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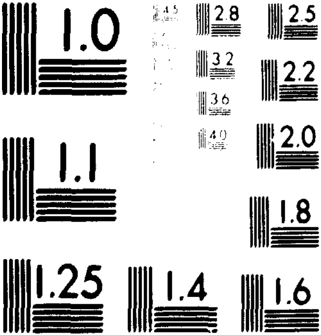
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(R) BLAST FURNACE EXPERT

TURKEY

(DP/TUR/76/038/11-06)

Final Report prepared for the Government of Turkey

by

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1. Introduction

This report is concerned with the split mission DP/TUR/76/038/11-06 in Karabük, Turkey. The mission was split into three phases:

- first, from 1 November 1978 to 15 December 1978, (covered under DP/TUR/77/014)

- second, from 2 September 1979 to 1 October 1979 and

- third, from 5 February 1980 to 5 March 1980.

In close agreement with Turkish Iron and Steel (TIS) Management in Karabük the first phase of the mission was mainly devoted to the modernization relining of the blast furnace in 3 (BF3), the second to modernization works on the blast furnace in 2 (BF2) and the last, third part of the mission, to elaborate the programme for the modernization relining of the blast furnace in 1 (BF1).

During the three phases of my mission the evaluation and recommendations for current blast furnace operation in Karabük Steel Works were continuously provided. Part of time was devoted to Sivas Group preparing the feasibility study for Fourth Steel Works in Sivas, Hasancelebi Group, and Steel Works in Iskenderun and Eregli.

The findings of entire mission are presented in four parts:

1. Reviewing modernization works of BF3, which were prepared and performed during the 1st and 2nd phase of my mission.

2. Reviewing the entire modernization works of BF2, which were prepared and performed during the 2nd and (3rd) last phase of my mission.

3. Calculation of basic data and elaboration of preliminary drawings for future modernization BF1. These works were done mainly in the last phase of my mission.

4. Proposals and remarks to the current BF's operation in Karabük in the light of earlier presented recommendations (see the Final Report of the first mission to Turkey on 20 May 1978 and Interim Reports of the first and second phases of current mission).

Major data and main sketches are presented in Appendices.

I am very grateful to Turkish Iron and Steel Management and Karabük Steel Works Staff for their friendly assistance and great collaboration in all ranges of my activity.

2. Findings

2.1. Evaluation of performed BF3 modernization works.

In the period from 19 April 1979 to 25 June 1979 were performed renovation works on BF3. Despite very short time for preparational activities, all works undertaken on BF3 by only TIS staff, without any assistance from outside were done with excellent quality. It was performed under the great programme of the construction which brought the fact that the present BF3 is "a new, modern blast furnace built on the old foundation".

Almost all points of wide programme of modernization (see Interim Report of 1-st phase my mission) were fulfilled. In details:

2.1.1. BF profile was changed with increasing number of tuyers from 14 to 16.

2.1.2. New shell performed in Turkey was applied.

2.1.3. New copper coolers casted in Castin- Department Karabük Steel Works, were installed.

A very advanced air cooking system was built in the bottom.

2.1.4. The lining was made in accordance with the previous agreement, using the refractory delivered by Brothal, F.R.Germany.

A new stable throat armour was installed on the top of the stack lining.

2.1.5. The"worn out" stove lining was repaired. Part of checkers and combustion chambers of all three stoves were replaced.

2.1.6. A new blast ring was installed.

2.1.7. New draft chimney was installed with the small hot blast valve, as the draft chimney valve.

2.1.8. Newly constructed blast elements were installed according to prepared drawings. They make possible blast to reach 1100 - 1150°C. Two new chambers tuyers were casted in Karabük Steel Works in order to cope with adifficulty in BF operation.

2.1.9. The slag notch was installed.

2.1.10. A newly made big bell was applied, which was casted in Karabük Casting Department.

2.1.11. Parts of the new control equipment was installed in very small, old control room.

2.1.12. A great part of all mechanical and electrical equipment was improved.

All these changes contributed to the fact that the present BF3 is completely modern and there are no limitations for further improvement of BF operation.

To fulfil the entire programme which should be applied in the future following points were discussed with Karabük TIS Management:

2.1.13. Construction of new, bigger control room according to the design prepared during previous mission. During the installation in new control room following instruments should be installed in addition to the replacement of old instruments.

- stove chimney gas (waste gas) analizer (O_2,CO,CO_2)
- coke moisture recorder,
- water pressure recorders for each cooling region,
- water quality recorders for each coolin- region.

2.1.14. Installation of stag granulater. Current conditions of stag and iron transportation (unsatisfactory number of iron laddles and slag cars) make difficult to increase cast number on BF3 from 6 to 8 per day. Slag granulation should:

- solve the problem of slag transportation from BF5 to present slag pit, used in future as granulate stockyard,;
- increase the yearly output of granulated slag from BF3 from 250 to 300 thousand t (see Final Report 20 May 1978, page 23.)

2.1.15. During the renovation works was the new modern charging system, designed by Rheinstahl, F.R.Germany not installed. inspite of recommendation presented during my previous mission (see Final Report, 20 May 1978, page 22, point 12).

It is postponed to the undefinite future. Future construction of charging system on BF under operation, with cause of great difficulties and production losses.

2.1.16. New blower for BF3 discussed during previous mission will be installed with the realization of the great programme of modernization for Karabük Steel Works' Power Plant (about 1983).

2.1.17. Judging from present BF operation data and raw material costs installation of fuel oil injection seems to be unsuitable.

The details of presented points of BF3 modernization programme were described in the previous report.

Appendix 1 refers to:

- remarks to the construction and equipment installed on the BF3;
- evaluation of BF3 "blow out" and "blow in" periods.

2.2. Evaluation of performed BF2 modernization works.

Modernization relining of BF2 was performed from 19 November to 28 December 1979. In very short time of 39 days several elements of BF structure were changed, entire BF was relined and BF stoves were repaired.

BF modernization was prepared during my mission in Karabük, new elements and structure were prepared in Karabük Steel Works and in the stopage time all works were carried out by Karabük Steel Works Staff.

During the stopage all the below mentioned points were performed:

2.2.1. Installation of new big bell with diameter 3150 mm (10' - 4"). This solution increases distance between big bell and throat wall from 608 to 711 mm. New bell was casted and machined in Karabük Steel Works.

2.2.2. A new shell was installed in the bosh which originally had no shell. The new, welded type, 25 mm thick shell is connected to the top with the stack ring and in the lower part with old hearth shell.

2.2.3. Installation of new type of copper coolers in bosh region. This type is similar to coolers used on BF3. Coolers were cast in Karabük Steel Works' Foundry.

2.2.4. The relining was performed according to earlier agreement. For improvement of bottom lining construction, the 400 mm thick layer of graphite blocks were used below bottom carbon blocks. The refractory materials are delivered by Brothal, F.R.Germany.

2.2.5. New bigger control room was built for BF2. There are installed new instruments and recorders according to the list presented in my previous Report.

During the stoppage were two platforms around BF stack constructed to maintain thermocouples installed in BF stack lining.

2.2.6. In the repair time, the upper part of stove checkers and lining of combustion chamber were changed.

To complete the entire programme which should be applied in the near future following points, which were not performed during the stoppage time are recommended:

2.2.7. Newly constructed tuyers should be installed. According to present satisfactory results of new, two chambers tuyers on BF3 it was agreed to install the same type of tuyers on BF2.

2.2.8. According to the conclusions connected to all my Reports two weighing hoppers should be installed for coke.

The installation of very advanced charging system developed by Rheinstahl, F.R.Germa-y is postponed to undefinite future. During the stoppage was neither Rheinstahl system, nor simply weighing system installed - proposed in my Reports. In the last phase of my mission (February 1980) it was finally accepted by Mr.I.Korkmaz designated by the Karabük Management, that the screening and weighing system would be installed in future in order to give more satisfactory results. The details are presented in appendix 2.

Appendix 2 is also connected to:

- Remarks to the construction and equipment installed on the BF2
- Evaluation BF2 "blow out" and "blow in" periods.

2.3. Modernization programme of BF1

BF1 was blown in the year 1939. Assumed time of relining, preliminary accepted by MS Karabük Management is spring-time 1982.

BF1 retains the original structure without changes. Furnace and stoves shell are rivetted, Stack is supported by 8 volumns, and bosh is built without jacket, using only rings to bind the lining. During the last relining on BF2 were performed a few modifications. Short time for preliminary works limited the range of modernization. Two years until BF1 relining gives possibility to extend rangs of modernization. On this base during my last phase of mission (February 1980) was established Group headed by Mr.Erlan Göksu to prepare future BF1 modernization. During February 1980 all activities were concentrated to the following points:

- Examination of the present condition of BF1 (mechanical electrical equipment and structural elements), necessary rage of renovation works. This part of activity was done by TIS Karabük Staff. Results of examination are whown in appendix 3.

- Elaboration of the proposals for modernization programme.

On the meeting held on 26.2.1980 it was confirmed that main part of all elements of BF1 are worn out and during the relining it must be chosen:

- Whether the present structure should be utilized or

- newly constructed structure specially designed should be applied.

These two alternatives are reason for two alternatives of future modernization programme:

- programme "minimum", which is an expanded programme performed last year on BF2 and

- programme "maximum" which is in reality the erection of the new BF1 on the old, reinforced foundation.

