Ministry of Public Health and Sanitation
Republic of Kenya

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR THE
REINFORCEMENT OF VACCINE STORAGE
IN
THE REPUBLIC OF KENYA

JANUARY 2011

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

YOKOGAWA ARCHITECTS & ENGINEERS, INC.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey on the Project for the Reinforcement of Vaccine Storage in the Republic of Kenya, and organized a survey team headed by Mr. Shoichi Tashiro of Yokogawa Architects & Engineers, Inc. between January and February 2010 as well as in July 2010.

The survey team held a series of discussions with the officials concerned of the Government of Kenya, and conducted field investigations. As a result of further studies in Japan, 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.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Kenya for their close cooperation extended to the survey team.

January, 2011

Nobuko Kayashima
Director General
Human Development Department
Japan International Cooperation Agency

SUMMARY

SUMMARY

Overview of the Country

The Republic of Kenya (hereinafter referred to as "Kenya") is situated in the middle of the African Continent, covering an area of 583,000km^2 and having a population of 38.77 million people (according to the World Bank in 2008). Although the country is located on the equator, the temperature is not very high because most areas of the country are highlands; the monthly mean maximum temperature ranges from 20.6˚C to 25.6˚C and the monthly minimum temperature from 10.1˚C to 14.0˚C in Nairobi. Kenya is in the tropical zone and there are two rainy seasons in the year: from March to May, called the major rainy season, and from September to November, called the minor rainy season.

Socially, population growth and increasing poverty in both rural and urban areas, and the flow of weapons from neighboring countries, against a backdrop of poverty, has increased the crime rate and induced social unrest. In addition, the spread of AIDS has become a major problem.

In terms of the transportation and communication sector, aerial, road and rail networks have been established stretching out from Nairobi. Mombasa Port serves as a logistics gateway to Kenya as well as to East Africa, including inland countries such as Uganda and Rwanda.

Compared to other East African countries Kenya has become increasingly industrialized; however, it is traditionally an agrarian country, yielding horticultural crops and tea as major products. Agriculture comprises about 24% of its GDP, with about 50% of the labor force engaged in farming and related industries. In recent years, Kenya has shown steady growth through the implementation of sound macroeconomic policies and structural reforms. Real GDP growth rose from 6.4% in 2006 to 7.0% in 2007, which was the highest recorded growth. Economic growth, however, suffered significantly from riots after the election at the end of 2007. In addition to the effect of political disturbances, owing to soaring fuel and food prices worldwide, an inflation rate of 13% in 2008 put increased pressure on the population. Affected by these factors, the economic growth rate in and after 2009 is expected to fall.

Background, History and Outline of the Requested Japanese Assistance

In Kenya, about half of its population is below the poverty line. According to the family budget survey in 2003 concerning health and medical services, about 44% of the population answered that they did not receive any medical care even if they got sick because they could not afford it, which indicates that poverty continues to limit access to medical services. The mortality rate remains high. Especially, the under five mortality rate, which increased to 115 per 1,000 live births in 2003 from 105 in 1998, may hinder accomplishing the Millennium Development Goals.

Many of the population are affected by vaccine preventable diseases, and tremendous costs are necessary to cure them. In order to emerge from this situation, medical services highlighting the prevention of diseases should be promoted.

The long-term development plan "Kenya Vision 2030" emphasizes the 'Health Service' in the 'Society' section among other thrusts of the plan, and aims to provide the entire nation with medical services of good quality at a reasonable cost. The immunization coverage increased from 59% in 2003 to 73% in 2007. In the Middle-term Programme (2008 – 2012) it is stated that the immunization coverage of children under 12 months of age should reach 95% during the planned period.

In Nairobi, vaccine stocks are stored in insufficient spaces in different buildings of the Kenyatta National Hospital, and DVI is located in another building, which is obstructive to the effective management of inventory and loading and offloading services. In the regional vaccine depots where the vaccine stock requirement is not satisfied due to insufficient storage space, vaccines have to be stored in neighboring provinces and transported from there. Vaccination costs rise along with the increase of transport frequency and distance.

In such circumstances, the Government of Kenya has aimed to enable more efficient stock management and transportation of vaccines in order to contribute to the improvement of the immunization rate, and requested the Government of Japan for grant aid for the reinforcement of national and regional vaccine depots.

The outline of the request components is as follows:

a) Construction of facilities

1. Nairobi National Vaccine Depot: coordination office, warehouse, workshop, incinerator shed; approximately 2,822m^2 in total

2. Regional Vaccine Depots in Kakamega, Meru and Garissa: housing for the cold rooms (700m^2); 4,922m^2 in total

b) Supply and installation of equipment

1. Nairobi National Vaccine Depot: forklift, manual pallet lifter, computerized fridge temperature monitoring system, computerized stock management system, etc.

2. Regional Vaccine Depots in Garissa, Meru, Nyeri and Kisumu: freezer, etc.
   Regional Vaccine Depots in Eldoret, Mombasa, Nakuru: cold room, freezer, etc.

Outline of the Survey Results and Description of the Project

After considering the request, the Government of Japan decided upon the implementation of a preparatory survey, and the Japan International Corporation Agency (hereinafter referred to as "JICA") conducted a preparatory survey (outline design 1) from January 14 to February 18, 2010. Then, because of problems related to the ownership of the land for the site of the Nairobi National Vaccine Depot, the Kenyan side proposed a new site in the suburbs of Nairobi. The Government of Japan decided to conduct a second field survey (outline design 2) to confirm the appropriateness of

this land and JICA sent a second survey team from July 4 to 10, 2010. The analysis of the results of the preparatory survey (outline designs 1 and 2) were compiled in the draft report. JICA sent an explanatory mission from December 5 to 11, 2010, and the Kenyan side has agreed to the outline design presented by the Japanese side.

The agreed-upon facility construction work of this Project consists of construction of a warehouse, a coordination office, a workshop and a generator house at the Nairobi National Vaccine Depot, and construction of a warehouse at each regional vaccine depot in Kakamega, Meru and Garissa. The equipment work consists of procurement and installation of freezer rooms, cold rooms, temperature monitoring systems for these rooms, fork lifts and other relevant equipment at the Nairobi National Vaccine Depot, and procurement and installation of cold rooms, freezers, manual pallet lifters and other relevant equipment at eight regional vaccine depots in Nyeri, Nakuru, Eldoret, Kisumu, Mombasa, Meru, Kakamega and Garissa.

The outline of the project components at the time of the preparatory survey is shown in the following table.

Project Components

	Facility	Structure/Areas	Component	Equipment
Nairobi National Vaccine Depot	Warehouse	Structure: RC*, partly S* Floor Areas: 1,612.0m^2	Dry storage, Cold storage, Store, Office, Medical lab technologist room, Officer in charge of vaccine depot room, Dry storage manager room, Assistant room, Support staff room, Fire pump room, Security room, Kitchen, WC	Cold room, Freezer room, Forklift, Manual pallet lifter
	Coordination Office	Structure: RC, partly S Floor Areas: 507.0m^2	Head of DVI room, Deputy head of DVI room, Secretary room, Office, Data room, Conference room, Server room, Support staff room, Store, Kitchen, WC	—
	Workshop	Structure: RC, partly S Floor Areas: 210.0m^2	Workshop, Chief medical engineer's room, Medical engineer's room	Cold room, Freezer room, Cold room/freezer room temperature monitoring system, Manual pallet lifter, Refrigeration gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set
	Generator House	Structure: RC, partly S Floor Areas: 40.0m^2	Generator room, Switch panel room	—
	Floor Areas	2,369.0m^2		
Regional Vaccine Depots	Kakamega	Structure: RC, partly S Floor Areas: 675.0m^2	Warehouse, Officer in charge of vaccine depot room, Secretary / Waiting room, Support staff room, Store, WC	Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set
	Meru	Structure: RC, partly S Floor Areas: 415.0m^2	Warehouse, Officer in charge of vaccine depot room, Secretary / Waiting room, Support staff room, Store, WC	Freezer, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator

	Facility	Structure/Areas	Component	Equipment
Regional Vaccine Depots	Garissa	Structure: RC, partly S Floor Areas: 395.0m^2	Warehouse, Officer in charge of vaccine depot room, Secretary / Waiting room, Support staff room, Store, WC	Freezer, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator
	Nyeri		—	Freezer, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator
	Nakuru		—	Cold room, Freezer, Cabinet for Non-EPI vaccine, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator
	Eldoret		—	Cold room, Freezer, Cabinet for Non-EPI vaccine, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator
	Kisumu		—	Freezer, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator
	Mombasa		—	Cold room, Freezer, Cabinet for Non-EPI vaccine, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator
	Floor Areas	1,485.0m^2		
Total Floor Areas		3,854.0m^2		

*RC: Reinforced concrete structure, S: Steel structure

Project Schedule and Cost Estimate

When this Project is implemented, the detailed design will take about 7.0 months, and the construction work including procurement and installation of the equipment will take about 12.0 months. The total cost to be borne by the Kenyan side is estimated at approximately 2 million yen.

Project Evaluation

1. Relevance

The validity of the implementation of this Project is considered as follows:

- The direct beneficiaries will be pregnant women and children under one year old who will receive vaccinations. In addition, this Project will lead to the prevention of the spread of

infectious diseases. From this viewpoint it will be beneficial to all the people of Kenya.

- The Kenya Expanded Program on Immunization (hereinafter referred to as “KEPI”) is one of the social health services and is intended to protect the people of Kenya from infectious diseases. The implementation of KEPI will release the people from the "fear of the spread of infectious diseases" and the "lack of disease prevention measures", and will become a guarantee of security. In addition, Kenya plans to introduce two non-EPI vaccines; however, the existing facilities do not have sufficient capacity for their storage. In this regard, the urgency of this Project is high.

- KEPI has become an established program with approximately 30 years of history after its start. Thus, with partial donor support, DVI has been doing operation and maintenance with its own finance, human resources and technology, and it is possible to ensure sustainability in the future.

- The goals of Kenya's Middle-term Programme (2008-2012) include a "reduction of the under-five mortality rate" and an "increase in immunization rates of children under one year old". The increased vaccine storage capacity of each vaccine depot through the implementation of this Project will facilitate KEPI activities that will contribute to increasing the immunization coverage of children under one year old. In addition, higher vaccination rates can lead to reducing the number of measles, pneumonia, and diarrhoeal diseases that are major causes of under-five mortality, which will contribute to the achievement of the Middle-term Programme.

- The vaccination service is provided free of charge, thus, there is no direct profit from the Project.

- Although the site environment may change partially as a result of the project implementation, which includes removal of existing trees, installation of wastewater treatment facilities and an incinerator shed, it is planned to comply with Kenyan environmental standards and minimize negative impacts such as the destruction of nature and water contamination.

- MOPHS is familiar with the Japanese grant aid scheme through a previous project entitled “the Project for Improvement of Health Centers in the Western Part of Kenya”. Therefore, there does not seem to be any special difficulty in implementing this Project.

- Vaccine storage facilities should be capable of maintaining the quality of vaccines because their degradation may harm humans. In this regard, there are advantages of the necessity to apply Japanese construction technology for this Project.

2. Effectiveness

The following qualitative and quantitative effects are expected when this Project is implemented.

(1) Quantitative Effects

The following outputs of the Project are expected to have quantitative effects:

Full immunization coverage of children under one year old differs in the provinces from about 50% to 85% (average of about 73%). The Middle-term Programme (2008-2012) aims to improve the immunization coverage of children under 12 months of age to 95% by 2012, while

DVI, in order to minimize the wastage rate of unused vaccines, retains the actual purchase of vaccines at about 80% of the target population.

In addition, after the implementation of this Project, the vaccine distribution system will be established throughout the country, and regular distribution of vaccines will be realized instead of frequent and irregular distribution in the past.

The following table shows the quantitative effect which is anticipated through the implementation of the Project. The standard value is set in the year 2010, before the implementation of the Project, while the target value is set in the year 2016, three years after the completion of the Project.

Expected Quantitative Effects

Indicator	Standard (2010)	Target (2016)
Full immunization coverage of children under 12 month old (average percentage)	73%	80%
Frequency of vaccine distribution (at Kakamega)	12 times/year	4 times/year
Frequency of vaccine distribution (at all the vaccine depots)	4 times/year	*4 times/year

* The frequency of vaccine distribution is not expected to change because the facility planning in this Project takes into consideration sufficient storage capacity corresponding to the future increase of vaccine storage according to the introduction of Non-EPI vaccines (rotavirus vaccine, pneumococcus vaccine).

(2) Qualitative Effects

The following outputs of the Project are expected to have qualitative effects:

① Currently in the Nairobi National Vaccine Depot, DVI Coordination Office, Vaccine Warehouse, and Workshop, etc. are scattered in the premises of the Kenyatta National Hospital. Operational efficiency will be improved because these functions will be concentrated in one place.

② The centralized management of the vaccine inventory and efficient on-off loading work will lead to the minimization of the wastage rate of vaccines, the deterioration of vaccine quality and the work hours.

③ Reduction of the frequency of delivery and transportation will promote saving costs of vaccine management.

④ Introduction of a cold room/freezer room temperature monitoring system can minimize vaccine damage due to temperature rises.

⑤ Non-EPI vaccines will be introduced as scheduled.

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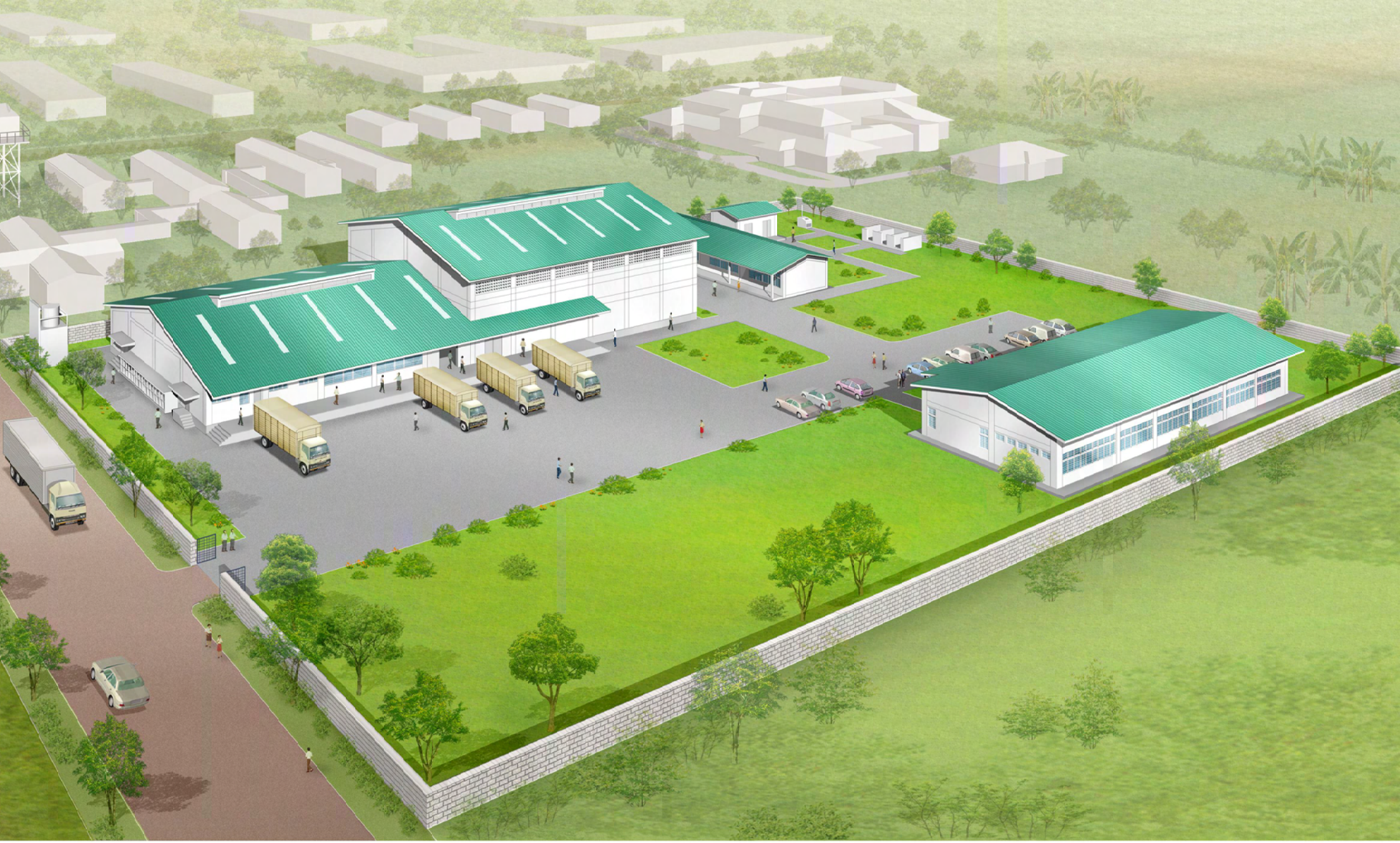
Chapter 3 Project Evaluation

