

DESA

BHUTAN, KINGDOM OF BHUTAN
UNIDO GEOLOGICAL SURVEY PROJECT PROPOSAL

15 MAR - 6 JULY 1974

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Rinchen Dorji
Director of Industries

DEPARTMENT OF INDUSTRIES
MINISTRY OF TRADE, INDUSTRY & FORESTS
ROYAL GOVERNMENT OF BHUTAN
TASHICHHODZONG, THIMPHU
BHUTAN

DO.IA-1/Min(12)/UNDP-GGS/74/0154

July 6, 1974

BY AIR MAIL

TO 3 11/1 Bmt

Dear Mr. Robertson,

I express my thanks to you on behalf of the Secretary, Ministry of Trade, Industry & Forests, who is on leave, for your letter dated 4th June 1974. We are glad to hear that you will be sending a draft project document at the earliest. I find from your letter that you will be including consultant time to provide professional examination of the Gypsum and Limestone deposits. In this connection further discussions with the Geological Survey of India (Bhutan Circle) has revealed that drilling work to establish the Gypsum deposits have been completed by them. The deposits are established to contain a reserve of 47.5 million tonnes of good quality Gypsum. We are, therefore, interested at the present juncture to obtain consultancy help to get a feasibility report prepared on the exploitation of Gypsum based on the data already collected by the Geological Survey of India (Bhutan Circle). The consultancy will mainly have to be for assessing the economics of mining and transporting Gypsum from the angle of marketing the deposits outside Bhutan in places such as India and Bangladesh particularly. The documents already prepared by the Geological Survey of India (Bhutan Circle) will be available for the consultant who could make the necessary recommendations regarding the feasibility after making a study of the deposits from the angle of economics. I am writing this so that you will be able to make the necessary provision for such a consultancy work in your project document.

We are awaiting the draft project document from you through the officers of UNDP in New Delhi.

.... /2



DEPARTMENT OF INDUSTRIES
MINISTRY OF TRADE, INDUSTRY & FORESTS
ROYAL GOVERNMENT OF BHUTAN
TASHICHHODZONG, THIMPHU
BHUTAN

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Thanking you once again for all the valuable suggestions which you have offered us during your visit.

With kind regards,

Yours sincerely


Rinchen Dorji

Mr. D. P. Robertson
Inter-Regional Adviser
Geology & Mining Section
Resources & Transportation Division
United Nations
N.Y. 10017
New York

UNITED NATIONS



NATIONS UNIES

INTEROFFICE MEMORANDUM

MEMORANDUM INTERIEUR

TO: Mr. V. Baum, Acting Director
A: Resources and Transport Division

DATE: 15 March 1974

THROUGH:
S/C DE:

REFERENCE: TE 311/1 BHUTAN

FROM: W. van der Heide, Acting Deputy Director
DE: Asia and Middle East Branch, OTC

SUBJECT: BHUTAN - Assistance to Geological Survey
OBJET: BHUTAN - Assistance to Geological Survey

..... Attached please find a copy of the letter from the Resident Representative in India, Mr. McDiarmid, forwarding two requests from the Government of Bhutan for assistance to its Geological Survey.

I would be most grateful if you would review the requests and forward to us your comments and observations in this regard at your earliest convenience. Please note that the Resident Representative would like an adviser to visit Bhutan for a period of three to four weeks to assess the country's needs in the field of mineral exploration.

UNITED NATIONS
DEVELOPMENT PROGRAMME



संयुक्त राष्ट्र
विकास कार्यक्रम

TELEX : UNDP - ND - 2611
CABLES : UNDEVPRO - NEW DELHI
TELEPHONES : 40043, 43041, 43628, 44368

21, KASTURBA GANDHI MARG,
NEW DELHI-110001

POST BOX NO. 136

Mr. R. J. Crooks
11-3-74

BHU/74/001

19 February 1974

Joe,
Dear Mr. Crooks,

Re: Assistance to the Geological Survey of Bhutan

.... I attach copies of two requests received from the Government of Bhutan for assistance to its Geological Survey. As you will note, these requests are not in the proper form but they convey the substance of the requests sufficiently for at least initial comment.

During the visit of the UNDP Team to Bhutan in March/April 1973, the possibility of some assistance to the Geological Survey of Bhutan was discussed with the Chief of the Survey who is an Indian national on deputation. We had suggested at that time that the best course might be for a staff member of the United Nations or a Regional Adviser to visit Bhutan and to draw up a request taking into consideration the various felt needs of the Survey. We had heard nothing more on this subject until we received the present requests earlier this month.

Although no costs are given, it seems likely that the items and fellowships covered by the requests will not exceed \$100,000 and therefore will be subject to my approval. Personally, I believe that the rock drilling staff may be competent to handle the equipment items requested but I would like to have this checked by someone knowledgeable.

Moreover, the requests need to be reworked into one consolidated request, probably under the title of "Mineral Exploration" for which, I assume, the United Nations would be the Executing Agency. It is also possible that there are other items or areas of assistance which might be included in a reworked request. I would be grateful therefore if you could designate someone to visit Bhutan for three to four weeks - if possible a Regional or Inter-regional Adviser who would not be charged against the IPF - to examine the present requests against the general background of Bhutan's mineral investigation and development programmes and to satisfy himself that the specific assistance sought is feasible and desirable. If you agree to this, we would have to get the Bhutan Government's formal agreement to such a visit.

Mr. R.J. Crooks
Director, UNOTC
United Nations
New York

RECEIVED

MAR 14 1974

GTC



- 2 -

Unfortunately, an earlier request from the same Ministry regarding the feasibility of establishing a Cement Plant could not be accepted by UNDP since it did not meet the necessary criteria. I am therefore particularly anxious that we should not again have to disappoint the Ministry with the present requests. Before we send anyone to Bhutan or even propose such a visit to the Government, I want to be completely sure that the assistance as now sought, regardless of any additions which may be suggested later, is agreed to in principle and subject only to verification that the items and training sought are the most suitable to meet the objectives.

I would be most grateful for a quick reply on this matter.

*With kind regards,
and all good wishes in
your new post. We have
a lot of mutual business
going on!
J.*

Yours sincerely,

A handwritten signature in dark ink, appearing to read 'John'.

John McDiarmid
Resident Representative

cc: Mr. R. Coomaraswamy, UNDP/NY - with encl.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

SPECIAL INDUSTRIAL SERVICES

PROJECT DATA SHEET

1. Reference :

Country : BHUTAN

Project Title

: Aid for training Bhutanese nationals
in drilling.

Date Formal Request
Recorded

Government Department
submitting request

: Ministry of Trade, Industry & Forests

Specific Government
Agency concerned with
the Project

: Ministry of Trade, Industry & Forests

2. Description of the Project : Suitable Bhutanese nationals with qualification and experience in drilling to be sent for advanced training course in drilling technique, particularly with reference to handling Packsack Diamond Drills and X-ray Drills to be procured through UNDP Aid.

3. Background information : A number of Bhutanese nationals have gained qualification and experience in drilling within Bhutan. They have been working with the Geological Survey of India (Bhutan Circle) for a number of years. A few of these trained personnel who have more than 7 years experience as Drillmen may be selected to undergo advanced training in drilling. UNDP may decide on suitable training course taking into account their existing experience and qualification.

4. Relationship with other technical assistance project or

REQUESTS :

This training programme will be tied up with the project for supply of advanced drilling equipments to the Government of Bhutan by UNDP.

Field Activity

Duration

Cost

Does not apply

5. Request approved :

for UNIDO

for UNDP

Date _____

Date _____

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Reference :

Country : BHUTAN

Project Title : Assistance for supply of drilling equipments
for Geological Survey of Bhutan.

Date Formal
Request Recorded

Government Department Ministry of Trade, Industry & Forests
submitting request

Specific Government Ministry of Trade, Industry & Forests
Agency concerned with
the Project

2. Description of the Project : The geological survey of Bhutan is handicaped for want of suitable drills. The request is for the following drills as well as for necessary spare parts for these drills. It is understood that the smallest practical drill equipment for light weight drilling is the Packsack Diamond Drill manufactured by Truco Canada Ltd, P.O. Box 136, North Bay, Ontario. Maximum practical depth is 100-150 feet. All rods are pulled manually or with a winch. The drill is powered by a 10 HP gasoline motor and the small pump similarly powered. Core is 7/8" diameter. Weight including 250' rods and accessories is less than 500 lbs and cost, with accessories around \$ 2,000. This is a two-man drill best adapted for very shallow drilling i.e. 75 feet or less.

The next larger size is the X-ray Drill manufactured by Boyles Drilling Company of Canada, Vancouver, B.C. This machine is useful for depths upto 200 feet. Drill and pump are powered by gasoline motors. Core diameter is 3/4". Weight including 500' rods, half of them steel and half aluminium, would be around 1,000 lbs. Pulling of rods is assisted by a cat-head assembly powered off the drill motor. Cost with accessories : \$ 3,000 - 5,000.

1. Packsack Diamond Drill :
Manufactured by TRUCO
CANADA LTD., complete 2 sets
with bits, rods, pump
and all other access-
ories.

2. X-ray Drill :

Manufactured by Boyles Drilling
Co. of Canada Ltd, complete with
bits, rods, pump and all other
accessories.

