資料　３：

ケニア国政府の要請書

OFFICE OF THE VICE PRESIDENT
AND
MINISTRY OF FINANCE

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THE TREASURY
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NAIROBI, KENYA

Ref. No. EA/FA 79/78/06/C/(45) and date

Date 18th November 1992

H.E. The Ambassador
Embassy of Japan
NAIROBI

Your Excellency

REQUEST FOR DEVELOPMENT SURVEY ASSISTANCE FOR GRAND FALLS HYDROPOWER PROJECT

I hereby request your esteemed Government to finance the feasibility study for the above project on grant basis. The Grand Falls Hydropower Project has long been considered as one of the most promising hydropower projects to be developed to meet the increasing power demand in Kenya. In the recent National Power Development Plan (1991 - 2010), the feasibility study of the low Grand Falls Project is recommended on a high priority basis to be commissioned after the Sondu-Miriu Hydropower Project. The Grand Falls Hydropower Project is located on River Tana down stream of Kiambere Hydro Station as shown in the attached document.

Your Excellency may recall that the National Water Master Plan conducted by JICA and completed in July 1992, has assessed and recommended this project as a priority project to be commissioned by the year 2000. The optimization of the Grand Falls Project will secure and help accelerate the irrigation agricultural development downstream.

I enclose herewith for your perusal and consideration the Terms of Referenc and Reconnoissance Report on the project.

Please accept Your Excellency, the assurances of my highest consideration.

Yours sincerely

W. KOINANGE
PERMANENT SECRETARY/TREASURY

c.c.

Mr. C.N. Mutitu
Permanent Secretary
Ministry of Energy
NAIROBI

TECHNICAL AID PROPOSAL
FOR
FEASIBILITY STUDY ON GRAND FALLS HYDROPOWER PROJECT

Project Title	: Feasibility Study for Grand Falls Hydropower Project
Location	: 45 km downstream of Kiambere dam, Tana River Basin
Executing Agency	: Ministry of Energy/Kenya Power Company
Proposed sources of assistance	: The Government of Japan through a technical assistance programme of Japan International Cooperation Agency (JICA)
Objectives of the Study	: The proposed study aims at formulating an optimum plan of the Grand Falls hydropower project on the Tana River from the technical, economical and environmental viewpoints under the framework of the National Power Development Plan.
Project description	: The background information and the justification of need of the study are presented in the following sheets. The proposed Terms of Reference (draft) is presented herein as the Appendix A.

1. Introduction

Kenya is a non-oil producing country. Therefore, as a national energy policy, the country has placed priority to development to indigenous energy resources such as hydropower and geothermal. Recently (1988/1989) hydropower shared about 84% in terms of the total energy supplied in Kenya. The second major generating source is geothermal, which development is also expected to be accelerated.

The Tana River has a great potential for water resources development including hydropower generation. Of these resources, several hydropower projects have been developed to date. Principal projects are existing power plants built at Masinga, Kamburu, Gitaru, Kindaruma, and Kiambere, the total installed capacity of which is 440 MW. On the other hand, some prospective potential still remain untapped.

The Grand Falls hydropower project is one of a series of the Tana hydropower schemes. This project is proposed downstream if the existing Kiambere project as one of the promising cascade schemes to be developed successively. For the project, two alternative schemes are envisaged; (i) one is the Low Grand Falls Scheme (in combination with the Mutonga project in the upstream) and (ii) the other is the High Grand Falls scheme. A preliminary investigation was carried out in 1979 concurrently when the feasibility study of the Kiambere hydropower project was made. However, no detailed study has been conducted on this project, except for some review using existing data which was made in the study on the National Power Development Plan.

So it is recommended to take necessary steps towards the realization of the project to cope with the increasing power demand in Kenya. A draft terms of reference for conducting the feasibility study is hereto attached.

2. Electricity Energy Supply in Kenya

2.1 Power Supply Status

The present power and energy demand of the system (1989/90) is as follows.

- Peak power demand 520 MW
- Annual energy demand 3,136 GWh (production base)

The existing installed capacity of power generation in the integrated system is 705 MW (January 1991), which comprises 496 MW of hydroelectric, 146 MW of conventional thermal and 45 MW of geothermal, 18 MW of diesel.

Hydropower has a large share in generating capacity and therefore the supply capacity of the system is much influenced by available water. According to the National Power Development Plan (1991 to 2010), the reliable supply capacity in the critical dry sequences is assessed at 469 MW, which corresponds to 2,570 GWh of annual firm energy.

2.2 Power Demand Projection

The past annual growth of net energy generation requirement in the system was 8.5% from 1972 to 1979, 5.6% from 1979 to 1985 and 6.6% from 1986 to 1990.

According to the National Power Development Plan, load projection is made as follows.

Year	Peak load (MW)	Net generation required (GWh/yr)
1990/91	560	3,150
1991/92	591	3,313
1994/95	710	3,963
1999/00	959	5,321
2004/05	1,290	7,127
2009/10	1,727	9,501

The estimated growth rate of net energy generation requirement is about 6.0% per year for the period from 1992 until the planning horizon of 2010. The increment in peak load is 1,167 MW between mid-1990 and mid-2009 and the corresponding increment in annual net energy is 6,351 GWh.

2.3 Potential New Generating Sources

In line with the national policy of energy development, two indigenous resources are contemplated; geothermal and hydropower resources.

Hydropower potentials have been tapped mainly in the Tana River. The total hydropower potential in this basin is assessed at about 600 MW (1,351 MW theoretically), of which 460 MW has been developed.

The Sondu River, which drains the north-western part of the country and pours into Lake Victoria, also has a high potential for hydropower development. Engineering design of the Sondu/Miriu run-of-river hydropower project (60 MW) has been completed. The project is proposed to put into commissioning in 1997. Further a feasibility study of the Magwagwa project (120 MW) which is located upstream of the Sondu/Miriu project was completed in 1991.

3. The Tana River Basin

3.1 General

The Tana River, which is the largest river in Kenya, drains the eastern slope of the Aberdares and the southern slopes of the snow capped Mount Kenya and pours into the Indian Ocean. It has a total catchment area of some 100,000 km^2 and includes a wide variety of areas in rainfall, relief, population and development potential. (See Figure 3.)

The headwaters consist of numerous mountain streams which join the mainstream Tana in an area known as Seven Forks. The river descends by about 630 m through the length of 200 km, thereby affording the most attractive hydropower sites.

In the upstream basin, the mean annual rainfall is over 1,800 mm. In most of the lower catchment downstream of Grand Falls and Garissa, the annual mean rainfall is less than 400 mm.

The upper catchment above the existing Low Tana power station (upstream of Masinga dam) is heavily populated and widespread cultivation is practised. The middle and the lower catchments are sparsely populated with sporadic cultivation.

The Tana basin experiences two wet periods separated by two drier seasons every year. The largest flows generally occur between April and June but some of the heaviest floods were recorded in November to December. The river flow decreases to 25 m^3/s at Kiambere in the months of September to October and the driest month usually occurs in February to March with flows as low as 17 m^3/s.

3.2 Existing Hydropower Projects in the Tana River

In the Tana River several hydropower projects have been developed and operated by harnessing a total head of about 500 m over the section of 60 km. Besides the existing small hydro plants, major serial development schemes are presented in Figure 4 and summarized as follows.

