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Agenda item 2

ASSISTANCE BY NIPPON STEEL CORPORATION TO DEVELOPING COUNTRIES IN ESTABLISHING THEIR IRON AND STEEL INDUSTRIES[1]

by

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SUMMARY

I. Throughout the past twenty years, Nippon Steel Corporation has positively and constructively promoted technological cooperation through the initiation of various projects, the most representative of which are: USIMINAS in Brazil, MALAYAWATA in Malaysia, and Pohang Iron and Steel in Korea. These are explained in detail.

II. The basic rationale behind Nippon Steel's program for technological cooperation are as follows:

1. The level of technology is raised through technological exchange and cooperation. Accordingly, technological exchange should be positively encouraged and promoted.

2. The effectiveness and success of a technological exchange program rest on a relationship of mutual confidence between the parties involved.

3. In view of the steel industry's nature as a basic industry, plans should be mapped out on a long-range basis.

4. Particular attention and consideration must be given to the implantation and development of technology.

5. The success or failure of a project depends on recognition of its being only a part of a greater integral whole, and acting accordingly.

6. Constructive promotion of technological cooperation is a prime obligation of developed nations.

III. In the pursuit of its general technological cooperation program, Nippon Steel adopts a fundamental policy of absolute and positive encouragement, and possesses integrated well-organized systems necessary for its implementation.

FOREWORD

1. As always, steel remains the basic material with which a nation's industry is built.

   Henceforth, its function may witness even greater expansion, and it will certainly suffer no diminution. The position of the iron and steel industry within a nation's industrial framework is, therefore, an extremely important factor to be considered by any nation in the process of formulating its industrialization policies. It is no wonder then that in the remarkable progress exhibited by the developing countries during the post-war period, the iron and steel industry has always occupied the supreme role. Of course, the conditions and motives behind the establishment of an iron and steel industry differ from nation to nation. Among these, the pragmatic utilization of natural resources, the creation of employment opportunities, the deterrence of the excessive outflow of foreign exchange reserves, the supply of related industries with the basic material and equipment for growth, and the improvement of the scientific and technical level may be cited. Nevertheless, despite the diversity of their demands, the general impact of the iron and steel industry on all these nations remains equally and incalculably great.

2. Nippon Steel has lost no time in positively responding to the various needs of developing countries, and through the past twenty years, its technological assistance projects have included capital aid and participation, construction engineering, equipment supply and provision, operational guidance (operation survey), feasibility studies and many other forms of cooperation.

These projects affect both the government and private industry in numerous countries in the Middle East, South America, Central America, Southeast Asia, and Africa.

3. At this opportunity, we would like to express our profound gratitude to the governments, industries,and various organizations of the countries involved, as well as to the Japanese government, for the indispensable cooperation and guidance which they have given us in the realization of these projects.

4. Likewise, we would like to extend our deep gratitude to UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION and other related organizations for their role in making this 3rd Symposium on the Iron and Steel Industry an international conference of noteworthy significance.

5. During this symposium held for the third time in history, we appreciate very much the opportunity given us to share with you some of our efforts and experience in this area.

6. Through the following brief summaries of the various projects which we have designed and participated in, we would like to illuminate before you the numerous lessons we have learned in the course of their implementation. By the same token, we would appreciate any criticism which you might have to offer.

A BRIEF OUTLINE OF OUR PRINCIPAL PROJECTS

For information regarding all the projects in which Nippon Steel has participated up to the present, please refer to the attached list. Among these, the main ones are: Brazil's USIMINAS, Malaysia's MALAYAWATA, and Korea's Pohang Iron and Steel. These are briefly outlined below:

I. Brazil, Usinas Siderurgicas de Minas Gerais (USIMINAS)

1. Outline of the Project

1.1. Established

April 26, 1956

1.2. Capital

Common stock	CR 604,440,000
Preferred stock	CR 604,440,000
Total	CR 1,208,880,000

	Common	Preferred
BNDE (73.13%)	382,698,345	501,358,925
Nippon USIMINAS (18.73%)	126,341,317	100,074,768

1.3 Main equipment

	Existing	1.4 million ton/yr expansion plan	2.4 million ton/yr expansion plan	Production Plan	
				1970	1975
Iron-making	No.1 & No.2 B.F. ($891\ m^3$)	Relining of No.1 & No.2 B.F. ($957\ m^3$)	No.3 B.F. ($2,500\ m^3$)	Pig iron t/yr 760,000	2,160,000
Sintering	No.1 Sintering plant ($89.3\ m^2$)	No.2 Sintering plant ($180\ m^2$)		Sintered ore 1,168,000	2,710,000
Coke	No.1 & No.2 Coke-oven plant (13.4^t/ch x 53 ovens x 2)	No.3 Coke-oven plant (27^t/ch x 55 ovens)		Coke 544,000	1,259,000
Steel-making	No.1 & No.2 B.O.F. (68^t/ch x 2)	No.3 B.O.F. (70^t/ch)	No.4 & No.5 B.O.F. (160^t/ch) C.C (1,000,000 t/yr)	Steel 854,000	ingot 2,400,000
Slabbing mill	2-Hi			Slab 742,000	1,550,000
Plate & hot strip mill	120" 4-Hi plate mill 80" tandem strip mill	Hot skinpass line	160" 4-Hi plate mill	Plate 249,000 Hot strip 237,000	235,000 611,000
Cold strip mill	66" cont. pickling line 66" cold reversing mill	56" cont. pickling line 66" tandem cold strip mill	Recoiling line	Cold strip 131,000	519,000

1.4. Layout

See Figure 1.

1.5. Employees 7,200

1.6. Production records

	1966	1969	1970	1971	1972 (estimate)
Pig iron	505,063	711,434	760,818	853,413	1,061,749
Ingot	529,323	790,914	850,234	950,040	1,179,296
Plate	146,874	209,740	232,036	325,240	412,960
Hot coil	171,969	337,177	391,971	342,557	238,763
Hot-rolled sheet	54,853	98,441	94,210	75,297	101,372
Cold coil	41,072	112,050	132,847	28,065	38,205
Cold-rolled sheet	35,783	86,945	98,817	133,250	109,692

1.7. Brief history

April '56 The Brazilian government requested the Japanese government to help in the construction of an integrated steel mill in Brazil.

April '56 Establishment of USIMINAS.

Dec. '57 Establishment of Nippon USIMINAS.

Jan. '58 USIMINAS started as Brazilian-Japanese joint venture.

Oct. '62 Blow-in of No.1 B.F.

June '63 B.O.F. started operation.

Oct. '65 Cold strip mill started operation.

Completion of 500,000 ton integrated steel plant.

Dec. '68 Started 1.4 million ton expansion project.

Aug. '71 Started 2.4 million ton expansion project.

2. Outline of Technical Assistance by NSC

2.1. Operational assistance

A. Scope

A-1 Operational and maintenance techniques regarding manufacture of strip and plate products.

A-2 Standard operation control systems.

B. Dispatch of NSC's personnel within 16 persons, 6 months/person per team.

C. Training of USIMINAS personnel within 12 persons, 6 months/person per year.

D. Contract period

10 years from April 1966.

