of 2,650 million tonnes, which places India on the fifth place in the world list.

With the vast reserves of bauxite and coal in India, the aluminium industry has ambitious plans for a faster rate keeping in view the future demand in the foundry and export potentials.

The existing alumina/aluminium plants in India are based almost entirely on technology imported from various sources. Both in the area of production of alumina and aluminium, a number of technological improvements have taken place in advance aluminium producing countries. Import of advanced technology is not always possible, also its introduction is not feasible in the existing plants. Import and transfer of technology necessitates proper assessments to determine its suitability under Indian conditions, the available raw materials, product demands, state of engineering developments, etc. Though research and development work is being carried out by the major aluminium producers in the country, these are mainly directed towards solving their day to day process problems in the plants. No work is done for the development of process know-how and basic engineering in alumina/aluminium technology which is expected to be covered by the subject Aluminium Research, Development and Design Centre at Nagpur. The technologies followed in the existing plants are from various countries/companies - KAISER, ALUTERV-FKI, VAMI, ALCAN, MONTTECATINI and ALUMINIUM PECHINEY. Apart from the strategic importance of having an indigenous Research, Development and Design Centre for Aluminium, the Centre is expected to save substantial hard currency payments.

For meeting the estimated demand of aluminium by the turn of the century, substantial additional capacities for alumina and aluminium will have to be set up in 1990ies. Additional demand for aluminium by the turn of the century, which is in excess of the currently available capacity (including NALCO Plant) would be of the order of 440,000 tonnes per annum.

It is to be noted that all the leading aluminium producing countries have their own R and D Centres. Close interactions among these Centres' research and development institutions and industry has enabled numerous technological advances - this example is needed to be followed in India.

In the light of the above, a co-ordinated effort in R & D will be essential for the development of know-how and basic engineering to self-reliance in alumina and aluminium technology needed for the establishment of future plants without need to go for foreign consultancy. Future development of aluminium industry in the country based on indigenous expertise demands the immediate establishment of a self-sustained full-fledged and independent research, development and design centre for aluminium at the national level.

The development objective of the project is to aim at self-reliance in alumina and aluminium production technology and to achieve faster growth of the Indian aluminium industry to meet the domestic demand for aluminium products. This goal will be achieved by setting up of Aluminium Research, Development and Design Centre at the national level which will be in a position to carry out research and development in the field of bauxite processing, alumina and aluminium production leading to improvement in the existing plants and creating new production facilities. Thus, the output of the project will be physical facilities of an Aluminium Research Development and Design Centre, adequately equipped for specialized research and development and design assistance for the continuous improvement of technology in the existing plants and for setting up of new alumina/aluminium production facilities based on indigenous raw materials and natural resources. In addition, the Centre will handle related projects such as dealing with the use of by-products, design improvements for saving of energy and materials, development of new products and alloys similar to those covered under UNDP projects DP/IND/81/015 Electro-metallurgical production of aluminium; DP/IND/84/004 Techno-economic study for bauxite processing; DP/IND/84/005 Aluminium calciner and DP/IND/84/007 Production of Super Purity Aluminium. Another particular problem that the Centre is expected to address is emanating from the lack of adequate and uninterrupted production capacities in the recent past. Investigations into energy saving technologies of alumina and aluminium production will be one of the important tasks that the Centre will have to tackle.

It is expected that once the Centre is established, it will meet the fast growing technological service needs of the aluminium industry in India.