Plant	Installed capacity	Year commissioned
- Masinga :	40.0 MW	1981
- Kamburu :	94.2 MW	1974
- Gitaru :	147.0 MW	1978
- Kindaruma :	44.0 MW	1968
- Kiambere :	144.0 MW	1988

The Masinga dam has the largest reservoir (called Upper Reservoir) with the gross volume of 1,560 million m^3 which is equivalent to over 70% of the annual mean flow. Therefore, in combination with the relatively small Kamburu reservoir (147 million m^3), the Upper Reservoir is able to regulate almost completely the flows in the upper part of the Seven Forks reach.

3.3 Irrigation Development in the Tana River Basin

According to National Master Water Plan, Kenya is endowed with irrigation development potentials of 540,000 ha, of which about 37% (200,000 ha) is located in the Tana and Athi River basins. Of the said 200,000 ha, 52,000 ha is located in Upper Area of the Tana river, 100,000 ha in the Lower Area and 48,000 ha in the Delta Area. The Tana River has contributed much to national agriculture development and the basin still involves a great potential for irrigation development in future.

On the other hand, hydropower development projects in the Tana River may influence more or less to the irrigation schemes, both existing and under-planned.

In the reaches downstream of the proposed Grand Falls hydropower scheme, the following existing and under-planned irrigation schemes are identified as follows. (See Figure 3 and 5.)

(ha)

No.	Schemes	Existing	Envisaged	Total
(1)	Garissa irrg.	240	0	240
2)	Bura irrig.	6,700	7,300	14,000
(3)	Hola irrig.	872	0	872
(4)	Tana Delta	2,200	9,800	12,000
(5)	Lower Tana Small Irr.	243	800	1,043
(6)	Witu/Lamu Irrig.	0	(To be filled)	0
Total		10,255	17,900	28,155

As seen in the above, the acreage of the existing schemes is about 10,300 ha and that of under-planned schemes is about 18,000 ha, being 28,200 ha in total. It is noted that the greater part of under-planned schemes will be located in Bura East and Tana Delta and the total irrigation area of 28,200 ha counts for only 19% of the total potential irrigable area in the Lower and Delta Areas.

On the other hand, there are existing irrigation schemes in the Mutonga River (Mitunguu and Ishiara irrigation schemes). Further, in the Kazita River which joins the Tana River at Grand Falls, the Thanantu irrigation scheme is proposed for development.

Water resources in the Tana River should be used most effectively not only for power generation but also for irrigation use. It has been considered that new dam and reservoir schemes at Grand Falls would not give significant influence to the downstream irrigation schemes because of their relatively small regulation effect of the river runoff.

For establishing any water resources development plan in the basin, a comprehensive study on potential water use for other sectors will be quite essential.

4. Grand Falls Project

4.1 General

The hydropower project at the Grand Falls site has long been considered as a promising project to be developed for the increasing power demand in Kenya. In the recent National Power Development Plan (1991 to 2010), the Low Grand Falls project is assessed to be a priority project and ranked as the project to be commissioned in 2000/2001, following the Sondu/Miriu hydropower project.

The project site is located about 200 km northeast of Nairobi. The proposed damsite is about 45 km below the existing Kiambere dam and 4 km downstream of the Grand Falls or the junction of the Kazita River. Access to the damsite was made from the left bank via Chokaıge and Gatunga when the site reconnaissance was made in May 1991. (See Figure 6.)

The Tana River drains an area of 17,490 km^2 at the proposed Grand Falls damsite, of which 11,965 km^2 is above the Kiambere damsite. At this damsite, two alternative dam heights are conceivable, that is, a high dam scheme and a low dam scheme.

The project envisages two mutually exclusive alternative development schemes; (i) High Grand Falls project alone and (ii) Low Grand Falls project in conjunction with the Mutonga project which is planned between the Kiambere dam and the proposed Grand Falls dam, that is, 25 km upstream of the Grand Falls damsite. The High Grand Falls project will preclude the Low Grand Falls and Mutonga projects since it would raise the head upto the Kiambere tailwater. (See Figure 4.) .

4.2 Meteoro-hydrology

It is reported in the feasibility report on the Kiambere project (1979) that the flow of the Tana River usually peaks near Adamson's Falls about 70 km downstream of Grand Falls and below Kora rapids, further 50 km downstream, losses occur at the Hameyi swamp and further in the reaches downstream of Garissa.

The average flow at Grand Falls was estimated to be 134 m^3/s in the feasibility study for the Kiambere project (based on records from 1947 to 1977). The study of National Power Development Plan estimates it to be 146.2 m^3/s based on a simulation study.

On the other hand, the estimated flood peaks at Grand Falls are as follows:

Return period	Peak discharge (m^3/s)
1:10	3,200
1:25	4,000
1:100	5,300
1:1,000	7,400
1:10,000	9,500

Source: Kiambere feasibility study

It is noted that the above values on peak discharge ignore attenuation effect of the upper reservoirs.

4.3 Site Geology

The site geological investigation for the Grand Falls project was carried out in 1979 by EPD Consultant, England at prefeasibility extent. This investigation was concurrently made with those for the Kiambere and Mutonga projects.

The investigation consisted of reconnaissance geological mapping, limited trial pitting along the dam axis and a geophysical survey comprising some 5.7 km of seismic prospecting. However, no test drilling was conducted in this investigation.

The rocks in the project area belong to the Kenya Basement System which is of Archaean age. They consist of high grade metamorphic gneisses, with rare small lenses of crystalline limestone, intruded by contemporary granite and pegmatite bodies.

The most obvious feature of the rock structure is the foliation. The foliation strikes N-S and dips 60 degrees to the west. No major faulting has been recognized, only two photo-lineaments, striking E-W, south of Tharaka, 4.5 km from the river.

Most rocks exhibit high strength except for the mafic gneisses. The hard rocks form linear ridges, parallel to the foliation and this is also the case at the damsite.

4.4 Project Features

The Low Grand Falls project is planned as a hydropower scheme with a dam and reservoir as presented in Figure 7. The reservoir will submerge an area of 70 km^2 at FSL, and create the live storage of 701 million m^3 for 12 m drawdown which is 17% of the mean annual flow volume.

The dam is a rockfill dam, with an earthfill core flanked by fine and coarse filter zones and rock-fill shells. The dam height is 79 m at the maximum and the crest length is 850 m for the main dam and 800 m for the saddle dam. The total embankment volume is approximately 6 million m^3.

Two diversion tunnels of each about 10 m in diameter will be located on the right bank. The intakes, powerhouse and spillway are located on the left bank. The gated spillway will have a capacity to discharge 11,300 m^3/s of the routed PMF.

Two power shafts and tunnels will extend through the foundation rock to the semi-underground powerhouse. The total length of the power shafts and tunnels from the intake gates to the turbine inlets is 120 m. The powerhouse will accommodate two turbine-generator units rated at 60 MW each (net head of 64.8 m and design discharge of 212 m^3/s).

The project is expected to produce the firm energy of 535 GWh/yr in 1 in 40 year dry hydrologic sequence and 620 GWh/yr in average hydrologic year.

