MINISTRY OF HEALTH
THE KINGDOM OF TONGA

No.

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR UPGRADING AND REFURBISHMENT
FOR VIOLA HOSPITAL
IN
THE KINGDOM OF TONGA

MARCH, 2004

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
KUME SEKKEI CO., LTD.

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PREFACE

In response to a request from the Government of the Kingdom of Tonga the Government of Japan decided to conduct a basic design study on the Project for Upgrading and Refurbishment for Viola Hospital in the Kingdom of Tonga and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Tonga a study team from October 13 to November 10, 2003.

The team held discussions with the officials concerned of the Government of Tonga, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Tonga in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Kingdom of Tonga for their close cooperation extended to the teams.

March, 2004

Kunimitsu Yoshinaga
Vice President
Japan International Cooperation Agency

March, 2004

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Upgrading and Refurbishment for Viola Hospital in the Kingdom of Tonga.

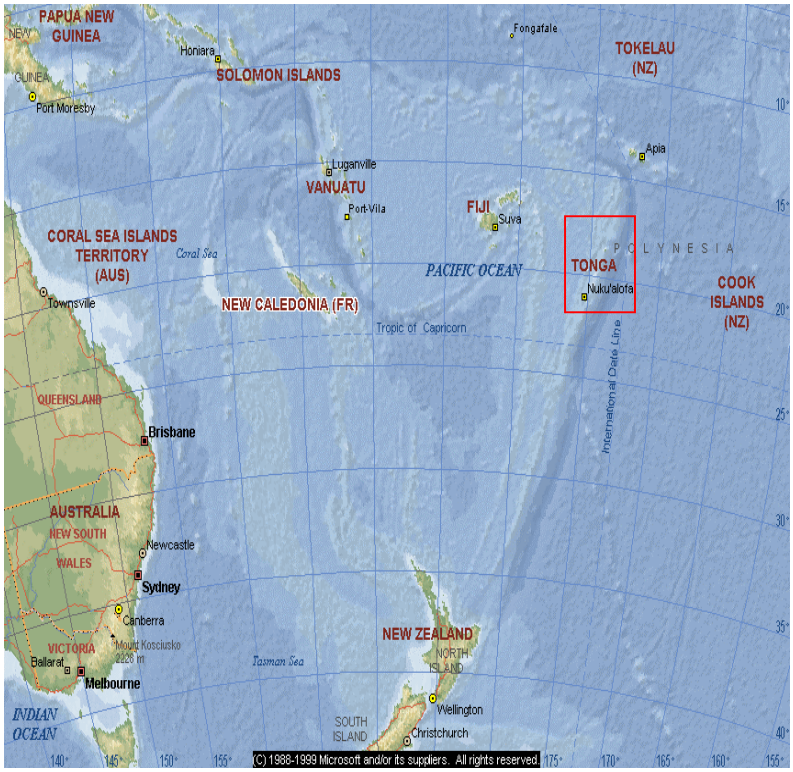
This study was conducted by Kume Sekkei Co., Ltd., under a contract to JICA, during the period from October 13 to November 10, 2003. In conducting the study, we have examined the feasibility and rational of the project with due consideration to the present situation of Tonga and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

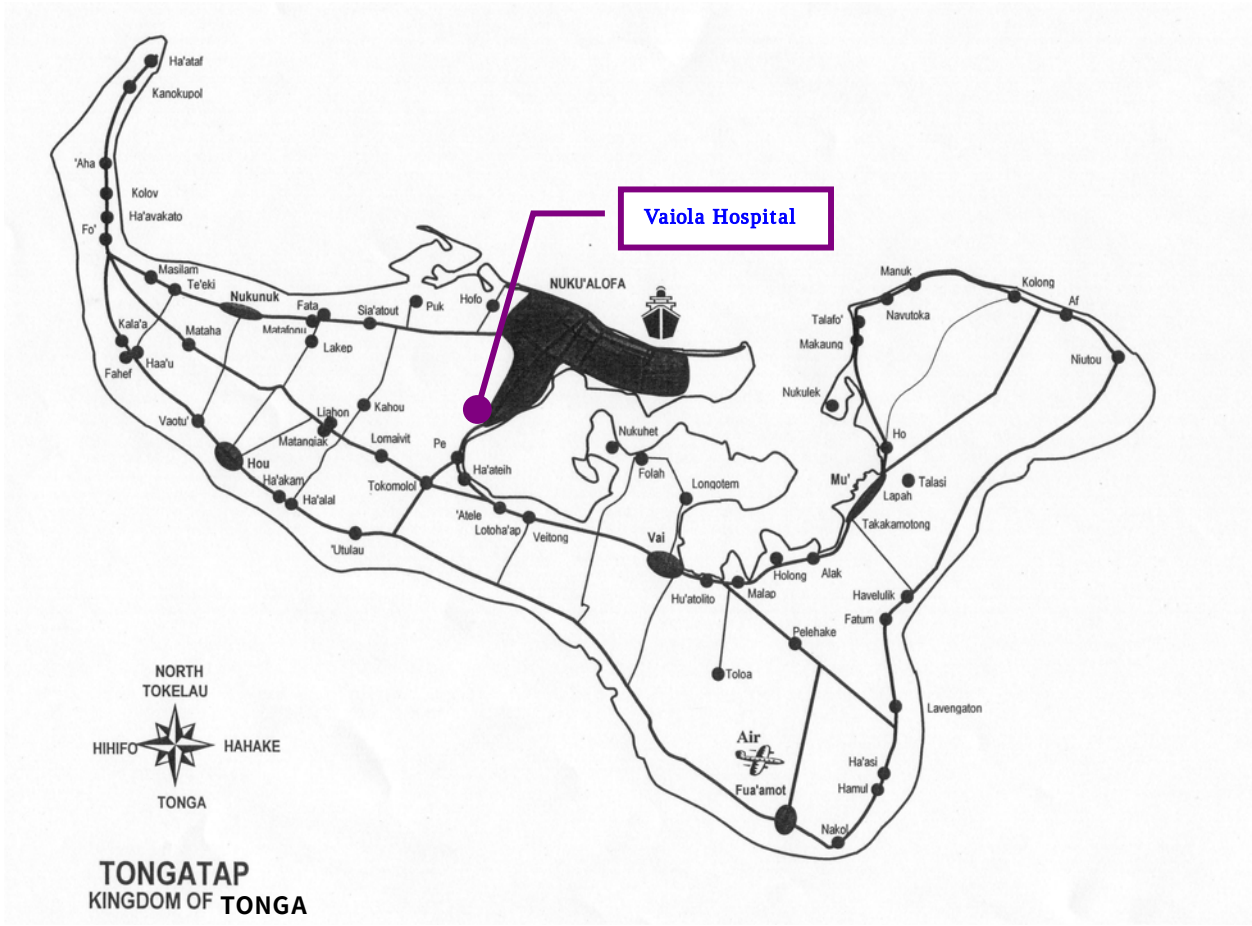
Very truly yours,

Shigeru Enomoto
Project Manager,
Basic Design Study Team on The Project for Upgrading and Refurbishment for Viola Hospital in the Kingdom of Tonga
Kume Sekkei Co., Ltd.

■ South Pacific Ocean：The Kingdom of Tonga



■ Location of Vaiola Hospital in Tongatapu Is.



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SUMMARY

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The Kingdom of Tonga (hereinafter referred to as “Tonga”) is a islands country and locate to the central region in the south west pacific at latitude 15 ° - 23 ° 30’ south, longitude 173 ° - 177 ° West. Tonga is consisting of some 170 islands (130 islands has inhabitant) and classifies coral islands (central and south region) and volcanic islands (northern region), and its total area is about 750km² that is same area as Tsusima Island (697 km²) in Japan. Tonga has a total population of approximately 101,000 (2002), of which some 69,000 (68%) live on Tongatapu in and around Nuku'alofao, the capital.

Tongatapu Island, the main island, is Tonga's largest island, and north area is coral area with flat land, south area is volcanic area with sharp hilly cliff.

The climate is belong to tropics, and average temperature in northern islands Vavau is about 23.5℃, southern islands Tongatapu is about 21℃ and it become cooler and dry in southern area. The local summer lasts from December to March when the temperature increases to nearly 30°C. As this is a period of cyclones, the rainfall level is high during the summer. The period from April to October is milder with less rainfall and the temperature drops to around 20°C from June to September. Rainwater is stored for drinking purposes. The annual rainfall is as high as some 1,920 mm on Tongatapu Island but has shown a decreasing trend in recent years.

Tonga economy is relying on the primary industry especially to the farming products. The major export products were copra, sweet potato, banana, vanilla and so on, and production of squash (a variety of pumpkin) rapidly expanded in late 1980 and it grows as most important crop to acquire foreign currency and supporting Tongan economy at present.

However, the national economy is vulnerable to fluctuations of the export prices of its main export products as well as fluctuation of global consumer prices and also to natural disasters caused by cyclones, etc.

Tongan Government tries to stabilize the economic condition by promoting export, training private enterprises and attract tourist to Tonga, but there are negative factors make difficult to achieve the target by the small size of the country, remote from the market and lack of natural resources.

Table: Comparison of Neighbor countries GDP Unit: US$

Country	GDP per person				
	1990	1997	1998	1999	2002
Tonga	1,170	1,760	1,750	1,730	*1,360
Fiji	1,870	2,560	2,210	2,310	-
Samoa	930	1,170	1,080	1,070	-
Solomon	720	840	780	750	-
Kiribati	810	1,130	1,170	910	-

Source: Country data 2001 Official Development Aid

* : Aus AID Country Brief-Tonga

GDP per person kept US$1,700 from 1997 to 1999 as shown in the table above, but it failed to US$1,360 in the year 2002. This factor comes from poor harvest of squash and price down by the export competition with other counties and this made less the Government foreign income.

Estimated 2002/2003 fiscal year Government budget is T$155,532,710 (¥85.52 hundreds million) and its breakdown consisted Government revenue T$112,980,798 (¥62.12 hundreds million), Overseas funding (cash) T$25,330,842 (¥13.92 hundreds million), Oversea donor funding (inkind) T$9,670,564 (¥5.31 hundreds million), Trust fund T$391,017(¥21.5million) and Revolving fund T$7,159,490 (¥3.93hundreds million), it means that 27% of Government budget is rely of oversea funding in Tonga.

In its Seventh National Development Plan (2001 – 2004), the Government of Tonga has adopted the sustainable development of politics, economy, environment and culture as its long-term development goals up to 2025. In the health sector, efforts are being made under the slogan of “establishment of a health system which Tongans can be proud of by 2020”. This drive to establish health care services aims at the provision of highly effective and high quality health care services with the concrete target of “providing standard health care services for all Tongans, including those living on remote islands”. In accordance with such objective and goal, the guideline is set at increasing the doctor-population ratio from one doctor per 2,279 people in 2000 to one doctor per 823 people by 2015. The improvement and development of medical facilities and equipment are, therefore, considered to be prioritized issues to achieve these health sector targets.

The Vaiola Hospital which is the target of the Project is the only Tongan hospital capable of providing advanced medical services. Apart from its status as the leading referral hospital, the Vaiola Hospital also provides primary health care services for residents of Tongatapu Island. In 2002, the average number of outpatients was as high as 335/day (87,139/year) while the bed occupancy rate of the obstetric, medical and surgical wards was also as high as 80%, patient for dental per day is about 100 (28,177patients/year) and number of delivery is about 5.6 times per day (2,053 delivery/2002) in the hospital and health center, and 75% of all deliveries are done in Vaiola Hospital, indicating the extreme importance of promoting health care services in Tonga.

The Vaiola Hospital was first opened in 1971 and, after 33 years of service, the following problems can be pointed out with its health and medical care services.

- Dispersing related function to Clinical Service Building (CSB) makes worsening the work efficiency
- Shortage of operating theatres (currently two) and risk of hospital infection due to the unclear separation of the clean and dirty zones
- Shortage of post-operation recovery beds and ICU beds
- Inability to secure the required sterilization capacity of the CSSD due to frequent breakdowns of the sterilizer
- Frequent breakdowns of the X-ray photography apparatus, impeding the efficiency of clinical diagnosis
- Insufficient capacity of the open-type septic tank, causing environmental problems and the risk of the spread of contamination

To solve these problems, the work to prepare the Master Plan for the Redevelopment of Vaiola Hospital (M/P) is still in progress with the assistance of the AusAID and World Bank to establish the improvement programmes and scales for the entire Vaiola Hospital. The principal idea is the implementation of the construction and refurbishment work for the entire hospital in six stages and an aid organization or donor will be sought at each stage to proceed with the plan.

Under these circumstances, the Government of Tonga made a request to the Government of Japan in 1999 for the implementation of the Project for Upgrading and Refurbishment of Vaiola Hospital to improve the conditions of health and medical services at the Vaiola Hospital in order to solve the existing problems and to provide standard medical services. The contents of the original request are given below.

- Construction or refurbishment of the entire facilities of the Vaiola Hospital and procurement of the necessary equipment

  - Facilities:New : Operating theater building, Health Science Research Institute, outpatient-only building, radiography department and mortuary, etc.

Refurbishment : Outpatient department/emergency department, obstetric department, nurses' accommodation, laboratories and three-story ward building, etc.

- Building services improvement: Hot water supply system, power receiving system, septic tank (installation), fire extinguishers, power generation system and medical gas pipelines, etc.

- Equipment : Renewal of the entire medical equipment of the hospital and ambulances, etc.: 1,073 items

In response to this request, the Japan International Cooperation Agency (JICA) dispatched the Preliminary Study Team to Tonga for the period from 7th to 31st October, 2002 to study the situation of health and medical services in Tonga, trends of aid by other donors and current conditions of the Vaiola Hospital, etc. The Study Team was presented with the outline of M/P prepared with the assistance of the AusAID.

Based on the findings of the Preliminary Study Team, the JICA dispatched the Basic Design Study Team to Tonga for the period from 13th October to 10th November, 2003 to conduct a field survey, including discussions on the contents of the request with the Tongan side, a project site survey and the gathering of relevant information.
At the time of the Basic Design Study, the original request included a pediatric ward and a medical ward. However, these wards were dropped from the scope of the Japanese Grant Aid following detailed examination of their urgency, priority and necessity and consultations with the Tongan side.

The Basic Design Study Team then determined the following design policies for the Project based on the field survey findings.

① The number of operating theatres, beds in the surgical and obstetric wards and delivery suites are determined by examining the relevant contents of the M/P and the situation of their use at the hospital.
② The grades of the new facilities are determined so as not to cause a technical as well as financial burden in connection with their operation and maintenance while referring to the grades of existing comparable facilities at the hospital.
③ Septic tanks capable of handling the entire sewage from the hospital will be constructed as an environmental improvement measure.
④ The necessary consideration is given to the fact that the construction work of the new facilities will be conducted while the existing hospital continues to operate.
⑤ Only medical equipment for the new facilities to be constructed with grant aid will be procured, mainly to replace deteriorated equipment, and specifications which are suitable for the technical level of the existing staff and which allow easy maintenance will be selected. Existing equipment can still be used will be relocated for their continued use.

Based on the above policies, the optimal contents and scale of the facilities and equipment were examined together with estimation of the project cost and the basic design and implementation plan were proposed. Having received these proposals, the JICA then dispatched a mission to Tonga for the period from 2nd to 14th February, 2004 to explain and discuss the Basic Design Study Report (Draft) with the Tongan side and a basic agreement between the two sides was reached. The outline of the finally proposed Project is described below.

In regard to the link between the Project and the M/P, the Project was originally considered to be the second stage of the M/P which would commenced in August, 2005 or later following the completion of the first stage, i.e. the construction of the new mental hospital ward and kitchen building, in May, 2005 and the subsequent relocation and demolition of the existing mental hospital ward and diabetes clinic. However, as this timing is not compatible with the planned implementation period for the Project, both sides have agreed that the Project will be implemented independently of the implementation schedule of the M/P.

< Facilities >
Structure : RC structure two story buildings
Floor area : Total floor area of 3,757 m^2 (Total area of hospital site: 63,813 m^2)

< Buildings >

Building	Floor/Floor Area (m^2)	Description of Facilities
CSB	GF (918.0)	Radiology; Blood Bank; Laboratories; Biomedical Equipment Workshop; Inpatient Pharmacy
	1F (864.0)	Operating Theatres (2); Outpatient Operating Theatre (1); ICU (2 beds); Recovery Beds (3 beds); CSSD
Ward Building	GF (1,121.0)	Obstetrics Ward (34 beds + SNC 6 cots); Delivery Suites (6 beds)
	1F (853.5)	Surgical Ward (40 beds)
Septic Tanks	Sufficient capacity to deal with the existing facilities (600 persons x 3)	
Medical Equipment	Medical equipment and oxygen condensing system required for the above facilities	

< Equipment >

Department	Equipment
Operating Theatre	Operating light; Operating table; Anesthesia apparatus with ventilator; Electrosurgical unit; Patient monitor; Surgical scrub station; Operating microscope for ENT; Defibrillator
CSSD	High pressure steam sterilizer; Table top ultrasonic washer
ICU	Ventilator for adult and pediatric; Patient monitor
Laboratories	Blood cell counter; Safety cabinet
Blood Bank	Blood bank refrigerator
Inpatient Pharmacy	Medical refrigerator; Distilled water unit
Biomedical Equipment Workshop	Maintenance set
Radiology & Ultrasound	X-Ray unit; Automatic film processor; Ultrasound scanner B/W
Obstetric Ward	Doppler fetus detector; Bedpan sanitiser
Delivery Room	Fetal monitor (CTG); Delivery Table; Delivery light
Special Care Nursery (SCN)	Baby resuscitation trolley; Infant incubator
Surgical Ward	Traction apparatus with bed; Pulse oxymeter
Other (Facility)	Oxygen condensing system

If the Project is implemented with grant aid provided by the Government of Japan, the total duration of the construction work is expected to be 20 months, including the time required for the detailed design and tender period. The necessary total project cost is estimated to be approximately ¥1,137 million with a Japanese portion of ¥1,030 million and a Tongan portion of ¥107million. It has been confirmed that the Tongan side will apply for funding allocation for the Project in the FY 2004/2005 and FY 2005/2006 budgets to cover the cost of the work to be undertaken by the Tongan side as part of the Project.