2 sets

3. Background information : The Ministry of Trade and Industry is responsible for the over-all development of the mineral resources in the country. So far the general surveys on the mineral deposits have been carried out under the aegis of the Geological Survey of India (Bhutan Circle). The Geological Survey of India is also finding it difficult to carry out detailed investigations of the mineral deposits whenever requests are made by the Government of Bhutan for want of suitable drills. Once the existence of deposits have been tentatively established by the Geological Survey of India, the Government of Bhutan requires detailed investigation by means of drilling to find out the actual quality and quantity of the deposits in order to formulate schemes for industrial exploitation of these minerals. Some of the minerals already established have been Dolomite, Limestone, Gypsum, Graphite, Slate, Lead and Zinc. The equipments will be with the Government of Bhutan who will employ them through suitable agencies for conducting necessary detailed surveys of the mineral deposits. Quite a number of Bhutanese nationals have been trained in drilling and possess practical experience of drilling in Bhutan. Therefore there is no dearth of qualified men who can operate these drills. We are also making a separate proposal to give advanced training to few of them. Once the drills and necessary spare parts are provided, facilities for their maintenance will be available within Bhutan.

4. Relationship with other technical assistance project or REQUESTS

A separate request is being made for training Bhutanese personnel in drilling. The present project will gain the benefits of the training to be imparted to the Bhutanese personnel.

Field of Activity

Duration

Cost

Does not apply

5. Request Approved

for UNIDO

for UNDP

Date _____

Date _____

Mission Report

BHUTAN

by

D.P. Robertson
Interregional Adviser
Geology and Mining Section
Resources and Transport Division

18 - 26 April 1974

Itinerary:

- April 18 - Arrive Phuntsholing, Bhutan from Siliguri, India by car.
- " 19 - Arrive Paro, Bhutan by car.
- " 20 - To Dzong (Government House), Thimphu and return to Paro.
- " 24 - To Thimphu and return to Paro.
- " 25 - Arrive border town Phuntsholing.
- " 26 - Depart Bhutan for Calcutta.
- " 27 - Discussion in Calcutta with Director of Geological Survey, Dr. C. Karunakaran.

Meetings and Discussion

The writer attended a meeting at the Government House in Thimphu on the 20th of April, which was presided over by Mr. Om Pradhan, Secretary, Ministry of Industries, Trade and Forests. Also in attendance were: Mr. Ninzin Dorji, Director of Industries, Government of Bhutan; Mr. Ramachandran, Industrial Adviser, Government of Bhutan; and Mr. A.R. Gokul, Director, Bhutan Circle, Geological Survey of India.

A second meeting was held on April 24 which was presided over by HH Prince Wangyal Wangchuk, Minister and attended by Messrs. Pradhan, Ramachandran, Gokul and Robertson.

Mission Terms of Reference and Discussion

The writer was requested to visit the country in order to advise:

- i) on the type of drilling equipment most suitable for local conditions and needs;
- ii) on the most effective training programme;
- iii) on other related needs in the field of mineral exploration; and
- iv) advise the Government in re-formulating a request.

Between 24 March and 1 April 1974 a UNDP mission was made to Bhutan which considered, in detail, many aspects of assistance in various fields including mining. It is useful to quote from Appendix V of the report of this mission as the Government's wishes are expressed:

"Mr. Dorji began by explaining that at present, as far as geological work is concerned, a branch of the Geological Survey of India is carrying out work in Bhutan. He added that the Government of Bhutan wished ultimately to establish a Geological Survey of Bhutan but that it did not expect to have the necessary personnel and material resources for some time. Mr. Dorji said that his Ministry had considered the possibility of requesting UNDP for a general survey of mineral resources but had decided that it might be better to begin with a request for specific assistance geared to known deposits. Mr. Dorji presented three proposals covering graphite, gypsum and slate and explained that the Government of Bhutan is also interested in lead and zinc but that it did not have sufficient background documents on these minerals at this stage.

After some discussions, it was agreed that the Government of Bhutan should request an exploratory mission to assess the existing information on the mineral deposits concerned and to propose further exploratory works needed to be done. The number of members of this exploratory mission would be determined by the United Nations bearing in mind the minerals to be investigated. Mr. Dorji undertook to send a copy of available reports to the United Nations so that this could be read before the mission's visit to Bhutan.

It was felt that the exploratory mission would be the first of three stages towards mineral exploitation which might be aided by UNDP. The second stage, if requested, would be pre-investment surveys of the minerals concerned and these in turn might lead to a full investment feasibility study which would be the basis for a decision on commercial exploitation."

The writer did not have an opportunity for briefing before the mission but has borne these remarks in mind in preparing a draft Project Document which is attached to this report. During the first meeting on 20 April the

wish of the Government to equip and train a drilling team nucleus was discussed as well as the provision for consultants to make examination of the gypsum and limestone (or other) deposits located and examined by the Bhutan Circle (i.e. the branch of the Geological Survey of India operating within Bhutan).

The writer was given copies of 2 draft documents for assistance in preparing provision for a drilling equipment and for expert instruction of Bhutanese nationals and the use of this equipment.

In the following days, reports and maps of the work of the Bhutan Circle, and feasibility reports on the Pagli limestone (and cement plant) were studied. The writer is indebted to Mr. Gokul for time spent providing background information. This data is summarized in Appendix A.

For the second and final meeting, sufficient data had been gathered to enable the rough parameters of a project in accordance with the requirements of the Government to be presented for discussion. That information is attached as Appendix B.

In preparing the draft Project Document (Appendix C) the adviser has since had the advantage of obtaining up-to-date prices on equipment at Headquarters and also the advantage of looking a longer view.

It was revealed during the meeting with the Director of the Geological Survey of India, Dr. Karunakaran (after leaving Bhutan) that a wireline rig could not be provided in Bhutan - this has now been incorporated in the UNDP equipment component. To support the work of the Bhutan Circle in a regional geochemistry programme, a geochemist post has been included and a provision for \$15,000 in sub-contract for analyses of samples by the GSI and for outside check analyses have also been included.

In the event that one Bhutanese General Science graduate may be interested in following a geological career, a two-year Fellowship is included in the Project. Consultant time is included to provide study of the gypsum and limestone deposits by specialists. If feasibility studies are then warranted, these will require separate project preparation and financing.

The overall design of the draft Project Document is to satisfy the following factors:

- a) the desire of the Government to advance known deposits to the exploitation stage as rapidly as possible;

- b) the desire to have modern drill equipment and trained drill runners as a nucleus team for mining investigations;
- c) to provide for primary exploration work that will investigate as rapidly as possible the mineral potential of a new selected area and at the same time provide additional targets for the drill team;
- d) to provide fellowship training; and
- e) to provide the material support to carry out the above objectives.

BHUTAN

Background Information to the Mining SectorGeneral

The country has an area of approximately 18,000 sq. miles and a population of 1.1 million. The principal towns are Thimphu (the capital) and Paro which are in the west and Tashigang which is near the eastern border. Bhutan is bordered on the south by the Ganges delta and on the north by the Himalaya mountain system. It has the Indian state of West Bengal on its southern border, Sikkim on the west, the Tibet region of China on the north and on the east, the North East Frontier Agency (NEFA) of India.

Topography and Access

The northern edge of the Ganges delta practically coincides with the south boundary of Bhutan and with steep rise to the foothill mountains of Bhutan. The terrain is very rugged with peaks to 15,000 and deeply incised valleys. The front of these mountains gives rise to heavy precipitation, hence for some 20 miles into the country rain and mist is common. The vegetation is very luxuriant and dense making off-the-road travel extremely difficult. The central area has less precipitation and less vegetation though the mountains are formidable. The inhabited interior valleys are at an elevation of roughly 6,000-8,000 feet with the mountains rising to 12,000 and 15,000 feet.

Access to the capital and the interior is by a narrow but paved road from Shantasholing on the Indian border. There is an airstrip at Paro, which is 2 hours by road from Thimphu but this is rarely used due to the dangerous conditions. From the border to the capital is 179 kms, requiring approximately 6 hours travel.

There is a seasonal jeep road which runs east of Thimphu in the middle of the country and which connects with Tashigang. A road runs from Tashigang south to the border town of Samdrup Jongkhar. In all about 1,700 kms of road exist.

The drainage pattern is from north to south and there are about a dozen major river systems.

Phuntsholing is 3 hours by road from the West Bengal town of Siliguri and the nearby Bagdogra airport has a daily air service with Calcutta.

Geology

The foothills rise abruptly from the Ganges delta where the sediments are believed to be from 15,000 to 20,000 feet in depth. There is a probable subduction zone at the boundary of the two zones. The tectonics and stratigraphy of Bhutan is complicated - there has been regional thrusting, strike faulting with tightly folded synclines and anticlines on an E-W axis, with regional anticlinoriums with N-S axis superimposed. The succession from south to north is - Siwalik (middle Miocene to Lower Pleistocene) coal-bearing Permo-Triassic, Pre-cambrian mica-schists, phyllites, quartzites, paragneiss, etc., and on the north, Paleozoic to Mesozoic fossiliferous sediments. In aerial extent, the Pre-cambrian predominates by far.

Intrusive into the Pre-cambrian complex are younger granites and related rocks which occur as sporadic exposures on an E-W line north of Thimphu. Dips are generally to the north.