2.3.1. BF1 modernization programme "minimum"

Programme "minimum" can be compared to executed modernization of BF2. The future BF2 modernization should contain following points:

1. Installation of the shell in the bosh. The construction should be prepared the same as for BF2. The new, 25 mm thick, welded bosh shell, will be connected on the top with the stack ring, in the lower part to new, welded hearth shell.

2. Installation of new constructed, welded shell into the hearth. The original rivetted structure is very old. Application of a new type hearth cooling causes also the change of hearth shell.

3. Change of the all cooling system. In the furnace bottom and partly in hearth should be installed new type stave coolers. For the bosh region should be designed new type copper coolers. It must be put into consideration coolers to stack, connected with the old, rivetted shell. After 40 years practice without coolers in this region, current stage of the old stack shell, refuses the solution used normally in modern BF construction.

4. Correction of present BF profile. First change performed on BF2 concerned big bell dia only. It was caused by the fact, that all refractory was earlier ordered, and should be used to relining.

   BF1 profile should be changed according to the data shown as the alternative 2 (appendix 3). It is proposed to increase the hearth dia from 4572 to 4800 mm, bosh dia form 5791 to 6000 (5900) mm and strongly reduce the throat dia from 4572 to 4200 (4100) mm. Height of bosh parallel and stack will be also corrected.

   Correction of BF profile can cause change of the BF shell shape.

5. Installation in the throat of the modern type throat armour.

6. Installation of new big bell with 2700 (2600) mm dia and new big bell hopper according to given proposals during my mission. That solution increases distance between big bell and throat wall to 750 mm.

7. The lining construction should be done using high alumina bricks in the lower part of stack, bosh parallel and bosh. In the hearth and bottom should be applied the same structure as on BF2 corrected to the new dimensions.

8. Installation of new hot blast elements (neck, goose-neck, elbow, blow-pipe, tuyer and tuyer holder) the same as on BF3. They can raise blast temperature to 1100 - 1150°C.

9. Installation of new hot elements and increasing hot blast temperature requires change of the blast ring. The main data of new blast ring and blast main are given in appendix 3. Notable changes in blast ring construction are:

   - increasing the inside dia from 790 to 900 or 1000 mm,

   - increasing the thickness of refractory from 294 to 405 mm.

   It makes possible to use three layers: permanent layer and two "working" layers of high alumina bricks.

10. During the relining time the higher part of stove checkers and lining of combustion chamber must be changed. It can be considered following alternatives:

    - repair the stove lining maintaining the old structure. In that case maximum blast temperature can reach 850°C.

    - reconstruction of the stoves of old shell according to the alternative 2, which gives possibility to increase blast temperature to 950°C.

- construction new stoves with 6 m dia and 30 - 32 m height. That solution increases but temperature to desirable 1100°C.

  The two last alternatives require change of stove burner.

  According to the TIS General Manager's request stove reconstruction will be executed in September 1980.

11. The draft chimney similar to BF3 should be installed. The satisfactory result on BF3 with draft chimney valve in Karabük Steel Works is the good reason to desi, ı and construct new craft chimney valve with dia adopted to BF1.

12. Current control equipment is very limited:

    - built the new control room, bigger than for BF 2,

    - install new control equipment according to my previous recommendation for BF3.

    Installation of thermocouples in stack lining requires construction of two new platforms same as on BF2.

13. Installation of new screening and charging system for coke is required and will be constructed by "Nace" firm in Ankara. That very serious problem was not solved more than two years ago and must be taken up as soon as possible. It means that during the stoppage should be performed some improvements to connect the coke screening and charging system to BF automatic charging system.

2.3.2. BF1 modernization programme "maximum"

The programme,"minimum"was limited by old stack construction. Charge of blast furnace tuyer number from 8 to 10 Correction of BF profile requires change of upper part BF foundation and therefore change total BF construction.

Programme "maximum" roughly contains:

1. Change of BF profile. The new profile (see alternative 3 and 4 in appendix 3) was calculated to the current trend and the best examples in the world.

   The main changes are:

   - increasing the hearth dia from 4572 to 4800 mm,
   - increasing the bosh parallel dia from 5791 to 5800 (5700) mm,
   - decreasing the throat dia from 4572 to 4000 (3900) mm,
   - reducing the big bell dia from 3353 to 2500 (2400) mm.

That correction changes the angle of bosh from 78° 14' to desirable 80° 32' 15" (81° 28' 09") and stack angle from 87° 08' to 85° 33' 48".

Together with new profile should be increased number of tuyers from 8 to 10.

2. New BF shell will be designed and constructed according to prepared sketches during my last mission. Shell is supported by two rows of 5 columns (in each row). Lower columns extended from the reconstructed foundation to stack ring, upper row of columns is based on the stack ring and supports throat platform.

   The structure should be calculated and preliminary designed before September 1980.

3. Change of columns number and reconstruction lower part of shell require change and reinforcement of BF foundation. Preliminary sketches were performed and design should be prepared at the same time when BF steelwork is designed.

4. It should be installed with new cooling system. Upper part of stack, hearth and bottom region will be cooled by spray cooling. In lower part of stack, bosh aprallel and bosh will be installed copper plate coolers, new type, especially designed for BF1.

   In the region of copper coolers additionally spray cooling system should be also installed.

5. Change of BF profile and its construction requires to design new big bell and its hopper. The both new elements can collaborate with old top gear.

6. BF lining should be based on the same principle as proposals for the programme " minimum" and will be designed in autumn 1980.

7. During the stoppage charging system should be improved and built new, big control room equipped in wide range of new instruments indicators and recorders.

8. New hot blast elements, new blast ring and blast main should be installed (see points 8,9 and 11 programme "minimum").

9. The new, modern BF requires new stoves. The new (6 m dia, 30 - 32 m height) stoves will be designed in the next mission according to the request of General Manager TIS.

2.4. Remarks to current BF operation

New, modern BF3 construction and modernization of BF2 caused possibility for notable growth of furnace output and reduction of coke ratio. At present are all conditions of BF construction for improvement furnace operation fulfilled. (For example: increasing blast temperature on BF3 up to 1000°C). The serious limitation on that way is very poor burden quality. This weakness of Karabük Steel Works was indicated in all Reports (see Final Report, 20 May 1978 pages: 1,2,5,6,9 etc.). These problems were also many times discussed with Karabük TIS Management.

2.4.1. Coke quality

Coke produced is of low value coals from Zonguldak region. During last 2 years no improvement was noticed in coke quality. High ash content up to 21 %, unstaable high volatiles from 1.1 to 2.5 % oversize coke. During blast furnace operation coke crashes and turns to a lot of coke fines. These are the main weakness of Karabük coke. In the present condition without change of quality of coals used in coke plant no improvement can be expected. Therefore realize coke handling facilities between coke yard and BF plants as soon as possible - coke crashing and screening plant can considerably improve coke mechanical properties.

Before putting into operation coke crushing and screening plant they must consider following:

- construction new, 600 m long, railway - track,
- design and installation dust cleaning system.

It was considered and presented to Karabük TIS Management coke crushing plant is urgently needed and coke granulation sent to BFs is needed to be estimated to bring better results of the operation.

At least it was decided to crush all coke over + 60 mm (instead installed screens 75 mm) and then screen all coke to 4 classes:

from 40 to 60 mm	for BF3
from 25 to 40 mm	for BF1 and BF2
from 10 to 25 mm	for other purposes (for example for sale).
from 0 to 10 mm	to Karabük sinter plant.

It was also considered to screen to 3 classes:

from 25 to 60 mm	for BFs
from 10 to 25 mm	for sale
from 0 to 10 mm	to Karabük sinter plant.

The first alternative is more difficult becaus of using only the existing conveyer belt between coke crushing plant and BF bunkers. Very exactly executed programme has to be used to send classified coke in separated portions ("big" and "small" size coke) of BF3 and BF1 + 2 bunkers.

The test in the operated coke crashing plant was performed to decide for future programmes.

2.4.2. Limestone

In all previous Reports it was presented that limestone used into BFs has too many oversize pieces and at the same time too much fines. Screening analyses taken from time to time on BF bunkers confirm this view. Karabük limestone vein is situated only 18 km from Karabük Steel Works Crashing plant to ensure the size from 60 to 20 mm can be installed without any difficulty. During my last mission that opinion was presented to General Manager TIS.

2.4.3. Sinter and classified iron ores

Sinter quality was improved during last two years in very limited range. Almost all findings and conclusions contained in Mr.R.Jennings, UNIDO expert, reports are not performed.

BF1 and 2 are working with the unscreened iron ores with enormous share of fines. At the same time the existing iron ore crushing and screening plant is utilized in 70 % only. During my mission the programme for increasing the screening efficiency on the crushing and screening plant was discussed. After installation of 8 mm screens during summer time, instead of present existing 10 mm, the total output of screened ore should reach 1200 t per day. At the same time should sinter quality and sinter production be improved.

2.4.4. Improvements of BF operation

During present mission the "old" (connected in previous reports) and "new" recommendation, especially for BF3 operation were discussed with BF Management.

First of all following problems seem to be the most important:

- BF3 should be tapped 8 times instead present 6 times daily. Present 6 times tap schedule reduces gas and burden flow in furnace and decrease BF daily output.

- Alkali balance for each BF should be made daily. Current high alkali content in burden (12 kg per 1 t iron) may cause difficulties in BF operation in the future. This is well recognized in Karabük Steel Works.

- New shift report should be used for each shift, especially for BF3 (see table 13).

- According to previous remarks coke weighing hoppers on BF1 and BF2 should be installed as soon as possible. This problem was presented in details in appendix 2.