APPENDICES

LOCATION MAP

- Construction of Coordination Office, Warehouse, Workshop, etc.
- Installation of Cold Rooms
- Housing for the Cold Rooms
- Supply and Installation of Equipment



THE PROJECT FOR THE REINFORCEMENT OF VACCINE STORAGE IN THE REPUBLIC OF KENYA

NAIROBI NATIONAL VACCINE DEPOT

THE PROJECT FOR THE REINFORCEMENT OF VACCINE STORAGE IN THE REPUBLIC OF KENYA

KAKAMEGA REGIONAL VACCINE DEPOT

LIST OF FIGURES AND TABLES

ABBREVIATOINS

Abbreviation	English
BCG	Bacillus Calmette-Guerin
DVI	Division of Vaccines & Immunization
DPT	Diphtheria, Peruses and Tetanus
EPI	Expanded Programme on Immunization
EU	European Union
GDP	Gross Domestic Product
Hib	Hemophilus influenza Type b
HpB	Hepatitis B
JICA	Japan International Cooperation Agency
KEMRI	Kenya Medical Research Institute
KEMSA	Kenya Medical Supply Agency
KEPI	Kenya Expanded Programme on Immunization
KShs	Kenya Shilling
MOPHS	Ministry of Public Health & Sanitation
OPV	oral poliovaccine
PCV	Pneumococcus vaccine
TT	Tetanus Toxoid
UNICEF	United Nations Children's Fund
VAT	Value Added Tax
WB	World Bank
WHO	World Health Organization
WMF	Wastage Multiplication Factor

CHAPTER 1 BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1-1 Background, History and Outline of the Requested Japanese Assistance

The Republic of Kenya (hereinafter referred to as "Kenya") spreads about 583 thousand square kilometers in the east of central Africa. Its population is approximately 37.5 million (by World Bank 2007), about half of which is below the poverty line. According to the family budget survey in 2003 concerning health and medical services, about 44% of the population answered that they did not receive any medical care even if they got sick because they could not afford it, which indicates that poverty continues to limit access to medical services. The mortality rate remains high. Especially, the under five mortality rate, which increased to 115 per 1,000 live births in 2003 from 105 in 1998, may hinder accomplishing the Millennium Development Goals.
Many of the population are affected by vaccine preventable diseases, and tremendous costs are necessary to cure them. In order to emerge from this situation, medical services highlighting the prevention of diseases should be promoted.

The long-term development plan "Kenya Vision 2030" emphasizes the 'Health Service' in the 'Society' section among other thrusts of the plan, and aims to provide the entire nation with medical services of good quality at a reasonable cost. The immunization coverage increased from 59% in 2003 to 73% in 2007. In the Middle-term Program (2008 – 2012) it is stated that the immunization coverage of children under 12 months of age should reach 95% during the planned period.

In Nairobi City, vaccine stocks are stored in insufficient spaces in different buildings of the Kenyatta National Hospital, and the Division of Vaccine and Immunization (hereinafter referred to as "DVI") is located in another building, which is obstructive to the effective management of inventory and, loading and offloading services. In the regional vaccine depots where the vaccine stock requirement is not satisfied due to insufficient storage space, vaccines have to be stored in neighboring provinces and transported from there. Vaccination costs rise along with the increase of transport frequency and distance.

In such circumstances, the Government of Kenya requested Grant Aid from the Government of Japan for the purpose of improving the vaccine storage system of both central and regional levels to contribute to the improvement of immunization services through the establishment of the efficient storage and transport system of vaccines.

1-2 Natural Conditions

Three holes of 20m depth were bored in the site ground of the Nairobi National Vaccine Depot. In each site ground for the regional vaccine depots at Kakamega, Meru and Garissa, two holes of 10m depth were bored for the geotechnical investigations. Partial copies of the geotechnical investigation report at each site are attached to Appendix 5-3 of this report.

① Nairobi National Vaccine Depot

The site ground of the Nairobi National Vaccine Depot is a slight slope from west to east. In the east high area of the site the geological investigations indicate the N-value is 37, the compressive strength 100 t/m^2 at 7.5m depth, and 1,000 t/m^2 at 11m depth and below, which means extremely hard rock courses lie there. In the central area of the site the geological investigations indicate the N-value is 58 at 2.45m depth, and very hard rock courses of 750 t/m^2 compressive strength at 5.75m and deeper levels. In the west, the lowest area of the site the geological investigations also indicate extremely hard rock courses of 1,000 t/m^2 compressive strength near the surface only 2.5m deep and below.

② Kakamega and Meru Regional Vaccine Depots

The geological investigations at the site ground in the Kakamega and Meru indicate red clay soil layers commonly known as red coffee soil. The soil bearing capacity (N value) is 13 at -1.95m depth, 6 at -2.95m depth and recovers to over 14 in the layers between -3.95m and -5.95m.

③ Garissa Regional Vaccine Depot

The geological investigations in the site ground indicate sandy clay soil layers. The soil bearing capacity (N value) is 19 at -1.45m depth, 16 at -2.45m depth and recovers to 18 at -3.35m and 20 at -4.45m and continues over 20 in the layers below.

1-3 Environmental Considerations

Currently, the Nairobi National Vaccine Depot consigns Kenya Medical Research Institute (hereinafter referred to as “KEMRI”) of waste disposal. After vaccines and medical equipment like syringes are loaded, they are unpacked, sorted and sent out to each regional vaccine depot. During this process used packages become wastes. In addition, expired syringes and vaccines should be discarded as medical wastes. The amount of wastes to be disposed of DVI will increase after this Project and the need for separate disposal space is expected high. Thus, a separate disposal space will be designed, and an incinerator will be installed for burning office paper and cardboard packages, etc. that will not generate harmful gases. The disposal process is specified by the National Health Waste Management Plan of Kenya.