2.2. Technical assistance regarding test and research

A. Scope

Technical assistance concerning research organization, testing methods, and research approach methods.

B. Dispatch of NSC's personnel within 2 persons, 6 months/person per year.

C. Training of USIMINAS personnel within 12 man-month.

D. Contract term

1969 ~ 1974

2.3. Engineering agreement for 1.5 million ton expansion programme

A. Scope of engineering service

A-1 Technical study of equipment plan.

A-2 Detail engineering services for each equipment (B.F. relining, coke oven plant, sintering plant, B.O.F.)

A-3 Assistance concerning construction and expediting.

B. Contract term

1970 ~ 1975

2.4. Engineering agreement for 2.5 million ton expansion programme

A. Scope of engineering services

A-1 Preparation and review of purchase specifications.

A-2 Technical explanation to bidders.

A-3 Comparative study of and technical discussions on specifications.

A-4 Supply of foundation and building drawings.

A-5 Basic technical data for civil works concerning foundations and brick works.

A-6 Advice on installation works and inspection.

B. Contract term

1971 ~ 5 years

II. Malaysia, Malayawata Steel Bhd.

1. Outline of the Project

1.1. Established

August, 1965

1.2. Capital

M$ 38,875,000 (As of Sept., 1972)

Including

NSC	20.8 %
Other Japanese companies	18.2
Malaysian Gov't.	11.1
I.F.C.	9.2

1.3. Main equipment

Blast furnace (x 2)	11,400 t/m
B.O.F. (x 2)	11,300 "
Rolling mill (bar, angle, wire rod)	10,000 "
Electric furnace	20,000 t/yr
C.C. (2 strands x 1)	50,000 "
Hot-coil processing line	70,000 "
Sintering plant	10,000 t/m

1.4. Layout

See Figure 2.

1.5. Employees

1,750

1.6. Production records (rolled products)

1967	12,171 ton
1968	47,034
1969	64,609
1970	71,308
1971	107,524

1.7. Brief history

Aug. '65	MALAYAWATA was incorporated.
Apr. '66	Started construction of phase I project.
Aug. '67	Completion of phase I project (B.F. x 1)
Aug. '69	Started construction of phase II project.
Jan. '71	Completion of phase II project.

2. Outline of the Technical Assistance by NSC

2.1. Engineering and operational assistance for the construction of an integrated steel mill.

A. Scope of technical assistance

A-1 Engineering services.

A-2 Technical assistance for the construction and operation.

B. Contract term

December 1965 ~ 10 years

C. Records of dispatch of NSC personnel

At the peak of construction	157
At present	9

2.2. Agreement for the purchase and installation of the equipment

A. Scope of assistance

A-1 Supply of equipment.

A-2 Supervisory services of equipment installation.

A-3 Finance (deferred payment).

2.3. Technical assistance for expansion project

A. Installation of electric furnace and C.C.

B. Installation of hot coil processing plant

III. Republic of Korea, Pohang Iron & Steel Co., Ltd. (POSCO)

1. Outline of the Project

1.1. Established

March 26th, 1968

1.2. Capital

44,817.00 Wong (As of Dec., 1972)

Korean Government

35,317.00 Wong

1.3. Main equipment

A. Sintering plant	
Dwight Lloyd	4,060 t/d
Grate area	132 m^2
B. Coke-oven plant	
Otto	68 ovens, 1,600 t/d
C. No.1 Blast furnace	1,660 m^3, 2,600 t/d
D. Steel-making plant	
B.O.F.	100 t/ch. x 2
E. Blooming & slabbing mill	890,000 t/yr, 2-Hi reversing
F. Billeting mill	141,000 t/yr, 2-Hi reversing
G. Hot strip mill	583,000 t/yr
(Roughing)	4-Hi reversing
(Finishing)	4-Hi continuous
	Pickling line
H. Plate mill	184,000 t/yr, 4-Hi reversing

1.4. Layout

See Figure 3.

1.5. Employees

5,000

1.6. Production Plan

Equipment		1st Stage Ingot base 1,032,000 t/yr	2nd Stage Ingot base 2,600,000 t/yr
Billeting mill	Billet	141,000	109,000
	Sections		137,000
	Sub-total	141,000	246,000
Hot strip mill	Hot coil	183,000	637,000
	Hot skelp	180,000	227,000
	Hot sheet	220,000	153,000
	Sub-total	583,000	1,017,000
Plate mill	Plate	184,800	336,000
Cold strip mill	Cold coil	-	80,000
	Cold sheet	-	316,000
	G.I. sheet	-	80,000
	Sub-total	-	476,000
Grand Total		908,800 (1974)	2,075,000 (1978)

1.7. Brief history

A. Upon the request of the government of the Republic of Korea, a mission comprising six Japanese steel manufacturers was sent to

Korea in 1965 to study feasibility of an integrated steel industry in Korea. However, it was found premature to take up the project at that time.

B. Afterwards, the Koppers Co. of U.S.A. studied the project and the so-called "KISA Group" was formed with the participation of leading machinery manufacturers of U.S.A., Great Britain, West Germany, France, and Italy. The group concluded an agreement with the Korean government in October, 1967, for the construction of an integrated steel industry with an annual capacity of 600,000 tons. In order to implement the plan, Pohang Iron & Steel Co., Ltd. was established in April, 1968, by the government.

C. The former Yawata and Fuji and Nippon Kokan entered into a consulting agreement with the Korean government to undertake technical review of the KISA Plan and to provide training facilities for the managerial staff of POSCO.

D. However the KISA Group failed to raise the necessary finance and the plan was shelved.

E. In August, 1969, the Korean government asked for the assistance of the Japanese government for the POSCO project and the Japanese government agreed to grant a credit of $125,700,000 in December of the same year after receiving the report of a survey mission which it had sent to Korea.

F. On the other hand, the Korean government revised the KISA project to a one million-ton project (with the ultimate target of five million tons) and requested the Japanese group to study the plan.

G. The aforesaid three Japanese companies undertook the study and submitted the study report in April, 1970, based on the preliminary engineering agreement which was concluded upon the finalization of the financial assistance between the two government.

H. In July, 1970, the Japanese group (NSC and NKK) concluded the engineering and consulting agreement with POSCO to provide technical assistance for the preparation and review of the specifications etc. and training of construction staff of POSCO.

I. Partly modifying the above agreement, another technical assistance agreement for construction and operation was concluded in May, 1971.

2. Outline of the Technical Assistance by NSC

A. Scope of the assistance

A-1 Technical assistance for the planning of the integrated steel plant.

(i) Preparation of the equipment specifications and supply of basic design data.

(ii) Advice concerning equipment purchasing and review of drawings.

A-2 Technical assistance for construction and plant operation.

A-3 Training of construction and operation staff of POSCO.