3. Conclusions

3.1. During m· mission in Karabük, Turkey two modernization relinings were performed:

- on BF3 (19.4.1979 - 25.6.1979) and
- on BF2 (19.11.1979 - 28.12.1979),

Modernization works were connected several construction changes and improvements.

3.2. During my last phase of mission programme of first sketches for BF1 modernization was discussed and prepared. That activity will continue in the future.

3.3. Limited progress was reached in current BF operation. It is urgently needed to put into operation new coke crushing and screening plant, improve quality of sinter, iron ore and limestone, and solve serious problem of cooling water quality.

Appendix 1

1. Remarks to construction and equipment installed on BF3

During the 2nd and 3rd phase of mission all installed elements, details and equipment were very carefully inspected. On the base of this inspection it was presented in chapter 2.1. that the preliminary, workshop and erection as well as installation works were excellently performed. Remaining problems are the following:

1.1. Tight to the shell air cooling pipes in the bottom cooling on the outlet-side. Recent stage could cause penetration of moisture into the BF bottom and destroy the carbon mass applied between cooling pipes and bottom shell.

The simple method of the tightening of this points was discussed with TIS staff and will be applied.

1.. Use insulation layer in blow-pipes. During the modernization works new constructed blow-pipes, which should be isolated with heat resistance concrete, were installed. In Karabük Steel Works is enough heat resistance mass - Castbrick 25. There is no problem to apply in the near future on BF3 all isolated blow-pipes for blast temperature above 1000° C.

1.3. The most important problem in present BF operation is the quality of cooling water. In all my previous Reports it was pointed out that: "Karabük cooling water is not acceptable". Cooling water contains a lot of turbidity (up to 1 g per 1 dm^3 = 1000 cm^3 water) and has very high hardness (see Final Report, 20 May 1978 page 5,25 and table 6).

In spite of the new constructed cooling system (installed new coolers, tuyers and slag notch elements) during the summer-time the process of destruction of BF lining proceeded very fast. At the end of August 1979, only 3 months after "blow in", lining temperature in the lower part of stack reached 1200° C. The situation improved during winter-time 1980. This condition is caused, first of all, by unsatisfactory water quality, wrong water distribution between all cooling sections, but also by slow improvement of burden quality and BF operation.

Present quality of cooling water causes very fast worn out of BF lining and further destruction of water cooling system. This problem was defined as the most important during the second and third phase of mission. (September 1979, February 1980).

In the agreement with TIS Management in Karabük, in September 1979, a Group to elaborate very simple methods for improvement of water quality was established. It was taken into consideration to supply

BF3 partly by clean source water instead "dirty" river water, to build the recirculation system with possibility for cooling warm, outlet water in store reservoir. Activity of Group in Febr. 1980 was unsatisfactory and must be reviewed. The entire programme should bring notable improvement of water quality but first of all considerable recution of content of turbidity.

According to the agreement between UNDP in Ankara and TIS Management a UNIDO expert to assist in the solution of this very urgent problem should be sent to Karabük.

1.4. Method of shell cleaning was discussed; cleaning the water runners; washing cooling boxes with the high pressure water; cleaning shell of blast ring etc. All these currently applied activities should partly help to reduce the fast process of lining destruction.

2. Remarks to the BF3 "blow out" and "blow in" periods

During the first phase of mission the programme for "blow out" and "blow in" periods was discussed in detail. According to the documents presented by BF Management all operations were performed according to earlier schedules.

On the connected tables the presumed and performed data compared:

- "blow out" period (table 1)
- "blow in" period (table 2)
- drying of BF lining (table 3)
- "blow in" burden (table 4)
- BF operation after "blow in" (table 5)

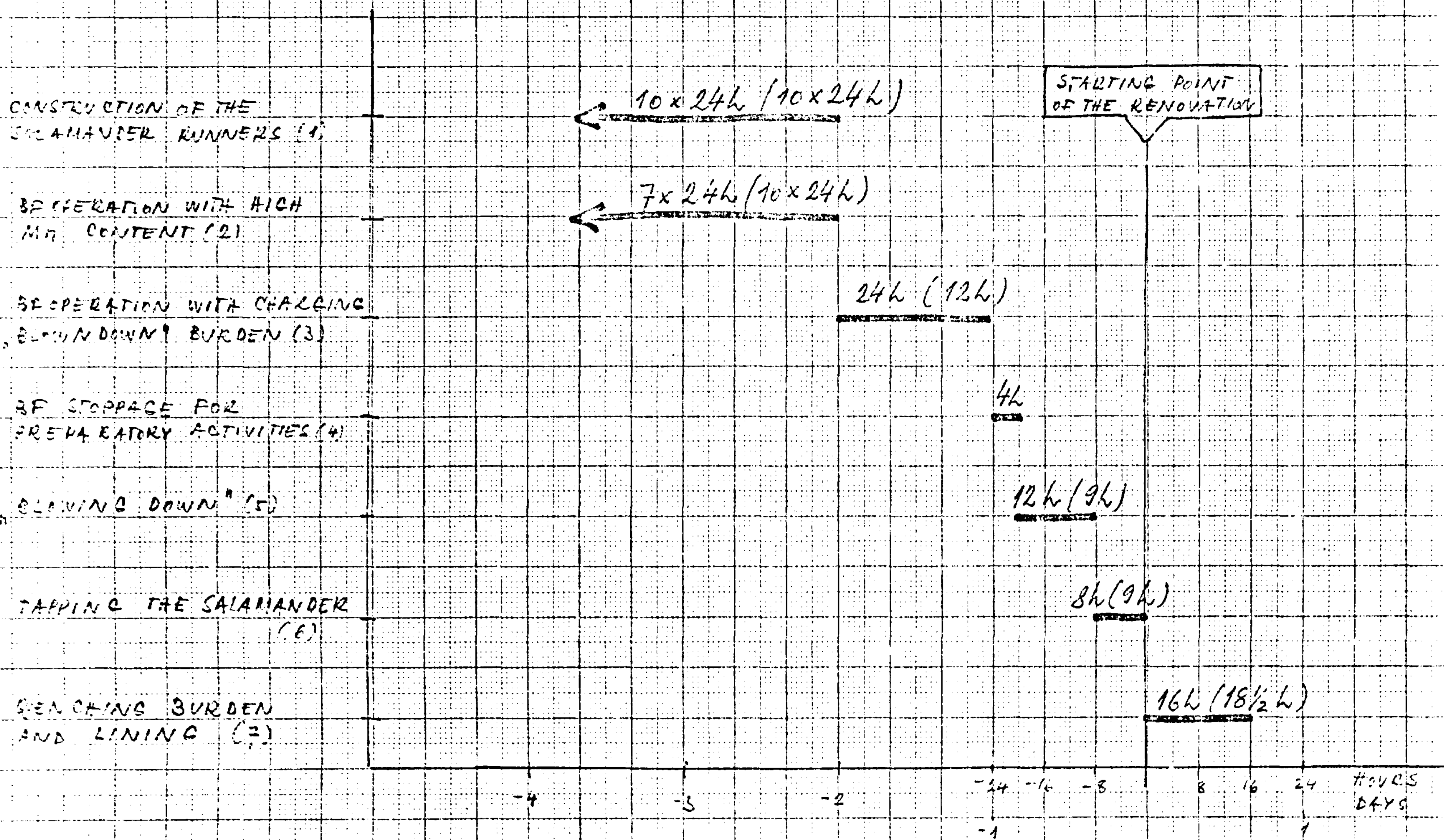
All activities undertaken by BF operation before and after stoppage were fulfilled without difficulties. BF 3 reached a normal iron quality with about 1.5 % Si content 6 days after "blow in". It must be pointed out that this was a considerable success of BF Management. On table 6 is presented Si, Mn and S content in iron shown in the first week after "blow in".

