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REPORT TO UNIDO  
ON THE CONSULTANCY WORK CARRIED OUT IN YUGOSLAVIA  
8-13 DECEMBER 1986 IN THE CONTEXT OF THE PROJECT  
DP/YUG/75/022

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265

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REPORT TO UNIDO  
ON THE CONSULTANCY WORK CARRIED OUT IN YUGOSLAVIA  
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The author of this report was requested by UNIDO/PPRS to carry out in December 1986 a Consultancy assignment in Titograd in order to assist the Project Director in the organization and management of the actual project activities. The relevant Job Description indicates those items which had to be considered during this assignment and processed in agreement with the Project Director. The structure of the present report reflects the stipulations of the Job Description DP/YUG/75/022/11-52/31.8.A. regarding the tasks to be completed. Information about the results of the mission was given to Mr. Nevelic, Chairman of KAT on 11/12/1986 in Titograd and to Mr. Reifenrath, UNDP, Resident Representative and Mr. Buric, Programme Officer in Belgrade on 13/12/86.

1) Review of the results/outputs achieved so far by the project referring to project objectives

A. Project Objectives

The development objective of the project can be extracted from the Project Document as follows: "It is the intention of the Government to fully exploit the potential of this industry in support of its national aims, domestically and for external trade purposes." The immediate objective of the project is to create within the KAT the capacity to:

- a.) Undertake applied research relevant to the development of problems of the aluminium industry in such priority areas as
  - alumina technology;
  - establishment of the heat-balance of the aluminium electrolysis pots;
  - alumina, aluminium and aluminium alloy technology and product development;
  - modelling of aluminium anodic protection.
- b.) Establish new technologies for better utilization of bauxite through extraction of additional useful elements (Ga, Va), development of more efficient technologies for the smelter, the production of semis, castings and finished products, including beneficiation of wastes and recycling of aluminium scrap and other similar materials.
- c.) Carry out laboratory and pilot research work and analysis, oriented to process improvement and development and to product development and product application.
- d.) Establish training programmes for technical staff from developing countries, in the technologies used in the Yugoslav aluminium industry.

The impact on the national economy of the creation of capability in applied aluminium industry research was judged to be considerable and manifold:

Possibility in the future to maintain without foreign assistance the basic technologies being used in the aluminium industry on the requested up to date level and later further develop them;  
selection of the Kombinat Aluminijuma (KAT) for the location of the Aluminium Institute, option which seemed to be the most suitable for the achievement of the policy objectives of the authorities;  
fostering a better utilization of natural resources with the support of the Government of Yugoslavia and the Alumina Association of this country.

Without any hesitation one can say high priority is attached in the actual industrial development programme of the Government to the development objective of the project. It seems also that the development hypothesis on which the project was based is correct and the achievement of the project purpose would represent an important contribution to the development objective.

It should however be mentioned that, considering the suggested duration of 48 months of the project, some elements of the project hypothesis explained in the Background and Justification Chapter of the Project Document were somehow too ambitious and lead to difficulties and delays in project implementation. The majority of these problems is related to the stipulations contained in Annex I, II and III to the Project Document explaining among others the role and duties of the Aluminium Institute at the federal level and the data on institutional growth priorities.

Mainly due to these reasons one can state that the capacities for research indicated in Chapter B, Immediate objective, paras a, b and c of the Project Document were not fully created while activity concerning para d., training programmes for the technical staff from developing countries was not yet initiated.

#### B. Outputs

According to Chapter E of the Project Document the following outputs are to be measured annually:

- 1) An appropriately staffed Institute, in accordance with the plan shown in Annex III, capable of undertaking priority applied research activities in accordance with the priority objectives of the aluminium industry.
- 2) Equipment provided by UNDP/UNIDO and the Government installed and operational as required for the activities mentioned above.
- 3) Full co-ordination and co-operation of the Institute's activities with the KAT and the Aluminium Association of Yugoslavia.
- 4) Training programmes for training of technicians from abroad.

