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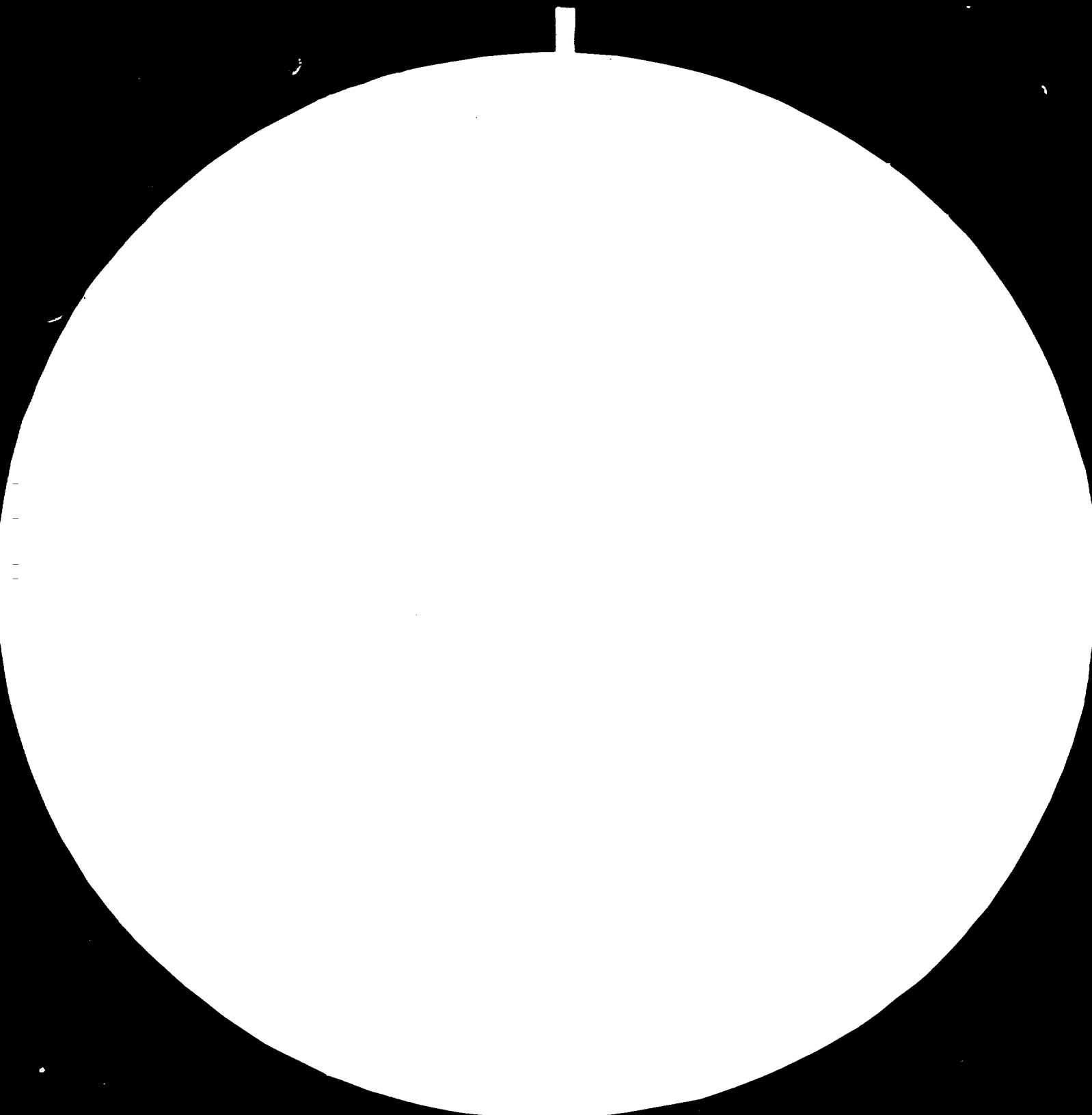
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TURKEY.