B. THE AIM OF THE PROJECT

To assist the Government of India in setting up a functioning Aluminium Research, Development and Design Centre consisting of:

a) Alumina Production Research Department

b) Aluminium Electrolysis Department

c) Analytical Research Department

d) General Services, Instrumentation and Control Department (incl. Workshop and Maintenance)

e) General Administration and Finance Department

The Centre will develop capability of carrying out the following main functions on behalf of and in co-operation with the bauxite processing/alumina production and aluminium smelter industries in the country:

a) Assimilation and adaptation of available technologies.

b) Providing recommendations and ad hoc or applied and analytical research to local industries in process improvement, transfer of technology, etc.

c) Setting up and operating a data bank

d) Providing training

The basic activities of the Centre should cover:

- applied research work in laboratory, large laboratory and pilot scale;

- evaluation and data processing of research results;

- preparation of basic engineering packages;

- preparation of different pre-investment studies for reconstruction of existing production capacities and establishment of new ones;

- modernization of the plant equipment;

- elaboration and development of automatic and instrumental control of the production processes;

- environmental control in all area of aluminium industry;

- collection of technical-scientific information and documentation including standardization and patent/licence services.

C. THE SCOPE OF THE CONTRACTING SERVICES

The Contractor should act as a consulting firm to the Indian counterparts.

Two consulting firms will be engaged in the project management and engineering: one Indian consulting firm and one International consulting firm (the Contractor).

The Indian consulting firm will be mainly responsible for design and construction of the biddings, procurement and installation of the locally bought equipment as well as installation of the imported equipment.

The Contractor (International Consulting Firm) has to provide the following services:

1. To provide specialized technical assistance in the conceptual and detailed Centre and the pilot plant designs.

2. To review, consult and assist in finalization of Centre design.

3. To provide and submit test and analysis procedures (methodology) required for the Centre.

4. To provide supervision and guidance for the research, development and design activities of the Centre.

5. To provide criteria for selection and to assist in identification and specification of the specialized imported equipment; to consult counterparts for proper installation and commissioning of the testing equipment.

6. To assist in preparation of the Centre Training Programme.

7. Upon request and out of the scope of the subject Contract price to provide training of counterparts at the Contractor's laboratories/facilities and at the Centre as well.

The duration of the contracting services will be three years (36 months). The proposed start of the Contract is set to January 1990.

D. GENERAL TIME SCHEDULE FOR CONTRACTOR'S WORK

Activity	Time after signing of the Contract (months)
1. Award of Contract	0
2. Preparation of the Questionnaire for collecting all necessary technical information for the design of the Centre	1
3. Field work of 5 (five) Contractor's specialists (in aluminium electrolysis; instrumentation/control; alumina pilot plant design/operation; civil engineering; computerization) for 2 weeks (2,5 m/m) - discussion of Centre's activities, methods of testing, investigations, list of equipment, staff requirements, pilot plant design (prepared by National Consulting Firm), technical information/reply to the Contractor's Questionnaire and finalization of detailed Centre design	2
4. Ad-hoc consultation of the Contractor's specialists (as per 3 above) with total duration of 3 m/m field work (1 m/m each year)	periodically upon request
NOTE: Continuous contacts between the Contractor and the Centre/Counterparts will be kept by mail, telex and telefax. The Contractor should have appropriate facilities.	
5. Provision of testing and analysis methodology required for research and development work of the Centre	6 - 18
6. Assistance and participation in preparation of the Centre Training Programme	12 - 18
7. Provision of guidance and supervision for research, development and design activities of the Centre - 5 specialists for 1 month field work (totally 5 m/m, mainly in the third year)	18 - 36
8. Ad-hoc field consultations for identification, selection, installation and commisioning of the testing equipment of the Centre (5 specialits for 2 weeks) with total duration of 2,5 m/m	periodically upon request

E. CONTRACTOR'S PERSONNEL

The number of the personnel man-months should be stipulated in the Contract only as an estimate. It is the responsibility of the Contractor to determine the personnel inputs necessary for the full and satisfactory discharge of his responsibilities. It is also his responsibility to select specialists with appropriate qualifications.

F. LANGUAGE REQUIREMENTS

English will be the working language during the execution of the subject contract and for the reports.