CHAPTER 2 CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concepts of the Project

2-1-1 Superior and Project Objectives

(1) Superior Objectives

In Kenya, about a half of its population are poor people. According to the family budget survey in 2003 concerning health and medical services, about 44% of the population answered that they did not receive medical care even if they got sick because they could not afford it, which indicates that poverty continues to be disincentive to medical service access. The mortality rate of the country remains high. Especially, the under five mortality rate increased to 115 per 1,000 live births in 2003 from 105 in 1998, which may hinder the accomplishment of the Millennium Development Goals.

Many of the population are affected by vaccine preventable diseases, and tremendous costs are necessary to cure them. In order to emerge from this situation, medical services highlighting the prevention of diseases should be promoted.

The long-term development plan "Kenya Vision 2030" emphasizes the 'Health Service' in the 'Society' section among other thrusts of the plan, and aims to provide the entire nation with medical services of good quality at a reasonable cost. The immunization coverage increased from 59% in 2003 to 73% in 2007. In the Middle-term Programme (2008 – 2012) it is stated that the immunization coverage of children under 12 months of age should reach 95% during the planned period.

(2) Project Objectives

In Nairobi City, vaccines are stored in insufficient spaces in different buildings of the Kenyatta National Hospital, and DVI is located in another building, which is obstructive to the effective management of inventory and loading and offloading services. In the regional vaccine depots where the vaccine stock requirement is not satisfied due to insufficient storage space, vaccines have to be stored in neighboring provinces and transported from there. Vaccination costs rise along with the increase of transport frequency and distance.

In such circumstances, this project aims to contribute to the uplift of immunization rate and the reduction of under five mortality rate through the improvement of national and regional vaccine depots to enable more efficient stock management and transportation of vaccines.

The direct effects expected through the implementation of this project with Japanese Grant Aid will be the improvement of the immunization rate resulting from the efficient management of all immunization servers by Ministry of Public Health and Sanitation (hereinafter referred to as "MOPHS"). The indirect effects of the project will be that under-five children of about 6.54 million in Kenya (UNICEF, 2008) or rather all the Kenyan nations of about 37.5 million can be protected from vaccine preventable diseases.

2-1-2 Basic Concepts of the Project

The facility construction work of this project consists of construction of a warehouse, a coordination office, a workshop and a generator house at the Nairobi National Vaccine Depot, and construction of a warehouse at each regional vaccine depot in Kakamega, Meru and Garissa.

The equipment work consists of procurement and installation of freezer rooms, cold rooms, temperature monitoring system of these rooms, fork lifts and other relevant equipment at the Nairobi National Vaccine Depot, and procurement and installation of cold rooms, freezers, manual pallet lifter and other relevant equipment at eight regional vaccine depots in Nyeri, Nakuru, Eldoret, Kisumu, Mombasa, Meru, Kakamega and Garissa.

The outline of the request components at the time of preparatory survey is shown in Table-1.

Table-1 Request Components at the Time of Preparatory Survey

	Facility	Structure/Areas	Component	Equipment
Nairobi National Vaccine Depot	Warehouse	Structure: RC, partly S Floor Areas: 1,612.0m^2	Dry storage, Cold storage, Store, Office, Medical lab technologist room, Officer in charge of vaccine depot room, Dry storage manager room, Assistant room, Support staff room, Fire pump room, Security room, Kitchen, WC	Cold room, Freezer room, Forklift, Manual pallet lifter
	Coordination Office	Structure: RC, partly S Floor Areas: 507.0m^2	Head of DVI room, Deputy head of DVI room, Secretary room, Office, Data room, Conference room, Server room, Support staff room, Store, Kitchen, WC	—
	Workshop	Structure: RC, partly S Floor Areas: 210.0m^2	Workshop, Chief medical engineer's room, Medical engineer's room	Cold room, Freezer room, Cold room/freezer room temperature monitoring system, Manual pallet lifter, Refrigeration gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set
	Floor Areas	2,329m^2		
	Facility		Component	Equipment
Regional Vaccine Depot	Kakamega	Structure: RC, partly S Floor Areas: 675.0m^2	Warehouse, Officer in charge of vaccine depot room, Secretary / Waiting room, Support staff room, Store, WC	Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set
	Meru	Structure: RC, partly S Floor Areas: 415.0m^2	Warehouse, Officer in charge of vaccine depot room, Secretary / Waiting room, Support staff room, Store, WC	Freezer, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator
	Garissa	Structure: RC, partly S Floor Areas: 395.0m^2	Warehouse, Officer in charge of vaccine depot room, Secretary / Waiting room, Support staff room, Store, WC	Freezer, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator

Regional Vaccine Depot	Nyeri		—	Freezer, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator
	Nakuru		—	Cold room, Freezer, Cabinet for Non-EPI vaccine, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator
	Eldoret		—	Cold room, Freezer, Cabinet for Non-EPI vaccine, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator
	Kisumu		—	Freezer, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator
	Mombasa		—	Cold room, Freezer, Cabinet for Non-EPI vaccine, Manual pallet lifter, Refrigerant gas charging station, Oxy-acetylene gas soldering set, Nitrogen gas cylinder set, Automatic voltage regulator
	Floor Areas	1,485m^2		
Total Floor Areas		3,814m^2		

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policies

(1) Basic Policies

1) Basic Principles to Facility Planning

The facility construction work of this project consists of construction of a warehouse, a coordination office, a workshop and a generator house at the Nairobi National Vaccine Depot, and construction of a warehouse at each regional vaccine depot in Kakamega, Meru and Garissa. These regional vaccine depots are located about 300km distant from Nairobi City, and the environmental conditions like climate and customs as well as the construction conditions like availability of materials and labors are different in each region. Based on this consideration, the following policies should be observed in the facility planning to realize the most suitable facilities of each depot.

① To comply with the local laws / directions of any governmental or regulatory authorities,
② To respect local custom and tradition and to consider climatologic, geologic and construction conditions at each site,
③ To ensure safety in the region,
④ To plan functional facilities for storing vaccines and relevant products and materials,
⑤ To economize the construction costs taking local conditions of construction and equipment procurement into consideration, and
⑥ To economize running costs such as to reduce electric power consumption of lights by adopting the roof top light system, etc.

2) Basic Policies to Equipment Planning

The equipment work consists of procurement and installation of vaccine storage equipment at the Nairobi National Vaccine Depot and eight regional vaccine depots. In consideration of different facility and equipment conditions at each depot, the following policies should be observed to develop the most suitable equipment planning.

① To consider, in principle, the replacement of old equipment and supplement of insufficient equipment. In selection of the equipment, the grade will be coordinated with to the technical and operation skill of the staff,
② To plan the storage capacity of the cold rooms, freezer rooms and freezers to satisfy the minimal storage requirement of vaccines to be considered in this project, and
③ To select such equipment in prior which can be managed and maintained by the current management system and technical skill level, as well as whose spare parts and consumables are easily available, for the purpose of minimizing the increase of operation and maintenance costs of the equipment.

(2) Policies to Meet Natural Conditions

1) Climatologic conditions

Although Kenya is located on the equator, the temperature is not very high because most areas are highlands of above sea level 1,000m or more. Similarly the mean maximum temperature in daytime in Kitengela, the construction ground of the Nairobi National Vaccine Depot, and Meru and Kakamega ranges from 20.6˚C to 25.6˚C throughout the year and the mean minimum temperature from 10.1˚C to 14.0˚C. Air conditioning system will not be considered in this project.

In Garissa where the altitude is low and the temperature is high, similarly, the air conditioning system will not be considered, because it causes the breakdown easily due to excessive load on the control unit bears excessive load at the time of power failure which occurs frequently, and its running cost by power consumption is considerably high.

Kenya is in the tropical climate zone and there are two rainy seasons in the year; from March to May, called the major rainy season, and from September to November, called the minor rainy season.