The implementation of the Project is expected to have the following main effects.

(1) Improvement of Health and Medical Service Environment at Vaiola Hospital

The implementation of the Project is expected to achieve the wide-ranging improvement of the Vaiola Hospital as listed below.

1) The construction of the new obstetric ward and surgical ward which will be the most frequently used and the centralization of the CBS functions will strengthen the medical services as well as primary treatment at the hospital, improving health and medical services for all Tongans.

2) The increase of the number of beds in the obstetric ward from 28 to 34 in view of the present high bed occupancy rate of 80% will make the hospitalization of pregnant women on a planned day possible, thus improving their care.

3) The number of operating theatres will be increased from two to three with the provision of new medical equipment (anaesthetic machine, electric scalpels, operating table; astral lamp, aspirator and forceps, etc.), eliminating the operating theatre shortage. And following improvements are expected.
   - Dissolution of shortage of operating theater and increase the number of operation
   - Easement of operation hour in the operating theater.
   - Improvement of the quality of operations.
   - Possible to make post-operation observation easier.
   - Ophthalmic operations will become possible.

4) The clear separation of clean zones from dirty zones in the operating theatres and CSSD will reduce the risk of hospital infection. And as two sterilizers with a capacity of 220 litres each will enable sterilization operation.

5) The renewal of the X-ray photography apparatus and mobile X-ray apparatus will enable continual X-ray photography and the annual number of X-ray photographs taken will increase from 9,504 to 10,500 together with an improvement of the diagnosis accuracy. And the introduction of a protective wall in the radiology room will reduce the level of exposure to radiation by X-ray engineers.

6) The introduction of closed-type septic treatment tanks will reduce the adverse impacts on the environment.

(2) Indirect effects is expected as follows

1) The reduced risk of hospital infection will enhance the reliability of the hospital, giving peace of mind to medical workers as well as patients.

2) Infant mortality rate and maternal mortality rate in the health index will be improved

Thus, improving the medical and health services environment in Vaiola Hospital to serve standard medical health services for all of Tongan nationals is the Project target and matching with the National Plan, and be expected to contributes to the achievement of National Development Plan.

CONTENTS

CHAPTER 1 BACKGROUND OF THE PROJECT

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1.1 Situation of Medical Care in Tonga

(1) Health Care System

Health and medical care services in Tonga are provided for five health administration areas, including the three main island groups (Tongatapu, Ha'apai and Vavau) as shown in Table 1-1. A hospital is located on each island with approximately 5,000 or more residents while there are 34 clinics which serve as primary health care facilities. Those islands without a hospital basically have a health centre (14 in total). These health centres have a health officer or a student nurse while clinics have a public health nurse (PHN) or a midwife. In addition to the Vaiola Hospital, there are another three hospitals in Tonga, i.e. the Niu'eiki Hospital (18 beds serving a population of 5,000) on Eua Island, the Niu'ui Hospital (25 beds serving a population of 8,000) on Ha'apai Island and the Prince Wellington Ngu Hospital (61 beds serving a population of 16,500) on Vavau Island.

The Vaiola Hospital (202 beds serving a population of 69,000) in the capital of Nuku'alofa on Tongatapu Island is the country's leading referral hospital and is the only hospital in Tonga which is capable of providing advanced medical care. The medical care system in the private sector is little developed with resident doctors of the Ministry of Health providing some services after their official working hours. The number of private clinics is very small.

Table 1-1 Health Administration Areas and Medical Care Facilities in Tonga

Administration Area	Population (persons)	Distance (km)	Public Hospitals			Health Centres	Clinics
			Name	No. of Beds	No. of Staff		
Tongatapu	68,000	0	Vaiola	202	285	7	19
Eua	5,000	30	Niu'eiki	18	6	0	3
Vavau	16,000	240	Ngu	61	40	3	5
Ha'apai	8,000	129	Niu'ui	25	27	2	5
Niua's	2,000	520	-	-	-	2	2
Total	100,000	-	-	306	67	14	34

Source: Ministry of Health, 2002 (Preliminary Study Report)

(2) Present Activities of the Vaiola Hospital

Table1-2 shows the present activities of the Vaiola Hospital (FY 2002). The hospital receives some 330 outpatients a day (87,139 per year) and has 6,120 inpatients a year. The hospital's dental clinic treats some 100 patients a day (28,177 per year). An average of 5.6 babies are born every day (2,053 per year) in the hospital, accounting for 75% of the total births in Tonga are delivered in Vaiola Hospital. The high utilization rate of the Vaiola Hospital in Tonga is partly explained by its status as the only hospital providing advanced medical care and partly because of the free treatment and free prescriptions except for dental treatment.

Table 1-2 Present Activities of the Vaiola Hospital (FY2002)

	Hospital				Total	Year			
	Vaiola	NGU	NIU'UI	NIU'EIKI	2002	2001	2000	1999	1998
1. No. of Beds and Usage									
No. of Bed	199	61	25	18	303	302	307	307	307
No. of Cot	38	12	5	2	57	57	57	54	54
Occupancy Rate：Bed	50%	31%	27%	23%	32%	39%	31%	34%	35%
Cot	51%	23%	27%	56%	41%	46%	44%	40%	35%
2. Outline of in patient									
Admission： Adult	4,857	956	381	295	6,489	6,899	6,198	6,254	6,601
Child	767	120	78	70	1,035	1,178	1,187	1,144	607
Infant	496	76	55	39	666	940	943	826	4,714
No. of Total Admission	6,120	1,152	514	404	8,190	9,017	8,328	8,224	11,922
No. fo Discharge： Adult	4,651	955	405	291	6,302	6,918	6,247	6,305	6,618
Child	761	120	77	68	1,026	1,189	1,193	1,132	607
Infant	531	82	52	40	705	953	951	817	717
Discharge	5,943	1,157	534	399	8,033	9,060	8,391	8,254	7,942
Death： Adult	141	26	9	8	184	182	100	116	153
Child	6	-	-	1	7	7	8	7	5
Infant	4	5	-	1	10	23	18	30	30
Death	151	31	9	10	201	212	126	153	188
Day of Admittance									
Adult	29,461	5,921	1,950	1,095	38,427	43,013	34,327	38,466	38,876
Child	3,742	674	321	284	5,021	6,030	4,679	4,399	3,054
Infant	3,373	327	167	128	3,995	4,979	4,488	3,975	4,195
Average Days of Admittance									
Adult	6	6	5	4	5	6	5	6	6
Child	4	6	4	4	5	5	4	4	5
Infant	6	4	3	3	4	5	5	5	6
3. Delivery									
Delivery： Normal	1,703	392	125	191	2,411	2,226	2,282	2,252	2,324
Breech	34	12	2	1	49	58	52	53	29
Forceps	32	-	-	-	32	53	22	30	16
Caesarean	224	21	3	-	248	143	125	130	12
total： Birth	2,033	425	130	192	2,780	2,455	2,495	2,499	2,293
Death	20	11	1	1	33	27	41	29	32
4. Outpatient									
Consultation	87,139	39,426	16,041	14,585	157,191	129,906	127,911	129,535	109,305
5. Operation									
Admission	1,620	85	32	-	1,737	2,885	1,456	1,316	1,394
Infection after Operation	2	5	-	-	7	-	3	6	24
Death in Operation	2	-	-	-	2	1	-	-	-
Day surgery	1,991	189	50	-	2,230	2,099	800	1,639	1,554
Major Operation	994	61	11	-	1,066	786	656	778	1,034
General Anesthesia	1,577	73	5	-	1,655	1,663	1,277	1,165	1,061
Spinal Anesthesia	154	28	4	-	186	242	188	156	129
Local Anesthesia	496	100	47	-	643	351	835	572	1,165
6. Dental									
Patient	28,177	6,150	2,472	1,906	38,705	44,438	56,394	33,984	47,816

Source: Report of the Minister of Health for 2002

The nationwide hospital bed occupancy rate is approximately 32% as shown in Table 1-2 but has been as high as 50% or more for the Vaiola Hospital since 1990. The Vaiola Hospital was originally constructed based on a hospital design targeting infectious diseases which often involve the long hospitalization of many people. As infectious diseases are now almost under control, the bed occupancy rate of the isolation ward in particular is extremely low as shown in the Table 1-3. In contrast, the bed occupancy rate of the obstetric and surgical wards is as high as 80%, indicating a situation of almost full occupancy.

Table1-3 Bed Occupancy Rate and Average Length of Stay of Inpatients (2002)

	Bed Occupancy Rate (%)	No of Occupied Beds (Beds)	Average Length of Stay (day)
ICU	23 %	1	7
Paediatrics Ward	44 %	31	5
Surgery Ward	76 %	41	8
Obstetrics Ward	80 %	28	3
Obstetrics(SCN)	81 %	6	9
Medical Ward	61 %	40	8
Isolate Ward	6 %	22	41
Mental Health Ward	40 %	22	15-28
Total	51 %	191	(6)

Source: Report of the Minister of Health for the year 2002

(3) Main Diseases and Causes of Death

The main diseases in Tonga are said to be ARI caused by infection and diarrhea. The main causes of death are circulatory illnesses (heart disease and high blood pressure, reflecting the local lifestyle), neoplasms (cancer) and diabetes. “Health Management: Tonga” published in March, 2001 points out the increasing trend of lifestyle diseases (geriatric diseases) over the last 30 years. In view of the anticipated demographic shift towards older ages in Tonga, the future hospital plan must consider an effective response to geriatric diseases.

Table 1-4 Main Diseases and Causes of Death in Tonga (2002)

<Five Leading Diseases>			<Five Leading Causes of Death>		
Diseases	No. of Patients	%	Cause	No. of Patients	%
Acute respiratory infection (ARI)	24,082	46	Diseases of the circulatory system	192	33
Influenza	22,395	43	Neoplasms	76	13
Broncho-pneumonia	1,498	3	Ill-defined signs and symptoms	54	9
Diarrhoea (children)	1,396	3	Diseases of the respiratory system	50	9
Diarrhoea (adults)	1,273	3	Diagnosis of the digestive system	44	8
Total	50,644	96	Total	416	72
Number of notified illnesses	52,559	100	Total deaths	581	100

Source: Annual Report of the Tongan Ministry of Health, 2002

(4) Current Problems of the Vaiola Hospital

The Vaiola Hospital was first opened in 1971 and, after 33 years of service, the following problems can be pointed out with its health and medical care services and their urgent improvement is required.

① Shortage of operating theatres (currently two) and risk of hospital infection due to the unclear separation of the clean and dirty zones
② Shortage of post-operation recovery beds and ICU beds
③ Inability to secure the required sterilization capacity of the CSSD due to frequent breakdowns of the sterilizer
④ Frequent breakdowns of the X-ray photography apparatus, impeding the efficiency of clinical diagnosis
⑤ Insufficient capacity of the open-type septic tank, causing environmental problems and the risk of the spread of contamination
⑥ The provision of second-hand medical equipment by various countries in the past was not accompanied by a proper operation manual and spare parts for such equipment are no longer available, making their repair impossible.

⑦ Many of the showers and toilets in the wards (pediatric, medical and surgical) have broken down and hot water is not provided.
⑧ The absence of fire alarms except in the laboratory presents a major fire risk.
⑨ The old transformer requires replacement.
⑩ The concentrator plant of oxygen produced by the oxygen generator is approximately 70%, failing to meet the required 90% for medical oxygen.

(5) Existing condition of referrals from Health Center to Vaiola Hospital

Table 1-5 shows the number of referral from Health Canter to Vaiola hospital in Tongatapu Island in the year 1999/2000, and shows that the 1.0% of the Health Center patients were send to Vaiola Hospital.

Table 1-5 Health Center Referrals to Vaiola Hospital

Name of Health Center	Number of Patients (Person)	Number of referrals (Person)	Ration (%)
Kolonga	8,081	27	0.3
Mu'a	992	76	7.6
Fua'amotu	4,004	69	1.7
Vaini	4,250	47	1.1
Houma	2,383	4	0.2
Nukunuku	2,942	18	0.6
Kolovai	6,433	61	1.0
Total	29,085	302	1.0

Source: Report of the Minister of Health for the year 2001

(6) Existing condition of referrals from Tonga to New Zealand

Those patients who cannot diagnosis or treat at Vaiola Hospital by the lack of medical equipment and if MOH approve to treat in New Zealand, they can be diagnosis and treat in New Zealand. Cost for the medical treatment will be borne by the Government of New Zealand. Table 1-6 shows the amount of this assistance programme by the Government of New Zealand.

Table 1-6 Budget for medical assistance to the Government of Tonga

Items	2003/4 (NZ$)	2004/5 (NZ$)	2005/6 (NZ$)
Medical treatment in New Zealand	300,000	250,000	250,000
Visiting medical specialists in Tonga	50	50	50
Total	350,000	300,000	300,000

Source: High commission of New Zealand in Kingdom of Tonga

Total numbers of 128 patients were sent to New Zealand for diagnosis and medical treatment in last four years from 1999 to 2002. Following diseases are referred to New Zealand.

① Diagnose Cancer by CT Scan and treatment

② Cardiac surgery and heart failure

③ Fracture of bond and skull

④ Renal stone and urolithiasis

⑤ Ophthalmology surgery

1.2. Background of the Request for Grant Aid

(1) Official request to the government of Japan

It has been passed 33years since Vaiola Hospital opened in 1971, and the facilities and medical equipment are become out of date. Tonga officially requested grant aid of "Upgrading and Refurbishment for Vaiola Hospital" to the Government of Japan in February, 1999. Contents of the request were consisted by upgrading and refurbishment of building, building services and medical equipment and the contents itself is as follows.

Contents of the request: Upgrading and Refurbishment of Vaiola Hospital
Facilities: Construct new building
①Operation Theater, ②Institute of Health Sciences, ③Special Clinic, ④Radiology, ⑤ Mortuary

: Renovation
①Out-patient and Emergency Department, ②Obstetrics, ③Nurse Dormitory, ④Laboratory, ⑤3 Stories Ward Building

: Building services
①Hot Water Supply, ②Electrical Services, ③Sewage treatment Tank、④Fire Protection, ⑤Renewal of Generator

: Equipment
Renewal of medical equipment, Supply medical gas by centralization system, ambulance total 1073 items.

(2) Vaiola Hospital Redevelopment Master Plan

The preparation of the Vaiola Hospital Improvement Master Plan (hereinafter referred to as the Master Plan) is in progress in Tonga with the assistance of the World Bank as part of the efforts to improve the medical treatment services as Health Sector Support Project. This Master Plan proposes the construction of new hospital facilities, rehabilitation of some of the existing buildings and the full-scale improvement of infrastructure relating to electricity supply, water supply, waste water treatment and the disposal of medical waste, etc but no detailed description about medical equipment.

The Draft Master Plan, which was presented in October 2003 divides the process of hospital improvement into seven packages (Package A to G) and plans to proceed with the construction of new facilities → relocation → demolition of some of the existing buildings → construction of new facilities → rehabilitation of some of the existing buildings without suspending the operation of the hospital.

The preparation of Master Plan was still on going, and there is no description about the Japanese Grant Aid in the draft master plan at this stage. During the Basic Design Study in Tonga, the Basic Design study Team proposed the contents of the Japanese Grant Aid and execution schedule to the Tongan Government, and it was agreed to describe about Japanese Grant Aid in the Final Master Plan.

(3) Staging option of Master Plan

The latest Master Plan which was presented in December, 2003 revised from 7 to 6 stages (A to F) programme and developed two staging options by the proposal made by the JICA Study Team.

- Option 1 - is the Ministries preferred option incorporating 23 stages grouped into six works packages (package A-F), and

- Option 2 –integration of the proposed JICA works (package B) into the Ministries preferred option.

Construction schedule of the Japanese Grant Aid in the Option 2 is still the same as Option 1. After completion Package A (construction of new Mental Health and new Kitchen/ Laundry buildings, and demolishing Ex. Mental Health, Ex. Diabetes Clinic and Ex. Physiotherapy), then the Japanese Grant Aid work (Package B) is scheduled.