G. REPORTS

a) Progress Contractor's Reports to be submitted every six months summarizing/reporting the work done and activities carried out with results.

b) Terminal (draft and final) Contractor's Report to be submitted on completion of all contracted activities by the end of the contract execution.

c) Number and distribution of reports:

Totally 12 copies of each distributed as follows:

- 3 copies to UNIDO
- 7 copies to the Indian counterparts
- 2 copies to UNDP, New Delhi

Amendment No. 1
Contract No. 89/153
Project No. DP/IND/88/015

AMENDMENT NO. 1
to
CONTRACT
between
THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
and
ALUTERV-FKI
for the
provision of services relating to the
JAWAHARLAL NEHRU ALUMINIUM RESEARCH DEVELOPMENT AND DESIGN CENTRE
in
NAGPUR, INDIA

1. This Amendment No. 1 to Contract No. 89/153 is issued to:

(a) reduce the number of man-months of services in the Project Area from eight (8) to six point five (6.5);

(b) extend the duration of the original Contract by one (1) year, i.e. until 30 November 1993; and

c) amend the payment schedule.

2. The scope of the duration of the Contractor's activities shall be as follows:

		Man-months	
		Home Office	Project Area
a)	Provision of expertise in information services, carbon material testing, alumina process equipment, alumina heat and balance, techno-economic evaluation of pre-investment studies (3rd-4th quarter of 1993)	4	6
b)	Preparation of Draft Final and Final Reports (4th quarter of 1993)	2	0.5
c)	Three (3) days de-briefing at UNIDO Headquarters Vienna (3 days upon submission of the Draft Final Report)		

LIST OF ANALYTICAL AND TEST METHODS, PROCEDURES

ISO PUBLICATIONS RELATING TO ALUMINIUM OXIDE PRIMARILY USED FOR THE PRODUCTION OF ALUMINIUM

ISO 802 - Preparation and storage of test samples.

ISO 803 - Determination of loss of mass at 300°C /conventional moisture/.

ISO 804 - Preparation of solution for analysis - Method by alkaline fusion.

ISO 805 - Determination of iron content - 1,10-Phenanthroline photometric method.

ISO 806 - Determination of loss of mass at 1000 and 1200°C

ISO 900 - Determination of titanium content - Diantipyrylmethane photometric method.

ISO 1232 - Determination of silica content - Reduced molybdosilicate spectrophotometric method.

ISO 1617 - Determination of sodium content - Flame emission spectrophotometric method.

ISO 1618 - Determination of vanadium content - N-Benzoyl-N-Phenylhydroxylamine photometric method.

ISO 2089 - Determination of calcium content - Flame atomic absorption method.

ISO/R 2070 - Determination of calcium content - Spectrophotometric method using naphthalhydroxamic acid.

ISO 2071 - Determination of zinc content - Flame atomic absorption method.

ISO/R 2072 - Determination of zinc content - PAN photometric method.

ISO 2073 - Preparation of solution for analysis - Method by hydrochloric acid attack under pressure.

ISO 2828 - Determination of fluorine content - Alizarin complexone and lanthanum chloride spectrophotometric method.

ISO 2829 - Determination of phosphorus content - Reduced phosphomolybdate spectrophotometric method.

ISO 2883 - Determination of boron content - Curcumin spectrophotometric method.

ISO 2927 - Sampling.

ISO 3390 - Determination of manganese content - Flame atomic absorption method.

ISO PUBLICATIONS RELATING TO BAUXITE

ISO 0606 - Aluminium ores - Determination of loss of mass at 1075°C - Gravimetric method

ISO 6607 - Aluminium ores - Determination of total silicon content - Combined gravimetric and spectrophotometric method

ISO 0609 - Aluminium ores - Determination of iron content - Titrimetric method

ISO 0994 - Aluminium ores - Determination of aluminium content - EDTA titrimetric method

ISO 6995 - Aluminium ores - Determination of titanium content - 4,4'- Diantipyrylmethane spectrophotometric method

ISO 8550 - Aluminium ores - Determination of phosphorus content - Molybdenum blue spectrophotometric method