Technical report: Examination of the Feasibility
Study for steelmaking and continuous casting of the
4-th Integrated Steel Works in Turkey at Sivas area

Prepared for the Government of Turkey by the
United Nations Industrial Development Organization
executing agency for the United Nations Development Programme

Based on the work of Stanislaw Tochowicz, expert in
steelmaking and continuous casting

United Nations Industrial Development Organization
Vienna

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This report has not been cleared with the United Nations
Industrial Development Organization which does not, therefore,
necessarily share the views presented.

ABSTRACT

Examination of the Feasibility Study of steelmaking and continuous casting of the 4-th Integrated Steel Works in Turkey in Sivas area.

Job description: DP/TUR/76/038/11-14/31.8.C

Duration: 1 month, from 3 to 28 February 1981

Duty station: Ankara

By the examination of the Feasibility Study have been prepared, findings contained the estimate of the study and advices further steps of project. In the recommendations have been presented problems which should be made more precise or should be settled before beginning of the detailed study.

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INTRODUCTION

The State Planning Organization of Turkey in his elaborations and projections has foreseen demand of steel products in years from 1980 till 1990. There are some gaps between the demand and production especially in years after 1986 in bars, rods, heavy sections, rails (long products) . In aim to strike the long products balances in the country Turkish Government decided in 1976 to establish the 4-th Integrated Iron and Steel Works named Sidemir in Sivas region. Sidemir would be constructed in two stages. The production of crude steel in stage I will be about 1 350 000 tpy and in stage II about 2 760 000 tpy. The crude steel will be produced in BOF converter of 130 tons capacity and will be casted in continuous casting machines curved type for billets and blooms.

The previous Feasibility Reports prepared:

Kaiser Engineers Ltd., and

Sidemir Group's Feasibility Study

After the revising and up to dated of this report Sidemir Group prepared in 1980 the Feasibility Study which has been approved as a basis for further work.

Expert of UNIDO would in cooperation with the Sidemir Group for Feasibility Study examine the study of Integrated Iron and Steel Works of Sivas and give advices for further improvement of this study, in the part of BOF steelmaking and continuous casting (Job description DP/TUR/76/038/11-14/31.8.C).

The examined and eventually improved Feasibility Study will be the basis for the Sivas Project Group for preparing of detailed project study of BOF plant and continuous casting.

The establishment of the Fourth Integrated Iron and Steel Works in Turkey has been considered in Third Five-years Plan.

The construction of anew work in Sivas would be helpful in solving some problems of unemployment in this area. By preparing of the project it is necessary to take into consideration the fact of the construction of the up to date ^{work} in the area where is a lack of skilled labour. In these conditions all methods of the production and all installations must be sure and tried.

I. FINDINGS

The increasing of the steel products and crude steel production premising the construction of the BF shop and using own ores, can be obtained in the best way by construction of BOF steel making shop and by using of continuous casting method. The selection of the production methods made by the Sivas Group is right and correct. From the other BOF steel making methods the LD method is the best known, least complicated, known and used in Turkey. The equipment for this steel making method is known and tried and a large group of constructors can build it without troubles.

So is with continuous casting of steel. For killed carbon and low alloyed steel this method is applicable without hesitation. The improvement of steel product yield from the crude steel, the lowering of cost of the construction of Integrated Steel Work are the arguments which is not possible to discuss.

Confirming the choice of the principal production methods I have some problems to take into construction before and by making the detailed project study of the steel making shop.

- The choice of the quantity and capacity of the converters is reasonable. The increasing of the possible productivity of the Integrated Steel Work is right, though it had brought some troubles for the steel melting shop introducing in its programme the rail material. There are some reserves by calculating the the steel melting shop capacity (e.g. in calculation of the melt time, in accepted number of the working days in a year) but from other point of view in the calculation was not taken into consideration the number of taps with reblowing. This number can be kept low using the method of going down with the carbon and carburizing the bath in the ladle to the required level of carbon contents. In these conditions, it is necessary to foresee the making ready of dry materials for carburization.