The Main Boundary Fault separates the Siwalik series at the extreme south of the country (which is unmetamorphosed and has normal attitude dipping north) from the highly tectonically altered but not hydrothermally altered Gondwana series. The fault and formations both dip north. The overlying paragneiss of Pre-cambrian age therefore has inverted attitude with respect to the underlying younger series.

Exploration Background

The Geological Survey of India began work in Bhutan in 1960-1961, the main effort being systematic mapping with prospection. It is known as the Bhutan Circle and operates from a base at Samchi, about a dozen miles west of the border town of Phuntsholing. There are 15 geologists, 3 chemists, 1 drill engineer, 3 drillers and 8 surveyors. There are 6 medium to heavy drills. Analyses are done at Samchi with overflow and specialized analyses done in Calcutta. There are 4 Bhutanese nationals who have had several years experience with the CSI and 2 who are attached to the Bhutan Circle.

Exploration work has consisted of identification of prospects during quarter degree mapping, followed by, in some instances, geochemical surveys and/or detailed mapping prior to drilling.

The terrain presents formidable impediment to all aspects of exploration and mining. The south half of the country, in addition to the steep terrain, is covered densely with vegetation. Once the road is left, traversing is extremely arduous. The advance of mineral exploration by this method is therefore costly and slow and will continue to be so. Helicopter operations are not feasible due to the lack, at least in the south half, of free landing sites.

The following prospects have been identified and examined to various degree. Practically all are non-metallic. It must be born in mind that in the area now being worked, i.e. largely the south-west of Bhutan, but including areas in the south-east, the geological environment is such that very few metallic prospects can be expected.

This condition may or may not be more favourable in the middle sector of the country embracing granite intrusives, i.e. in an east-west belt north of the latitude of Thimphu and south of the High Himalayas. This sector is the logical area for investigation by a regional geochemical programme.

Prospects:

Gypsum

A gypsum deposit has been located and partially examined by the Bhutan Circle. It is located between Khothakpa Village and Dentsi Village in the Shumar subdivision, Shongar District. The site is accessible by a path only, 25 kms from the nearest roadhead at Km post 71 on the Samdrup Jongkhar-Tashigang highway.

Nine holes have been drilled so far, indicating probable reserves of 26 million tons - 72% gypsum and anhydrite, 16% impurities. The easternmost holes were bottcoring in gypsum, so that the depth of the body there is unknown.

The physiographic location apparently indicates that quarrying could be successfully conducted. There is a ready market for acceptable material in India and Bangladesh.

Comment - Additional holes must be drilled to expand and better define the body.

It is recommended that a consultant specialist be engaged to examine this deposit. In addition to examining the core and advising on changes that might be necessary to define the reserves, the consultant would contact bulk purchasers of the material in India to establish the marketability. Bulk testing might be required by the consultant. The report of the consultant would be of a pre-feasibility nature in which the extraction method, beneficiation, if any, equipment requirements, investment capital, operating costs and any other factors pertinent to the bulk removal and sale would be considered.

A truck road to the site from the highway should be built as soon as quality, grade and tonnage has been established.

REMARKS

1) Khancho Deposit, Paro - The Khancho deposit at Paro was searched for a grade to provide raw material for a small cement plant within the country. Extensive geological and sampling studies have been completed at the site which is located at the edge of the town. Road access, water and power is at hand and the material is quarriable. Final costs will have to be determined.

Drilling has just started to prove up the deposit. There appears to be more than ample tonnage to supply the modest 30 ton/day cement plant to be constructed. There are probable reserves of 55 million tons from the surface studies, of which 14 million is without overburden. The prospect should be examined by a specialist consultant who would consider the raw material supply, within country market, capital and operating costs, etc. in a feasibility study. This study would be conducted at the same time as a study of the larger cement plant proposal at Pagli.

2) Pagli Deposit - Twenty-three million tons of limestone has been outlined at Pagli, near Phuntsholing, of which 4.7 million are reported of high quality. A feasibility study by one company indicated that a 300 ton/day cement plant would be economic. Pagli is considered a suitable site in view of the low cost of transport of limestone and other raw materials including coal to plant, availability of water, building site, and distance (20 kms) from railhead.

On the other hand, another cement organization has questioned the limestone source as to the distribution of magnesia-rich impurities, suggesting that sorting might have to be used, giving rise to high mining costs.

It is recommended that a limestone-cement manufacture specialist review the feasibility studies with respect to the limestone source and particularly to costing in the light of changed conditions since the preparation of the feasibility report.

3) Chaibar and Korunghi Deposits - These are located in Eastern Bhutan, having possible tonnages of 12 million and 7 million tons respectively. They are too remote for consideration at this time.

Coal

Coal has been located in the Gondwana series in the area north of Doothang. It has an east-west trend and occurs intermittently. It has been tested in places by pitting and trenching by geologists of the GSI. Mining to the present has been sporadic small-scale artisan extraction. The coal has undergone great tectonic metamorphism and as a consequence, while it is of high quality, it pinches and swells along and across strike, is pulverized

in places and mixed with sandstone. It is very unlikely that consistent thicknesses of beds will be found under these conditions. Under low priority, reconnaissance along the exposures and test drilling of the best appearing zone would be warranted.

Graphite

Graphite is found near Paro and Ha, associated with mica-schist. It is estimated that a reserve of 70 million tons of graphitic schist exists in the Khepchi Shi area with a low carbon content. The best areas contain 2.2 million tons of 17% to 21% of Grade C up to 30 meters depth of which .54 million tons of 60%-65% Grade C can be recovered from 3 blocks.

Up-grading tests by flotation were undertaken and while one flow-sheet showed an 8% C product with 88% recovery, this was only suitable for low value uses, the ash content being too high for higher grade uses. Chemical treatment to reduce the ash content to 0.3% is quite costly. Given the remote location, the low grade of raw material and world price structure, no further investigation is warranted at this time.

Dolomite

Approximately 5.5 million tons have been defined at Kulesur near Phuntsholing. May have possible use in steel plants in India.

Slate

Extensive deposits of slate occur north-east of W. Phodrang, along the Tang Chu (river). Apparently there are good grade material in the sampling so far. Possible local use for flag-stones, roofing, etc.

Talc

Talc is found in Bhutan and if of acceptable quality and size, may have sales possibilities as insulation material and fillers in West Bengal.

Lead and Zinc

Located by geochemical survey, a showing was found 6 miles north-east of Confluence. It has been partly drilled and drilling will resume in the near future. The minerals occur as a stratiform bedded deposits in limestone. So far only low grade values (e.g. 5% lead-zinc combined) have been defined.

D.P. Robertson, Interregional Adviser
25 April 1974

APPENDIX B

Notes on
PROPOSED DRILLING TRAINING PROJECT
IN BHUTAN

Comment

The writer arrived for an approximate one week visit to Bhutan (18-26 April 1974) for the purpose of advising the Government, at its request, on the formulation of a project for training in drilling to Bhutan nationals and in this regard, to recommend most suitable drilling equipment for local needs and conditions. He is also required to advise in related needs in the field of mineral exploration.

These notes are for the purpose of a discussion to be held with Government officials at Thimphu on 24 April 1974.

1. Insufficient time is available to prepare a draft document while in Bhutan -- in fact the writer considers it preferable to consult with drilling specialists attached to New York Headquarters as to types and brands of equipment (and their present prices) which are most suitable, having acquired data on terrain and geological conditions during the mission.

2. It is appropriate to acknowledge the whole-hearted cooperation of Mr. A.R. Gekul, Director of the Bhutan Circle, who gave much of his time to make the writer aware of the activities and findings of the GSI in Bhutan over the past dozen years. The search and mapping activities of the GSI have been carried out under the most arduous physical conditions that the writer has seen in 5 continents.

3. With regard to training, it is universally recognized that practical on-the-job training is the most effective method and has to be carried out over a period of time, although initial lectures and demonstrations on the equipment and components is obviously necessary. Preferably the trainee will have demonstrated mechanical ability. Two capable drill supervisors, very experienced on all types of drills under various working conditions and in the performance of drill programmes, are proposed. These supervisors will act as drill runners (operators) in carrying out their training duties.

4. A Team Leader cum Economic Geologist is proposed, whose duties would be to co-ordinate the work of the drill supervisors, to administer and control the finances of the project, to select and arrange for consultant and/or

pre-feasibility studies, to liaise with the Bhutan Government, the UNDP and the GSI and, having had previous experience in United Nations procedures, to prepare requisitions for equipment and follow-through on its delivery.

5. Selection of the equipment will be made on return to Headquarters before preparing a draft Project Document and after determining the approximate funds available. While it is the policy of the UN to require international bidding, a case can be made for specific brand types when these are uniquely required for specific conditions. The Packsack and X-ray drills (referred to in the first document) have been successfully used for many years but more modern, lighter and efficient rigs are on the market, e.g. - the Winkie 10 type which is highly transportable, uses light zirconium-magnesium rods and has capacity to 90 meters. It is felt that training should be given on wireline technique, on light portable drills and on rotary percussion drills. Vehicles must be allowed for, as well as camp equipment, etc. These items will be noted on the draft prodoc with costing. In the case of drills, description of equipment will be semi-detailed only as an itemized list of components would need several pages and is only necessary when ordering.

6. It is strongly recommended that 4 radio transceivers be purchased to provide communication between office and field and for safety reasons. This will require permission from the Government and assignment of a frequency.

