

No. 10

**METALLURGICAL RESEARCH  
AND  
DEVELOPMENT CENTER  
OF  
BURMA**

**BASIC DESIGN SURVEY REPORT**

**MARCH 1979**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

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METALLURGICAL RESEARCH  
AND  
DEVELOPMENT CENTER  
OF  
BURMA

BASIC DESIGN SURVEY REPORT

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国際協力事業団	
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## PREFACE

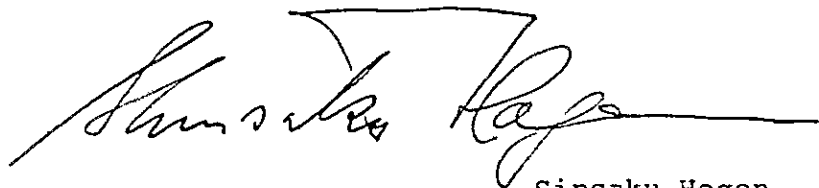
In response to the request of the Government of the Socialist Republic of the Union of Burma, the Government of Japan decided to cooperate in the construction project of the Metallurgical Research and Development Center of Burma, and the Japan International Cooperation Agency conducted its basic design survey.

The purposes of the aforementioned center are to conduct research and development, to extend technical advisory service to the industry and to provide theoretical and practical training for the personnel in the fields of analytical study, mineralogical study, ore dressing, smelting and refining.

An on-the-spot survey of the project was carried out during the period of 8th to 24th December 1978. The basic design based there-upon was duly explained to and approved by the competent authorities of the Burmese Government during the period from 20th to 27th February 1979 and the present report has been finalized.

I would like to express my sincere appreciation to the officers and people concerned of the Burmese Government who have extended close cooperation and assistance to our survey team.

March 1979

A handwritten signature in black ink, appearing to read 'Sinsaku Hogen', with a long horizontal line extending to the right.

Sinsaku Hogen

President

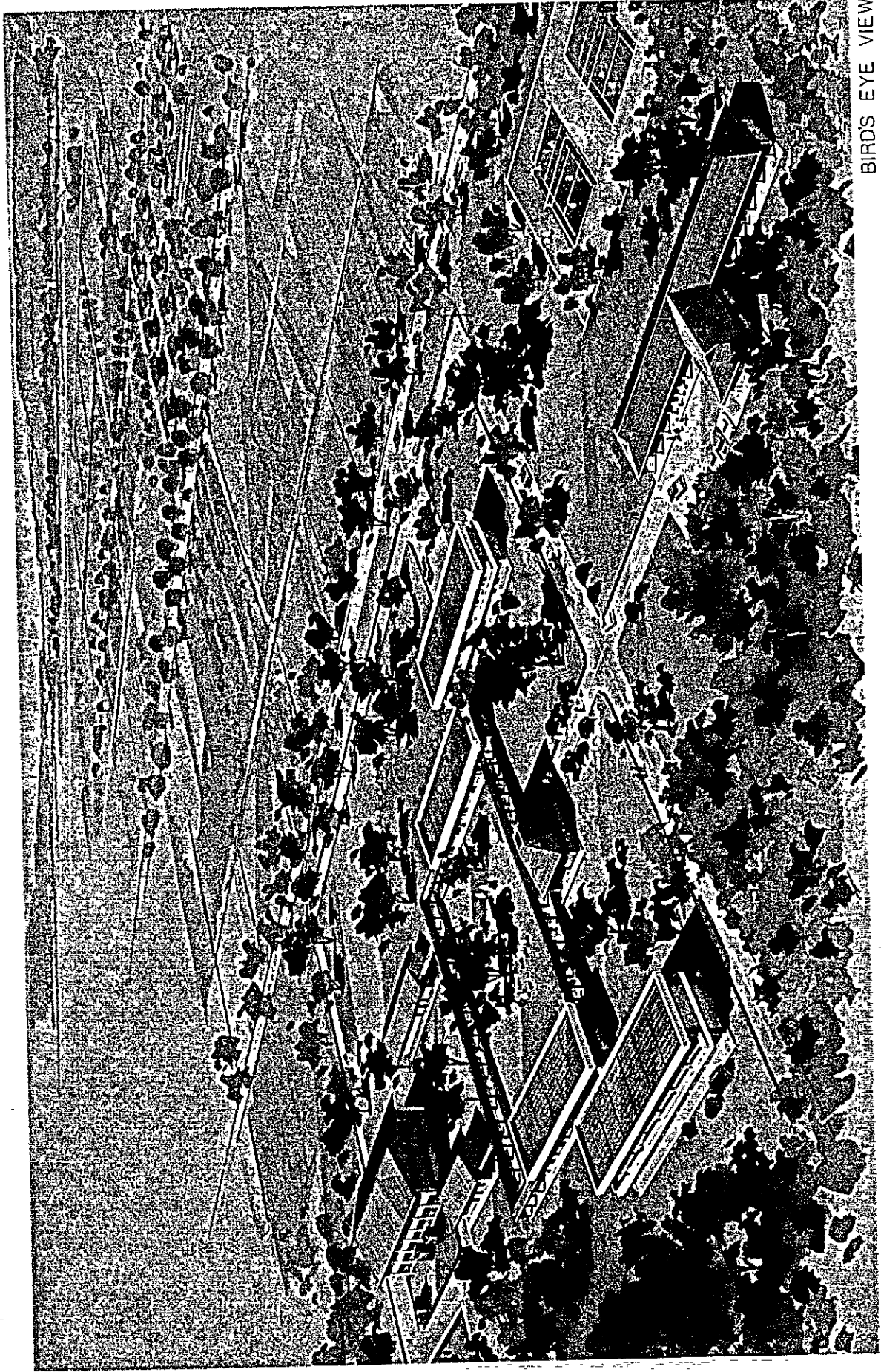
Japan International Cooperation Agency



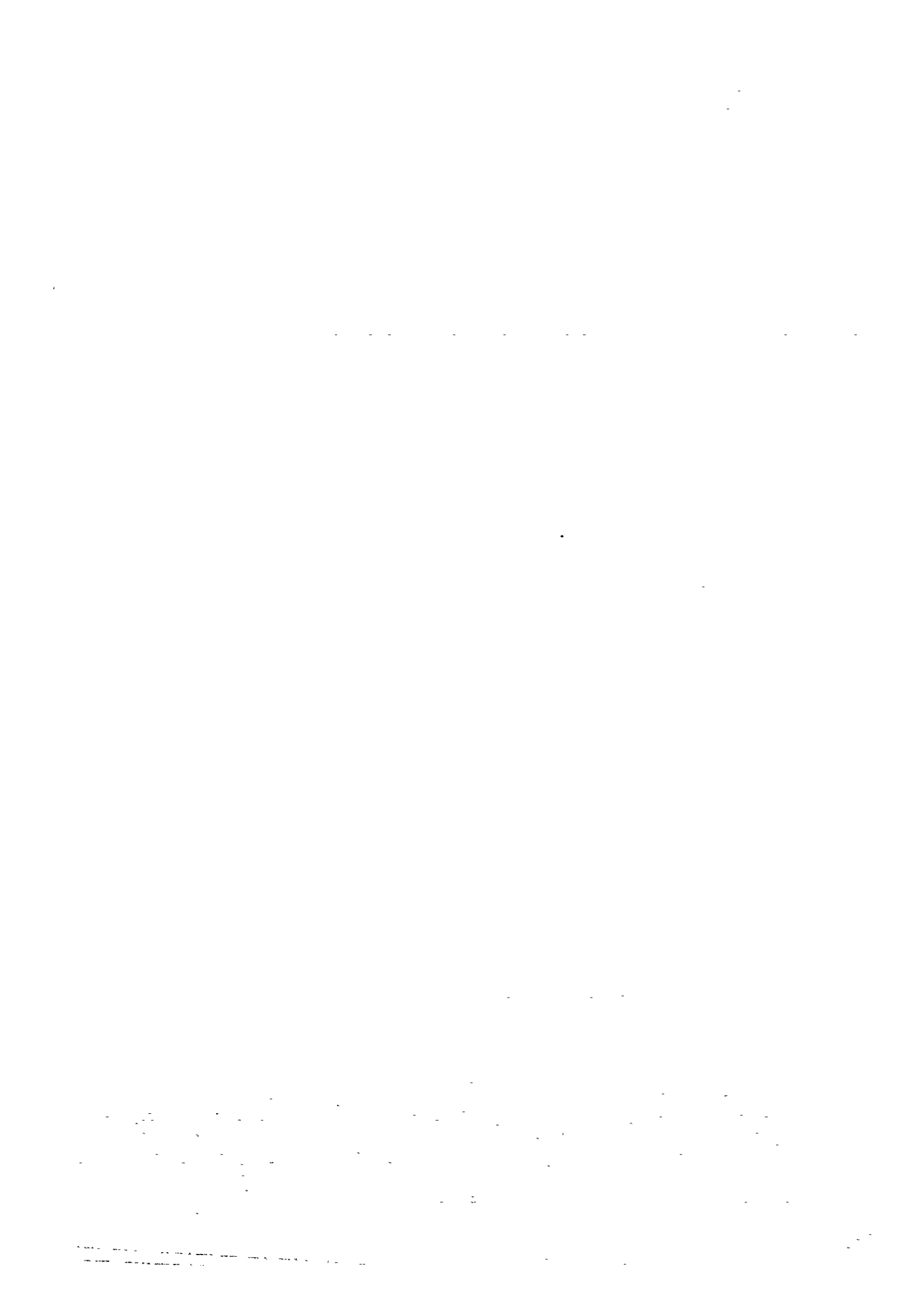
This report is an outline of the basic design survey of the Metallurgical Research and Development Center of Burma, and was prepared by Nihon Architects Engineers and Consultants Inc. commissioned by Japan International Co-operation Agency.