Expected outputs of the research programmes are given in Annex VI."

ad 1)

Without any hesitation we can agree that the role of the Institute is increasing in the solution of technological problems of the KAT. Among others the Institute was instrumental in the publication of the following important studies: Strategy for the technological development in the KAT and in Crna-Gora; optimal model for the development of the Aluminium Industry in Crna-Gora; Aluminium and Energy. The Institute also published reference books concerning respectively the composition, structure and proprieties of aluminium alloys and the possibility of establishing small-scale production capacities for aluminium goods of high-value. It was involved in the preparation of feasibility studies referring to different problems of development of the KAT, including the establishment of a new Aluminium Foundry.

The Institute carried out applied research for the solution of important problems, e.g. improvement of the conditions of alumina calcination; mineralogical investigation of the alumina produced in KAT with a view to contribute to the project of production of some special aluminas; continuous purification of aluminium melts; development of special alloys for forging and extrusion; development of technology for deep drawing of aluminium sheets and plates for the production of bottle-cups and can-stock; practical application of the surface treatment technology using the pilot-equipment.

Notwithstanding the above enumerated positive results achieved by the Institute, the non-realization by the KAT Management of the Institutional Growth Plan included in the Project Document, if urgent appropriate action is not taken, might seriously hamper further project implementation and the desired smooth continuous development of the Institute. The necessity of adjusting the Project's workplan for 1985 and 1986 was partly due to the delayed delivery of equipments but was also strongly related to the staffing of the Institute. The present staffing of the Institute of 11 graduates and 7 technicians is also quite unsatisfactory compared to the stipulations of the Project Document suggesting 29 persons for the end of 85 and through interpolation 32 for the end of 1986. This situation limits the capacity of acquisition by the Institute of the knowledge necessary for the creation of new research capabilities reflected in the Project Document and compatible with the development objective and the purpose of the Project.

The staffing situation of the Institute, - without any doubt - contributed to the unbalanced structure of implementation of the Project regarding the delivery of different project components. While by the end of this year the amount in the budget for purchase of equipment will be fully utilized, the implementation of the expert component will be about 68-70% and that of the fellowship and study-tour components respectively roughly 32% and 50%. It should be mentioned that considerable delays were caused by the difficulties of UNIDO in the placement of the fellows, this is one of the reasons of the underimplementation of this component in 1986. These data illustrate the important amount of work to be done after 1986 in order to complete all the activities indicated in the Project Document and its revisions.

ad 2)

The experience of implementation demonstrates that the list of the main equipment to be purchased through project activities was correctly established. Annex IV. to the Project Document contains 10 important items from which only 1, the H<sub>2</sub> content tester, was not realized because it was bought directly by the KAT. The relevant savings were used by the Project, with the agreement of UNDP and UNIDO for the acquisition of an Universal Mechanical Testing Instrument. Savings allowed also to purchase the following: polarizing microscope; IBM PC; offset machine; photo multiplier.

The equipment component of the Project will practically be fully implemented by the end of this year. This does not mean that at this moment all the equipment will be fully installed and utilized: the Siemens X-ray texture diffractometer is installed but cannot be used mainly because of not complete delivery, corrective action of the supplier is expected for very soon; the delivery of the Universal Mechanical Testing Instrument was scheduled for May 1986, delayed to November and not yet realized.

Through project activities powerful, up-to-date research equipment was made available for the Institute, which in 1987 - without any doubt - will become fully operational.

ad 3)