The construction cost of the project is reviewed in the recent National Power Development Plan. The cost thus estimated is US$276 million, inclusive of contingency, engineering and camp but excluding transmission line, though due review is necessary based on more in-depth investigation.

5. Need for Further Study

5.1 Basic Considerations for Further Study

To support the nation's economic activities and enhance the social well-being of people, stable and reliable electric power supply is very essential.

At present, hydroelectric generation plays a key role in supply of electricity in Kenya. In 1989, the share of hydropower is 70% in terms of the installed capacity and 87% in energy supply including energy import from Uganda. Though the share of hydropower will drop

less than 50% beyond the year 2000, the present hydro-dominated power supply system will remain unchanged even if much base load plants such as geothermal and coal-fired thermal plants are introduced.

The Tana River basin is endowed with water resources. Of these resources hydropower potentials should be developed most effectively as an indigenous, recycling and clean energy source to meet the increasing energy demand in line with the national energy policy.

The Low Grand Falls hydropower project is ranked as one of the priority schemes to be developed in near future, in particular in the least cost generation expansion plan of KPLC.

This project is compared with the High Grand Falls Project which would replace the Low Grand Falls and Mutonga projects. Previous studies resulted in a higher economic indicator to the Low Grand Falls project. However, this preference should be confirmed in a more comprehensive way, being supported with in-depth field surveys on hydrology, topography, geology, natural and social environmental aspects, potential irrigation use, etc.