B. Period

August, 1970 ~ August, 1975

C. Dispatch schedule of NSC personnel and training programme of POSCO personnel.

	Despatch of NSC personnel	Training of POSCO personnel
1970	16 m/m	123
1971	125	482
1972	528	975
1973	523	-
Total	1192	1580

BASIC PRINCIPLES AND POLICIES OF NIPPON STEEL'S TECHNOLOGICAL COOPERATION PROGRAM

1. Technology is a fundamental and universal cultural asset that belongs to all of mankind. Accordingly, regardless of race, geography, or cultural background, all nations are entitled to the widest diffusion of technology. We believe that by positively promoting technological cooperation, industry fulfills one of its prime responsibilities towards society. With regard to technological cooperation, Nippon Steel professes a fundamental attitude of positive encouragement and promotion.

2. We also believe that technological exchange is an immeasurably effective instrument for raising the level of scientific technology. The monopolization of technology by any one party would only eventually result in its stagnation and decay. To add to this, it is a flagrant violation of industry's social obligations. It does not matter where the technological exchange is taking place. Nor does it matter who the parties involved are. The plain fact is that wherever it is taking place, the various new problems encountered will signal a way to even greater technical progress and to an even better tomorrow.

3. Whether the medium of technological exchange is print or machinery, it all boils down to people linked with other people. The final results of technological cooperation may be concretely manifested in increased production, improved quality, as well as supply of equipment and machinery. But the real criterion for evaluating technological cooperation is technology per se which can never bear fruit without people-to-people relationships. At this point, the most important problem that must be considered is, we think, the creation of a relationship based on mutual confidence. To put it more

extremely, once this relationship of mutual confidence is established, results far better than those first expected will certainly and definitely come. The basis of mutual confidence is, of course, mutual understanding. For this reason, an understanding of the national character, a correct grasp of the problems involved (including the role to be played by the project concerned in the national economy, etc.), and the employment of the best methods in problem-solving are indispensable. Another point to be given consideration in any project whatsoever is the adoption of a long-range perspective. The steel industry being a capital-intensive industry and the cornerstone upon which a nation's industrialization policies are built, the results of such projects must not be judged from a short-range view. With these forming the background, we maintain great interest in the constant harmony among the various governments, international monetary organizations, and other related entities concerned.

4. Along with the long-range consideration of such projects, what attract our strong attention and concern are the implantation and the development of technology. The viable implantation of technology becomes a reality only when the technology concerned meets the specific needs and conditions existing in the country concerned and thus becomes "absorbable". Equally decisive is a deep-rooted cooperation between the donor and the receiver of technological assistance. As always, the smooth relationship of mutual confidence is the fundamental premise upon which technological exchange is based. Technology which is inappropriate for a certain country's special conditions may be introduced, but not without bringing about a bad case of "indigestion" or undue prolongation of the period of technological cooperation required, which is an extremely high price to pay for the results desired. Either case will eventually deal an undesirably heavy blow to the iron and steel industry as the core industry of

a nation. Due consideration should rather be given on a long-range view of the project which eliminates undesirable side-effects and on the elevation of technical standards. This would take the concrete form of concentration on equipment and machinery planning as well as forms and methods of technological cooperation.

5. In the actual design and formulation of the projects, we always give prime consideration to its integral economic rationality. This problem embraces such factors as layout, material balance, energy balance, and construction schedule in a comprehensive plan that allows for future expansion. Upon this integral economic rationality hangs the success or failure of the project. Consequently, for the smooth implementation of a project, complete agreement between the supplier and the recipient of technological assistance is an absolute and practical prerequisite.

6. The next point not to be neglected in the technological cooperation is its possibility of expanding to various other phases of cooperation. This means that technological assistance does not always end with the construction of the steelworks or subsequent operational guidance. Many cases further require cooperation that extends to capital aid and management supervision, i.e. cooperation on an integrated and comprehensive level. We in Nippon Steel have positively responded to the demands and requirements of our partner countries. The coming days hold promise of even more of such positively-oriented projects.

7. The most striking characteristic of the technological cooperation program at Nippon Steel is that it makes available the newest steel-making technology to its partners. In addition to operational management engineers, we employ a large number of construction engineers and R-D (research and

development) engineers, who are constantly striving towards the refinement of steel-manufacturing techniques. Likewise, on the new and powerful plane of computer enineering, Nippon Steel can claim a leading position in the twin areas of business computers and process computers.

8. Another remarkable feature is the availability of Nippon Steel's Machinery Division, which manufactures blast furnaces, B.O.F.'s, rolling mills, and other equipment not only for its own use but also for other companies outside. Consequently, when Nippon Steel engages in technological assistance, it is making available its equipment and machinery manufacturing know-how.

9. Furthermore, Nippon Steel is engaged in positive efforts aimed at environmental protection, as manifested by the enormous amount of manpower and capital investment directed towards this end. Henceforth, the formulation of iron and steel industry projects in the developing nations will include paramount stress on the problem of environmental pollution. Nippon Steel is doing the very best it can in this area, not through a passive role, but through an active promotion of integrated environmental development, harmony between nature and industry, and ecological balance. These are the underlying themes behind all our effort.

CONCLUSION

As briefly described above, we at Nippon Steel have put in the very best of determined and positive efforts towards fruitful technological exchange and cooperation. It is our firm intention to expand these efforts in the future, always and in every case responding to the specific needs and requirements of all countries concerned. It is a great joy on our part to be given this opportunity, through technological assistance and cooperation, to be able to contribute in our own modest way towards world peace, progress, and prosperity.

Annex III

Major Steel's overseas supply lists

1. Engineering & Contracting

Area & Country	Company	Equipment/Process	Contents of technical collaboration
A. Europe			
1. Italy	Società Finanziaria Siderurgica Finsider per Azioni	(1) Iron & steel making area (ore preparation, sintering plant, coke plant, B.F., steel making plant)	Operation
		(2) Slabbing mill, hot & cold strip mill, plate mill	"
		(3) Continuous casting	"
		(4) B.F. (Taranto No.2 & No.3)	Engineering
		(5) B.F. (Taranto No.5)	"
		(6) B.F. top charging equipment	"
		(7) B.F. oil injection equipment	"
		(8) B.O.F. & O.G. system	"
		(9) Slab cooler	"
		(10) Walking-beam furnace	"
		(11) Hot finishing line	"
		(12) Hot strip mill	"
		(13) Desulphurization equipment	"
		(14) Integrated steel mill management system	System engineering
	Danieli & C.S.P.A.	(1) Trommel	Engineering
2. Federal Republic of Germany	Klöckner Werke A.G.	(1) Hot strip mill	Engineering
		(2) Tin-free steel	Engineering & operation
		(3) B.F.	Engineering
	Fried. Krupp GmbH Industriebau und Maschinenfabriken Essen	(1) B.F.	Engineering
	Fried. Krupp Hüttenwerke A.G.	(1) B.F.	Start-up operation
	Hoesch A.G.	(1) Tin-free steel	Engineering & operation