Newly built, adequate and spacious premises were made available for the Institute by KAT: the transformation of the Aluminium Institute in an independent working organization (OOUR) within KAT is being implemented. After completion of this action the status of the Institute within KAT will be similar to that of the important production units e.g. alumina plant, electrolysis, rolling mill, etc. Notwithstanding these positive phenomena there are problems of understanding in KAT regarding the importance of applied research. KAT is an important and powerful organization including almost 5000 persons and it can only hardly be conceived that the non-implementation by the KAT Management of the Institutional Growth Plan included in the Project Document would be the consequence of lack of appropriate resources. The drafter of the present report seriously hopes that the present staffing situation of the Institute has for reason the fact that the KAT Management did not yet have the possibility to deeply analyze the ideas and issues explained in the Project Document regarding the importance of applied aluminium industry research for KAT and for the totality of the Yugoslav aluminium industry. The drafter also hopes that in agreement with the spirit of the Project Document, the KAT Management will define a strategic and yearly programme of applied research on a level compatible with the strategy for technological development adopted by the Board of KAT and will release without delay the resources, including staff, necessary for its full realization. It is encouraging to note, that on 11/12/1986 at a meeting held in the office of the Chairman of the KAT with the participation of the Project Director and the drafter of this report, the Project Director was requested to submit urgently the updated programme of research for the Institute for 1987. The Chairman took the commitment to review it without delay and release the resources necessary for its implementation. The Chairman also agreed to consider in this programme the training of the Institute's staff as an output.

The Project Manager established contacts with the Aluminium Association of Yugoslavia and with the representatives of different other aluminium producers in the country. Results of research activities of the Institute were made available to other aluminium producers through lectures and publications. The Project Director was appointed Chairman of the Committee for Scientific Work and Development of the Aluminium Association. The representatives of several Yugoslav aluminium producers participated at the official opening of the Aluminium Institute which took place the 12/2/1986 and expressed interest in the activities of the Institute. Nevertheless an organized involvement of the Aluminium Association or of its members in the activities of the Institute has not yet started.

It should also be mentioned that the Institute started in 1986 to provide useful services also for a clientèle outside the KAT. For the Serbian Academy e.g. quality of aluminium welding was studied and structure and size distribution of titanium was established. For the enterprise KRUSIK in Valjevo microstructure of Dural castings was determined.

ad 4)

The staffing problems of the Institute explain that up till now it was not possible to initiate to the organization of training programmes in Titograd for technicians from abroad.

Regarding "expected outputs of the research programmes are given in Annex VI" only deviations from the stipulations of the Project Document are listed in Annex I to the present report.

On the basis of the indications of this Annex and the informations received from the Project Director the following very tentative observations can be made:

- i) Annex 1 demonstrates that in 1987 a very important amount of work is to be done in order to complete the implementation of the Project.
  - ii) The pilote-scale anodizing equipment gives full satisfaction, is operating on a semi-industrial level and is suitable for giving all the information necessary for the establishment of the KAT policy in surface protection and finishing.
2. Needs for improvement, and reinforcement of the overall applied research capability in the Institute in the course of the forthcoming two years

At the confection of the Project Document appropriate attention was devoted to the available research and laboratory facilities in the KAT and the list of equipment was established with a view to make the Institute capable to carry out practically all the usual operations required for applied aluminium industry research. During project implementation the equipment list was purposefully updated by the Project Director. Similarly when considering the Project Document the capabilities in KAT for carrying out applied aluminium industry research were assessed and for the desirable development of these capabilities in

the Project Document appropriate provision for expertise and study-tours/training were included. During implementation it appeared that in addition to expert services concerning installation of the new equipment and the interpretation of the obtained results, an additional step in expertise is also needed namely the multi-disciplinary interpretation of the information obtained via different methods of investigation about the same material or a given phenomenon. Appropriate action was taken by the Project Director in order to include relevant activities in the work programmes of the Project. On this basis one can state that the Project Document contained all the elements which reasonably are necessary for the creation of effective applied aluminium industry research capabilities and the Project Director took care of the amendments the necessity of which appeared during implementation. It seems therefore, that the most important action to be actually taken in order to improve and reinforce the overall applied research capacity of the Institute is to complete as quickly as reasonably possible the Project DP/YUG/75/022. It shall also be taken into consideration that, when in 1982-83 the necessity of the creation of the Aluminium Institute was recognized, the world economy was in the status of recovery, the demand in metals increased and the prices were relatively high. Even under these conditions the UNDP, the competent Yugoslav authorities, the Aluminium Association of Yugoslavia and the KAT felt appropriate to establish the Aluminium Institute with a view to foster the development of this industrial branch in the country, increase its competitiveness on the foreign markets and decrease its dependence on foreign technology.