Fig. 1-1 Outline of the Master Plan

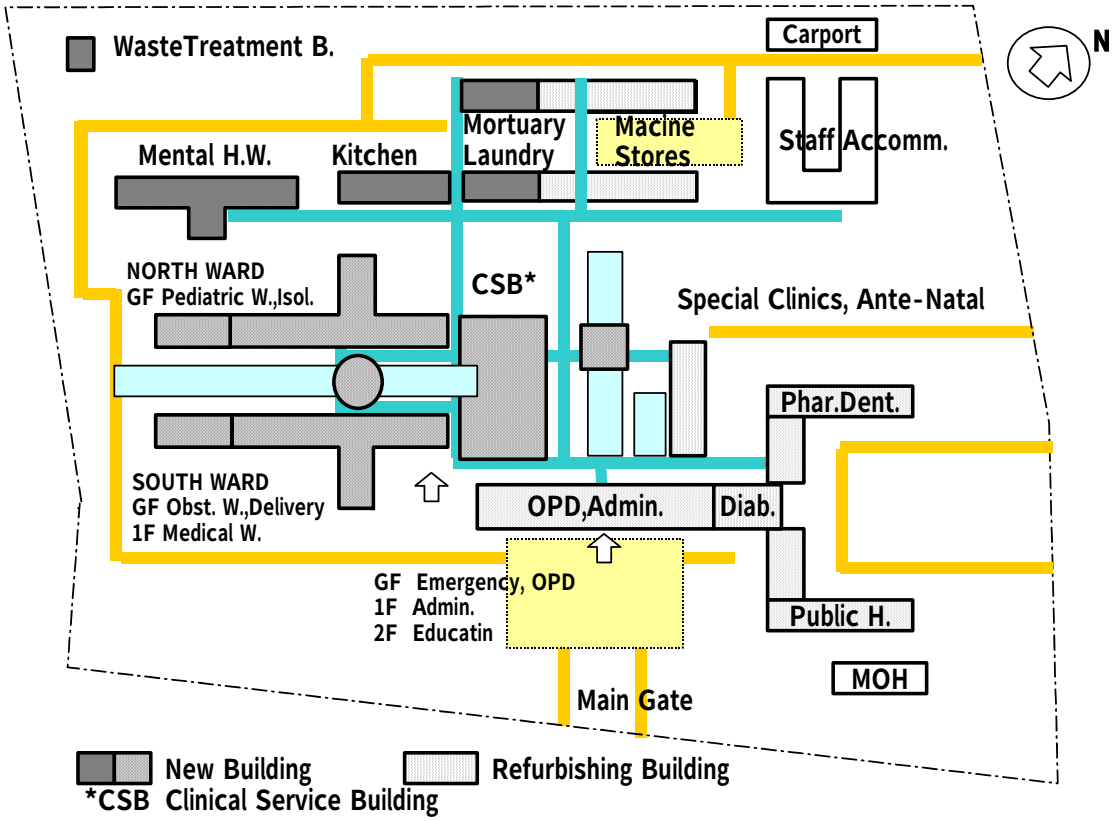


Table 1-7 Package and Construction area of M/P

Package	Activities	Construction Area (㎡)			
		Construction	Renovation	Demolishing	Open Corridor
A	Mental Health, Sewage Treatment Tank	935			
	Kitchen Laundry (no finish)	600			
B	Mental Health/Isolation/Diabetic			1,092	
	CSB	2,390			
	Ward(Pediatric, Medical, Obstetrics, Surgical)	4,618			
C	Road, Bus Stops, Incinerator	336			
D	3 stories Ward	450	2,190		
	Laboratory	70	545		
	Obstetrics & Delivery			1,276	
	Canteen	280			
E	Out-patient (Dental, Pharmacy,		1,392		
F	Nurse Dormitory, Mortuary, Workshop	335	1,730		
	Kitchen(Laundry, Machine,)		450		
	External Work				2,680
Sub Total		10,014	6,307	2,368	2,680
Grand total		21,369			

(4) Preparatory Survey by JICA

Preparatory Survey for the Upgrading and Refurbishment for Viola Hospital was dispatched by JICA from October 7 to 31, 2002, and surveyed the contents of Master Plan for the Redevelopment of Vaiola Hospital and direction of Japanese Government Grant Aid based on the Master Plan and collected relevant data.

(5) Basic Design Survey and Draft Report explanatory Survey

JICA sent the Basic Design Survey Team to Tonga from October 13 to November 10, 2003 for the Project of Upgrading and Refurbishment for Viola Hospital. The team confirmed the contents of request, survey of utilization of Vaiola Hospital facilities and medical equipment and collected relevant information. After series of discussion with Ministry of Health, construction of CSB, Obstetric Ward/Delivery Suite and Surgical Ward were agreed to nominate for the component of Grant Aid in view of urgency, importance and necessity in the hospital. It was agreed that the Medical equipment are renewed only for above mentioned buildings, construction of sewage treatment tank as for environmental measure and renewal of oxygen concentrator in view of medical standard, and MOH describe about the contents of Japanese Grant Aid in the Master Plan.

JICA dispatched the Basic design Survey Team(Explanation of draft report) from February 2 to 14, 2004 and confirmed the contents of basic design survey report (draft) which was further studied and prepared in Japan. Description about this Project in the Master Plan was made in the Package B in the Option 2 and construct CSB in between existing Diabetic Clinic and Obstetric Ward without demolishing any building. Execution Schedule of the Japanese Government Grant Aid in the Option 2 shows in the Package B in the Table 1-7

as 2nd Phase work.
Construction of Package A which is financed by World Bank, Government of Tonga decided the full turn key base and design build method and construction scheduled to start from September to May 2005 and demolish the Mental Health Building, Isolation Ward and Diabetic Clinic building and start the Package B from August 2005.
The construction schedule of Japanese Government's Grant Aid and the construction schedule described in the Master Plan does not fit, so the Government of Tonga agreed with the basic design study team (explanation of draft report) to start the construction of Japanese side work separately from the schedule of Master Plan.

1.2.1 Contents of the Request

(1) Facilities

Based on the components of the Improvement Plan proposed in the Draft Master Plan, the Government of Tonga has indicated the contents of the request to the Basic Design Study Team as listed below.

Table 1-8 Contents of the Request

Building/Facility	Floor	Description of Facilities
CSB	Ground Floor	Physiotherapy; Radiology & Ultrasound; Blood Bank; Pathology Laboratories; Biomedical Equipment Workshop; Inpatient Pharmacy
	First Floor	ICU (6 beds); Day Surgery Reception; Operating Theatres (3); CSSD
South Ward Building	Ground Floor	Obstetric Ward (38 beds + 6 cots); Delivery Suits (6 beds)
	First Floor	Medical Ward (40 beds)
North Ward Building	Ground Floor	Paediatric Ward (30 beds), Isolation Ward (6 beds)
	First Floor	Surgical Ward (40 beds)
Septic Tanks	Sufficient capacity to deal with the existing facilities	
Medical Equipment	Medical equipment required for the above facilities	

Source: Draft Master Plan

The requested components were examined in detail from the viewpoints of urgency, priority and necessity. The following revised contents of the request were agreed through consultations and were incorporated in the Minutes of Discussions (M/D) dated 30th October, 2003. In regard to the number of beds and location of Physiotherapy, the possibility of reviewing the number set in the Master Plan to reflect the actual bed occupancy of each department and changing the location of Physiotherapy in other building were explained to the Ministry of Health and this explanation was accepted.

(2) Equipment

< Outline of Equipment Request >
It was concluded by mutual consent between the Tongan side and the Japanese side in the Basic Design Study that procurement of the equipment was to be made only for the project facilities and the furnishings were not to be procured in this project. The procurement request was made in the final list of requests for the necessities of CSB, Surgical Ward, Obstetrics Ward, Delivery Suite, Medical Ward, Isolation Ward and Pediatrics Ward. After the analysis and discussions in Japan, it was confirmed that the project facilities were to be CSB, Surgical Ward, Obstetrics Ward and Delivery Suite. The procurement shall be made for the equipment of the above-designated facilities in this project. Procurement is planned in due consideration of transfer of the existing equipment that is still serviceable and

CHAPTER 2 CONTENTS OF THE PROJECT

common use of the shareable equipment within each department.
Most of the existing equipment has been used for 10 years or more in Vaiola Hospital. This hospital has met problems that the equipment are frequently in trouble and manufacture of the spare parts have discontinued. The requests are almost replacements for the existing but old equipment. Such requests carry validity to improve the medical services in Vaiola Hospital. When a mission was sent to Tonga in order to explain the Draft Report on the Basic Design Study, another request was made for procurement of an Oxygen Condensing System that produces and supplies oxygen to the Operating Theatres, ICU and others. The existing Oxygen Condensing System is so cranky that the oxygen concentration is lower than 90%, and the oxygen flow rate cannot be accurately gauged with an anaesthesia or an oxygen flowmeter. Moreover, the Oxygen Condensing System in Vaiola Hospital also makes oxygen supply to other medical facilities in Tonga. The procurement of this equipment assumes high urgency and importance, and this is eventually included in the equipment list.
In selecting the equipment, the procurement shall be made for the model that is equivalent to the existing equipment in specifications that do not require acquiring advanced skills for use and do not cause rapid increase in the maintenance cost. The main equipment are shown in the Table 1-9.

Table 1-9 Main Equipment List

Department	Name of Equipment
Operating Theatre	Operating Light; Operating Table; Anesthesia apparatus with ventilator; Electrosurgical unit; Patient monitor; Surgical scrub station; Operating microscope for ENT; Defibrillator
CSSD	High Pressure steam sterilizer; Table top ultrasonic washer
ICU	Ventilator for adult and pediatric; Patient monitor
Laboratories	Blood cell counter; Safety cabinet
Blood Bank	Blood bank refrigerator
Inpatient Pharmacy	Medical refrigerator; Distilled water unit
Biomedical equipment workshop	Maintenance set
Radiology & Ultrasound	X-Ray unit, Automatic film processor, Ultrasound scanner B/W
Obstetric Ward	Doppler fetus detector; Bedpan sanitiser
Delivery Room	Fetal monitor (CTG); Delivery Table; Delivery light
Special Care Nursery (SCN)	Baby resuscitation trolley; Infant incubator
Surgical Ward	Traction apparatus with bed; Pulse Oxymeter
Other (Facility)	Oxygen condensing system

CHAPTER 2 CONTENTS OF THE PROJECT

2.1 Basic Concept of the Project

2.1.1 Objectives of the Project

The Vaiola Hospital which is the only Tongan hospital capable of providing advanced medical services. Apart from its status as the leading referral hospital, the Vaiola Hospital also provides primary health care services for residents of Tongatapu Island. In 2002, the average number of outpatients was as high as 335/day (87,139 per year) while the bed occupancy rate of the obstetric, medical and surgical wards was also as high as 80%, indicating the extremely important role played by the hospital in promoting health care services in Tonga.

The Vaiola Hospital has been designated as a hospital for intern training (14 months) for post-graduate medical students of the Fiji School of Medicine, which accepts a large number of medical students from the South Pacific region. Training commenced in the surgical department in July, 2000 and will be extended to other departments in the coming years.

The Vaiola Hospital was first opened in 1971 and, after 33 years of service, the following problems can be pointed out with its health and medical care services.

- Shortage of operating theatres and risk of hospital infection due to the unclear separation of the clean and dirty zones in the operating theater and CSSD
- Shortage of post-operation recovery beds and ICU beds
- Inability to secure the required sterilization capacity of the CSSD due to frequent breakdowns of the sterilizer
- Frequent breakdowns of the X-ray photography apparatus, impeding the efficiency of clinical diagnosis
- Insufficient capacity of the open-type septic tank, causing environmental problems and the risk of the spread of contamination

The Project aims at improving the medical service functions of the Vaiola Hospital through the improvement and upgrading of the hospital's medical facilities and equipment, thereby improving the conditions of health and medical services throughout Tonga.

2.1.2 Basic Concept of the Project

2.1.2.1 Planned Functions and Activities

(1) Planned Functions of Facilities

For the improvement and upgrading of the Vaiola Hospital, it has been confirmed that the new hospital facilities will have the following functions.

1) Common Features for All Departments
   ① The lines of flow for attendance and visitors will be separated from the lines of flow for medical treatment.
   ② A nurse station will be located in an appropriate position, taking the walking distance for nurses to each bedroom into consideration.
   ③ The facility design will be barrier-free and will reduce the fire risk.
   ④ In principle, the bedrooms will have natural ventilation and natural lighting. Each lighting switch zone will be minimized to reduce the electricity consumption.
   ⑤ The supply of centralized medical gases will be considered.
   ⑥ The finishing materials and arrangements for each room will allow easy cleaning.

2) Clinical Service Bureau (CSB)
   ① As the CSB requires a high level of linkage between the departments, careful consideration should be given to the planning of the lines of flow. Effective linkage should be planned for the lines of flow involving the Operating Theatres, ICU-Recovery beds, Blood Bank, Laboratories and CSSD.
   ② As energy supply is the central function of the CSB, an emergency power supply and a water tank for the CSB will be installed.
   ③ The X-ray photography time in the Radiology Department will be shortened to reduce the number of waiting patients.
   ④ The Blood Bank will have facilities to allow blood donors to rest after giving blood.

3) Obstetric Ward and Delivery Suites
   ① Ensuring the privacy of pregnant women in the ward as well as delivery suites will create an environment, which allows delivery with peace of mind.
   ② The route to the operating theatres will be secured to deal with emergency situations at the time of delivery.
   ③ Private rooms will be introduced with a view to earning a surcharge for upgraded bedrooms.

4) Surgical Ward
   ① The surgical ward will be located on the first floor near the operating theatres.
   ② The privacy of the bedrooms will be secured by separating the male wing from the female wing.
   ③ Private rooms will be introduced with a view to earning a surcharge for upgraded bedrooms.

(2) Upgrading and Refurbishment

1) CSB
   - Increased number of operations in an environment which is free from the risk of hospital infection
   - Increased number of X-ray photographs

- Increased volume of sterilization
- Increased number of patients undergoing endoscopes and ultrasonic diagnosis
- Increased use of recovery beds and ICU beds

2) Obstetric Ward and Delivery Suites
- Increased number of inpatients as well as pre-delivery hospitalizations due to the increased number of beds
- Decline of the infant mortality rate and maternal mortality rate

3) Surgical Ward
- Increase of the bed occupancy rate

(2) Equipment Functions

- The specifications of the new equipment will be equivalent to those of the existing equipment, as they will neither demand that the operators learn advanced skills nor increase the maintenance cost.
- Equipment which can be shared by different departments will be shared.

2.1.3 Study of Contents of the Request

(1) Facilities

The requested components were examined in detail from the viewpoints of urgency, priority and necessity. The following revised contents of the request were agreed through consultations and were incorporated in the Minutes of Discussions (M/D) dated 30th October, 2003. In regard to the number of beds and location of Physiotherapy, the possibility of reviewing the number set in the Master Plan to reflect the actual bed occupancy of each department and changing the location of Physiotherapy in other building were explained to the Ministry of Health and this explanation was accepted. The revised contents of the request (listed in the M/D) are shown in Table 2-1

Table 2-1 Contents of the Request

Building/Facility	Floor	Description of Facilities
CSB	Ground Floor	Radiology; Blood Bank; Laboratories; Biomedical Equipment Workshop; Inpatient Pharmacy
	First Floor	ICU; Day Surgery; Operating Theatres; CSSD
Ward Building	Ground Floor	Obstetrics Ward; Delivery Suits
	First Floor	Surgical Ward
Septic Tanks	Sufficient capacity to deal with the existing facilities	
Medical Equipment	Medical equipment required for the above facilities	

Source: Revision of World Bank Master Plan

(2) Examination of Target Facilities

1) CSB

The importance and urgency of constructing the CSB are judged to be high by the Study Team as this building will accommodate the central facilities for diagnosis and treatment at the hospital. As it was difficult to forecast the concrete timing for work implementation based on the implementation schedule in the Master Plan, the building shape has been

remodeled and a proposal put to the MOH and World Bank consultants for the construction of the CSB on an vacant site between the existing buildings to avoid the process of demolition and removal of diabetes clinic. This proposal received a favorable response from the MOH's consultants and the MOH agreed to include the contents of the proposal in the Final Master Plan and described as in the option - 2 in the Master Plan.

2) Obstetric Ward, Delivery Suites and Surgical Ward

It was decided that the construction of an Obstetric Ward/Delivery Suite and Surgical Ward Building strongly requested by the Government of Tonga would be further examined in Japan in view of the high utilization rate of ward beds and its strong connection to the Operating Theatres in the CSB. The contents of the final request are shown in Table 2-1.

3) Contents of Cooperation

The policy of contents of cooperation by grant aid for the facilities and equipment were confirmed as shown in table 2-2 after the analysis and discussion in Japan. Table 2-3 compares the number of existing beds at the Vaiola Hospital, those listed in the Master Plan and those planned under the Project.

Table 2-2 Scope of Assistance for the Gant Aid

Building	Floor	Description of Facilities
CSB	GF	Radiology; Blood Bank; Laboratories; Biomedical Equipment Workshop; Inpatient Pharmacy
	1F	ICU (2 beds); Recovery Beds (3 beds); Day Surgery Reception; Operating Theatres; CSSD
Ward Building	GF	Obstetrics Ward (34 beds + SNC 6 cots); Delivery Suites (6 beds)
	1F	Surgical Ward (40 beds)
Septic Tanks	Sufficient capacity to deal with the existing facilities	
Medical Equipment	Medical equipment required for the above facilities	

Table 2-3 Comparison of Number of Beds With Vaiola Hospital and Master Plan

Room	Vaiola Hospital (Present)	Final Master Plan (Beds)	Project (Beds)
Obstetric Ward	28	38	34
SNC (cots)	5	6 (Rooming In Beds 6)	6
Surgical Ward	41	40	40
ICU	1	6	2
Total	75	90	82
Operating Theatre	2	2	2
Day surgery	-	1	1
Delivery Suites	Delivery: 2 Labour: 3	6 -	6 -
Recovery Beds	2	6	3

(3) Equipment

< Outline of Equipment Request >

It was concluded by mutual consent between the Tongan side and the Japanese side in the Basic Design Study that procurement of the equipment was to be made only for the project facilities and the furnishings were not to be procured in this project. The procurement request was made in the final list of requests for the necessities of CSB, Surgical Ward,

Obstetrics Ward, Delivery Suite, Medical Ward, Isolation Ward and Pediatrics Ward. After the analysis and discussions in Japan, it was confirmed that the project facilities were to be CSB, Surgical Ward, Obstetrics Ward and Delivery Suite. The procurement shall be made for the equipment of the above designated facilities in this project. Procurement is planned in due consideration of transfer of the existing equipment that is still serviceable and common use of the shareable equipment within each department.

Most of the existing equipment has been used for 10 years or more in Vaiola Hospital. This hospital has met problems that the equipment is frequently in trouble and manufacture of the spare parts has discontinued. The requests are almost replacements for the existing but old equipment. Such requests carry validity to improve the medical services in Vaiola Hospital. When a mission was sent to Tonga in order to explain the Draft Report on the Basic Design Study, another request was made for procurement of an Oxygen Condensing System that produces and supplies oxygen to the Operating Theatres, ICU and others. The existing Oxygen Condensing System is so cranky that the oxygen concentration is lower than 90%, and the oxygen flow rate cannot be accurately gauged with an anaesthesia or an oxygen flowmeter. Moreover, the Oxygen Condensing System in Vaiola Hospital also makes oxygen supply to other medical facilities in Tonga. The procurement of this equipment assumes high urgency and importance, and this is eventually included in the equipment list.
In selecting the equipment, the procurement shall be made for the model that is equivalent to the existing equipment in specifications that do not require acquiring advanced skills for use and do not cause rapid increase in the maintenance cost. The basic specifications of the main equipment are shown in the Table 2-4.