Area/Country	Company	Equipment/Process	Contents of technical collaboration
	Koppers-Wistra Ofenbau GmbH	(1) Walking-beam furnace	Engineering
	Demag Aktiengesellschaft	(1) Trommel	Engineering
		(2) O.G. system	"
	Baumco Apparatebau GmbH	(1) O.G. system	Engineering
	Metallgesellschaft A.G.	(1) Bonde pretreatment	Engineering
3. Austria	Vereinigte Österreichische Eisen und Stahl Werke A.G.	(1) O.G. system	Engineering
4. United Kingdom	British Steel Corp.	(1) B.O.F.	Engineering & operation
		(2) Iron-making area (ore preparation, sintering plant, B.F.)	Survey
	Ashmore, Benson, Pease & Co., Ltd.	(1) B.F.	Engineering
		(2) O.G. system	"
5. France	Société Lorraine de Laminage Continu	(1) Tin-free steel	Engineering & operation
6. Portugal	Siderúrgia Nacional S.A.R.L.	(1) Iron-making area (ore preparation, sintering plant, B.F.)	Survey
		(2) Steel-making area(B.O.F., electric furnace, continuous casting)	"
		(3) Tin-free steel	Engineering & operation
7. Finland	OVAKO Oy	(1) Iron-making area (ore preparation, sintering plant, B.F.)	Survey
		(2) Iron-making area (ore preparation, sintering plant, B.F.)	Operation
8. Sweden	Trafikaktiebolaget Grängesberg-Oxelösund	(1) High-strength steel	Engineering
		(2) Desulphurization equipment	"

Area/Country	Company	Equipment/Process	Contents of technical collaboration
9. Belgium	Phénix Works S.A.	(1) Tin-free steel	Engineering
	Cockerill-Ougrée-Providence	(1) Tin-free steel	Engineering & operation
		(2) B.F.	Engineering survey
10. Netherlands	Koninklijke Nederlandsche Hoogovens en Staalfabriken N.V.	(1) Tin-free steel	Engineering & operation
B. Asia			
1. Malaysia	Malayawata Steel Berhad	(1) Integrated steel mill (ore preparation, sintering plant, B.F., steel-making plant, bar & wire rod mill)	Engineering & operation
		(2) Electric furnace & continuous casting	" "
		(3) Hot coil processing line	" "
		(4) E.T.L.	" "
2. Republic of Korea	Pohang Iron & Steel Co., Ltd.	(1) Integrated steel mill (ore preparation, sintering plant, coke plant, B.F., steel-making plant, slabbing mill, hot strip mill)	Engineering & operation
	Union Steel Manufacturing Co., Ltd.	(1) Cold mill	Engineering & operation
	Inchon Ironworks Co.	(1) Rail mill	Engineering
		(2) Channel	"
3. Philippines	Elizalde Iron & Steel Corp.	(1) Cold mill	Engineering & operation
		(2) Tin-free steel	" "
	Iligan Integrated Steel Mills Inc.	(1) Cold mill & E.T.L.	Operation
4. India	Mukand Iron & Steel Works	(1) Electric furnace, continuous casting & wire rod mill	Operation
	W.S. Atkins Private Ltd.	(1) Cold mill & E.T.L.	Engineering

Area/Country	Company	Equipment Equipment/Process	Contents of technical collaboration
5. Pakistan	Steel Corporation of Pakistan	(1) Bar & wire rod mill	Operation
C. U.S.A., Central & South America			
1. Brazil	Usinas Siderúrgicas de Minas Gerais S.A.	(1) Iron & steel making area (ore preparation, sintering plant, coke plant, B.F., steel-making plant), strip mill & plate mill	Operation
		(2) Research & development	
		(3) Reheating furnace & annealing furnace	Engineering
		(4) B.F., coke oven, Sintering machine, B.O.F., hot & cold strip mill, plate mill	"
		(5) Management & control information system	System engineering
	Companhia Siderúgica Paulista	(1) Iron & steel making area (ore preparation, sintering plant, coke plant, B.F., steel-making plant), hot & cold strip mill, plate mill	Operation
		(2) Integrated mill expansion	Engineering survey
		(3) B.F., plate mill & raw material handling	Engineering
	Companhia Siderúrgica Nacional	(1) Iron-making area (ore preparation, sintering plant, B.F.)	Survey
		(2) B.F. blower	Engineering
2. Venezuela	C.V.G.-Siderúrgica del Orinoco C.A.	(1) Integrated mill expansion	Engineering survey
3. Chile	Compania de Acero del Pacifico S.A.	(1) Iron-making area (ore preparation, B.F.)	Survey
		(2) Coke plant	"
4. Mexico	Fundidora de Fierro y Acero de Monterrey S.A.	(1) Integrated iron & steel making	Operation

Area/Country	Company	Equipment/Process	Contents of technical collaboration
5. Honduras	Banco Centroamericano de Integracion Economica	(1) Integrated steel mill	Survey
6. U.S.A.	Chemical Construction Corp.	(1) O.G. system	Engineering
	Bethlehem Steel Corp.	(1) Tin-free steel	Engineering & operation
	Youngstown Sheet & Tube Co.	(1) Tin-free steel	Engineering & operation
	National Steel Corp.	(1) Tin-free steel	Engineering & operation
	Armco Steel Corp.	(1) IN-steel (2) Zn plate (3) HI-B silicon steel plate	Operation " "
D. Others			
1. Australia	Australian Iron & Steel Proprietary Ltd.	(1) B.O.F.	Engineering & operation
	Broken Hill Proprietary Co., Ltd.	(1) Rail mill	Engineering study
2. Algeria	Société Nationale de Sidérurgie	(1) Iron-making area (ore preparation, sintering plant, B.F.) & spiral mill	Operation