Having in mind the recent rather negative changes in the international economic situation and particularly the evolution of the metal markets, the achievement of the objectives of Project might be even more profitable for KAT and for the other aluminium producers in the country than it was considered when the Project was approved. Therefore in order to compensate as far as possible the possible consequences of the delayed installation of several important instruments and that of the problems related to the staffing situation of the Institute an extension of the Project for three years should be considered with a view to provide direct support to the Institute in order to assist it in the possibly full and adequate use of the new research capability which have been or are being created with UNDP contribution. Purpose and modalities of implementation of the suggested Project extension will be explained in Parts 3 and 4 of the present report.

In conclusion the following can be suggested with a view to reinforce the overall applied research capability of the Institute in the course of the forthcoming years:

2.1. Completion of the Project DP/YUG/75/022

- 1) The KAT Management should take urgent action in order to define a strategic and yearly programme of applied research for the Institute and for its realization make available at least the personnel indicated in the Project Document.
- 11) The Project Director should update the last 1986 September version of the Workplan for 1987, because of the additional delays which occurred in different project activities.



Considering the volume of different activities to be scheduled for 1987 and the training to be organized for the new staff-members to be recruited for the Institute, the Project Director should not hesitate - if appropriate - to schedule project activities partly also for 1988.

## 2.2 Extension of the Project DP/YUG/75/022

Part 4 of the present report contains suggestions concerning the most important amendments to be transcribed to the Project Document. The duration of the Project should be extended by 3 years, because 1987 will practically be fully devoted to the activities indicated in the present Project Document. During this year regarding the possible extension only preparatory activities could be suggested. UNDP should consider as a prerequisite for the approval of the project extension the full implementation by the KAT Management of the stipulations of the Project Document regarding the Institutional Growth Plan (Annex III to the Project Document).

### 3. Research and Development Programmes being carried out and to be initiated with priority taking into consideration the actual status and future needs for aluminium production in the KAT.

The activities of the Alumina Institute are carried out within the framework of the strategy by 2000 of technological development adopted by the Board of the KAT. In this framework for all relevant activities of all units within KAT 5 years plans are prepared. The yearly programme of the activities of the Institute is submitted by the Director to the Board of the KAT.

The KAT like the other important aluminium companies has actually to consider 3 main tasks in their R&D activities: intensification of the main production lines and increase their effectiveness; improvement of the rentability of the operations through diversification of the production introducing new activities requiring relatively small investments and leading to relatively high added value; expansion, through appropriate measures of the downstream aluminium production in the own production facilities and in those of the clientèle. The KAT Management oriented the yet modest research capacities in the last two directions namely diversification of the production and downstream operations. It would be too ambitious to express an opinion on the basis of a short mission about the appropriateness of this direction of the activities of the Institute but the results already obtained show that their avenues are promising. It seems therefore to be of purpose to speed up through direct UNDP support these programmes of the Institute particularly concerning the possibility of diversification in the alumina industry and the expansion of downstream activities regarding aluminium semis. The suggested extension of the Project would have the following purposes:

- 1) Using the results of a critical review of the alumina technology being used in the KAT indicate the possibility and conditions of its diversification in the following directions:

special aluminas

extraction of gallium  
red-mud processing  
production of refractory materials on alumina basis  
production of artificial white bauxite.

If appropriate the findings of the critical review could be used for the development of the technology of production of metallurgical alumina in KAT.

ii) Using the results of a critical review of the technology of aluminium semis production in KAT indicate the possibility and conditions of the fabrication of new or expanded high technology aluminium products e.g. computer disc, parabolic antennas, new automotive parts etc. either with KAT or with its clientèle. The findings of the exercise will be also used for updating of the technology of production of aluminium semis in KAT.