In particular, some key issues which require due attention will be as follows.

(1) Any proposed reservoir scheme would inundate a vast land after completion, though population is sparse, and cultivation or cattle grazing does not appear so intensive in the proposed reservoir area. However, careful investigation is required of the natural and social problems related to reservoir submergence, including preparation of a plan for countermeasures, if necessary, for the possible emerging negative problems.

(2) For the cascade power development below Kiambere, study should be also made of the priority development among Low Grand Falls, High Grand Falls, and Mutonga in due consideration of hydrological and hydraulic influences between the upper scheme and the lower scheme.

(3) Sedimentation in the proposed reservoir should be investigated carefully by observing the actual siltation behaviours in the upper reservoirs.

(4) Influence to the existing irrigation schemes and potential irrigation development schemes resulting from the development of hydropower scheme at Grand Falls.

With due attention to the above, therefore, it is recommended to carry out the investigation and study of feasibility extent on the Grand Falls project at the earliest time.

It is also recommended to divide the study in two phases. The Phase 1 study is to investigate and confirm a relative advantage of the Low Grand Falls project (but not always limited to) to the High Grand Falls and Mutonga projects based on more detailed mapping, field reconnaissance and in-situ geological investigations. The Phase 2 study is to conduct a full-scale feasibility study for the scheme which will be selected as a high priority scheme in the Phase 1 study.

FIGURES

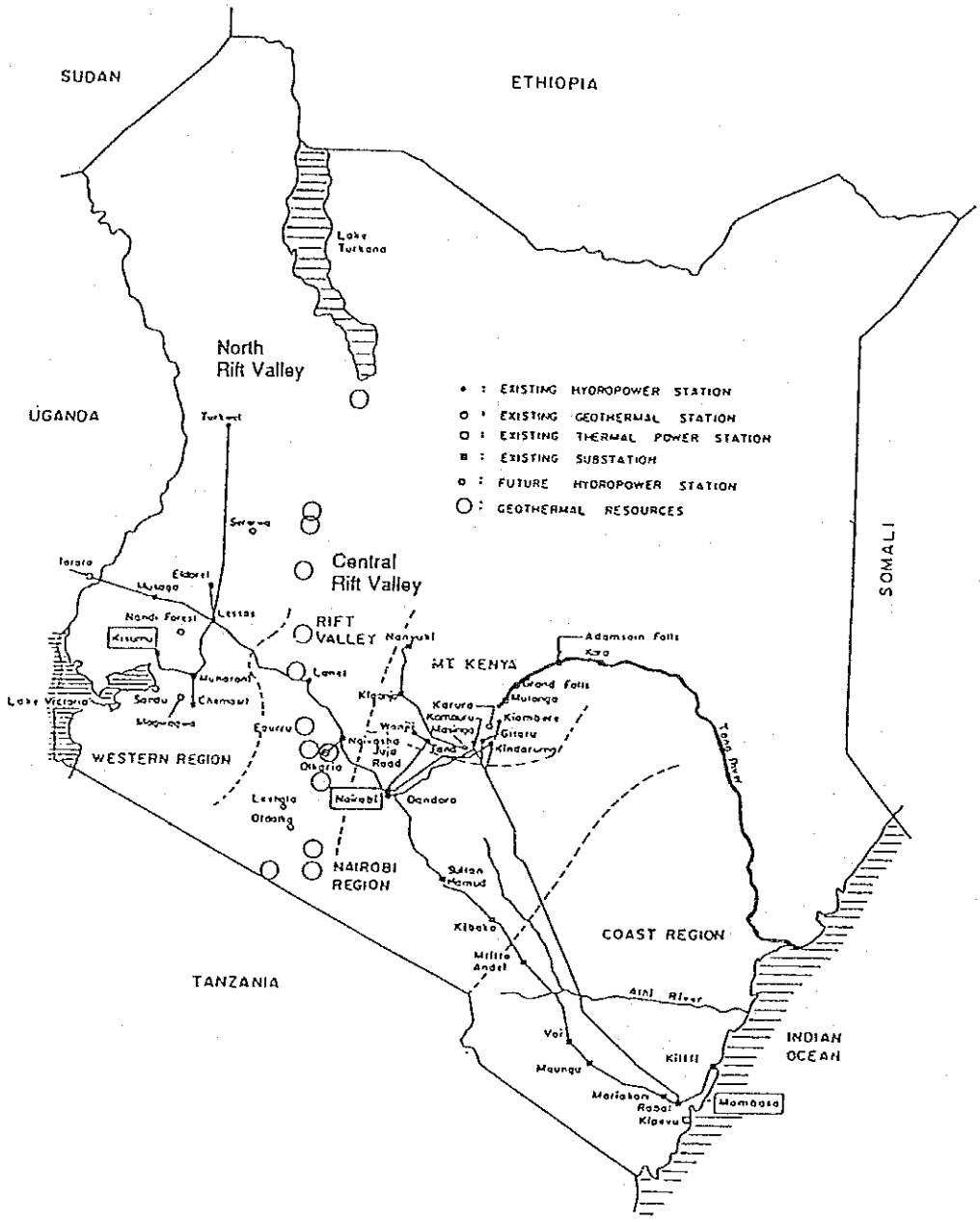
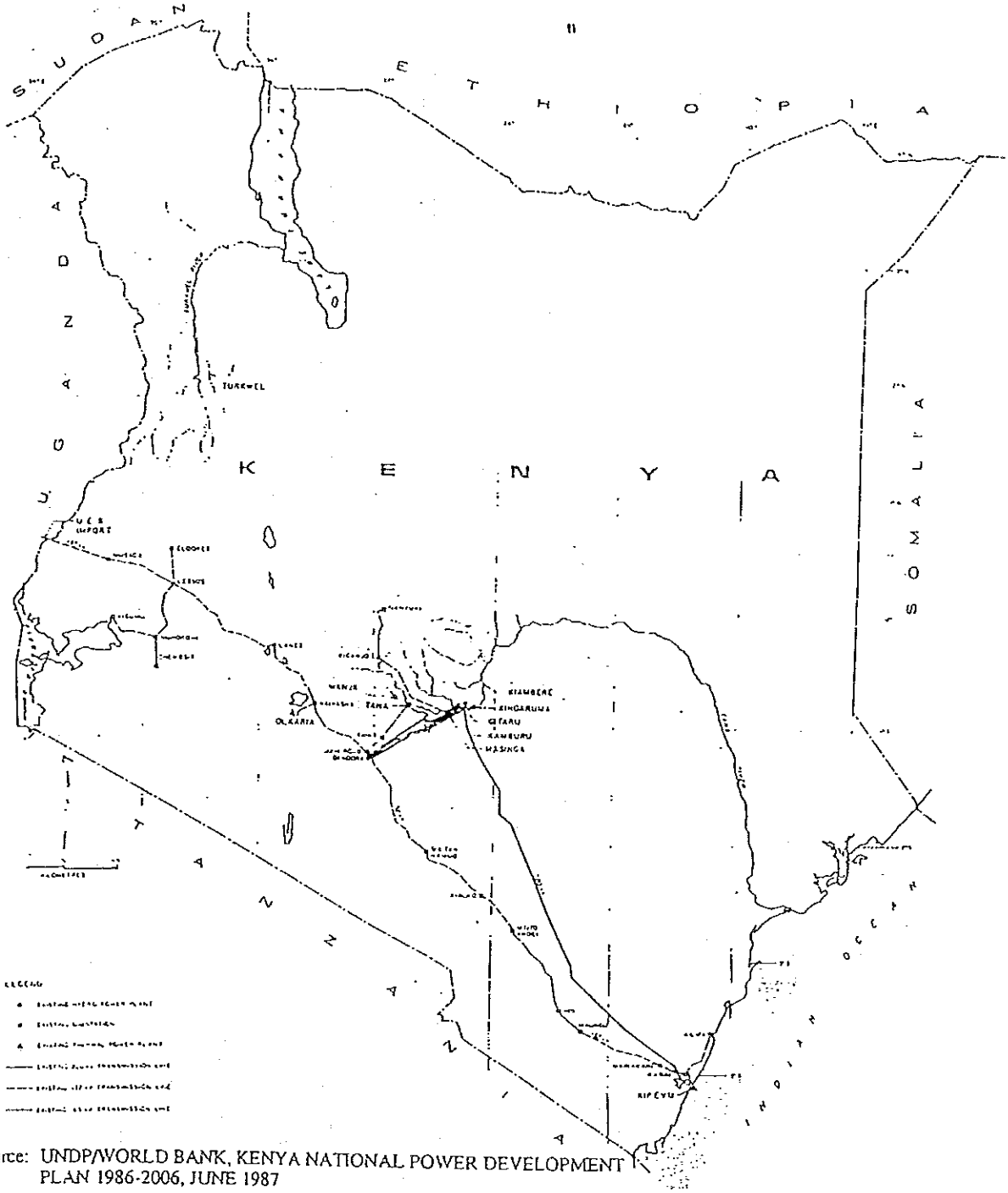