7. The Government will be requested to assign its best drillers to the project. The further experience gained by these men will the more enable them to act as instructors themselves on termination of the project. Sufficient remuneration should be given the trainees - not only to provide incentive to attend to the job and stay in the trade, but in recognition that, in the end, they will be highly skilled craftsmen and teachers themselves.

8. The Government inputs to the project will also consist of provision of funds for operation and maintenance of vehicles and drills, home salaries of trainees, provision of housing for expatriate staff, and a combined office and storage building with required domestic services.

Background Comments

Drilling is a precision tool and an expensive one - it is only used when a deposit of interest has been carried to that stage. Preceding that stage several mining studies will have been completed, and preceding those,

the area of interest will have resulted from primary exploration itself, which may take one or more of several forms, e.g. airborne geophysics, regional geochemistry, prospection in conjunction with systematic geologic mapping.

It must be accepted that large areas have to be examined and many prospects located and studied within those areas before obtaining a few targets warranting drilling. It is therefore essential to have an ample well-planned exploration programme underway before drilling is contemplated. While the proposed project is concerned with drill training, it is common sense to drill viable targets.

It is obvious that close cooperation between the GSI and the project is necessary - the project will be entirely dependent on the GSI for its targets. It is sincerely hoped and believed that that organization will accept a close working relationship with the project in a mutual effort benefiting Bhutan.

As an example - the Bhutan Circle has 6 heavy drills in the country. If one of these can be exchanged for a wireline rig, this could be used in the training and obviate the purchase by the UNDP. The drill objectives must dovetail with the work of the GSI - the Team Leader must coordinate constantly with the GSI - analyses must necessarily be conducted by the GSI.

The writer has discussed at length the geological environment of Bhutan with Mr. Gokul. It is probable that in the south half of the country, non-metallics are the likely finds. As for the north half, this is untested territory, however there is a general east-west trend of granitic type intrusives lying between 15 and 14 kms north of Thimphu, extending across the country. The drainage pattern is north-south across this area, which has the Thimphu-Tashigang road along its south boundary to provide access. If metallic deposits are to be found, that granitic axis would be the most favourable hunting ground. It is therefore suggested that a broad regional stream sediment geochemical survey in that sector (not including the High Himalaya) may be fruitful. By not attempting to map the precipitous slopes, faster progress will be made towards mineralized objectives. It is not known at this writing, whether or not helicopter transport is feasible.

Airborne geophysical surveys, either fixed wing or by helicopter, are not indicated for Bhutan. The terrain is too abrupt to maintain altitude clearance, there would be other physical difficulties and instrumental errors. Moreover the geological environment, so far as it is known or can be inferred, does not provide objectives for such surveys. If metallic deposits exist, they will be more easily located by regional geochemistry.

Geology Trainees

If, prior to the project, one or two Bhutanese general science graduates can be encouraged to consider the mining field, then it would be desirable to include fellowships of not less than two years as part of this project. The Government is urged to consider this aspect as this would provide a start to the establishment of a mining organization in the country.

TENTATIVE PROJECT BUDGET

Title: Training in Drilling Techniques

Government Institution: Dept. of Industry, Ministry of Industry, Trade and Forests

UNDP INPUTS

| <u>Staffing</u> | <u>Estimated Cost (US \$)</u> | |
|---|-------------------------------|---------|
| - Team Leader (2 1/2 yrs) 2 drill supervisors (2 yrs) | 195,000 | |
| - Consultants (4 months and travel) | 14,000 | |
| - Fellowships (?) (2 for 2 yrs) | 25,000 | |
| | <hr/> | |
| | 234,000 | 234,000 |

Equipment

| | | |
|--|---------|---------------|
| - 2 light drills, 1 rotary percussion drill, compressor, rods, casing, tools, etc., mud, additives, spares, etc. | 90,000 | |
| - pumps, tubing, etc. | 10,000 | |
| - diamond bits, percussion bits, shoes, shells, etc. | 20,000 | |
| - field supplies, tents, etc. | 5,000 | |
| - 3 jeeps, 1 power wagon, tires, spares | 17,000 | |
| - 4 radio transceivers, charges, crystals | 9,000 | |
| - office, sundry and miscellaneous | 4,000 | |
| | <hr/> | |
| | 155,000 | 155,000 |
| Total UNDP Input - | | <hr/> 389,000 |

GOVERNMENT INPUTS

| <u>Staffing</u> | <u>Rupees (local currency)</u> | |
|--|--------------------------------|-----------------|
| - 7 drillers (2 years) | 135,000 | |
| - 4 drivers, 10 casual labour | 75,000 | |
| - maintenance of trainees (?) | 300,000 | |
| | <hr/> | |
| | 510,000 | 510,000 |
| <u>Other</u> | | |
| - maintenance of vehicles and drills | 350,000 | |
| - housing, office and storage | 155,000 | |
| - services (water, phone, light, etc.) | 45,000 | |
| | <hr/> | |
| | 550,000 | 550,000 |
| Total Government Input - | | <hr/> 1,060,000 |

Footnote:

Several changes have been introduced since the above notes were made and the changes are incorporated in the draft Project Document (Appendix C).

The number of drill supervisors has been reduced to one since insufficient work would exist to occupy 2 supervisors; moreover, the money saved is much better spent on a geochemist to assist a set-up of the regional geochemical programme.

The type, amount and prices of equipment has been established.

Provision for acquisition of Earth Resources Technology Satellite imagery is included.

Because of the delay in equipment deliveries, this must be ordered to arrive in accord with its required use in the project; i.e. as soon as possible after signature by all parties, the equipment for first use in the project must be ordered at U.N. Headquarters and the arrival date of the Team Leader must be timed for 8-9 months afterwards.

UNITED NATIONS DEVELOPMENT PROGRAMME

Project of the Government of
BHUTAN

Title: Drill Training and Exploration Project

Number:

Duration: Two years and three
months

Sector:

Sub-sector:

Government:

Co-operating Agency: Ministry of Industry,
Trade and Forests

Date of Submission:

Starting Date: 1 June 1975

Government Contribution: Rs 759,400
(in Local Currency)UNDP Contribution: \$ 399,800
(in US Dollars)Approved: _____
on behalf of the Government
(signature)

Date: _____

on behalf of Executing Agency
(signature)

Date: _____

on behalf of UNDP
(signature)

Date: _____

I. BACKGROUND AND SUPPORTING INFORMATION

A. Justification for the Project

Most of the population of Bhutan is employed in agriculture and the economy is pastoral in nature - there is practically no mining in the country, except for local usage on a minor scale of slate and coal deposits.

Geological mapping of the country has been in progress only since 1951-1962, being undertaken by the Geological Survey of India. The area being mapped is in the southern most part of the country and principally in the south-west. It is being undertaken under arduous terrain conditions, which is mountainous and precipitous, and further handicapped by dense vegetation. Under these circumstances the mapping is necessarily very slow and the rate of discovery of mineral resources by this means correspondingly slow. Nevertheless two types of minerals, gypsum and limestone (as raw material for production of cement) have been located in apparently economic amounts and other minerals, e.g. lead-zinc, coal, slate, graphite, and dolomite are under investigation.

The vast majority of the country has not been prospected however. In spite of the lack of geologically trained professionals in the country, the Government of Bhutan desires that the mining sector should advance as rapidly as possible in order that it may make its contribution, along with other sectors such as forestry and agriculture, to the advancement of the economy.

The project counts on the contribution of the Bhutan Circle (which is the branch of the Geological Survey of India working in Bhutan) to staff a number of field parties to conduct a regional geochemical programme in a selected area (see sketch of Bhutan) of the country heretofore unexplored and in which it is hoped that one or more metallic deposits may be detected. This type of programme is a rapid and effective method of exploration for mineralization and is widely used throughout the world. If Bhutan is required to wait until its professionals are fully trained and also if the prospection is limited to discoveries revealed during systematic mapping, years will pass before the mineral potential is determined.

In addition, the Government desires that Bhutanese nationals be trained in the latest drilling methods using most modern equipment applicable to the conditions within the country. This is satisfied within this project by

the introduction of 2 drill rigs embracing 4 methods of drilling (portable diamond drilling, standard wireline drilling, auger drilling and mission drilling) and by the establishment of a drill supervisor's post.

The deposits of gypsum and limestone deposits will be studied by consultants and feasibility reports made. These studies will hasten the procedure leading to exploitation.

The Government will endeavour to interest a General Science graduate in mining, and ^{an} international fellowship post is included to provide university post graduate training in geology and mining for a two year period.

The project provides for a geochemist post in order that instruction in the most effective geochemical procedures will be provided the geologists who are to do the field work.

The mineral potential of the area selected is unknown, but because granite masses are reported to intrude the geological series, this is believed to be the most favourable area for investigation. While all primary exploration is of a high risk nature and carries no guarantee of successful finds, there are reasonable hopes that a well conducted search can locate deposits.

B. Institutional Framework

Mining matters are under the jurisdiction of the Ministry of Industry, Trade and Forests, Department of Industry. There are no national professionals nor mining institutions in the country. For several years seven nationals have been working with the Bhutan Circle as drillers. The Bhutan Circle has its headquarters at Samachi in the south-west.

