

2.4.2. Current Condition of the Proposed Facilities

(1) History of the Kenyatta National Hospital

The forerunner of the hospital was the National Civil Hospital built in 1900. The records show that in 1908, this hospital had 45 beds, 712 in-patients, and 6,425 out-patients. Fifty years ago, in 1939 the hospital added a new hospital wing with 300 beds. In 1953, the surgical wing with 300 beds and the Ismail Rahimtulla wing for Asian patients were built, so that the hospital grew to a scale of approximately 1,000 beds by 1969. In 1951, the hospital changed its name to King George VI Hospital.

In 1964 the hospital was named the Kenyatta National Hospital after the President of the Republic of Kenya. It became the largest general hospital in the country functioning both as a national hospital and as a provincial and a regional hospital for Nairobi area. In 1965, the hospital started to train and teach medical students as a clinical lecturing establishment, followed in December 1965, by the opening of a maternity department and the commencement of training for state-approved midwives. Since 1965, the history of the Kenyatta National Hospital can be summarized as follows:

1964: Being named Kenyatta National Hospital

1965: Taking over the services of the British Military Hospital in Nairobi as the Orthopedic Surgery Department.

1971: Opening of a new general out-patient wing

1972: Opening of a spine lesion wing

1981: Opening of a new wing (the Tower Block) with 1,200 beds.
(The combined total of the old and new wings add up to 2,000 beds.)

1990: Start of the Rehabilitation by the World Bank.

(2) Overview of the Management of the Kenyatta National Hospital

The Kenyatta National Hospital is managed under the direct

control of the Ministry of Health, with a Board of Management being appointed in the hospital to take all management decisions as the supreme decision-making body. In principle, medical care services are provided free of charge. In practice, however, charges are imposed only on patients with the means to pay for out-patient treatment, radiology examination, clinical examination, and childbirth. Compared with the charges imposed on patients by the private medical care establishments, however, these rates are very low, so that a large proportion of the management costs of the Kenyatta National Hospital are defrayed from the national budget.

1) Number of Beds

The hospital has 1,928 beds as of 1991. Fig. 2 - 21 gives a breakdown of this bed availability.

Table 2-21 Bed Capacity of KNH

Pediatrics ward	176beds	Prison ward	195beds
Internal ward	200	Burns unit	19
Surgical ward	351	Infections disease ward	247
Rahimtulla ward	83	Orthopedic unit	120
Casualty ward	15	Maternity unit	236
Recovery ward	90	Others	174
Intensive care ward	22	Total	1,928beds

Source : MOH

2) Departments in the Hospital

At present, the hospital has 16 departments and special departments.

General Medical Departments:

Department of internal medicine, Department of dermatology, Department of psychiatry, Department of neurosurgery, Department of cardiac surgery, Department of plastic surgery, Department of obstetrics and gynecology, Department of ophthalmology, Dental

department, Department of Otorhinolaryngology, Department of orthopedics, Department of urology, Department of anesthesiology, Department of pediatrics and radiotherapy, others

Special Department:

Renal dialysis, intensive care, infectious diseases, burns, family planning, speech therapy, counselling on cardiac diseases, others

3) Medical Staff

The hospital has a total staff of some 3,100 as of 1990. This includes 155 doctors and 981 nurses. The hospital has one doctor for 590 in-patients and one doctor for 4,700 out-patients. Table 3-7 of the next chapter gives a breakdown of the hospital staff.

4) State of Services

The general service level of the hospital can be seen from the changes in out-patient number (Table 2-22), the number of x-ray examinations (Table 2-23), the number of clinical-pathological examinations, and the number of operations performed (Table 2-25) over a period of three years in the past. These statistics seem to indicate that the number of patients is decreasing year by year. In reality, however, the hospital is faced with the problems of a significant decline in its patient-handling capacity as a result of a weakening of its medical service capability due to shortage of medical equipment and treatment facilities and appliances.

Table 2-22 Trend of Out Patient

	1989	1990	1991
No. of out patient(day)	3,086.2	2,629.4	2,606.9
New attd. (year)	391,328	329,238	314,182
Re-attd. (year)	377,130	325,489	334,924
Total	768,458	654,727	649,106

Source : MOH

Table 2-23 Number of X-ray Exam.

	1989	1990	1991
X-ray exam.	70,283	49,091	41,240

Source : MOH

Table 2-24 Number of Clinical Pathology Exam.

	1989	1990	1991
Clinical pathology exam.	187,233	183,914	150,947

Source : MOH

Table 2-25 Number of Operation in the Past 3 Years

	1989	1990	1991
Major operation	3,652	3,146	2,139
Caesarean operation	1,395	1,304	1,427
Minor operation(hospital patient)	18,018	4,854	2,715
Minor operation(out patient)	10,781	10,378	4,451
Total	33,846	19,682	10,732

Source : MOH

(3) Budget and Expenditure of the Kenyatta National Hospital

In terms of its budget allocation, the Kenyatta National Hospital is awarded allocation by the Ministry of Health to cover its recurrent costs in accordance with the hospital's actual results, its revenue and expenditures. This dependence for funding on the Ministry of Health is due to the fact that the Kenyatta National Hospital is placed under the jurisdiction of the Ministry of Health as one of the Ministry's departments. As a result, the Kenyatta National Hospital is directly affected in its budget allocation by budget reductions made by central government. Table 2 - 26 gives the latest planned and actual revenue and expenditure data for the Kenyatta National Hospital. Recently, actual government spending has fallen short of the previous year as a result of financial constraints. By way of imposing a fee system for new out-patients clinical examinations etc. and expanding this charge system, however, the Hospital has been able to increase its revenues and curb its deficit. According to calculations made by the USAID, however, the revenue from such charges will not bring in more than about 16% of all of the hospital's expenditures even if an extension of the

revenue by the chargeable service system is anticipated. The Hospital will thus remain in deficit.

Table 2-26 Forward Budget, Actual Budget and Total Expenditure for KNH (1988~1990)

(Unit : Kenyan pound)

		1987/88	1988/89	Growth rate to last year (%)	1989/90	Growth rate to last year (%)	1990/91	Growth rate to last year (%)
FORWARD BUDGET	GROSS	12,055,300	12,876,557	+ 6.8	15,314,059	+18.9	17,500,000	+14.2
	A. I. A.	516,300	591,900	+14.6	1,997,000	+237.3	4,131,102	+106.8
	NET	11,539,000	12,284,567	+ 6.5	13,317,059	+ 8.4	13,368,898	+0.4
APPROVED ESTIMATES	GROSS	12,905,300	12,406,509	- 3.9	15,314,059	+23.4	17,000,000	+11.0
	A. I. A.	516,100	591,900	+14.7	2,297,000	+288.1	2,352,000	+2.4
	NET	12,389,200	11,814,609	-4.6	13,017,059	+10.2	14,648,000	+12.5
ACTUAL RECEIPTS OF GRANT AND OTHER RECEIPTS	NET	12,744,018	12,537,900	-1.7	12,209,960	-2.6	12,180,574	-0.2
	A. I. A.	420,237	535,315	+27.4	946,717	+76.8	816,307	-13.8
	GROSS	12,389,781	12,002,585	-3.1	11,263,243	-6.1	11,319,267	+0.5
TOTAL EXPENDITURE		13,593,318	15,037,752	+10.6	14,068,244	-6.4	18,085,214	+28.5
UNSETTLED EXPENDITURE		849,300	2,499,852		1,858,284		5,904,640	

Source: MOH

Table 2-27 gives the detailed accounts for the expenditure items recorded for the three year period from 1988 through 1990. As of 1990, the costs for the purchase of new medical equipment are extremely low, amounting to only 0.03% of the total budget. Virtually the entire budget is spent on general cost items such as personnel costs. Only about 1.4% of the total budget, that is, 4 million Kenyan shillings (approximately 16.6 million yen) is assigned for maintenance engineering, and practically all of these funds are spent on ancillary equipment such as boiler and generator etc., while only a very small amount is spent on medical equipment maintenance.

Table 2-27 Kenyatta National Hospital Income and Expenditure Account
for the Year Ended 1989 and 1990

		(K. shs.)		
		1988	1989	1990
INCOME	Grands	244,095,614	232,619,840	219,125,291
	Apropriation In Aid (AIA)	8,404,614	10,706,307	18,934,348
	Transfer from Heart Fund	—	6,636,419	517,993
TOTAL INCOME		252,500,228	249,962,566	238,577,632
	Personnel emoluments	126,273,880	141,062,339	125,334,461
	Granuity and pensions	12,257,672	6,214,279	7,166,606
	House allowance	16,521,660	14,225,528	13,335,813
	Other allowances	3,811,040	2,297	34,476
	Passage and leave	604,000	511,862	939,611
	Transport operating	1,367,760	1,261,888	1,301,514
	Travelling and accommodation	689,980	549,401	263,870
	Postal and telegram	5,040	29,793	*
	Telephones	2,838,944	4,619,644	3,640,341
	Board and entertainment	84,300	51,303	44,166
	Electricity, water and conservancy	20,764,396	31,932,975	17,544,642
	Materials for production	776,120	1,128,150	2,225,598
	Drugs and dressings	31,111,053	40,001,432	50,859,198
	Materials for specialised units	14,331,229	3,444,228	3,453,337
	X-ray supplies	1,172,540	1,527,067	1,338,478
	Patients' food	12,650,520	12,675,928	12,350,183
	Doctors' and nurses' food	1,256,780	1,955,630	2,046,605
	Senior staff canteen	289,380	319,965	479,191
	Cleaning materials	1,310,512	1,054,694	737,503
	Uniform and clothing	3,917,900	1,501,404	1,317,940
	Library	1,500	4,300	—
	Stationery	979,247	1,471,488	2,061,107
	Advertising and publicity	54,820	60,344	195,782
	Rent and rates	5,627,080	7,263,364	12,753,501
	Professional services	16,740	31,511	—
	Hire of machinery and transport	24,840	58,135	—
	Miscellaneous	401,536	275,320	543,982
	Staff development	106,960	380,300	995,674
	Maintenance of buildings	244,380	2,654,208	2,849,061
	Local seminars	406,980	81,926	107,300
	Medical	82,300	429,256	85,264
	Maintenance of plant and machinery	5,118,235	3,990,670	4,059,833
	Road works	142,240	—	—
	Fuel and gases	—	10,944,280	10,410,477
	Doubtful debts provision	—	94,243	14,506
	Bank charges	—	8,879	38,996
ACTUAL EXPENDITURE		265,241,564	291,818,031	278,529,016
EXCESS OF EXPENDITURE OVER INCOME		(12,741,336)	(41,855,465)	(39,951,384)

Source : MOH

(4) Outline of the Kenyatta National Hospital

1) Overview of the activities

Table 2-28 Overview of the Activities of the Kenyatta National Hospital

1. Level (Ranking)				
As the only general hospital in Kenya, the Kenyatta National Hospital is the top referral institution in the country. It also functions as a regional hospital for Nairobi city, and its scope ranges from primary to tertiary service. It also functions as a teaching institution for the Nairobi University's School of Medicine.				
2. Beneficiary population (Metropolitan population)				
The Nairobi metropolitan area has a population of 1,429,000. Since the hospital is also the country's top referral institution, it indirectly has a population of 23.9 million people (total population of Kenya) benefiting from its services.				
3. No. of out-patients		1989	1990	1991
Out-patient attendance(No.of persons)		768,500	654,700	649,100
Average number of outpatients per day		3,100	2,600	2,600
4. Number of beds				
Approximately 2,000 (1928 beds as of 1989)				
<ul style="list-style-type: none"> • Main wing (Tower Block and other general wings) 1,300 • Infectious diseases hospital wing (IDH) - 273 • Orthopedic ward (KABETE) - 120 • Islaim Rahimtulla ward - 39 • Prisoner ward - 195 • King George ward - 44 				
5. In-patient statistics (1989 - 90)				
	1989	1988	1989	1990
No. of beds	1,928	1,928	1,928	1,860
No. of in-patients	68,598	40,111	76,334	68,508
Discharged patients	56,118	66,449	69,835	66,508
Death	3,938	3,656	3,556	3,951
No. of days of bed occupancy	568,074	630,516	662,392	591,251
Bed occupancy rate (%)	85	96	100.3	87

6. No. of medical staff (As of 1989)	
Overall number of hospital personnel	
Doctors	155
Nurses	981
Office staff	377
Paramedical staff	535
Maintenance engineers	156
Other hospital employees	922
--- Total 3,126	
7. State of diagnostic and treatment services	
• Number of departments (16)	
General Medical Departments:	
Department of internal medicine, Department of dermatology, Department of psychiatry, Department of neurosurgery, Department of cardiac surgery, Department of plastic surgery, Department of obstetrics and gynecology, Department of ophthalmology, Dental department, Department of Otorhinolaryngology, Department of orthopedics, Department of urology, Department of anesthesiology, Department of pediatrics and radiotherapy, others	
Special Department: Renal dialysis, intensive care, infectious diseases, burns, family planning, speech therapy, counselling on cardiac diseases, others	
8. Main diseases treated (Top five)	
Nairobi Metropolitan Area	Kenya as a Whole
1. Respiratory organ diseases	1. Malaria
2. Malaria	2. Respiratory organ diseases
3. Diarrheal diseases	3. Skin diseases
4. Parasitic infections	4. Parasitic infections
5. Skin diseases	5. Diarrheal diseases

2) Present condition of the facilities of KNH

KNH receives about 2,600 out-patients per day from various parts of the country as the top referral hospital in Kenya and the principle hospital in Nairobi metropolitan area.

This hospital has reached present scale by way of repeating the expansions and reconstructions since its establishment in 1939. However, the operation of the hospital is compelled to be uneconomical and inefficient due to being not functional layout of the facilities which were added one after another without paying due consideration to the convenience of medical activities.

The patient ward of eleven storied building constructed in 1981 was designed taking consideration of the relation with the radiation diagnosis department of casualty, the department of operation theater and CSSD. Although this building is comparatively new, more than ten years has passed since its

construction and leakage of water pipes, leakage of high pressure steam, cutting of electric wiring, cracks on ceiling and concrete wall are observed. Therefore emergent repairs are being desired.

(5) Present Condition of Medical Equipment at KNH

The present condition of the equipment can be described as below. For fuller details, Appendix 6 gives an account of the present equipment availabilities and their utilization levels in a listing entitled "Main Equipment Available and Its Utilization."

- 1) In the mid-1970s, the Kenyatta National Hospital completed its function as Kenya's only general hospital with a comprehensive range of medical equipment being installed for this purpose. It was at that time equipped with all facilities essential for offering diagnostic and therapeutic services. Yet, all of the hospital's equipment was introduced prior to the 1980s so that these equipment are now 10 or 20 years old. Problems also exist in connection with the maintenance of the equipment, as many of the units have broken down or are defective requiring either replacement or renewal. The construction after 1985 of the new hospital wing has increased the scale of the hospital to a 2,000 bed outfit so that the equipment available is inadequate in quantitative terms.
- 2) Up to the latter part of the 1970s, the Kenyatta National Hospital had purchased medical equipment with its own budget resources, and thereafter new acquisitions were made with an aid from the western countries (mainly the United Kingdom and the Netherlands). Japan extended, in the period from 1970 to 1978, technical cooperation on a project basis, including the supply of equipment associated with intensive care unit and cardiac surgery department.
- 3) The maintenance of medical equipment at the Kenyatta National Hospital is handled internally by the Biomedical Engineering

Services. Faced with the problems of inadequate manpower and budgetary resources and a lack of consistent organization of the management system, this Engineering Services has not been able to fully develop its activities and functions. The maintenance of the sophisticated equipment with built-in electronic circuit has been a particular problem. Among the present Rehabilitation Project implemented through the cooperation of the World Bank the amelioration of the maintenance system has been a major theme. Efforts are now being made to create an effective maintenance system not only for the medical equipment but for the hospital facilities as a whole.

- 4) Since the early half of the 1980s, the budget of the Ministry of Health has been curtailed. This has adversely affected the Kenyatta National Hospital to an extent that it is now having difficulty in paying the costs for the upkeep and maintenance of hospital equipment and for the acquisition of new medical equipment. As a result, the existing equipment at the hospital have become obsolete and have deteriorated to an extent that the Kenyatta National Hospital has prevented from playing its role as a general hospital offering a comprehensive medical service and as a teaching hospital. In 1990, the Kenyan government, with intention of a fundamental improvement of the situation, asked the cooperation of the World Bank which initiated the present Rehabilitation Project, and also made the request to the Japanese government for the procurement of medical equipment under the grant aid assistance.

(6) Current Situation of Main Departments of KNH and their Existing Equipment

1) Radiation Therapy Department

The Department handles a total of approx. 13,000 cases a year. with approx. 1,600 new patients every year. There is currently a very long waiting list of patients.

Equipment such as Cobalt 60 radiation unit, intracavity machine,

and superficial x-ray machine are being used to perform radiation therapy treatment. The number of equipment units is desparately short in view of the long waiting list of patients.

Description of equipment currently installed:

Cobalt 60 radiation unit, remote after loading intracravity machine, x-ray simulator, x-ray equipment, anesthetia machine, patient monitors, and other equipment

In association with this department, there is also a radiation diagnosis department at the Kenyatta National Hospital. As an integral part of the Sixth Five-Year Plan for the Refurbishing and Upgrading of the Kenyatta National Hospital, the Dutch government has extended its cooperation to provide practically all new x-ray equipment. The main equipment currently installed in the radiation diagnosis department includes:

- | | |
|--|---------|
| 1. Vertical bucky stand (for emergencies) | 1 unit |
| 2. Ceiling-mounted x-ray unit | 2 units |
| 3. Mobile x-ray unit | 2 units |
| 4. Urological x-ray equipment | 2 units |
| 5. Bucky table (For head) | 1 unit |
| 6. Ceiling-mounted x-ray unit | 2 units |
| 7. Mammographic x-ray system | 1 unit |
| 8. Ultrasound scanner | 2 units |
| 9. CT scanner (Due to be installed) | 1 unit |
| 10. Automatic x-ray film processor | 1 unit |
| 11. Remote control fluoroscopic imaging unit | 4 units |
| 12. Ultrasound sector scanner | 1 unit |
| 13. Coronary angiography system | 1 unit |

(Overhead gantry x-ray tube, 9/6 inch II tube, film changer, cinecamera, etc. - 2 sets)

2) Laboratory

This Department consists of nine units (Pathological chemistry, hematology, microbiology, histology, cytology, immunology, general (out-patient/casualty) examination,

dialysis, intensive care, and examination room for infectious diseases). This Department is used as a teaching facility for the students of the School of Medicine of Nairobi University. It is an extremely large organization with a total personnel of some 250 (31 consultants, 150 examining physicians, etc.) Each unit has its own rooms. The measuring equipment and appliances for conducting the examinations concerned are available, though most of them are old models and many of them cannot be repaired.

Descriptions of existing equipment:

Flame photometers, blood cell counters, microscopes, clinical chemistry analyzers, incubator, centrifuge, spectrophotometers, refrigeration cupboards, hot air oven, automatic balances, microtome, electrophoresis, etc,

3) Department of operation theater

This Department has 12 main theaters in the surgery wing and two further operating theaters in the casualty department as well as two operating theaters in the Maternity Department. It thus has 19 theaters under its control.

The surgery wing (12 theaters) is located on the second floor of the Tower Block and was equipped with all basic facilities at the time of construction. At present, however, most of the equipment is not in proper functional order. The two operating theaters in the casualty department has no equipment in a satisfactory condition for use.

Description of available equipment:

Operating table, operating room lamps, anesthetic machine, electrosurgical unit, mechanical tables, surgical microscopes, suction unit, etc.

4) TSSU

4) TSSU

This department is responsible for sterilizing and disinfecting the surgical instruments supplied to the Department of Operation theater. Both the autoclave and the ultrasound washer are prone to be out so that manual disinfection is necessary in small lots. This makes it impossible to supply sterilized surgical instruments for surgery in the large quantities required.

Description of available equipment:

Washer for surgical gloves, autoclave, ovens, etc.

5) CSSD

This department is responsible for sterilization of the materials/instruments used in the patient ward and the casualty department. For the large-scale Kenyatta National Hospital with 2,000 beds, and an out-patient number of 2,500 people/day (new and re-examining patients) (some 800,000 people a year, as of 1989), the present equipment availability is very inadequate in both qualitative and quantitative terms. The autoclave, in particular, tend to break down frequently and therefore their replacement is an urgent need.

Description of available equipment:

Washer for surgical gloves, hot air oven (large and medium types), etc.

6) Intensive Care Unit

At present, the unit has 11 beds for intensive care treatment. There are also isolation bed rooms for infectious diseases. When this Unit was established in the period from 1970 - 1978, Japan provided technical cooperation on a project basis and supplied some of the equipment in conjunction with medical cooperation. These equipment have already finished their service life and under unserviceable condition.