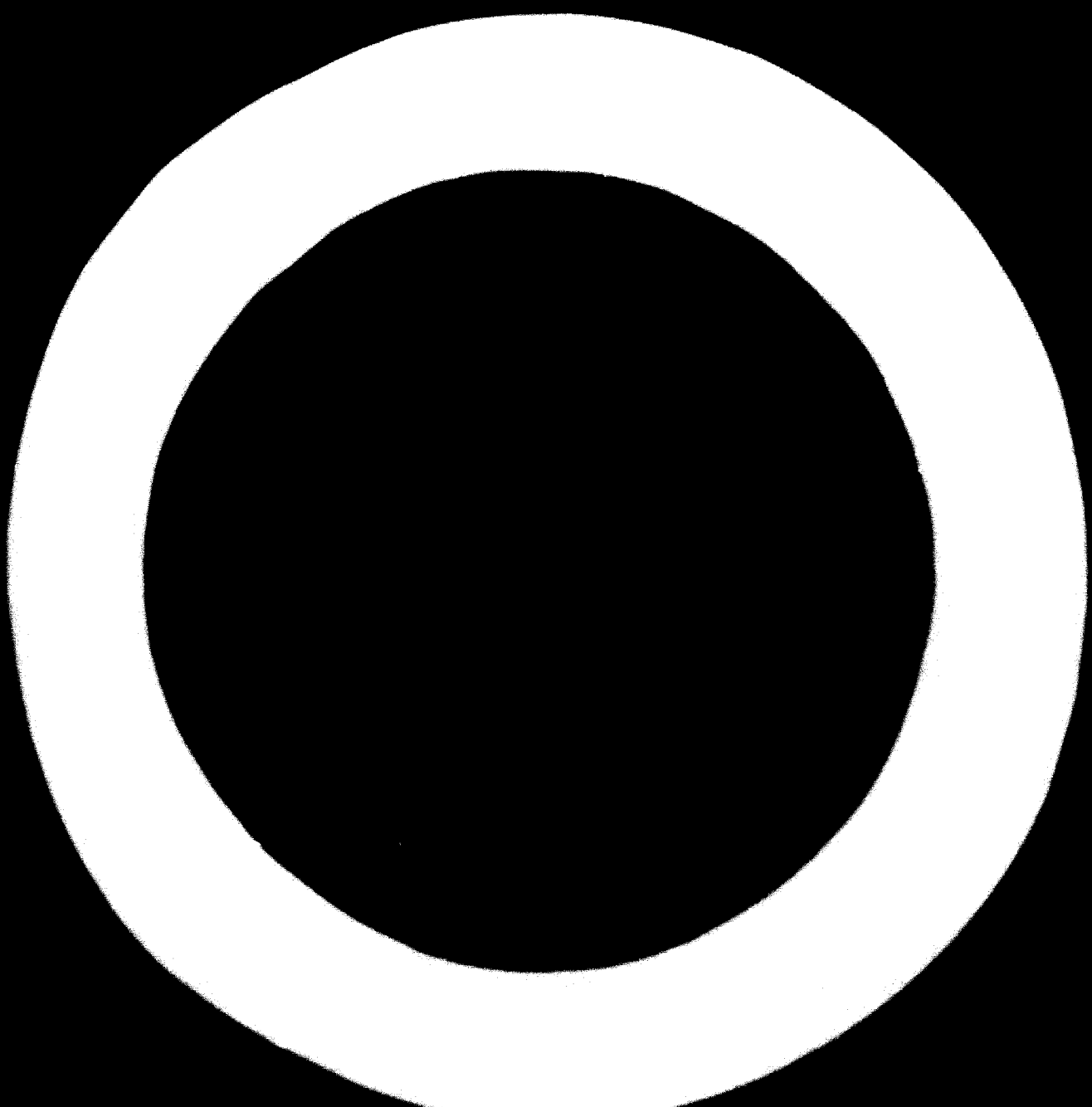
II. Equipment

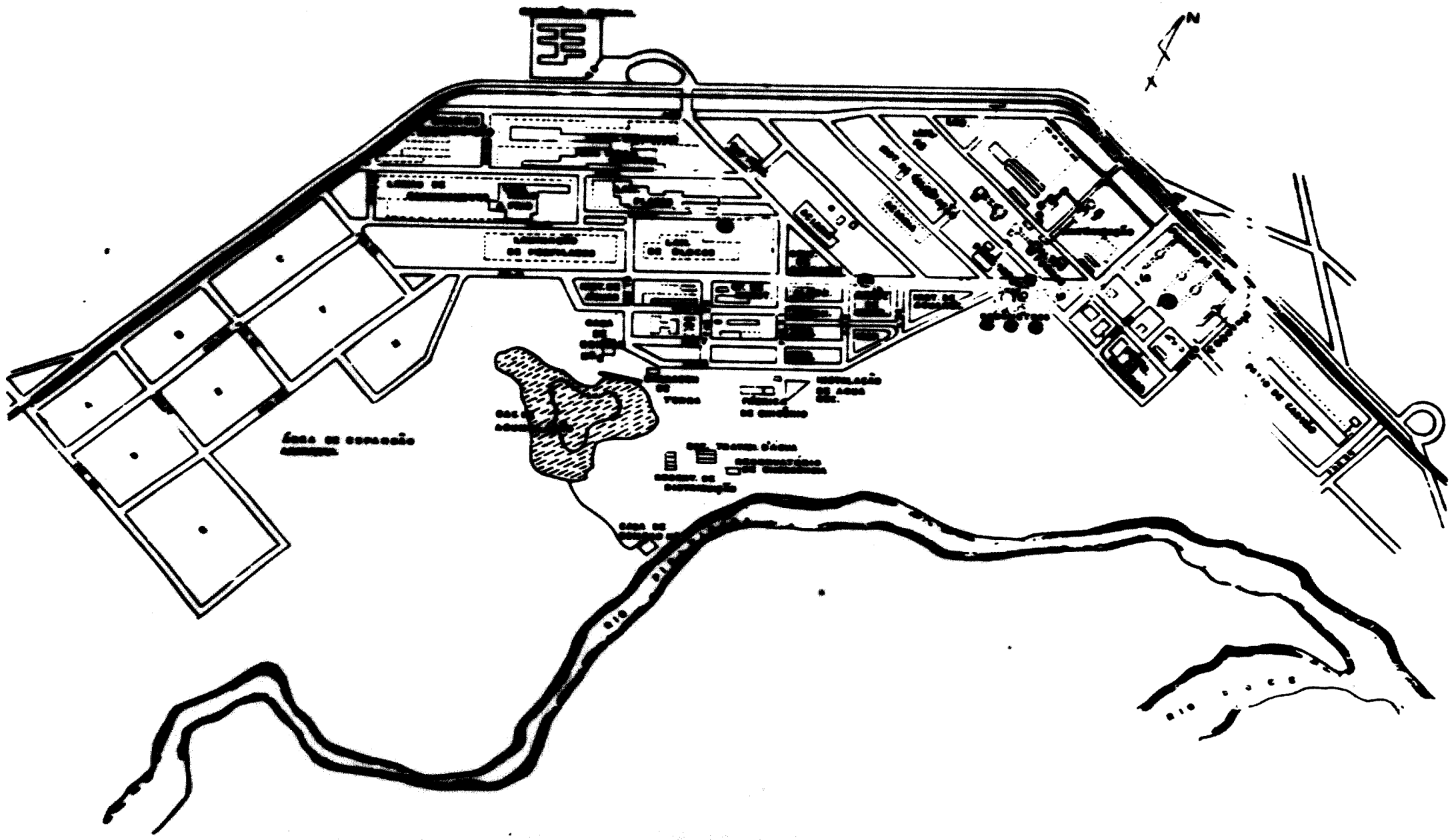
Country	Client	Description of job	No. of units
A. Iron-making equipment			
1. Italy	Italsider S.p.A.	Top charging equipment for Taranto No.5 B.F.	1
		Tap hole drill and jib crane for Taranto No.5 B.F.	1
2. Brazil	Companhia Siderúrgica Nacional	Blast furnace No.3	1
3. U.S.A.	United States Steel Crop.	Top charging equipment for Gary Works	1
B. Steel making equipment			
1. Italy	Italsider S.p.A.	KR desulphurization process	1
2. France	SOLMER	Mold cooler (cooling equipment of ingot mold)	2
3. Malaysia	Malayawata Steel Berhad	No.1 & No.2 basic oxygen furnaces	2
4. Brazil	Usinas Siderúrgicas de Minas Gerais S.A.	Basic oxygen furnace	1
	Companhia Siderúrgica Nacional	Basic oxygen furnace (vessel, tilting drive, lance hoist, material additive system)	2
5. Australia	Australian Iron & Steel Proprietary Ltd.	Basic oxygen furnace	-
	Broken Hill Proprietary Co., Ltd.	Newcastle Works basic oxygen furnace	2
C. Ingot making equipment			
1. Malaysia	Malayawata Steel Berhad	Continuous reheating furnace (section)	1
2. Brazil	Companhia Siderúrgica Nacional	Coke oven	-