There are 15 geologists, 3 chemists, 1 drill engineer, 3 drillers and 3 surveyors. Six medium to heavy diamond drills are available. Laboratory analyses are done at Samachi as well as in Calcutta depending on demand and if specialized analyses are required.

The Government Counterpart Agency in the project will be the Department of Industry and substantive support will be supplied by the Bhutan Circle which has offered its co-operation to the project.

A Consultative Committee will be established by the Government which will meet from time to time to be informed about, review and to approve the operations of the project.

The Chairman will be appointed by the Ministry of Industry, Trade and Forests. The members, in addition to the Chairman, will include the following (or their designates):

The Industrial Adviser to the Ministry
The Director, Bhutan Circle
A representative of UNDP
The Team Leader.

C. Provision for Government Follow-up

Efforts are being made to interest at least one of the few General Science graduates in the geology and mining field.

The Government will consider the establishment of a Mining Agency which would have administrative function to establish mining policy, the framing of a mining code governing the granting of mining reservations, and regulations with respect to exploration, development and exploitation practices and methods of enforcement. Such an agency would require expatriate advice in its construction and for some years in its staffing. The drilling team of this project can be attached to a technical arm of the same agency, which would be headed by an expatriate professional team to carry out exploration work until such time as nationals could be trained and be enabled to take over.

D. Other related activities

There are no activities related to the project other than those operations of the Bhutan Circle. The exploitation of gypsum and the start of construction of one or more cement plants is likely to occur during the life of the project. In the case of gypsum, the sale of bulk material to the Indian market is apparently the most promising and quickest method of gaining revenue from commercial exploitation in the mining sector.

E. Future UNDP Assistance

Future UNDP assistance can be anticipated in the formation and management of a mining institution in the country.

II. OBJECTIVES OF THE PROJECT

A. Long range objectives

It is the wish of the Government of Bhutan that the mineral potential of the country should be determined as soon as possible in order that the mining sector may contribute its share to the economic development of the country.

B. Immediate objectives

The immediate objectives of the project are: (i) to conduct a search of a selected area for mineralization which may lead to one or more exploitable deposits; (ii) to have feasibility studies made of already partly defined deposits of gypsum and cement limestone, in order that, if encouraging results are obtained they may be brought to production in the near future; and (iii) to train Bhutanese nationals in modern drilling techniques.

.....

The area for study is outlined in the attached sketch. It comprises approximately 7,700 square miles and it overlies principally Pre-cambrian metamorphosis which are reportedly intruded by a younger series of granitic intrusives which occur along an east-west axis in a zone north of and parallel to the Thimphu-Tashigang Road. The area has not been mapped; hence the location and extent of intrusives is unknown. Intrusives of this nature frequently are the source for a variety of metallic minerals and it is proposed to locate any such mineralized areas by means of a regional geochemical programme in the first instance, followed by detailed geochemical, geophysical and geological surveys as required. Following the above studies, diamond drilling will be required which will be performed by Bhutan nationals under the instruction of a supervisor.

The project has therefore economic and instructive aims.

III. WORK PLAN

A. Description of project activities

The principal activity of the project will be centered on a selected area (outlined in accompanying sketch) where a regional geochemical survey will be conducted and where drilling of mineralized targets resulting from the survey will serve as on-the-job training for Bhutan nationals.

The project will be dependent on the Bhutan Circle for professional staffing of field parties for the first phase and for any detailed geochemical or geophysical surveys that may be required prior to the drilling stage. The number of geologists required must be determined by the Team Leader and the Director of the Bhutan Circle having regard for the terrain and effort required to work in the area. Possibly six field parties may be required. At each sampling point, stream sediment samples are ^{to be} taken and geology will be noted. There are a dozen major rivers with their tributaries forming a drainage pattern that is predominantly north-south. For most of the area a road runs east-west along the southern boundary - this will provide transport to each river system.

The experts provided for in the project will be three - a geologist Team Leader, a geochemist and a drill supervisor.

The Team Leader will co-ordinate the work of the drill supervisor and geochemist and will be the manager of the project. He will administer and control the finances of the project; assist in the selection of the consultants and in making arrangements for studies; liaise with the Government with respect to Government inputs and other responsibilities, and with the UNDP and the Geological Survey of India. He will, having had previous U.N. experience, prepare requisitions, expedite and receive project equipment.

Due to great delay in the delivery of equipment, drills, vehicles and other major items of equipment must be ordered prior to the operational beginning of the project, in order to fully utilize the term of the experts.

The Team Leader will be followed shortly by the geochemist who, after making orientation surveys, will organize the main programme, utilizing drainage maps, airphotos and/or mosaics for control. He will co-operate closely with Bhutan Circle geologists assigned seasonally to the project, providing instruction as may be needed in latest techniques of geochemistry. He will be responsible for the organization of the field parties and its logistics. He will be concerned with the analytic aspects of the programme to be conducted by the G.S.I. in Samachi and Calcutta and with the sub-contract arrangements with that organization. He will determine the techniques of sampling and analyzing, i.e. for what elements, the use of heavy mineral fractions, etc.

Seven months after the arrival of the Team Leader, the drill supervisor is to arrive, to coincide with the arrival of drill equipment. During the initial few months equipment will be tested and instruction carried on directly with the Bhutan Circle until targets are developed in the regional survey programme.

The Team Leader will be provided with Earth Resources Technology Satellite (ERTS) imagery to assist him in structural and lithological interpretations. Although the area is geologically unmapped, information will be gained from the traverses run during the course of the geochemical programme which combined with photointerpretation will help to guide the progress of the field work. A sub-contract amount is allocated for selection of imagery and interpretation.

Five months of consultant time is included to enable pre-feasibility studies to be made of gypsum deposits/^{and a} review, with recommendations on previous feasibility studies on limestone-cement production and one consultancy to be decided later. If ^{the} gypsum deposit is to be developed for export sale of bulk material (a simple operation) the consultant's report should suffice - no further detailed feasibility study will be necessary. The consultant and the term of his appointment should be chosen accordingly.

Since operations will be conducted in separate localities and under very difficult physical conditions, radio transceivers will provide a safety factor as well as improving efficiency.

Five vehicles are provided to meet the necessities of the field parties and drill programmes and appropriate expendable equipment for both.

Provision is made for a two-year post-graduate university study course in geology and mining for a General Science graduate to commence in the fall term (i.e. September).

The geochemist and drill supervisor posts are for a period of 18 months each - the term of the Team Leader is for 27 months, overlapping the other terms.

Periodic reports will be prepared by the Team Leader during the project in addition to technical reports, plus a terminal report on its completion.

Timing of project activities

Pre-project activities

Ordering by the Executing Agency of vehicles and major drill equipment 8-9 months prior to arrival of the Team Leader.

Selection of candidates and arrangements for fellowship six months before September - start of university term.

Recruitment of Team Leader with sufficient lead-time that he arrives in June and the geochemist two months later at the end of the monsoon period which is May, June and July.

First Two Months after Operational start (June - July 1975)

- Arrival of Team Leader - Organization of housing, warehousing, garaging, service and repair facilities, receipt of equipment - Liaison with G.S.I. in regard to co-ordinating activities of the Bhutan Circle on the project.

Last half of 1975

- Arrival of geochemist - Orientation surveys - Pre-programme arrangements for regional survey - Assignment and training of Bhutan Circle geologists, organization and operation of field parties.

First Quarter 1976

- Continuing regional geochemical survey - Arrival of drill supervisor and drilling rigs, assembly, testing and instruction on drills.

Second Quarter 1976

- Continuing regional geochemical survey; plotting of results, selection of mineralized areas, detailing of first targets by geochemistry and geophysics - Drilling of first objectives in target area.

Last Half of 1976

- Continuing regional and detailed geochemical surveys, concentration on mineralized areas to identify and classify targets, drilling of targets - Preparation of technical reports.

1. SUMMARY OF 1977

The report of geochronologist and his departure to the United States of America is as before.

2. SUMMARY OF 1978

The drilling report, departure of Dr. H. J. ... and ... continuation of ...

3. SUMMARY OF 1979

The report of the ... and ... reconciliation of ...