Description of available equipment:

Respirators, bed side monitors, electrocardiograph, monitors (ECG), Defibrillators , etc.

7) E.C.G./Cardiology

With a little under 8,000 patients a year, this is the only facility in Kenya with surgeons capable of performing heart surgery. The hospital has the necessary equipment. At present, there is a Phillips angiocardiology system. This unit was acquired in 1975 and is now 17 years old. It has lost its functional capability to a significant extent and makes it impossible to obtain an accurate diagnosis. All the equipment including the ancillary units, are old type and now it is difficult to conduct proper maintenance and repair.

Description of available equipment:

Angiocardiology system, contrast medium injector, ultrasound scanner, cardiac load measuring unit, electrocardiogram, Defibrillator, respirator, etc.

8) Renal Department

This is the only state hospital in the whole of Kenya offering hemodialysis treatment for patients with renal failure at present. This Department also handles acute renal failure cases, with onset due to a variety of causal factors such as general renal disorders or diseases of the urinary organs. There is an large number of patients waiting for treatment by hemodialysis or peritoneal dialysis. At present, only eight of the dialysis machines can be used. This number is too small to accommodate all patients. A total of seven dialysis machines have broken down and cannot be used. Their urgent repair is of the greatest importance, although the machines are too old to be repaired.

Description of available equipment:

Hemodialysis machines, water purified unit, etc.

9) Biomedical Engineering Services

With staffs of 14, it has a main workshop of 70 square meter size, as well as sub-workshops in the Intensive Care Unit, the Renal Unit, and the Dentistry Department. It is responsible for the maintenance as well as the repair of the hospital equipments of all departments. At present, its repair activities is limited to simple electrical and mechanical faults. Due to the lack of measuring equipment and repair tools it is not in a position to discharge its role as a general repair and maintenance system for medical equipment in general. For repairing electronic and large equipment, the repair needs are met by concluding direct maintenance contracts with the equipment manufacturers. Due to the lack of funds, however, most equipment are not covered by maintenance contracts. The importance of the problem of equipment maintenance has been recognized and is being emphasized by the World Bank in its current Rehabilitation Project. It is seen as essential to create new systems on a broader scale, improve workshops, acquire equipment and tools for carrying out maintenance and supervision tasks, establish an equipment maintenance system capable of ensuring daily inspection and periodical checks and to provide a system of assigning responsibility for maintenance with a clear definition of the scope of responsibility of the engineers in the hospital.

Description of available equipment:

Grinders, vices, soldering irons, general tools, oscilloscopes, testers, generators, etc.

10) Casualty Department

As Kenya's only public general hospital, the Kenyatta National Hospital is the top-referral institution in the country, attracting referral patients from all parts of Kenya. While the hospital is functionally equipped for this purpose, the number of out-patients is so large that it reaches some 800,000 a year or

roughly 2,600 a day. It is equipped with six examination rooms, four emergency resuscitating units, two operating theaters, and recovery rooms. To handle the large number of patients, there are 27 doctors, 61 nurses, 7 doctor's assistant working 24 hours in three shifts. It suffers from a practically total absence of defibrillators, electrocardiogram monitors, oxymeters, and stretchers, necessary for the treatment of emergency cases. Nor are the medical equipment in general in serviceable condition.

Description of available equipment:

Sphygmomanometers, suction unit, mechanical tables, operating table, anesthetia apparatus, etc.

(7) Current Condition of the Building and Facilities of KNH

1) Building

The Kenyatta National Hospital can be broadly divided into the General Hospital Block (1,694 beds) and the Infectious Diseases Hospital (IDH, 234 beds) built on a different plot.

The General Hospital Block consists mainly of the 11-floor building completed in 1981. In addition to this new hospital building there are some older wings.

The new high-rise steel-reinforced concrete building has 11 floors designed on a multi-wing block plan. It has a number of adjoining low-rise units housing the various departments and the out-patient department. The building and its facilities are now 15 - 30 years old since they were built, During these years, no adequate provisions for the maintenance has been taken so that signs of aging, deterioration, and decay are in evidence everywhere. Under these conditions, plans were made in 1990 to repair the Kenyatta National Hospital. This plan has been and is being implemented under the present Rehabilitation Project of the World Bank.

Table 2-29 gives an overview of the present condition of the buildings and facilities.

Table 2-29 Current Conditions of Buildings and Facilities of the
Hospital Departments

1. Radiation Therapy Department	
Year when built (Position) : 1950 (Within the King George Hospital)	
Structure, Number of floors, Floor area: Stretcher-bond brick building, 3 floors, 1,597 sq.m.	
Installations, fixtures: Cobalt 60 radiation room, Simulator room, x-ray therapy room, waiting room, library room, office room, wards, etc.	
General Condition of installations: Old complex built in the early 1950s, of sound construction, equipped with central system medical piping and in perfect functional order. The cobalt 60 radiation room needed radioactive screening which was later added in the early 1980s.	
Installations, including air-conditioning system, lighting, medical gases, medical piping, : Fan (suction fan) system (Cobalt 60 radiation room) Central gas pipe system (Treatment room, radiation room) - Medical piping (Vacuum suction, oxygen) - Operating room lamps (Treatment rooms) -- Lighting (Fluorescent strip lighting in the rooms and spot lights) -- Elevators (2 elevators: one for personal and one for goods transport)	
2. Laboratory Department	
Year when built (Position): 1970 (Located at one end of the Nairobi University's Medical Department)	
Structure, Number of floors, Floor area: Steelframe, steel-reinforced concrete structure, 2 floors. 3,600 sq.m	

<p>Installations, fixtures:</p> <p>Pathochemical Examination Room, hematological examination room, microbiological examination room, histological/cytological examination room, immunological examination room, etc.</p> <p>Note: The examination rooms for the casualty department, the intensive care unit, the hemodialysis section, and the infectious diseases department all have their own clinical sections.</p>	
<p>General Condition of installations:</p> <p>This complex is the clinical examination facility of the Nairobi University's School of Medicine. It is the nucleus of Kenya's medical examination facilities. Currently available equipment was all acquired before 1980 and is now obsolete in its entirety. Requests for the installation of advanced testing equipment have been made by the Nairobi University. However, the present facility has so badly deteriorated with age that improvement work is necessary to refurbish the building and the equipment.</p>	
<p>Installations, including air-conditioning system, lighting, medical gases, medical piping,:</p> <p>Natural lighting (Large windows for good daylight brightness)</p> <p>Exhaust fans (Natural evacuation , except for draught chamber)</p>	
<p>No special air-conditioning and exhaust fan systems installed.</p> <p>Hot water supply and steam pipe for sterilization available.</p> <p>(At present, the pipework is defective and erosion is in evidence on the walls.)</p>	
3. Operation theater	
<p>Year when built (Position):</p> <p>1953 and 1981 (High-rise hospital block and low-rise surgical block)</p>	
<p>Structure, Number of floors, Floor area:</p> <p>Steel-frame, steel-reinforced concrete structure, second floor of two-floor building, 3,093 sq.m.</p>	

Installations, fixtures:

12 operating theaters

General acute diseases operating theaters (4), gynecology op. theaters (2), plastic and orthopedic surgery (2 theaters), heart surgery (1 theater), pediatric surgery (1 theater), ENT surgery (1 theater), brain surgery/ophthalmic surgery (1 theater)

General Condition of installations:

All operating theaters have a sufficiently spacious floor area. Scrubbing and cleaning rooms and an anteroom form a module for every four operating theaters. This is an ideal arrangement. Adequate allowance has also been made in the layout for liaison and contact with the surgical instruments supply section. The roof showed signs of leaking, but is generally in good conditions

Installations, including air-conditioning system, lighting, medical gases, medical piping.:

Lighting (operating room lighting)

Medical piping (Medical gases, vacuum aspiration)

Air-conditioning system (Installed in the entire surgery wing)

Emergency standby power (battery type)

Elevators for transporting materials

4. TSSU - CSSD

Year when built (Position): 1981 (Adjacent to high-rise block)

Structure, Number of floors, Floor area:

Steel-frame, steel-reinforced concrete structure, first floor of two-floor building, 2,096 sq.m.

Installations, fixtures:

Preliminary washing room, anteroom, disinfecting/sterilizing room, surgical glove sterilizing room, packaging room, sterilized materials storage room, office, etc.

General Condition of installations:

In this hospital, sterilized materials are supplied to the surgical and other departments on the basis of a clear differentiation. Since materials for the same type of facilities are stored side by side, this supply store is of relatively large proportions. Poor maintenance of autoclave equipment, with frequent breakdowns.

Water supply and sewage, as well as steam supply pipework has aged and is in a state of poor repair. The lamps on electrical equipment are mostly not working.

Installations, including air-conditioning system, lighting, medical gases, medical piping,:

Steam pipe (4 autoclave) Autoclaves (Desk top-type sterilizers - 3 units) - Dry sterilizer (Electric dry sterilizer units - 3) , ultrasonic cleaners, etc.

5. Intensive Care Unit

Year when built (Position):

1981 (Low-rise wing on south side of high-rise hospital block)

Structure, Number of floors, Floor area:

Steel-frame, steel-reinforced concrete structure, second floor, 980 sq.m.

Installations, fixtures:

Pathological examination/test room, office, disinfecting room, private (payable) ward, general treatment room, office room, etc.

General Condition of installations:

At present, there are 11 intensive care beds in the ICU, and these are occupied at a high rate. Normally beds are short. There are also two private wards available on a fee basis. Medical pipework is in correct functional order, but patient monitoring equipment is desperately inadequate.

<p>Installations, including air-conditioning system, lighting, medical gases, medical piping.:</p> <p>Medical gas pipework (Laid underneath the window along each bed). No particular air-conditioning and exhaust fan systems installed.</p>	
6. E.C.G./cardiology	
<p>Year when built (Position):</p> <p>1981 (Low-rise wing on east side of high-rise hospital block)</p>	
<p>Structure, Number of floors, Floor area:</p> <p>Steel-frame, steel-reinforced concrete structure, second floor of two-floor building, 793 sq.m.</p>	
<p>Installations, fixtures:</p> <p>Diagnosis rooms (2), pathological examination/test room, diagnosis room with cardiovascular imaging unit, dark room, motor function measuring room, office room, etc.</p>	
<p>General Condition of installations:</p> <p>Structurally, the building is in good condition. This includes the steel-frame steel-reinforced concrete and the frame structure. In the planar view, a center box-type window ensures good daylight and makes the entire wing bright during the day. Apart from the deterioration of the angiocardiology system unit, the facility as such is still in satisfactory functional order.</p>	
<p>Installations, including air-conditioning system, lighting, medical gases, medical piping.:</p> <p>Air-conditioning equipment is installed (in the catheter examining room).</p>	
7. Renal	
<p>Year when built (Position):</p> <p>1981 (Low-rise wing on south side of intensive care unit)</p>	
<p>Structure, Number of floors, Floor area:</p> <p>Steel-frame, steel-reinforced concrete structure, two floors, and partly third floor , 606 sq.m.</p>	

<p>Installations, fixtures:</p> <p>1st floor: Physicians' rooms (9), seminar room, renal examination room, store</p> <p>2nd floor: General wards (2 wards with 12 beds each), isolation wards, nurse station, pantry</p> <p>3rd floor: Renal dialysis grade water purified unit</p>	
<p>General Condition of installations:</p> <p>Dialysis machine, spaces has a maximum capacity for installing 21 machines. At present, only eight dialysis machines are operational. The hospital is therefore forced to select and shortlist patients from a very large queue.</p> <p>Shortage of dialysis machines poses a serious problem, and additional machines are very much needed.</p>	
<p>Installations, including air-conditioning system, lighting, medical gases, medical piping.:</p> <p>Water purified generating units (including pipework for feeding the pure water to the dialysis wards) are installed.</p> <p>No air-conditioning systems</p>	
8. Biomedical Engineering Services	
<p>Year when built (Position):</p> <p>1950 (At one end of the King George Hospital)</p>	
<p>Structure, Number of floors, Floor area:</p> <p>Stretcher-bond brick construction, flat roof building. 100 sq.m</p>	
<p>Installations, fixtures:</p> <p>Workshop (60 sq.m) Has sub-workshops in the intensive care unit, renal diseases department, and the dentistry department.</p>	
<p>General Condition of installations:</p> <p>Maintenance system organization, including the recruitment of skilled engineering staff and the structuring of this Services is now in progress under the Rehabilitation Project undertaken by the World Bank.</p>	

At present, the Department has a staff of 14 engineers now reduced to mere repair work for simple mechanical faults, since the workshop lacks measuring equipment and repair tools.

Installations, including air-conditioning system, lighting, medical gases, medical piping.:

No particular equipment for a workshop. Under the World Bank's Rehabilitation Program, plans are being pursued to house the Department permanently in the still unoccupied part of the third floor of the high-rise hospital block (Tower Block) by installing new sashes and partitionings.

9. Casualty Department

Year when built (Position): 1981 (Part north of the main entrance)

Structure, Number of floors, Floor area:

Steel-frame, steel-reinforced concrete structure, flat-roof building, 2,035 sq.m.

Installations, fixtures:

Diagnosis rooms (6), emergency resuscitation rooms (4), operating theaters (4), plaster room, recovery room (20 beds), pharmacy, reception, etc.

General Condition of installations:

All casualty patients receive a first checkup/diagnosis at the outpatient/casualty department for onward referral to the appropriate department. Patients are admitted round the clock, with some 2,500 patients handled a day.

This department is relatively dirty and badly damaged in part, with serious signs of deterioration. This may partly be due to the heavy use with the massive influx of patients. The installation is also aging and medical equipment is largely defective and conspicuously inadequate to cope with the heavy demand.

Installations, including air-conditioning system, lighting, medical gases, medical piping.:

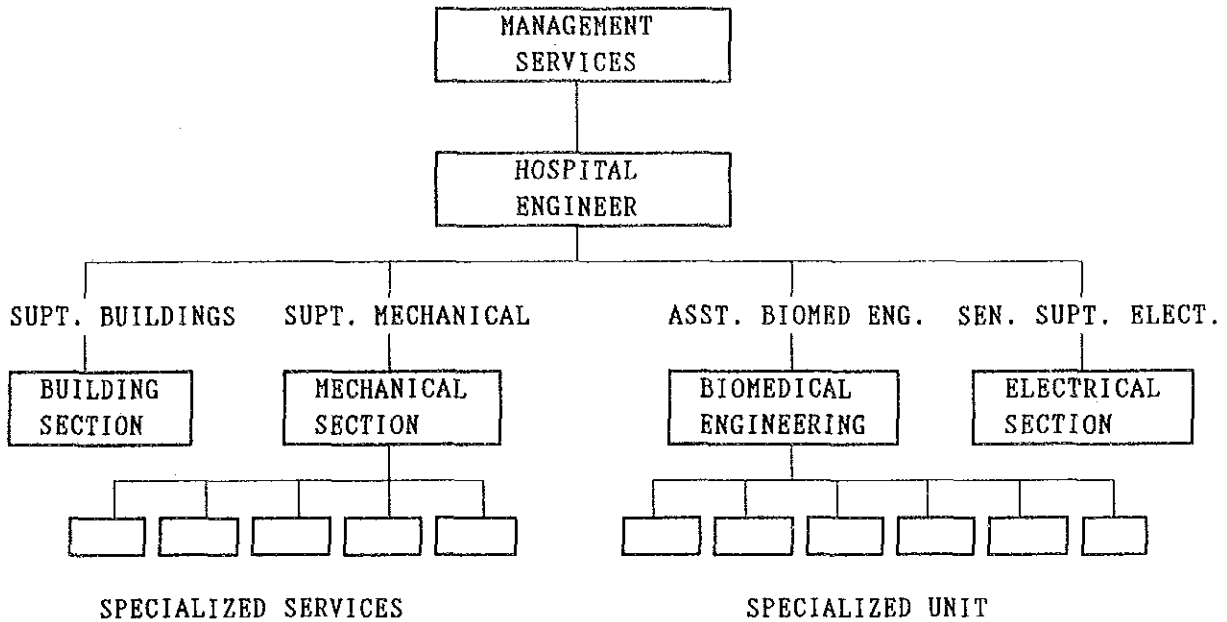
No air-conditioning systems. Medical pipework (gases, vacuum) is available.

2.4.3. Operation and Maintenance System

(1) Organization of Hospital Maintenance Services

The Hospital's Biomedical Engineering Services Department has been organized as part of the Hospital Maintenance Services Division with responsibility to ensure the maintenance and repair of medical equipment in the Hospital. The Hospital Maintenance Services is responsible for the maintenance of all hospital facilities, including the building, the equipment facilities. Fig. 2-8 shows the organization of the Hospital Maintenance Services and Table 2-30 gives the number of personnel, including the technical staff. Under the Management Services, it consists of 106 technical staff members, under the engineers of the Hospital Maintenance Services. The Biomedical Engineering Services consists of one chief engineer, one engineer and nine technicians. Because of the lack of repair materials, unavailability of repair manuals, and the lack of spare/wearing parts, the Biomedical Engineering Services is currently capable of carrying out only simple repair services. Technically, however, the engineering staff is of a high level, with the inclusion of some university graduates from Mechanical Engineering Departments, to create an advanced technical system ensuring sophisticated medical equipment repair/maintenance capability. In addition, the current Rehabilitation Project implemented by the World Bank includes an effort to re-organize the maintenance engineering system, with steps being undertaken to intensify the teaching and training of staff to upgrade their technical capabilities.

Figure 2-8 Organization Structure of Hospital Maintenance Services



Source: MOH

Table 2-30 Maintenance Organization and Systems

Biomedical section	14
Biomedical engineering	
Building section	17
Carpenters, Painter	
Electrical section	25
Mechanical section	50
General Office	14
Located in the tower block	6
Boilers house attendance	11
Laundry and other plant	6
Refrigeration and air condition	5
Boiler and steam distribution	7

(2) Budget for Maintenance

Table 2-31 gives the budgetary requirements of the Hospital Maintenance Services Division for the fiscal year 1992/93. The budget for the maintenance of medical equipment assigned approximately 450,000 Kenyan pounds (equivalent to approximately 37.5 million yen) to the Hospital Maintenance Services Division. These budget assignments are designed to cover the costs for the maintenance of medical equipment and the costs for purchasing medical equipment. In the previous fiscal year, however, the actual maintenance costs allocated had only been approximately 450,000 Kenyan pounds (see Table 3-21), and needed in view of the necessity of the equipment maintenance, large increase of the budget is being attempted.

Table2-31 Maintenance Budget for 1992/1993 Fiscal Year

		Rate of budget(%)
A. Recurrent		31.7%
Maintenance of buildings	£ 1,751,500	
Minor maintenance	£ 439,500	
Major maintenance	£ 1,312,000	
Maintenance of electrical installations	£ 455,939	
Minor maintenance	£ 251,939	
Major maintenance	£ 204,000	
Maintenance of medical equipment	£ 449,500	
Maintenance of plant and machinery	£ 884,632	
Minor maintenance	£ 339,632	
Major maintenance	£ 545,000	
Utilities	£ 2,257,060	
Electricity expenses	£ 604,900	
Water and sewage	£ 480,000	
Boiler fuel	£ 1,170,000	
Welding gas	£ 2,160	
B. Development	£12,510,000	68.3%
Purchase of biomedical engineering workshop tools	£ 50,000	
Rehabilitation of planning unit offices and X-ray department	£ 150,000	
Rehabilitation and upgrading of existing facilities	£11,300,000	
Construction of registrar flats	£ 500,000	
Improvement of I. D. H. kitchen equipment	£ 35,000	
Provision of piped medical gas to renal unit	£ 100,000	
Provision of kitchen equipment to doctors mess.	£ 20,000	
Provision of standby generator for I. D. H.	£ 50,000	
Rehabilitation of theater emergency lighting system	£ 30,000	
Purchase of tools for general maintenance	£ 75,000	
Minor works	£ 200,000	
Grand Total	£18,308,631	100%

Source: MOH

(3) Current Status of Equipment Maintenance Contract

The Ministry of Health concludes maintenance contracts with the local distributors or dealers of equipment manufacturers to ensure the maintenance of medical equipment. Table 2-32 gives a breakdown of the current maintenance contracts as of 1992. The government of Kenya is fully aware of the need for maintenance contracts, however, as for some equipment, the lack of funds has not allowed to renew the contracts.