Fig. 1 National Power Grid Map



Source: UNDP/WORLD BANK, KENYA NATIONAL POWER DEVELOPMENT PLAN 1986-2006, JUNE 1987

Fig. 2 Existing Power System

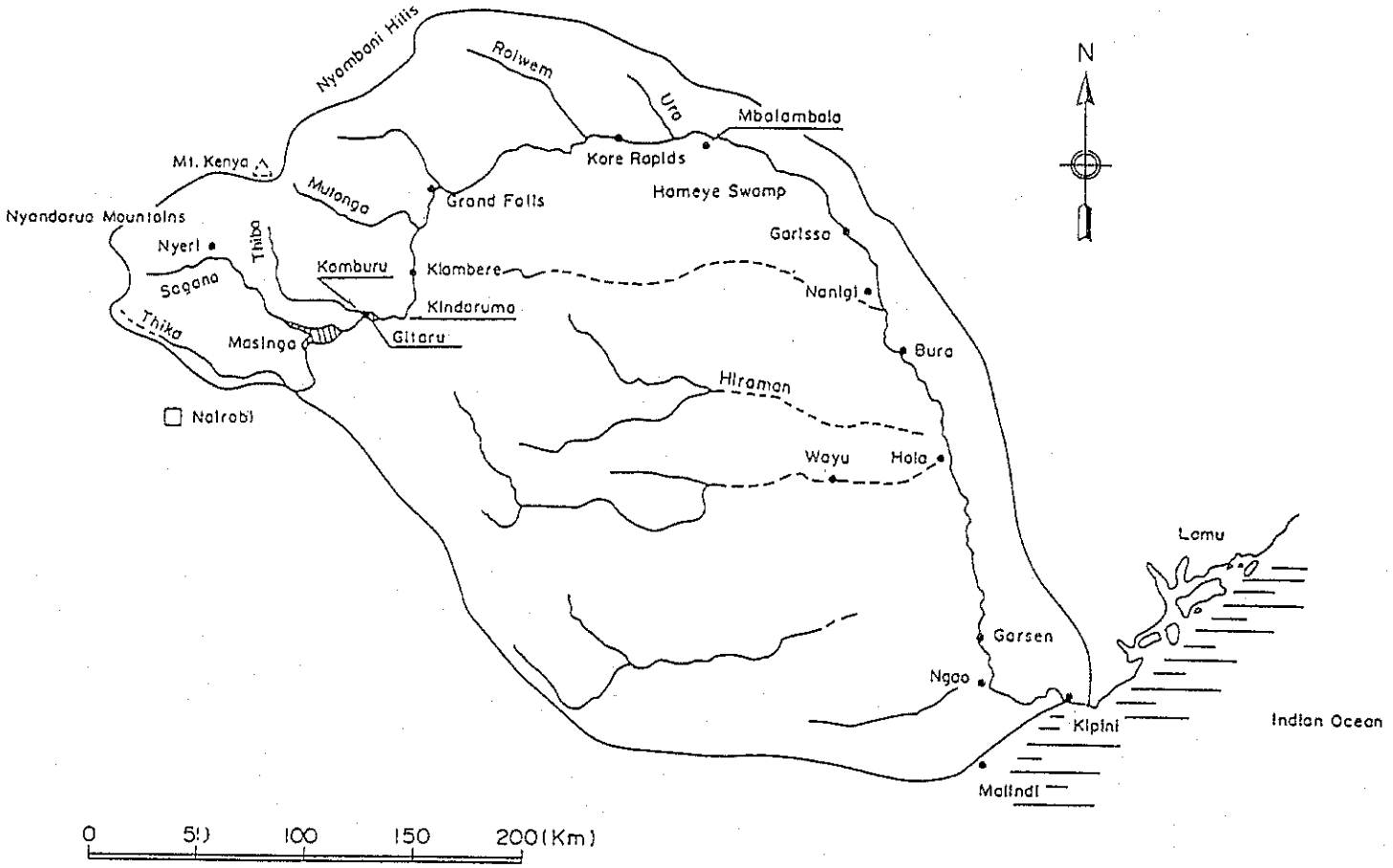


Fig. 3 Tana River Basin