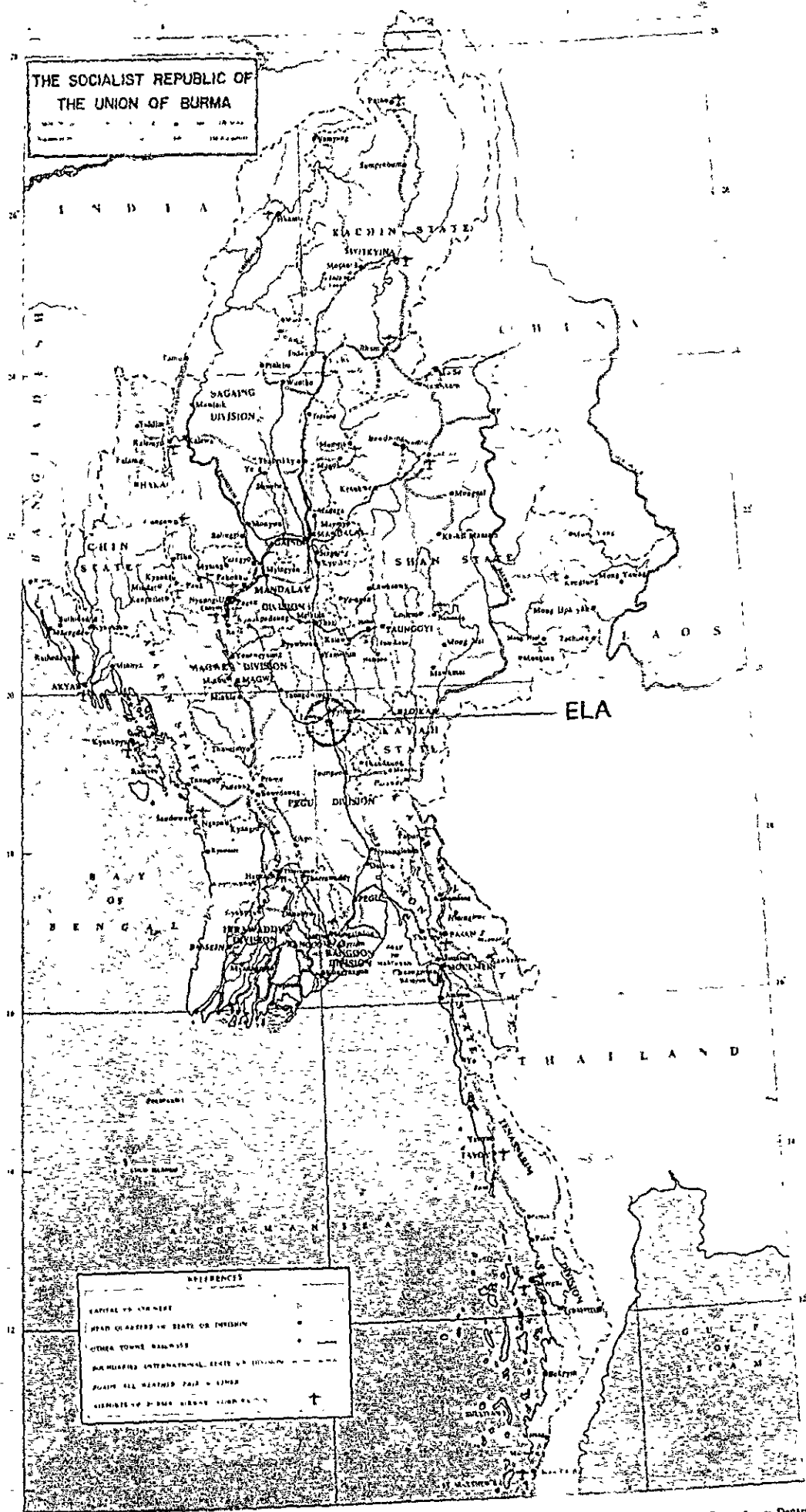






BIRD'S EYE VIEW

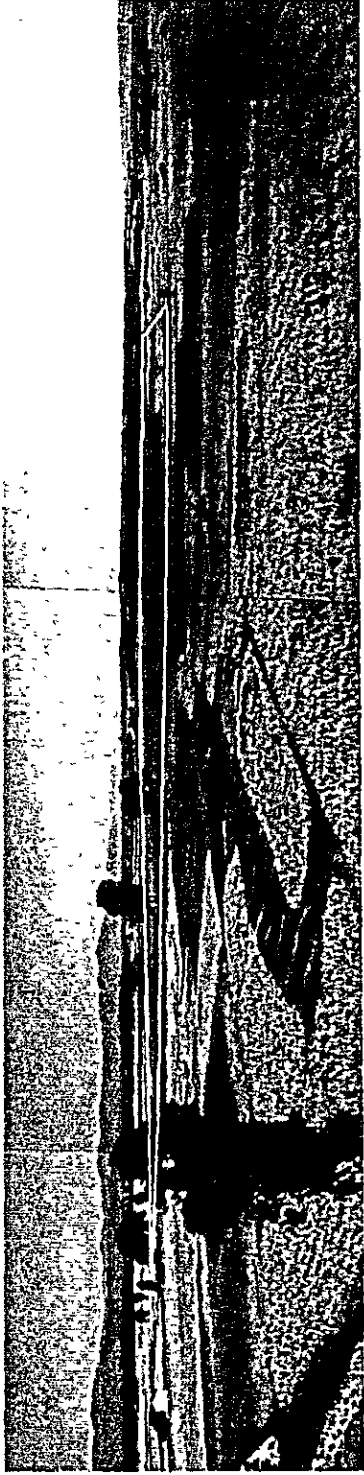




THE MAP OF BURMA

Printed at the Map Printing Office, Burma Survey Department

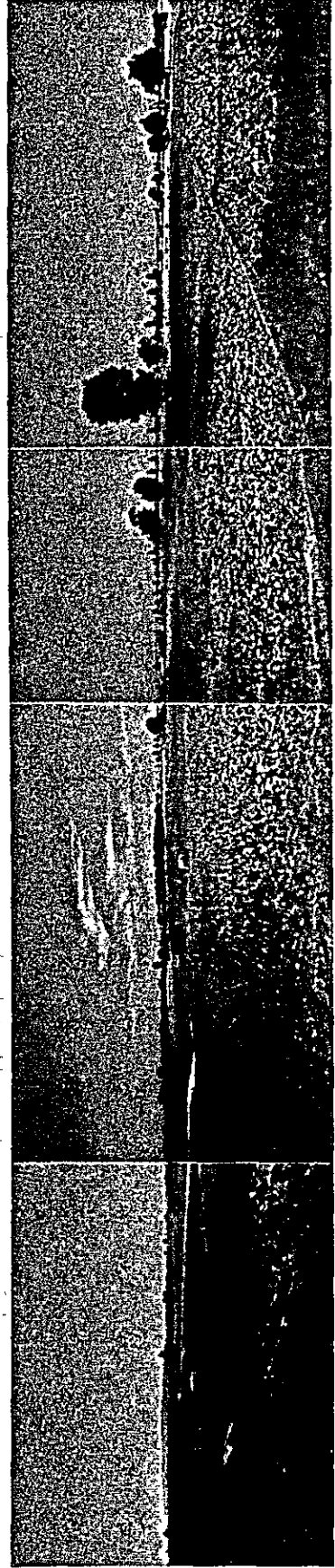




PROPOSED SITE FROM NORTH



GENERAL VIEW OF THE SITE FROM SOUTH-WEST CORNER



GENERAL VIEW OF THE SITE FROM SOUTH-EAST CORNER





FRONT ROAD OF THE SITE



RAIL WAY AND NATURAL LAKE  
NEAR THE SITE



YONBIN CHAUNG RIVER NEAR THE SITE



APPROACH TO EXISTING STAFF HOUSES



EXISTING STAFF HOUSES





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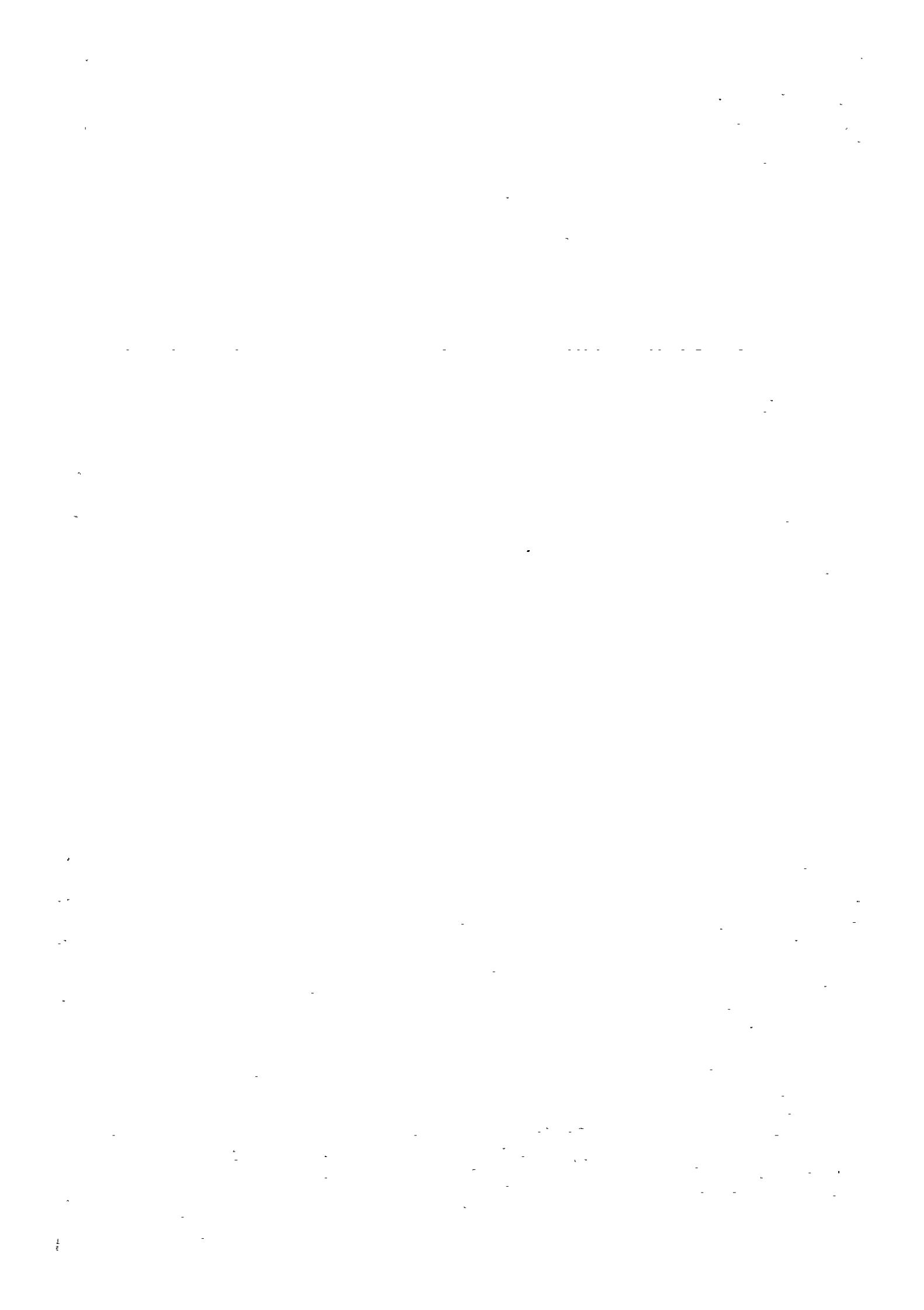
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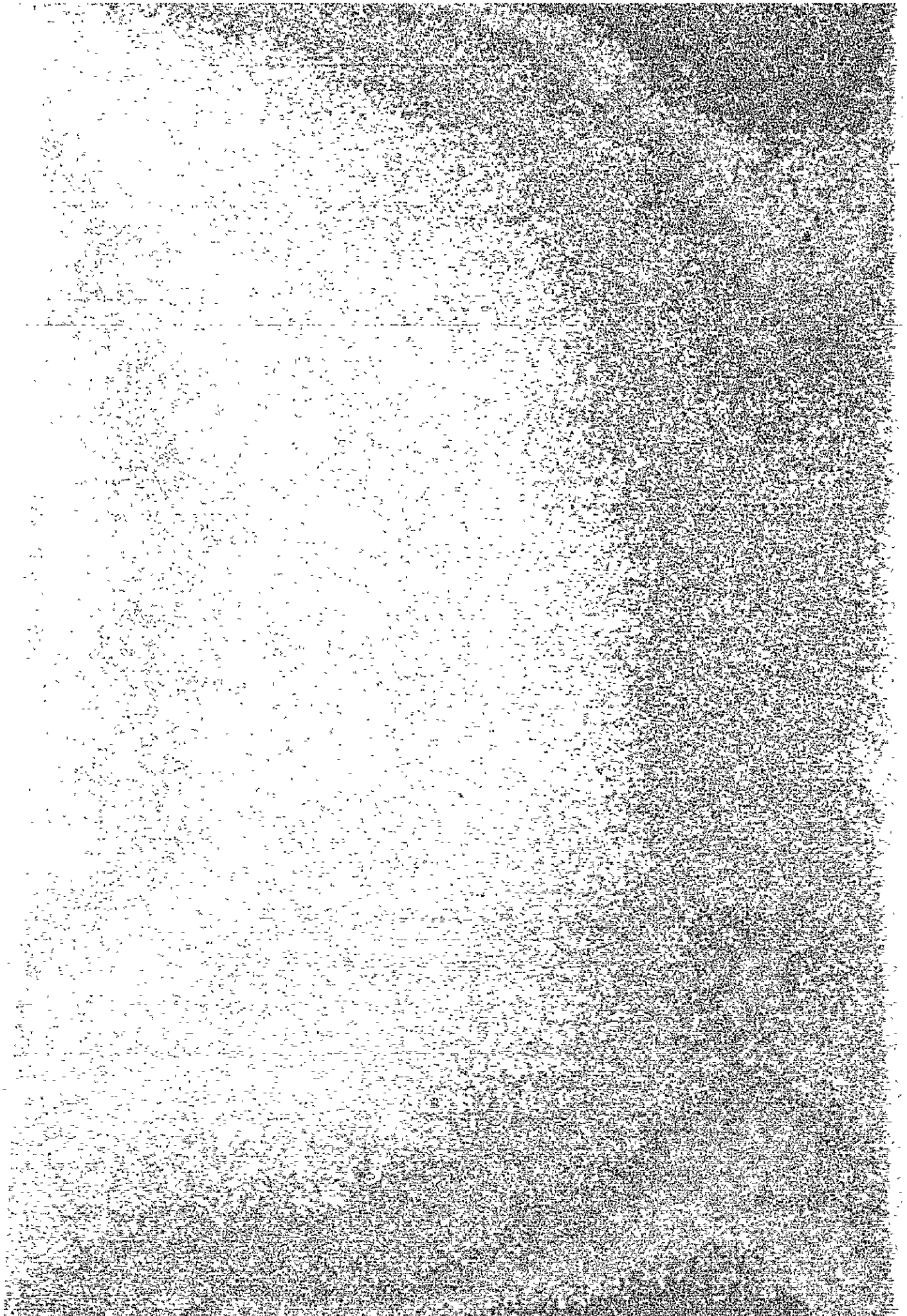
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## OUTLINE OF THE PROJECT





## OUTLINE OF THE PROJECT

The Project is summarized as follows:

### [1] PURPOSE OF THE CENTER

The Center is intended to provide necessary data for developing the underground mineral resources of Burma and also to provide a guideline for improving the operations of the existing mines and smelters through basic research it will and studies for practical application. At the same time, educate and train engineers in the areas of assay, ore dressing, smelting and refining.

### [2] ORGANIZATION AND FUNCTION OF THE CENTER

The Center comprises the following four departments:

- Basic Research Department - Sample preparation, assay and mineralogy;
- Applied Research Department - Flotation, gravity concentration and metallurgy;
- Basic Training Department - Pyrometallurgy; and
- Services Department - Office works, education, miscellaneous services, housing, etc.

### [3] CONSTRUCTION SITE

The construction site is located in Ela, Mandalay Division, about 400 km north of Rangoon. This site is part of the land which the Government has acquired for the use of an industrial complex in the future.

The site prepared for the Center is an almost square area of flat land of about 300 m north to south and about 360 m east to west with an area of about 11 hectares. To the north of the site runs a road of a width of about 7 m.

The site is located in a relatively high area. Presently part of it is farm land and the rest is barren.

#### [4] FACILITIES

The Center comprised the following buildings, facilities and equipment.

##### (1) Buildings

###### (a) Administration Building (about 750 m<sup>2</sup>)

Including the director's office, managers' offices, administration office, conference room, lecture room and library.