Table 2-32 Maintenance of Medical Equipment

NO.	ITEM DESCRIPTION	QUANT.	ESTIMATED MAINTENANCE COST: 1992	COMMENTS
1.	Anaesthetic machines:- (a) Service Contract (b) Spare for Service Contract (c) Ventilators	31 4	600,000/= 400,000/= 100,000/=	Existing Service Contract
2.	Auto-Chemical Analyser:- (a) Service Contract (b) Spares	1	430,000/=	Existing Contract-Recommended for renewal
3.	Haematology Blood Cell Counter: (a) Service Contract (b) Spares	1	500,000/=	Existing contract-Recommended for renewal
4.	Blood gas Analyser: (a) Servicing and Training (b) Spares	1	200,000/=	No existing contract. Overhaul + training necessary
5.	Bennet Respirators - I. C. U. (a) Servicing	6	400,000/=	Normal Service
6.	Pagers and Paging Transmitter	80	160,000/=	Repairs to paging transmitter purchase of batteries e. t. c.
7.	X-ray Equipment (a) Fixed (b) Mobile	13 20	1,600,000/= 500,000/=	New equipment recently installed. Requires regular preventive Maintenance (PPM) xxx Stocks of Spares.
8.	Radiotherapy Equipment: (a) Major equipment (b) Other equipment	3 6	1,000,000/=	Overhauling of Cobalt 60 and artificial treatment unit (Therasim)
9.	Renal Dialysis Equipment Others:-	15 6	600,000/= 100,000/=	Routine maintenance but they would need replacement
10.	Dental Equipment (a) Chairs (b) Other equipment	28 10	400,000/=	To have the equipment on a service contract
11.	Physiotherapy equipment	30	400,000/=	Installation, repairs and routine servicing of the equipment is necessary - Priority - rating -recommended.
TOTAL ESTIMATION			7,790,000/ksr.	

2.5. Background and Details of Request

2.5.1 Background of Request

The Kenyatta National Hospital is a general hospital at the apex of the Kenyan medical health care system. It also functions as a teaching institution for the Medical Department of the Nairobi University. It plays a major role as a hospital offering advanced medical services and as a research center in the field of medical science and therapeutic medicine. The hospital as a whole has approximately 2,000 beds and records an average of some 2,600 out-patients a day. This underscores the importance of the Kenyatta National Hospital as the nation's largest medical institution. For economic reasons, however, no repairs, replacements, and refurbishing/upgrading work has been carried out on the building, equipment, and installations since 1981 when the high-rise hospital block (Tower Block) was newly built. Because of age, moreover, it became physically difficult for the hospital to fulfill its role of providing advanced medical treatment services due to the quantitative and qualitative inadequacies resulting from a decline in functional availability of the equipment and facilities. Since equipment is lacking in absolute quantitative terms in the treatment facilities, the queue of patients waiting long hours and even whole day for diagnosis and/or treatment is relentlessly growing. So bad is the situation that the hospital has been forced to adopt selection procedures for the shortlisting of patients eligible on a selection criteria (age, income, medical records etc.) for hemodialysis treatment on the dialysis machine. The mere fact that the hospital is forced to resort to such shortlisting procedures for patients with a life-threatening disease is a clear indication of the urgency of the improvement/refurbishing program on humanitarian consideration. Under the existing conditions, the government of Kenya has established its Master Plan for the Refurbishing and Improvement of the Kenyatta National Hospital, a reconstruction plan designed to reinforce the performance capability of the Kenyatta National Hospital as a public general hospital. Based on this Master Plan, the government has established its Five-Year Plan for the

rehabilitation of the Kenyatta National Hospital with the cooperation provided by the World Bank. On the basis of this Five-Year Plan aimed at reinforcing the performance capability of the national hospital, the Bank has embarked on a cooperation execution scheme, the Rehabilitation Project, whose main objectives are to improve the facilities and equipment of the hospital and improve hospital management. Within the scope of this Project, the government of Kenya, being aware of its difficulty to procure the equipment required with its own resources, has requested the Japanese government for a grant aid to supply the equipment essentially and urgently required for the improvement program. The equipment requested by the government of Kenya consists mainly of basic equipment essential for the therapeutic and diagnostic service functions as well as virtually important medical equipment befitting the Kenyatta National Hospital as the nation's supreme medical institution.

Table 2-33 outlines the Five-Year Plan for the rehabilitation of the Kenyatta National Hospital. Centering on the improvement of equipment facilities and the provision operational control and management systems, this plan will be executed with a loan from the World Bank, with the government of the United States of America providing a grant aid fund to assist in the financial recovery and with the Japanese as well as the Dutch and Belgian government providing grant aid funds to supply the medical equipment required. The Plan is thus a tripartite arrangement.

The equipment supplied by the Dutch government is now already installed, except for a certain part thereof (CT scanner), and the intercom telephone switchboard system supplied by Belgium is now operational.

Table 2-33 Outline of the Five-year Plan for Rehabilitation
of the Kenyatta National Hospital

Outline of the Plan for Rehabilitation of the Kenyatta National Hospital.	
Supporting Country	Details of Project
1. Loan from the World Bank - Rehabilitation Project	
	<ul style="list-style-type: none"> • Improvement of buildings, refurbishing <ol style="list-style-type: none"> 1) Repair of facilities 2) Infrastructure improvement 3) Procurement of beds and vehicles • Provision of reinforcement of management and control system <ol style="list-style-type: none"> 1) Training of hospital managers and engineers 2) Reinforcement of finance, personnel, purchase departments 3) Restructuring of the maintenance division • Provision/upgrading of medical services <ol style="list-style-type: none"> 1) Upgrading of medical services for the Nairobi area 2) Development support for medical care plans
2. US grant aid	
	<ul style="list-style-type: none"> • Financial recovery <ol style="list-style-type: none"> 1) Cooperation toward inquiry committee on health care finance 2) Establishing a cost sharing program and advice/guidance thereon 3) Developing programs for the effective use of human and financial resources 4) Advice and guidance for a reform of the management system 5) Upgrading the referral system
3. 1. Dutch grant aid	
2. Belgian grant aid	
3. Japanese grant aid (request by the present project)	
	<ul style="list-style-type: none"> • Provision/upgrading of medical equipment <ol style="list-style-type: none"> 1) CT scanner and x-ray equipment 2) Intercom telephone system 3) Diagnostic and therapeutic equipment

Source: MOH

Contents of the Plan for Rehabilitation of the Kenyatta National Hospital is shown in Appendix 7. Rehabilitation work for the facilities is shown in Table 2-34.

Table 2-34 Rehabilitation Work for Facilities

Dept. Name	Room Name		Floor	Wall	Ceiling	Others
Radiotherapy Department	Treatment Room (Ground Floor)	Existing Material	PVC Tile	Cement Plaster	Cement Plaster	
		Remedy	Replace partially	Repaint	Repaint	Doors repair
	Controle/ Monitoring Room	Existing Material	PVC Tile	Cement Plaster	Cement Plaster	
		Remedy	Replace partially	Crack repair	Crack repair	Doors repair
	Simulator Room	Existing Material	Grano	Cement Plaster	Cement Plaster	
		Remedy		Repaint	Repaint	
	Treatment Room (2nd Floor)	Existing Material	Grano	Cement Plaster	Cement Plaster	
		Remedy	Repolish	Repaint	Repaint	Windows repair
Laboratories Chemical Pathology	Laboratory 1	Existing Material	PVC strips	Cement Plaster	Cement Plaster	
		Remedy		Crack repair	Repaint	Windows repair
	Laboratory 2	Existing Material	PVC Tile	Cement Plaster	Cement Plaster	
		Remedy	Reseal	Crack repair	Repaint	Windows repair
Hematology	Laboratory 1	Existing Material	PVC strips	Cement Plaster	Cement Plaster	
		Remedy	Reseal	Crack repair	Repaint	Windows repair work top repair
	Laboratory 2	Existing Material	PVC strips	Cement Plaster	Cement Plaster	
		Remedy	Reseal	Crack repair	Repaint	Windows repair
Microbiology/ Parasitology	Laboratory (1F)	Existing Material	PVC strips	Cement Plaster	Cement Plaster	
		Remedy	Replace	Crack repair	Damp part repair	Window pane replace Work top repair
	Laboratory (2F)	Existing Material	PVC strips	Cement Plaster	Cement Plaster	
		Remedy	Reseal	Crack repair	Repaint	Windows repair
	Preparation room (2F)	Existing Material	Ceramic tiles	Cement Plaster	Cement Plaster	
		Remedy	Cleaning	Crack repair	Crack repair	Window, sink repair
Pathology/ Histology	Laboratory (1F)	Existing Material	PVC strips	Cement Plaster	Cement Plaster	
		Remedy	Reseal	Crack repair	Damp part repair	Windows repair

Dept. Name	Room Name		Floor	Wall	Ceiling	Others
Pathology/ Histology	Laboratory (2F-1)	Existing Material	PVC strips	Cement Plaster	Cement Plaster	
		Remedy	Reseal	Crack repair	Damp part repair	Window pane replace Work top repair
	Laboratory (2F-2)	Existing Material	PVC strips	Cement Plaster	Cement Plaster	
		Remedy	Replace partially	Crack repair	Damp part repair	Window pane replace Work top repair
Immunology	Laboratory	Existing Material	PVC strips	Cement Plaster	Cement Plaster	
		Remedy	Replace partially	Repaint	Repaint	
Routine Laboratory	Laboratory	Existing Material	PVC tile	Cement Plaster	Cement Plaster	
		Remedy	Replace to grano	Repaint	Repaint	Window, door replace
	Office	Existing Material	PVC tile	Cement Plaster	Cement Plaster	
		Remedy		Repaint	Repaint	
Theatres	Theatre	Existing Material	Terrazzo	Cement Plaster	Cement Plaster	
		Remedy	Repolish	Crack repair	Repaint	Doors repair
	Theatre Preparation Room	Existing Material	Terrazzo	Cement Plaster	Cement Plaster	
		Remedy	Repolish	Repaint	Repaint	Doors repair
	Anaesthetics Room	Existing Material	Terrazzo	Cement Plaster	Cement Plaster	
		Remedy	Repolish	Repaint	Repaint	Doors repair
	Theatre Scrub-up	Existing Material	Ceramic tiles	Cement Plaster	Cement Plaster	
		Remedy		Repaint	Repaint	Doors repair Worktop replace
C. S. S. D.	Work Preparation	Existing Material	PVC tile	Cement Plaster	Asbestos panel	
		Remedy	Replace to grano	Repaint	Repaint	Worktop replace
	Autoclave	Existing Material	PVC strips	Cement Plaster	Asbestos panel	
		Remedy	Replace		Repaint	
	Sterile store	Existing Material	PVC tile	Cement Plaster	Asbestos panel	
		Remedy			Repaint	Doors repair

Dept. Name	Room Name		Floor	Wall	Ceiling	Others
Intensive care unit	Open ward	Existing Material	PVC tile	Cement Plaster	Asbestos panel	
		Remedy		Repaint	Repaint	
	Nurses/doctors station	Existing Material	PVC tile	Cement Plaster	Asbestos panel	
		Remedy		Repaint	Repaint	Worktop replace
	Laboratory	Existing Material	PVC tile	Cement Plaster	Asbestos panel	
		Remedy			Repaint	Window pane replace
Dirty utility	Existing Material	Terrazzo	Cement Plaster	Asbestos panel		
	Remedy	Repolish	Repaint	Repaint		
Radiotherapy	Catherization room	Existing Material	PVC tile	Cement Plaster	Asbestos panel	
		Remedy	Replace to grano	Repaint	Repaint	Sink replace
	Dark room	Existing Material	PVC tile	Cement Plaster	Asbestos panel	
		Remedy			Repaint	Worktop repair
	Laboratory	Existing Material	PVC tile	Cement Plaster	Cement Plaster	
		Remedy	Replace	Crack repair	Repaint	Cupboard repair
Renal Dialysis Unit	Ward	Existing Material	PVC tile	Cement Plaster	Asbestos panel	
		Remedy		Crack repair Repaint	Repaint	
	Nurse/doctor rest area	Existing Material	PVC tile	Cement Plaster	Asbestos panel	
		Remedy				Worktop replace
	Laboratory	Existing Material	Grano	Cement Plaster	Cement Plaster	
		Remedy	Replace	Repaint	Repaint	Worktop replace
Casualty	Waiting	Existing Material	Grano	Cement Plaster	Asbestos panel	
		Remedy	Replace	Repaint	Repaint	
	Examination room	Existing Material	PVC tile	Cement Plaster	Asbestos panel	
		Remedy	Replace	Repaint	Replace	
	Resuscitation room	Existing Material	PVC strips	Cement Plaster	Asbestos panel	
		Remedy	Replace	Repaint	Replace	
	Treatment room	Existing Material	PVC tile	Cement Plaster	Cement Plaster	
		Remedy	Replace	Repaint	Repaint	

Dept. Name	Room Name		Floor	Wall	Ceiling	Others
Casualty	Recovery ward	Existing Material	PVC tile	Cement Plaster	Cement Plaster	
		Remedy		Repaint	Repaint	Window repair
	Operating theatre	Existing Material	Cement screed	Cement Plaster	Cement Plaster	
		Remedy		Repaint	Repaint	

Source: World Bank

2.5.2. Details of Request

The request made by the government of Kenya covers the provision and improvement of equipment with which the hospital will be able to provide diagnosis and therapeutic services. The equipment included in the procurement program included basic and essential medical equipment and equipment required for offering advanced medical services of the latest standards of medical practice. The following is a summary of the equipment and facilities requested.

Table 2-35 Main Required Equipment List by Division

Dispositions	Main Equipment List
Radiation Therapy	Cobalt 60 radiation unit, X-ray simulator, Superficial x-ray simulator, Intracavity machine remort after loading, Treatment planning system, Anesthesia machine, Operating table, Suction unit portable, Diagnostic set, Biopsy punch, Vaginal speculum, Others
Laboratory	Clinical chemistry analyzer, Refrigerated centrifuge, Protein electrophoresis, Deekp freezer, Incubator, Spectrophotometer, Tissue embedding system, Electronic blood counter, Water distriller, Auto stainer, Microtome rotary, CO ₂ incubator, Analyzer for sodium & potassinn, Blood gas Analyzer, Incubator, Affinity immuno assay system, Others
Operating Theaters	Electro surgical unit, Operating microscope, Cardiac monitors, Fiberscope, Cryo machine for eye surgery, Pace makers, Laproscope, Operating table, Others
I. C. U.	Bed-side monitors, Respirators, Respirators pediatric, ICU incubators, Non-invasive blood pressure monitor, Ultrasonic nebulizer, Photo therapy unit, Others
E. C. G. /Cardiology	Angiocardiology system, E. C. G., Stethoscope, X-ray protective aprons, pacemaker, Ultrasound scanner, Others
Renal	Hemodialysis machine, Ultrasound scanner, bedside cabinet, sphygnomanometer, Difibrilator, Patient trolley, Others
Bio-medical engineering	Ociloscope, Synthesiser, Paging system, Welding machine, Drill, Light source, Spot welding machine, Others
T. S. S. U.	Ultrasonic instrument washer, Surgical glove powdering machine, Drying cabinets, Manual sewing machines, Others
C. S. S. D.	Drying cabinets, Ultrasonic instrument washer, Surgical glove powdering machine, Others
Casualty	Difibrilator, Bedside monitors, Operating table, Patient card imprinting, Instrument sterilizer, Anesthesia machine, Portable x-ray film illuminator, Others
Total 10 divisions	

Chapter 3 Outline of the Project

Chapter 3 Outline of the Project

3.1 Objective of the Project

Concurrently with the World Bank's Rehabilitation Project the present project aims to reinstate the functions of Kenyatta National Hospital as the most leading medical institution in Kenya. For this end, it will be attempted to renew and replenish medical equipment which is extremely insufficient in number and urgently needed, to modernize the facilities and equipment of the hospital, and to effectuate both quantitative and qualitative improvement of the health care services practiced at the hospital. Through the renewal of facilities and equipment, the Project also attempts to improve opportunities for health personnel to get better education, so that the training of physicians, nurses, etc. may be accelerated.

3.2 Examination of the Request

3.2.1 Examination of the Necessity and Appropriateness of the Request

The low-income segment of the Kenyan people, who represent a large majority of the population, depend for their health care on relatively inexpensive public medical institutions. Among public medical institutions, including provincial hospitals, district hospitals, and health centers distributed all over the country, Kenyatta National Hospital is operated as the top referral hospital with its full range of clinical departments. The hospital is the most authoritative provider of health care in the country, and also playing an important role in the training of medical staffs. It is serving as the educational hospital for Nairobi University, School of Medicine and the nursing schools. However, because of economic reasons, the hospital has been suffering from the shortage of human resources and equipment, which has led to a considerable loss of its functions to deliver high quality medical services. This project, in cooperation with the Five-Year Plan for the Improvement of Kenyatta National Hospital implemented by the Republic of Kenya, assists the procurement of medical equipment to restore and reinforce the medical functions of the hospital. The

Project is expected to give indirect assistance to the attainment of the goals of the national health development plan of Kenya. It is expected that the provision of medical equipment at Kenyatta National Hospital under this project will allow effective delivery of services at this hospital both as a general hospital and as an educational institution. Therefore, in view of the objective of the project and the levels of the project goals, the appropriateness and the necessity of this project are considered high and very reasonable.

3.2.2. Study on Project Components

The Project is designed to improve the equipment availabilities of the Kenyatta National Hospital aiming in particular at those services areas of the hospital which suffer from inadequacies in both qualitative and quantitative terms, as well as those departments of the hospital for which the need for improvement is particularly urgent. The following therefore examines the service conditions at present of the department falling within the scope of this Project.

1) Radiation Therapy Department

It is a characteristics feature of Kenya's morbidity pattern that there is a high incidence of lymphoma and cervical cancer. The Kenyatta National Hospital is the only hospital in the country offering radiotherapy treatment for malignant neoplasms. It therefore receives referral patients for radiotherapy not only from all parts of Kenya itself but also from neighboring countries. This has led to a continuous increase in the number of patients year after year. While there are two cobalt isotope radiation therapy rooms, only one of them is equipped with a cobalt isopte radiotherapy unit and serviceable. The radiation source (cobalt isotope) loaded in the equipment has meanwhile decayed and the emission is so weak that it takes a longer exposure time per patient to effect treatment. Since the waiting list of patients is constantly growing, the situation has become unmanageable. The statistics (as of 1990) show that an average of

69 patients receive treatment in the radiotherapy department every day, and the waiting list is usually filled with a queue of 450 patients. The average queueing time on the waiting list is now given as four months. These conditions are a major factor responsible for worsening of the treatment efficiency for cancer patients, since the long waiting time implies the possibility of metastasis of the tumor before treatment can be conducted. The department also suffers from the fact that it has only one intracavitary radioation therapy unit (for insertion in the abdominal cavity; remote after-loading unit), so that it is not capable of adequately meeting the demand for the treatment of cervical cancer patients. In view of these service conditions, this department qualifies as a high-priority area under the present Project. (see table 3-1)

Table 3-1 Radiology Dept. Statistics (1984~1990)

Average number of waiting patient : 400
Average waiting period : 4 months

	1984	1985	1986	1987	1988	1989	1990
PATIENTS VISITS IN RADIOTHERAPY	16,024	11,328	15,623	17,870	11,068	20,343	23,796
NEW PATIENT SEEN IN RADIOTHERAPY	751	4,448	4,702	4,934	5,478	3,255	5,688
TOTAL	16,775	15,776	20,325	22,804	16,546	23,598	29,484
NUMBER OF TREATMENT OF SINGLE COBALT 60 MACHINE	17,200	13,430	15,236	15,333	14,266	17,088	18,108
NUMBER OF TREATMENT OF CS 137	—	—	21	84	99	76	10

Source : MOH

2) Laboratory

Table 3-2 shows the number of laboratory technicians and the types and numbers of tests performed in each of the reference years. The laboratory does not only handle the tests of KNH but

also carries out tests on samples sent from the country's provincial and district hospitals. Since the test equipment is of the old type, dating back to an estimated 15 or 20 years, it offers poor functional availability. The testing equipment is also inadequate in quantitative terms, covering no more than about 60 percent of the actual need for testing. The shortfall is particularly serious in the area of microbiological testing as the facilities available now handle only some 35 percent of the number of testings it did handle before in 1986. This reduced volume of testing is not due to a falling number of samples to be tested. On the contrary out-patient statistics make it clear that the number of samples to be tested tends to increase constantly year after year. Yet, despite this growing demand for testing, the testing capacity of the laboratory has deteriorated due to the shortage of equipment so that the needs cannot be adequately met. To ensure a more definite diagnostic service and permit more effective and appropriate medical treatment, it is therefore essential that the improvement in quality and quantity of the equipment in this laboratory is of vital importance in order to restore proper functional availability of the laboratory.