- In The further steps of projecting, it will be useful to examine the necessity of the mixer installation. A mixer of 1200t capacity for a BOF melting shop producing about 4000t a day in the first stage and 8000t a day in the second is a little one. All contain of the pig iron will change in about eight hours in the first stage and in about four hours in the second stage. Because of capacity and connected with it strong foundation the construction is expensive. Because of expensive, imported special magnesite lining the up keep costs will be high. The other possibility is the use of torpedo ladles in number depending of their capacity. The pig iron waiting time in the torpedo ladle can be up to 24 hours without troubles. The fireclay lining of the torpedo ladle is cheaper and can be made in the country. The knowledge of the exact chemical composition of pig iron, very important for BOF steelmakers can be assured by using of fast methods of chemical analysis and observations of changes of pig iron chemical composition the preceding BF casts. Using the torpedo ladles it is necessary to prepare in the project a place for the casting of the pig iron from torpedo ladle to the hot metal ladle, a place for taking off the pig iron slag before pouring of the iron into the converter. Would be very useful to foresee a place for the desulphurization of the pig iron for higher sorts of steel. The content of the sulphur written in the Feasibility Study as likely for the pig iron (0.04%) is not low and for higher sorts of steel it is to keep it lower. The method of pig iron desulphurization is the cheapest and easiest one.

- Using of tar dolomite blocks for the lining of the converters is right and life of the lining about 800 taps is possible to obtain. Using of dolomite blocks prepared in Iskenderun is possible, but blocks prepared have to be transported in hermetick closed containers. Adequate number of containers must be bought or projected and constructed.

- The further steps of projecting must precede the good recognition of steel work production conditions. The quality

of the ores must be good known because of it depends the quality of the pig iron (e.g. the contents of As in the ores which leads to the contents of As in the pig iron forces to lowering of the sulphur contents in the pig iron. The sum of As + S is very important for higher sorts of steel). The supplying of the good, clean water is necessary to be certain. The possession of sufficient quantity of good, metallurgical dolomite must be undoubted (this is not the fact-page VI.3 of Feasibility Study)

- The introducing of the rails material in the steel shop production programme makes some conditions of the production necessary. It is comprehensible with regard to the conditions of their work (very low temperatures down to -30, -40°C). The steel to be sure for this conditions must contain low quantity of S and H. The lower content of S is the better. The desulphurization of the pig iron before using in converter is very useful. The content of hydrogen must be lower than 2cu.cm.H /100 gram of steel, or the rails must be very slow cooled after the rolling. The preparing of the possibility of slow cooling of so long products as rails is not an easy problem. The degassing ought to be made in the ladle before casting. For the ladles 130 ton capacity to obtain a good degassing of all quantity of steel the portion methods (DH, RH) are the best. Independent of the vacuum degassing it is necessary to use all known means in a_{sm} to keep the content of hydrogen in the steel as low as possible (e.g. to use very dry carburizator without moisture, by carburizing of the steel during the tapping).

It is good to know that the trials of using steel with As for the production of rails did not give good results.

Adding of the Fe-Mn during the tapping it is necessary to use it in pieces of 40-50 mm diameter to assure fast and good solution of the added material in the steel.

- The calculation of the oxygen consumption (Annex VIII, page4) is only the first approximation. This consumption is dependent on a number of parameters. It is safely to take a

little greater quantity of consumption (at least $55 \text{ Nm}^3/\text{ton}$). It is not because of productivity of the oxygen plant. It is bigger than necessary for steel melting shop in aim to use oxygen in BF and other purposes. But with using the datum of oxygen consumption for 1 ton crude steel obtained datum of possible rate of oxygen flow in pipes and tuyeres, $446 \text{ Nm}^3/\text{min}$ (page VIII.19, first part of study) is too small. It is better to have some reserves in oxygen and gas pipes, this reserve can be utilized for eventual intensification of the productivity.