Table 2-4 Basic Specifications of the Main Equipment

Department	Equipment	Basic Specifications
Operating Theatre	Operating light	Light intensity: main lamp – 135,000 lux, sub-lamp – 100,000 lux
	Operating table	Manual hydraulic: Table top dimensions – 1,900 m (L) x 450 mm (W)
	Anesthesia apparatus with ventilator	Flow meter: (N20, 02); vaporiser (halosen, isoflurane)
	Electric scalpel	Bipolar function; output; 100 W for coagulation, 250 W for cutting and 200 W for mixing
	Patient monitor	Measured parameters: 1) ECG 2) Non invasive blood pressure 3) respiration 4) Spo2 5) Pulse 6)Temperature 7) CO_2; monitor: LCD with display size of approximately 6", simultaneous display of four waveforms
	Surgical scrub station	Main unit: integral cabinet; material: stainless steel; sterilization method: two stepped filter + sterilization lamp; switch: foot-pedal operated
	Operating microscope for ENT	Magnification: 3 – 15 X; field of vision: 14 – 65 mm; operating distance: 290 mm; luminous intensity: 68,000 lux
	Defibrillator	Energy output: 2 – 360 J; monitor, rapid charger, ECG cable and recording equipment
Endoscopic room	Gastroscope with lightsource	Gastroscope: Outer diameter:9.8mm, Bending section:up210°,down 120°, Lightsource:150W Halogen lamp, Biopsy foceps
CSSD	High pressure steam sterilizer	Capacity: 220 litres; dual path method; electric steam generator and water softener
	Table top ultrasonic washer	Capacity: 20 litres
ICU	Ventilator for adult and pediatric	Applicable age: infants to adults; ventilation volume: 60 – 900 ml
	Patient monitor	Measuring parameters: 1) ECG 2) Non invasive blood pressure 3) Respiration 4) Spo2 5) Pulse 6) Temperature 6) Invasive blood pressure

Department	Equipment	Basic Specifications
Laboratory	Blood cell counter	Measuring items: 18; processing capacity: 50 samples/hour; sample volume: entire blood
	Safety cabinet	Inside width of work chamber: 800 mm; ventilation volume: 5.3-6.7 m^3/min; internal burner, sterilisation lamp and power outlet
Blood bank	Blood bank refrigerator	Capacity: 460 litres; warning: 7°C for high temperature and 3°C for low temperature; recording equipment
Inpatient's Pharmacy	Medical refrigerator	Capacity: 290 litres; measuring range of temperature: -2° - +14°C; high temperature warning: 25°C
	Distilled water unit	Single step distillation using electric heating; material: stainless steel; distillation capacity: 5.0 litres/hour
Biomedical unit	Maintenance set	Composition: various measuring instruments and electric tool set
X-ray unit	X-ray unit	X-ray tube voltage: 150 kV; X-ray tube current: 500 mA; composition: X-ray generator, X-ray tube, Bucky's table and Bucky's stand
Dark room	Automatic film processor	Developing speed: 90 seconds/film; developing capacity: 90 films/hour
Ultrasound room	Ultrasound scanner, B/W	Monitor: black and white: probe: convex, linear, via vagina
Obstetric Ward	Doppler fetus detector	Composition: main unit with built-in speaker with one probe; functions; ultrasonic frequency: approximately 2.5 MHz; pulse indication: 50 – 210 bpm; internal battery-driven type; display: pulse number
Delivery suite	Fetel monitor (CTG)	Fetus cardiac sound monitoring: one or more; detection range: 50 – 210 bpm with display function; throes cycle and cardiac sound of foetus can be recorded by a recorder
SCN (Special care nursery)	Baby resuscitation trolley	Temperature control: servo control; set range: 30-42°C; accessories: body temperature probe and oxygen supply/suction unit
Surgical Ward	Oxygen saturation meter	Specifications: 5po2; measuring range: 1-100%; display: Spo2; pulse warning function
Other (Facility)	Oxygen condensing system	Air compressor: Air flow: 750L/min., Oxygen concentrator: Oxygen flow rate:50L/min.

2.2. BASIC DESIGN OF THE REQUESTED JAPANESE ASSISTANCE

2.2.1 Design Policies

< Policies Regarding the Grade of Facilities >

After 33 years since starting operation of Vaiola Hospital with insufficient routine maintenance, the existing buildings are suffering from peeling paint, rusting of ferrous materials, separation of the flooring materials, rusting of the roofing materials, damage to the toilet and shower units and damage to the guttering, etc. In regard to the grade of the new facilities, the Project adopts a policy of introducing facilities that are easy to maintain by adopting design and material specifications that will prevent similar problems in the future. In regard to the Operating Theatres, an air-conditioning system will be introduced to maintain the required level of cleanliness instead of hepa filters of which the high maintenance cost could lead to a lack of routine maintenance.

2.2.1.1 Basic Policies

The design policies for the Project are explained herewith.

(1) Policy Regarding Master Plan (M/P) Prepared by Government of Tonga

Respect for M/P: The Government of Tonga is preparing to proceed with the improvement of the Vaiola Hospital based on the M/P and the basic design will basically be compiled respecting the contents of the M/P. The project design will consider the future links between the buildings to be constructed under the Project and other ward buildings, etc. planned under the M/P.

(2) Policy Regarding EIA

The basic design for the Project will be compiled through coordination efforts with the Ministry of Health which is responsible for the compilation of an EIA report regarding data, including environmental standards (BOD standard, electricity consumption and water consumption, etc.), which is related to the approval of an EIA report and not mentioned in the M/P. There is a time lag between the time of approval of EIA and completion of Basic Design Study, so the Japanese Grant Aid cannot adopt the environmental regulation stipulated in the EIA. Therefore, it was agreed by Ministry of Health and Japanese Basic Design Survey Team (Explanation of Draft Report) that the additional cost to cover the Regulation stipulated by the EIA shall be borne by Government of Tonga.

(3) Scope of Cooperation for Equipment

The scope of cooperation for equipment under the Project will be limited to medical equipment to be used at the target facilities of the Project.

(4) Consideration of Operation at Existing Facilities during Construction

As the construction of the new facilities will be conducted while the existing hospital operates as usual, switching over work will be necessary for the electricity, water supply systems and sewage line. The best planning will be necessary for this work to prevent any adverse impacts on the operation of the existing hospital. Noise and dust, etc. caused by the construction work will be dealt with by means of temporary fencing and other measures.

(5) Policies Regarding Natural Conditions

1) Temperature and Solar Radiation

The climate of Tonga is relatively mild because of trade winds except in the hot period in January and February. The Project will emphasize energy saving and natural ventilation and natural lighting will be employed in rooms other than those where an air-conditioning unit will be installed. The eaves will be deep to prevent the intrusion of direct sunlight into the rooms in order to prevent an unwanted rise of the room temperature. In view of the strong solar radiation, rock wool will be laid under the roofing metal to enhance the heat insulation effect to prevent a rise of the room temperature. Ceiling fans will be installed in the general wards to lower the heat inside.

2) Salt Damage

Salt breeze often blows through the hospital premises depending on the wind direction from a seawater lagoon located some 100 m southwest of the hospital, making the adoption of salt damage prevention measures, including highly durable, anti-rust paint to the exposed iron components, essential for the hospital buildings. In the case of concrete work, as sea sand is not presently used, the concrete has little salt content. To confirm this, a cantab test, which is a simple method to check the salt content of concrete, will be conducted during construction pahse.

3) Earthquakes

The National Building Code of the Kingdom of Tonga adopts the San Francisco coefficient of 0.4Z (the same as San Francisco) of the San Francisco Building Code. This seismic coefficient will be used for the structural computation for the Project.

4) Harmony with Surrounding Landscape

There are some 15 single story and two story buildings on the premises of the Vaiola Hospital. These buildings have a gable roof covered by corrugated iron sheets. The walls are block masonry with a mortar and paint finish. The windows of the older buildings have an iron frame and newly constructed building window are aluminum frame. As the building design is uniform, the design of the new buildings must be compatible with the existing design so as not to damage the established atmosphere of the hospital.

(6) Social Conditions

1) Safe and Functional Facilities

The planned facilities will form part of the leading referral hospital in Tonga and it is necessary for the hospital to provide primary health care for all types of diseases. For this reason, measures to prevent hospital infection and the spread of contamination to the surrounding area will be given the highest priority.

2) Environmental Care

New closed-type septic tanks with a capacity to serve 1,800 persons will be constructed under the Project. These tanks will be constructed following National Building Code and will mitigate the risk of contamination or infection to curtail any adverse impacts on the environment.

Chemical agents discharged from the laboratories without prior treatment will kill the bacteria in the septic tanks, preventing the purification function of these tanks. A container to treat waste water containing chemical agents will, therefore, be introduced in the laboratories and the treated waste water will be disposed of in a safe place. Chemical waste from film development machine in the radiology room needs same treatment as laboratory.

(7) Maintenance

1) Reduction of Operation and Maintenance Cost

The priority for the procurement of building service systems and the power control system will be given to those which are widely used in Tonga and which will be easy to operate. Materials with high durability and weatherability will be used to reduce the maintenance cost. For example, the air-conditioning units will be procured from a single manufacturer to simplify their maintenance and parts replacement work and to facilitate the use of common parts. Each room will face an open space where possible in view of the adequate use of natural lighting and reduction of the lighting equipment cost as well as the energy consumption.

2) Use of Local Materials and Local Construction Methods

The local building material market generally sells products imported from Fiji, New Zealand and Australia but the prices are relatively high because of the local construction boom in those countries. In principle, locally procurable and easy to maintain or repair materials will be used while examining their prices, available quantities and delivery times. Local buildings commonly use a RC frame and concrete block walls. As the use of a construction method employing special technologies would incur a relatively high cost because of the lack of local engineers as well as the required materials, the use of a special construction method has been ruled out.

3) Local Procurement of Laboratory Equipment

As laboratory equipment, which meets the required quality, is not manufactured locally, the procurement of local products will not be considered for the Project. Meanwhile, the list of the planned equipment includes X-ray equipment and safety cabinets, which require periodic inspection. The procurement priority will be given to manufacturers, which have a local agent in consideration of product liability. It will be recommended that the Ministry of Health conclude a maintenance contract with the manufacturers.

2.2.2 Basic Plan (Facilities Plan and Equipment Plan)

(1) Master Plan Evaluation and Review Policies

1) Number of beds:

The number of beds is reviewed based on the bed occupancy rate and growth rate of population.

2) Total size:

The facility size will be re-assessed in view of the actual situation of use and the adequate and necessary floor area will be determined.

3) Staging:

The process will be reviewed to ensure the optimal process of facility development/improvement reflecting the importance and urgency of each facility.

4) Layout plan:

The basic concepts of the Master Plan, such as the dispersal of buildings, building distribution based on function and layout plan for alleviation of the congested outpatient facilities, are judged to be reasonable. However, the line of flow tends to be stretched and issues of an invasion of privacy. The positioning of corridors along the buildings poses questions of an invasion of privacy. The layout and building shape will be re-examined to

ensure efficient hospital operation and a comfortable indoor environment by creating a compact design for the entire hospital.

(2) Layout Plan

For the Project, the following two changes have been made to the Master Plan.

1) Shape of CSB

The shape of the CSB has been changed to allow its construction without the demolition of the Mental Health Ward, Isolation Ward and Diabetes and Cardiovascular Center.

2) Shape of Ward Building

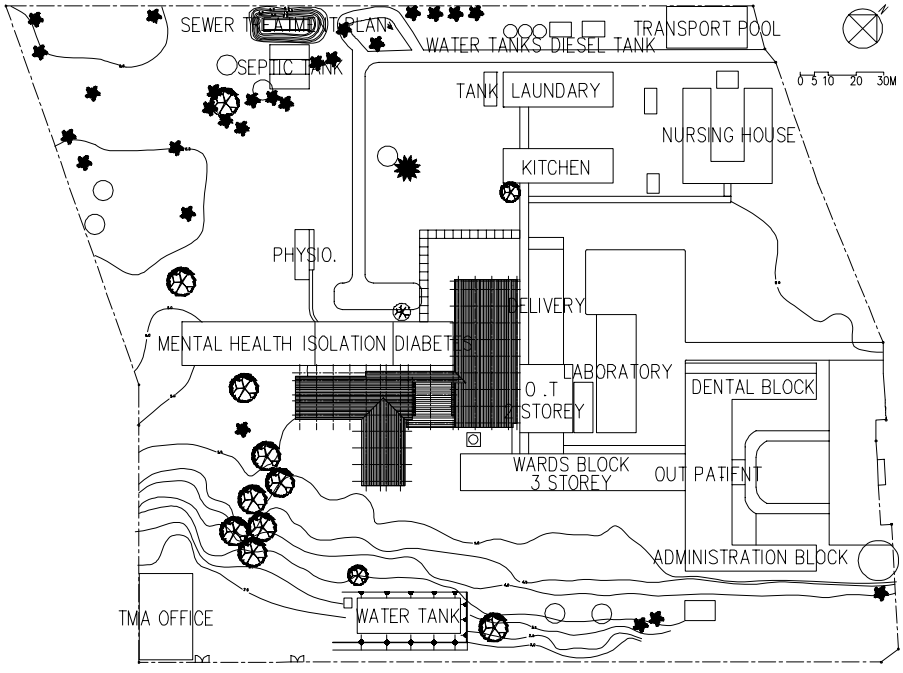
The plan for the ward buildings has been changed from a straight line to an L-shape to allow the corridors to be linked at the point of intersection of the L-shaped ward buildings in order to shorten the lines of flow and to ensure the privacy of inpatients. Re-arrangement of shape of the CSB will also make it possible to construct the CSB, Obstetric Ward/Delivery Suite and Surgical Ward at any time, allowing the separate construction of those buildings incorporated in the Master Plan.

3) Relation to CSB (Operating Theater)

The CSB is the core function for diagnosis and treatment at the hospital and is located in the middle of outpatient building and wards. As the Delivery Suites mainly receive patients who are admitted as emergency cases, they were moved to the side of the rehabilitated Accident & Emergency Department (A & E) in the draft Master Plan. The Project inherits this arrangement.

The Surgical ward of which the bed occupancy rate is as high as 76% is located on the first floor to establish linkage with the CSB, particularly the operating theatres. Another reason for the location of the surgical ward on the first floor is the impossibility of even temporarily using the surgical ward currently located on the first floor of the existing ward building because of the complicated line of flow. To be more precise, a problem arises from the prospect of post-operative patients having to go to the ground floor by lift and then move up to the first floor using the existing lift because of the absence of a direct link between the planned CSB and the existing ward building.

Fig.2-1 Building Layout Plan



(3) Floor Plan

1) CSB

- The ground floor will house the Laboratory, Blood Bank, Radiology and Ultrasound, forming the core service facilities for outpatients, accompanied by a Medical Equipment Workshop and an In Patient Pharmacy.

- The first floor will house the operating theatres which are closely related to the surgical ward and the ICU/Recovery Beds. The CSSD and Day Surgery Unit will also be located on this floor.

2) Ward Building (Obstetric Ward/Delivery Suite and Surgical Ward)

- This two-story building will be constructed to the southeast and next to the CSB.

- The ground floor will have Delivery Suite near the emergency entrance as most cases of delivery involve the emergency arrival of a pregnant woman. The obstetric ward will be linked to this area.

- The first floor will have a Surgical Ward, which is linked to the operating theatres, and ICU/Recovery Beds. Each ward will be linked to the CSB via a connecting corridor to allow the easy transportation of patients and medical equipment.

- The ward building will be L-shaped and each wing will have special characteristics in terms of the gender of patients, level of patient conditions. The windows of the bedrooms will face an open space in view of good ventilation, lighting and the view to create a comfortable indoor environment. By linking the connecting corridors at the corner of the L-shaped building, the distance between the CSB and the ward building entrance will be minimized in addition to such effects as blocking the view of patients' rooms and reducing the noise.

(4) Internal Zoning and Flow Plan

1) Concept of Zoning and Lines of Flow for the Ground Floor

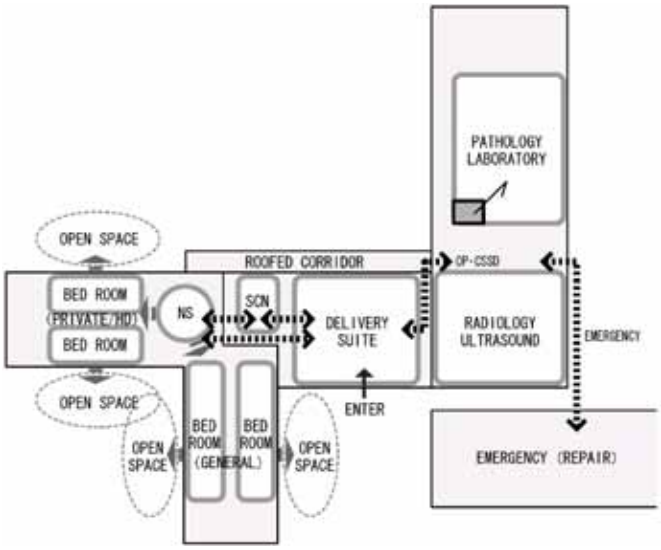
- The ground floor of the CSB will have the Radiology and Ultrasound in the south section and the Laboratories and Blood Bank in the north section.

- A hall with an east-west axis will be located in the central section to facilitate the access of outpatients and inpatients to the various facilities.

- The entrance to the Delivery Suite will be located next to the A & E department in preparation for emergency arrivals. The Special Nurse Care (SCN) will be located between the Delivery Suite and the Obstetric Ward to shorten the line of flow for newly born babies and post-delivery patients.

- A lift at the centre of the CSB will be used to provide an emergency line of flow.