Table 3-2 Laboratory Statistics (No. of specimens processed)
from 1986 to 1990

SECTION	No. of Staff (Technologist)	1986	1987	1988	1989	1990
MICROBIOLOGY PARASITOLOGY(a)	30	54,663	26,383	30,657	27,892	19,330
CHEMICAL PATHOLOGY	16	38,551	34,728	38,814	47,666	43,330
HISTOLOGY	11	4,378	4,022	3,489	2,943	4,461
HEMATOLOGY	17	N/A -	61,208	77,486	80,000	75,000
IMMUNOLOGY	5	N/A -	2,242	4,775	5,000	16,565
CYTOLOGY	3	3,910	4,827	5,477	3,343	3,134
ROUTINE LABORATORY(b)	28	68,000	75,900	79,888	83,222	90,000
ICU LABO.	12	4,789	6,950	8,320	17,940	13,400
RENAL UNIT	9	13,000	16,335	16,233	13,439	14,000
RECORDED DEATH at KNH	14	6,700	6,640	7,103	7,566	7,699
AUTOPSIES		219	149	180	170	179

(a) Include Urines, stools, swabs and other body fluids.

(b) This laboratory performs emergency Hematology, Biochemistry,
Microbiology and Parasitology work on a 24 hr basis.

N/A : Not Available

Source: MOH

3) Department Operation Theater

The hospital has 12 operating theaters, including in particular, cardiac surgery, thoracotomy, and laparotomy, as well as orthopedic surgery, ophthalmic surgery, otorhinolaryngeal surgery, and pediatric surgery. However, the equipment currently installed is extremely outdated and is seriously deteriorated such as the bulbs of the operating shadowless lamp are out, and the balancer is not function properly making it difficult for the surgeon to position correctly and the hydraulic pump of the operating table has broken down so that it is no longer possible to vertically adjust the table position. For reasons of this nature, the operating theaters are therefore not able to perform

properly because of obsolete and defective equipment. As can be seen from Table 3-3, the number of operations performed since 1987 has been decreased. It is therefore essential that the equipment too old to be repaired should be renewed so as to restore its proper functional capacity so that the hospital can fulfill its function as a general hospital.

Table 3-3 Operation Statistics from 1985~1990

Operation Statistics	1985	1986	1987	1988	1989	1990
General Surgery	2,353	1,744	1,857	1,837	1,120	2,117
OBS/GYNE, Surgery	4,670	2,858	5,946	4,275	1,024	1,329
E. N. T. Surgery	801	750	742	715	1,427	744
Orthopedics Surgery	883	870	1,007	907	1,212	954
Eye Surgery	903	903	815	627	531	645
Neuro Surgery	295	241	253	197	263	359
Cardio-thoracic Surgery	368	303	333	366	435	427
Pediatric Surgery	685	560	717	721	873	795
Plastic Surgery	226	152	158	446	287	236
Dental Surgery	81	56	82	80	72	136
TOTAL	11,305	8,441	12,317	10,161	7,262	78,771

4) Intensive Care Unit

Table 3-4 gives the intensive care patient statistics for the various departments concerned. The proportion of patients receiving intensive postoperative care amounts to 64 percent of all intensive care patients. The intensive care patients with internal diseases account for 26 percent, and those with external trauma and lesions for 10 percent. Patients after operation account for 322, it consists of 4.1 percent in 7,771.

Table 3-4 Admissions, Transfers and, Mortality

CASES	PATIENTS NO.	TRANSFERS	DEATHS	MORTALITY
POST-OPERATIVE CASE	322(64%)	227	95	29.5%(Avl.)
MEDICAL CASES	129(26%)	62	67	51.9%(Avl.)
SURGICAL CASES	51(10%)	27	24	47.1%(Avl.)
TOTAL	502	316	186	37.1%(Avl.)

Source: MOH

The above post operative ICU patients can be broken down as follows: 104 patients after cardiovascular operation or some 32 percent of the total number required intensive post operative care (in 1990). The next highest proportion were the pediatric patients amounting to 14 percent and the neuro surgery patients amounting to 12 percent.

Table 3-5 Post Operative Cases

	NO. OF PATIENTS	TRANSFER	DEATHS	MORTALITY
CARDIOTHORACIC AND VASCULAR SURGERY	104	92	12	11.5%
PEDIATRIC SURGERY	46	19	27	58.7%
E. N. T. SURGERY	37	34	3	8.1%
ORAL MAXILLO-FICIAL SURGERY	32	32	0	0%
NEURO SURGERY	41	27	14	34.1%
GENERAL SURGERY	31	14	17	54.9%
OBS/GYNE.	30	19	11	36.7%
ORTHOPEDIC SURGERY	1	1	0	0%
TOTAL	322	228	94	29.2%

Source: MOH

In terms of the patients' age breakdown, it can be seen that the child segment (under 12 years of age) accounts for the largest share of 39.5 percent of all ICU patients, including 27.5 percent of infants aged under five. (See Table 3-6) The available equipment, however, has been selected for the treatment of adults and is thus not in a position to meet the needs for pediatric patient intensive care.

Table 3-6 Age Distribution

AGE	NO. OF PATIENTS	ENTAGE
UNDER 5 YEARS	139	27.7%
6 YEARS~12 YEARS	59	11.8%
13 YEARS~21 YEARS	58	11.6%
22 YEARS~55 YEARS	185	36.8%
OVER 56 YEARS	61	12.1%
TOTAL	502	100.0%

Source: MOH

In view of the above conditions, it is concluded that the improvement of the intensive care equipment and facilities such as the monitors for checking cardiac function, artificial respiration units for adults as well as child and infant patients, and blood gas analyzers for respiration control will make it possible for the hospital to assure for its post operative patients adequate and appropriate intensive care and will lead to an effective improvement in the hospital's overall medical service capability in conjunction with the upgrading of equipment in the other department of the Kenyatta National Hospital.

5) Department of E.C.G./Cardiology

The Kenyatta National Hospital assumes an important position as the nation's only medical facility capable of performing cardiac surgery. Associated with its moderninzation, Kenya is also showing an increase in the incidence of ischemic heart diseases and an increasing rate of discovery of congenital cardiac diseases. In view of this morbidity pattern, there has been and is a constantly growing demand for therapy of Cardiac and Circulatory Organs. The number of patients has grown approximately 1.3-fold over the last five years. (See Table 3-7)

Table 3-7 Cardiology Department Statistics (1985~1990)

	1985	1986	1987	1988	1989	1990
OUTPATIENT CONSULTANT CARDIAC CLINIC ATTENDANCE	5, 723	5, 882	6, 016	7, 775	7, 913	7, 753
ELECTROCARDIOGRAMS	2, 533	3, 161	3, 179	1, 640	2, 652	1, 445
ECHOCARDIOGRAMS				541	1, 361	1, 524
CARDIAC CATHETERIZATION	32	131	139	137	110	169
EXERCISE ELECTROCARDIOGRAMS					56	164

Source : MOH

Table 3-8 shows the hospital's statistics for patients undergoing surgery for cardiac and thoracic diseases. While the number of patients is growing, the number of those receiving treatment remains stagnant or shows a certain declining trend. This Department also has a cardiac catheter test room to provide test data for cardiac surgery. The existing equipment, however, is obsolete and inadequate in quantitative terms, and these problems are compounded by the inadequate availability of appliances and instruments in the operating theaters and the lack of a proper equipment infrastructure for the intensive care system, so that the medical services available are declining. Aligned with the related departments, this Department is in urgent need to improve its equipment so as to restore its medical service capability. This is considered of vital importance so that the Kenyatta National Hospital will be able to discharge its inherent mission as a general hospital.

Table 3-8 Cardiac and Thoracic Surgery Statistics (1985~1990)

	1985	1986	1987	1988	1989	1990
CARDIAC AND THORACIC SURGICAL ADMISSION	290	243	249	229	247	259
CLOSED HEART OPERATIONS	53	50	46	49	56	34
OPEN HEART OPERATIONS	5	25	30	32	39	32
ICU ADMISSION GENERAL	157	491	440	452	560	493
WAITING LIST FOR OPEN HEART SURGERY						137

Source : MOH

6) Renal Unit

In Kenya, more than 20,000 renal failure cases are reported every year. Treatment for these patients requires the availability of skilled medical staff experienced in the special equipment and techniques for performing hemodialysis, peritoneal perfusion, and kidney transplant operations and for administering the drugs required for chemotherapy. This Unit handles patients with general renal and urological disorders as well as terminal patients and acute renal failure cases. Table 3-9 shows the statistics for the dialysis and urological patients. The figures for the dialysis unit refers to the chronic and acute renal failure patients, giving the number of patients receiving hemodialysis treatment or peritoneal perfusion. The Unit has currently eight dialysis machines in operation, only half of the machine number installed. The remainder is in such a poor state of repair that it is unfit for use, either because the manufacturer's warranty period has expired and spare parts are unobtainable or because they are beyond repair. The Unit is therefore not able to provide all patients in need of dialysis treatment with the required service. Patients are therefore selected and shortlisted for dialysis treatment on a set of

criteria determined by the urgency of treatment (see Table 3-10). These selection criteria are not absolute, and the Kenya Kidney Patients Association Fund tries to bring relief especially for patients from the poorer strata of society. Yet, the urgency with which suitable measures are required is all the more evident because of that the treatment service of this unit is for people directly facing death.

Table 3-9 Attendance: Renal and Urology Clinic (1985~1990)

CLINIC		1985	1986	1987	1988	1989	1990
RENAL	TOTAL	5,480	3,026	3,203	2,686	2,531	2,455
	NEW CASE	2,563	374	1,212	330	310	251
	OLD CASE	2,917	2,652	1,919	2,356	2,221	2,204
UROLOGY	TOTAL	3,546	2,898	2,053	1,213	3,227	2,423
	NEW CASE	632	555	432	406	568	410
	OLD CASE	2,914	2,343	1,612	1,507	2,659	2,013

Source : MOH

Table 3-10 Selection Criteria for Eligibility to Hemodialysis Treatment

- | |
|--|
| <ol style="list-style-type: none"> 1. Age 50 or below 2. B type hepatitis and AIDS virus negative 3. Retrievability of treatment costs 4. Willingsness to undergo kidney transplant operation in the future 5. No malignant tumor or other disease. |
|--|

Table 3-11 shows the number of patients refused dialysis treatment because they did not meet the selection criteria although dialysis treatment would have been indicated.

In 1990, a total of 412 patients failed to meet the selection criteria. This is approximately 16.78 percent of the patients who were admitted for hemodialysis treatment and 1.64 times as

much as the number of new patients. The refusal of patients for dialysis treatment is tantamount to letting them die within a few weeks. From humanitarian considerations, it is therefore of vital importance to create the necessary service infrastructure as a matter of the greatest urgency. It is therefore concluded that the provision and upgrading of hemodialysis machines and related equipment for this unit is one of the most important problems.

Table 3-11 Numbers of Patients Turned Away from Dialysis Treatment

YEAR	1985	1986	1987	1988	1989	1990
NUMBER OF PATIENT	168	177	256	307	386	412

7) Biomedical Engineering Services

The Biomedical Engineering Services is organized as a part of the Hospital Maintenance Services and specializes in the maintenance of medical equipment. Table 3-12 gives the qualifications of the engineers working in the Biomedical Engineering Services. In view of the lack of equipment and tools, the Biomedical Engineering Services is able to repair only simple medical equipment. The Rehabilitation Project of World Bank tries to upgrade and extend this Services, with the construction of a new workshop of some 500 square meter size. It also tries to create a management and supervision systems for the Hospital Maintenance Services, including the Biomedical Engineering Services. To ensure the long-term availability and fitness for use of equipment after it has been supplied, it is essential to upgrade and expand the maintenance system. It is therefore concluded that it will be essential to include the Biomedical Engineering Services in the execution of the present Project and make provisions for the procurement of the equipment, appliances, and tools required for the maintenance and repair of hospital equipment.

Table 3-12 Engineers Working in the Biomedical Engineering Services and Their Qualifications

Qualification	No. of Engineers
Biomedical engineer	1
Medical engineer technologist grade 2	5
Medical engineer technologist grade 3	4
Technician	4
T o t a l	14

8) T.S.S.U.

This Unit is responsible for furnishing the surgical instruments and surgical consumables required for surgery at the Kenyatta National Hospital. The Hospitals performs about 43 operations a day, and this Unit is in charge of sterilizing and disinfecting the surgical instruments on a full-capacity operating cycle. Autoclaves are prone to break down, and only one of the two autoclaves is barely in a state fit to operate. The surgical glove inspection unit is beyond repair so that the only means of checking for holes in the gloves is by visual inspection or by inflation with the mouth. The result is a very poor efficiency and it is therefore concluded that the implementation of a program to equip this Unit with the necessary equipment as a part of the project will be vital to restore the hospital to its proper functional capability.

9) C.S.S.D.

Similarly to the TSSU, this Department is responsible primarily for the supply of sterilized instruments to the wards and the out-patient department. The installed equipment is similar in terms of types, quantities, and age, to the TSSU unit. The age of the available equipment has begun to show a conspicuous trend of breakingdown and the imminent need for repair.

10) Casualty Department

Table 3-13 shows the statistics for the daily average number of outpatients from 1988 to 1990. The total number of patients attending the consultant clinics, accident and emergency, general out-patient, stands at an average of approximately 2,600. All of the new patients of the hospital come to the casualty department first which is thus the most important point of contact between the hospital and the patient. The conditions at the hospital have reached such a serious degree of shortage and inadequacy in equipment availability that practically all diagnosis rooms are equipped only with a minimum of sphygmomanometers and suction unit, and even these are in most cases about to break down, so that one unit has to be shared out by many rooms. The adjacent general out-patient operating theater is in no better condition. Though it may be described as having the equipment to perform operations, practically all of this equipment has aged to beyond its service life and is far from suited for surgical treatment for emergency cases. While this Department is also eligible for equipment repair and expansions under the Rehabilitation Project by the World Bank, it is considered essential that this Department should be included in this Project as part of the Hospital upgrading program to provide the equipment needed to be functionally capable of admitting patients in need of treatment and respond to emergency cases with effective measures.

Table 3-13 Summary of Outpatient Utilization at KNH (1988~1990)

	1988		1989		1990	
	New Attd.	Re- Attd.	New Attd.	Re- Attd.	New Attd.	Re- Attd.
CONSULTANTS CLINICS	32,159	153,852	81,492	191,628	32,709	149,418
ACCIDENT & EMERGENCY	132,727	21,474	141,359	29,473	123,051	27,870
GENERAL OUTPATIENT	60,281	51,048	64,794	46,047	57,945	39,520
DENTAL CLINIC	65,168	48,648	61,568	39,655	51,631	40,354
OTHER C. AREAS	96,383	82,664	42,160	70,327	63,274	80,047
TOTAL	386,718	357,676	391,328	377,130	351,824	337,209

Source: MOH

3.2.3 Examination of Operating Plans

(1) Personnel Plan

As of September, 1991, Kenyatta National Hospital is staffed with 3,126 persons as shown in Table 3-14. Chiefs of some departments are assisted by consultant physicians, who are responsible for specialized medical practice. The items of the medical equipment which are planned to be procured under this project are those which are in the need for renewal or replenishment and are installed presently or were used in the past at Kenyatta National Hospital. Therefore, the present number, organization, and skill level of medical staff are considered sufficient to handle the planned equipment. As described later, the hospital is considered to have a sufficient number of personnel for the maintenance of equipment.

Table 3-14 Member of Staff

Staff	Number of person
Doctors	155
Nurses	981
Maintenance staff	156
Administrative officer	377
Assistant staff	922
Para medical	535
TOTAL	3,126

Source: MOH

(2) Budget of KNH

The budget of Kenyatta National Hospital is allocated from the budget of the Ministry of Health, based on the needs and considering the previous records of expenditures. Table 3-15 shows the breakdown of the budget of Kenyatta National Hospital. As mentioned above, this project is intended for the renewal and replenishment of equipment superannuated, or to supply insufficient medical equipment at Kenyatta National Hospital. Most of the equipment planned to be procured under this project will be comparable with existing equipment in terms of capacity and functions. Therefore, if the improvement of equipment will be conducted according to this project, it is supposed to be no need for a special budgetary arrangement. In view of the fact, however, that current budget for maintenance is not sufficient for the maintenance of existing equipment, it is necessary to try to increase the budget for maintenance. It is also necessary to provide budget to cover the costs of maintenance contracts for advanced medical equipment. On the other hand, it is expected to improve the financial condition of the hospital with the Rehabilitation Project of the World Bank which will improve the efficiency of hospital management, finance, and medical facilities. As the synergic effect of such improvement, there will be an increase in revenue and a decrease in expenditures of the hospital. However, it is pointed out that sufficient maintenance is essential to use the equipment as effectively as possible for a long time.

Table 3-15 KNH Allocation of Budget 1991/92 Fiscal Year

(Unit: Kenya Ibs.)

	Initial alloc. 1990/91	%	Total exp. 1990/91	%	Allocation 1991/92	%
Staff expenses	7,789,250.00	52.741	6,951,383.00	47.068	9,742,084.00	59.361
Administrative expenses	1,653,968.00	11.199	1,817,364.00	12.305	1,891,948.00	11.528
Patient care	3,334,298.00	22.576	2,928,348.00	19.828	3,447,596.00	21.007
Maintenance expenses	256,656.00	1.738	343,689.00	2.327	445,906.00	2.717
Rent & rates	600,000.00	4.063	819,894.00	5.551	666,736.00	4.063
Transport, operating expenses of vehicles	65,246.00	0.442	47,939.00	0.325	75,330.00	0.459
Purchase of plant & equipment	69,480.00	0.470	16,688.00	0.113		0.000
I. D. H.		0.000	133,843.00	0.906	135,000.00	0.823
Reserve	1,000,000.00	6.771			7,000.00	0.043
	14,769,898.00	100.000	13,059,148.00	88.423	16,411,600.00	100.000

Source: MOH

3.2.4 Examination of the Relation with Similar Projects

The World Bank is promoting the improvement of the facilities and equipment of the hospital under Kenyatta National Hospital Rehabilitation Project. The United States is providing grant aid for revamping the financial status of the hospital. The Rehabilitation Project mentioned above plans to provide some of the hospital equipment including laundry and kitchen, as well as beds, instrument tables, examination lamps, and other equipment installed in wards. This Rehabilitation Project does not include radiotherapeutic and other equipment which is planned to be procured under this project.

Last year, the Netherlands assisted the improvement of the Radiology Department, including the procurement of plain radiographic, tomographic, and fluoroscopic X-ray equipment. Most of these items have been delivered to the hospital. As the improvement of this department has been excluded from the present project, it is

considered that there will be no overlapping between this project and the project of the Netherlands.

3.2.5 Consistency of the Execution Schedule with the World Bank

Rehabilitation Project

The World Bank is conducting the bidding process for the Rehabilitation Project according to the schedule shown in Table 3-16. The works for the improvement of facilities are planned to be commenced in February, 1993. The World Bank is also promoting the reorganization of the Hospital Maintenance Services to facilitate the execution of the Rehabilitation Project. In relation to this project, the World Bank has confirmed that it will cooperate with Japan in terms of the establishment of a system for the operation and maintenance of the equipment procured under this project, as well as the monitoring activities for this sake (see Appendix 8).

Table 3-16 Bidding Schedule of Rehabilitation Plan for Facilities

Public announcement (completion)	April 30, 1992	Approval of tender result (hospital)	late-Nov.
Examination of qualification	mid-July	Approval of tender result (World Bank)	mid.-Dec.
Approval of applicant qualification	late-July	Signature of construction contract	mid.-Jan. 1993
Distribution of tender book	mid.-Aug.	Starting work	late-Jan.
Tender and tender open	mid.-Oct.	Partial completion of construction	late-Sept.
Appraisal of tender	early-Nov.	(Facilities of this plan)	

The works conducted under the Rehabilitation Project are planned to be completed in two years. It has been agreed between the Basic Design Study Team and the World Bank that a priority is given to the works related to this project, so that the works will be completed before the arrival of the equipment procured under this project. Table 3-17 shows the schedule of the Rehabilitation Project which is related to the

project.

Table 3-17 Schedule for Rehabilitation Project for Facilities

Division	Year	1993												1994			
	Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1) Radiation Therapy								※	⇒	⇒	◆						
2) Laboratory				※	⇒	⇒	⇒	⇒	⇒	◆							
3) Operating Theaters						※	⇒	⇒	⇒	◆							
4) T. S. S. U.		※	⇒	⇒	◆												
5) C. S. S. D.		※	⇒	⇒	⇒	◆											
6) I. C. U.							※	⇒	⇒	◆							
7) E. C. G. /Cardiology				※	⇒	⇒	◆										
8) Renal						※	⇒	⇒	◆								
9) Bio-medical eng.		※	⇒	⇒	◆												
10) Casualty			※	⇒	⇒	⇒	⇒	◆									

※ Commencement of construction ⇒ be in progress of construction ◆ completion of construction

3.2.6 Examination of Requested Equipment

The purpose of this project is to restore the functions of the hospital as the most leading medical institution in the country. For this end, the contents of the request were examined under a principle of assisting the renewal and replenishment of existing medical equipment. The followings are a summary of the examination:

(1) Radiation Therapy

The request includes cobalt-60 radiotherapy unit, x-ray simulator, treatment planning system, and other equipment which are all essential for accurate diagnosis and treatment. These items are intended to cover the loss of performance due to superannuation or the shortage due to the increase in the number of patients. Therefore, the request is considered appropriate. As for the quantity, one set of the equipment will be installed in the therapy room prepared.