Country	Client	Description of job	No. of units
D. Rolling mill equipment			
1. Malaysia	Malayawata Steel Berhad	R_1 & R_1 rougher mill (medium-section)	2
2. Brazil	Usinas Siderúrgicas de Minas Gerais S.A.	Slab cooler	1
3. Canada	Steel Company of Canada	Slab cooler (only design)	1
E. Treating and processing equipment for sheets and coils			
1. Italy	Italsider S.p.A.	Combination shearing line (C.S.L.)	1
2. Malaysia	Malayawata Steel Berhad	Slitting line	1
		Cold-forming equipment	1
3. Republic of Korea	Union Steel Manufacturing Co., Ltd.	Electric cleaning line	2
	Korea Electric Metallurgy Co.	Light-gauge shape production equipment	1
4. Philippines	Elizalde Iron & Steel Corp.	Tin free steel sheet production line	1

III. Steel structural fabrication and construction

Country	Client	Description of job	No. of units
1. Saudi Arabia	Aramdam Oil Co.	Fabrication of jacket for oil drilling and platform	
2. Indonesia	Pertamina	(1) Construction of submarine crude oil loading pipeline of double line circulation system	
		(2) Supply and installation of 150,000 BBF S.B.M.	
		(3) Construction of jetty and access roadway	
	Atlantic Richfield Co.	Fabrication of jacket for flow station	
	Japan Gasoline Co.	Fabrication and installation of flare-stack for Brunei liquid Natural Gas Plant	
3. Republic of Korea	Korean Government	Construction of Han-Nam Bridge	





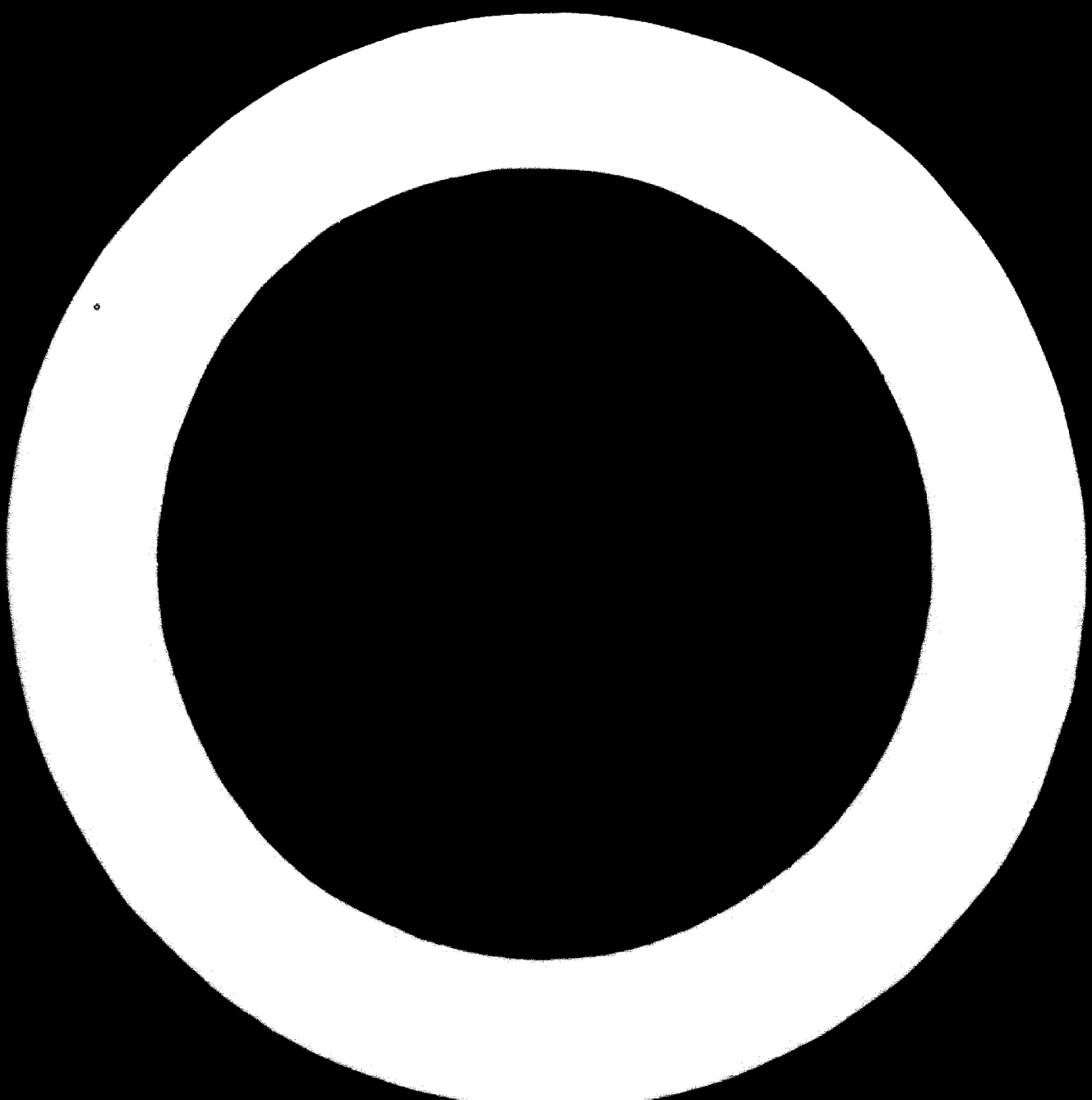
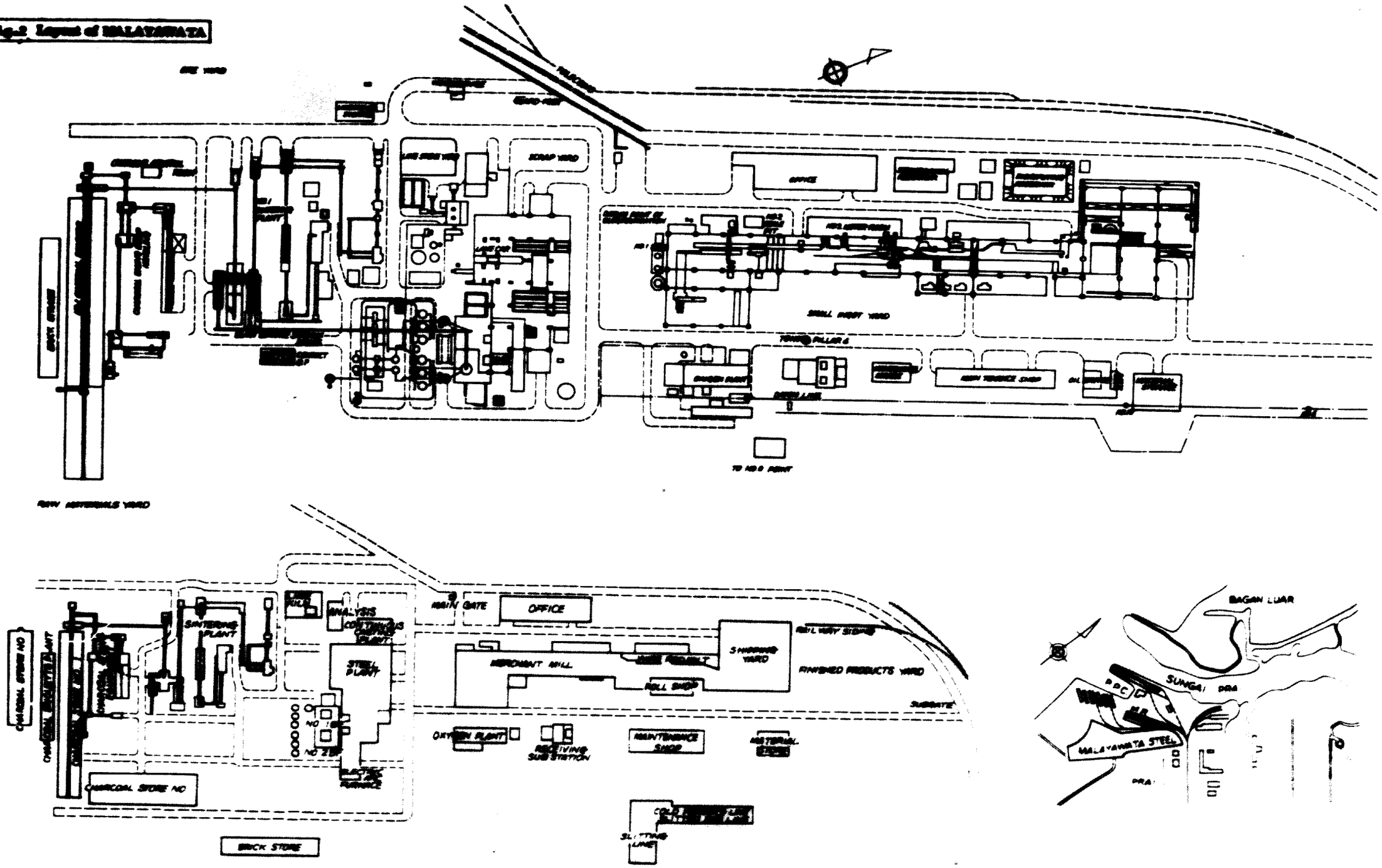