4. SUMMARY OF UNDP INPUTS

| <u>1. Name of International Staff</u> | <u>Duty Station</u> | <u>Starting Date</u> | <u>Duration</u> |
|---|---------------------|----------------------|-----------------|
| Geologist - Geologist | Tripoli | 1 June 1977 | 27 mos. |
| He is required to have long and varied experience in mining exploration and development, e.g. the design and management of open pit field operations using modern techniques of photogeology, geology, geochemistry, and diamond drilling, evaluation of progress. He will preferably have worked in mountainous terrain, and under adverse conditions. He will also have had U.N. project experience as Project Manager or Project Engineer. He will be responsible for the overall management and performance of the project. | | | |
| Geologist | Tripoli | 1 August 1977 | 18 mos. |
| He will have experience in the planning and management of regional and detailed geological surveys and preferably will have worked under similar conditions as in the past. He will have adequate knowledge of the geology and mineral resources of the area. | | | |

| | <u>Duty Station</u> | <u>Starting Date</u> | <u>Duration</u> |
|---|---------------------|----------------------|------------------|
| c) Drill supervisor | Thimphu | 1 January 1976 | 18 mos. |
| <p>A long and varied experience is necessary under diverse and arduous conditions. He will have worked on diamond drilling, auger drilling and mission drilling (down-the-hole). In addition he must demonstrate ability to design and carry out drill programmes efficiently and above all, capability of instructing others in the trade, which he will do on a day-to-day, on-the-job basis. His thorough practical knowledge of drill running will outweigh academic qualifications.</p> | | | |
| d) Consultant in Gypsum Operations | | 1975 or 1976 | to be determined |
| <p>The expert will have specialized in non-metallic mining operations, preferably with experience of gypsum mining. The consultant will be required to make a pre-feasibility study of gypsum deposits in Bhutan, assessing the quality and size of the deposits, determine the marketability, and if exploitation is warranted, design mining operations including equipment necessary and cost the extraction, transport, sales and overhead expenses and capital investment required. The expert will probably have a mining engineer degree and have advanced to the managerial level in his career.</p> | | | |
| e) Consultant in Cement Operations | | 1975 or 1976 | to be determined |
| <p>A feasibility study has been made for the erection of a cement plant at Pagli near the India frontier and a limestone deposit is being drilled at Paro for a small cement operation for internal consumption. The expert will be required to determine if the raw material from the Pagli plant is of an acceptable quality. The design of the whole operation at Pagli must be reviewed and costs brought up-to-date and recommendations sought whether or not the operation is a viable one. At Paro, marketability within Bhutan must be examined and a complete feasibility study must be made for a small 30-60 ton operation if warranted.</p> | | | |

Provision for Contractual Services

a) A sum of \$1,500 is provided for the extraction of imagery coverage of the whole of Bhutan from computer stored inputs from the Earth Resources Technology Satellite and for subsequent geological interpretation that may be required by the Team Leader.

b) A sum of \$15,000 is allocated for: (i) financial assistance to the Geological Survey of India in its analytical work on project samples, and (ii) for limited outside check analyses.

Training

There is provision under training for one fellowship for two year post-graduate university instruction in geology and mining for a Bhutanese graduate in General Science.

| <u>2. UNDP Provided Supplies and Equipment</u> | <u>Arrival</u> | <u>Cost in US \$</u> |
|---|--|----------------------|
| <u>a) Expendable equipment</u> | | |
| -- geological drilling and geochemical field supplies - tents, camp gear, compasses, hammers, pans, sieves, sample bags, geochemical kits | 1 June '75 | 9,000 |
| -- office supplies, draughting supplies | 1 June '75 1 Jan. '77 | 1,500 |
| -- drilling mud, additives, tools, rod grease, etc. | 1 Jan. '76 1 Oct. '76 | 5,000 |
| -- drill bits, shells, shoes for 2 rigs (18 months) | 1 Jan. '76 1 July '76 1 Jan. '77 | 30,000 |
| -- ERTS imagery photos | 1 June '75 | 500 |
| Total expendable equipment -- | | 46,000 46,000 |
| <u>b) Non-expendable equipment</u> | | |
| 1) Drill equipment (BHSI or equivalent) | | |
| -- medium size skid mounted diamond drill easily dismantled frame and moved by man power or mule back and its own power through hoisting cable with sheaves and fairleads. Powered by aircooled engine. Capacity of 1500 feet with A wireline complete with wireline hoist. Main hoist, | 1 Jan. '76 | 14,000 |

| | <u>Arrival</u> | <u>Cost in US \$</u> |
|---|----------------|----------------------|
| hydraulic swivelhead bore of 3-5/8" travel feed, 30 inches with hydraulic chuck. Transmission with a slow ratio of 30 rpm on chuck speed to use in combination with a down-the-hole air hammer complete with pressure gauge, bit indicator, sheave etc. with spare parts | | |
| - pumping units triplex skid mounted powered by aircooled engine complete with hoses foot valves, safety valves, pressure gauges, pump tree, with spare parts for two years operation including 2500 feet of 1" hose for water line heavy duty, in sections of 100 feet with fittings | 1 Jan. '76 | 12,500 |
| - wireline drill rods 60 N, B and A sizes, casings N,B and A size drive hammer, subs,water swivels, hoisting plugs, tops, fishing tools, foot clamps with jaws, core barrel assemblies | 1 Jan. '76 | 22,200 |
| - diesel powered rotary vane compressor, trailer mounted capacity 250 CFM complete with line oiler for down hole air tool, Mission hammer, bits tools, subs with spare parts for 1 1/2 year operation. | 1 Jan. '76 | 22,700 |
| - portable drill | | |
| (GW15 Winkie with auger equipment) | | |
| - GW15 Winkie with capacity of 350 ft. size complete with 6 ft. mechanical pulldown equipped with auger transmission 9-1 ratio with subs. Heavy duty chain on pulldown, anchor bolts gas tank tripod, etc. complete with spare parts for 2 years operation, including operating manual and parts list | 1 Jan. '76 | 4,700 |
| - 2 pumping units PRA-4-22 (Long John) Maynes pumps complete with hoses gauges etc. with 2 years of spare parts | 1 Jan. '76 | 4,000 |
| - rods, casing, subs, fishing tools, hoisting, lowering equipment, core barrels assemblies, hoses, mechanical tools, auger flight, auger bits, rod grease, core boxes, core splitters, motor oil, etc. | 1 Jan. '76 | 10,800 |
| | | 90,900 90,900 |

| | <u>Arrival</u> | <u>Cost in US \$</u> | |
|--|----------------|----------------------|----------------------|
| ii) Vehicles | | | |
| - 2 Landrovers or equivalent | 1 June '75 | 12,500 | |
| - 2 Pickups | 1 June '75 | 10,100 | |
| - 1 Dodge power-wagon | 1 June '75 | 7,800 | |
| | | <hr/> 30,400 | 30,400 |
| iii) Office and field equipment | | | |
| - 4 radio transceivers, extra crystals, batteries, battery charger | 1 June '75 | 9,000 | |
| - 2 sets Walkie-talkies, extra batteries | 1 June '75 | 600 | |
| | | <hr/> 9,600 | 9,600 |
| - office electronic calculator, typewriters, draughting instruments, draughting paper. | 1 June '75 | 2,000 | |
| | | <hr/> 2,000 | 2,000 |
| Total non-expendable equipment | | | <hr/> 132,900 |
| TOTAL Expendable and Non-expendable equipment | | | <hr/> <u>178,900</u> |

C. Description of Government inputs

1. Prerequisites

The Government will establish the Consultative Committee mentioned under Institutional Framework. All maps, photos and information necessary for the proper function of the project will be made available by the Government upon request.

The Government will ensure that housing, warehousing, office facilities, servicing and garaging is available as required.

The Government agrees not to allow mining leases or grants to be made in the working area of the project during its life, in order not to impede or frustrate its work and to ensure that studies may be carried to completion,

The Government will assign a radio frequency for use by the project upon signature in order that the correct crystals may be ordered with the transceivers.

2. Assignment of National Staff

| <u>Posts</u> | <u>Starting Date</u> |
|---|------------------------------|
| Drill runners (4) | 1 Jan. 1976 |
| Drill helpers (12) | 1 Jan. 1976 |
| Administrative clerk-typist | 1 June 1975 |
| Drivers (5) | as required from 1 June 1975 |
| Porters, camp helpers and manual labourers (50) | as required from 1 June 1975 |
| Cooks (8) | as required from 1 June 1975 |

Training

The Government will maintain the fellow's salary while on fellowship.

Premises

The Government will provide housing for experts, office space and furnishings, garage servicing and parking, warehousing, free customs clearances for project equipment.

In providing support for all services (including maintenance and operational costs of drills and vehicles) the actual requirements of the project will prevail, rather than the estimated costs in the accompanying budget.

D. Description of Bilateral inputs

Personnel

The project counts on the support of the Bhutan Circle of the Geological Survey of India in that 4 to 6 geologists and, as indicated, a geophysicist will be required to act as field party chief in carrying out the regional and detailed geochemical surveys, and subsequent ground geophysical surveys on project findings. This will necessitate re-assignment of the professionals during the field season.

Geologists' assistants may also be assigned to the field parties.

The project will be responsible for camp gear, supplies and other man-power.

Services

It will be necessary to use the laboratory facilities at Samachi and in Calcutta for analyzing the geochemical, heavy mineral fractures and rock specimen samples obtained by the project.

The project is allocating the major portion of \$15,000 towards the cost of these analyses.