ISO 8557 - Aluminium ores - Determination of hygroscopic moisture in analitical samples - Gravimetric method

ISO 8558 - Aluminium ores - Preparation of pre-dried test samples

ISO 9208 - Aluminium ores - Determination of vanadium content - BPHA spectrophotometric method

ALUMINIUM-FLUORIDE FOR INDUSTRIAL USE

ISO 2362 - Determination of fluorine content -
Modified Willard-Winter method

ISO 2368 - Determination of iron content -
1,10-phenantroline photometric method

ISO 2369 - Determination of silica content -
Spectrophotometric method using the reduced silicomolybdic complex

ISO 2925 - Preparation and storage of test samples

ISO 3393 - Cryolite, natural and artifical, and aluminium fluoride for industrial use -
Determination of moisture content -
Gravimetric method

ISO 4279 - Determination of sodium content -
Flame emission spectrophotometric method

ALUMINIUM AND ALUMINIUM ALLOYS

ISO 793 - Determination of iron - Orthophenantrolin photometric method

ISO 795 - Determination of copper concent - Oxalyldihydrazine photometric method

ISO 796 - Determination of copper - Electrolytic method

ISO 797 - Determination of silicon - Gravimetric method

ISO 808 - Determination of silicon - Spectrophotometric method with the reduced silicomolybdic complex

ISO 886 - Determination of manganese - Photometric method /Manganese concent between 0,005 and 1,5 % /

ISO 1118 - Determination of titanium - Spectrophotometric chromotropic acid method

ISO 1784 - Determination of zinc-EDTA titrimetric method

ISO 2297 - Complexometric determination of magnesium

ISO 3258 - Determination of magnesium - Atomic absorption spectrophotometric method

ISO 3978 - Determination of chromicum - Spectrophotometric method using diphenylcarbazide after extraction

ISO 3979 - Determination of nickel -

Spectrophotometric method using dimethylglyoxime

ISO 3980 - Determination of copper -
Atomic absorption spectrophotometric method

ISO 3981 - Aluminium et alliages d'aluminium -
Dosage du nickel -
Méthode par spectrophotometrie d'absorption
atomique

ISO 4192 - Determination of lead content -
Flame atomic absorption spectrometric method

ISO 4193 - Determination of chromium content -
Flame atomic absorption spectrometric method

ISO 5194 - Determination of zinc content -
Flame atomic absorption spectrometric method

CRYOLITE. NATURELLE ET ARTIFICIELLE

ISO 1619 - Preparation et conservation des échantillons pour essai

ISO 1620 - Dosage de la silice - Méthode spéctrophotometrique au molibdosilicate réduit

ISO 1693 - Dosage du fluor - Méthode de Willard--Winter modifiée

ISO 1694 - Dosage du fer - Méthode Photometrique 'a la phénanthroline -1.10

ISO 2366 - Dosage du sodium - Méthodes par spectrophotometrie de flamme /émission/ et par absorption atomiqu-

ISO 2367 - Dosage de l'aluminium-Méthode gravimetrique á l'hydroxy-8 quinoléine

ISO 2830 - Dosage de l'aluminium - Méthode par abvsorption atomique

ISO 3391 - Dosage du calcium - Méthode par absorption atomique dans la flamme

ISO 3392 - ...et fluorure d'aluminium 'a usage industriel - Dosage de l'eau - Méthode électrometrique

ISO 3393 - ...et fluorure d'aluminium 'a usage industriel - Détermination de l'humidité - Méthode gravimétrique

ISO 4277 - Essai cónvewntionnel pour l'évaluation de la teneur en fluorures libres

ISO 4280 - ...et fluorure d'aluminium 'a usage industriel - Dosage del sulfates - Méthode gravimétrique

'a l'état de sulfate de baryum

ISO 5930 - ... et fluorure d'aluminium 'a usage industriel - Dosage du phosphore - Méthode photometrique au molybdophosphate réduit