The roof is greatly projected from making a large amount of rain fall at a time as the squall, and so as not to interfere to the carrying out insertion work done on the loading bay, rain is considered.

The roof will be greatly projected so that the rainfall called squall in which a large amount of rain falls at a time may not interfere to loading in and out of vaccines and other materials on the loading bay.

2) Earthquake

Kenyan seismic standards states that seismic force need not be considered in case of low buildings with rigid frame construction. However, an earthquake of magnitude 6.8 occurred near the border of Tanzania and the Democratic Republic of the Congo on December 6, 2005. Houses and churches collapsed in the Democratic Republic of the Congo, several casualties were reported, and there is a record of seismic waves transmitted to Kenya. The survey team inquired the officer of the Department of Architectural Planning, Ministry of Public Works, whether seismic force should be considered in this project, and was confirmed that Japanese seismic standards should be applied to the structural design in this project.

3) Geological features

① Nairobi National Vaccine Depot

In the east high area of the site ground of the Nairobi National Vaccine Depot the geological investigations indicate the N-value is 37 and the compressive strength 100t/m^2 at 7.5 m depth, which means hard rock courses lie there. In the central area of the site the geological investigations indicate the N-value is 58 at 2.45m depth, and very hard rock courses of 750t/m^2 compressive strength at 5.75m and deeper levels. In the west, the lowest area of the site the geological investigations also indicate extremely hard rock courses of

1,000t/m^2 compressive strength near the surface only 2.5m deep and below. Based on these geological investigation results, the direct foundations down to GL-1.0 to -1.2 m depth as the foundation bottom layer will be designed.

② Kakamega and Meru Regional Vaccine Depots

The geological investigations at the site ground in the Kakamega and Meru indicate red clay soil layers. The soil bearing capacity (N value) is 13 at -1.95m depth, 6 at -2.95m depth and recovers to over 14 in the layers between -3.95 m and -5.95 m. Based on this investigation result, the direct foundations down to GL-1.0 to 2.0 m depth as the foundation bottom layer will be designed.

③ Garissa Regional Vaccine Depot

The geological investigations in the site ground indicate sandy clay soil layers. The soil bearing capacity (N value) is 19 at -1.45m depth and 18 at -3.35m and 20 at -4.45m. Based on this investigation result, the direct foundations down to GL-1.0 to 2.0 m depth as the foundation bottom layer will be designed.

(3) Policies concerning Social Economic Conditions

It is predominant in Kenya as well as the present DVI office buildings that a steel grid door is installed at the main entrance of the building as a protection against burglary. Interior doors are also equipped with a steel grid door with lock system on the corridor side of the wooden door. Following this custom, the buildings to be planned in this project will be equipped with careful security system including the protective window grill and double door systems.

Based on this consideration, the following policies should be observed in the architectural planning.

(4) Policies to Construction and Procurement Situations

1) Nairobi National Vaccine Depot

Various kinds of construction materials with sufficient quantity are available in Nairobi City. Technical skill levels of construction contractors and their workers are relatively high. There seem no problems in the construction works of this project.

2) Regional Vaccine Depots

Kakamega is located 355km distant from Nairobi, Meru 298km, and Garissa 374km. In all these areas aggregates for concrete are only materials that can be obtained locally, and it is necessary to transport all the construction materials from Nairobi. Technical skill levels of the local construction labor are low, and the experienced workers have to be sent from Nairobi. Consequently, the unit price of the construction materials and machinery becomes expensive because of the additional transport costs from Nairobi. Similarly, labor costs become rather expensive in order to employ the experienced workers in Nairobi.

For the facility planning of the regional vaccine depots, the above-mentioned construction procurement conditions will be considered to develop cost saving plans without unnecessary expenses.

(5) Policies for Commissioning to Local Companies

1) Local consultants

The Kenyan authorities and people concerned explained that no building permission would be required for this project, because the buildings to be planned in this project are designed within the premises of the existing hospitals and district governmental offices. It means the support of the local consultant will not be necessary for the application of building permission. However, based on the principle that the facility planning should abide by the local environmental conservation codes, legal regulations and other laws as much as possible, support of the local consultants will be considered to confirm the appropriateness of the design.

The entire construction period is scheduled to be 12 months which is rather short period of time to complete four sites. For a certain period three sites are scheduled to be under construction simultaneously. In consideration of about 300km distance of each regional site, a skillful engineer will be selected from among the local consultant staff as a member of the site representatives of the consultant at the sites of the regional vaccine depots.

2) Local contractors

There are about 100 so called “large” construction contractors in Kenya, whose technology is considerably high. There seems no serious problem in the construction works of the Nairobi National Vaccine Depot, while for the construction of the regional vaccine depots it is essential to select the local contractors with good procurement capability of materials and skilled workers from Nairobi. Such contractor should also have engineering management skill to administer the construction works in Nairobi and three regional sites in parallel and to complete the works within a limited schedule.

(6) Policies concerning Capability of the Implementing Agency for Proper Management and Maintenance

1) Facilities

Five technicians of the maintenance department of the Workshop at the Nairobi National Vaccine Depot maintain the equipment at DVI. A workshop will be also included in this project. At present they do mainly the equipment maintenance and repairs, but will be capable of the maintenance of door and window sashes, fitting hardware, ventilators, lights, etc. after the completion of the project, since their maintenance can be dealt with the repair tools and machinery in the Workshop. There do not seem problems in the maintenance of facilities.

2) Equipment

Five technicians of the maintenance department of the Nairobi National Vaccine Depot mainly take care of the maintenance of cold chain equipment throughout the country. For the equipment at the eight regional vaccine depots, technicians of the maintenance departments of local provincial general hospitals and district hospitals are also involved in the maintenance and repairs of the equipment. In consideration of these situations, the equipment which can be maintained by the local maintenance technicians and whose spare parts and consumables are easily available in Kenya should be selected in prior for the purpose of minimizing the increase of operation and maintenance costs.

(7) Policies for setting Grade of Facilities and Equipment

1) Facilities

As mentioned above,

Since the principle purpose of the facilities to be planned in this project are storage of vaccines at the Nairobi National Vaccine Depot and the regional vaccine depots, they will be constructed with materials and products available easily in the market in Nairobi, not to adopt gorgeous and expensive finishing materials, easily damaged materials, and equipment that costs for operation and maintenance.

The same grade of finishing materials and the equipment as the warehouse will be applied to the Coordination Office in the Nairobi National Vaccine Depot, to reduce the management and maintenance expenses.

2) Equipment

According to the basic policies, the grade of equipment to be supplied in the project will be coordinated with that of the equipment is currently used in the target vaccine depots as well as the skill of the maintenance technicians of the target vaccine deports and the medical institutions which take care of the equipment maintenance for the purpose of minimizing the increase of operation and maintenance costs.

(8) Policies to Methods and Period of Construction and Procurement

1) Facilities

Construction methods predominantly adopted in Kenya should be applied. Structures that will enable low construction costs, and low maintenance costs and short construction periods should be planned in principle, by adopting the foundations, floor slabs, column and beams to be made of reinforced concrete construction, walls of concrete blocks, and roofs of steel trusses as the lightweight solution, etc.

The construction schedule is to be divided into two groups: group one for the construction of the Nairobi National Vaccine Depot which takes 12 months and the Meru Regional Vaccine Depot which is not so far from Nairobi, and group two for the construction of the Kakamega and Garissa Regional Vaccine Depots. This efficient scheduling will facilitate construction

works and supervisory works to complete the works in a short period of time.

2) Equipment

In principle, equipment made in Kenya and EU counties are commonly used in the target vaccine depots. For such equipment that needs after-the-sales service, in addition to the Kenyan and Japanese products, procurement of equipment from the manufacturers based in Western countries which has local agents in Kenya should be considered.