###### (b) Assay Laboratory (about 850 m<sup>2</sup>)

Laboratory for determining component materials, such as spectrochemical analysis, gas chromatography and wet chemical analysis.

###### (c) Mineral Processing Laboratory-1 (about 400 m<sup>2</sup>), and

###### (d) Mineral Processing Laboratory-2 (about 350 m<sup>2</sup>)

Comprising research rooms and sample preparation divisions for ore dressing including flotation, gravity concentration and leaching and mineralogy.

###### (e) Metallurgical Laboratory-1 (about 400 m<sup>2</sup>), and

###### (f) Metallurgical Laboratory-2 (about 200 m<sup>2</sup>)

Comprising research rooms for fundamental metallurgy by wet and dry processes and electrolysis.

###### (g) Pyrometallurgical Laboratory (about 850 m<sup>2</sup>)

Laboratory provided with fluidizing roaster and electric furnace for study of dry

smelting and refining by means of batch smelting and refining apparatus and for training.

(h) Dormitory (about 400 m<sup>2</sup>)

Building having ten lodging rooms, dining room, kitchen, shower room and lavatory for lodging of trainees (about 20 persons) and senior staff.

(i) Power Sub-Station (about 150 m<sup>2</sup>)

Shed for 1500 KVA transformer, switch-board and other related facilities.

(j) Annexes (to be borne by Burmese side)

Attached Building, Guard House, etc.

(2) Facilities

(a) Water supply facilities

Pump, elevated tanks and filters.

(b) Piping for water supply and drainage.

(c) Sewage disposal facilities.

(d) Power reception and transformer (1500 KVA).

(e) Wiring in the compound from the power sub-station.

(f) Emergency power generating facility (100 KVA).

(3) Equipment and machinery for

(a) Sample preparation.

(b) Assay laboratory.

(c) Mineral processing laboratory.

(d) Flotation laboratory including workshop.

(e) Gravity concentration laboratory.

(f) Metallurgical laboratory.

(g) Pyrometallurgical laboratory.

## [5] LAYOUT OF FACILITIES

The buildings have different characteristics and some of these such as noise and vibration can interfere with others. The Administration Building will be nearest to the main approach, and the other buildings will be arranged so that the more a building is likely to interfere with its surroundings, the further it is placed.

The buildings generating vibration, noise and/or exhaust gas will be set away from the Administration Building and Assay Laboratory. Such buildings are the Mineral Processing Laboratory-2, Metallurgical Laboratory-2 and the Pyrometallurgical Laboratory.

The flow lines will be so planned that the flow of people will be clearly separated from that of vehicles and so that vehicle deliveries to and from the respective buildings in the compound will be made from the loop road, while the pedestrians will use the covered walks and the passages facing the courtyard.

The covered walks will connect buildings to shelter the pedestrians from rain and sunlight.

The axial line of the buildings will be in the direction of east to west because of considerations of the wind direction and sunlight.

## [6] BURMESE SHARE IN ESTABLISHING THE CENTER

The Burmese Government will furnish the following items.

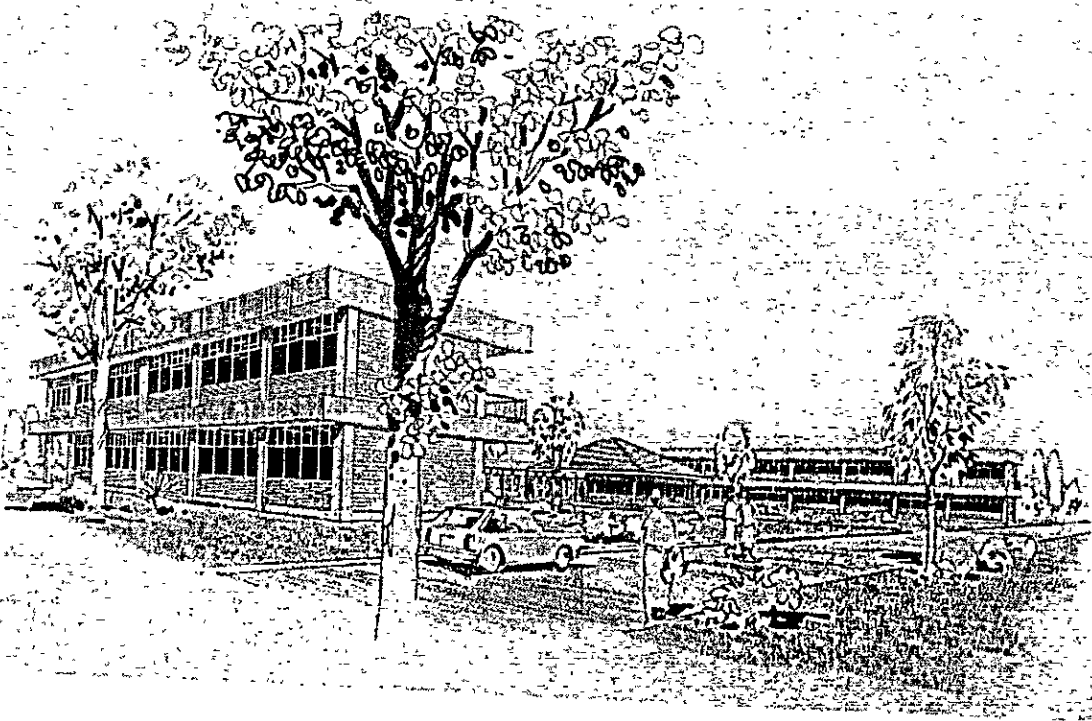
- (1) Fundamental work
  - a) Site reclamation
  - b) Wells
  - c) Electrical power supply to the power sub-station

- d) Settling Pond for waste water from laboratories
- (2) Building construction work
  - a) Staff houses
  - b) Attached buildings including tea room, utility room, covered way, storage, storage of inflammable material, gas storage and guard house
- (3) Road, paved yard, lawn, trees and fence at the site
- (4) Furniture and sundry items
- (5) With respect to machinery, equipment and other materials necessary for the establishment of the Center;
  - a) Internal transportation from the port of entry to the site
  - b) Taxation and any other charges
  - c) Cargo loading and unloading
  - d) Storage charge
  - e) Security guard
- (6) Temporary building and facilities for the construction period.

#### [7] CONSTRUCTION MATERIALS

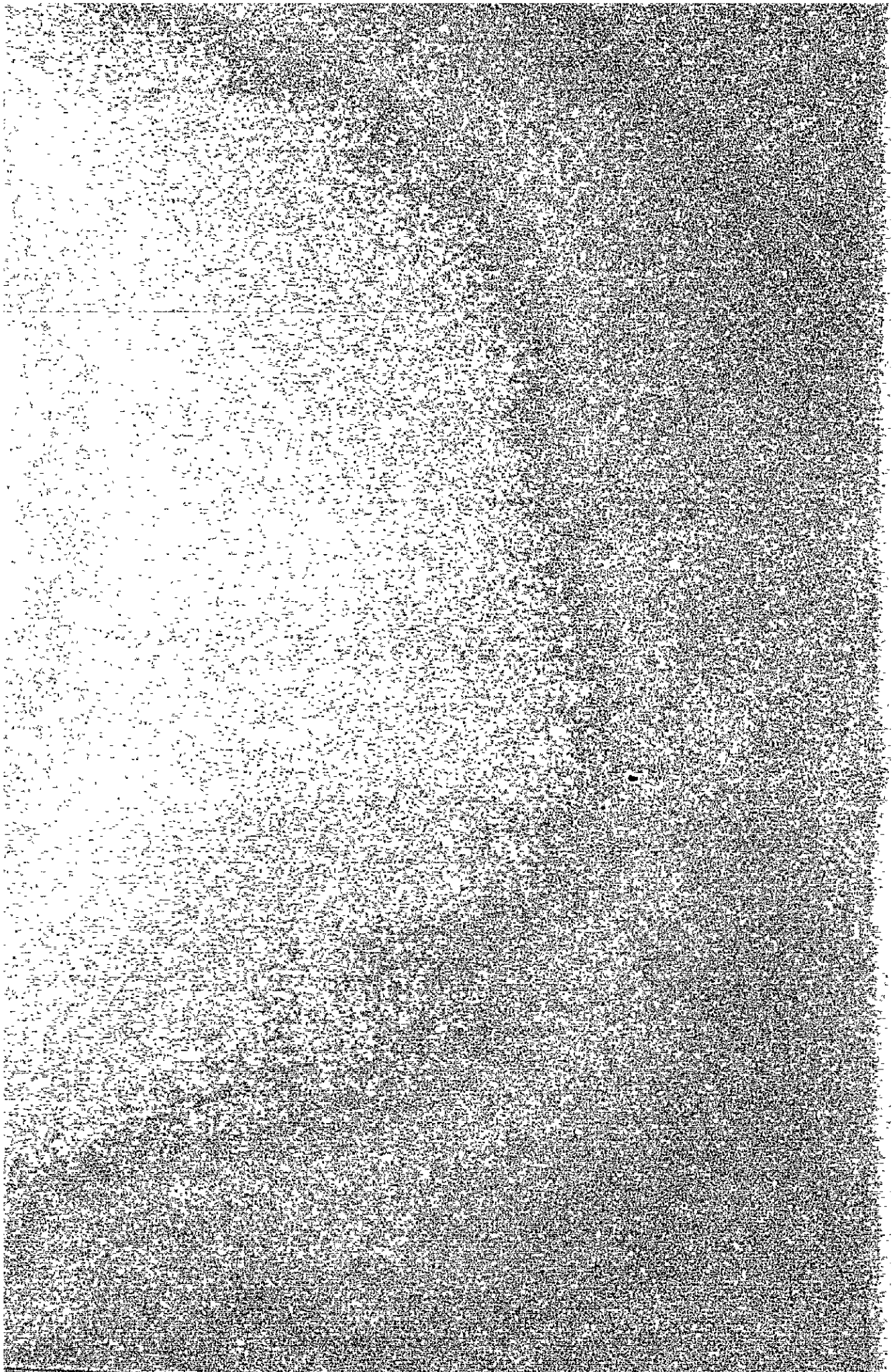
The construction materials will be so specified that Burmese domestic products will be used as far as practicable. However, the domestic construction materials are limited to cement, aggregates (sand and gravel), timber, bricks and asbestos slates, and the other materials, machinery and equipment will be imported, in principle, from Japan.