(2) Laboratory

The request includes automatic blood analyzer, spectrophotometer, blood gas analyzer, high-speed centrifuge, incubator, and other equipment which are essential for clinical examination and diagnosis. Although these items are presently operated with barely acceptable performance, they are considerably deteriorated and it takes a long time to obtain test results, causing serious impediment to the operation of this department. The Laboratory Department is composed of several rooms specialized in clinical, pathological, bacteriological, and other types of examination. Because these rooms have different roles and deal with different types of samples, some of the equipment must be installed in each of the rooms requiring them, if they cannot be shared among these rooms in the sense of time or functions.

(3) Operating Theaters

The request includes operating room lamp, operating table, suction unit, electrosurgical unit, artificial heart-lung machine, and other equipment which are mostly indispensable in the operating rooms. These items are intended to renew existing equipment. Of the 19 operating rooms, 12 main operating rooms in the new building will be equipped with these items.

(4) Intensive Care Unit

The request includes heart monitor and respirator for postoperative patients and emergency patients, blood gas analyzer for respiration management, and other items. Equipment are renewal of existing items which are superannuated or insufficient in number. In view of the number of patients and the availability of personnel, the capacity of the Intensive Care Unit should be improved to cover about 20 patients, which is a half of the maximum number of patients (40 persons) that is supposed to be accommodated in the unit.

(5) ECG/Cardiology

The request includes cardiac catheter angiography for the diagnosis and surgical treatment of heart diseases, electrocardiograph and ultrasound scanner for the diagnosis of basic heart diseases, and other equipment which will replace existing equipment. Since the existing items are of old models and have been used for more than 10 years, they are considerably inferior to the newest models in terms of performance and efficiency. These items will be replaced by one set of a new system.

(6) Renal Unit

The request includes hemodialysis unit, peritoneal dialysis unit, and other equipment for the treatment of severe renal diseases. Because of irreparable damage, the existing equipment is always insufficient in number. As it is considered necessary, 10 hemodialysis units and related equipment will be procured.

(7) Biomedical Engineering Service

The request includes multi-tester, oscilloscope, ohm-meter, and other items for the repair and test of medical equipment. Existing tools and instruments are insufficient in number and variety, and several engineers must share one machine. As the requested tools and instruments will allow rapid response to unexpected needs for repair, the request is considered appropriate. In view of the frequency of use, one or two units will be shared. Items used routinely will be procured in appropriate numbers.

(8) T.S.S.U.

The request includes ultrasonic cleaner for operation instruments, grinder for operation instruments, dryer and powdering machine for surgical gloves, and other equipment for the cleaning of tools and materials used in the operating rooms. Since existing equipment is out of order, all cleaning processes

are conducted by manual labor at present. These items will be renewed in the same numbers as the existing equipment.

(9) C.S.S.D.

Similar to T.S.S.U., the washing of equipment and materials is performed by hand and the capacity is always insufficient. The equipment will be renewed in the same numbers as the existing equipment.

(10) Casualty

The request includes defibrillator, suction unit, oxygen inhalation equipment, and other equipment which are necessary in emergency and life-saving care. This department is, as a whole, provided necessary equipment for medical services, but the quantity are not sufficient. Because each of these items is used in several consultation rooms, it is consumed long time for consultation and clinical activities are impeded considerably. Furthermore, the operating tables for minor surgery are not in good condition and can be used only for very simple operations. The equipment will be procured to be installed in 8 consulting rooms and 2 minor operating rooms. As for the items that can be shared, they will be procured in the smallest number required.

The main equipment listed in the followings requires the revision of the level and quantity because of the reasons described.

Planned Equipment	Requested Quantity	Changes and Reasons
Radiotherapy simulator	Repair	In view of cost and durability, it is difficult to repair and continue to use the existing unit, which is superannuated and has many damaged parts.
C-arm surgical x-ray TV equipment	1 set	It was planned to be installed in Casualty Unit. However, there is uncertainty about the place of installation and personnel, and the equipment in Radiology Department can be shared. There is no urgent need for this equipment in this project.
Cardioangiography	1 set	A biplane unit is requested. However, the necessity of this function should be reconsidered in view of the space in the examination room and the convenience of use.
Hemodialysis units	20 sets	The space of the dialysis room is sufficient to accommodate 20 units. However, the number should be revised in view of the capacity of the water purifying apparatus and the number of existing units (8 sets).
Operating room lamps	0	Because operating room lamps were mistaken to be accessories to the building, they were considered to be procured with the World Bank's project. However, they are excluded from the World Bank project as purely medical equipment. Procurement of these lamps should be considered, as they are indispensable in operating rooms.
Operation instruments	about 130 types	These should be grouped into several types of instruments in view of the convenience of management.

3.2.7 Necessity of Technical Cooperation

The maintenance of all medical equipment at Kenyatta National Hospital is conducted by Biomedical Engineering Services. Although this Services has fairly adequate organization and personnel, the system for the maintenance and management of equipment is hardly

sufficient including that for the equipment to be procured under this project. If the procured equipment should be utilized for a long time, expert should be sent to the hospital to provide technical training concerning maintenance. Technical training should be provided in the methods of routine maintenance, routine inspection, methods of trouble shooting, procedures of repair, procurement of spare parts, and the recommendation to cope with unrepairable cases. Kenyan engineers should be trained by the manufacturers of certain apparatuses such as radiological equipment and automatic chemical analyzer.

3.2.8 Basic Policy of Implementation of Cooperation

This project is intended to help provide the Kenyan people with high-quality medical services by assisting the improvement of Kenyatta National Hospital, which is positioned at the top of the national medical system and playing a key role in the health services in Kenya, and thus assisting the Kenyatta National Hospital Rehabilitation Project promoted by the Ministry of Health. Many of the medical equipment installed at this hospital are considerably exceeding the service life. The loss of performance due to superannuation, damage, and malfunction are causing serious shortage of equipment.

Because of the following reasons, it is judged that this project is appropriate to be promoted under the Japan's grant aid assistance.

- (1) The project is intended to enrich the health care activities of the only top-referral hospital in Kenya through the renewal of medical equipment and the replenishment of the shortage of medical equipment due to the growth of population. This assistance is expected to restore the functions of the hospital which the hospital once had.
- (2) The hospital is currently operated and there will be no need for the deployment of additional manpower or budgetary arrangement.

(3) The examination previously mentioned has proved the effectiveness and feasibility of this project, as well as the preparedness and capability of the Kenyan counterpart in this project.

(4) The scale and the effects of this project are compatible with the criteria for the Japan's grant aid system.

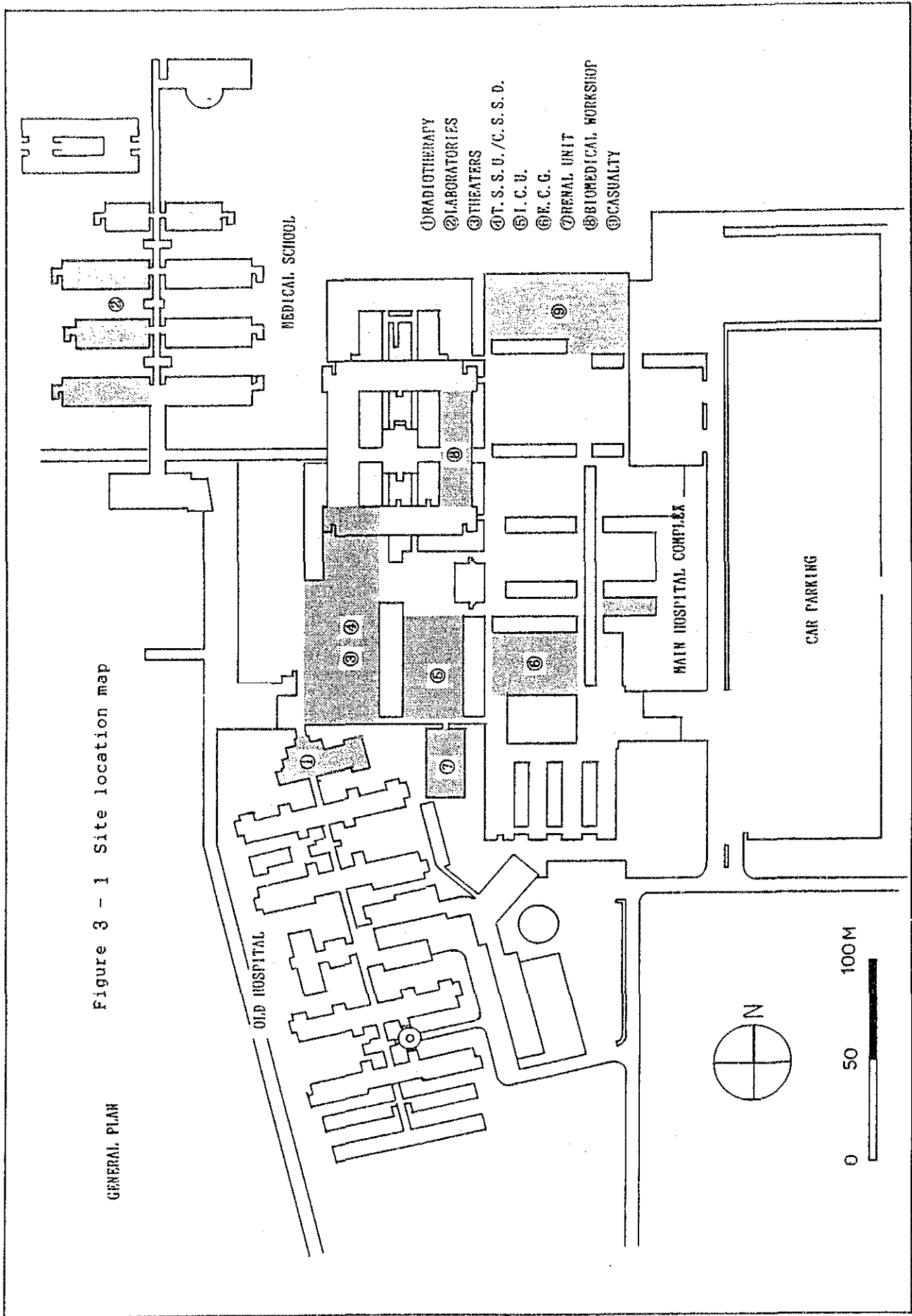
Therefore, the outline of the project is examined as described in the following sections and the basic designs are worked out. However, as mentioned above, it is considered necessary to change a part of the request.

3.3 Outline of the Project

The plan of the project site where the equipment will be installed under this project is as shown in Fig. 3-1.

Figure 3 - 1 Site location map

GENERAL PLAN



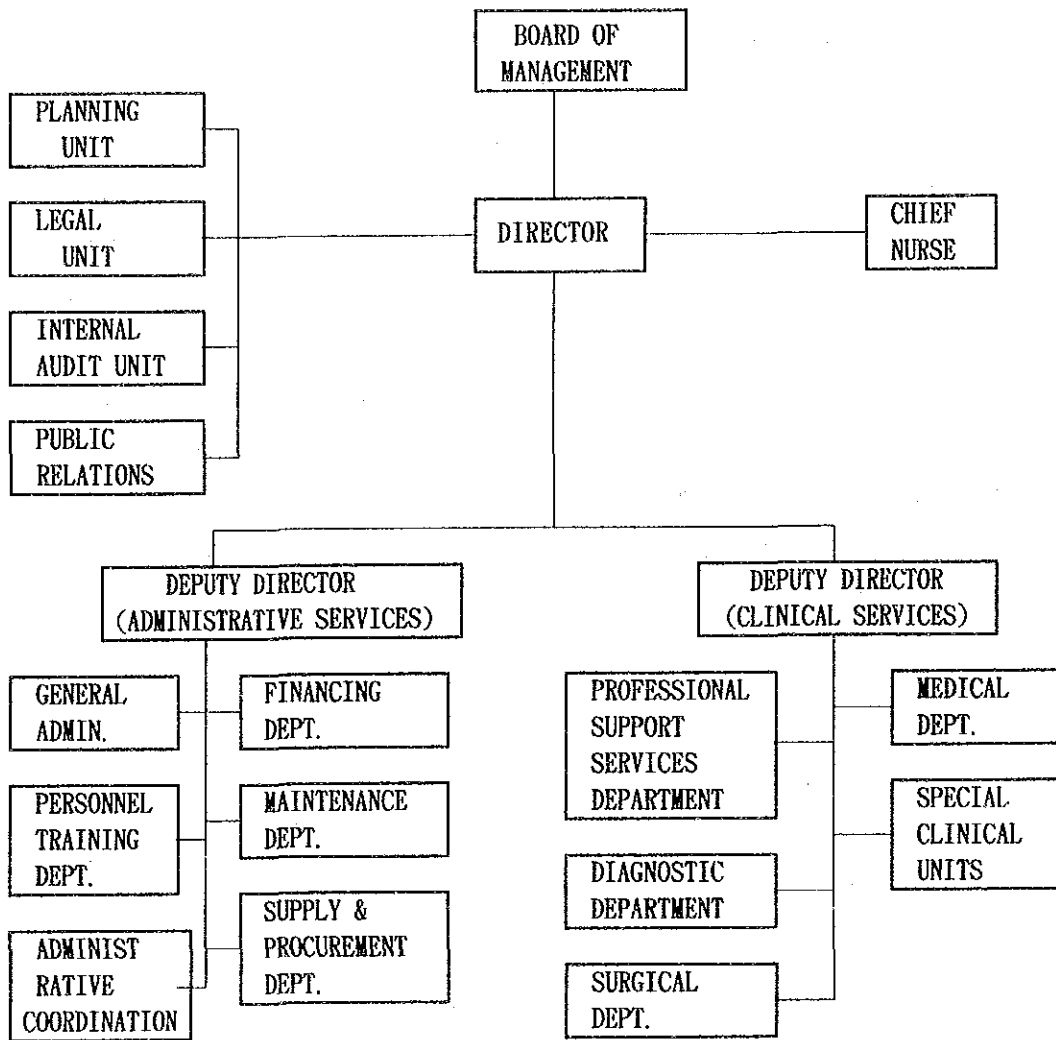
3.3.1 Executing Agency and Its Management Organization

(1) Organization of Kenyatta National Hospital

Unlike other public hospitals, the operation of Kenyatta National Hospital is conducted by the Board of Management, which is an autonomous body under the control of the Ministry of Health. The members of the Board are professors of the university, officials from the Ministry of Health, entrepreneurs, and the Director of the hospital.

Kenyatta National Hospital is operated by an autonomous management system under the Board of Management. The Director controls Administrative Services and Clinical Services, each of which is led by a Deputy Director. Fig. 3-2 shows organization chart of KNH.

Fig. 3-2 Organization Chart of KNH



(2) Management Organization

1) Medical Personnel

Table 3-18 summarizes the number of staffs in each department and unit. Most of the equipment procured under this project is intended to be used in Clinical Services. Of the personnel in Clinical Services, 2,623 persons are involved in this project.

Table 3-18 Staff Allocation

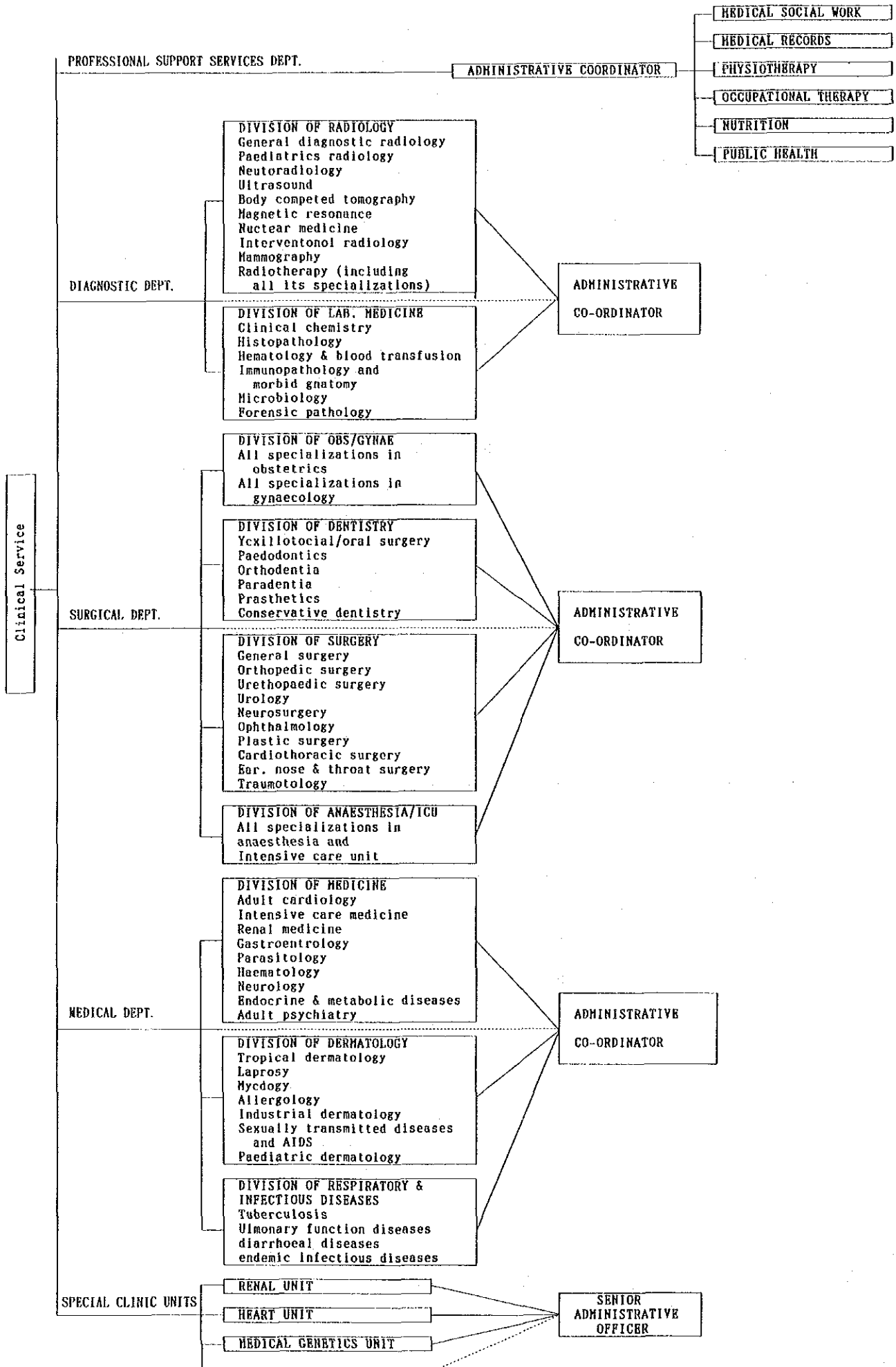
No. of Medical Personnel of KNH		Total 3,359人	1990年
Administrative Service Total 736		Clinical Services	Total 2,623
General Administration	42	Medical Records	67
Personnel Dep.	69	Pharmacy	95
Accounts Dep.	46	Casualty	189
Catering Dep.	49	Social Work	8
Supplies Dep.	85	Health Education	5
Maintenance Dep.	142	Medicine	293
Laundry Dep.	76	Obs/Gyn.	211
Legal Dep.	1	Laboratory	239
Internal Audit	1	Anaesthesia	148
Security Dep.	76	Surgery	462
Transport Dep.	40	Radiology	364
Telephone Exchange	29	Pediatrics	255
Domestic Services	63	Dental Unit	73
Secretarial Staff	17	Amenity Ward	51
		I. D. H.	143
		Workshop/Orthopaedic	20

Source: MOH

2) Organization of Clinical Services

Fig. 3-3 shows the organization of Clinical Services and the activities of the Services. T.S.S.U. and C.S.S.D., which are not directly involved in clinical care, belong to Administrative Services.

Figure 3-3 Organization of Clinical Service



3.3.2 Plan of Operation

This project is positioned as a part of the Five-Year Project for the Rehabilitation of Kenyatta National Hospital implemented by the Ministry of Health. Under the Five-Year Project, this project complements the World Bank's Rehabilitation Project in the procurement of equipment which is difficult to obtain in Kenya and urgently needed to be repaired, renewed, or replenished because it has become unusable or functionally deteriorated due to superannuation. The project intends to improve diagnostic and therapeutic activities in Radiation Therapy, Laboratory, ECG/Cardiology, and other divisions of Kenyatta National Hospital, as outlined below.