BF3

SCHEDULE OF „BLOW OUT" PERIOD

DERPORMED DATA IN BRACKETS

TABLE 1



BF3

SCHEDULE OF "BLOW IN" PERIOD
PERFORMED DATA IN BRACKETS

TABLE 2

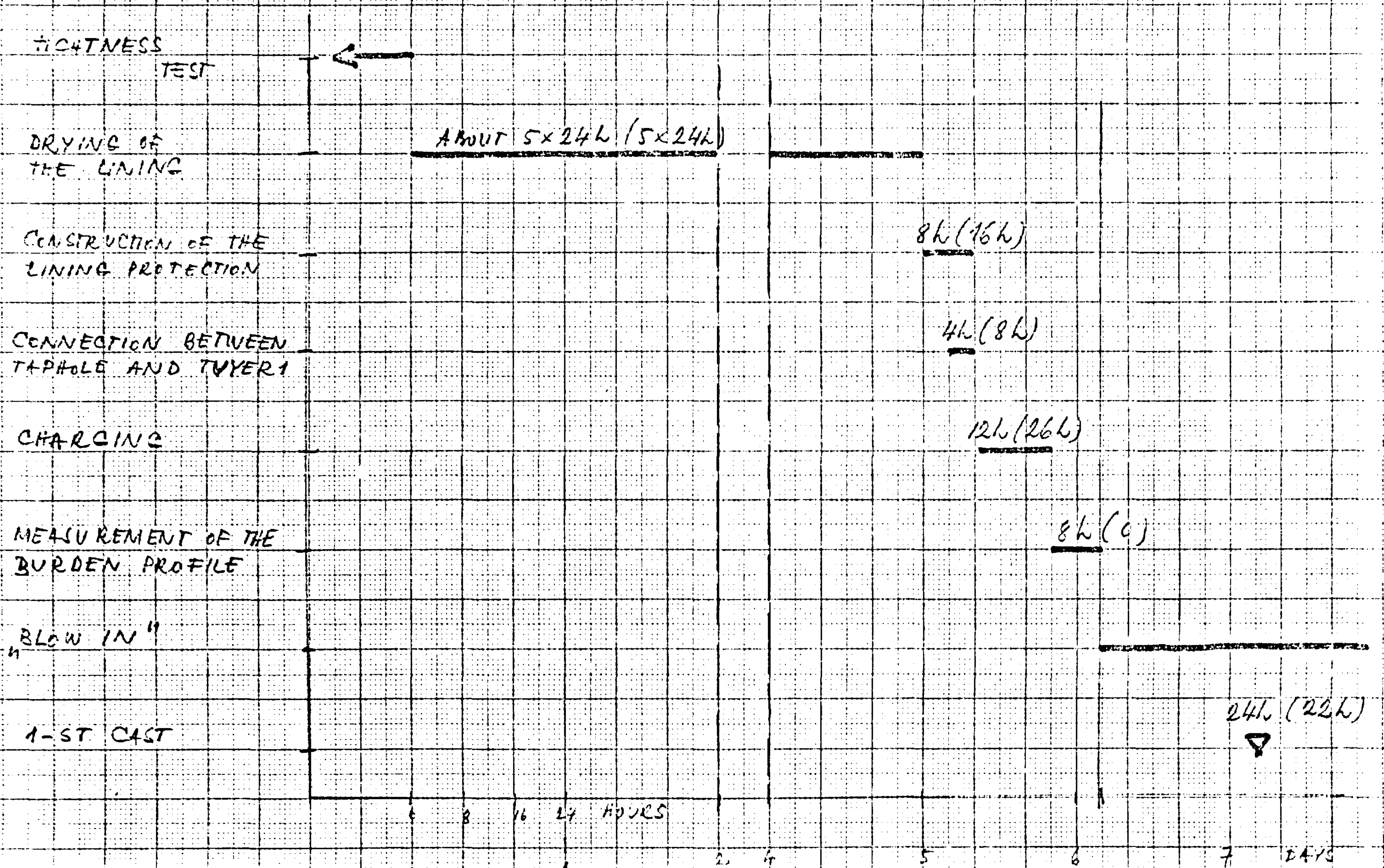


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TABLE 3

DRYING OF LINING

ASSUMED AND PERFORMED BLAST VOLUME 40 THOU. m^3/h

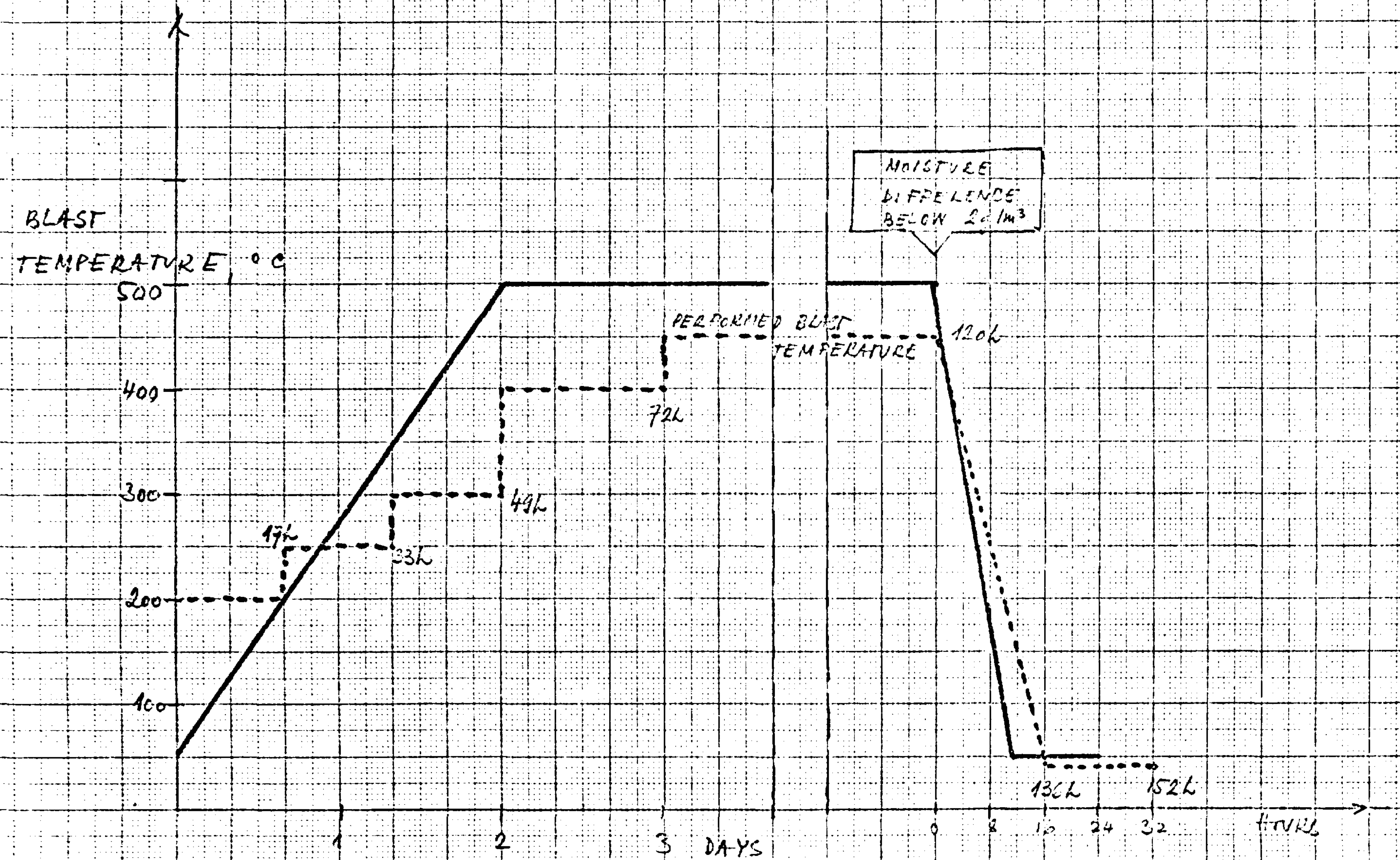


Table 4

The "blow in" burden

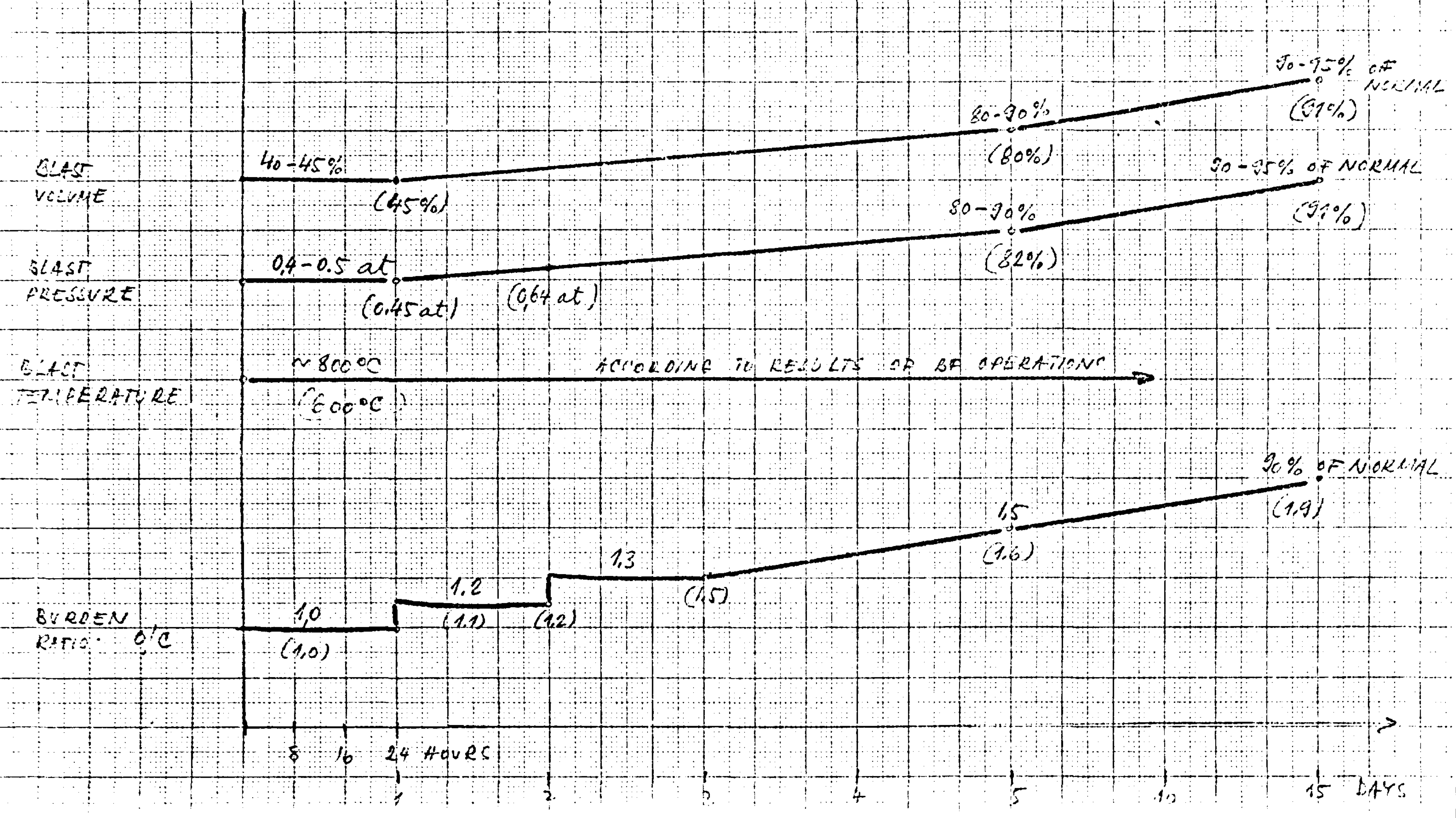
The assumed data:

1. iron analysis: 3,5 %; 3÷4 % Si, ~1.0 % Mn
2. total "blow in" burden index O/C ≈ 0.60
   (O = iron ore + sinter + Mn ore + BFslag
   C = coke)
3. slag basicity = 0.90 ÷ 0.95

Number of charge	O/C	Coke t	BF Slag, t	Iron ore, t	Sinter t	Mn ore, t	Lime-stone, t	Remarks
10		5.0	-				must be calculated according to assumed data and burden anal.	
20		5.0	1.0					Screened BF slag
10		5.0	2.0	-				
10	0.7	5.0	1.0	2.5	–	–		
10	0.8	5.0	1.0	2.5		0.5		Screened Mn ore with high Mn content
10	0.9	5.0	1.0	3.0		0.5		
10	1.1	5.0	1.0	4.0	-	0.5		
80		400.0	80.0	120.0		15.0		tonnage of total "blow in" charge, t
		800.0	44.0	50.0		7.0		volume of total "blow in" charge, m^3
up to 1st cast	1.0	5.0	-	3.5	1.0	0.5	must be calculated	

BF3 SCHEDULE OF FURNACE OPERATION „IN BLOW IN" PERIOD TABLE 5

PERFORMED DATA IN BRACKETS



Appendix 2

1. Remarks to construction and equipment installed on BF2

During short time after "blow in" (December 1979 - February 1980), which may be short for proper estimation, all new constructed elements work well. The connection of the new constructed bosh shell with stack ring and old hearth shell is tight. The water problem, which is the same as on BF3, should be solved, though it is not more urgent than on the bigger BF3.

A few points should be stressed out:

1.1. During one of the first casts the connection between thermocouples installed in the furnace bottom and recorder in the control room was burned. The installation of the new cable, which is a very simple work, was not done for weeks and it makes it impossible to check very important valve-temperature in the bottom. According to bottom temperature result of layer of graphite blocks installed in bottom will be evaluated.

1.2. Thermocouples installed in the furnace throat are very important index for estimation of BF operation. BF Management should teach all BF2 staff how to interpret the throat temperature to improve furnace operation.

1.3. During my last mission in February 1980 three meetings with Management and engineers from the firm Nace, Ankara were held. It was accepted that Nace staff prepares proposals for installation of coke screening and weighing system on BFs 1 and 2.

Each of the two existing coke bunkers (on each BF) will be connected to combined vibrofeeder- vibroscreen (with eyes 25 mm). Coke fines will be transported by presently working conveyer; size coke will be passed through the runner to 5 m^3 volume weighing hopper.

Coke will be weighed automatically; opening of valve close to the hopper will be steered by presently working operator.

2. Remarks to the BF2 "blow out" and "blow in" periods

During September 1979 a programme for "blow out" and "blow in" periods was prepared and considered. According to documents presented by BF Management and their opinion all points of the programme were performed in line with earlier accepted schedules. On the tables connected to appendix 2 the presumed and performed activities are described.

- "blow out" period (table 7)
- "blow in" period (table 8)
- drying of BF lining (table 9)
- "blow in" burden (table 10)
- BF operation data after "blow in" (table 11)

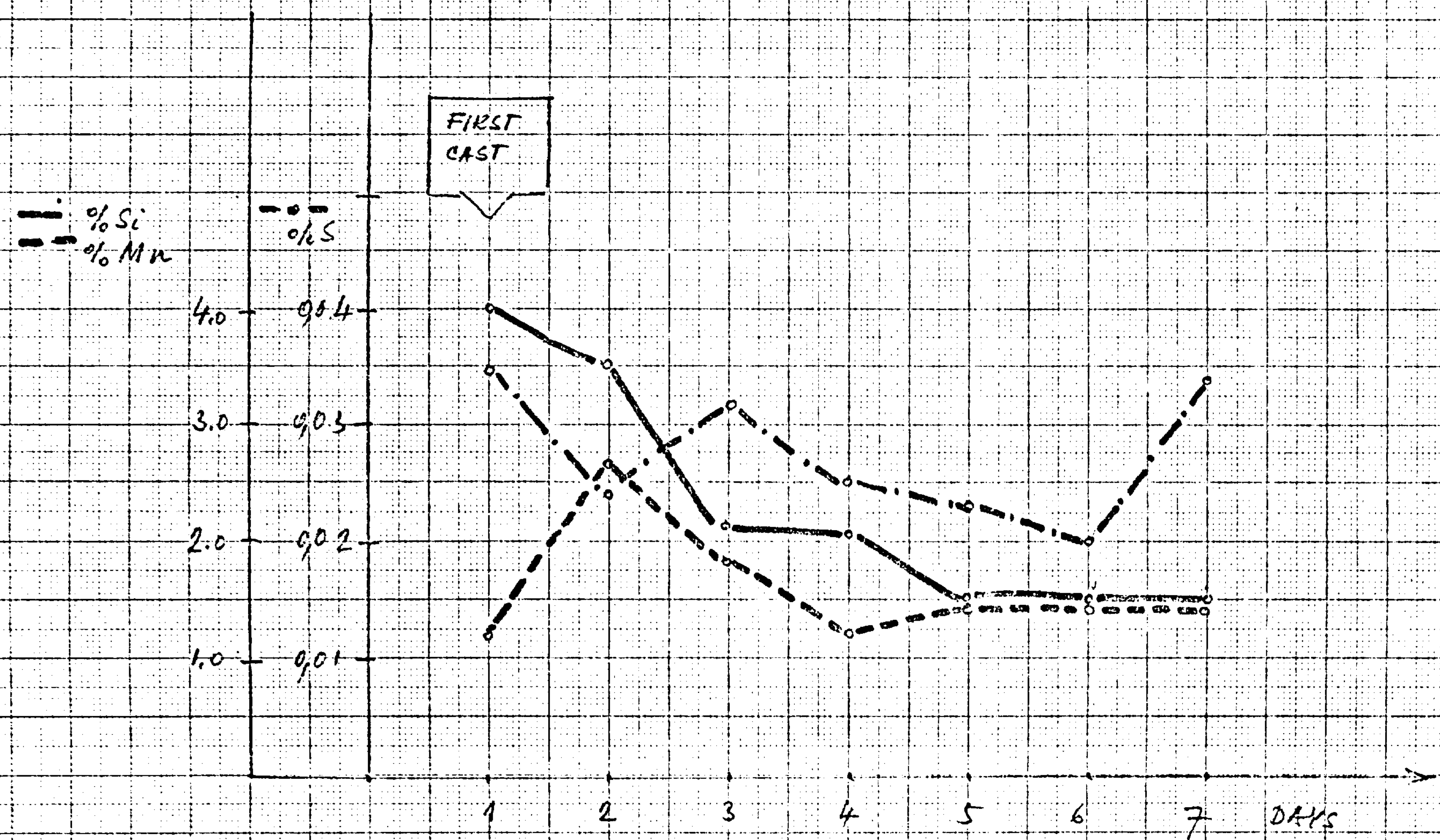
There were no difficulties in all "blow out" and "blow in" periods. BF2 reached after one week the normal iron quality. It is a real goal of BF Management. On table 12 contents of Si, Mn and S in iron in the first 7 days after "blow in" are shown.