ISO 5938 - ...et fluorure d'aluminium 'a usage industriel - Dosage du soufre - Méthode par spéctrométrie de fluorescence X

1.02.1. METHOD FOR TEST OF FLOWRATE OF GASES REMOVED FROM REDUCTION POTS BY HOOD EXHAUST SYSTEM

1.02.2. METHOD FOR TEST OF FLOWRATE OF GASES REMOVED THROUGH ROOF MONITOR

1.02.3. METHOD FOR TEST OF DUST LOAD IN GASES REMOVED FROM REDUCTION POTS BY HOOD EXHAUST SYSTEM

1.02.4. METHOD FOR TEST OF HYDROGEN FLUORIDE CONCENTRATION IN GASES REMOVED FROM REDUCTION POTS BY HOOD EXHAUST SYSTEM

1.02.5. METHOD FOR TEST OF SULFUR DIOXIDE CONCENTRATION IN GASES REMOVED FROM REDUCTION POTS BY HOOD EXHAUST SYSTEM

1.02.6. METHOD FOR TEST OF PARTICULATE FLUORIDE CONCENTRATION IN GASES REMOVED FROM REDUCTION POTS BY HOOD EXHAUST SYSTEM

1.02.8. METHOD FOR TEST OF DUST LOAD IN GASES REMOVED THROUGH ROOF MONITOR

1.02.9. METHOD FOR TEST OF PARTICULATE FLUORIDE CONCENTRATION IN GASES REMOVED THROUGH ROOF MONITOR

1.02.10. METHOD FOR TEST OF HYDROGEN FLUORIDE CONCENTRATION IN GASES REMOVED THROUGH ROOF MONITOR

1.02.11. METHOD FOR TEST OF SULFUR DIOXIDE CONCENTRATION IN GASES REMOVED THROUGH ROOF MONITORS

2

1.02.13. METHOD FOR TEST OF HYDROGEN FLUORIDE CONCENTRATION IN GASES AFTER WET SCRUBBERS

1.02.14. METHOD FOR TEST OF SULFUR DIOXIDE CONCENTRATION IN GASES AFTER WET SCRUBBERS

1.02.15. METHOD FOR TEST OF RESIDUAL DROP CONTENT IN GASES AFTER WET SCRUBBERS

TECHNOLOGICAL PROCEDURES USED AT ALUTERV-FKI
ALUMINA AND ALUMINIUM PRODUCTION

1. Determination of Bauxite Grindability
2. Standard Test Method for Grindability of Coal by Hardgrove-Machine Method
3. Predesilication of Bauxites
4. Bauxite Digestion Test
5. Alumina Hydrate Precipitation
6. Caustic Soda Regeneration by Causticization of Red Mud
7. Test of Alumina Dissolution
8. Electrode Reactions on Aluminium and Carbon in Cryolite-Alumina Melts
9. Method for Testing Anode Mass

METHODS FOR THE DETERMINATION OF BAUXITE/RED MUD CONSTITUENTS

METHOD FOR THE DETERMINATION OF SODIUM-ALUMINATE LIQUOR CONSTITUENTS AND OF THE DISSOLVED METALS IN CRYOLITIC MELTS

I.

1. Preparation of alumina liquors for chemical analysis
2. Determination of caustic soda content of aluminate liquor
3. Determination of Al_2O_3 content of aluminate liquor
4. Determination of carbon content of aluminate liquor
5. Determination of SiO_2 content of aluminate liquor
6. Determination of P_2O_5 content of aluminate liquor
7. Determination of organic substance of aluminate liquors
8. Determination of sulfate content of aluminate liquors
9. Determination of chloride content of aluminate liquors
10. Determination of chloride content of aluminate liquors
11. Determination of ZnO content of aluminate liquors
12. Determination of Fe_2O_3 content of aluminate liquor
13. Determination of vanadium and chromium content of aluminate liquors
14. Determination of total Na_2O_t content of aluminate liquors
15. Determination of sodium oxalate in aluminate liquors

II.