Table 3-19 Operating Plan in Each Division

Division to be Improved	Contents of Improvement
1) Radiation Therapy	Additional cobalt therapy equipment is installed. The long waiting list of patients is eliminated to allow early treatment so that the effectiveness may be improved.
2) Laboratory	The capacity of handling samples is increased to be able to accept test samples from lower medical facilities and private hospitals. The tests for private hospitals should be charged.
3) Operating Theater	The 12 operating rooms are improved to be capable of various types of operation.
4) T.S.S.U.	The capacity of sterilization is improved to respond to the expansion of the services of Operating Theaters.
5) C.S.S.D.	The capacity of sterilization is improved to respond to the expansion of the services of Casualty and other divisions.
6) Intensive Care Unit	The capacity to accept patients is increased.
7) ECG/Cardiology	High-performance equipment is introduced to shorten the time required for diagnosis and to accept more patients.
8) Renal Unit	Only 8 hemodialysis units are operated at present. These units are replenished to provide treatment to all patients.
9) Biomedical Engineering Services	Tools and instruments for the maintenance of electronic medical equipment are provided.

Division to be Improved	Contents of Improvement
10) Casualty	Medical equipment is installed in each consultation room to allow rapid diagnosis and treatment of 2,600 outpatients arriving everyday.

Source: MOH

3.3.3 Outline of Equipment

On condition that the Japan's grant aid assistance is extended to the project, the following equipment is necessary to be included in the project based on the results of the examination described in 3.2.

- ① Renewal is needed urgently because of considerable loss of performance due to superannuation.
- ② Renewal is needed because the spare parts for damaged equipment are not available since the manufacturer's gurantee has expired.
- ③ Replacement or replenishment is needed because of considerable loss of therapeutic effectiveness due to the loss of performance of superannuated equipment or old model equipment.
- ④ Replenishment is needed because of the shortage of equipment due to an increase in the number of patients.
- ⑤ Replenishment is needed as the equipment is extremely insufficient in number because of the expiration of the service life or damage.

Table 3-20 Purpose of Proposed Equipment

Division name Equipment name	Qty.	Reason marked ①~⑤ of above criteria	Purpose of Use and Expected Effects
Radiation Therapy			
Cobalt-60 irradiation therapy unit	1	④	Use for radiotherapy against malignant neoplasm. Combination with surgical treatment can give high efficacy even in the patients with stage 3 cancer. One unit will be installed in a room where the condition for installation has been prepared.
Intracavity machine	1	③ ④	Use chiefly for the treatment of malignant neoplasm in the body cavity, such as cancer of the uterus. By means of remote control, irradiation is given from the vicinity of the affected area to obtain high efficacy. The use of cesium-137, which has a half life of as long as 30.2 years, provides economical advantage. One unit will be installed as the renewal of the existing unit.
Superficial X-ray equipment	1	③ ④	Use for the treatment of malignant neoplasm which is located to deep to be treated with cobalt irradiation and that located superficially. The therapy is effective against various types of cases from tumors in the head or lower abdomen to skin cancer. One unit will be installed as the renewal of the existing unit.
Water phantom	1	③	Use for the calibration of cobalt radiation source. The confirmation of the irradiation conditions is essential for effective treatment.
Anesthesia machine	1	②	Use for relieving the pain of the patient when the radiation source of the internal radiotherapy unit is inserted toward the affected part. The use of the anesthesia machine reduces the load on the patient.

Division name Equipment name	Qty.	Reason marked ①~⑤ of above criteria	Purpose of Use and Expected Effects
X-ray Simulator	1	③	Use to confirm the location of the affected part before radiotherapy. Accurate location of the affected part provides better efficacy.
Treatment Planning System	1	③	Use in planning radiotherapy against malignant neoplasm. The dose, duration, area, direction, and frequency of irradiation are determined using a computer. Accurate determination of therapy plan enables effective treatment. One unit will be installed as the renewal of the existing unit.
2) Laboratory			
Automatic chemistry analyzer	1	①	Use for the biochemical analysis of blood enzymes (diagnosis of angina pectoris), sugar, lipid, protein, etc. and that of urine. Automated analysis provides stable test results and accurate diagnosis. One unit will be installed as the renewal of the existing unit.
Refrigerated centrifuge	2	①③	Use for the low-temperature separation of blood to extract serum and plasma. The unit can treat a large quantity of blood in a short time. Plasma exchange is used against fulminant hepatitis. One unit each will be installed in Biochemistry Laboratory and Casualty Laboratory.
Spectrophotometer	3	②③	Use for the analysis of blood protein and nucleic acid. Use for the determination of diagnosis. One unit each will be installed in Biochemistry Laboratory, Casualty Laboratory, and Infectious Disease Ward Laboratory

Division name Equipment name	Qty.	Reason marked ①~⑤ of above criteria	Purpose of Use and Expected Effects
Tissue embedding system	1	⑤	Use in the preparation of specimens for histopathological examination and pathologic anatomy. Samples are embedded in paraffin before they are thin-sectioned for microscopic observation. The machine can handle a large number of specimens in a short time.
Automatic knife sharpener	1	⑤	Use to sharpen the microtome knife which cuts the thin-sections for microscopic observation. Automatic sharpening speeds up the treatment of the knife, and the knife can be used repeatedly for a long period.
Automatic staining machine	1	④⑤	Use to stain specimens fixed on microscopic slides and treat them for microscopic observation. Automatization of the complicated process of slide staining saves manpower.
CO ₂ incubator	1	③	Use in the stationary culture of animal (human) cells to aerate the medium with CO ₂ to keep appropriate pH. The apparatus keeps the environment for the growth of animal cells, which are more delicate than microbes. Effective in the basic examinations in cell biology, genetics, virology, and pharmacology. One unit will be installed as the renewal of the existing unit.
Double head microscope	1	⑤	A microscope with which plural persons can observe the same specimen at the same time. Used chiefly for educational purpose and the consultation on diagnosis. It is an indispensable item for the training of medical staff and student.

Division name Equipment name	Qty.	Reason marked ①~⑤ of above criteria	Purpose of Use and Expected Effects
Blood gas analyzer	2	②③	Use to measure the partial pressure of oxygen and carbon dioxide in blood. Used for diagnosis in clinical pathological examination and in the respiration management of patients under intensive care. As the unit enables accurate understanding of the patient's conditions, it provides effective treatment. One unit each will be installed in Biochemistry Laboratory and Casualty.
Semi-Auto Chemistry Analyzer	4	③	Use for the biochemical analysis of oxygen, sugar, lipid, protein, etc. in blood. The semiautomatic unit is economical because it consumes less reagents and diluting solution. A limited number of test items can be analyzed immediately on the spot. One unit each will be installed in Hematology Laboratory, Immunology Laboratory, Intensive Care Unit, and Infectious Disease Ward.
3) Operating Theaters			
Cardiac monitor	3	⑤	Monitors the heart functions of the patients during and after operation. The unit alarms the nurses and /or medical staff and care providers whenever the values exceeded the preset ranges. The units will be shared by the 12 operating rooms.
Respirator	2	⑤	Use to assist the patient's respiration during and after operation. The unit can save the life of patients who have difficulty in natural/normal respiration and who are in respiratory arrest. One unit each will be installed in operating rooms and recovery room.

Division name Equipment name	Qty.	Reason marked ①~⑤ of above criteria	Purpose of Use and Expected Effects
Artificial heart-lung machine	1	③	Use to maintain gas exchange and circulation during heart surgery. This machine is indispensable in open heart surgery.
Operating table	7	①	The patient is placed on the table top and the table top is moved and transformed to achieve various positions for the surgery of chest, abdomen, limbs, etc. Of the 12 operating rooms, 7 severely deteriorated tables will be replaced.
Resuscitation trolley	1	④	Use in recovery room for life- saving care. The unit is equipped with defibrillator, oxygen resuscitator, etc. and can treat a patient in cardiac and respiratory arrest.
Broncho fiberscope	1	④	Use for the diagnosis of lung diseases, pulmonary tuberculosis, and other chest diseases and the detection and removal of foreign materials in the bronchus.
Rectoscope	1	④	Use for the diagnosis and treatment of diseases in the rectum and the sigmoid colon within 25cm from the anus.
Cystoscope/ Urethroscope set	1	③	Use for the diagnosis and treat- ment of diseases in the urethra and the bladder. Used for ureteral catheterization, incision of the ureteral opening, and removal of ureteral stone.
Bone surgery instrument set	2	④	Use for the surgical treatment of bone. Bone is reinforced with steel plates.
Orthopedic surgery instrument set	1	④	Deformed broken bone is treated with supportive devices.
Gastric endoscope	1	④⑤	Use for the diagnosis and treatment of diseases in the stomach and the esophagus. Endoscopic examination using fiberscope reduces the suffering of the patient.

Division name Equipment name	Qty.	Reason marked ①~⑤ of above criteria	Purpose of Use and Expected Effects
4) T.S.S.U.			
Ultrasonic instrument washer	1	②	Removes dirt from operation instruments and other steel tools and glassware with the action of ultrasound waves. Pre-washed tools are placed in the basin and ultrasound is applied. Dirt in narrow complicated parts can be removed. One unit will be installed as the renewal of the existing unit.
Surgical gloves drying and powdering machine	1	②	Rubber operating gloves are dried after washing and powdered. Powdered gloved can be re-used. One unit will be installed as the renewal of the existing unit.
Hot air oven	2	③	Use for sterilizing metal, porcelain, or glass items and for drying and sterilizing glass ampoules and vials. Two units will be installed and operated alternately to allow continuous sterilization.
5) C.S.S.D.			
Hot air oven	2	②	Use for sterilizing metal, porcelain, or glass items and for drying and sterilizing glass ampoules and vials. Two units will be installed and operated alternately to allow continuous sterilization.
Ultrasonic instrument washer	1	②	Removes dirt from operation instruments and other steel tools and glassware with the action of ultrasound waves. Pre-washed tools are placed in the basin and ultrasound is applied. Dirt in narrow complicated parts can be removed. One unit will be installed as the renewal of the existing unit.

Division name Equipment name	Qty.	Reason marked ①~⑤ of above criteria	Purpose of Use and Expected Effects
Surgical gloves drying and powdering machine	1	②	Rubber operating gloves are dried after washing and powdered. Powdered gloves can be re-used. One unit will be installed as the renewal of the existing unit.
6) Intensive Care Unit			
Nurse station central monitoring system (for 8 patients)	1	②	Use to monitor the heart and respiratory functions, body temperature, etc. of patients under intensive care. The monitoring unit will be installed in the nurse station so that the conditions of the patients can be monitored centrally.
Autoclave	1	②	Use for therapeutic instruments. The unit enables immediate sterilization of urgently needed instruments without depending on C.S.S.D
Emergency trolley	2	④	Use in recovery room for life- saving care. The unit is equipped with defibrillator, oxygen resuscitator, etc. and can treat a patient in cardiac and respiratory arrest.
7) ECG/Cardiology			
Angio-Cardiography system	1	①③	Use for the diagnosis of cardiac blood vessels in angina pectoris, myocardial infarction, etc. Because no direct information can be obtained from electrocardiography, measurement of serum enzymes, and the measurement of the electric phenomena of the heart using nuclear medicine, contrast medium is infused through a catheter and fluoroscopic observation is conducted to obtain accurate information for the diagnosis and surgical treatment of stenosis and other abnormal conditions of cardiac blood vessels.

Division name Equipment name	Qty.	Reason marked ①~⑤ of above criteria	Purpose of Use and Expected Effects
Ultrasound scanner	1	④	Examines fat, organs, bone, etc. in the body using Doppler effect of ultrasound waves. The sector-type detector examines the heart from between chest bones.
8) Renal unit			
Hemodialysis machine	10	③④⑤	Use for hemodialysis in the patients with renal insufficiency. Urea and other waste matters are removed from the patient's blood across a semipermeable membrane. The unit is indispensable for maintaining the life of patients with severe renal insufficiency. While 8 units are operated at present, 2 units which tend to fail will be replaced.
Peritoneal dialysis cyclers	4	③④⑤	Dializing fluid is injected into the peritoneum of the patient with renal insufficiency and removed after a while so that urea and other waste matters are removed from blood. The unit is indispensable for life-saving care of patients with severe renal insufficiency. Four existing units which tend to fail will be replaced.
Defibrillator	1	⑤	Use for treating patients who presented fibrillation of the heart due to heart failure. High-voltage pulses are applied to the chest to remove fibrillation and restore normal pulsation. The unit is intended to treat heart attack during dialysis. 1 unit which tend to fail will be replace

Division name Equipment name	Qty.	Reason marked ①~⑤ of above criteria	Purpose of Use and Expected Effects
9) Biomedical Engineering			
Oscilloscope	2	⑤	Use for the examination of circuits and functions of electric equipment. This instrument is indispensable for the maintenance of X-ray equipment, ultrasound scanner, and other equipment having electronic circuitry. One unit each will be installed for radiology equipment engineer and electric medical equipment engineer.
Frequency counter	1	⑤	Use for the waveform examination of waveform of high-voltage generator, the examination of A/C power control circuit, the waveform examination of switching power source, etc. Used for maintenance tests of X-ray equipment and other electronic equipment having micro computers. One unit will be installed.
10) Casualty			
Defibrillator	2	⑤	Use for treating patients who presented fibrillation of the heart due to heart failure. High-voltage pulses are applied to the chest to remove fibrillation and restore normal pulsation. One unit each will be installed in Casualty Unit and Casualty Operating Room.
Bedside monitor	2	⑤	Use to diagnose myocardial infarction, angina pectoris, coronary insufficiency, and other ischemic heart disease and to monitor the conditions of the myocardium in hypertension cardiomegaly, valvular heart disease, and idiopathic cardiomyopathy. As the identification of disease becomes possible before close examination, efficient therapeutic activities are made possible.

Division name Equipment name	Qty.	Reason marked ①~⑤ of above criteria	Purpose of Use and Expected Effects
Operating table	2	①	Use for operation on emergency patients. Chiefly used for minor surgery and orthopedic surgery. These will be installed in 2 operating rooms.
Anesthesia machine	1	①	Use in minor surgery. By performing simple operations in Casualty Unit, the load on the central operation rooms can be reduced. Of the 2 operation rooms, the machine in one room which tends to fail will be replaced.
Operating room lamp	2	①	Use for illumination during operation. Shadows under the hands of surgeons are eliminated by the use of multiple light sources. These will be installed in 2 operating rooms.

3.3.4 Costs of Operation and Maintenance

The costs of the operation of the equipment procured under this project are as shown in the followings. The calculation of these costs is based on the standard prices (as of April, 1992).

(1) Costs of Therapy and Diagnosis

1) Costs of Therapy and Diagnosis

In order to support routine medical services, the hospital must expense the costs of medical supplies, the costs of nursing supplies, and the costs of the purchase of reagents and drugs. These include direct costs such as those related to endoscopy and general laboratory examination, as well as indirect costs such as those related to operation materials and inpatients. However, so long as a currently existing institution continues to provide medical services at the same level as before, there will be no need for additional financial arrangement. Even when the effectiveness of health care is assumed to be increased by 10-20% (as estimated from the proportion of procured equipment to existing equipment) as the result of the procurement of new equipment, the amount corresponding to this increase will not exceed 1% of the total budget of Kenyatta National Hospital. Therefore, these costs will not be considered in this section, except for the costs of certain equipment (as mentioned later). The table below summarizes an estimation of the costs which are directly and indirectly related to diagnosis and therapy by the introduction of the equipment to be newly procured under this project. (Although a part of the medical care provided by Kenyatta National Hospital is charged, the medical care charge differs according to the social class of patients. For this reason, the estimation is based on the amount of fees concerned in Japan and 5% of this amount is substituted as the net material costs.)

ITEM	Number of Cases/Year	Total (1000 Ksh)
Endoscope Examination		
Bronchoscopy	Average 40	5.0
Esophagoscopy	" 50	7.0
Gastro Fiberscopy	" 50	7.0
Cystoscope	" 30	5.0
Clinical Test (Except test with auto-analyzer)	" 200,000	2,222.0
Anatomical Pathology Test	" 4,700	78.0
Surgical Materials	" 15,000	6,750.0
Out-patient Material	Approx. 650,000	21,666.0
In-patient Material(Including ICU)	" 550,000	12,222.0
	TOTAL	103,716.0

(2) Costs of the Operation of Equipment

The costs of the operation and maintenance which will be needed as a result of the procurement of equipment under this project are estimated as shown below. However, since most of the procured equipment is intended to replace existing superannuated equipment or that became broken recently and cannot be repaired, maintenance budget will not be increased and also there is no need to allocate additional budget for this purpose.

Electricity cost:	Approx. Ksh.	18,400
Gas for Anesthesia Apparatus:	" "	36,400
Consumables for Medical Equipment:	" "	9,493,900
TOTAL:	Approx. Ksh.	9,548,700

The rationale for the estimation of these costs is shown below.

<u>Public Rates</u>			
Electricity	Ksh. 1.43/Kwh		
Water	0~9,000 Litter	Ksh. 4.00/1000 Litter	
	9,001~18,000 "	" "	6.00 "
	18,001~30,000 "	" "	8.00 "
	30,001 Litter Up	" "	10.00 "
Sewerage	0~18,000 Litter	Ksh. 3.00/1000 Litter	
	18,001~30,000 "	" "	3.50 "
	30,001 Litter Up	" "	4.25 "
<u>Fuel</u>			
Gasoline	Ksh. 20/Litter		
Diesel	Ksh. 12/Litter		
<u>Medical Gas</u>			
Oxygen	6.8m ³ Cylinder(L)	Ksh. 248.00	
	1.36m ³ " (S)	" "	62.00
Nitrous Oxide	16,560 Litter	"	4,103.50
Medical Air	6.2m ³	"	146.30
<u>Consumables</u>			
X-ray film 14"x17"	50 pieces	Ksh. 2,000	
Film developing solution for auto	40 Litter	Ksh. 1,400	
	for manual 60 Litter	"	450
Fixing solution for auto	35 Litter	"	800
	for manual 5 Litter	"	600
Dialyzer	1 pack	Ksh. 500	
Peritoneal Dialysis, Solution	10 Litter	Ksh. 500	

2) Cost of Electricity

The average monthly usage of electricity and the cost of electricity are as shown below.

Cost of electricity..... 784,936 Kenya shillings/month in average
(about 3,532,000 yen).

Break down: Average monthly usage of electricity: 481,860 kWH
Average monthly power loss: 1,300 kWH
Price of electricity: 1.43 Kenya shillings/kWH
Price of power loss: 45 Kenya shillings/kWH

Calculation: Cost of electricity: 481,860 kWh x 1.43 Kenya shillings
= 689,060 Kenya shillings
Cost of power loss: 1,300 kWh x 45 Kenya shillings
= 58,500 Kenya shillings
Added value tax 5%: 37,378 Kenya shillings

* Price and cost of Power loss means additional charge on the loss of power due to the trouble in the transformer on the incoming line or other electric equipment.

The followings are the list of main units procured under this project which consumes much electricity. These units consume as little as 2.33% of the total amount of electricity consumed at Kenyatta National Hospital, and thus have little effect on the maintenance budget of the hospital.

Equipment	Quant.	Power consumption KW/H.	Operation time/day	Operation day/month	Power consumption KW/month	Remarks
Cobalt 60 radiation unit	1	5.0	2.0	22	220	10 patient/day 12 min. /treatment
X-ray Simulator	1	25.0	2.0	15	750	6 patient/day 20 min. /treatment
Superficial X-ray Machine	1	25.0	2.0	15	750	9 patient/day 10 min. /treatment
Clinical Chemistry Analyzer	1	1.0	6.0	22	132	300 tests/day
Refrigerated centrifuge	2	1.8	1.0	30	108	24 hrs. continous
Hot Air Oven	14	4.0	3.5	22	4,312	
Deep Freezer	3	1.5	12.0	30	1,620	24 hrs. continous
Autoclave	5	5.0	2.5	22	1,375	2 times/day
CO ₂ Incubater	1	1.5	1.0	10	15	1 time/day
Blood Gas Analyzer	2	0.3	24.0	30	432	24 hrs. continous
Portable Suction Unit	16	0.2	2.5	22	176	
Operating Room Lamp (Major)	9	1.0	4.5	22	891	1 time/day
Operating Room Lamp (Casualty)	2	0.8	4.5	30	216	3 times/day
Ultrasound Cleaner	3	1.3	3.0	22	257	3 times/day
Cardiac Angiocardigraphy System	1	30.0	1.0	10	300	1 time/day
Ultrasound Scanner	2	0.5	3.0	22	66	6 patient/day 30 min. /inspec.
Hemodialysis Machine	10	0.6	8.0	22	1,056	40 patient/day
Peritoneal Dialysis Cyclers	4	0.3	4.0	22	105	8 patient/day
TOTAL					12,781KW	

2) Cost of Water and Sewerage

The average cost of water and sewerage is as shown below.

Cost of water and sewerage: 510,000 Kenya shillings/month in average.