BF3

PERFORMED IRON ANALYSES

TABLE 6

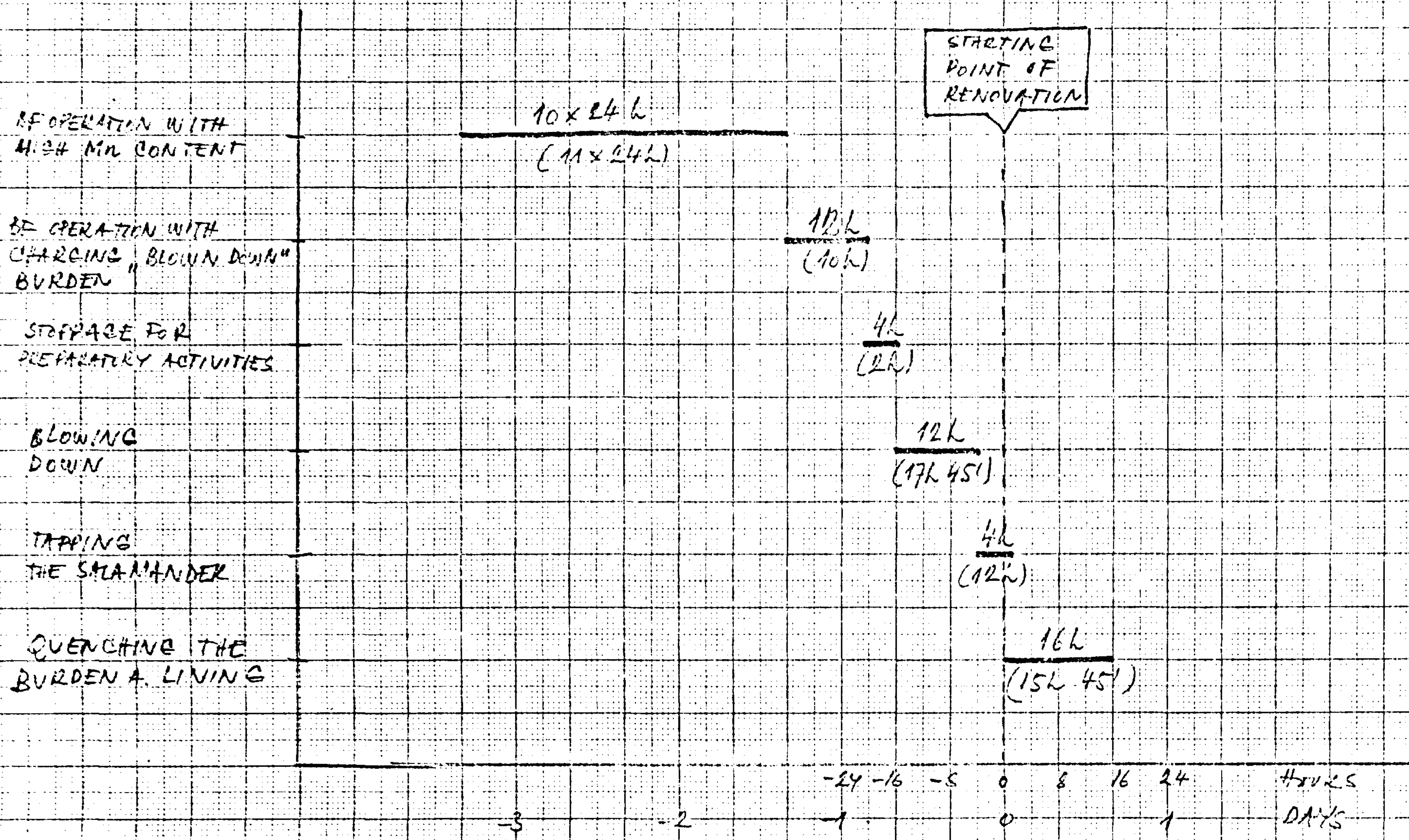
IN „BLOW IN" PERIOD



BF 2 TABLE 7

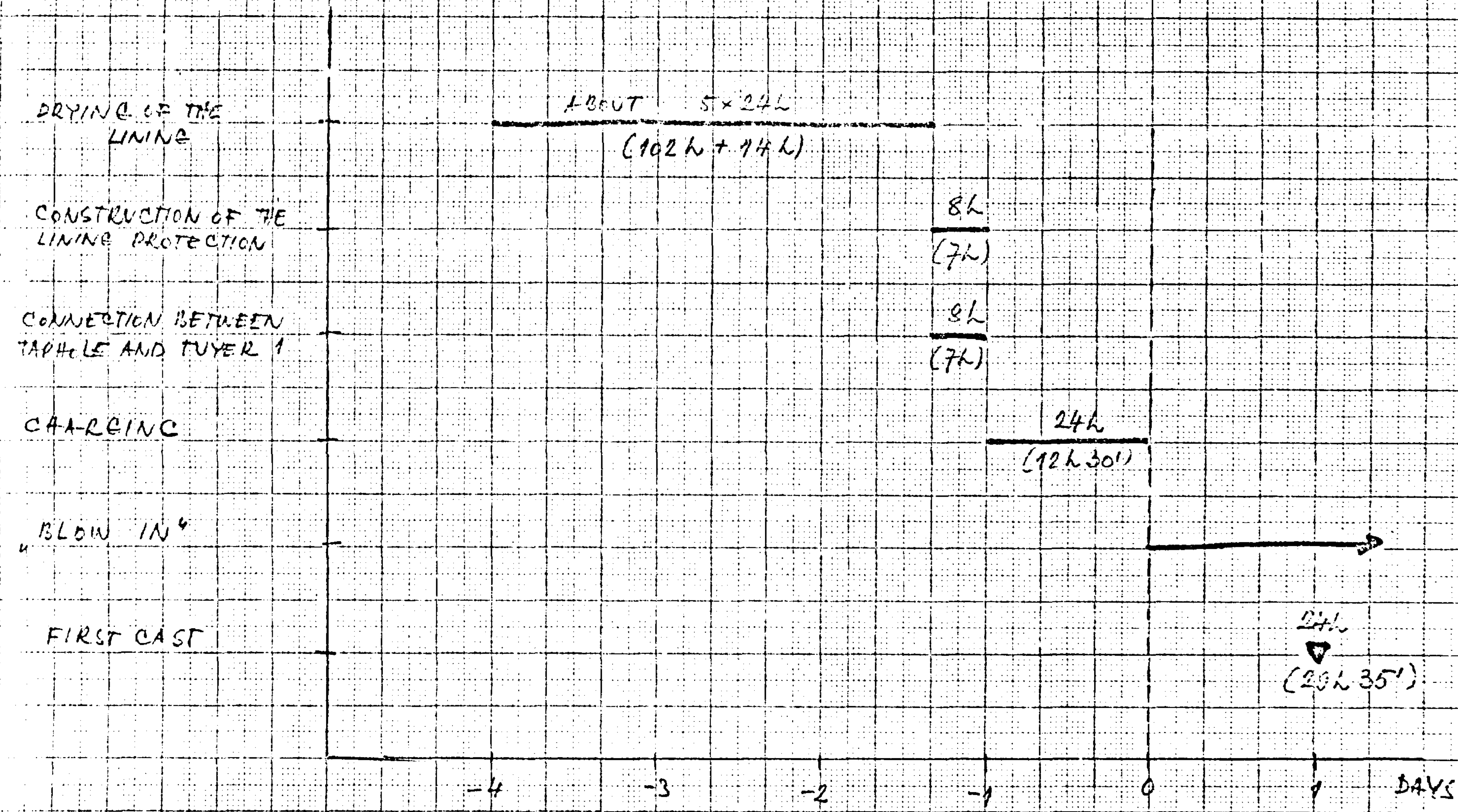
SCHEDULE OF „BLOW OUT" PERIOD

PERFORMED DATA IN BRACKETS



BF2 SCHEDULE OF „BLOW IN" PERIOD TABLE 8

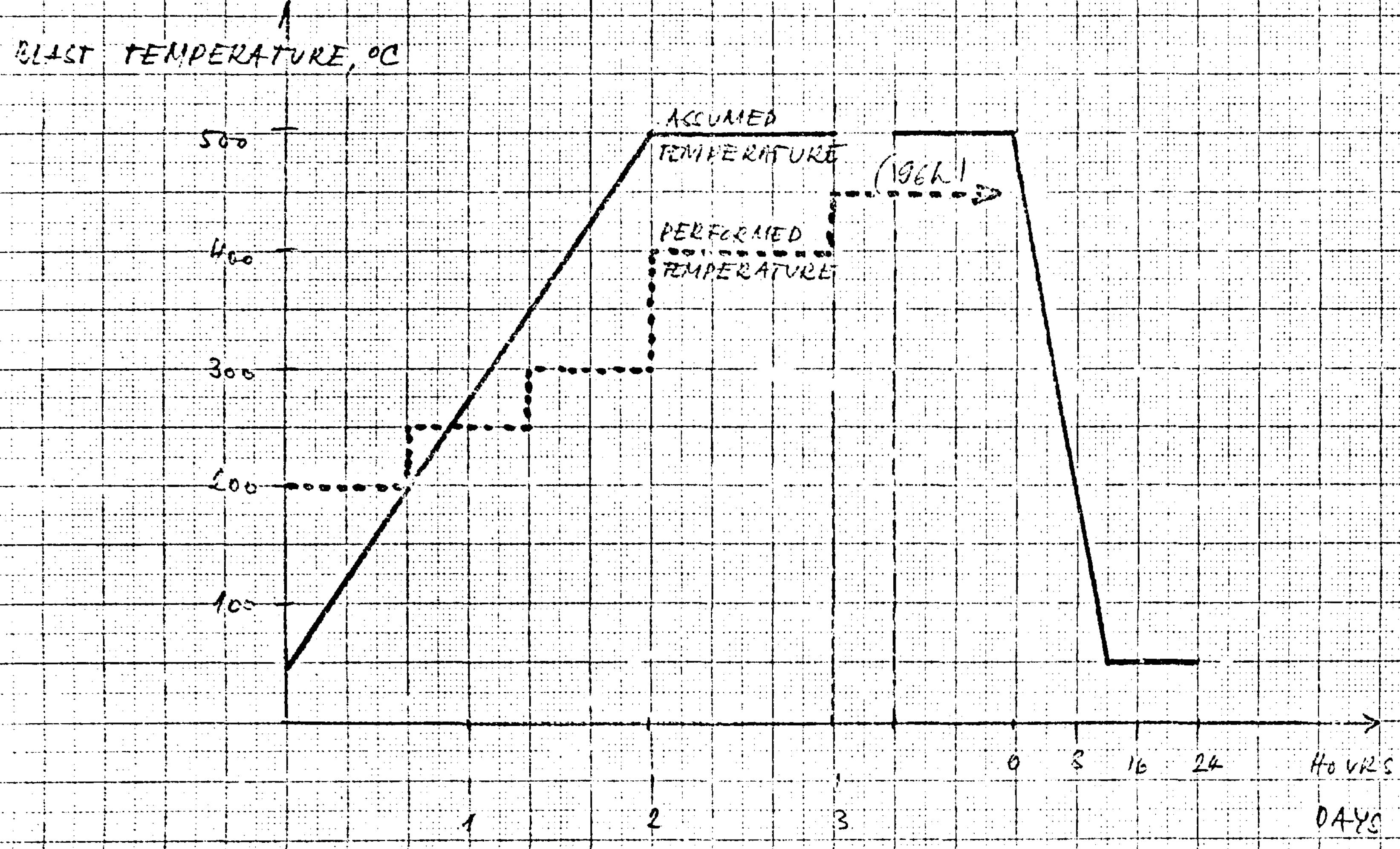
PERFORMED DATA IN BRACKETS



BF2 TABLE 9

DRYING OF FURNACE LINING

BLAST VOLUME 500 m^3/min.