Fig. 2-2 Zoning Plan - Ground Floor



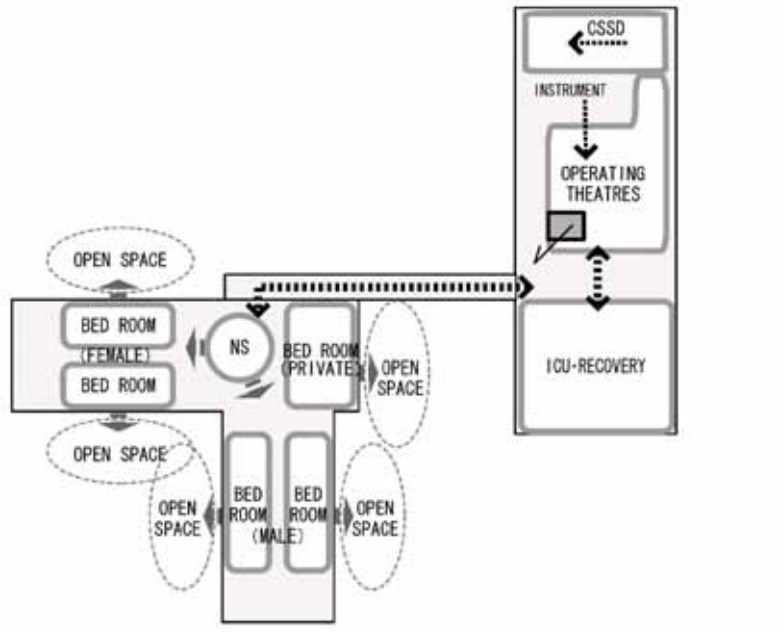
2) Concept of Zoning and Lines of Flow for the First Floor

- The first floor of the CSB building will have adjoining Operating Theatres and CSSD in the north section while clearly separating the lines of flow for clean and contaminated operating equipment and tools.

- Short lines of flow will be provided for post-operation patients to the ICU or the recovery room. Outpatients due for Day Surgery Unit will report to the reception via the lift or staircase.

- The rooms in Wards for inpatients will face an open space to secure a good hospital environment and privacy. The ward entrance and Nurse Station (NS) will be located at the central point of the male and female wing to monitor visitors to the wards and the movements of inpatients. Private beds will be located at the side of the entrance.

Fig 2-3 Zoning Plan - First Floor

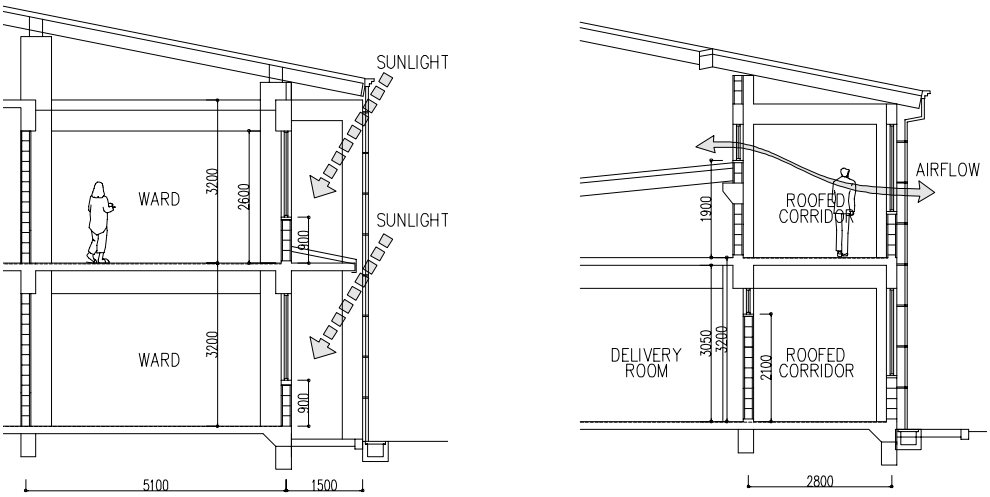


(5) Sectional Plan

- The buildings will have two floors. Deep eaves will be adopted to block out strong solar radiation and rain.

- A pitched roof will also be adopted to collect rainwater by gutter. As many openings as possible will be introduced and facilitate natural lighting and ventilation.

Fig 2-4 Section Plan



Section of ward room **Section of Corridor**

(6) Facilities Plan

1) CSB Building

① Operating Theatre

- There are three Operating Theatres including Day Surgery Theatre.

- Two Operating Theatres are judged to be appropriate in view of the current intensity of operations, i.e. four major operations and eight minor and day surgery operations per day, and concentrated operation exercises by foreign medical teams.

- It is reasonable to separate operations for in patient and day surgery for outpatients (the annual number of operations for in admitted patients is 994 and day surgery operations is 1991 respectively).

- To solve the current problem of disorder lines of flow for clean and contaminated equipment/tools, an independent corridor leading to the adjacent CSSD will be introduced.

- The standard size of the operating theatres is almost the same as the present operating theatre size 30.7 m^2 (5.9m x 5.2m). However, the size of Operating Theatre-1 for difficult decease is 45.8m^2 (7.2m x 6.4m) in consideration as major operations.

- The Day Surgery Theater will have such attached facilities as a Waiting Room 14.4 m^2, a Preparation/Treatment Room 13.3 m^2 and a Consultation Room 14.4 m^2.

② CSSD

- To clearly distinguish areas for the handling of clean and contaminated equipment/tools, a through type floor plan is adopted to separate the cleaning and assembly room and the post sterilization room by autoclaves.

- The CSSD has a floor area of 144.0 $m^{2,}$ which is slightly larger than the existing area of 110 m^2. It includes stock space for the tools and linens of the operating department.

③ Recovery Beds and ICU Beds

- While the Master Plan assumes six beds for the ICU, the separation of these beds into Recovery and ICU beds is necessary. At present, two recovery beds are used for not only post-major operation patients but also post-minor operation patients if necessary. In September 2003, the recovery beds were used by as many as 143 patients (daily average of 5.7 patients).

- From the viewpoint of patient care, it is advantageous for the same team to observe the post-operation recovery patients and the ICU patients. There is currently only one ICU bed. In September and October 2003, this bed was used by five patients for a total of 31 days. Because of the manpower shortage, some patients were transferred to the ward. Six ICU nurses are currently undergoing training abroad and it is anticipated that the manpower shortage will be solved in the near future.

- Three Recovery Beds (two turnovers a day) and two ICU beds are assumed under the Project for the centralized observation and care of the subject patients.

- The distance between the beds is set at 3.5 m or 2.0 m because of the need to place necessary equipment and the overall floor area is set at 89.0 m^2, including the space for NS.

④ Radiology & Ultrasound

- The Radiology and Ultrasound is combined to ensure their efficient operation.

- The radiography facilities will consist of two rooms with sufficient radiation shielding.

- The control space, dark room and film viewing apace is separated from the radiology room. The introduction of a dark room in the middle will make the interpreting area.

- The planned floor area of the Radiology Room-1 is 28.70 m^2 (6.2m x 4.6m) similar to that of the existing facilities. Radiology Room-2 is 28.4 m^2 (6.2m x 4.6m) and the size is 70% of existing facility. The Ultrasound Room will have efficiently allows the examination of two patients in a single room and area is 32.8 m^2 (7.8m x 4.2m) smaller than existing facility of 40 $m^{2.}$

- To avoid the congestion of staffs, inpatients and out patients at the corridor, entrance for out patient and waiting area provided along with the external corridor. Entrance for Ultrasound room has two doors from Radiology area and Delivery Suite for convenient utilization.

⑤ Biomedical Laboratory

- The existing facilities have been reviewed from the viewpoint of their respective functions to plan the new laboratory facilities.

- To avoid the congestion of staffs and out patients at the corridor, entrance for out patient and waiting area provided along with the external corridor.

- Pathological, bacteriological and TB tests handling bacilli and generating odour are separated from others. The general testing area, biochemical testing area and blood test table are combined into one unit and the space currently not used is reduced to achieve efficient planning of the floor space 236.90 m^2 compare to the total floor area of existing Biomedical Laboratory 459.16 m^2. The blood and urine sampling spaces will be located near the entrance. A TB corner (9.5 m^2), pathology laboratory (23.30 m^2) and bacteriology laboratories (29.10 m^2) are partitioned will as independent facilities in view of the bad odour and risk of infection.

- The Blood Bank will have an independent blood collecting room and a rest room for patients and staff area. The floor area will be reduced to 60.5 m^2 compare to existing facility floor area 68.8 m^2.

- Concentration of these functions and location is expected to improve the efficiency of Operating Theatres and Biomedical Laboratory.

⑥ Inpatient Pharmacy

- The present hospital pharmacy has a hygiene problem in that boxes containing drip infusion bags for inpatients are placed between the shelves for general drugs. One of the main themes of the Master Plan is the clear separation of the zone for outpatients often escorted by other people and the zone for inpatients. It also proposes the separation of the pharmacy for inpatients to facilitate hygiene control.

- The new inpatient pharmacy will be located in the CSB near to a ward to ensure its hygiene as well as efficiency. The planned floor area is to create an exclusive stock space for inpatient drugs in the CSB and the facility area is reduced to 46.90 m^2 from existing area of 51.0 m^2.

⑦ Biomedical Equipment Workshop

- There is a strong need for a biomedical equipment workshop to (i) achieve efficient maintenance by means of locating it near the operating theatres, ICU and radiology & ultrasound, etc. which demand frequent equipment maintenance and (ii) improve the maintenance level of medical equipment through the proper provision of parts and maintenance tools.

- The planned floor area is 50.0 m^2, including a medical gas room and a pump room for fire hydrant compare to Master Plan's floor area 64.0 m^2.

2) Obstetric Ward and Delivery Suites

① Obstetric Ward

- At present, the average length of stay in the Obstetric is 3 days due to an insufficient number of beds (28beds). The hospital management recommends to lengthen the stay to 4 – 5 days. The bed occupancy rate of 80% is quite high.

- The Master Plan envisages an increase of the number of beds to 38 (32 for general, two for high dependency patients and four for private beds).

- Calculation of the required number of beds:

  Based on the number of deliveries in 2002 and an average length of stay of 4 – 5 days:
  2,053 x 4.5 ÷ 365 ÷ 0.8 = 31.6
  The number of beds by calculation is 32 beds at the moment.

- The number of childbirths in Tonga is showing a slightly increasing trend, from 2,597 in 2000 to 2,700 in 2001 and 2,694 in 2002. As shown in the table 2-5, the crude birth rate is approximately 2.7%. Following its rehabilitation, the new Obstetric Ward becomes more attractive and the number of deliveries and inpatients will expected to increase. A ward size of 34 beds appears to be appropriate in view of such increased birth rate of the obstetric ward.

Table 2-5 Population Growth Rate in Tonga

	1998	1999	2000	2001	2002
Population (Estimate)	98,400	99,800	100,300	100,700	101,000
Difference / Rate of Increase on Previous Year (%)	-	900 (1.4)	500 (0.5)	400 (0.4)	300 (0.3)
Crude Birth Rate (per 1000)	-	-	2.6	2.7	2.7

Source: Ministry of Health Report, 2002

- The ward will have an L-shape so that the Nurses Station in the centre can view the entire ward. Four-bedded Rooms will be located in the south wing while rooms for the High Dependency Beds (HD) and Private Beds will be located in the west wing.

- The ward will consist of six four-bedded rooms, two twin rooms and six single rooms, out of which two will be designated as HD rooms.

- The floor area for each type of room is planned to be the same as that of the existing corresponding room, i.e. 30.6 m^2 (6 m x 5.1 m) for a four-bedded room, two beds room is 15.3 m^2 (3.0m x 5.1m), one bed room is 15.3 m^2 (3.0m x 5.1m). The corridor width will be 2.1 m.

- Staff-related rooms (sister's room, staff room, doctor's room and treatment room) will be located near the Nurses Station. A day room will also be introduced to provide a better environment for inpatients.

- Toilet and shower facilities for the disabled will be located at the end of the wing together with ordinary toilet and shower facilities.

② Delivery Suites

- Pregnant women often arrive at the hospital in an emergency manner after feeling pains and are directly admitted to a delivery room to give birth. The treatment for post-delivery mother and bathing of the baby are conducted in the same delivery room.

- On departure, the delivery room is tidied, cleaned and disinfected by nurse in preparation for the next delivery. It takes 4 – 9 hours to complete this delivery cycle.

- The average number of childbirths per day at the Vaiola Hospital is currently 5.6 and six delivery suites without a labour room are judged to be appropriate.

- These six delivery suites are located around a hall and each delivery is similar to that of the present delivery rooms 20 m^2 (5m x 4m). 4 delivery suites install shower sets and 2 delivery rooms install bath tabs with hot water supply.

③ Special Care Nursery (SCN)

- The SCN will be located between the Obstetric Ward and the Delivery Suites to enable a proper response to an emergency situation and to allow its control from the ward.

- While the SCN currently has two separate rooms (29.4 m^2) with five cots, the Master Plan envisages six cots in the 35.7 m^2. Given the current cots occupancy rate of 81%, the introduction of six cots is judged to be appropriate. The planned floor area is 39.0 m^2. Rooming in bed will take place in the HD.

3) Surgical Ward

- The Master Plan envisages 40 beds (28 ordinary beds, four beds for the high dependency, four beds for private; including beds for gynaecological patients and four private beds). The surgical ward currently has 41 beds and the bed occupancy rate is as high as 76%. As an increase of the bed occupancy rate is anticipated due to the inclusion of gynaecological patients in the new surgical ward, its size of 40 beds is judged to be appropriate.

- This ward is also planned to have a L-shape to make it possible to view the entire ward from the nurses station in the centre. The south wing and the west wing are designated as the male ward and the female ward respectively and private beds will be located near the entrance.

- The ward will consist of 40 beds by eight four-bedded rooms (6.0m x 5.1m=30.6 m^2 8 rooms) and eight single rooms, out of which four rooms of single rooms will be designated as high dependency rooms to accommodate seriously ill patients.

- The floor area for each type of room is planned to be the same as the existing corresponding room (6.0m x 5.1m=30.6 m^2). The private rooms (3.0m x 5.1m=15.3 $m^{2)}$ will be located separately from the group of other rooms and accompanied by exclusive toilet and shower facilities. The corridor width will be 2.1 m. At the end of both winds, an external staircase will be provided for emergency evacuation.

- Staff-related rooms (Sister's Room, Staff Room, Doctor's Room and Treatment Room) will be located near the Nurses Station. In addition, a day room will be introduced to provide a better environment for inpatients.

- Day room will be used for meeting space with family and installed kitchen facilities for heating food for the inpatients. Low partition will be installed around day room to prevent spreading noise and crowd. Treatment room in the Consultation Room for Gynaecological patients will be provided near to the Nurse Station.

- Toilet and shower facilities for the disabled will be located at the end of the wing together with ordinary toilet and shower facilities.

- The placing of the Obstetric Ward and the Surgical Ward on top of one another with a similar layout will make the building structure and building service systems more efficient and economical.

4) Septic Tanks

- Apart from its insufficient treatment capacity, the present open type septic tank causes such environmental problems as a risk of contamination via birds, animals and insects and bad odour, indicating the urgent necessity for its improvement.

- The EIA regulations in Tonga do not have any regulated or standard value for waste water treatment. Under the Project, a septic tank consisting of three continuous sewage treatment tanks, each of which is capable of treating the sewage of 600 persons, as shown by the National Building Code for the Kingdom of Tonga will be provided. The treatment of sewage will be conducted by means of ground infiltration instead of the direct discharge of treated sewage to a water channel, river or harbour. A treatment capacity of a closed septic tank of 160 m^3/day and a quality (BOD) of discharging water value of 50 – 100 ppm are assumed.

- In case of above mentioned specification is insufficient to the EIA condition, it was agreed by MOH and Draft Basic Design Study Report Explanatory Team that the additional cost for construction and design work for upgrading of specification shall be born by MOH.

- Additional connection valves will be installed to make easy connection by the MOH in the future.

(7) Comparison of Number of Beds

1) Comparison of Number of Beds in Master Plan and the Project with existing number of beds at Vaiola Hospital

The number of beds comparison is shown in following Table 2-6.

① Obstetrics Ward

The Master Plan puts the number of beds for the Obstetric Ward at 38. At present, there are 28 beds with an occupancy rate of 80% and an average stay of three days per patient. As the hospital delivery ratio in Tonga is more than 90%, the Vaiola Hospital plays a major role in this regard. Under the Project, 34 beds are believed to be appropriate based on the estimated use of the new facilities and taking the recent trend of an increasing number of births into consideration. The hospitalisation period is extended to 4 – 5 days and the resulting increased demand for beds is also considered in the decision to provide 34 beds. Four patients will be cared for in the special care wing.

② Surgical Ward

The Master Plan puts the number of beds for the Surgical Ward at 40. This number is also equivalent to the existing number of beds and is judged to be appropriate in view of the current high bed occupancy rate of 76% by the standards of the Vaiola Hospital.