Breakdown: Average monthly usage: 36,000 m³

Water charges: 10 Kenya shillings x 36,000 m³
= 360,000 Kenya shillings

Sewerage charges: 4.25 Kenya shillings x 36,000 m³
= 153,000 Kenya shillings

None of the equipment procured under the project requires much supply and drainage of water. There will be virtually no effect on the total amount of water and sewerage charges.

3) Medical Gases

One anesthetic machine is planned to be procured under this project.

If this machine is operated for 2.5 hours a day in average and 22 days in a month, the annual consumption and the cost will be as follows:

① OXYGEN	
2 Litters/min. x 150 min. = 240 litters x 22 days x 12 month = 57,600 litter/year	
79,200 litter ÷ 1,360 litter/cylinder = 60 cylinders approx.	
Gas charge cost : Ksh. 62 X 60 cylinder = Ksh. 3,720	
② NITROUS OXIDE	
4 litter/min. x 120 min. ⇒ 480 litter x 22 days x 12 months = 126,720 litter/year	
126,720 litter ÷ 16,560 litter = 8 cylinders approx.	
Gas charge cost : Ksh. 4,103/cylinder X 8 cylinders = Ksh. 32,824	
TOTAL COST FOR MEDICAL GASES	Ksh. 36,544

4) Consumables

① RADIATION THERAPY	
X-RAY FILM 10 films/day	
10 films/day x 240 day/year = 2,400 films/year x Ksh. 40/film	
= Ksh. 96,000	

Film Developing Cost	
Ksh. 1,050 (Developing solution : Ksh. 450	
+ fixing solution: Ksh. 600) / 600 films	
.....Ksh. 1.75/film	
2,400 film/year X Ksh. 1.75 ⇒ Ksh. 4,200	

TOTAL	Ksh. 100,200

② E. C. G. /CARDIOLOGY	
E. C. G. Paper 2 rolls/month = 24 rolls/year	
24 rolls X Ksh. 60 / 1 roll = Ksh. 1,440	

Cine Film for Angiocardiography	
1 film/day X 286 days ⇒ 286 rolls	
Ksh. 450/roll X 286 rolls ⇒ Ksh. 128,700 (including cost of development)	

TOTAL Cost for X-ray consumables Ksh. 130,140	

③ LABORATORY	
Clinical Auto Analyzer : Reagent 2,500 tests/1 set	
300 test/day X 286 day ⇒ 85,800 tests ÷ 2,500 tests/1 set ⇒ 34 sets	
Reagent : Ksh. 1,800/set X 34 sets = Ksh. 61,200	

Blood Gas Analyzer : Reagent, CO ₂ Gas	
1,000 tests/1 set + CO ₂ gas - 1 cylinder	
20 test/day X 286 days ⇒ 5,712 tests ÷ 1,000 test/set ⇒ 6 sets	
Reagent : Ksh. 3,000 + CO ₂ Gas: Ksh. 1,200 = Ksh. 4,200	
X 6 sets X 2 units ⇒ Ksh. 50,400	

TOTAL	Ksh. 111,600

④ RENAL UNIT	
Dialyzer Tube, Solution : Ksh. 3,200/set	
2 patients/day/unit X average 5 unit/day ⇒ 10 patient X 286 days	
⇒ 2,860 patient/day X Ksh. 3,200 = Ksh. 9,152,000	

Medical Consumables TOTAL	Ksh. 9,493,940

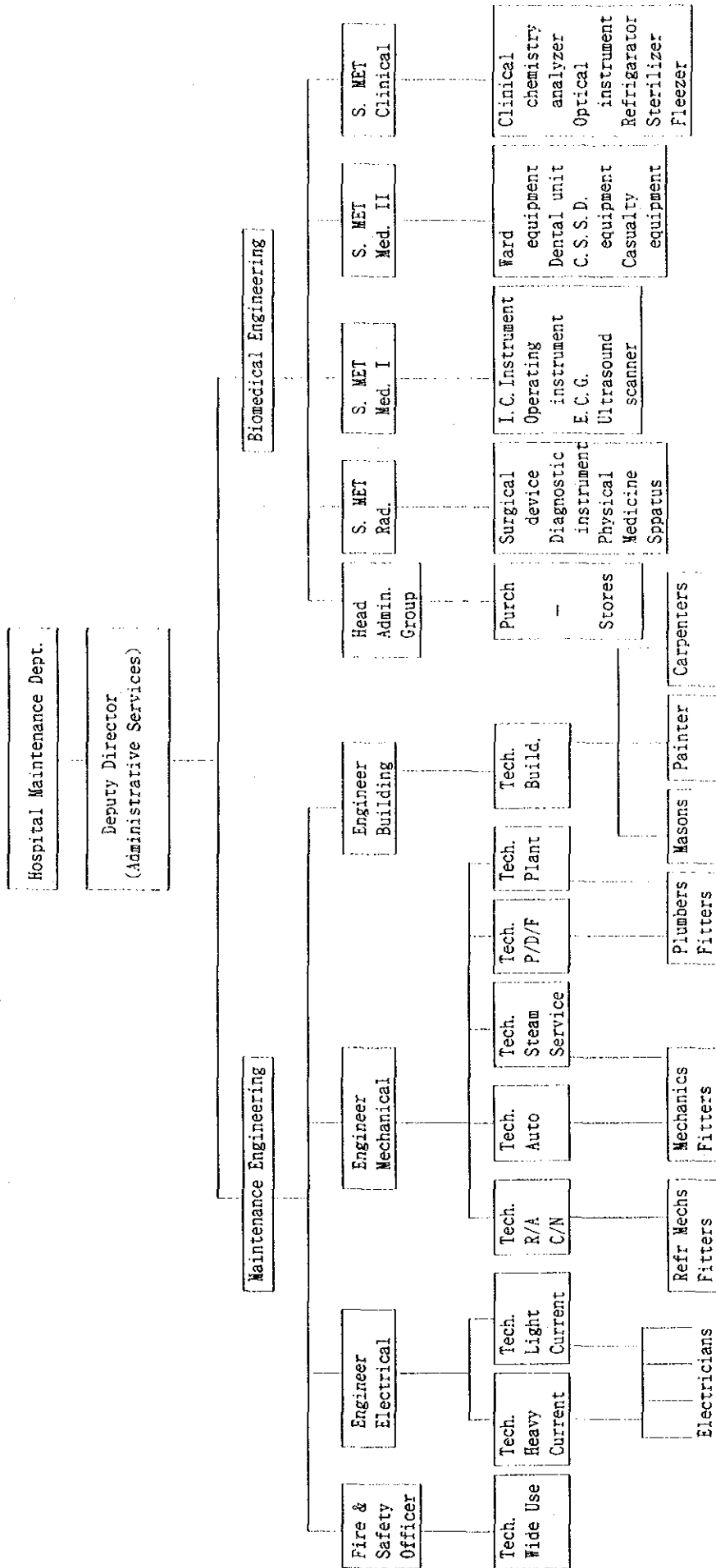
3.3.5 Operation and Maintenance System

As mentioned above, Kenyatta National Hospital at present has Biomedical Engineering Services under the control of Hospital Maintenance Department. However, since the engineers and equipment of the Services have been organized with more emphasis on general facilities than medical equipment, the maintenance of the latter is not fully supported by an adequate maintenance system. In relation to the execution of this project, it is considered necessary that the organization of Hospital Maintenance Department, the maintenance system, and the maintenance budget should be reorganized, reformed, and improved as follows.

(1) Reorganization of Hospital Maintenance Department

The conventional organization for maintenance has been working with horizontal linkage and cooperation among different sections. As a result of the fact that all sections are jointly responsible for the works conducted, this organization has a drawback that nobody takes responsibility in effect. An organization such as the one shown in Fig. 3-4 should be constructed in order to clarify the range of responsibility of each section and each engineer and to clarify the channels of command. In this organization, each engineer in charge of an equipment unit will be responsible for the routine inspection and the instruction to the operator concerning the proper use of the unit.

Figure 3 - 4 HOSPITAL MAINTENANCE ORGANIZATION STRUCTURE



(2) Innovation of the Maintenance System

According to the vertical channels of communication, the maintenance system should be organized as follows:

1) Recording System

The following recording forms should be provided in order to enable comprehensive and strict maintenance. These forms should be maintained for an individual unit of the equipment.

① Equipment Record Card

The registration number, date of procurement, position of installation, name of manufacturer, year of manufacture, model, service life, name of sales agent, conditions of maintenance contract, name of the section in charge, and other basic information should be recorded on this card and controlled centrally.

② Weekly/Monthly Works Sheet

Regular inspection should be conducted daily, weekly, and monthly according to the conditions of maintenance and the frequency of use. The results of inspection should be recorded on this sheet by the engineer who conducted inspection. The engineer should try to detect abnormal conditions and troubles so that serious troubles can be avoided.

③ Preventive Maintenance Work Order

Checking of periodically replaced parts and inspection of the performance and the working conditions of the equipment should be conducted at intervals of 6 months or 1 year. If there are damaged parts or parts requiring replacement, these should be recorded and adequate action should be taken.

④ Corrective Maintenance Work Order

On the request for repair, the personnel in charge of the equipment should conduct repair, referring to the results of previous regular inspection and previous repairs, and record the results of the work. The cost of repair should be charged on the relevant personnel in the field, so that they will be aware of costs.

2) System of Responsibility

① A person should be assigned to take charge of each equipment, and this person should control the above recording system with responsibility.

② Each section should assign an engineer in charge of equipment, who takes responsibility for the proper use and management of the equipment in the field.

③ Engineer in charge shall be given the authority to give advice and instruction concerning the proper handling of equipment to medical personnel in the field.

④ The engineer in charge of maintenance should take responsibility for the equipment which he is requested to repair until the completion of repair. If repair is impossible, the fact should be noticed to the relevant section with reasons and recommended measures.

Fig. 3-5 Communication Concerning the Request of Repair

Person in charge of the management of equipment

↓ Submit the request for repair.

Person in charge of medical equipment in a division

↓ Confirm the contents of the above request for repair and notify
↓ it to Biomedical Engineering

Biomedical Engineering Services

↓ Confirm the contents of the request for repair and assign the
↓ person to take charge of the repair.

Management Section of Biomedical Engineering

↓ Record the contents of request and notify to the person in
↓ charge.

Maintenance engineer in charge of the equipment

Person in charge of maintenance

↓ Record repair works, inspection, and the result of repair.
↓ Deliver the equipment via Biomedical Engineering to the section
↓ using it.
↓ If repair is impossible, write the reasons and recommended
↓ measures on the request sheet and return it to the person in
↓ charge of medical equipment in the division. Decide on
↓ necessary actions, such as the purchase of parts.

Biomedical Engineering Services

↓ Record the history of repair and the cost of repair.

Person in charge of medical equipment in a division

↓ Confirm the operation of the equipment and deliver it to the
↓ person in charge of the management of equipment.

3) Maintenance Budget

Tables 3-21 shows the actual budget result of Hospital Maintenance Services from fiscal year of 1990 to 1992. In 1992, the budget was increased about 10% of that in the previous year, reflecting the increased awareness for the importance of maintenance.

Table 3-21 Hospital Maintenance Services Actual Budget Result

(Unit: Kenya shilling)

Subject	1989/90	1990/91	1991/92
Machinery facilities maintenance	161,793	160,168	275,000
Office equipment maintenance	13,203	49,037	60,000
Facilities maintenance	145,864	134,484	110,906
Maintenance expense total	320,860	343,689	445,906

Source: MOH

Allocation budget (Table 3-22) shows the increase for medical equipment purchase expense and medical equipment maintenance cost, but some of equipment being procured under this project require maintenance services by the manufacturers and the cost of maintenance contract is calculated to be 7,400,000 Kenyan shilling (budget for this 450,000 Kenyan pound). After the one year's guarantee is over, Kenyan side should require to prepare the cost for this service. Regarding this cost Ministry of Health Plans to establish a special account based on National Hospital Insurance Fund (NHIF).

Table 3-22 Hospital Maintenance Services Allocation Budget

(Unit: Kenya shilling)

Subject	1991/92	1992/93
Vehicles purchase expense	0	60,000
Medical equipment purchase expense	0	250,000
Electricity	405,809	604,990
Water works and sewerage	400,000	480,000
Boiler fuel expense	800,000	1,170,000
Industrial gasoline	0	2,160
Facilities electricity maintenance cost	—	255,236
Facilities maintenance cost	110,906	865,500
Machinery facilities maintenance cost	275,000	172,132
Medical equipment maintenance cost	—	449,500
Business equipment maintenance cost	60,000	0
TOTAL	2,051,715	4,309,428

Source: MOH

Table 3-23 and 3-24 show an estimation of the annual costs of maintenance contracts and spot maintenance services.

In order to receive the maintenance services under contract continuously every year, 7.4 Million Kenyan shillings is required, which is equivalent to 5.4% of total allocation budget of 1992/1993 for the KNH excluding expenditure for personnel.

For securing these expenses, a special account of MOH is established, being separated from the normal budget, based on the income from National Hospital Insurance Fund.

Table 3-23 Service Charge of Maintenance

(Unit: Ksh)

Equipment required maintenance contract	Q' ty	No. of periodical check	Periodical check expense/year
Cobalt 60 radiation unit	1	Twice/year	647, 000
X-ray simulator	1	"	712, 000
Intracrabity machine remote after loading	1	"	474, 000
Superficial x-ray machine	1	"	184, 000
Auto clinical chemistry analyzer	1	"	430, 000
Blood gas analyzer	2	"	200, 000
Clinical chemistry analyzer	4	"	575, 000
Analyzer for soduim & potasium	5	"	215, 000
Central monitoring system	3	"	259, 000
Angiocardiography system	1	"	2, 733, 000
Hemodialysis machine	11	"	913, 000
Peritoneal dialysis cyclers	2	"	65, 000
TOTAL			7, 407, 000

Table3-24 Maintenance Cost of Equipment for Occasional Check

(Unit: Ksh)

Equipment required occasional maintenance	Q' ty	No. of periodical check	Periodical check expense/year
Ultrasound scanner	2	At least once/year	20, 000
Respirator	13	"	85, 000
Cardiac monitors	9	"	38, 000
TOTAL			143, 000

* It is assumed that maintenance contracts are conducted by local agents under the control of the manufacturers. Spot maintenance services are provided by local agents on request for repair.

3.3.6 Cooperation from Private Sector

(1) Current situation of Maintenance Services by Private Sectors

Almost no medical equipment is produced in the Republic of Kenya. The country depends for most of such equipment on the exportation from other countries. When a local agent of a foreign

manufacturer sells a machine, the agent and the customer, or a medical institution in this case, make various service contracts ranging from a spot repair contract, under which the agent visits the customer only when a trouble has occurred, to a comprehensive maintenance contract including regular inspection. The type of contract is determined according to the frequency of use, the grade of equipment, and the urgency of repair. Private medical institutions which have affluent financial resources enter into maintenance contracts for advanced medical equipment and receives nearly perfect services. The equipment installed at such private institutions is maintained in excellent conditions, and the machines are rarely out of order or out of use. Spare parts and supplies are also provided smoothly. One of the local agents provides the maintenance services for computerized, tomography X-ray units, and can be evaluated to have an acceptable level of technical skill.

(2) List of Local Agents of Manufacturers

Table 3-25 lists major local agents of medical equipment which is widely used in Kenya. These companies are based in the Nairobi metropolitan area, and have some past records of transaction with Kenyatta National Hospital.

Table 3-25 Local Agent of Main Medical Equipment

Company Name	Address	Main Handling Items
1. Nairobi X-ray Supplies	P. O. Box 41669 NRB	X-ray machine, Ultrasound scanner, ME equipment, Others
2. Philips (K) Limited	P. O. Box 30554 NRB	X-ray machine, Ultrasound scanner, ME equipment, Others
3. Achelis (K) Ltd.	P. O. Box 30378 NRB	X-ray machine, Ultrasound scanner, ME equipment, Others
4. United Import Agencies	P. O. Box 43951 NRB	X-ray machine, Ultrasound scanner, ME equipment, Others
5. Kodak (K) Ltd.	P. O. Box 18210 NRB	Automatic processor, Film
6. Harleys (K) Ltd.	P. O. Box 42718 NRB	Suction unit, Sphygmomanometers, Others
7. Kenya Bureau of Standard	P. O. Box 54974	
8. East African Oxygen	P. O. Box	Incubator, Anesthesia machine, Medical gas, Others
9. Harun International Ltd.	P. O. Box 10972 NRB	Dental unit, Others
10. Kenya Electronics Ltd.	P. O. Box	
11. Medical & Healthcare Industries	P. O. Box 60647 NRB	Electrosurgical unit, Suction unit, Operating table, Others
12. NIMIKAM	Box 46381 NRB	Hemodialysis machine, Others
13. Hoechst East Africa Ltd.	P. O. Box 30467 NRB	Hemodialysis machine, Others
14. Instrument Technology Centre Ltd.	P. O. Box 66911 NRB 751624	Inspection instrument, ME equipment
15. Coulter Electronics Ltd.	P. O. Box 25157 NRB	Blood gas analyzer, Blood cell counter
16. Avery (K) Ltd.	P. O. Box 30417 NRB	Analytical balance, Others
17. Scientronics (KENYA) Ltd.		Clinical chemistry analyzer, Inspection instrument
18. Sahaj Laboratory Supplies	P. O. Box 39130 NRB	Inspection reagent
19. Bayer Diagnostics	P. O. Box 30321 NRB	Clinical chemistry analyzer, Others
20. Sciencescope Ltd.	P. O. Box 72963 NRB	Microscope, Others, Optical instrument
21. Jos Hanssen	P. O. Box 30196 NRB	Inspection reagent
22. Wellcome (k) Ltd.	Private Bag, Kabete	
23. Becton Dickinson Equipment	P. O. Box 46463 NRB	
24. Howse & McGeorge	P. O. Box 72030 NRB	Inspection reagent
25. Pharma Share	P. O. Box 39130 NRB	Centrifuge, Others

Chapter 4 Basic Design

Chapter 4 Basic Design

4.1 Design Policy

The formulation of the project should adhere to the following design conditions.

(1) Design Conditions on the Demand Side

- 1) The project should be designed so that it is appropriate for the trend of diseases in Kenya, the number of beneficiaries, and the level of medical technology, taking in consideration the fact that the project site is the top-referral hospital in the country.

- 2) An attempt should be made to rehabilitate the medical functions of the hospital, which have been declining, as well as to ensure the capability to deliver high quality health care as the only nationally-operated general hospital and the top referral hospital in the country, through the provision of necessary equipment.

(2) Design Condition on the Technical Side

- 1) The items of the equipment planned under this project should be urgently needed items which, although already installed in the hospital, do not function satisfactorily at present because of superannuation or other reasons or which are insufficient in number.

- 2) The technical level of the equipment procured under this project should be comparable with that of the existing equipment, and the procured equipment should be suitable to the level of technical skills of the existing medical personnel of the hospital.

- 3) The equipment procured under this project should be relatively simple in structure, durable, basically trouble-free, and can be serviced to a certain degree under the existing equipment maintenance system.

4) The costs of the operation and maintenance of the procured equipment should be affordable within the current health care budget of the Republic of Kenya.

(3) Design Conditions in Terms of Installation Works

1) In implementing the project, the works for the installation of the equipment should be planned to be conducted efficiently in a short period so that the works should not interfere with the routine operation of the hospital.

2) The works should be planned consistently with the World Bank's Rehabilitation Project in terms of the execution plan and the equipment plan. Items requiring installation works should be procured only when the reforming of the place of installation can be prepared before the execution of this project.

3) Some of heavy duty and advanced medical equipment requiring installation works should be subjected to test installation and pre-shipment inspection at the manufacturer's factory, so that the term of installation works in the site can be shortened.

(4) Policies Concerning the Utilization of Local Products and Procurement of Equipment from Third-party Countries

1) In view of the ease and reliability of maintenance after procurement, as well as the relationship with the existing equipment, it should be taken into consideration that a part of the equipment may be procured from third-party countries.

2) Items that can be procured in Kenya should be procured locally, so long as no problem is expected in maintenance.

3) Spare parts, periodically replaced parts, consumable supplies, and maintenance services for the procured equipment must be available in Kenya or neighbouring countries.

(5) Basic Conditions Related to Natural Environment

- 1) The equipment should have sufficient resistance to heat, humidity, and dust so that it can withstand the tropical climate in Kenya.

- 2) Precision machines should be planned to have air conditioners, ventilation fans, and other means to prevent dust hazard.

4.2 Examination of Design Conditions

4.2.1 Examination of Maintenance System

Although the maintenance of the equipment procured under this project is planned to be conducted by Biomedical Engineering Services of Kenyatta National Hospital, it is considered difficult to conduct maintenance under current budgetary plan and personnel plan of the hospital. Even if a new management system is established after the reorganization of the Services, it may be impossible to maintain all items of the equipment including many advanced medical units by the sole effort of the hospital. In the basic design, the items are designed by way of being classified into 4 groups according to the ease or difficulty of maintenance.