Project Budget Covering UNDP Contribution
(in US Dollars)

Country: Bhutan

Project No.:

Title: Drill Training and Exploration Project

| | <u>Total</u> | | <u>1975</u> | | <u>1976</u> | | <u>1977</u> | |
|---|--------------|----------------|-------------|---------------|-------------|----------------|-------------|---------------|
| | m/m | \$ | m/m | \$ | m/m | \$ | m/m | \$ |
| <u>1. PROJECT PERSONNEL COMPONENT</u> | | | | | | | | |
| 11. <u>Experts</u> | | | | | | | | |
| 11-01 Geologist (Team Leader) | 27 | 67,500 | 7 | 17,500 | 12 | 30,000 | 8 | 20,000 |
| 11-02 Geochemist | 18 | 45,000 | 5 | 12,500 | 12 | 30,000 | 1 | 2,500 |
| 11-03 Drill Supervisor | 18 | 45,000 | - | - | 12 | 30,000 | 6 | 15,000 |
| 11-04 Consultant(s) (Gypsum and Cement Production) | 5 | 15,500 | 2 | 7,000 | 3 | 8,500 | - | - |
| 11-99 Component Total | <u>68</u> | <u>173,000</u> | <u>14</u> | <u>37,000</u> | <u>39</u> | <u>98,500</u> | <u>15</u> | <u>37,500</u> |
| <u>2. SUB-CONTRACTS COMPONENT</u> | | | | | | | | |
| 21. <u>Sub-contract</u> | | | | | | | | |
| 21-01 ERTS interpretation | | 1,500 | | 1,500 | | | | - |
| 21-02 Analyses | | 15,000 | | 2,500 | | 8,500 | | 4,000 |
| 21-99 Component Total | | <u>16,500</u> | | <u>4,000</u> | | <u>8,500</u> | | <u>4,000</u> |
| <u>3. TRAINING COMPONENT</u> | | | | | | | | |
| 31. <u>Fellowships</u> | | | | | | | | |
| 31-01 Geology Training (1) (2 years) | 22 | 19,700 | 4 | 3,900 | 12 | 10,200 | 6 | 5,600 |
| 31-99 Component Total | <u>22</u> | <u>19,700</u> | <u>4</u> | <u>3,900</u> | <u>12</u> | <u>10,200</u> | <u>6</u> | <u>5,600</u> |
| <u>4. EQUIPMENT COMPONENT</u> | | | | | | | | |
| 41. Expendable equipment | | 46,000 | | 10,500 | | 25,000 | | 10,500 |
| 42. Non-expendable equipment | | 132,900 | | 42,000 | | 90,900 | | - |
| 49. Component Total | | <u>178,900</u> | | <u>52,500</u> | | <u>115,900</u> | | <u>10,500</u> |

| | <u>Total</u> | <u>1975</u> | <u>1976</u> | <u>1977</u> |
|------------------------------------|--------------|-------------|-------------|-------------|
| | m/m \$ | m/m \$ | m/m \$ | m/m \$ |
| 50. <u>MISCELLANEOUS COMPONENT</u> | | | | |
| 52. Reports | 3,000 | - | - | 3,000 |
| 53. Sundry | 1,500 | 500 | 800 | 200 |
| 54. UNDP direct costs | 4,000 | 1,000 | 2,000 | 1,000 |
| 55. Agency Technical Missions | 3,200 | - | 1,600 | 1,600 |
| 59. Component Total | 11,700 | 1,500 | 4,400 | 5,800 |
| 99 GRAND TOTAL | 90 399,800 | 18 98,900 | 51 237,500 | 21 63,400 |

Project Budget Covering Government Counterpart Contribution in Kind
(in Local Currency)

Country: Bhutan

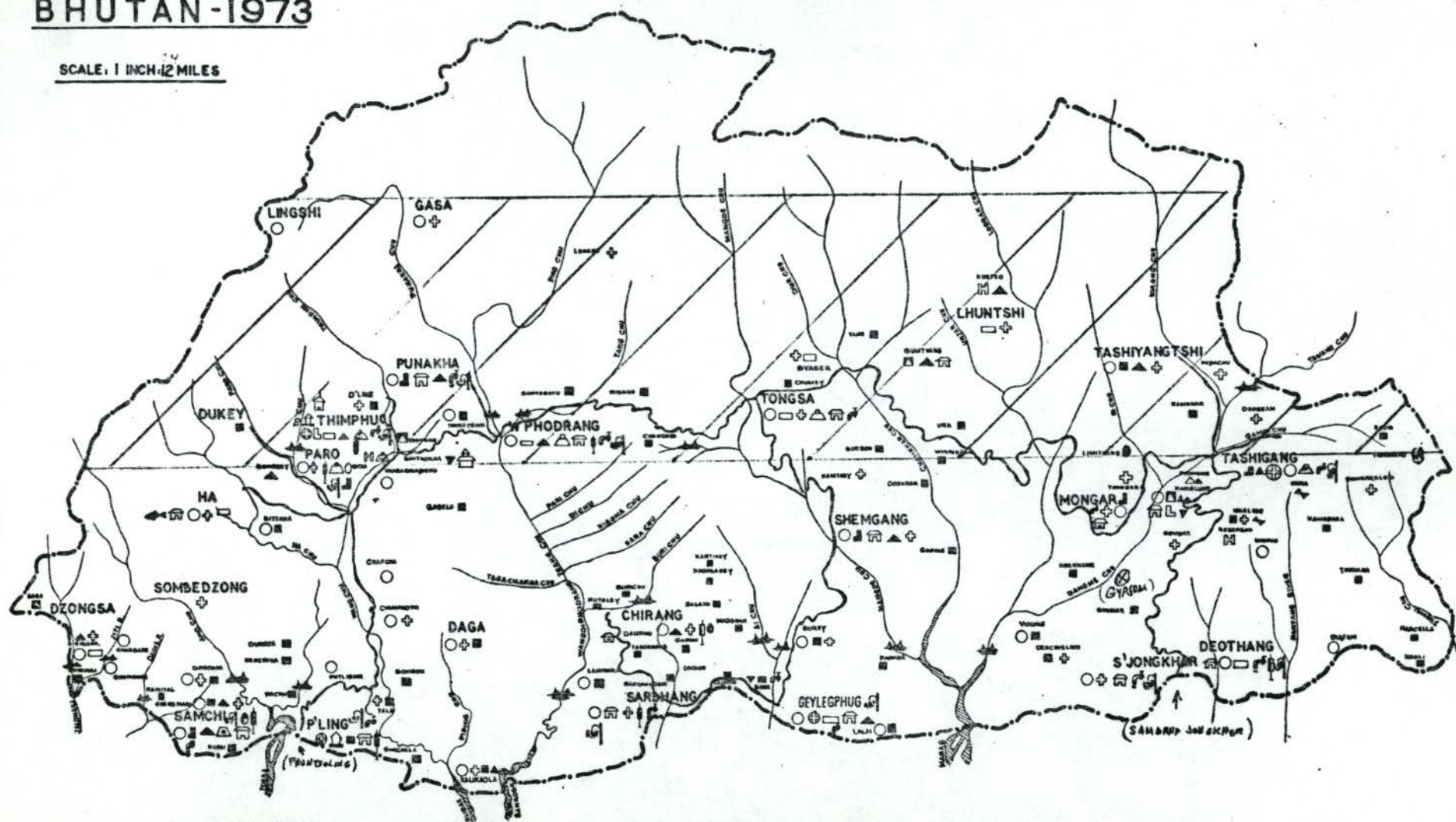
Project No.:

Title: Drill Training and Exploration Project

| | <u>Total</u> | | <u>1975</u> | | <u>1976</u> | | <u>1977</u> | |
|---|--------------|----------------|--------------|---------------|-------------|----------------|-------------|----------------|
| | n/m | Rs | n/m | Rs | n/m | Rs | n/m | Rs |
| 10. <u>PROJECT PERSONNEL COMPONENT</u> | | | | | | | | |
| Drill Runners (4) | 72 | 54,000 | - | - | 48 | 36,000 | 24 | 18,000 |
| Drill Helpers (12) | 216 | 43,200 | - | - | 144 | 28,800 | 72 | 14,400 |
| Administrative Clerk-Typist | 27 | 27,000 | 7 | 7,000 | 12 | 12,000 | 8 | 8,000 |
| Drivers (5) | 111 | 22,200 | 21 | 4,200 | 60 | 12,000 | 30 | 6,000 |
| Porters (50), Camp Helpers and Manual Labourers | 816 | 102,000 | 60 | 7,500 | 480 | 60,000 | 276 | 34,500 |
| Cooks (8) | 168 | 42,000 | 24 | 6,000 | 96 | 24,000 | 48 | 12,000 |
| 19 Component Total | <u>1410</u> | <u>290,400</u> | <u>112</u> | <u>24,700</u> | <u>840</u> | <u>172,800</u> | <u>458</u> | <u>92,900</u> |
| 30. <u>TRAINING COMPONENT</u> | | | | | | | | |
| 31. National Salary of Trainee | | | Pour Memoire | | | | | |
| 40. <u>EQUIPMENT COMPONENT</u> | | | | | | | | |
| 43. Premises | | 209,000 | | 46,450 | | 93,000 | | 69,550 |
| 49 Component Total | | <u>209,000</u> | | <u>46,450</u> | | <u>93,000</u> | | <u>69,550</u> |
| 50. <u>MISCELLANEOUS COMPONENT</u> | | | | | | | | |
| 51. Operatin and maintenance of vehicles and drills | | 215,000 | | 5,500 | | 140,000 | | 69,500 |
| 53. Sundry | | 45,000 | | 11,700 | | 20,000 | | 13,300 |
| 59 Component Total | | 260,000 | | 17,200 | | 160,000 | | 82,800 |
| 99 GRAND TOTAL | <u>1410</u> | <u>759,400</u> | <u>112</u> | <u>88,350</u> | <u>840</u> | <u>425,800</u> | <u>458</u> | <u>245,250</u> |