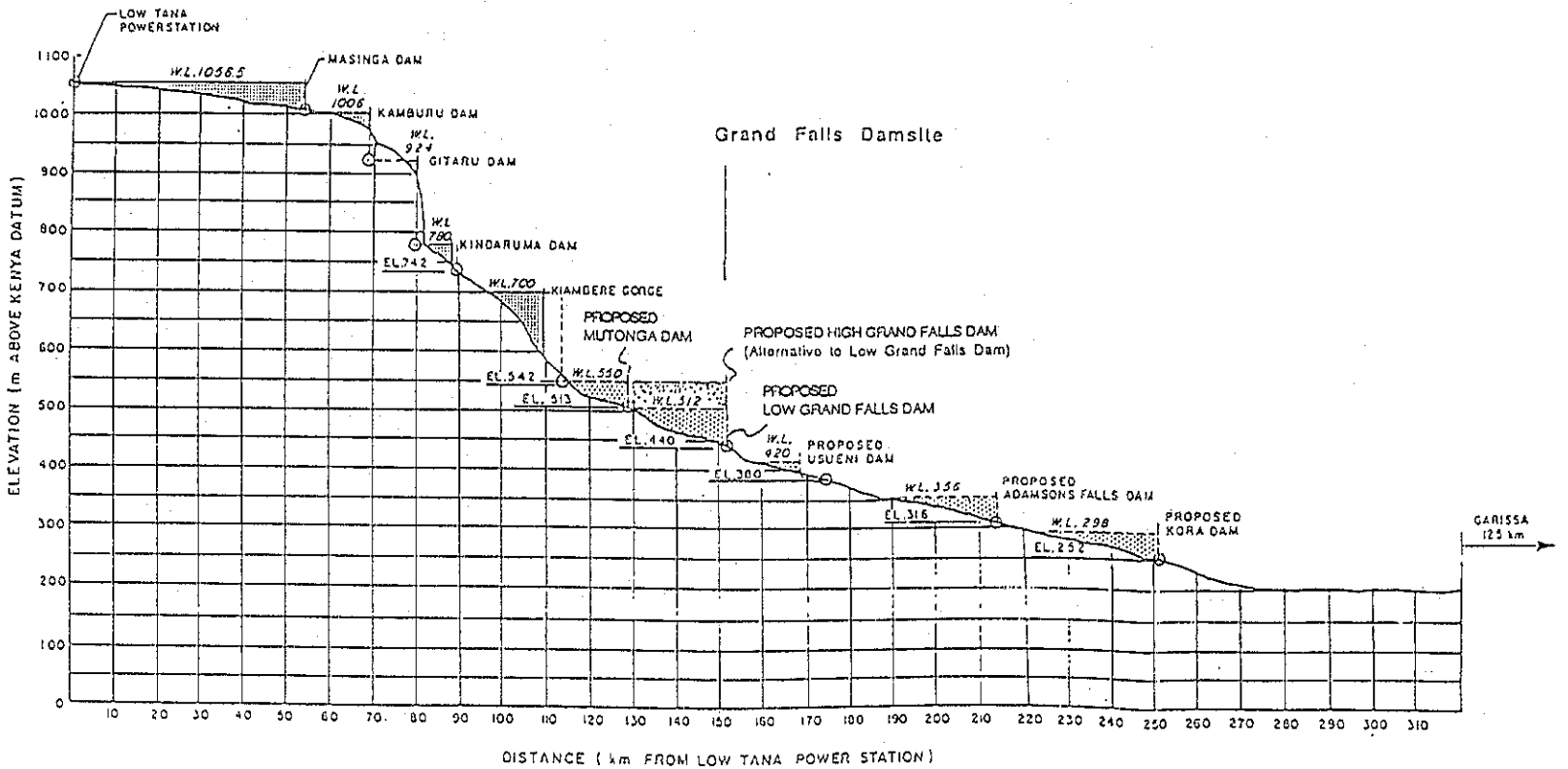


Fig. 4 Tana Hydropower Schemes

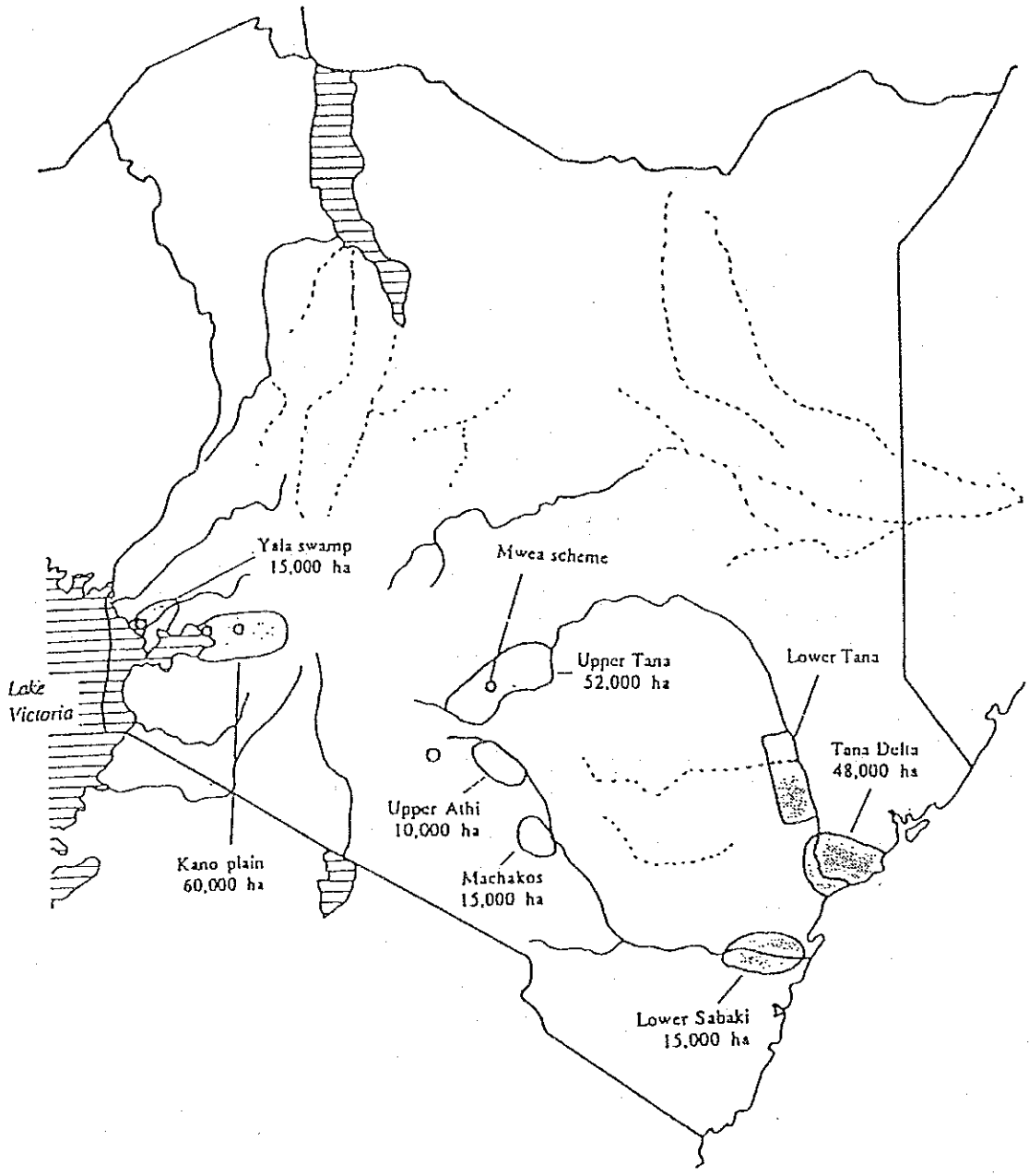


Fig. 5 Potential Irrigation Areas

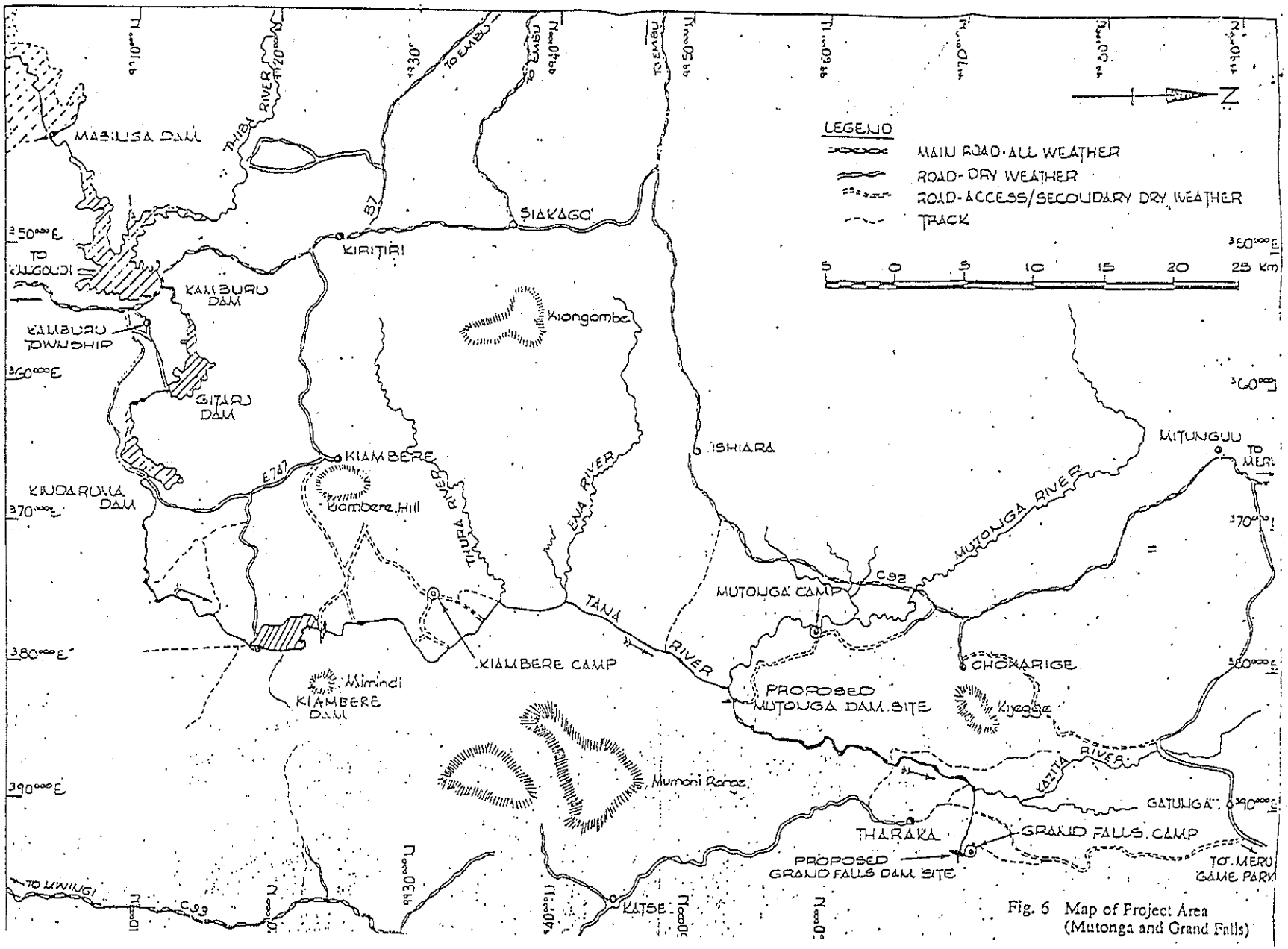


Fig. 6 Map of Project Area (Mutonga and Grand Falls)