BF2 "blow in" burden

The assumed data:

1. iron analysis : 3.5 % C, 3 ÷ 4 % Si, ~1.0 % Mn
2. total "blow in" burden index $O/C \geq 0.60$

   O = iron ore + sinter + Mn ore + BF slag, t
   C = coke, t

3. slag basicity = 0.90 ÷ 0.95

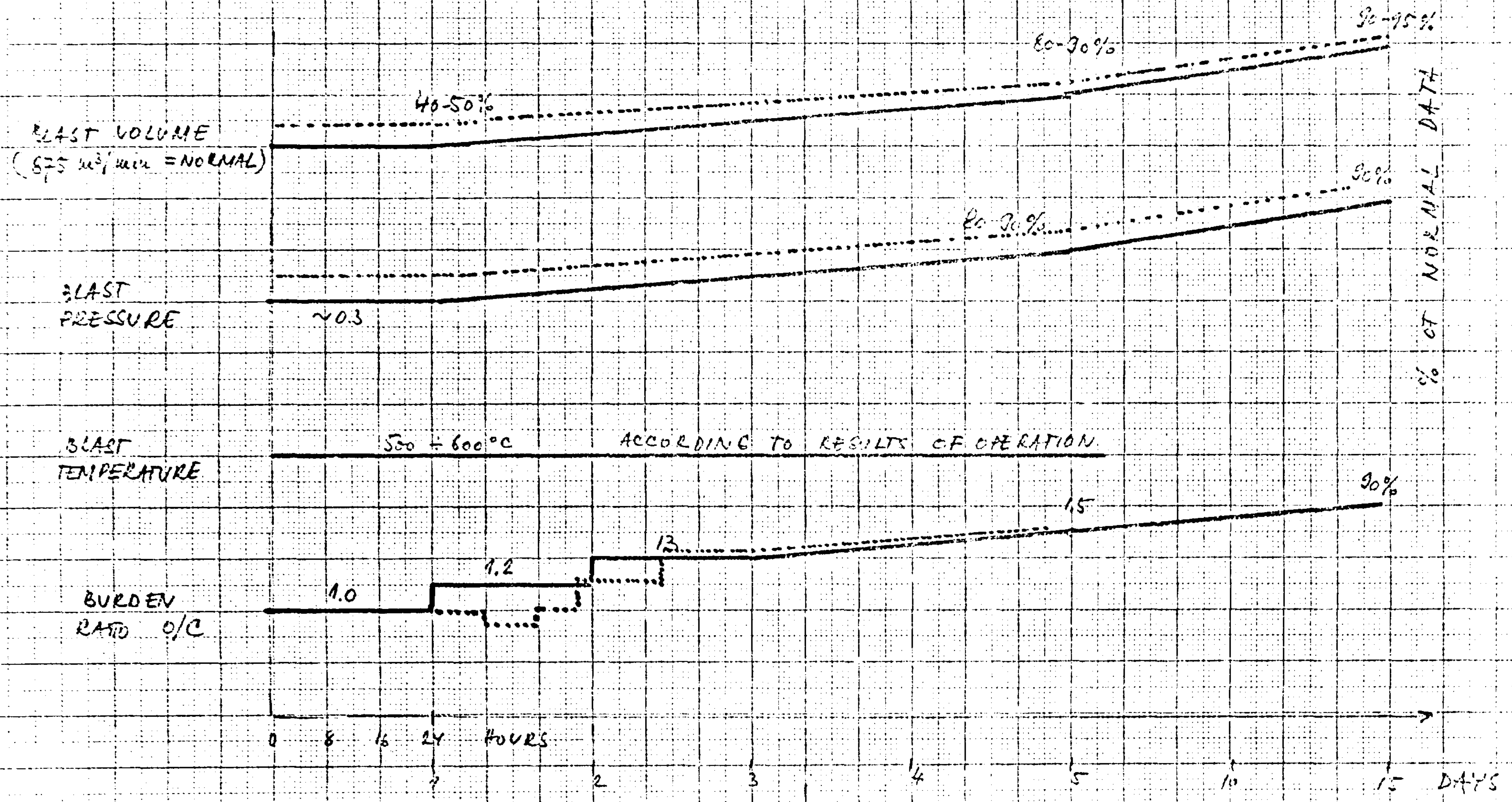
Number of Charge	O/C	Coke, t	BF Slag, t	iron ore, t	Sinter t	Mn ore, t	Limestone +	Remarks
8		4.0	-					
10		4.0	0.8				-	Screened BF slag
5		4.0	1.6	-				
5	0.7	4.0	0.8	2.0		-		
5	0.8	4.0	0.8	2.0		0.4		Screened Mn ore, with high Mn conten
5	0.9	4.0	0.8	2.4		0.4		
5	1.1	4.0	0.8	3.2		0.4		
		172.0	32.0	48.0		8.0		tonnage of total "blow in" burden
		344.0	17.6	20.0		3.7		volume of total "blow in" burden
up to 1 cast	1.0	4.0	-	2.8	0.8	0.4	should be calculated	

RF2

TABLE 11

SCHEDULE OF FURNACE OPERATION IN BLOW IN PERIODS

(——— ASSUMED .... PERFORMED DATA)

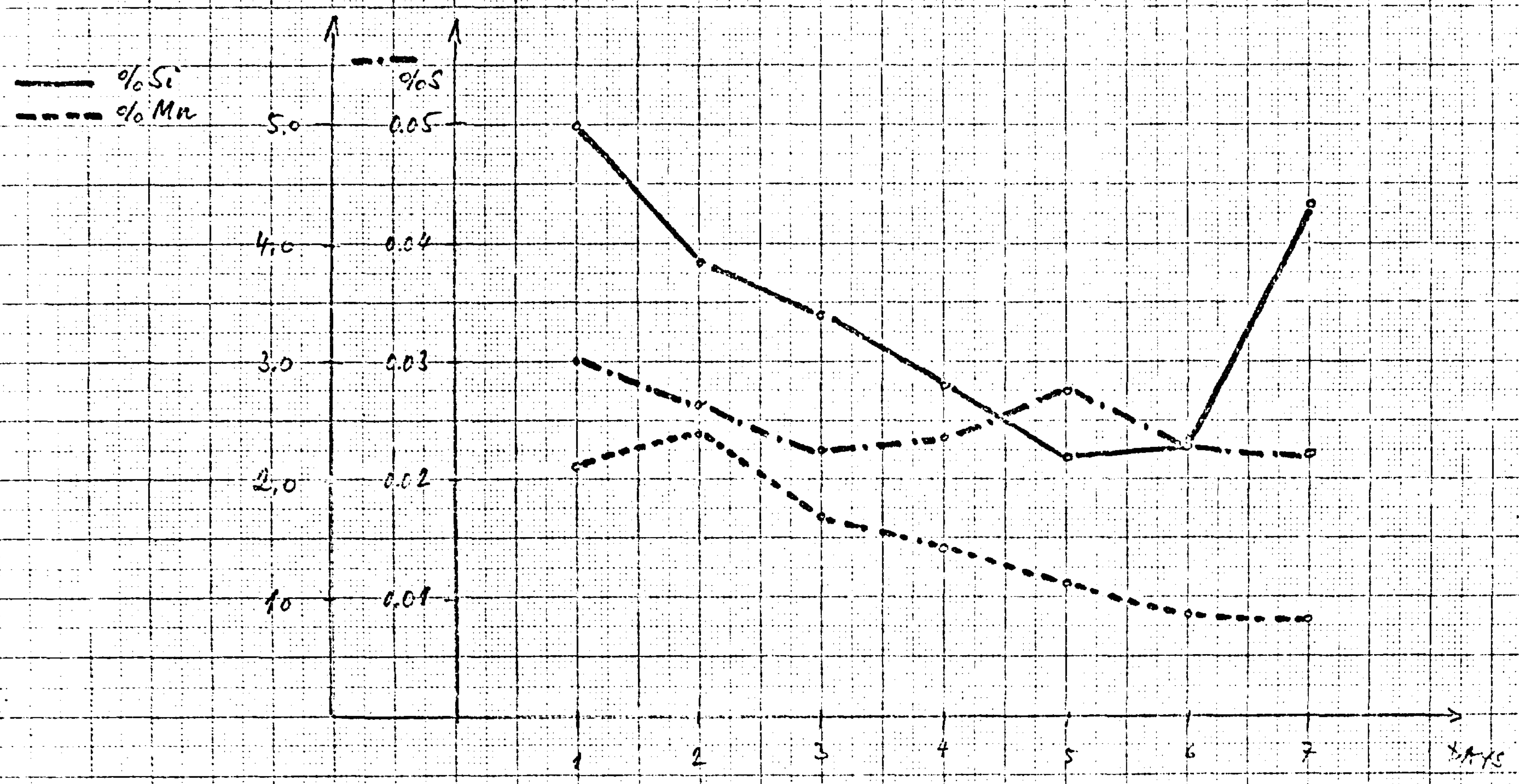


BE2

PERFORMED IRON ANALYSES

IN BLOW IN PERIOD

TABLE 12



Appendix 3

Present situation of mechanical equipment and proposals by mechanical maintenance department

(executed by Karabük TIS Staff)

1. Gas leaks from small bell.

   Proposal: Construction of a new oiled gasket for small bell.