Grouping of Equipment for Maintenance

	Group 1	Group 2	Group 3	Group 4
	Very little skill is required.	Some skill is required.	Medium level of skill is required.	Very high level of skill is required.
Equipment	Stretcher Supply trolley Instrument cart I. V. stand Operation instruments Others	Operation light Instrument sterilizer Water distiler Microscope Others	ECG monitor Anesthesia machine Electro surgical unit Autoclave Others	Cardioangiography Cobalt 60 radio-therapy unit X-ray simulator Automatic blood chemical analyzer Blood gas analyzer ICU monitor Dialysis unit Respirator Others
Maintenance and repair in Biomedical Engineering Services	Possible with existing skill	Simple training is needed on the delivery of equipment.	Medium to long-term training enables a certain level of maintenance.	Impossible
Supply of spare parts	Spare casters, bearings, wing nuts, etc. will be supplied to Biomedical Engineering Services.	Spare bulbs, heaters, filters, switches, etc. will be supplied to Biomedical Engineering Services.	Spare parts equivalent to about 20% of the cost of equipment will be supplied to Biomedical Engineering Services.	No spare parts will be supplied.
Necessity of local agent of the manufacturer	Local agent not required.	An agent must be located in a neighbouring country.	An agent must be located in Kenya.	An agent must be located in Kenya, and maintenance by the manufacturer's engineers must be available.
Need for maintenance training	No maintenance training is needed.	Maintenance training will be given on the delivery of equipment.	Engineers of Biomedical Engineering Services, will be trained twice within 1 year after delivery.	Practical training for 2-3 weeks will be given at least once a year for 5 years after delivery.
Need for maintenance contract	Not needed.	Not needed.	Necessary (maintenance on a spot contract).	Absolutely necessary. The contract should cover: 1. a period of 4 years or more 2. preventive maintenance 3. corrective maintenance 4. supply of free parts for repair 5. maintenance training of engineers.

The maintenance of the Group 4 equipment will be covered by the guarantee of the manufacturer for the first 1 years. The manufacturer will provide maintenance services and give training to the engineering personnel of Kenyatta National Hospital according to the planned contract of guarantee. The maintenance after this period will be covered partly by technology transfer based on the 1 year training of engineers, which is expected to be effective. On the other hand, the Kenyan side will reserve funds during the guaranteed period and enter into a maintenance contract with the manufacturer and/or its local agent, so that long-term utilization of the equipment will be ensured.

4.2.2 Procurement of the Equipment

As described before, in view of the ease and certainty of maintenance after procurement and the availability of periodically replaced parts, repair parts, and consumable supplies, it should be taken into consideration that the following items may be procured from third-party countries. Some items must be procured from third-party countries, because they are not produced in Japan.

EQUIPMENT	POSSIBLE COUNTRY TO MANUFACTURE
Cobalt 60 radio-therapy unit	Canada, France, U.S.A., Japan
X-ray simulator	Netherlands, Canada, U.S.A., Japan
Intracavity machine remote after loading	Netherlands, Canada, Japan, Others
Superficial X-ray simulator	U.K., Germany, Canada, U.S.A.
Clinical chemistry analyzer	Switzerland, Germany, U.S.A., Japan
Blood gas analyzer	Switzerland, Netherlands, Germany, U.S.A., Japan
Ultrasound scanner	Netherlands, France, U.S.A., Japan
Angio cardiography system	Netherlands, Germany, France, U.S.A., Japan
Hemodialysis machine	Sweden, U.S.A., Germany, Japan
Peritoneal dialysis cyclers	Sweden, U.S.A., Germany
Respirator	U.S.A., Germany, France, Japan, Others

4.2.3 Selection of Equipment

The equipment planned to be supplied in each division was selected based on the following condition:

1) Radiation Therapy

The planned items include cobalt 60-radio therapy unit, x-ray simulator, intracavity radiotherapy machine unit, and other equipment which are needed in response to the increasing occurrence of malignant tumor patients.

2) Laboratory

The planned items are indispensable for examinations in clinical chemistry, histopathology, hematology, transfusion, immunopathology, pathological anatomy, microbiology, etc. and are needed urgently because of mechanical troubles and other reasons.

3) Operation Theaters

The planned items include shadowless lamp, operating table, electro-surgical unit, suction unit, and other equipment which enable the hospital to treat a wide range of surgery from general surgery to cerebral and heart surgery.

4) Intensive Care Unit

Most of the planned items are basic therapeutic equipment which are needed for care to the large number of post operative patients.

5) E.C.G./Cardiology

The planned items include cardioangiography system and related equipment which are necessary for heart catheterization.

6) Renal Unit

The planned items include hemodialysis unit, peritoneal dialysis unit, and other equipment which are needed for dialysis treatment of the patients with renal diseases.

7) Biomedical Engineering Services

The planned items include electronics measurement instruments and repair tools for electronic devices, repair tools for electric devices, electrically-driven tools, and other equipment needed for the maintenance and repair of medical equipment.

8) T.S.S.U.

The planned items include equipment for the washing, sterilization, and transportation of operation instruments.

9) C.S.S.D.

The planned items include equipment for the washing, sterilization, and transportation of diagnostic instruments and instruments for minor surgery.

10) Casualty

Most of the planned items are equipment for the treatment of emergency patients.

4.3 Basic Plan

4.3.1 Equipment Distribution Plan

Based on the basic design policies and conditions described above, it was considered appropriate that about 385 different types of items should be procured under this project, as detailed in the followings:

RADIATION THERAPY (R)

R-1	Cobalt 60 Radiation unit	1
R-2	X-ray simulator	1
R-3	Intracavity machine remote after loading	1
R-4	Superficial x-ray machine	1
R-5	PTW Dosimeter	1
R-6	Farmer's dosimeter	1
R-7	Treatment planning system	1
R-8	Anesthesia machine	1
R-9	Autoclave, medium / portable	1
R-10	Examining light, portable	6
R-11	Alarm dosimeter	8
R-12	Suction unit, portable	6
R-13	Diagnostic set	8
R-14	O ₂ flow meter	1
R-15	Stethoscope	4
R-16	Sphygmomanometer	4
R-17	Operating table	1
R-18	File cabinet, four drawer / metal	7
R-19	Supply trolley, stainless steel	6
R-20	Wheel chair	4
R-21	Vaginal speculum (A)	1
R-22	Vaginal speculum (B)	1
R-23	Vaginal retractor	1
R-24	Tumor forceps	1
R-25	Sponge forceps	1
R-26	Uterine currettis	1
R-27	Weighted vaginal speculums	1
R-28	Aquaplast machine (Water phantom)	1
R-29	Lazer beam allignment unit	1
R-30	Cystoscope	1
R-31	Cystoscope biopsy forceps	1
R-32	Resectoscope	1
R-33	Biopsy punch	1
R-34	Kobaks needle	1
R-35	Laryngoscope	2
R-36	X-ray film illuminator	1
R-37	Patient modesty screen	6

R-38	Patient scale	2
R-39	IV stand	6
R-40	Doctors caliper	4
R-41	Measuring devices	6
R-42	Refrigerator with freezer	2
R-43	Portable heater, electric	4

LABORATORY (L)

L-1	Clinical chemistry analyzer	1
L-2	Refrigerated centrifuge (Large)	2
L-3	" " (Small)	2
L-4	Centrifuge, minor	3
L-5	PH/MV meter	5
L-6	Centrifuge, versatile bench top type	10
L-7	Magnetic stirrer	8
L-8	Analytical balance	2
L-9	Top weighing balance	10
L-10	Hot air oven	9
L-11	Test tube racks, stainless steel	20
L-12	Water distiller	9
L-13	Mechanical shakers	3
L-14	Electrothermal heater	2
L-15	Water bath, with lid & racks	8
L-16	Spectrophotometer	3
L-17	Protein electrophoresis apparatus	1
L-18	Refrigerator, double door	7
L-19	Lab. refrigerator, single door	4
L-20	Mixer	2
L-21	Incubator, bench-top type	3
L-22	Laboratory blender	1
L-23	Auto stainer	1
L-24	Plasma freezer	3
L-25	Binocular microscope	13
L-26	Laboratory counter	14
L-27	Electronic blood cell counter	3
L-28	Hemoglobin electrophoresis apparatus	1
L-29	Coagulometer, with fibrometer unit	1
L-30	Agurigometer	1

L-31	Microtome, rotary	1
L-32	Tissue embedding system	1
L-33	Automatic knife sharpener	1
L-34	Microtome knife	30
L-35	Media preparation system	1
L-36	Autoclave, cylindrical type	2
L-37	Deionizer	3
L-38	Portable autoclave	4
L-39	Fluorescence microscope	1
L-40	Laminar flow (2 major, 1 simple type)	1
L-41	Deep freezer	2
L-42	CO ₂ incubator	1
L-43	Glasspak anerobic jar	6
L-44	Rotator	2
L-45	Microscope, combined dark field	1
L-46	Double head microscope	1
L-47	Stop watch	20
L-48	Autoclave, automatic	1
L-49	Laboratory trays set, assorted sizes	20
L-50	Supply trolley, stainless steel	15
L-51	Pipette washer, automatic	5
L-52	Bunsen burner and Tripod stand set	20
L-53	Filling cabinet	8
L-54	Wire rack, for 100 bottles	20
L-55	Wooden rack, for 100 bottles	20
L-56	Metal rack, for 100 bottles	10
L-57	Analizer for sodium & potassium	5
L-58	Microhematocrit centrifuge	5
L-59	Glucometer	5
L-60	Colorimeter	1
L-61	Test tube mixer	2
L-62	Affinity immuno assay system	1
L-63	Plasma extractor	2
L-64	Vacuum filter	2
L-65	Blood gas analyzer	2
L-66	Hb meter complete	6
L-67	Sedimeter E.S.R. system	1
L-68	Hematology analyzer, electronic	1
L-69	Centrifuge	2
L-70	Semi-auto clinical chemistry analyzer	4

OPERATING THEATERS (O)

0-1	Laparoscope, with fiberoptic	1
0-2	Kick bucket	30
0-3	Cardiac monitor, for anesthesia machine	12
0-4	" " with recorder	3
0-5	" " for recovery room	2
0-6	Respirator, adult	2
0-7	" pediatric, B type	8
0-8	Supply trolley, large	12
0-9	Supply trolley, medium	12
0-10	Supply trolley, small	12
0-11	Instrument table	4
0-12	Mayo stand	12
0-13	Wall clock	16
0-14	Electrosurgical unit	10
0-15	Portable suction unit	10
0-16	Suction unit, wall mounted type	12
0-17	Surgical spot light, portable	5
0-18	Double basin stand	15
0-19	Brush dispenser	15
0-20	Soap dispenser, arm operated	15
0-21	Drug trolley	15
0-22	Operating microscope	1
0-23	Artificial Heart lung machine	1
0-24	Operating table	7
0-25	Recovery room trolley	12
0-26	Patient Stretcher	12
0-27	Fiberglass laundry hamper	8
0-28	Storage cabinet for fiberscope	2
0-29	Fiberoptic headlamp light guide set	3
0-30	Fiberoptic light source	4
0-31	Wall light	6
0-32	O ₂ flow meter	21
0-33	Resuscitation trolley with cardiac defibrillator	1
0-34	Pediatric straight forward telescope	2
0-35	Cystoscope/urethroscope set	1
0-36	Electric blanket	4
0-37	Laryngoscope	15

0-38	Rectoscope	1
0-39	Broncho fiberscope	1
0-40	Sigmoidoscope	1
0-41	Kelly proctoscope	1
0-42	Pediatric sigmoidoscope	1
0-43	Electric dermatome	1
0-44	Teaching aid for doctor at student of cystoscope	1
0-45	Cystoscope / urethroscopy set	1
0-46	Resectoscope	1
0-47	Defibrillator, internal	1
0-48	Cryo machine for eye surgery	1
0-49	Capnometer for measuring blood CO ₂	1
0-50	Pace makers	2
0-51	Sphygmomanometer, long tubing for anes.	15
0-52	Sphygmomanometer, short tubing	2
0-53	Stethoscope, long tubing for anes.	15
0-54	Stethoscope, short tubing for anes.	2
0-55	Freezer	2
0-56	Magnet for removal of foreign bodies from the eye	2
0-57	Gastric endoscope	1
0-58	Orthopedic surgery instrument set	1
0-59	Bone surgery instrument set (screw and plates etc.)	1
0-60	Transducer for measuring intra cranial pressure	1
0-61	Peripheral nerve stimulator	1
0-62	Operating room lamp	9

T.S.S.U. (T)

T-1	Honing machine for sharpening of surgical instrument	1
T-2	Ultrasonic instrument washer	1
T-3	Hot air oven	1
T-4	Supply rack, stainless steel	10
T-5	Surgical glove washing machine	1
T-6	Surgical glove drying and powdering machine	1
T-7	Supply trolley, stainless steel	3
T-8	Instrument pan, stainless steel	12
T-9	Manual sewing machines	4
T-10	Drying cabinet	2

C.S.S.D. (C)

C-1	Supply rack, stainless steel	3
C-2	Supply trolley, stainless steel	4
C-3	Hot air ovens	2
C-4	Drying cabinet	2
C-5	Ultrasound instrument washer	1
C-6	Metal laundry hamper	3
C-7	Fiberglass supply trolley-bin	2
C-8	Surgical glove washer	1
C-9	Surgical glove drying and powdering machine	1
C-10	Autoclave tape dispenser	6
C-11	Heat sealing machine	3
C-12	Refrigerator, double doors	1
C-13	Supply trolley	8

I.C.U. (I)

I-1	Bed-side monitor	3
I-2	Nurse station central monitoring system	1
I-3	Portable suction unit	5
I-4	Wall suction unit	11
I-5	Manual suction unit, foot operated type	5
I-6	Respirators, adult	4
I-7	" simple	5
I-8	" pediatric	2
I-9	Non-invasive blood pressure monitor	4
I-10	ICU incubator	4
I-11	Ultrasound nebulizer, with castored stand	4
I-12	ICU Patient bed	11
I-13	Pediatric crib	3
I-14	Blood pressure machine, wall mounted	11
I-15	Electric stove	1
I-16	Electric typewriter	1
I-17	Phototherapy unit	1
I-18	Cubicle curtains	6
I-19	Supply trolley, stainless steel	8
I-20	Instrument trolley, stainless steel	2
I-21	I.V. stand	11

I-22	Bedside cabinet	11
I-23	Bath trolley	5
I-24	Bed pan washer	2
I-25	Autoclave, free standing	1
I-26	Ultrasound instrument washer	1
I-27	Pulse oximeter	4
I-28	Critical care patient stretcher	2
I-29	Portable pacemaker	1
I-30	Automatic hand dryer	8
I-31	Electrocardiograph	1
I-32	Diagnostic set	6
I-33	Stethoscope	12
I-34	Infusion pump	11
I-35	Emergency trolley with defibrillator	2
I-36	Laryngoscope set, (L.M.S.)	6
I-37	Weighting scale, for baby	1
I-38	Weighting scale, for adult	1

E.C.G / CARDIOLOGY (E)

E-1	Angiocardiology system	1
E-2	Temporary pacemaker	2
E-3	Pacemaker, programmer	1
E-4	Film processor for the above system	1
E-5	Ultrasound scanner	1
E-6	Kick bucket	3
E-7	I.V. stand	3
E-8	Hot air oven	1
E-9	Patient trolley	3
E-10	Stethoscope	4
E-11	Laryngoscope, adult/infant/child blade	1
E-12	Diagnostic set	1
E-13	File cabinet	2
E-14	X-ray Protective apron	6
E-15	Heat sealing machine	1

RENAL (K)

K-1	Hemodialysis machine	11
K-2	Peritoneal dialysis cyclers	2
K-3	Patient bed	6
K-4	Bed scale for dialysis	1
K-5	Refrigerator	2
K-6	Supply trolley	6
K-7	I.V. stand	12
K-8	Bedside cabinet	15
K-9	Sphygmomanometer, aneroid type	3
K-10	Blood pressure machine, wall mounted	8
K-11	Non-invasive blood pressure machine	4
K-12	Stethoscope	12
K-13	Defibrillator	1
K-14	Wheel-chair	2
K-15	Patient trolley	2
K-16	Coagulation meter	3
K-17	Ultrasound scanner	1
K-18	Portable suction unit	6
K-19	Wall suction unit	10
K-20	Infusion pump	6
K-21	Portable color TV with VTR	2
K-22	Oxygen gas supply, wall type	10
K-23	Medical air supply compressor	2
K-24	Warmer for peritoneals	2
K-25	Weighing scale, chair type	2
K-26	Height scale	1
K-27	Carrage trolley	1
K-28	Drug supply trolley	1
K-29	Instrument cabinet	1

BIO-MEDICAL ENGINEERING (B)

B-1	Ocilloscope, type A	1
	" , type B	1
B-2	Multimeter	4
B-3	Universal AM meter	2
B-4	KV meter	2

B-5	Frequency counter	1
B-6	Synthesiser, programmable	2
B-7	Mini vices	2
B-8	Soldering iron (for IC)	8
B-9	DC power supply unit, 0-18 volts	3
B-10	DC power supply unit, 0-32 volts	3
B-11	High voltage probe for KV meter	2
B-12	Air gun & compressor	1
B-13	Wire set	2
B-14	Crimping tool set	4
B-15	Drill blade set	2
B-16	Hand drill	4
B-17	AC power drill	2
B-18	Heavy duty engineers vice	1
B-19	Extension cord, with adaptor	2
B-20	Light source	2
B-21	Spot welding machine, portable	1
B-22	Storage cabinet	6
B-23	Spring calipers	2
B-24	Kneedle file set	4
B-25	Trimming knife with blades	4
B-26	Caliper	2
B-27	Micrometer set	2
B-28	ME repair tool set, high grade	4
B-29	ME repair tool set, standard	4
B-30	Dial gauge set	2
B-31	Trimming tools	6
B-32	Antistatic protection set	3
B-33	Centre punch	2
B-34	Scriber	2
B-35	Mallet	4
B-36	Safety goggles	4
B-37	Vacuum cleaner	4
B-38	Round brush	12
B-39	Solder sucker	1
B-40	Fretsaw set	3
B-41	Solder cleaner	4
B-42	Solder iron, large 60W/200W	4

B-43	Multimeter	6
B-44	Tool box containing instruments	2
B-45	Grinding machine	1
B-46	Electric engraver	1
B-47	Stock and die set	3
B-48	Electric tools machines	1
B-49	Logic probe (tester)	3
B-50	Screw drivers set	2
B-51	Hex key wrench set	2
B-52	Mechanical tool kit	2
B-53	Multi-purpose vice	2
B-54	Pipe cutter	2
B-55	Arch welding machine	1
B-56	Dual trace oscilloscope	3
B-57	Lathe machine, small	1
B-58	Angle grinder, 115mm	1
B-59	Over head projector	1
B-60	Screen for OHP	1
B-61	Parts cabinet(plastic drawers)	1
B-62	Instrument cabinet/steel	2
B-63	Step down transformer	2
B-64	Documents cabinet/with lock	6
B-65	Tool locker	3
B-66	Shrink tube set	2
B-67	Analog Ohm meter	2
B-68	Clump tester	2
B-69	Digital thermometer	2
B-70	Paging system	1
B-71	Document lay-out system	1
B-72	Copy machine	2

CASUALTY (A)

A-1	Defibrillator	2
A-2	Bedside monitor	1
A-3	ECG unit, 1 channel	2
A-4	Wall suction unit	8
A-5	Portable suction unit	4
A-6	Patient trolley	12

A-7	Diagnostic set	12
A-8	Drug trolley	12
A-9	Glucometer	2
A-10	Sphygmomanometer	14
A-11	Laryngoscope, adult 6/pediatric 6	12
A-12	Stethoscope	24
A-13	Patella hammer/tuning fork set	6
A-14	I.V. stand	14
A-15	Patient modesty screens	12
A-16	Blood pressure apparatus, wall mounted	12
A-17	Doctor desk	12
A-18	Doctor chair	12
A-19	Molded fiberglass chair	12
A-20	Instrument sterilizer	1
A-21	Kick bucket, stainless steel	12
A-22	Portable x-ray film illuminator	12
A-23	Pulse oximeter	1
A-24	Operating table	2
A-25	Portable spot light	1
A-26	Anesthesia machine	1
A-27	Supply trolley	1
A-28	Mayo stand	4
A-29	Pneumatic tourniquet	2
A-30	Cabinet	2
A-31	Filing cabinet	4
A-32	Patient card imprinting machine	1
A-33	Operating room lamp	2
A-34	Floor polisher/vacumm cleaner	1
A-35	Ambu bag, with foot pump for adult	3
A-36	" " " " for small body	3