2-2-2 Basic Plan

(1) Plot Planning and Design Policies

1) Nairobi National Vaccine Depot

The project site for the Nairobi National Vaccine Depot is a 10,625m^2 large rectangular lot (125m x 85m) situated in the northwest corner of Kitengela Health Center to which indefinite people visit as patients or their families. An embedded sewage pipe for a newly built hospital runs from south to west in the premises of the Center. The new national depot buildings will be situated to avoid this sewage pipe. Since valuable vaccines will be stored in this depot and heavy vehicles for vaccine transport enter and exit, a safety measures such as to locate the entrance to the site at a certain distance from the entrance of the hospital. The Warehouse will be located near the entrance for the safety and convenience of the traffic of transport vehicles. The Workshop, in which the cold room / freezer room temperature monitoring system for the Warehouse will be installed, will be located near the Warehouse. The Coordination Office that needs preferable work environment will be located at a little distant from the Warehouse and the Workshop. The generator house and incinerator shed will be located apart from the Coordination Office so that noise, odors and dusts, etc. from these facilities may not affect the Coordination Office.

2) Regional Vaccine Depots

① Kakamega Regional Vaccine Depot

The project site is a flat lot situated in the premises of a provincial hospital. There are no obstructive structures or trees in the site, however, a sewage pipe runs underground through the center of the site. The project buildings will be arranged to evade this sewage piping. A gate will be designed across the gate of the Kenya Medical Supply Agency (hereinafter referred to as “KEMSA”), which will be favorable to cooperative distribution of vaccines and supplies. A new generator system is not necessary, because electric power will be supplied from the existing generator system installed adjacent to the site to the project buildings.

② Meru Regional Vaccine Depot

The project site is a lot situated in the lowest area of the premises of a district hospital

which is built on a slope land. Since the project site is lower than the surrounding areas, exterior systems should be carefully designed to prevent water and soils from entering the lot especially during the rainy seasons. The district hospital is equipped with a large 150KVA generator system which requires considerable energy cost for operation. Thus, a small generator to supply enough power to the vaccine depot will be provided in this project.

③ Garissa Regional Vaccine Depot

The proposed site for Garissa Depot is situated in the premises of a district office of MOPHS and the Civil Registration Office that serves the general public. The project buildings will be arranged in the left back of the site to keep a certain distance from the existing buildings so that the indefinite number of people who visit them may not enter the project buildings unawarely. The entrance to the project buildings will be arranged apart from the existing entrance in order to avoid intercourse or accidents of the vehicles to and from the existing buildings and to the project buildings.

Garissa City is in general warmer than Nairobi, Kakamega and Meru because the altitude is lower than these cities. It means vaccines and medical supplies may be affected by this high temperature. To avoid this, effective natural ventilation will be well considered to design the building structures, as well as to ensure sufficient ceiling height to reduce the temperature rise in the room. A small generator to supply enough power to the project buildings will be provided in this project.

(2) Architectural Planning

1) Architectural Planning

A. Nairobi National Vaccine Depot

Facilities of the Nairobi National Vaccine Depot will be planned based on the following principles:

① Warehouse

The warehouse is a combined building of a dry storage that requires large space where large packages will be piled up, and a cold storage that do not need large space. The structural design of the building will be carefully developed to serve for these two functions of the warehouse.

The specifications of cold rooms and freezer rooms to be installed in the cold storage require the maximum temperature below 43˚C. Accordingly, the temperature in the warehouse must be controlled not to exceed 43˚C. For this purpose, effective natural ventilation will be well considered in the facility design such as to install a louvered vent on the upper part of the roof, and to design the above-the-ceiling space as high as possible to pool heated air, etc.

② Coordination office

The Coordination Office is designed as a single floor building, but a concrete slab for the first floor will be designed in preparation for the future expansion by the Kenyan side. Columns on the first floor slab will be projected about 80 cm to keep the required anchorage length of reinforcement so that at the time of expansion, the concrete can be taken off and the steel bars can be anchored securely.

③ Workshop

The purpose of a workshop is to repair freezers, cold room compressors and generators, etc. for the vaccine depots over the country. Nevertheless, the present facility serving as the workshop is small and unable to respond the demand. Machines and equipment gathering from all over the country are piled up and trespass the work space. To solve this situation, the workshop designed in this project will have sufficient space both for the inoperable machines and equipment and for repair works.

④ Generator house

Kitengela Health Center is equipped with a hospitalization ward. Noise and vibrations during the operation of the generator system, therefore, should be kept minimal. For this purpose a generator house will be designed to have sufficient space to accommodate a generator and to have such construction to reduce the emission of noise and vibrations.

⑤ Waste disposal space (shed)

The waste disposal space will be divided into compartments where combustible wastes, wastes that generate detriment when burning, and medical wastes will be collected separately.

⑥ Incinerator space (shed)

Vaccines and medical supplies are delivered to the Nairobi National Vaccine Depot in cardboard boxes, crates, etc. and are repackaged into small portions to be transported to the regional vaccine depots. An incinerator shed will be installed to burn the used packages and boxes. The shed will be of brick masonry for saving construction cost.

B. Regional Vaccine Depots

Facilities of the regional vaccine depots will be planned based on the following principles:

① Warehouse

The warehouse will be one large space in which a cold room and freezers will be located side by side. A sufficient width will be ensured to facilitate loading in and out of products and materials. Expensive goods will be stored in a space enclosed by steel fence partitions. A vent grill will be designed on the roof top to intake natural wind as much as possible so that heated air may not stay inside and adversely affect the cold room. A top light on the

roof will enable daytime works without lights and will save running costs. The offices will be designed in the same building with the Warehouse to minimize the construction costs and to achieve work efficiency.

② Generator shed

A roofed shed will be designed for the generator system at the Meru and Garissa Regional Vaccine Depots to protect it against heavy rains during the rainy seasons. The door will be equipped with a lock system for security.

2) Floor Planning

Floors of the Nairobi National Vaccine Depot and the regional vaccine depots as well as their room components, floor areas, etc will be planned as follows:

① Warehouse (common to the Nairobi and regional sites)

The warehouse will be designed to have enough floor space to meet the storage volume of vaccines, medical supplies and other inventories corresponding to the target population of each depot, as well as to be functional to enable smooth loading and off-loading of the inventories.

Size of the dry storage and cold storage will be planned as follows:

- Dry storage

The storage volume per child in 2010 is calculated by the quantity of vaccines and medical supplies (43 kinds) stored in the dry storage at the Nairobi National Vaccine Depot in 2010, divided by the population of 2010. The design storage volume of the Nairobi National Vaccine Depot in the year 2020 (target year of the project) is estimated by multiplying this calculated storage volume per child by the estimated target population in 2020. The design storage volume of each site is estimated by multiplying with the estimated target population of each site area. (See the Estimation of Vaccine Storage Capacity in Appendices.)

- Cold storage

Based on the estimated storage volume of vaccines in 2020, sufficient space for cold storage will be calculated to accommodate cold rooms, freezer rooms and freezers determined by the equipment planning, and to ensure space for sorting, management, loading and off-loading of vaccines.

② Coordination Office (Nairobi National Vaccine Depot)

One large office room is designed combining spaces for each section in order to minimize the space requirement. The space for each section and central passage will be separated not by walls but by low shelves to keep a view of the entire room. Without the walls, light entering through the windows will reach throughout the office which will reduce electric costs for lighting.