Determination of dissolved metals in cryolitic melts

FIELD WORK

No	Name	Field of activities	Period
1	Dr. T. Kalman	First visit • Detailed Centre Design • Establishment of large alna lab • Review of equipment for alna lab • R&D projects in the field of alumina • Data supply to MECON for detailed design	22.01.90 - 03.02.90 2 weeks
		Second visit • Evaluation of ISC contract • Preparation and discussion the parts of the final report (draft)	31.10.93 - 15.11.93 2 weeks
2	Dr. J. Horvath	First visit Detailed Centre Design, parts: • Electrolysis Research Lab • Carbon Electrodes Lab • Mobile Measuring Unit	22.01.90 - 03.02.90 2 weeks
		Second visit • Installation of of Carbon Lab equipment supplied by ALUTERV-FKI • Demonstration of testing proceulures for the above	17.11.93 - 16.12.93 1 month
3	Dr. P. Siklosi	• Programme for setting up Process Engg and Study Group • Programme for upgrading pilot plant at Korba	22.01.90 - 03.02.90 2 weeks
4	M. Zaymus	• Programme for setting up mobile van • Review of equipment for data aquisition and processing	29.01.90 - 03.02.90 1 week
5	P. Vona	• Programme for process control activities • Review of equipment for process control activities	29.01.90 - 03.02.90 1 week
6	Dr. I. Sajo	First visit Detailed Centre Design • Analitycal Department • Computer isation • Information services	29.01.90 - 03.02.93 1 week
		Second visit • Transfer of software for evaluation XRD / XRF results • Workshop on utilisation of XRD / XRF technique in aluminium industry	12.10.92 - 20.11.92 6 weeks

7	J. Lang	Consultant in civil works • Data supply to MECON	29.01.90 - 03.02.90 1 week
8	Dr. K. Solymar	Consultant in alumina technology • Review of BALCO, HINDALCO and NALCO technology • Workshop on alumina production	04.04.92 - 02.05.92 1 month
9	J. Steiner	Consultant in alumina prod equipment • Discussion with BALCO, HINDALCO and NALCO • Workshop on alumina production	04.04.92 - 02.05.92 1 month
10	L. Varga	Expert in alumina process engineering • Preparation preinvestment studies for BALCO, HINDALCO and NALCO	26.09.93 - 23.11.93 2 months
11	E. Molnar	First visit • Transfer of software for modelling of Bayer production process Second visit Expert in alumina process technology • Preparation of mass and heat balance for BALCO, HINDALCO and NALCO preinvestment studies	16.07.92 - 07.08.92 3 weeks 26.09.93 - 06.11.93 6 weeks
12	A. Molnar	Expert in economic evaluation • Evaluation of preinvestment studies for BALCO, HINDALCO and NALCO	20.10.93 - 11.11.93 3 weeks
13	E. Hidvegi	Expert in information services • Finalisation programme for information services • Work programme for establishment and operation	20.10.93 - 11.11.93 3 weeks

REPORTS PREPARED IN THE FRAME OF ISC CONTRACT

Title of the report	Prepared by	Date
1. 1st Progress Report	Dr. T. Kalman	April 1990
2. 2nd Progress Report	Dr. T. Kalman	November 1990
3. 3d Progress Report	Dr. T. Kalman	April 1991
4. 4th Progress Report	Dr. T. Kalman	December 1991
5. 5th Progress Report	Dr. T. Kalman	May 1992
6. Interim Report	Dr. T. Kalman	February 1993
7. (Draft) Final Report	Dr. T. Kalman	November 1993
8. Mission Report	Dr. K. Solymar & J. Steiner	April 1992
9. Workshop notes on alumina production	Dr. K. Solymar & J. Steiner	April 1992