Fig.2 Layout of MALAYAWATA



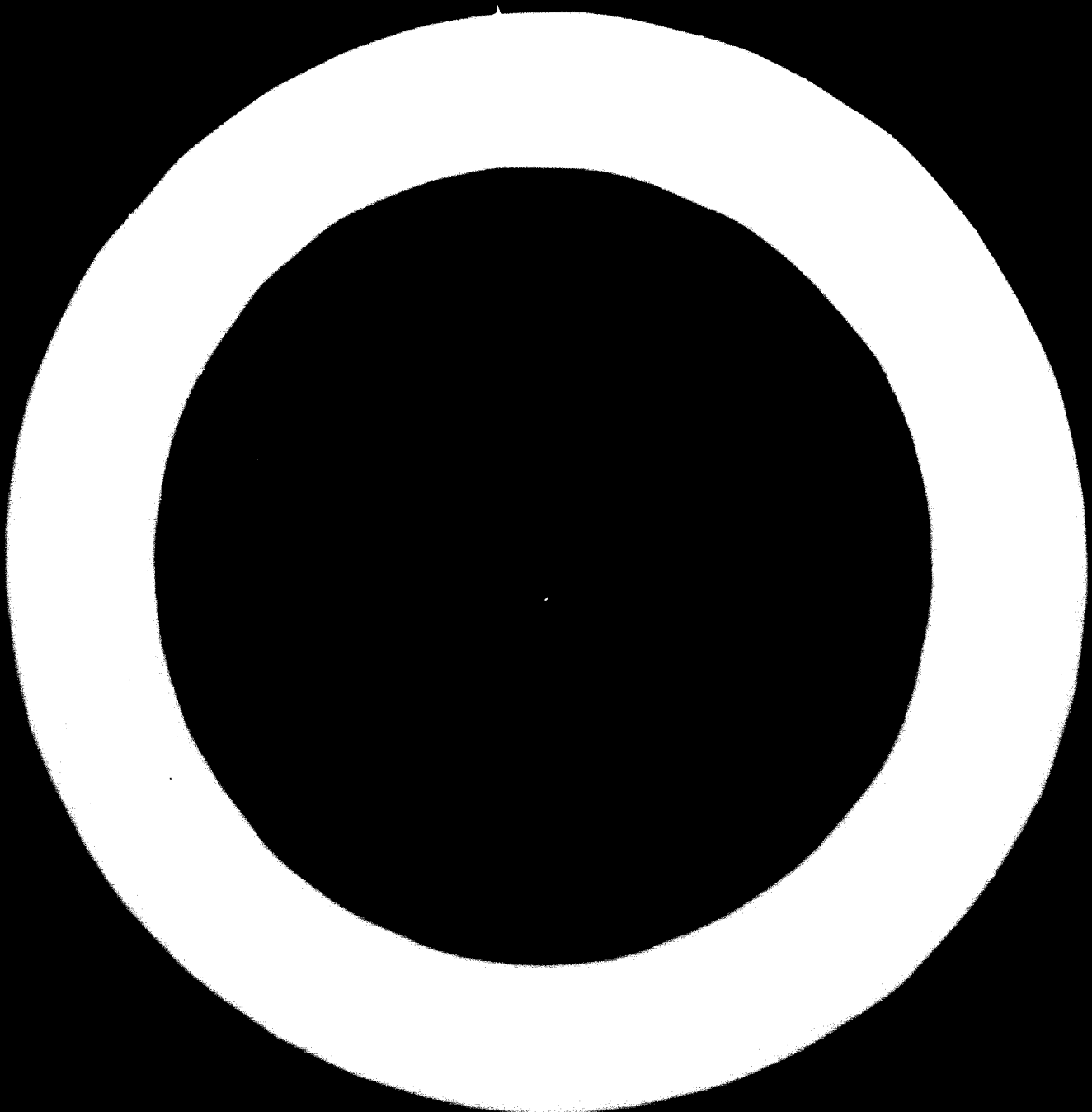
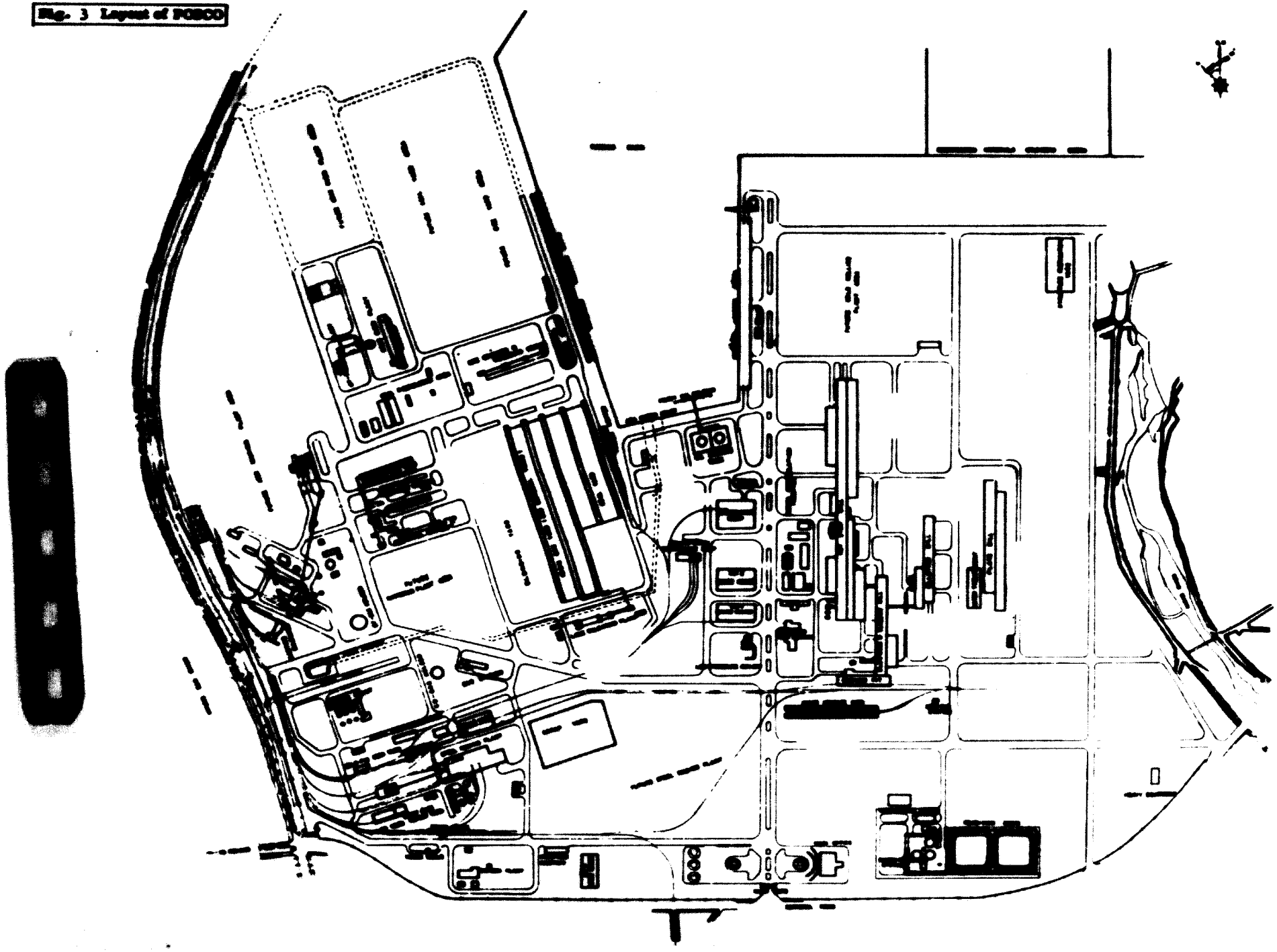