Further, if any construction materials produced in Burma involve problems in quality, quantity and/or delivery, such materials may substituted by others imported from Japan.



## BACKGROUND OF THE PROJECT

CHAPTER I





## 1-1 CIRCUMSTANCES OF THE PROJECT

The official telegram No. 575 dispatched on October 22, 1976, by the Embassy of Japan in Burma to the Japanese Ministry of Foreign Affairs, stated that cooperation was requested by the Socialist Republic of the Union of Burma concerning the establishment of the Center. The telegram called for a study on cooperation on the bases of grant aid and technical cooperation. Following this, in August 1978 the Ministry of Mines of the Socialist Republic of the Union of Burma presented a draft proposal for the establishment of the Center and once again called for the cooperation of Japan.

The draft proposal for the establishment was intended to establish an all-inclusive research and development center for the development of processing, smelting and refining technologies for mineral resources developed already and those to be developed in the future. For realization of such project, the Burmese side requested furnishing of the Center building as well as machinery and equipment and also technical cooperation through dispatch of Japanese experts.

The draft proposal presented by the Ministry of Mines of the Union of Burma is shown in Background Information III-1-1.

To comply with this request, Japan International Cooperation Agency, hereinafter referred to as JICA, decided to send a preliminary survey team to confirm the Burmese request in detail and conduct a necessary survey of such matters as the conditions at the site. Following this decision, a survey team organized by JICA conducted this survey in October 1978.

While in Burma, the preliminary survey team received a revised draft proposal for establishment of the Center from the Burmese side, and its details

are shown in Background Information III-1-2.

Upon the result of the preliminary survey, for further investigation, that would be needed for basic design pertaining to the Center construction project, a Basic Design survey team organized by JICA, conducted this survey in December 1978.

The foregoing two field surveys were carried out very smoothly through all-out cooperation extended by the Burmese side, and the basic design was drafted upon the results of the surveys.

In order to explain this draft basic design to the Burmese side and to obtain its concurrence and also to clearly set forth the details of the cooperation between the Union of Burma and Japan, JICA dispatched a Basic Design Draft Reporting Team to Burma.

The Reporting Team consulted and discussed with the Burmese government agencies concerned, and, as the result, agreement was reached with respect to the fundamental framework of the project, and the Minutes were signed by the Managing Director of No. 1 Mining Corporation, Ministry of Mines of Burma and the Leader of the Reporting Team. At that time, The Center, which had been provisionally named the Ela Central Metallurgical Laboratory, was then renamed the Metallurgical Research and Development Center of Buram.

The members' itineraries and survey results of the Preliminary Survey Team, Basic Design Survey Team and Basic Design Draft Reporting Team are described in Section 2-1.

## 1-2 THE NECESSITY OF THE PROJECT

The Government of Burma has been most anxious not only to carry out further exploration and development of underground mineral resources but also to acquire the techniques of metal smelting and refining in order to increase the value added.

To achieve this goal, the Government of Burma has already prepared a scheme for constructing a metallurgical industrial complex, mainly for zinc from Bawdwin Mine, copper from Monywa Mine and tin and tungsten from Tenasserim District, and intends quickly to realize this construction of the Center together with the mine development.

As higher education facilities for training engineers in the mining industrial field, there are the Rangoon Institute of Technology and national technical junior colleges for training junior engineers in the mining field. So there is presently no problem of the availability of engineers.

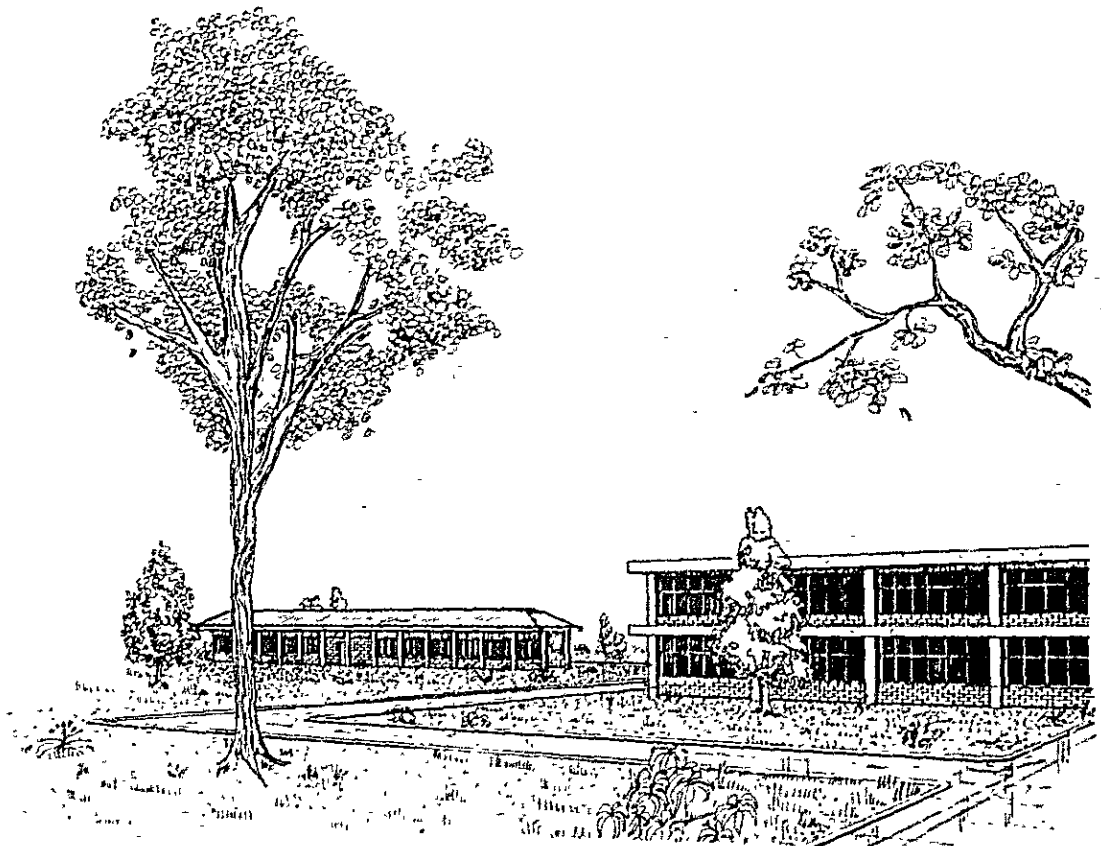
However, existing research facilities and equipment owned by these organizations seem to be insufficient. And it will be very difficult to train and educate potential engineers with knowledge sufficient for the actual development projects.

In addition, it seems that the existing governmental organizations concerned do not have the functions or facilities to perform services required for the mining development such as the determination and analysis of ores and the choice of appropriate mineral processing methods.

In view of this present situation and of the background outlined above, the objective of the project is obviously very reasonable and appropriate

since the purpose of this new center is to make up for the basic gaps stated above, to acquire the various basic and applied engineering skills in the area concerned, to train and educate professional engineers and to provide functions capable of performing services for the various organizations concerned.

It is certain that the establishment of this research and development center will become an indispensable driving force for the development of underground mineral resources with the advanced processing techniques which have been long hoped for. Also, it can be expected with certainty that the new center will contribute to making it possible for Burma not only to be self-sufficient in, but also an exporter of, base metals and various mineral products, which would improve the trade imbalance and social welfare by creating new employment opportunities.