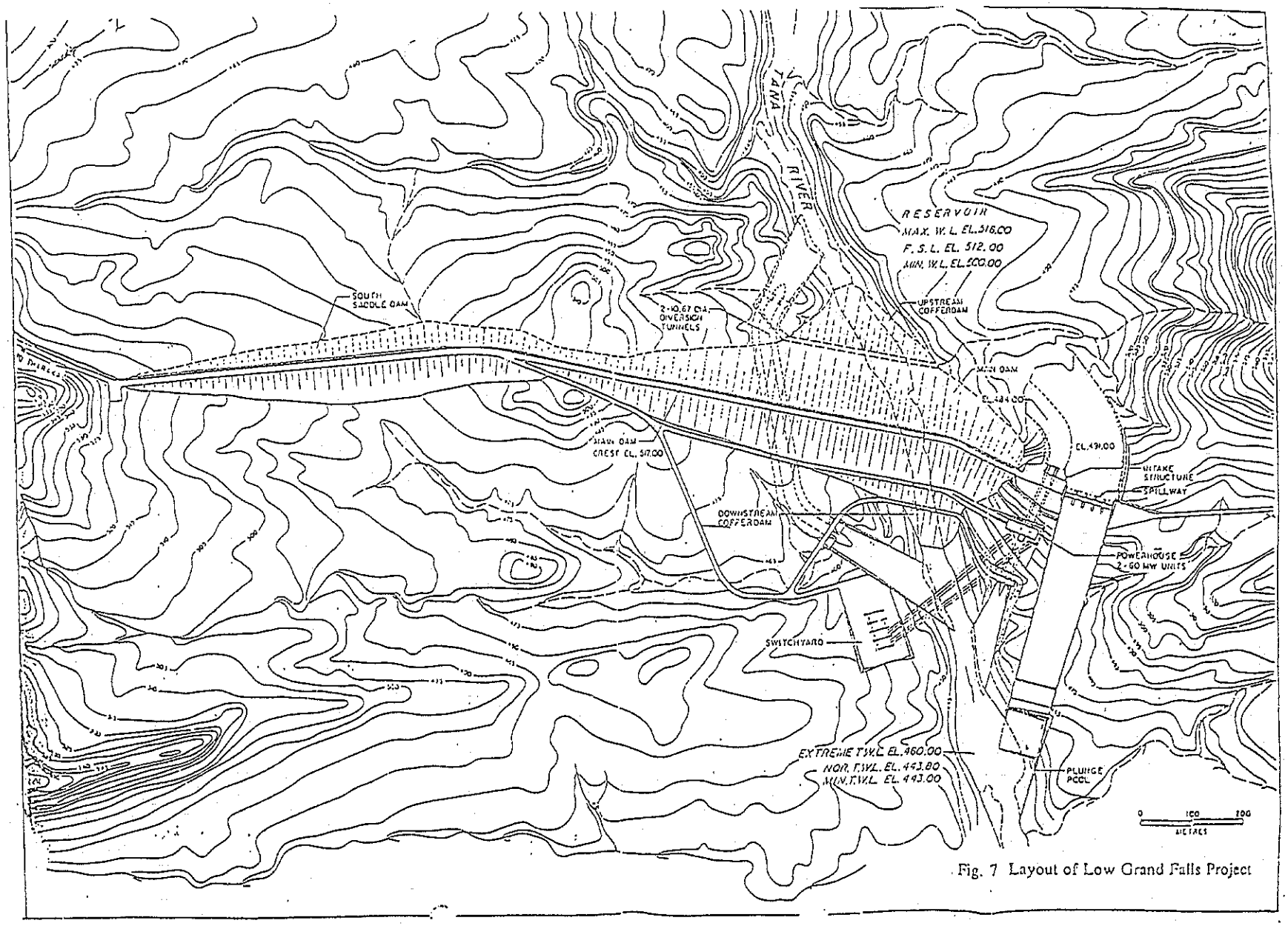


Fig. 7 Layout of Low Grand Falls Project

Appendix A

Terms of Reference

for

Grand Falls Hydropower Project.

Appendix A

TERMS OF REFERENCE
for
GRAND FALLS HYDROPOWER PROJECT

1. Objectives of the Study

The objective of the study is to formulate an optimum development plan of the Grand Falls hydropower project on the Tana River from the technical, economic and environmental viewpoints under the framework of the national power development plan.

During the course of study, it is required for a study team of experts to transfer technical knowledge related to formulating hydropower schemes to the staff and counterpart personnels of the executing agency and the Government.

In order to utilize the limited water resources in the basin most effectively and orderly, the study will be conducted in the following two phases.

Phase 1; Review the hydropower potentials and under-planned schemes on the Tana River located between the existing Kiambere plant and the proposed Grand Falls project site with due consideration to potential irrigation development in the basin, and confirm the higher priority of the Low Grand Falls project (but not always limited to) to other schemes such as Mutonga and High Grand Falls.

Phase 2; Conduct a full-scale feasibility study of the Low Grand Falls project or other priority project, after having confirmed its relative advantage for earlier development.

2. Executing Agency

The executing agency for the study is Kenya Power Company (KPC) under the Ministry of Energy.

Counterpart personnels and logistic supports necessary for the execution of the study will be provided by KPC.

3. Scope of Works

The study will be broadly divided into two stages; Phase 1 as definitive plan study to confirm and select a priority project and Phase 2 as feasibility study for the priority project.

3.1 Phase 1; Definitive Plan Study

(1) Collection and review of existing data and information related to the study, covering topographic maps, meteoro-hydrology, geology and seismology, soils, land uses, power market, socio-economy, previous power/water resources studies and environmental aspects.

(2) Identification of all possible hydropower development potentials downstream of the existing Kiambere project.

(3) Field reconnaissance of the schemes preliminarily evaluated to be prospective, for the purpose of confirming topographic and geological conditions specific to the sites.

(4) Aerial photogrammetric mapping on the proposed Grand Falls and Mutonga reservoir areas and the proposed transmission line route (scale: 1/5,000).

(5) Study on power market data, demand projections, system expansion programs of generating facilities and transmission lines, costs and supply conditions of thermal and geothermal plants, consumption and prices of fuels, and information of macro environment of the power sector in the country, such as reserve capacity, retirement of plant, captive power cost and development possibilities of coal, oil and natural gas.

(6) Review on influence of hydropower development to the existing and under-planned irrigation schemes and identification of promising irrigation schemes, if any, related with the hydropower development.

(7) Evaluation of advantages of the High Grand Falls, the Low Grand Falls and the Mutonpa hydropower projects within the configuration of the national power development plan and determination of priority order of the alternative hydropower schemes.

(8) Preparation of a development scenario of hydropower schemes in the Tana River basin in due consideration to other water use in the basin including irrigation and water supply and selection of a first-priority scheme to be taken up in the subsequent Phase 2 study.

3.2 Phase 2; Feasibility Study

(1) Undertaking of field investigation works, including preparation of technical specifications for the following items which will be let to local investigation firms.

(a) Topographic survey

- 1/1,000 contour map for main structure sites such as dam, spillway, waterway and powerhouse.

- Longitudinal and cross section surveys at damsite and along waterway, including river cross sections at dam and powerhouse sites.

(b) Geological investigation including geological mapping, core drilling, seismic refraction prospecting at main structure sites, rock quarry and other material borrow areas.

(c) Construction material survey including test pitting, trench cut, auger boring, sampling and laboratory test.

(d) Hydrological investigation, including;

- installation/rehabilitation of rain and water level gauges.
- discharge measurement.
- measurement and assessment of sediment inflow into the reservoir.
- sampling and analysis of water quality.

(e) Environmental and sociological survey including the investigation of present natural and social circumstances and environmental aspects in the project area.

(2) Hydrological analysis, including low and high flow analyses, sediment yield estimate, downstream water use for irrigation, flood control effect, reservoir operation study and power and energy output calculation.

(3) Survey of construction cost including availability of labours, materials and equipment in domestic or international construction market, access and transportation, and site conditions of the proposed scheme.

(4) Socio-economic survey including analysis of socio-economic data such as national and regional development plan including agricultural development by irrigation, general economic indicators, population, transportation, etc.

(5) Study on power demand/supply balance and system expansion plan. The study will deal with among others the following:

- power demand projection for the local grid as well as for the national power system.
- role of the proposed scheme in configuration of existing and future power system.
- formulation of power development programs in consideration of other schemes.
- power transmission and substation plan relevant to the proposed scheme.

(6) Plan formulation study of the scheme, paying specific attention to the following:

- selection of least cost layout plan of the proposed scheme through comparison of alternative layout/facility plans, in consideration of potential contribution to irrigation development, if any.
- determination of most economic development scale by adopting two-way approaches; (i) optimization aiming at the best use of site potential and (ii) optimization in terms of achieving the least cost solution in the overall power development program of the regional grid.

(7) Design of main structures and facilities covering civil works, electro-mechanical equipment, transmission line and substation and other associated facilities.

(8) Estimate of construction cost of the scheme, including preliminary study on construction method and schedule.

(9) Economic and financial evaluation of the scheme in due consideration of the most likely least cost alternative thermal/geothermal plant and/or saving in the total system development cost.

(10) Assessment of environmental impact to the project area and the downstream reaches, including influence of reservoir impounding to ecology, resettlement and compensation problems. The study shall identify proper and practical solutions for countermeasures, if necessary.