Table 2-6 Comparison of Number of Beds

Facility	Existing Beds	Master Plan		Project	
Obstetric Ward	28	38	General 4 beds x 5 rooms 2 beds x 5 rooms HD 1 bed x 2 rooms Single 1 bed x 2 rooms Single rooms in separate Wing 1 bed x 4 rooms	34	General 4 beds x 6 rooms 2 beds x 2 rooms HD 1 bed x 2 rooms Single 1 bed x 4 rooms
SNC (Cots)	5	6	6 cots in one room of the Obstretic (Rooming in bed :1 beds x 6 rooms)	6	6 cots in one room of the Obstretic Ward
Surgical Ward	41	40	General 4 beds x 4 rooms 2 beds x 6 rooms HD 1 bed x 4 rooms Single 1 bed x 4 rooms Single rooms in separate Wing 1 bed x 4 rooms	40	General 4 beds x 8 rooms HD 1 bed x 4 rooms Single 1 bed x 4 rooms
ICU	1	6		2	Parallel with the recovery bed
Total	75	90		82	
Operating Theatres	2	2		2	
Outpatient Operating Theatre	-	1		1	
Delivery Suites	Labour Rooms 2 Delivery Suite 2	6	Labour/Delivery 6 beds HD 1 bed	6	Labour/Delivery 6 beds
Recovery Beds	2	6		3	Parallel with the ICU

(8) Required Rooms and Their Floor Area

Table 2-7 Planned Floor Area by Room and Comparison With Existing Floor Area and Master Plan

Table 2-7-(1) CSB Ground Floor

Division, Room Name	Existing Building	Final Master Plan	Japanese Portion	Size of the room
Radiology	**246.29**	**305.00**	**246.70**	
Reception / Waiting Area	26.91	35.50	17.90	6.2×2.9m
Film Storage	5.50	10.50	17.10	5.4×3.2m
Office	9.68	-	26.10	Office to be concentrated
Office for Chief Radiographer	10.80	23.00		3.9×6.7m
Office for Radiologist	10.80	11.50		
Office for Sonographer	-	11.50		
Ultrasound Room	40.10	20.00	32.80	7.8×4.2m
X-Lay Screening Room-1	29.40	33.00	28.70	6.2×4.6m
X-Lay Screening Room-2	39.60	41.50	28.40	6.2×4.6m
Dark Room	12.00	16.50	13.80	2.3×6.0m
Radiologist Area / Viewing Area	26.20	10.50	23.40	3.9×6.0m
Preparation Room	10.50	-	-	
Toilet/Changing Room	10.80	12.00	8.00	3.9×2.0m
General Store	-	28.00	12.30	4.4×2.8m
Corridor for Radiology	14.00	51.50	38.20	2.1×18.2m
Blood Bank	**68.80**	**99.00**	**60.50**	
Bllod Bank	-	-	42.00	
Blood Collection Room	-	20.30	9.30	2.9×3.2m
Office	-	12.30	-	
Resting Room	-	-	9.20	2.9×3.2m
Store	-	8.20	-	
Corridor･etc	-	58.20	-	
Pathology Laboratory	**459.16**	**354.00**	**236.90**	
General Lab.	45.30	160.60	109.60	GeneralLab to be concentrated
Microbiology Lab.	69.12	-	29.10	5.0×5.8m
Pathology Lab.	46.08	-	23.30	4.0×5.8m
Biochemistry Lab.	69.12	-	-	
TB Lab.	23.04	31.00	9.50	3.2×3.0m
Media & Wash up Area	55.00	31.00	12.00	4.0×3.0m
Collection Room	-	14.00	-	
General Store	64.00	20.40	11.30	4.0×2.8m
Libraly	24.00	-	-	
Office / Staff Room	53.60	48.00	26.00	3.2×8.1m
Waiting/ Reception Area	9.90	49.00	16.10	Patient toilet to be attached 5.3×3.0m
Physiotherapy	**-**	**90.00**	**-**	
Physiotherapy	-	90.00	-	
Inpatient Pharmacy	**-**	**51.00**	**46.90**	
Inpatient Pharmacy	-	30.00	46.90	6.2×7.6m
Pharmacy Store	-	21.00	-	
Biomedical Engineering Workshop	**20.55**	**64.00**	**51.30**	
Engineering Workshop	20.55	42.00	43.30	6.2×7.0m
Gas cylinder Storage	-	8.00	8.00	4.0×2.0m
Reception	-	14.00	-	
Common Area, others	**-**	**118.00**	**275.70**	
Fire Hydrant Pump room	-	-	5.40	4.0×1.3m
Staff Room-1 inc. Toilet	-	58.00	56.80	Common use･5.7×9.2m
Staff Room-2 inc. Toilet	-	60.00	51.60	Common use･5.8×8.0m
Corridor, Stairs	-	-	161.90	
Sub total	**-**	**1,081.00**	**918.00**	
Comparison based on the Master Plan(%)	**-**	**100.00**	**84.92**	

The differences between the Project and the Master Plan for the Ground Floor of the CSB are:

① Physiotherapy Room is planned in a different building,
② Staff rooms for Radiology are combined into one room,
③ Floor area for the reception and waiting area has been reduced and
④ Laboratories have been functionally separated. Washing is conducted in the CSSD on the first floor and the size of the staff room has been reduced.

Table 2-7-(2) CSB First Floor

Division, Room Name	Existing Building	Final Master Plan	Japanese Portion	Size of the rooms
ICU・Operation Div.	**279.90**	**706.00**	**600.15**	
Recovery /ICU Room	31.20	160.50	89.00	Additional ICU・6.5×13.7m
Nurse Station -1	-	9.00	9.50	2.4×4.0m
Nurse Station -2	-	12.00	21.20	3.7×5.8m
Preparation Room	-	18.00	12.00	1.7×7.0m
Counselling Room	-	12.00	-	
Endoscope Room	13.80	-	25.60	6.0×4.3m
Treatment Room	-	-	13.30	Space for Day Surgery 3.5×3.8m
Consulting Room	-	-	14.40	Space for Day Surgery 3.5×4.1m
Reception/Waiting Area	-	37.00	14.40	Space for Day Surgery
ICU Corridor	-	-	49.00	
Doctor's Office	-	24.00	-	
Sister's Office	-	12.00	-	
Staff Room	-	35.00	37.50	8.8×4.3m
Toilet	-	-	8.00	
Store	-	6.00	-	
Operation theatre—1	32.40	34.50	45.80	7.2×6.4m
Operation Theatre—2	32.40	34.50	30.70	5.2×5.9m
Operation Theatre—3	-	34.50	31.60	for Day Surgery 7.0×4.5m
Transfer Area	-	28.30	40.20	Clear separation of dirty and clean area
Dirty Corridor	17.60	26.50	32.40	1.8×18.0m
Staff Room/Nurse Station	4.00	34.50	-	
Changing Room with Toilet-1	27.60	10.50	19.45	4.5×4.3m
Changing Room with Toilet-2	27.60	10.50	17.40	4.5×3.9m
Tea Preparation Room	7.20	-	-	
Operating Theatre Suite	33.90	98.40	45.70	3.5×13.0m
Store / ME Space	39.40	11.80	13.00	4.5×2.9m
Scrub up Area	-	16.20	30.00	5.1×2.8m (×2)
Dirty Utility	-	16.20	-	
Machine Room	12.80	-	-	
Corridor/Stairs	-	24.10	-	
CSSD	**110.32**	**195.00**	**144.00**	
Autoclave	9.52	-	4.30	3.1×1.4m
Washing Area	82.80	70.00	93.30	
Crean Room		92.70	37.00	6.0×6.2m
Clean Store		24.30	-	
Office			9.40	3.5×2.7m
Dirty / Crean Store	18.00	8.00	-	
Common	**-**	**-**	**119.85**	
Corridor/Stairs	-	-	119.85	
Sub Total	**-**	**901.00**	**864.00**	
Comparison based on the Master Plan(%)	**-**	**100.00**	**95.89**	

The difference between the Project and the Master Plan is the positioning of the recovery room and the ICU in parallel to make post-operative care easier. The size of the floor area has been reviewed for each facility. The doctor's office and sister's offices have been withdrawn under the Project.

Table 2-7-(3) Obstetrics Ward/Delivery Suite

Division, Room Name	Existing Building	Final Master Plan	Japanese Portion	Size of the room
Delivery Suite	**207.00**	**365.00**	**285.25**	
Consulting Room	-	-	13.93	5.5×2.5m
Toilet	-	7.50	5.18	
Nurse change-1	14.70	12.50	14.40	2.8×5.1m
Nurse change-2	-	12.50	14.40	2.8×5.1m
Doctor's Office	-	15.00	-	
Nurse Station	13.84	7.50	16.40	6.5×2.5m
Delivery Suite Hall	31.50	86.50	49.60	9.2×5.4m
Entrance Hall	14.70	30.00	42.70	
Labour Room-1	14.70	-	-	Change to delivery suite
Labour Room-2	14.70	-	-	Change to delivery suite
Labour Room-3	14.70	-	-	Change to delivery suite
Delivery Room-1	22.20	22.50	18.70	3.7×5.1m
Delivery Room-2	22.20	22.50	17.80	3.7×5.1m
Delivery Room-3	-	22.50	20.40	Change from labour room 4.0×5.1m
Delivery Room-4	-	22.50	18.80	Change from labour room 4.0×4.7m
Delivery Room-5	-	22.50	16.45	Change from labour room 3.5×4.7m
Delivery Room-6	-	-	16.45	Additional delivery room 3.5×4.7m
1 High Dependency Room	-	15.00	-	
Sterilization Room	13.50	-	-	CSSD in CSB can be utilised
Preparation Room	24.50	37.50	9.74	2.5×3.9m
Dirty Utility / Laundry	-	15.00	10.30	2.0×5.1m
Storage	5.76	13.50	-	
Obstetrics Ward	**621.00**	**950.00**	**835.75**	
Doctor's Office	-	15.00	15.30	3.0×5.1m
Sister's Office	-	7.50	8.70	3.4×2.6m
Staff Room	-	28.40	23.20	4.6×5.1m
Nurse Station	7.20	15.00	13.50	
Nurse changing room -1	7.50	15.00	-	
Nurse changing room -2	14.70	15.00	-	
Treatment Room	15.90	-	15.30	3.0×5.1m
Procedure Room	-	15.00	-	
Milk Preparation	9.80	-	-	
Nursery	44.10	-	-	
Special Care Nurse	29.40	35.70	39.00	5.1×7.7m
Rooming-in Beds (adjacent to SCN)	-	81.00	-	
1 Bed Ward	44.10	30.00	65.00	3.0×5.1m (×4)
1High Dependency Room	-	30.00	30.60	3.0×5.1m (×2)
2 Bed Ward	14.70	112.50	30.60	3.0×5.1m (×2)
4 Bed Ward	176.40	150.00	183.60	5.1×6.0m (×6)
Private Beds	-	85.00	-	
Day Room	-	30.00	27.80	
Pantry	14.70	-	-	
Linen room	14.70	-	-	Included in Storage.
Storage	24.50	13.50	10.40	
Secure Druge Store	-	7.50	-	
Dirty Utility -1	14.70	11.60	15.30	3.0×5.1m
Dirty Utility -2	14.70	-	15.30	5.1×3.0m
Laundry Room	9.80	-	-	
Toilet/Shower for Patient	29.40	15.00	31.20	
Handicapped Toilet/Shower	-	-	22.20	
Stair, Corridor, Lobby	15.90	237.30	160.05	
Roofed Corridor	118.80	-	128.70	
Sub Total	**828.00**	**1,315.00**	**1,121.00**	
Comparison based on the Master Plan(%)	**62.97**	**100.00**	**85.25**	

The differences between the Project and the Master Plan are:

① Preparation Room and the waste disposal room have been scaled down

② Consultation Room and the storage have been withdrawn on the grounds that these facilities are commonly used with other divisions.

Table 2-7-(4) Surgical Ward

Division, Room Name	Existing Building	Final Master Plan	Japanese Portion	Size of the rooms
Surgical Ward	**797.52**	**910.00**	**853.50**	
Doctor's Office	9.00	15.00	15.30	5.1×3.0m
Sister's Office	6.00	7.50	8.70	3.4×2.6m
Staff Room	15.00	58.40	16.30	3.2×5.1m
Nurse Station	15.00	7.50	14.50	
Treatment Room	-	22.50	20.60	5.1×4.0m
1 Bed Ward -1～4	75.00	146.00	61.20	5.0×3.0m (×4)
Toilet/Shower	-	-	10.63	
1High Dependency Room	-	60.00	61.20	3.0×5.1m (×4)
2 Bed Ward	60.00	135.00	-	
4 Bed Ward	240.00	120.00	244.80	6.0×5.1m (×8)
Day Room	-	37.50	33.00	
Pantry	15.00	-	-	
Linen, Storage -1	45.00	35.00	3.00	1.0×3.0m
Linen, Storage -2	-	-	4.00	1.8×1.1m (×2)
Dirty Utility	30.00	26.60	30.60	3.0×5.1m (×2)
Toilet/Shower	41.88	30.00	31.20	
Hadicapped Toilet/Shower	-	-	26.00	
Stair, Corridor	245.64	209.00	167.07	
Roofed Corridor	-	-	105.40	
Sub Total	**797.52**	**910.00**	**853.50**	
Comparison based on the Master Plan(%)	**87.64**	**100.00**	**93.79**	

The differences between the Project and the Master Plan are:

① Nurse and Staff Room has been scaled down,

② Total floor area has been reduced because of the changed number of beds in certain rooms despite the same number of beds in total

③ The shape of the ward has been changed from an I shape to an L shape.

The total floor area of the target facilities for Japanese assistance of 3,756.5 m^2 is compared with the nominated floor area of the Master Plan in the table below. Approximated floor area of existing Vaiola Hospital 3,154.8 m^2 cannot compare with other two plans because the room composition is different.

Table2-8 Comparison of Floor Area

	Existing (m^2)	Master Plan (m^2)	Project (m^2)
Total Floor Area	(3,154.8)	4,087.0	3,756.5
Relative Proportion (M/P=100) (%)	(74.9%)	100.0%	89.3%

Within the scope of the Project, the planned total floor area is smaller than the Master Plan by 10.7%.

(9) Building Materials Plan

The specifications of the building materials have been determined in consideration of their resistance to possible damage to the paint, roofing materials and iron products and strong solar radiation.

1) Exterior Finishing

Table 2-9 Materials of Exterior Finish

	Finishing Materials
Roofing	Thin potassium coated iron sheeting (0.55 m); fastened by screws
External Walls	Concrete block, mortar trowel and VP finish
Windows and Doors	Aluminum windows and doors (Almite finish)
Glass	Float glass; sheet glass (for jalousie windows)
Beams	Gravel (t = 150 mm)
Gutters	Steel sheeting: SOP
Vertical Drains	Steel pipes: 50∅, 3 m pitch
Connecting Corridors (External)	Floor: concrete with a trowel finish Roof: thin potassium coated iron sheeting (0.55 mm); fastened by screws Pillars: structural steel SOP

2) Interior Finishing

① Floor Materials

In the case of the administration office, staff rooms and wards where the floors are cleaned with a mop, PVC sheeting will mainly be used in view of waterproofing and hygiene. Meanwhile, epoxy coating, which has an excellent anti-chemical and waterproofing performance, will be used for the operating theatres, delivery suites, waste disposal room and toilets which require washing.

② Wall Finish

The wall finish will be mortar with a paint finish, which is common in Tonga.

③ Ceiling Finish

Flexible boards with a paint finish will be employed for those rooms which require a ceiling due to the function of the room. For such facilities as bedrooms, workshop, radiology rooms and laboratories, the exposed plaster finish will be painted with repair of the plaster if necessary.

The selection of the main building materials to be used described above is based on the analysis results of the present conditions of the existing facilities and the planned materials under the Project are shown in Table 2-10.

Table 2-10 Interior Finish materials

■ CSB

Floor	Department/Room	Floor	Skirting Board (H = 60)	Walls	Ceilings	CH (mm)
G	Radiology Department					
	Reception	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
	Ultrasonic Room	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
	Radiography Room	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
G	Blood Bank					
	Blood Bank	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
	Blood Collection Room	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
G	Laboratory Department					
	Laboratory	Epoxy coating	Epoxy rising	Mortar + paint	Fair Face repair + paint	3050
	Staff Room	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
G	Pharmacy		PVC		Fair Face repair + paint	
	Pharmacy	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
G	Equipment Workshop		PVC		Fair Face repair + paint	
	Equipment Workshop	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
	Medical Gas Storage	Concrete + trowel finish	PVC	Concrete	Fair Face repair + paint	3050
1st	ICU Department		PVC			
	Recovery/ICU Room	PVC sheet	PVC	Mortar + paint	Flexible board + paint	2600
	Endoscopy Room	PVC sheet	PVC	Mortar + paint	Flexible board + paint	2600
1st	Operating Department		PVC			
	Transfer Area	PVC sheet	PVC	Mortar + paint	Flexible board + paint	2600
	Corridor	PVC sheet	PVC	Mortar + paint	Flexible board + paint	2600
	Operating Theatre	Epoxy (coated)	PVC	Calcium silicate board + epoxy	Calcium silicate board + VP	3000
	Sterilization Room	PVC sheet	PVC	Mortar + paint	Flexible board + paint	2600

■ WARD BUILDING

G	Delivery Department					
	Entrance Hall	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
	Delivery Rooms (1-6)	Epoxy coating	Epoxy rising	Mortar + paint	Fair Face repair + paint	3050
G	Maternity Ward					
	NS	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
	SCN	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
	Day Room	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
	Corridor	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
	Bedroom	PVC sheet	PVC	Mortar + paint	Fair Face repair + paint	3050
1st	Surgical Ward					
	NS	PVC sheet	PVC	Mortar + paint	Flexible board + paint	3050
	Day Room	PVC sheet	PVC	Mortar + paint	Flexible board + paint	3050
	Corridor	PVC sheet	PVC	Mortar + paint	Flexible board + paint	3050
	Bedroom	PVC sheet	PVC	Mortar + paint	Flexible board + paint	3050
	Waste Treatment Room	Epoxy coating	-	Tiles	Calcium silicate board + paint	2600

■ Common Use Facilities

	Corridor	PVC sheet	PVC	Mortar + paint	Flexible board + paint	2600
	Staircase	PVC sheet	PVC	Mortar + paint	Flexible board + paint	2600
	Toilets	Epoxy coating	-	Tiles	Calcium silicate board + VP	2600

(10) Structural Plan

1) Subsoil Exploration

Subsoil excavation was conducted at 17 sites (TP1 through TP5 and DCP1 through DCP12) covering a wide area of the hospital premises. The ground around the planned buildings is generally flat. At TP1 through TP5, the subsoil was actually drilled through to confirm the soil properties down to the bedrock. According to the exploration results, the bedrock (coral limestone) is distributed at a depth of 0.6 – 2.6 m from the ground surface.

In the case of TP2 and TP4, laboratory tests (Atterberg's test, CBR test and moisture content test) were also conducted while the dynamic penetration test was conducted down to the depth of the bedrock in the case of DCP1 through DCP12 to check the soil strength.

The subsoil exploration results indicate that the surface soil to a depth of 20 – 30 cm is humus. Below this depth lies dark brown or light brown clay to a depth of 90 cm. While the dynamic penetration test results of this clay indicate a reasonable bearing capacity of 17 tons/m^2, special attention must be paid to ensuring that the excavation bottom is not immersed in water as the strength of this clay weakens on exposure to water.

2) Foundation Plan

As the foundation bottom of the planned two story buildings stands on hard clay, the type of foundations will be either independent footings or continuous footings. Prior to the commencement of the construction work, dynamic cone penetration test will be conducted in several places of the foundation bottom to verify the bearing strength.