### 1-3 FUNCTION AND BASIC CONCEPT OF THE CENTER

#### 1-3-1 BASIC CONCEPT

The purposes of the Center are to extend technical advisory services required for the development of the underground mineral resources, to conduct research and development work to provide guidelines for improving the results and operation of existing mines and smelters, and to train and educate engineers specializing in the areas of assay, ore dressing, smelting and refining.

For the time being, the main ores to be treated in the Center are copper, lead, zinc, tin and tungsten, and an appropriate set of laboratory machines and equipment required for the research and development of ore dressing and smelting of these ores will be installed.

Machinery and equipment have been selected for relatively simple maintenance and operation and the local meteorological conditions of high temperature and high humidity. In addition, the kinds of such machinery and equipment have been standardized as much as possible to ensure easy replaceability and availability of parts.

#### 1-3-2 ORGANIZATION AND FUNCTIONS OF THE CENTER

This research and development center basically consists of a basic research department, applied research department and training department. The first department contains an assay laboratory, mineralogical laboratory and a sample preparation division, the second has a flotation laboratory, gravity concentration

laboratory and metallurgical laboratory, and the third contains a pyrometallurgical laboratory.

The functions of the basic and applied research departments will be to perform a series of bench-scale tests including the grinding and quartering of ore samples, determination of ingredients and grades and the selection of useful minerals for recovering highly-purified metals by feeding these concentrates into the smelting process.

The Training Section includes the pyrometallurgical treatment model. The series of bench-scale test and research will give sufficient knowledge and training for the trainees to understand the basic processes and selection of equipment, and to estimate operating conditions and costs for the ore dressing and smelting procedures.

These experts will contribute to the future mine development and plant construction of Burma.

(1) Sample Preparation Equipment

This equipment will crush and grind ore to a size a suitable for the ore dressing test. It consists of a jaw crusher for primary crushing, sample grinder. Apparatus for blending and quartering will be also provided.

To prevent vibration, noise and dust, this equipment should be installed in a building with dust collecting facilities, separated from research buildings equipped with delicate machinery.

(2) Assay Laboratory

This laboratory will have equipment capable of determining the properties, texture and grade of ore, concentrate, blister, metal and other products of ore dressing and smelting procedure. The laboratory will be equipped with a weighing device, ordinary wet chemical analysis device, fire assay device for gold and silver, atomic absorption spectrometer for quantitative analysis of metal elements, emission spectrometer for small quantities, X-ray fluorescence spectrometer for non-breaking analysis, X-ray diffractometer for deciding the formal fabric of minerals of components included, gas chromatograph for polluting components such as organic mercury, microphotosizer for granular variation analysis of powder samples.

(3) Mineral Processing Laboratory

This laboratory will be equipped with reflection and polarizing microscopes for examining the properties of the ore sample, apparatus for producing thin plates and polish sections for the microscopes, and mineral processing equipment such as microphotography apparatus.

Using such equipment, the various properties of minerals such as texture of minerals, paragenesis and kinds of gangue minerals can be found, and, with such data, the most appropriate ore dressing method can be selected. For the purpose of basic tests for the

ore dressing, a bench-scale flotator, dry and wet type magnetic separator and high tension separator can be utilized. The grade of the products can be determined using the facilities of the assay laboratory, and the result of ore dressing work can be calculated.

(4) Flotation Laboratory

When treating minerals with very simple structure, the scale-up can be conceived as the results of the basic test conducted in the Mineral Processing Laboratory. However, when treating complex ores, various factors such as the effect of recycling middlings, effect of reagents on processes following their application and water recycling must be investigated. For this purpose, continuous tests will be necessary so that a series of equipment for feeding, primary crushing, secondary crushing, washing, grinding, flotation and dewatering will be installed in this laboratory.

In conjunction with the equipment described above, other supporting equipment will be necessary. The supporting equipment to be installed in this laboratory will consist of a slurry pump, reagent feeder, pH meter, water supply system, crane and workshop for simple repairs.



The flotation system and the number of flotation cells will vary depending upon the composition, grade and property of the ore to be treated. And the size and number of flotation cells in this laboratory have been decided by assuming that three kinds of concentrates will be sampled from ordinary sulphide ores. The capacity of the equipment is 300 lbs/hr.

This laboratory will be separated from other research buildings because of its vibration, noise and dust, and the requirements for various floor trenches and drain pits.

(5) Gravity Concentration Equipment

This equipment will be installed for research into processing and recovering heavy minerals such as tin and tungsten. For this purpose a gravity concentrator, including a jig, vibrating table and a spiral concentrator, will be provided. Since these make up a concentrator, a dewatering and filtering apparatus for minerals will be added, and, since they are closely related to the flotation process, this equipment will be placed close to the flotation laboratory described in section 4.

(6) Metallurgical Laboratory

This laboratory will be able to conduct the various basic bench tests for smelting and refining metals by the application of wet and dry processes, depending upon the composition

and properties of the sample of the concentrates expected to be sent from various mines in operation and of the products of concentrates recovered during the various ore dressing and concentration tests listed above.

At first, in order to find the composition and properties of ore samples and products of the smelting process, basic measuring equipment such as a sample grinder, metallurgical microscope, differential thermal balance, and a potentiogalvanostat will be installed together in the physical property testing room.

For research into the pyrometallurgical treatment process by smelting of concentrates such as copper, lead, zinc, tin and tungsten, equipment for crushing, grinding, screening and mixing required for preparatory work will be installed together with various pelletizers and sintering machines in this laboratory.

Adjacent to this preparatory workroom, various types of small furnaces, such as a fluosolid furnace, muffle furnace, crucible furnace, electric arc furnace, combustion furnace, and an induction furnace, will be installed to perform bench scale tests related to roasting, smelting and melting.

Since the preparatory work room and the furnace room may cause problems of noise, dust, vibration or high

temperatures, they will be separated from other buildings and equipped with fans, scrubbers, baghouses and wet cyclone collectors.

For oxide ores which cannot be easily recovered by the flotation method, application of a hydro-metallurgical method such as leaching can be considered. Thus, continuous leaching apparatus for performing such research will be installed, as will solvent extraction equipment for further condensing the pregnant solution obtained from the leaching apparatus and autoclave for extraction under high pressure and high temperature condition.

In addition, testing equipment for the electro-refining of crude metal obtained from the pyrometallurgical process and of pregnant solution obtained from the hydro-metallurgical process will be installed.

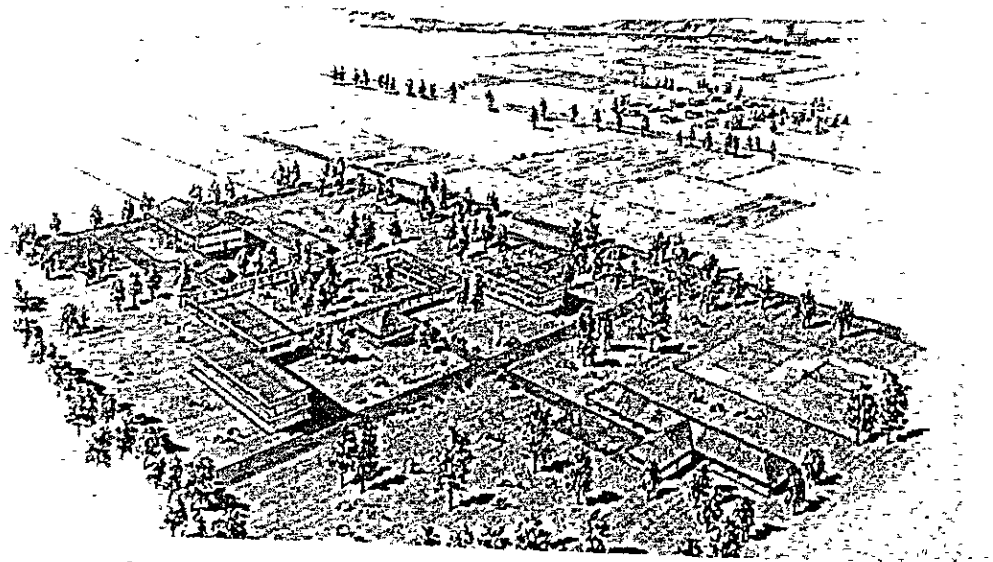
(7) Pyrometallurgical Laboratory

Facilities capable of training the engineers in typical non-ferrous metallurgy techniques such as pyrometallurgy for copper, lead and zinc through batch-scale tests will be installed. Tests conducted will be based upon the results obtained from basic research on the pyrometallurgical process described above. In addition, it is intended that basic methods for future metallurgical engineering on the continuous operating scale will be

developed and improved through tests in this laboratory.

The scale of the equipment for this laboratory is the minimum which will achieve the purposes described above, and continuous tests combining each process cannot be conducted with this equipment. Ores other than copper, lead and zinc can be also tested and studied by adding some apparatus with appropriate techniques.

A fluidizing roaster as a typical roasting apparatus for ores, a compact and easily operable electric furnace as smelting apparatus, a wind furnace equipped with a crucible widely used for melting metals and other minerals, and electrolytic apparatus generally used for refining will be installed in this laboratory. For treating exhaust gases such as sulfur dioxide generated in the operation of such testing and research apparatus, desulfurization apparatus will be also installed here.