REPORTS PREPARED IN THE CENTRE WITH THE ASSISTANCE / GUIDANCE OF ISC EXPERTS

Title of the report	Assisted / guided by	Date
10. Report on Detailed Centre Design	Group of 7 experts, see separate list	January - February 1990
11. Intensification of the production process and improvement of alumina quality at Korba Alumina Plant of BALCO	E. Molnar A. Molnar L. Varga	September - November 1993
12. Intensification of the production process and modernisation of precipitation at Renukoot Alumina Plant of HINDALCO	E. Molnar A. Molnar L. Varga	September - November 1993
13. Intensification of the production processes and expansion of production capacity at Damanjodi Alumina Plant of NALCO	E. Molnar A. Molnar L. Varga	September - November 1993
14. Programme for Establishment of information services	Dr. E Hidvegi	October - November 1993

JAWAHARLAL NEHRU ALUMINIUM RESEARCH DEVELOPMENT AND DESIGN CENTRE NAGPUR

November 15, 1993

SUB: Completion of contractual obligations of the ISC

REF: UNIDO/ALUTERV-FKI Contract No. 89/153 and Amendment No. 1 to the contract

In accordance with the terms of reference of the above contract a review was undertaken by Dr. Tibor Kalman, team leader of ISC, Dr. Zambo CTA and Dr. T.R.Ramachandran Director of the Jawaharlal Nehru Aluminium Research Development and Design Centre Nagpur. The main findings are summarised in the Table given below:

Services to be provided	Comments
Provide specialised technical assistance in conceptual and detailed design of the Centre and pilot plant	Fully offered
Review, consult and assist in the finalisation of Centre design	Successfully done
Provide and submit test and analysis procedures required for the Centre	Detailed write up submitted to the Centre
Assistance in specification and selection of equipments	Necessary information provided to UNIDO, Centre and MECON whenever requested
To assist in preparation of training programme for the Centre	Necessary assistance provided
Provide training of counterparts at the contractor's laboratories out of the scope of the subject contract price	Necessary support provided by ISC whenever requested by the Centre

The following points were reviewed with particular reference to the stipulations in paragraph 2 a & b of the amendment to the contract:

Para 2a - Technoeconomic evaluation of preinvestment studies - For the completion of this activity three experts from the ISC, Mr. L.Varga, Ms. E. Molnar and Mr. A. Molnar visited JNARDDC for durations of 2, 1.75 and 0.75 months respectively. They assisted/guided in the preparation of preinvestment studies for BALCO,

HINDALCO and NALCO. These studies are scheduled to be ready by November 19, '93.

Expert in Information Services - In order to establish a functional information Centre at JNARDDC, Dr. E. Hidvegi spent 0.75 month at the Centre during which period the preconditions for the starting up of information activities at the Centre were studied in detail. She assisted/guided in the preparation of a programme for the establishment of information services - this programme was handed over to the Centre.

Expert in carbon material testing - Due to delay in completion of the buildings, this activity was started only on November 19 '93 and is scheduled to be finalised by the middle of December by Dr. J. Horvath.

Para 2b - Preparation of draft final and final reports - The ISC team leader Dr. T. Kalman arrived at JNARDDC, Nagpur for -.5 months mission in order to discuss/evaluate the completion of ISC obligations fixed in the Terms of Reference of the subject contract and its Amendment No. 1 with the project management Dr. T.R. Ramachandran, Director, JNARDDC and Dr. J. Zambo, CTA, UNIDO.

IN CONCLUSION the main findings of the discussion are

- In the framework of the contract the ISC has accomplished the obligations stipulated in the terms of reference of the subject contract and the first amendemnt to it
- The ISC carried out 13 man-months of field work in fulfilment of the stipulations in the contract
- The executive summary of the draft final report has been prepared in agreement with the Project management.

(Dr. T. Kalman)	(Dr. J. Zambo)	(Dr. T.R. Ramachandran)
Team Leader	CTA	Director
ISC	JNARDDC	JNARDDC