- In further steps of projecting would be useful to examine in details the problems of converter gas using, the problem of dust from cleaning of the converter gas, and the problem of converter slag. The most important is the problem of the gas. From energetics point of views the cleaning, the storing and using for firing in the reheating furnaces is the most interesting. But all installation for the preparing of the gas to work safely must operate very precisely without any mistakes. It can be said that this installation is a little dangerous. There were already explosions in such installations in the world. In the exact study about this problem, it would be useful to examine the other possibilities of the converter gas utilization. For instance another easier installation is the waste heat boiler (economiser) in converter hood in aim to obtain the steam with pressure about 16-20 atü. A problem by using the waste heat boiler is the necessity of heating the boiler in times when there is no oxygen blowing.

The converter gas must be cleaned. The best method of the cleaning is the wet one. The dust after the cleaning is in form of slime. It is rich in iron but very small grained. The using of this slime for the cooling of sinter after the sintering would be useful.

The converter slag can be used as a part of BF charge in aim to utilize of the iron. In this case it is necessary to observe the content of P in the pig iron. All P from the BF charge goes to the pig iron so as almost all P from converter

charge goes to the slag. The pig iron becomes richer in P. So from time to time it is necessary to throw out a part of the slag from the circulation.

- The capacity and the type of continuous casting equipment is good connected with the capacity of steel melting shop and the production programme. The waiting time of the steel in the casting ladle (65 min) is of course admissible and even can be longer.

It is necessary to have in the consideration the cleanness of the cooling water in particular for the second cooling. Some sorts of steel are very tender for quality of the second cooling and it is possible to assure only by good cleanness of the water and connected with it all tuyeres of second stage of cooling being in operation.

By making the detailed projects, it will be useful to keep in mind some other little questions.

- Using of shaft furnaces for burning of the limestone is right but it is necessary to use the type of furnaces which can assure the obtaining of soft burnt lime. The quality of the burnt lime, the possibility of very fast creating of slag is very important for the BOF process, particularly for the life of the converter lining.

- The possibility of 3 days storage of burnt lime is not necessary having own furnaces for the burning and in conditions when it is very useful to give into the converter fresh burnt, soft lime.

- The borders of the lime grain sizes would be increased from required in the study 15-40 mm ^{to 10-40 mm which,} can be used in BOF converter without troubles and so the fraction lower than 10 mm, in the sinter plant.

- The stirring with argon, very useful for the 130 ton ladles, would be better using the lance, with tuyere plunged in the steel than introducing of the argon through the bottom

of the ladle. Results of the stirring would be the same but the first method is easier and more safe.

- In the further steps of the project it is necessary to prepare a good and fast method of BOF charge calculation for the each tap depended on the parameters of the pig iron and the scrap. It can be a method with using of computer or because of the easy program of the steel grades and other one with monograms or others.

II. RECOMMENDATIONS

Before starting with the preparing of detailed project study Sidemir Group should make more precise some questions and should settle some others. To the first questions belong:

1. The knowledge of ores and materials will be used in BF charge, to guarantee the needed quality of the pig iron for BOF melting shop. The stability of the pig iron quality factors is for steel making is very important too.

2. The settlement of the descending and quality of this part of scrap will be taken from abroad of the steel work. Only about 50% of the scrap needed for BOF melting shop will be taken as the scrap from own rolling mills.

3. Because the question of the limestone is clear, still the question of dolomite must be cleared up.

4. The knowledge of exact sorts of steel will be melted in BOF shop. It is necessary to choose of the methods needed for making sure the quality of the steels.

5. The knowledge of the water will be used in cooling systems of the BOF melting shop and continuous casting. The needed quantity of the water must be guaranteed. By troubles with the quality of the water it is necessary to settle the methods of the preparations of the water before using. The sufficient quality of the water is very important for BOF and continuous casting.

6. It is necessary to be sure about the ground properties because of foundations of heavy installations.

The questions from the second group should be settled using the opinions written in the findings before beginning of the detailed project study.

7. The choice between the mixer and torpedo lades for the transport of the pig iron from the BF to the BOF.

8. The settlement of the tar dolomite blocks producer.

9. The construction of the desulphurising installation depended on quality of the pig iron and sorts of steel will be produced.