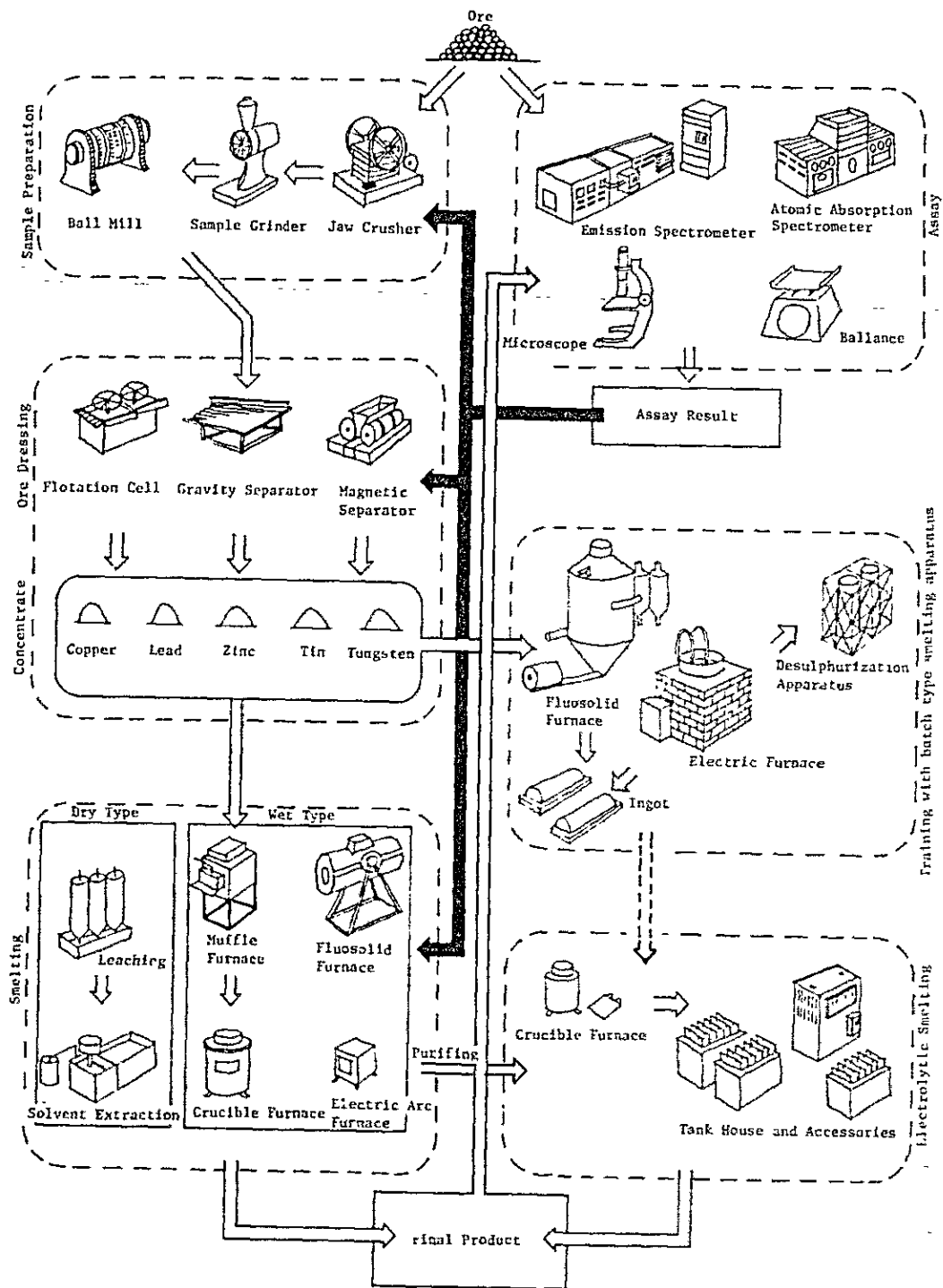


DIAGRAM OF RESEARCH AND TRAINING

TENTATIVE FLOW OF JAPAN'S COOPERATION IN GENERAL

Items	Time Sequence necessary for the Implementation of the Project
<p><u>I. TECHNICAL COOPERATION BASIS</u></p> <p>1. Dispatch of Japanese Missions</p> <p>2. Assignment of Japanese Experts</p> <p>3. Training of Burmese Counterparts in Japan</p> <p>4. Provision of Equipment (to make up for II-5)</p>	<p>Preliminary Survey Team</p> <p>Basic Design Survey Team</p> <p>Implementation Survey Team</p> <p>Consultation Team</p> <p>Technical Guidance Team</p> <p>Evaluation Team</p> <p>(Signing of Record of Discussions)</p> <p>Japanese Experts for a long-term Survey, if necessary</p> <p>Japanese Experts</p> <p>Burmese Counterparts</p> <p>Installation</p>
<p><u>II. GRANT AID BASIS</u></p> <p>1. Exchange of Notes</p> <p>2. Design for Buildings</p> <p>3. Construction of Buildings and Facilities</p> <p>4. Provision of Equipment</p>	<p>E/N</p> <p>Detailed Design</p> <p>Construction</p> <p>Specification, etc.</p> <p>Installation Test Run</p>

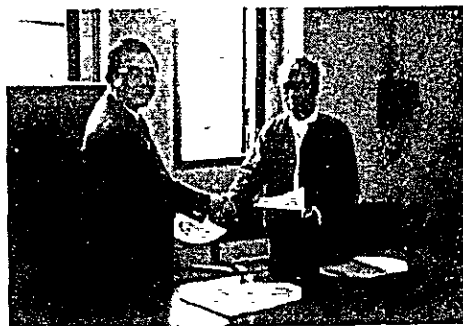
1-5 MINUTES

At the conference held between the Basic Design Draft Reporting Team and the governmental agencies concerned of Burma with respect to the fundamental framework of the Project, an agreement was reached. The Minutes of the conference were ratified with the signatures of Mr. Kenji Tomita, Leader of the Reporting Team representing the Japanese Team and U Ko Ko Than, President of No. 1 Mining Corporation representing No. 1 Mining Corporation affixed thereto on February 24.

The text of the Minutes is reproduced fully in the following pages.



SIGNING TO THE  
MINUTES



U KO KO THAN AND  
DR. KENJI TOMITA

Minutes on the Construction Programme  
of the Metallurgical Research and Development Center of Burma  
in the Socialist Republic of the Union of Burma

At the request of the Government of the Socialist Republic of the Union of Burma for cooperation in establishing the Metallurgical Research and Development Center ( hereinafter referred to as "the Center" ), the Government of Japan through the Japan International Cooperation Agency ( hereinafter referred to as "JICA" ) sent a survey team twice to the Socialist Republic of the Union of Burma.

In order to explain the details of the results of the aforementioned surveys and to exchange views with Burmese Authorities concerned on the establishment of the Center, the present survey team of JICA headed by Dr. Kenji Tomita, Deputy Director-General of the National Research Institute for Pollution and Resources, visited the Socialist Republic of the Union of Burma for 5 days from February 20, 1979 to February 24, 1979.

During the course of the discussions, the Burmese side fully understood the explanation made by the Japanese Team on the details of the Draft Summary Report and expressed its appreciation for the cooperation extended so far by the Japanese side in the preparatory stage of facilitating the Center project.

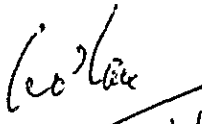
As a result of the discussions, both parties have agreed to recommend to their respective Governments to take such necessary measures for establishing the Center as described below:




1. The proposed Center will be established at Ela,  
Lewai Township, Mandalay Division;
2. The main functions of the Center are;
  - (1) to conduct research and development works;
  - (2) to extend the technical advisory service to the  
industry and
  - (3) to provide the theoretical and practical training  
for the present and future personnel of the  
industry;