BHUTAN-1973

SCALE: 1 INCH: 12 MILES



| EDUCATION | AGRICULTURE | POSTAL | HEALTH | ANIMAL HUSBANDRY | P.W.D. | HYDEL |
|---|---|---|---|---|--|---|
| <ul style="list-style-type: none"> 1 PUBLIC SCHOOL 2 CENTRAL SCHOOL 3 JUNIOR HIGH SCHOOL 4 PRIMARY SCHOOL 5 TEACHERS' TRAINING INSTITUTION 6 SCHOOL OF BUDDHIST STUDIES 7 SCHOOL OF MONASTIC STUDY | <ul style="list-style-type: none"> 1 AGRIC. RESEARCH STN. & TRAINING CENTRE 2 AGRIC. EXT. HUSBANDRY & DEMONSTRATION FARM 3 HORSE RESEARCH STATION 4 DISEASE CONTROL STATION | <ul style="list-style-type: none"> 1 GENERAL POST OFFICE 2 DEPARTMENTAL/EXTRA DEPT. POST OFFICE | <ul style="list-style-type: none"> 1 GENERAL HOSPITAL 2 LEPROSY HOSPITAL/CLINIC 3 DISPENSARY | <ul style="list-style-type: none"> 1 LIVESTOCK FARM 2 SHEEP BREEDING FARM 3 BATHY BREEDING FARM 4 VETERINARY DISPENSARY 5 DISEASE INVESTIGATION LAB. 6 PRODUCE LAB. | <ul style="list-style-type: none"> 1 ROAD 2 RAILWAY 3 SUSPENSION BRIDGE 4 WATER SUPPLY 5 TOWN ELECTRIFIED | <ul style="list-style-type: none"> 1 HYDEL STATION |

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THIS PAGE REPRESENTS

Job Descriptions of each post.

ORGANIZATION OF THE PROJECT

1. Pending finalization of the new consolidated Standard Agreement with Governments, the following standard text is to be appended to all project documents.

General responsibilities

2. The Government, the UNDP and the Executing Agency shall jointly be responsible for the execution of the project and the realization of its objectives as described in Part II of this Project Document.

3. The Government shall provide to the project the national project personnel, training facilities, land, buildings, equipment and other required services and facilities. It will designate the Government Co-operating Agency named in the cover page of this document, which will hereinafter be referred to as the "Co-operating Agency" and which will be directly responsible for the implementation of the Government contribution to the project.

4. The UNDP undertakes to complement and supplement the Government participation and will provide through the Executing Agency the required expert services, training, equipment and other services within the funds available to the project.

5. Upon commencement of the project the Executing Agency may be requested to assume primary responsibility for project execution. However, that primary responsibility shall be exercised in consultation and in agreement with the Co-operating Agency. Arrangements to this effect shall be stipulated in the project Work Plan as well as for the transfer of this responsibility to the Government or to an entity designated by the Government during the execution of the project.

6. Part of the Government's participation may take the form of a cash contribution to UNDP. In such cases, the Executing Agency will provide the related services and facilities and will account annually to the UNDP and to the Government for the expenditure incurred.

Participation of the Government

7. The Government shall provide to the project the services, equipment and facilities in the quantities and at the times specified in the Work Plan. Budgetary provision - either in kind or in cash - for the Government's participation so specified shall be set forth in the Project Budgets.

8. The Co-operating Agency shall in consultation with the Executing Agency assign a director for the project on a full-time basis. He shall carry out such responsibilities in the project as are assigned to him by the Co-operating Agency.
9. The estimated cost of items included in the Government contribution, as detailed in the Project Budget, shall be based on the best information available at the time of drafting this project proposal. It is understood that price fluctuations during the period of execution of the project may necessitate an adjustment of said contribution in monetary terms; the latter shall at all times be determined by the value of the services, equipment and facilities required for the proper execution of the project.
10. Within the given number of man-months of personnel services described in the Work Plan minor adjustments of individual assignments of project personnel provided by the Government may be made by the Government in consultation with the Executing Agency, if this is found to be in the best interests of the project.
11. The Government shall continue to pay the local salaries and appropriate allowances of national project personnel during the period of their absence from the project while on UNDP fellowships.
12. The Government shall defray any customs duties and other charges related to the clearance of project equipment, its transportation, handling, storage and related expenses within the country. It shall be responsible for safe custody of the equipment, its installation and maintenance, insurance, and replacement if necessary, after delivery to the project site.
13. The Government shall make available to the project - subject to existing security provisions - any published and unpublished reports, maps, records and other data which are considered necessary to the implementation of the project.
14. The Government shall assist all project personnel in finding suitable housing accommodation at reasonable rents.
15. The services and facilities specified in the Work Plan which are to be provided to the project by the Government by means of a contribution in cash shall be set forth in the Project Budget. Payment of this amount shall be made in local currency to the UNDP in accordance with the Schedule of Payments by the Government.

16. Payment of the above-mentioned contribution to the UNDP on or before the dates specified in the Schedule of Payments by the Government is a prerequisite to commencement or continuation of project operations.

Participation of the UNDP and of the Executing Agency

17. The UNDP shall provide to the project through the Executing Agency the services, equipment and facilities described in the Work Plan. Budgetary provision for the UNDP contribution as specified shall be set forth in the Project Budget.

18. The Executing Agency shall consult with the Government on the candidature of the Project Manager^{1/} who, under the direction of the Executing Agency, will be responsible in the country for the Executing Agency's participation in the project. The Project Manager shall supervise the experts and other agency personnel assigned to the project, and the on-the-job training of national project personnel. He shall be responsible for the management of all equipment provided to the project from UNDP funds.

19. The Executing Agency, in consultation with the Government, shall assign international staff and other personnel to the project as specified in the Work Plan, select candidates for fellowships and determine standards for the training of national project personnel.

20. Fellowships shall be administered in accordance with the fellowships regulations of the Executing Agency.

21. The Executing Agency may, in agreement with the Government and UNDP, execute part or all of the project by subcontract. The selection of subcontractors shall be made, after consultation with the Government, in accordance with the Executing Agency's procedures.

22. All material, equipment and supplies which are purchased from UNDP resources will be used exclusively for the execution of the project, and will remain the property of the UNDP in whose name it will be held by the Executing Agency. Equipment supplied by the UNDP shall be marked with the insignia of the UNDP and of the Executing Agency.

^{1/} May also be designated Team Leader or Chief Technical Adviser, as appropriate.

23. Arrangements may be made, if necessary, for a temporary transfer of custody of equipment to local authorities during the lifetime of the project, without prejudice to the final transfer.

24. Prior to completion of UNDP assistance to the project, the Government, the UNDP and the Executing Agency shall consult as to the disposition of all project equipment provided by the UNDP. Title to such equipment shall normally be transferred to the Government, or to an entity nominated by the Government, when it is required for continued operation of the project or for activities following directly therefrom. The UNDP may, however, at its discretion, retain title to part or all of such equipment.

25. At an agreed time after the completion of UNDP assistance to the project, the Government and the UNDP, and if necessary the Executing Agency, shall review the activities continuing from or consequent upon the project with a view to evaluating its results.

Facilities, privileges and immunities

UNDP and Executing Agency personnel

26. In accordance with the Agreement concluded by UNDP and the Government concerning the provision of assistance, the personnel of UNDP and other United Nations organizations associated with the project, shall be accorded facilities, privileges and immunities specified in the said Agreement.

Subcontractors and their personnel

27. The Executing Agency's contractors and their personnel (except Government residents employed locally) shall:

- (a) Be immune from legal process in respect of all acts performed by them in their official capacity in the execution of the project;
- (b) Be immune from national service obligations;
- (c) Be immune together with their spouses and relatives dependent on them from immigration restrictions;
- (d) Be accorded the privileges of bringing into the country reasonable amounts of foreign currency for the purposes of the project or for personal use of such personnel, and of withdrawing any such amounts brought into the country,

or, in accordance with the relevant foreign exchange regulations, such amounts as may be earned therein by such personnel in the execution of the project;

(e) Be accorded together with their spouses and relatives dependent on them the same repatriation facilities in the event of international crises as diplomatic envoys.

28. All personnel of the Executing Agency's contractors shall enjoy inviolability for all papers and documents relating to the project.

29. The Government shall either exempt from, or bear the cost of any taxes, duties, fees or levies which it may impose on any foreign firm or organization which may be retained by the Executing Agency and on the foreign personnel of any such firm or organization in respect of:

(a) The salaries or wages earned by such personnel in the execution of the project;

(b) Any equipment, materials and supplies brought into the country for the purposes of the project or which, after having been brought into the country, may be subsequently withdrawn therefrom;

(c) Any substantial quantities of equipment, materials and supplies obtained locally for the execution of the project, such as, for example, petrol and spare parts for the operation and maintenance of equipment mentioned under (b) above, with the provision that the types and approximate quantities to be exempted and relevant procedures to be followed shall be agreed upon with the Government and, as appropriate, recorded in the Work Plan; and

(d) As in the case of concessions currently granted to UNDP and Executing Agency's personnel, any property brought, including one privately owned automobile per employee, by the firm or organization or its personnel for their personal use or consumption or which after having been brought into the country, may subsequently be withdrawn therefrom upon departure of such personnel.

30. The privileges and immunities to which such firm or organization and its personnel may be entitled, referred to in the paragraphs above, may be waived by the Executing Agency where, in its opinion or in the opinion of the UNDP, the immunity would impede the course of justice and can be waived without prejudice to the successful completion of the project or to the interest of the UNDP or the Executing Agency.

31. The Executing Agency shall provide the Government through the Resident Representative with the list of personnel to whom the privileges and immunities enumerated above shall apply.