(11) Preparation of detailed terms of reference for further study on the scheme and recommendation of follow-up action program (project implementation program).

3.3 Transfer of Technology

Throughout the course of the study, transfer of technology and training will be made to the counterpart and personnel of KPC and the Government by the experts in the following field:

- Identification of hydropower sites.
- Planning and execution of field survey and investigation.
- Hydrological study and analysis.
- Hydropower planning and design.
- Preparation and use of computer program.

The above transfer of technology will be carried out in the form of on-the-job training and seminar/workshop during the course of the study. Besides overseas training will be also programmed to have opportunities to see the current practices related to development and operation of hydropower projects.

4. Schedule of the Study and Reports

The total period required for the study will be 18 months as shown in attached figure. (Fig. 1)

During the course of the study, the following reports shall be prepared in English and submitted by the prescribed time after the commencement of study:

	to be submitted by	volume of reports to be submitted
Phase 1:		
Inception report	1st month	20 copies
Progress report (1)	4th month	20 copies
Interim report	8th month	50 copies
Phase 2:		
Progress report (2)	12th month	20 copies
Draft final report	16th month	50 copies
Final report	18th month	50 copies

5. External Input

The executing agency and the government expect that the following inputs will be provided under the technical assistance program of foreign aid agency:

5.1 Expertise input

An appropriate number of experts will be assigned and mobilized to conduct field and home work studies.

Expertise will cover the fields of hydropower planning, dam engineering, soil mechanics, hydraulic and structural design of structures, hydrology, topographic survey, geo-technical engineering, electro-hydromechanical equipment, transmission line and substation, construction planning, socio-economics and environment.

The successful fulfilment of all study activities is presumed to require some 128 man-months of expert assignment excluding local firm's manpower for in-situ field investigation as shown in attached figure (Fig. 2).

5.2 Field Investigation and Equipment Supply

The following field investigation will be carried out by employing local investigation firms under the direct supervision of the study team.

- Aerial photogrammetric shooting and mapping for the project area (map scale 1:5,000)

- Topographic survey at main structure sites (map scale 1:1,000)

- Hydrological measurement and installation

- Geological investigation including geological mapping, core drilling and seismic refraction prospecting

- Construction material survey including sampling and laboratory test

The following equipment will be provided for use in field investigation and in the follow-up monitoring.

- Automatic rain gauge with manual gauge
- Evaporation pan
- Automatic water level gauge
- Current meter
- Sediment sampler
- Echo sounder (to be used in the existing reservoirs)
- Personal computer with printer (min. 3 units)

6. Undertakings of the Executing Agency/Government

In order to effectively facilitate the proposed study, the executing agency or the government will provide the following to the study team.

(1) To select a counterpart group which includes a coordinator responsible for making arrangements for site reconnaissance surveys and resolving any problems that may arise in the survey period.

(2) To provide the study team with arrangements for all the necessary permits and authorizations from the government agencies for clearance through customs, obtaining entry and exit visas, resident permits, domestic travel documents, etc. as required for carrying out the study.

(3) To provide the study team with an appropriate project office in Nairobi, complete with utilities such as electricity, water supply and telephone, furnitures and equipment such as desks, chairs, tables and filing cabinets and janitorial services.

(4) To provide the study team with documents relevant to the study such as reports, maps, drawings and basic data.

Figure 1 WORK SCHEDULE

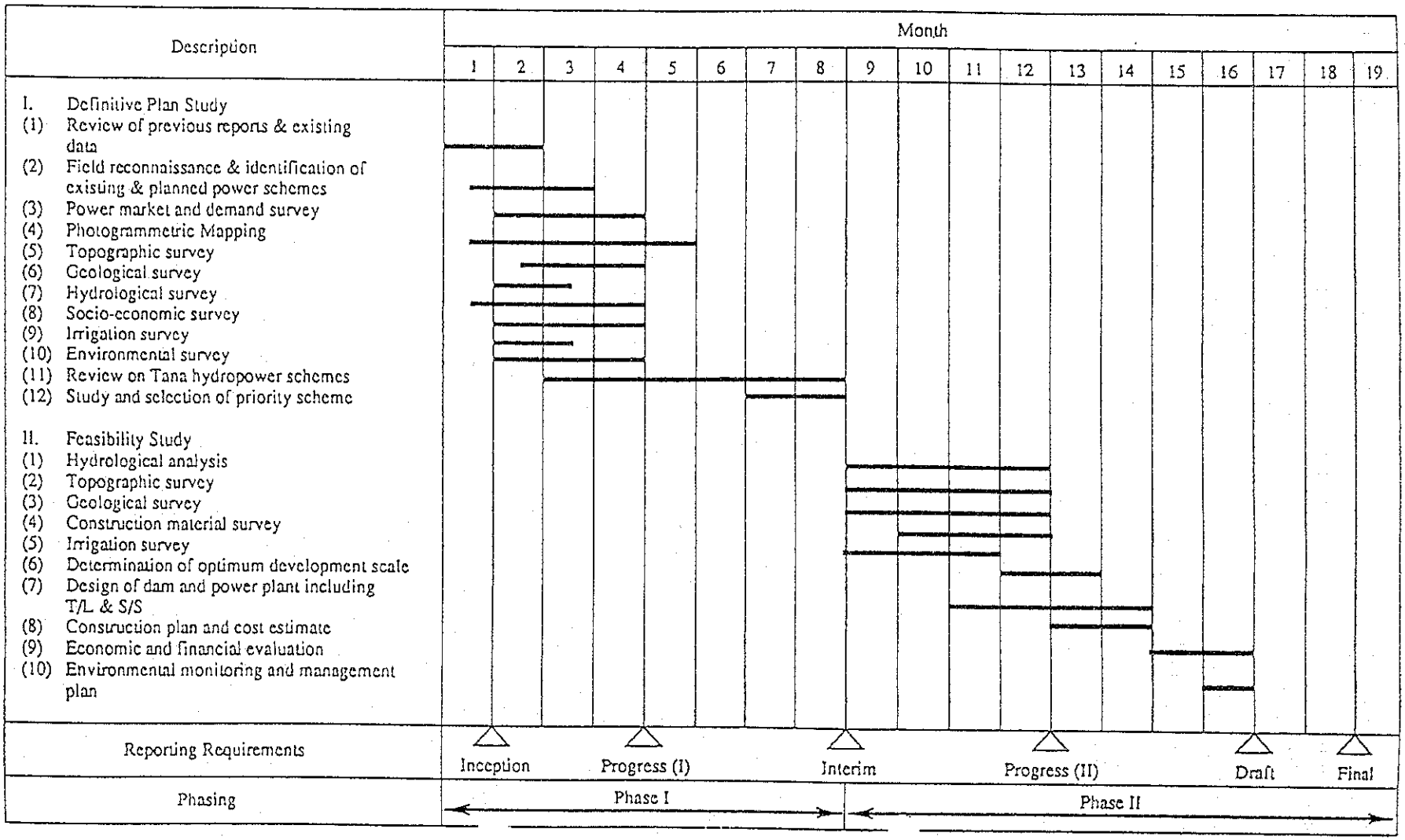


Figure 2 ASSIGNMENT SCHEDULE