10. The method of utilizing of the converter gas.

11. The construction of vacuum degassing installation for the rail material

The less important questions written in the part of findings, should be used by further steps of the project. After the questions written in the part of recommendations Sidemir will be ready to gather the offers for the installations and prepare the next step of the project.

ANNEX 1

Conditions of preparing of the detailed project study

Feasibility Study made ^{by} Sivas group it is the first step in preparing of the steel work project. In the study were examined problems about the:

- Production methods
- Capacity, type and productivity of the main equipment
- Production programme
- The share of the main products in the total production.

Would be useful to have in this study the demands of main energy carriers (power, water) in data of yearly, average and the greatest a day, average and the greatest an hour.

It is necessary in this study to examine very exactly the possibility of the covering of the main raw materials demand, demand of the water so as transport conditions in area of the projected steel work. Without of the certitude of having sufficient quantity and good quality of the ores, coke, water, limestone, dolomite it is not recommended to start to the next stages of the project.

The next stage will be detailed project study. The detailed project study should contain besides of capacity and type of main principal workshops equipment.

- further interesting details characteristics of main installation (e.g. type of the top device of the BF, charging equipment of BOF, type of tuyere of BOF, gas cleaning equipment, method converter gas using etc.)
- the main control and measuring equipments
- the possible performers of technical project of each kind of installation
- the possible performers of each installation in the country and abroad
- approximately terms of preparation of each project and considering construction of each kind of installation
- approximately cost of each kind of installation

- exact informations about the transport problems in the steel work and the connections with the transport in the country
- demands and balances of power, water, steam pressure, air and all other gases
- all problems of storage of raw materials, refractories, ferro-alloys, products and reserve parts
- problems of repair shops, electric shops etc.
- problems of the laboratories
- time schedules of all steps of the projecting and constructing of the steel work
- schedules of the staff
- financial problem of projecting and constructing of the steel work

To prepare the detailed project study it is necessary to have a very big project organization with specialists in each problem of technology. The other way is a smaller group of specialists so named engineering group which will be a coordinator of all the project. This group would be prepared for the coordination of works of selected, specialized firms from the country and abroad. This group can obtain all needed data in the way of asking for offers, studying other projects similar to the wanted ordering some projects after preparing all needed data. The group must work in a precise schedule knowing each step of the project.

In such organization in each specialists group would be working 2-3 employers. For instance in a group of steel-makers would be needed

- specialist of BOF technology
- specialist of continuous casting
- specialist of ref ractories

Every one specialist should be graduated, should have an at least 10 years long practice in steel making shop or project organization, should know two foreign languages (one of them is English) should be vigorous. Would be very useful to send him for a short practice to all steel melting shops in Turkey.

ANNEX II

Proposal of different alternatives of the construction of Fourth Integrated Steel Works at Sivas area

First alternative: It is the construction of the steel works with coke ovens, ore preparation, sinter plant, blast furnaces, steel melting shop, continuous casting and rolling mills.

This alternative is not cheapest one but gives the possibility for good connection of the problems from transport, energy, utilizing of the by-products from every step of production (e.g. BF gas for heating of coke ovens, BOF gas for steam production)

The construction of rolling mills only in the first step is not advisable because of expensive transport of blooms and billets to the mills and because of lack of fuel for the reheating furnaces. This alternative would be considered only in that case when all products from the mill should be used in the area of Sivas.

Second alternative: It is the construction in Sivas area at start only coke ovens, ore preparation, and sinter plant, BF, BOF and continuous casting. Billets and blooms would be send to the existing mills in the other part of Turkey and if there will be a demand for semi-products this alternative will be possible.

Third alternative: It is necessary to take into consideration because of possible troubles with suppliers of coke coal or coke. I think it will be useful to examine some methods of direct reduction of ores. Using the sponge iron it is possible to make steel of needed quality in electric furnaces, cast it in continuous casting installation and use in the rolling mills.