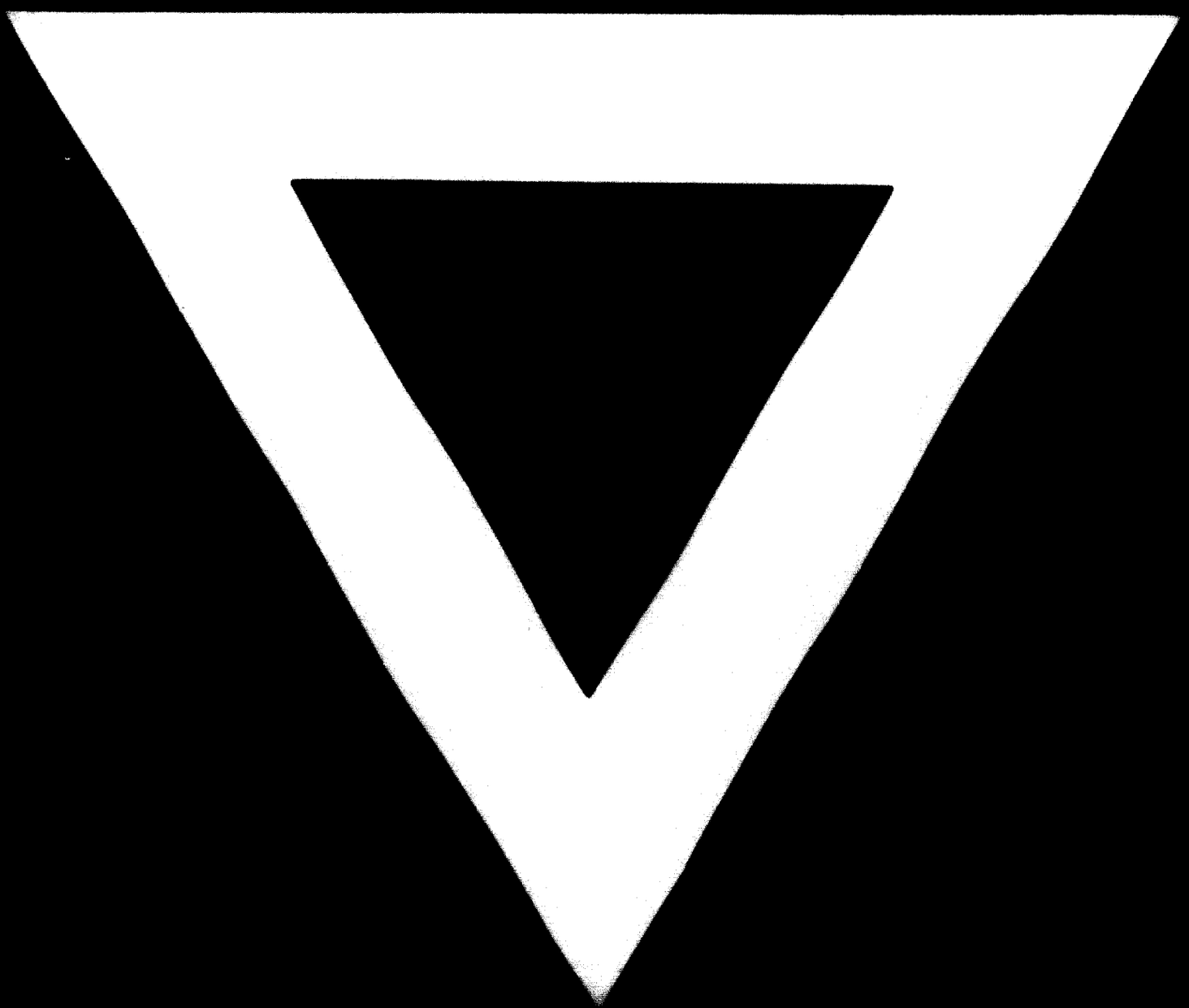


Fig. 3 Layout of POSCO





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