3) Structural Frame Plan

The building structure will be a rigid reinforced concrete structure. Structural concrete blocks will be used for the external walls and partition walls. The roof structure will be a structural steel roof truss covered with metal roofing sheets. The floor of the ground floor will comprise slab-on-earth. Expansion joints will be placed between the ward building and the CSB to create well-balanced floor planning with a view to preventing cracks caused by stress concentration caused by earthquakes and climate.

<Design Load>

・Design Wind Load shall obtain from Australian Standard (AS1170.2);
Max. Wind Speed: Vu = 70 m/s (ultimate strength), Vp = 57m/s (permissible stress)

・ Design Seismic Load shall be obtain from California Building Code;
Base Shear Coefficient for Design: Cd = 0.25

・ Design load shall be as follows for each rooms.

Table 2-11 Design Load

	Dead Load (N/mm2)	Live Load (N/mm2)	Total (N/mm2)
Ward	4,200	1,800	6,000
Office	4,200	2,900	7,100
Metal Roof	1,000	1,000	2,000

4) Applicable Standards

The structural design will follow the relevant standards in Tonga. In addition, the standards of the Architectural Institute of Japan will be used for reference purposes.

5) Structural Materials

Coral limestone is used locally as a concrete aggregate. Prior to the construction work, test mixing will be conducted to ensure the adequate quality of the concrete. Structural steel and bolts will be treated by rust-proofing paint to ensure their durability.

Table 2-12 Material for Main Stricture

	Specifications
Cement	Ordinary Portland Cement
Concrete	Strength: 25Mpa
Re-Bars	D10 – D16 Grade300 (AS/NZS4671) or SD295(JIS)
	D-20 – D25 Grade500(AS/NZS4671) or SD345(JIS)
Steel of Frame	Grade300 (AS/NZS3679) or SS400(JIS)

(11) Building Services Plan

The main focus of the building services plan is placed on “safety” which is the most important issue for hospital facilities based on the following basic policies for the Project.

1) Basic Policies

① Securing of Safety and Hygiene

The primary requirement of power supply, water supply and drainage systems which constitute the key building service systems is to eliminate any potential shortcomings in terms of safety. Given the fact that the water has a high mineral content, a water treatment device will be installed to minimize the degradation of the building service systems. Moreover, the maintainability will be improved by means of rational networking and the appropriate layout of the systems.

② Achievement of Energy Saving and a Low Running Cost

The building services plan will maximize energy saving with the use of rainwater and natural ventilation, etc. while minimizing the consumption of electricity and fuel oil.

③ Securing of Back-Up Systems

The introduction of an independent generator will be planned to provide a back-up for power supply.

In the case of water supply, the use of rainwater will be given priority with the municipal water supply.

2) Electrical Installations (Facility layout schedule is attached in the Annex.)

① Voltage Fluctuation

As shown in Table 2-5 and Table 2-6, the voltage at the Vaiola Hospital fluctuates with a certain daily pattern. Against the standard voltage of 240 V, the range of fluctuation for the Popua District is 8.3%, comprising 3.3% for the maximum rise to 248 V and 5% for the maximum drop to 228 V. The range of fluctuation for the Vaiola Hospital is less than 10%, comprising 2.9% for the maximum rise to 247 V and 7.1% for the maximum drop to 223 V. Given the relatively stability of the supply voltage as described above, it is judged that voltage fluctuation is to be small and does not pose a practical problem.

Fig 2-5: Voltage fluctuation recorded at a hotel in Popua District in the period from 19th October (Saturday) to 24th October (Friday), 2003

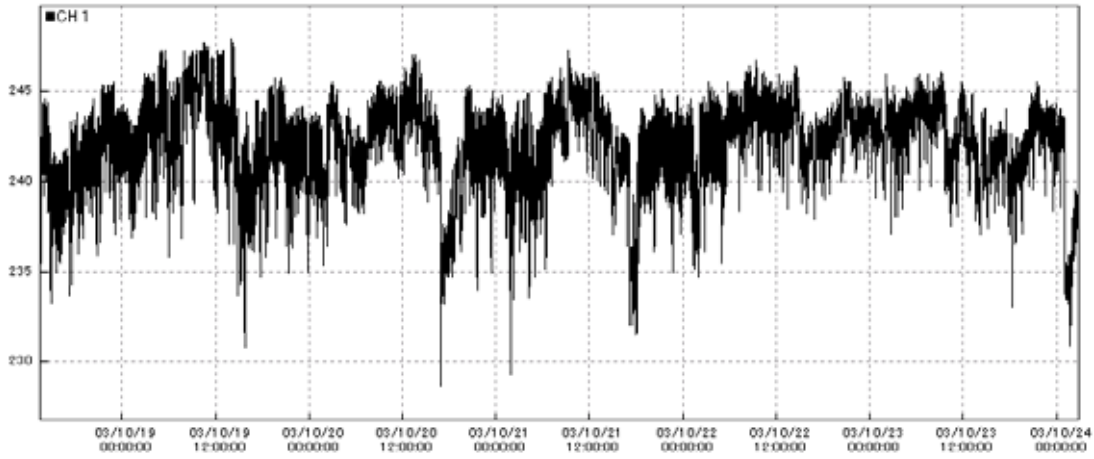


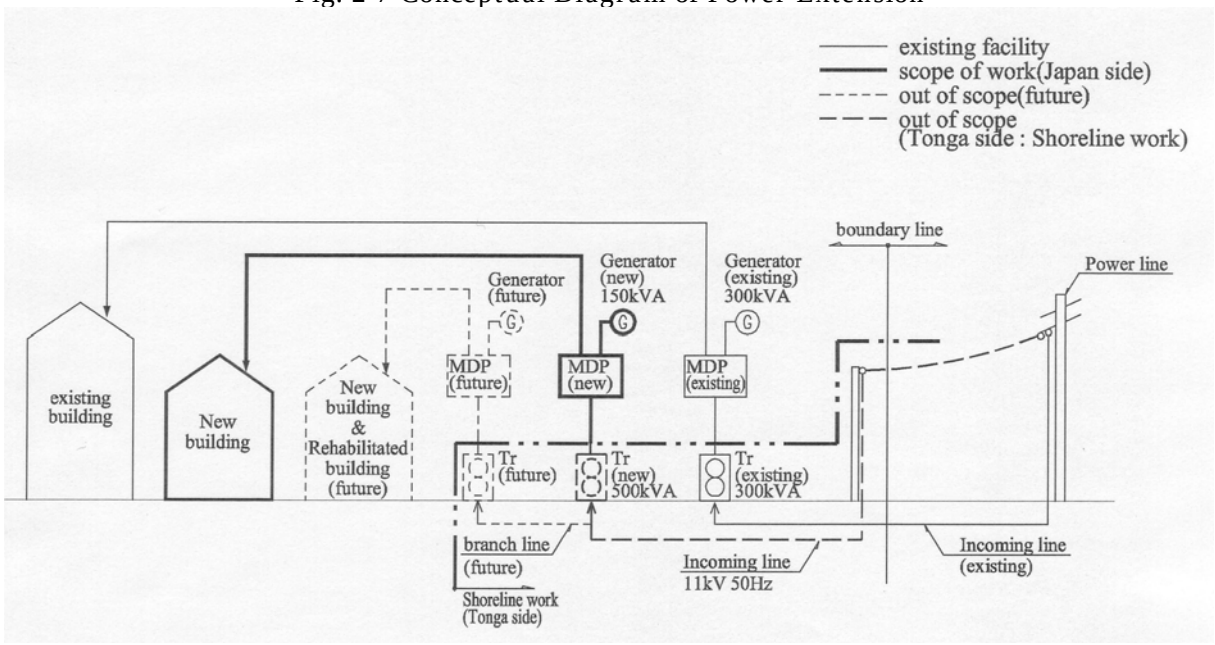
Fig 2-6: Voltage fluctuation recorded at the Vaiola Hospital (Tufoa District) in the period from 27th October (Monday) to 31st October (Friday), 2003

② Power Receiving and Transforming Equipment

The Government of Tonga shall be responsible for the provision of power receiving and transforming equipment. The additional transformer of the required capacity is 500KVA

at the time of branching out the high voltage supply from the newly extended line and the completion of installation of new transformer shall be two months before turnover the Project.

Fig. 2-7 Conceptual Diagram of Power Extension



The Japanese side shall be responsible for power distribution from the secondary side of the new transformer.

The new distribution panel will be installed next to the existing distribution panel and an automatic switch (ATS) will link the power distribution system to the newly installed emergency generator. As the voltage of supplied power is fairly stable, an AVR will not be installed.

③ Independent Power Plant (Generator)

A new power plant for emergency use will supply power to meet the emergency and safety loads of the minimum requirement (medical equipment in the operating theatres, SCN, HDs and ICU, lighting, lift, pressurised water supply pump unit and booster pump for fire-fighting, etc.) This power plant will consist of a diesel generator outdoor package type of 415/240 V and 150 KVA. Fuel oil for 24 hours consumption will be stored on site.

④ Trunk Power Supply System

Power will be supplied from the new distribution panel to the new buildings via an underground conduit or trench pit. The trunk line system will be adopted to provide power for lighting, plug sockets, medical equipment, air-conditioning units and other power equipment in each zone. An independent power supply line will be provided for the radiography apparatus, etc.

⑤ Lighting and Plug Sockets

Plug sockets will be provided to serve the new equipment, transferred one and future requirements. The types and luminous intensity of lighting equipment will be similar to those of the existing equipment to keep the maintenance and lighting costs low. The lighting sources are fluorescent lamps and switch will control the lighting in a small area for energy saving. The target luminous intensities are as follows.

- Operating theatres, ICU and laboratories : 400 lux
- Offices, radiation room and NS : 300 lux
- Corridors and bedrooms : 50 – 100 lux

In addition to ordinary lighting, a battery-operated emergency lighting system is planned for important rooms while guiding lights indicating emergency exits are planned for end exits.

⑥ Telephone System

The number of external telephone lines has now been increased to 13 but the Vaiola Hospital and the MOH have requested a further increase by four more lines. The local telephone company will be responsible for the work from the trunk telephone line to the on-site MDF and the existing switchboard shall be extended to accommodate the new telephone lines (if necessary) to be conducted by the MOH while the Japanese side will be responsible for the work beyond the MDF and some 20 telephones will be installed in the main rooms

⑦ Interphone System

An interphone system is planned for communication between the operating theatres, administration office and existing CSSD.

⑧ Nurse Call System

A push button is provided for each bed of wards, ICU and ward toilets while a display lump will be installed at the relevant NS. In the wards, a corridor lamp will be installed for each room and toilet area to indicate the location of the call for nurse.

⑨ Fire Alarming System

A fire Alarming system consisting of smoke detectors and push button call points are planned for each building. A fire call receiver will be temporarily installed in the office on the ground floor for fire monitoring throughout the building.

⑩ Lightning Arrester

A lightning arrester will not be installed due to low height of the planned buildings.

⑪ Others

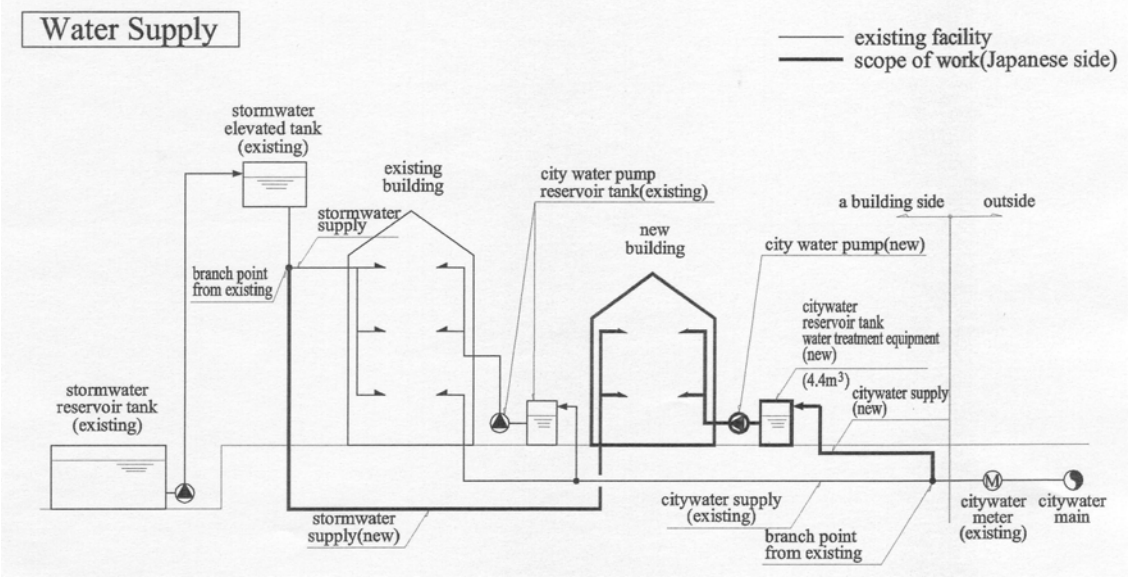
A common TV reception system and a broadcasting system will not be installed.

3) Plumbing Work (Facility layout schedule is attached in the Annex.)

① Water Supply System

The municipal water supply in Nuku'alofa is stable. However, the low water pressure (approximately 0.15 MPa) and hard water need special considerations. At present, the Vaiola Hospital actively uses rainwater that is more advantageous than municipal water in terms of quality. There is about 1,900mm of rain fall in Tongatapu Island in a year and water from roof gutter gather into reserve water tank and use it for daily use.

Fig. 2-8 Supply Water and Rainwater Utilization Plan



The water supply system using rainwater will branch out from the existing pipeline near the elevated water tank to serve mainly medical equipment and the hot water supply system. Rainwater is expected to account for some 20% of the annual water consumption of the hospital, and municipal water will be considered as back up in view of a possible drought. For water supply to the CSB, a new supply line will branch out near the site boundary. Given the insufficient water pressure, the municipal water will firstly be stored in the water tanks adjacent to CSB and Wards to be pressurized subsequently. A non chemical water treatment unit will be installed to improve the water quality in order to protect the piping and apparatus.

< Calculation of Required Tank Capacity for the Project >

- Average daily water consumption: 155 m^3 (based on the current figure)
- Average daily water consumption by 76 beds (excluding cots) instead of the existing 191 beds: 155^3 x (76/191) = 61.7 m^3
- The capacity of the water tank is determined based on the formula to calculate the required capacity of the elevated water tank as pressurized water supply is considered to be supplementary to the direct supply.

Water tank capacity = estimated maximum hourly water supply x storage time
= (average daily consumption ÷ average daily hours of use x maximum hourly use factor) x storage time
= (61.7 m^3 ÷ 14 hours/day x 2) x 0.5
= 4.4 m^3

In consideration of its durability and maintainability, the water tank will be a stainless panel tank equipped with a pump room. The actual dimensions of the water tank will be 2 m in length, 1.5 m in width and 2 m in height.

② Hot Water Supply System

In principle, hot water is not centralized, and will be supplied to the Laboratories, Delivery Suite, sink in the local assembly room, showers on the wards of Ground and First Floor of West Wing and baths on the surgical ward by means of electric water

heaters. The hot water supply pipes in the trench pits under the construction area will be re-routed if it is functional.

③ Steam Supply System

The steam and return water pipes in the trench pits under the construction area will be re-routed.

④ Drainage System

The drainage system will consist of three drainage lines serving storm water, sewage/ miscellaneous wastewater and laboratory wastewater respectively.

Storm water will be drained to the rainwater tank through connection with the existing storm water drainage pipes. Sewage and miscellaneous wastewater drained to the new septic tanks.

In regard to laboratory wastewater, the collection of chemical waste and water from secondary washing in the chemical waste tank is planned while wastewater from the washing of utensils and tools will be drained to the new septic tanks (discharging tank).

⑤ Sanitation Fixtures

The water closets will be the low tank type for wall drainage while the urinals will be the wall installation type (with a push button type flushing valve). The washbasins will be the single lever type.

⑥ Fire Extinguishing System

The fire hydrant will be installed as a fire fighting facility. Water source for fire hydrant is from rain water reserve tank and install booster pump near to the reserve tank. Fire extinguishers will be installed at strategic points.

⑦ Medical Gas Supply System

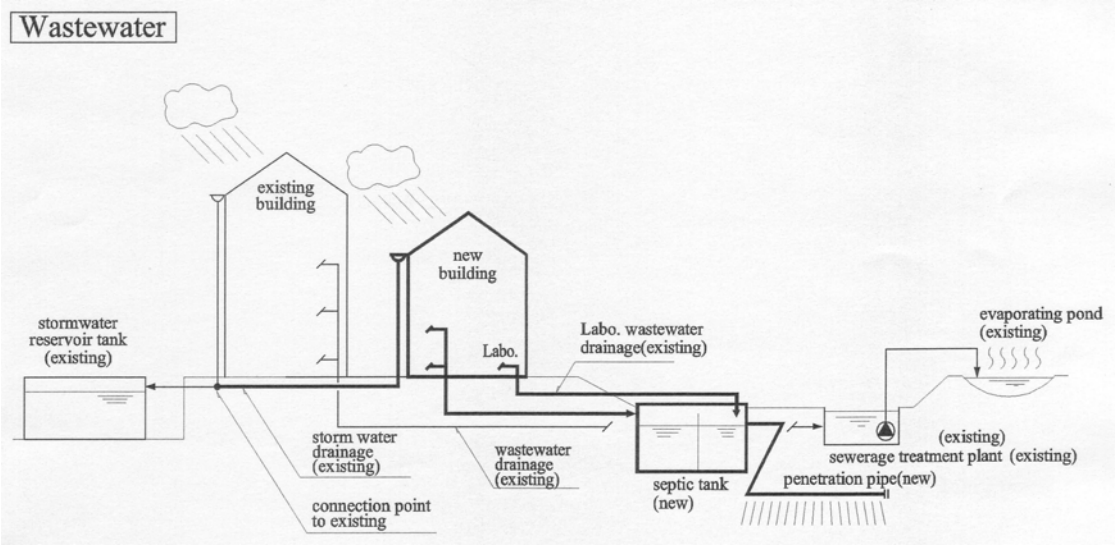
Central medical gas such as oxygen, suction and compressed air shall be connected to the Operating Theatres, the ICU/Recovery Room, and oxygen to the HDs. A manifold and suction compressor will be installed in the medical gas machine room on the ground floor of the CSB. The oxygen and medical air cylinder shall be produced at the existing oxygen supply plant on the hospital premises.