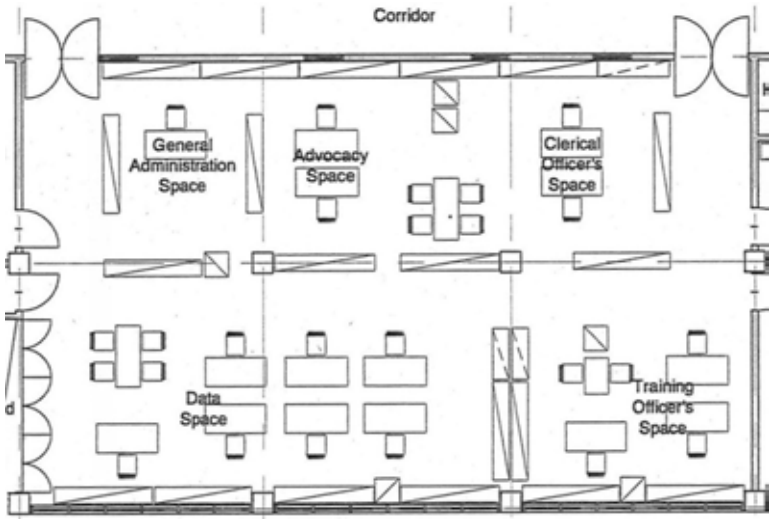


Figure-1 Floor Planning of the Nairobi National Vaccine Depot: Coordination Office

A. Nairobi National Vaccine Depot

Building	Room	Area (m^2)	Setting Basis
Warehouse	Dry storage	832	Dry storage racks for 43 items (18 rows) (space for another row for future expansion), passage for forklift, central corridor
	Windbreak room	27	Inside temperature control space especially for strong wind
	Cold storage	465	Cold rooms (8), freezer rooms (2), freezers (10), goods sorting space
	Logistics room	54	Desks and chairs (8), bookshelf, locker
	Medical lab technologist room	27	Desks and chairs (4), book cabinet, locker
	Officer in charge of vaccine depot room	13.5	
	Dry store manager room	13.5	Desk and chair, book cabinet, locker
	Assistant room	27	Desks and chairs (2), meeting table (for 2 persons), bookshelf, locker
	Support staff room	15	Desks and chairs (3), shelf, cleaning tool, locker
	Kitchen	2.5	Boiler, stainless steel sink, kitchen cabinet
	WC	18	WC for men, WC for women
	Security room	18	Security room, kitchen, WC
	Fire pump room	4.5	Fire pump
	Subtotal	1,612	(Including other space for common use)
Coordination Office	Secretary room	13.5	Reception counter, chair, bookshelf
	Waiting space	20	Chairs (2 sets)
	Head of DVI room	36	Desk & chair, meeting table (for 4), book cabinet, locker, copy machine
	Deputy head of DVI room	24	Desk & chair, meeting table (for 4), book cabinet, locker
	Registry room	14	Book cabinet

Coordination Office	Office	198	Space shared by 5 divisions, desk & chair (19), meeting table, book cabinet, locker
	Conference room	36	Meeting table (for 16), chair, bookshelf, locker
	Server room	9	Space for installing server system
	Support staff room	24.5	Support staff (2, janitor), driver's chair (5)
	Store	13	Store-1, Store-2 for storage of goods
	Kitchen	4	Stainless steel sink, cupboard
	Subtotal	507	(Including other space for common use)
Workshop	Workshop	114	Work table, sink, cabinet, work counter, machine
	Chief medical engineer's room	17	Desk and chair, meeting table (for 4) book cabinet, locker
	Medical engineer's room	28	Desk and chair (4), book cabinet, locker
	WC for women	11.4	Changing room, toilet, shower room
	WC for men	14.4	Changing room, toilet, shower room
	Subtotal	210	(Including other space for common use)
Generator House	Generator room	20	Generator for emergency use, machine foundation
	Switch panel room	20	Switch panel
		40	(Including other space for common use)
Disposal Space	(Shed)	0	Separate space for combustible, incombustible and medical wastes
Incinerator Space	(Shed)	0	Incineration of cardboard boxes, documents, paper, etc.
Total		2,369.0	

B. Regional Vaccine Depots

Site	Room	Area (m^2)	Setting Basis
Kakamega	Officer in charge of vaccine room	20	Desk & chair, meeting table (for 4 persons), book cabinet, locker, copy machine
	Office	28	Desks (2), meeting table (for 4 persons), bookshelf, locker
	Secretary/Waiting room	20	Reception counter & chair, bookshelf, waiting space, chairs
	Support staff room	12	Desk, chair, shelf, stainless steel sink, cleaning tool
	Warehouse	575	Store-1, Store-2, storage racks for dry storage (56) (space for 7 more racks for future expansion), cold room (1 and space for future expansion), freezers (6)
	WC	20	WC for men, WC for women
	Subtotal	675	
Meru	Officer in charge of vaccine room	20	Desk & chair, meeting table (for 4 persons), book cabinet, locker, copy machine
	Office	28	Desks (2), meeting table (for 4 persons), bookshelf, locker
	Secretary/Waiting room	20	Reception counter & chair, bookshelf, waiting space, chairs

Meru	Support staff room	12	Desk, chair, shelf, stainless steel sink, cleaning tool
	Warehouse	320	Store-1, Store-2, storage racks for dry storage (20) (space for 5 more racks for future expansion), cold room (1), freezers (3)
	WC	15	WC for men, WC for women
	Subtotal	415	
Garissa	Officer in charge of vaccine room	20	Desk & chair, meeting table (for 4 persons), book cabinet, locker, copy machine
	Office	28	Desks (2), meeting table (for 4 persons), bookshelf, locker
	Secretary/Waiting room	20	Reception counter & chair, bookshelf, waiting space, chairs
	Support staff room	12	Desk, chair, shelf, stainless steel sink, cleaning tool
	Warehouse	300	Store-1, Store-2, storage racks for dry storage, cold room (1 and space for future expansion), freezers (6)
	WC	15	WC for men, WC for women
	Subtotal	395	
Total		1,485	

3) Sectional Planning

① Nairobi National Vaccine Depot

a) Warehouse

i) Cold storage

Specifications of both the cold rooms to store vaccines that should be preserved under low temperature and the freezer rooms to store goods below 0˚C requires the ambient temperature not to exceed 43˚C. A vent grille will be designed on the roof top to enable natural ventilation by convection of heat so that heated air will not stay inside.

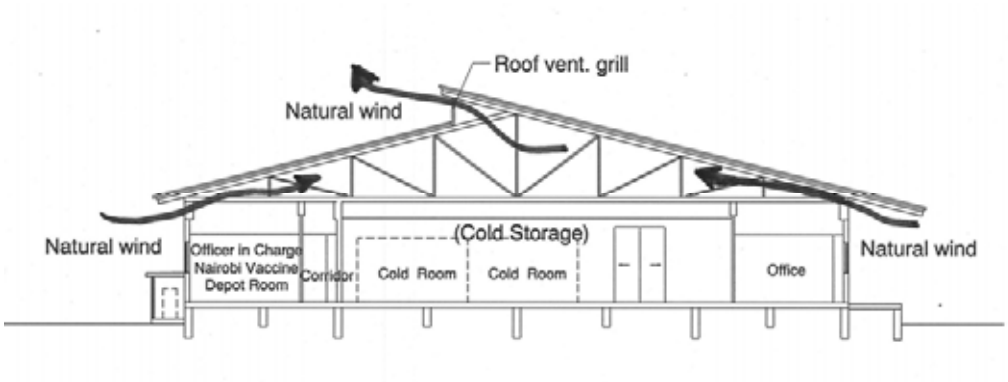


Figure-2 Sectional Planning of the Nairobi National Vaccine Depot: Cold Storage

ii) Dry storage

Similar to the Dry Storage, the ceiling will be designed high to create comfortable work environment, and a vent grille will be designed on the roof top to enable natural

ventilation by convection of heat to avoid heated air staying in the room.