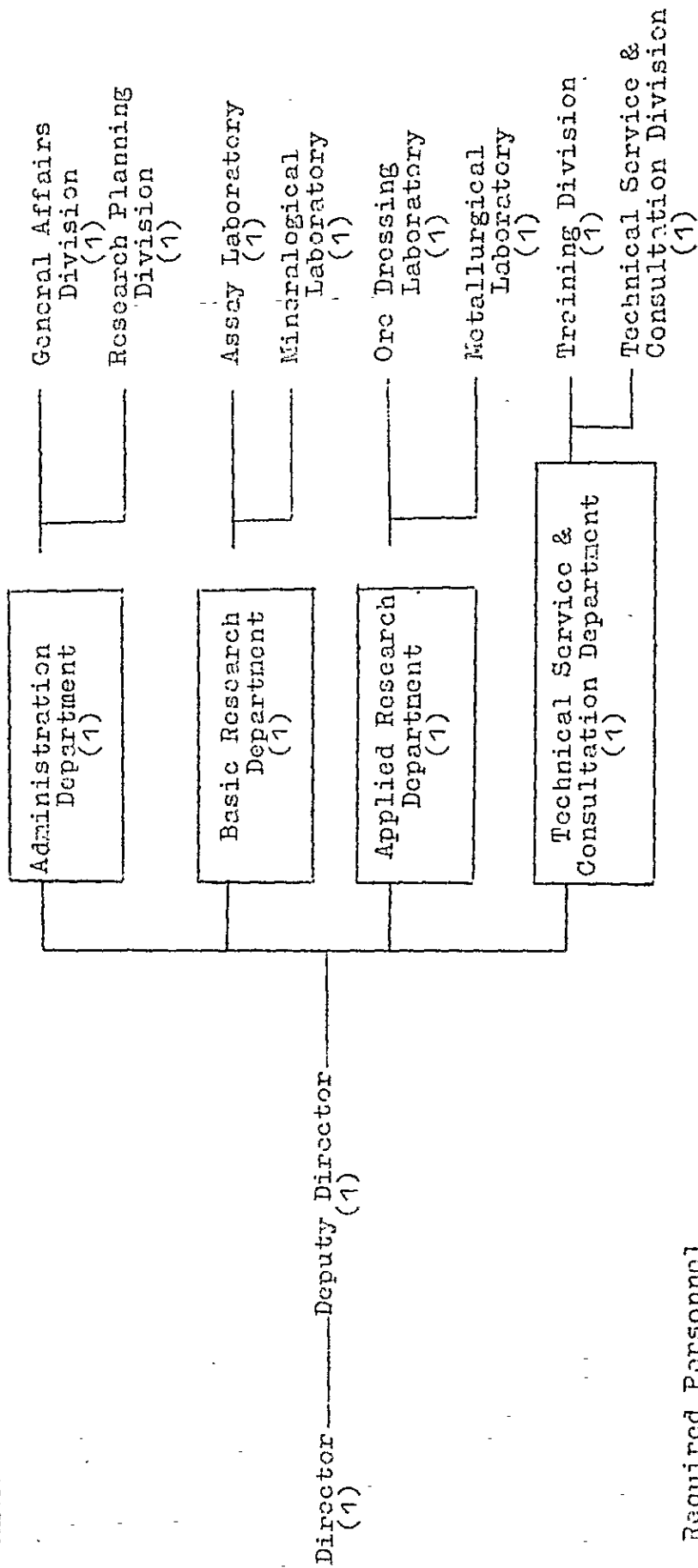
in the fields of analytical study, mineralogical study,  
ore dressing, smelting and refining;
3. The Center will consist of four (4) departments as  
shown in Annex I;
4. The Government of Japan will take necessary measures to  
provide such buildings, related facilities, machinery and  
equipment of the Center as listed in Annex II. The  
layout plan of the Center is shown in Annex III;
5. The Government of the Socialist Republic of the Union  
of Burma will take necessary measures as follows;
  - (1) to provide data and information necessary for the  
construction;
  - (2) to clear and level the site before the start of  
the construction;
  - (3) to bear the costs of items as listed in Annex IV;

Rangoon, February 24, 1979

  
\_\_\_\_\_  
U Ko Ko Than  
Managing Director  
No. 1 Mining Corporation  
Ministry of Mines

  
\_\_\_\_\_  
Dr. Kenji Tonita  
Team Leader  
The Consultation Team  
JICA

Annex I

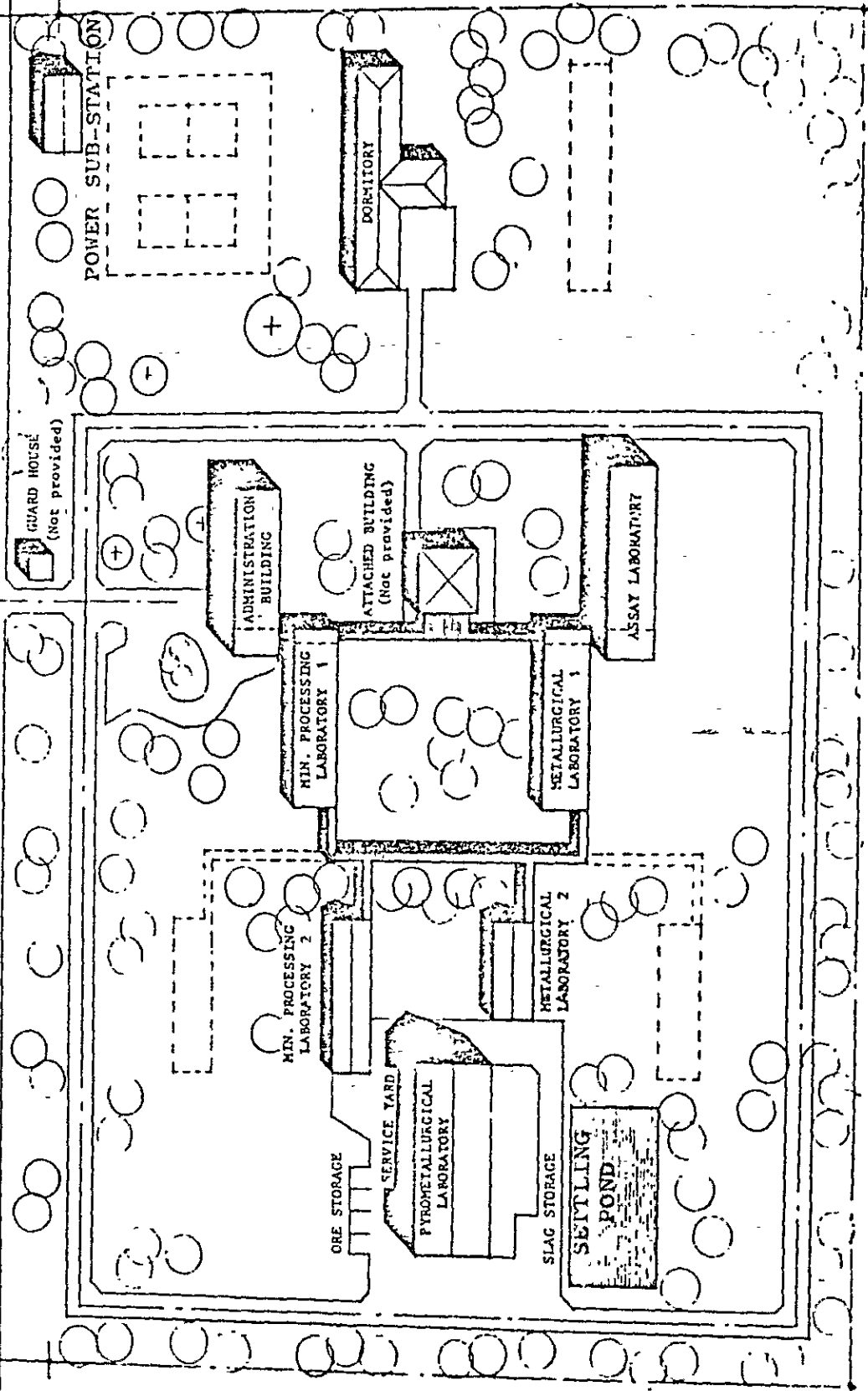
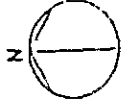


Required Personnel

Director	Deputy Director	Manager	Chief	Senior Staff
1	1	4	8	8

## Annex II

1. Buildings with related electric and plumbing works
  - (a) Administration building
  - (b) Assay laboratory
  - (c) Mineral processing laboratory
  - (d) Metallurgical laboratory
  - (e) Pyrometallurgical laboratory
  - (f) Dormitory
  - (g) Power sub-station
  
2. Related facilities at the site
  - (a) Generator
  - (b) Water-supply facilities to the building (pump, tank and filtration)
  - (c) Piping of water supply and drain
  - (d) Septic tank
  - (e) Electrical wiring work
  - (f) External lighting
  
3. Machinery and equipment for
  - (a) Sample preparation
  - (b) Assay laboratory
  - (c) Mineral processing laboratory
  - (d) Flotation laboratory including workshop
  - (e) Gravity concentration
  - (f) Metallurgical laboratory
  - (g) Pyrometallurgical laboratory



Annex III

Annex IV

1. Fundamental work
  - (a) Site reclamation
  - (b) Wells
  - (c) Electrical power supply to the power sub-station
  - (d) Settling pond for waste water from laboratories
2. Building construction work
  - (a) Staff houses
  - (b) Attached buildings including functions such as tea room, utility room, covered way, storage, inflammable storage, gas storage and guard house
3. Road, paved yard, lawn, trees and fence at the site
4. Furniture and miscellaneous
5. With respect to machinery, equipment and other materials necessary for the establishment of the Center;
  - (a) Internal transportation from the port of entry to the site
  - (b) Taxation and any other charges
  - (c) Cargo loading and unloading
  - (d) Storage Charge
  - (e) Security guard
6. Temporary building and facilities for the construction works