⑧ Septic Tanks

The system will consist of closed type septic tanks and infiltration tubes. In order to avoid excessive water treatment, the decomposition tank method will be used in view of easy maintenance and a low maintenance cost. Aeration will be conducted to ensure proper wastewater treatment.

Three septic tanks capable of treating the sewage produced by 600 persons each (1,800 persons in total) which meet the Building Standards Law in Tonga will be connected in parallel and will be constructed by the Japanese side. The Government of Tonga will connect these from the existing facilities.

Fig. 2-9 Utilization of Rainwater and Sewage Treatment Plan



4) Ventilation System (Facility layout schedule is attached in the Annex.)

① Air-Conditioning System

In regard to air-conditioning, split type room air-conditioning units will be installed in the Laboratories, ICU/Recovery room, Delivery Suite, SCN and Private Beds rooms. While natural ventilation is planned for the bedrooms (twin rooms and four-bedded rooms) and staff rooms, a ceiling fan(s) will be installed to assist ventilation.

A package type air-conditioning unit (floor mount type) will be installed in the operating theatres.

② Ventilation System

Mechanical ventilation using a fan will be conducted in the Laboratories, Toilets (not facing an external wall and such rooms as the Operating Theatres and Delivery Suit) and shower rooms, etc. to prevent the spread of odour and moisture to other parts of the hospital. The vent pipes for the ventilation system serving the Laboratories, (including the ventilation of safety cabinets), will rise to the roof. Natural ventilation will be employed for the toilets and shower through the windows

(12) Equipment Plan

1) Policies to Determine Equipment Grade

The basic design for the Project has adopted the following design policies.

① Selection of basic equipment (for diagnosis and treatment)
② Primarily the renewal of deteriorated equipment
③ Equipment which can be handled by the size and technical level of the existing staff
④ Design policies for equipment deployment
- Relocation to a new facility where possible
- Shared use between different departments or within a department where

possible

⑤ Design policies for maintenance
- Specifications for easy maintenance
- Exclusion of equipment which requires expensive consumables
- Supply of consumables for three months' consumption from the delivery of the equipment to cover the period during which ordering work and the control of consumables will have commenced on the right lines

⑥ Design policies for equipment procurement
- Products of those makers with an agent in either New Zealand or Australia for those requiring a maintenance service and/or the procurement of consumables given the geographical location of Tonga
- Large and solid delivery tables and examination tables, etc. made in either New Zealand or Australia

2) Outline of Equipment Plan by Department

The equipment plan has been prepared in consideration of the current activities of each department, the conditions of the existing equipment and the planning contents of the new facilities. The equipment plan by department is outlined in Table 2-13.

Table 2-13 Summary of the Departmental Equipment Plan

Department	Summary of Equipment Plan
Operating Theatre	Operating Lights and Operating Tables, of which installation work is necessary, are superannuated, and the procurement is planned for 3 units to each equipment as many as the number of operating theatres in the new building. Procurement of forceps is planned mainly for the instrument sets for Laparotomy and Orthopedic Surgery, which operations are frequently conducted at Vaiola Hospital. The existing 2 Anaesthesia Apparatuses and a Patient Monitor are transferred to the new building.
Endoscopy Room	The old Gastroscope is replaced with new one. An Endoscopes Cabinet with ultraviolet lamps is equipped as a substitute for the existing Endoscopes Cabinet to prevent infection in this room.
CSSD	In the existing building, CSSD is not divided into a contamination zone and a clean zone, and the High Pressure Steam Sterilizer of a front door type is set in the center of the room. Procurement is planned for the new building for 2 High Pressure Steam Sterilizers of a dual door path system that enable to divide the room into a contamination zone and a clean zone.
ICU	Replacement is planned for Patient Monitors, Ventilators and Syringe Pumps. Procurement is planned for the Patient Monitors of a basic model and the Ventilators of a model that is equivalent to the existing equipment in specifications and is applicable to the patients from neonates to adults.
Laboratory	The existing Blood Cell Counter often gets out of order, and the replacement is planned. The Incubator and Safety Cabinet are too old for use after a lapse of 20 years since they were procured for the Microbiology Room. The procurement is planned to replace them with new ones. Procurement is planned for the Autoclave for Laboratory (a model with a capacity of 100ℓ) and the Distilled Water Unit of a hand-operated model that enables easy maintenance in the same way as the existing one.

Department	Summary of Equipment Plan
Blood Bank	The existing Donor's Bed does not have the arm-support function, and the mattress is old and threadbare. Procurement is planned for a Donor's Bed with the arm-support function. Procurement is planned for a Balance for Blood Bank that is a hand-operated steelyard in the same way as the existing one.
Inpatient's Pharmacy	Procurement is planned for the Distilled Water Unit, Medical Refrigerator and Medicine Cabinet, in order to improve the function of the Inpatient's Pharmacy in the new building.
Biomedical Unit	When this project is implemented, the maintenance of equipment assumes greater importance. Provision of a maintenance and repair kit enables repairs on the equipment inside the hospital. The procurement is planned in order to pare down the maintenance cost.
Radiology & Ultrasound	Since the existing X-ray Unit is used frequently and often gets out of order, the replacement is planned. The existing X-ray Fluoroscope is transferred to the new building. The Ultrasound Scanner was procured for the Ultrasound Room 20 years ago, and the display monitor sometimes loses vision. The replacement is planned.
Obstetrics Ward	This department possesses only a Doppler Fetus Detector of a portable and battery-operated model, and a desktop model is to be procured. There are insufficient Baby Cots, which are placed next to the respective mother's beds after birth. The procurement is planned.
Delivery Suite	6 delivery rooms are established in the new building. Procurement is planned for 6 movable Delivery Lights of a stand type. Since the existing Delivery Set does not complete the set, the procurement is planned.
SCN	The SCN has high capacity utilization (about 80%). Procurement is planned for 2 Baby Resuscitation Trolleys (open-type incubators) and 1 Infant Incubator (closed type) in line with the construction plan of a new building. 3 Phototherapeutic Units are transferred to the new building and remain to be used.
Surgical Ward	Procurement is planned for Pulse Oxymeters and Traction Apparatus with Beds.
Other (Facilities)	The existing Oxygen Condensing System is not working properly. It is so cranky that the oxygen concentration is lower than 90%, and the oxygen flow rate cannot be accurately gauged with an anaesthesia apparatus or an oxygen flowmeter. It is very important for the hospital to make accurate and stable oxygen supply. Replacement is planned for Oxygen Condensing System.

Table 2-14 Selected Equipment List

Equipment	Use	Qty
Operating Light	This is lighting that lights up the operation region with the main light and the auxiliary light. It is used for main operations such as abdominal operation.	3
Operating Table	When a patient has an operation, the patient is laid on this table. It is used by adjusting the height and tilt angle of the table to the surgical form and the operation region.	3
Anaesthesia Apparatus with Ventilator	It is used for operations under general anaesthesia with an anaesthetic gas or a volatile anesthetic.	1
Electrosurgical Unit with Standard Accessories	It is used for incising and coagulating tissues during surgery to minimize bleeding.	1
Defibrillator	It is used for resuscitating a patient in cardiac arrest. This is a device that gives countershocks on a patient in ventricular fibrillation and restores the pulsation of his heart to the original rhythm.	1
Patient Monitor for Operating Theatre	It is used in the operating theatre for monitoring the vital signs of a patient in anesthetization.	2
Surgical Scrub Station	It is used for cleansing hands in water sterilized by ultraviolet rays.	2
Operating Microscope for ENT	It is used for delicate otolaryngology operations such as tympanoplasty.	1
Mobile X-ray	It is used for roentgenography of serious patients, those who are unable to move, those who are undergoing surgical operation, and those who have just gone through surgical operation.	1
Gastroscope with Light Source	It is a set of flexible gastroscope and light source that are used to diagnose the upper digestive tract by inserting it from the mouth of the patient. It observes the site with a crooked tip of gastroscope.	1
High Pressure Steam Sterilizer	It is used for sterilizing the operating gowns and surgical appliances that are used in the hospital with high-pressure steam.	2
Ventilator for Adult and Infant	This is a life-support system that makes respiratory care for the patient who cannot make voluntary respiration.	1
Patient Monitor for ICU	It is used for monitoring the fundamental vital signs of a serious patient such as ECG, pulsation and saturation of oxygen.	2
Safety Cabinet	It is used for protecting laboratory workers from bacteria during bacteriological examinations.	2
Blood Cell Counter	It is used for calculating the numbers of erythrocytes, leukocytes, etc. The result is submitted to the diagnosis.	1
Maintenance Set	This is a set of maintenance tools for the medical equipment.	1
X-ray Unit	It is used for taking X-ray photographs of the skeletal structures, chest, abdomen and soft tissues.	1
Automatic Film Processor	It is capable of automatic film processing from developing to drying after the X-ray photography.	1
Ultrasound Scanner B/W	It is mainly used for echography of the abdomen, and it contributes to the imaging diagnosis.	1
Oxygen Condensing System	It produces oxygen to supply the patients in the Operating Theatres, ICU and others, and it replenishes cylinders with oxygen.	1

2.2.3 Basic Design Drawings

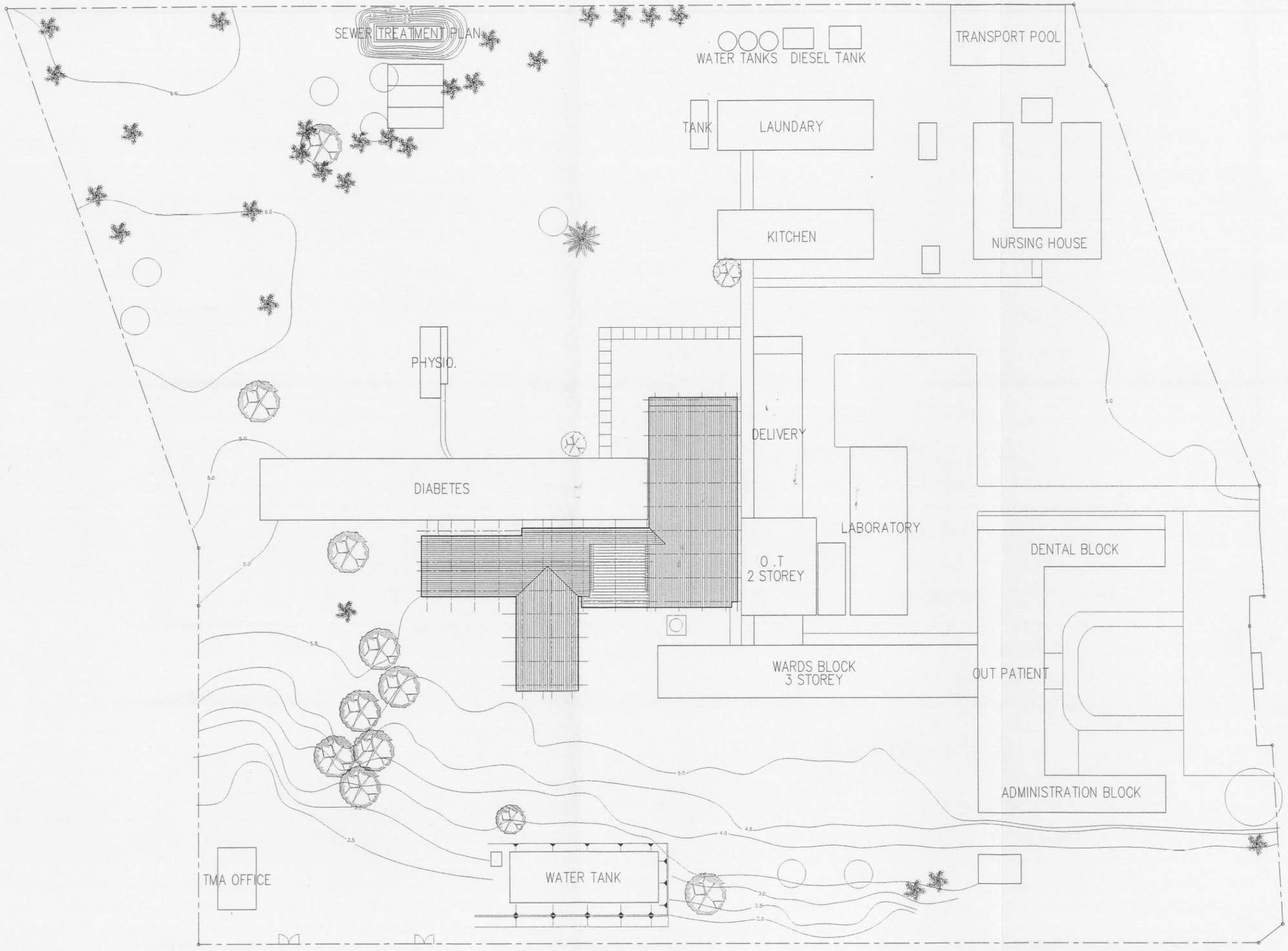
Building Plans

(1) Building Layout	1/1000
(2) Ground Floor Plan	1/300
(3) First Floor Plan	1/300
(4) Roof Plan	1/300
(5) Elevation Plan –1	1/300
(6) Elevation Plan –2	1/300
(7) Section Plan	1/300
(8) Equipment layout - Ground Floor	1/300
(9) Equipment Layout – First Floor	1/300

Equipment Layout Plan

(1) Ground Floor Plan	1/300
(2) First Floor Plan	1/300

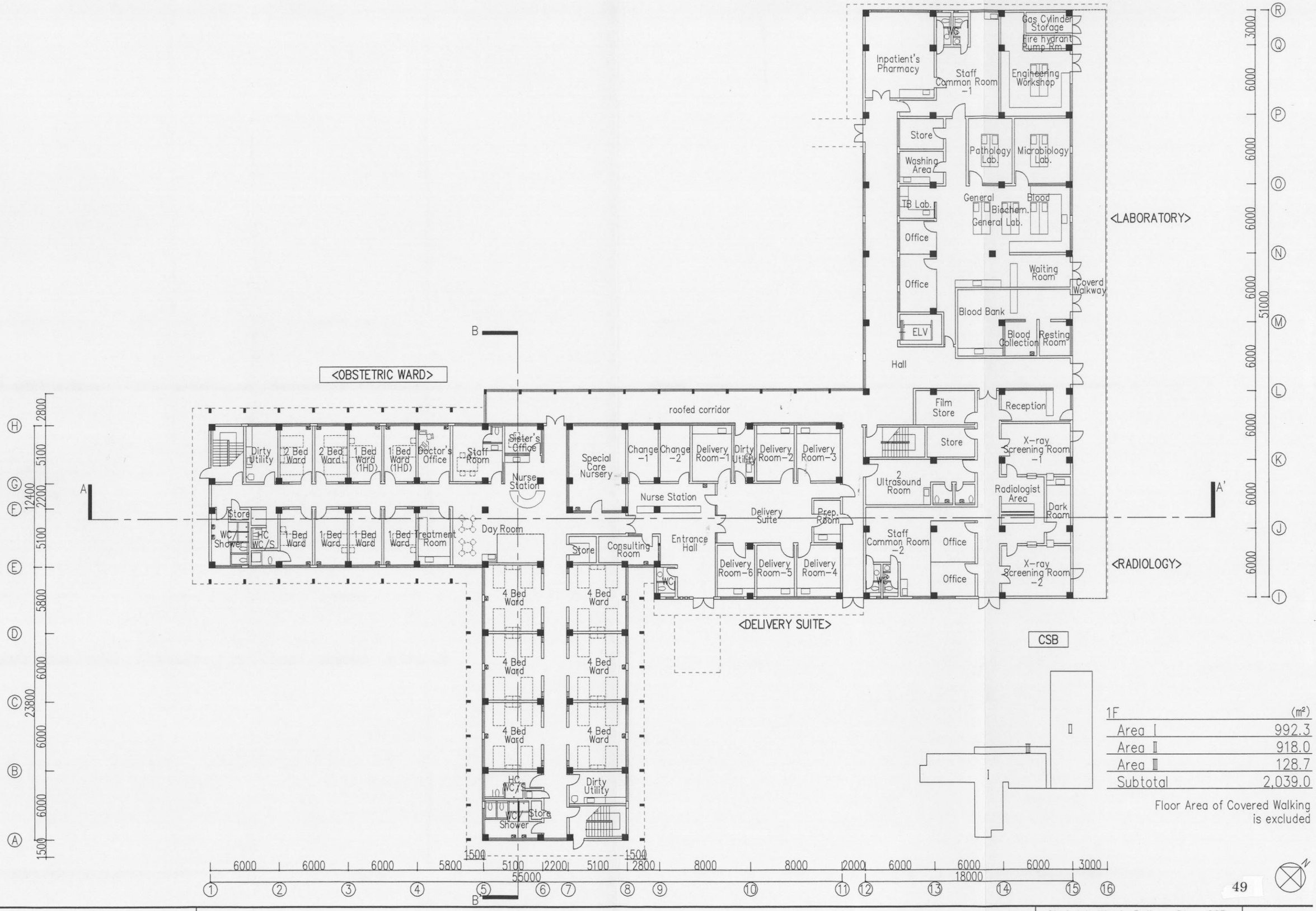
Table 2-15 Equipment List



PROJECT FOR UPGRADING AND REFURBISHMENT OF VAIOLA HOSPITAL

Site Plan

SCALE 1:1000



1F	(m²)
Area Ⅰ	992.3
Area Ⅱ	918.0
Area Ⅲ	128.7
Subtotal	2,039.0

Floor Area of Covered Walking is excluded

The Project for Upgrading and Refurbishment of Vaiola Hospital in the Kingdom of Tonga

Obstetric Ward , Delivery Div. , CSB

Ground Floor Plan

SCALE 1: 300