The suggested exercises could be organized according to the following tentative scheme: information to be given by the expert/consultant on the state of the art concerning the activity under consideration; critical review by the expert/consultant of the relevant technology and production and research possibilities available in KAT; identification of priority problems the solution of which should be envisaged through appropriate R & D activities within the Institute; establishment of a relevant programme; periodic review and evaluation with the participation of the expert of the progress of implementation; preparation of final reports; participation - if appropriate - of the expert/consultant in the practical application of findings. Representative of other Yugoslav aluminium producers might be invited to participate in these programmes.

The number of experts/consultants to be involved in these programmes and the duration and frequency of their participation should be tentatively specified at the next Project Revision and refined through implementation by the Project Director. Study tours conceived and organised following the advice of the experts could complete the above explained useful exercises.

The drafter of the present report is deeply convinced that better knowledge in KAT about the demand of the clientèle in more sophisticated products and broader dissemination of information to the clientèle on possible application of KAT products of higher value would, without any doubt, increase the competitiveness and revenues of KAT. Therefore the creation of Advisory Services for Customers within the Institute seems to be highly desirable.

#### 4. Extension of the Project DP/YUG/75/022

On the basis of the above explained justifications it is suggested to revise the Project Document and introduce the following changes:

- 1) function of the project: institution building cum direct support
- (ii) duration of the project: 7 years
- (iii) Outputs add e: Preparation of reports about the possible solution of technological problems in the

alumina and aluminium - semis production in KAT related to the envisaged diversification and down-stream orientation of these activities.

(iv) Increase the project budget with the following amounts:

11-xx :	US\$ 54,000
32-00 :	US\$ 15,000
51-00 :	US\$ 1,000
total	US\$ 70,000

5. Conclusions

Without any doubt one can state, that the role of the Institute is increasing in the solution of R&D problems of KAT. Because of delays in the delivery of some equipment items and staffing situation of the Institute a considerable part of the envisaged expert and training project activities have to be shifted to 1987. Finalization of the workplan for 1987 is an urgent task of the Project Director. Urgent assignment by KAT of qualified staff to the Institute is a prerequisite for further successful project activities. Direct support by UNDP to the Institute's activities through an extension of the Project for 1988-89 would be extremely useful.

6. Recommendations:

For UNDP and UNIDO

To agree with the extension of the Project DP/YUG/75/022 on the basis of the suggestions submitted in the present request. To process accordingly the revision of the Project Document.

For the Board and the Chairman of the KAT:

To approve as soon as possible a strategic and yearly programme of applied research and start immediately action to implement the Institutional Growth Plan included in the Project Document. To consider the possibility of organising Advisory Services for the Clientele based on the relevant experiences collected through project activities.

For the Project Director:

To submit for the consideration of the Chairman of the KAT a tentative strategic and an elaborated 1987 programme of applied research with a view to start as soon as possible the recruitment of additional staff for the Institute.

To transmit to UNIDO by the end of January 1987 the updated workplan of the Project for 1987.

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The drafter of this report wishes to express his full appreciation to Mr. Branislav Radonjic, Director of the Aluminium Institute, for the substantive and logistic support, be received from him during his mission to Titograd.

ANNEX I.

Status of Implementation of Expected Outputs of the Research Programme  
(Annex VI to the Project Document)

- ad I.B.4.: The experience showed that the training foreseen for sedimentation phenomena was not necessary.
- ad I.B.5.: Expertise foreseen regarding sedimentation phenomena was not necessary; it was provided by the alumina consultant.
- ad III.: Activities related to the capability of the Establishment of the Heat Balance for Pots did not take place.
- ad II.A.1.: Equipment under installation
- ad III.A.4.: 1.5 m/m of training will take place in 1987
- ad III.A.5.: Consultancy scheduled for 1987
- ad III.B.4.: 1 m/m of training shifted to 1987
- ad III.B.5.: 1.5 m/m consultancy should take place in 1987
- ad III.C.: The experience showed that the training foreseen for the operation of laboratory furnaces was not necessary
- ad III.D.: As indicated the equipment was purchased by KAT; it is fully operational
- ad IV.: Additional 0.75 m/m of training is foreseen for 1987