2. During changing of gas gate on the gas main should be made as a dead lid.

   Proposal: Construction of a water gate (ugate)

3. Gas leaks from chimneys on the top of Furnace, these can not be changed and cleaned.

   Proposal: Construction of a new system of Furnace chimneys.

4. Closing cylinders of big and small bells are equiped with gaskets. Changing of these gaskets requires long stoppage of the Furnace.

   Proposal: Construction of a new closing system with gearmotor and drum.

5. Lubrication syster of top equipment (pulleys, roler bearings of distrubuter, bearings of gaskets) is operated manually.

   Proposal: Construction of a new automatic lubrication system.

6. Charging material spills over from the chutle of transfer car.

   Proposal: Construction of flat sectioned portable chute and old rails must be placed as wearing face on this chute (AS THE CHUTE OF NO 1 BLAST FURNACE).

7. A permenant crane of 20 ton for the bell changing in order to save manpower and time and existing car rails must be extended to centre for this crane. The platform on the side of power plant must be portable.

8. REPLACEMENT OF CHARGING CAR AND AIR COMPRESSOR SYSTEM FOR NO 1 BRIDGE CRANE

   - As compressors are coupled with electrical motors, replacement and maintenence are difficult. For instance dificulty of making valve heads and existing valve heads are broken and replacement is not possible: for this reasons the system must be replaced.

   Proposal:

   8.1- The compressor giving the same data and electrical motor must be obtained.

   8.2- By seperating the complete body in the existing system and obtaining a compressor of 8-12 atmosphere the existing electrical motor can be used.

./..

9.a) In order to increse the life of the small bell bump must be made where the material strikes. This bump also prevent the wearing where the bell meets the cone. The bump must be welded with hard electrode.

b) The same thing must be applied to the big bell.

10. A lift must be placed between the furnaces.

REPORT

At the meeting in Project Design Directorate, dat_ing 11.2.1980, our Comission studied the assigned task of existing situation of the shield and steel construction of No 1 blast furnace and earmarked the followings:

1. The flat and corrugated sheets on the roof of casting bay have been weared off so these must be replaced completely.

2. The barrack constructed for the production of slag wool in the past is now being used as the place of working suit changing and cafeteria. For the same purpose building of a tidy looking "Changing Place" and a cafeterie will be useful at the same place or another suitable place.

3. On the tapping side of the casting bay one supporting leg has been seen as bended. However, a mono-rail crane will be placed and this supporting leg and the one adjacent to this will be replaced.

4. It has not seen any wear by the eye on the shield of the blast furnace up to the "stop" level; but on the modernization of No 2 blast furnace the shield outshine the coolers was seen to weared off. This same situation will be more likely on No 1 blast furnace. Therefore, the shield in the coolers region and above "stop" level must be constructed as one piece welded constructon.

5. The hole for loader entery must be shut with a bolted lid in order to save time in every relinning.

6. In order to increase the cooling effect of copper coolers increase of number of coolers will be useful giving consideration of brick sizes.

7. Application of temperature measuring platform on this furnace, as applied on No 2 blast furnace, will be useful.

8. Consideration must be given to place a lift on No 1 and No 2 blast furnaces each in order to reach their tops. The lifts will carry only personnel.

9. As there is a risk of gas leaks in region it has not been possible for the situation of walking platforms supported by the furnace under the roof of casting bay it will be decided whether to replace or not to replace after examination during a shut down.

Report date : 14.2.1980

BF1 Profile data

		BF1 present profile
1.	hearth dia, mm	4572
2.	bosh dia, mm	5791
3.	throat dia, mm	4572
4.	big bell dia, mm	3353
5.	distance between throat wall and big bell, mm	608
6.	hearth height, mm	2667
7.	bosh height, mm	3042
8.	bosh parallel height, mm	1295
9.	stack height, mm	12192
10.	throat height, mm	2286
11.	total height, mm	21482
12.	stack angle ( )	$87^{\circ}08'$
13.	bosh angle ( )	$78^{\circ}41'$
14.	total volume, m^3	437
15.	Number of tuyers	8
16.	Number of columns	8
17.	shell thickness, mm	
	- bottom	-
	- hearth	38/31
	- bosh	-
	- bosh parallel	-
	- stack	25.4/18
	- throat	18
	- dome	32

Table 13

Alt.1. BF2 profile	Alt.2. BF1 corrected profile	Alt.3. BF1 new profile	Alt.4. BF1 new profile
4572	4800	4800	3800
5791	6000	5800	5700
4572	4200	4000	3900
3048	2700	2500	2400
711	750	750	750
2667	2700	2700	2700
3042	3000	3000	3000
1295	2000	2000	2000
12192	11600	11600	11600
2286	2200	2200	2200
21482	21500	21500	21500
85°08'	85°33'48"	85°33'50"	85°33'48"
78°41'	78°41'24"	80°32'15"	81°28'09"
437	444	416	403
8	8	10	10
8	8	5	5
-	35/12	35/12	35/12
38/31	35	35	35
25	25	30	30
25	25	30	30
25.4/18	25.4	25	25
18	18	20	20
32	32	30	30

Table 14

Blast main (blast ring) data

		Present data	Future solution
1.	Total blast volume, m3/h	50.000	55.000
2.	Blast pressure, at	0.8	0.9
3.	Max. blast temperature, °C	850	1.100
4.	Real blast volume, m3/s	32.2	37.3
5.	Blast velocity, m/s	65.7	50 or 60
6.	Blast main inside dia, mm	790	1000 or 900
7.	Refractory thickness, mm	230	345
8.	Insulation thickness, mm	64	60
9.	Shell thickness, mm	9.5	10
10.	Blast main outside dia, mm	1.238	1.830 or 1.730
11.	Draft chimney inside dia, mm	-	300

Table 15

BF1 Stove Data

		Present data	Alt.1.	Alt.2.
1.	total height, mm	25.900	25.900	
2.	total dia, mm	5.790	5.790	
3.	H : D index	4,54	4,54	
4.	Combustion chamber cross-section, m2	1,78	1,78	2,00
5.	checker cross-section, m2	14,33	14,33	12,00
6.	checker height, mm	19.660	19.660	
7.	checker volume, m3	281,7	281,7	235,9
8.	checker surface per unit volume, m2/m3	28.7	40	40
9.	total heating surface per each stove, m2	8.085	11.270	9.437
10.	checker surface per unit BF volume m2/m3	55.0	76.1	63.8
11.	Max. blast temperature, ^{o}C	850	900	950

Table 16

Data noticed in new "BF Shift Report"

1. Charging system
   1.1. Charges together
   1.2. Charges per hour
   1.3. Stock level, m

2. Blast
   2.1. Blast volume, $10^3 m^3$
   2.2. Blast pressure, at
   2.3. Pressure difference (tuyers-throat), at
   2.4. Blast temperature, ^oC
   2.5. Moisture addition, g/m3
   2.6. Fuel oil addition

3. Throat
   3.1. Throat pressure, at
   3.2. Throat temperature (average, min.max.), ^oC
   3.3. Throat gas analyses (CO_2, H_2, CO %)

4. Cowpers
   For each cowper m 1,2 and 3
   4.1. Gas quantity, $10^3 m^3/h$
   4.2. Air quantity, $10^3 m^3/h$
   4.3. Dome temperature, ^oC
   4.4. Chimney gas analyses (O_2, CO, CO_2), %

5. Lining temperature, ^oC
   5.1. Bottom (average, min., max.)
   5.2. Platform 1 (average, min., max.)
   5.3. Platform 2 (average, min., max.)
   5.4. Platform 3 (average, min: ,max.)
   5.5. Throat (average, min., max.).

6. Casts
   6.1. Number
   6.2. Time (beginning, end)
   6.3. Tapehole latitude, m
   6.4. Tape clay, kg
   6.5. Cast weight, t
   6.6. Iron output in the shift, t

6.7. Slag quantity, slag cars

6.8. Iron analyses (Si, Mn, P, S, C), %

6.9. Slag analyses (SiO_2, CaO, MgO, Al_2O_3, alkali, MnO, FeO, S) %

7. Burden, t in charge

7.1. Number of charges

7.2. Coke

7.3. Sinter

7.4. Iron ore

7.5. Mn ore

7.6. Limestone

7.7. Dolomite

8. "Extra" coke, t

9. Burden sequence

10. Burden analyses (Fe, SiO_2, CaO, MgO, Al_2O_3, Alkali, MnO, S, C, volatile), %

11. Coke moisture, %

12. Master remarks

13. BF Management orders.