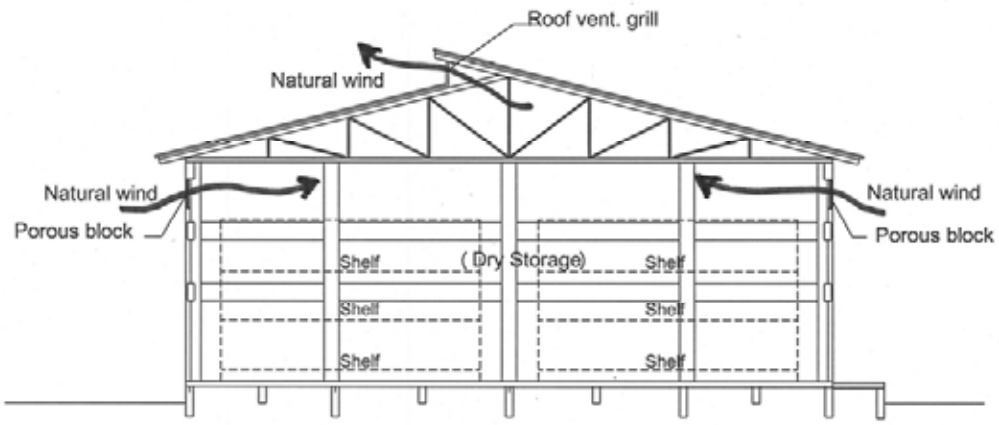


Figure-3 Sectional Planning of the Nairobi National Vaccine Depot: Dry Storage

b) Coordination Office

The Coordination Office is a single story building but a concrete slab floor will be designed on the ceiling in preparation for the future expansion of the second floor by the Kenyan side. A steel truss roof system will be designed so that the roof can be lifted up on the beam over the second floor at the time of expansion.

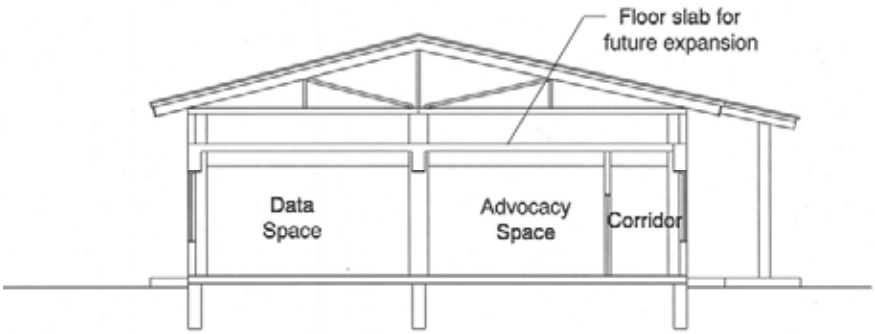


Figure-4 Sectional Planning of the Nairobi National Vaccine Depot: Coordination Office

② Regional Vaccine Depots

Because Kenya is located on the equator, the calorie of heat by direct sun rays onto the roof side is considerably high. The temperature control of dry storage is not required to be so strict, but the cold rooms need strict temperature control. Also comfortable work environment should be maintained. In consideration of these requirements, the ceiling (roof) of storage area will be designed high so that heated air may not stay in the room.

The floor height of Kakamega and Meru Regional Vaccine Depots will be designed at 3.2m high to install cold rooms, while at Garissa Regional Vaccine Depot, where the temperature is higher than the other regions, the ceiling height will be designed at 3.5 m

high so that the high temperature may not affect the cold room.

Air conditioners will not be considered for the purpose of avoiding future maintenance trouble and reducing running costs; instead natural breeze will be taken as much as possible, and an aluminum vent grille will be designed on the roof top to enable natural ventilation by convection of heat.

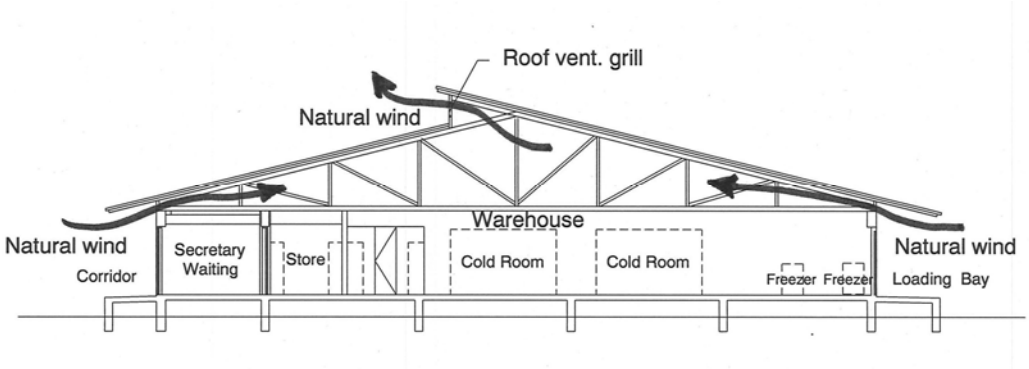


Figure-5 Sectional Planning of the Regional Vaccine Depots in Kakamega, Meru and Garissa

4) Structural Planning

① Structural design standards

The survey team and the officers of the Department of Architectural Planning, Ministry of Public Works of Kenya discussed and agreed that the Japanese structural design standards will be applicable to the structural design of the project buildings. Accordingly, the structures in this project will, in principle, comply with the Japanese structural standards with reference to the Kenyan structural standards if necessary.

② Design load

a) Dead load

All the weights of building structures, finishes, utility appliances will be considered.

b) Live load

Roof (folded roof deck)	: 0.25 KN/m^2 (limited access)
Warehouse	: 7.50 KN/m^2
Office	: 2.50 KN/m^2
Data room	: 7.50 KN/m^2
Corridor, stairs	: 4.00 KN/m^2

c) Wind load

The Building Codes of Kenya states that wind loads should comply with the British Standards. However, there are no statements of standard velocity in the areas of the three regional vaccine depots. There are no records of damages by strong winds, either. Consequently in this project, the minimal criteria of 38m/sec in the British Standards

will be set as the standard velocity to calculate the wind load.

$Vs = V \cdot S1 \cdot S2 \cdot S3$

$F = Cf \cdot q \cdot Ac$

$q = 0.613 \cdot Vs^2$

where:

Vs : Design velocity (m/s)
V : Standard velocity (=38m/sec.)
S1 : Topographic factor (=1.1)
S2 : Coefficient determined by ground roughness and building size (=1.0)
S3 : Statistical coefficient (=1.0)
F : Wind force (N)
Cf : Wind force coefficient
q : Design wind pressure (N/m^2)

d) Seismic load

Kenyan seismic standards states that seismic force need not be considered in case of low buildings with rigid frame construction. However, an earthquake of magnitude 6.8 occurred near the border of Tanzania and the Democratic Republic of the Congo on December 6, 2005. Houses and churches collapsed in the Democratic Republic of the Congo, several casualties were reported, and there is a record of seismic waves transmitted to Kenya. The survey team inquired the officer of the Architectural Division, Ministry of Public Works, whether seismic force should be considered in this project, and was confirmed that Japanese seismic standards should be applied to the structural design in this project.

③ Structural planning

The project buildings will be constructed of reinforced concrete with rigid frames which is a simple and practical frame system predominant in Kenya using materials available in local markets. Interior and exterior walls will be of concrete block construction. To sustain the load on the ground floor where considerable amount of goods will be stored, sand will be filled on the ground and gravels spread over, then reinforced concrete floor slab will be constructed. This construction method will be effective to prevent floor settling and reduce cracks.

④ Foundation planning

a) Nairobi Site

Three holes of 20 m depth were bored in the site ground. In the east high area of the site the geological investigations indicate the N-value is 37, the compressive strength $100t/m^2$ at 7.5m depth, and $1,000\ t/m^2$ at 11m depth and below, which means extremely

hard rock courses lie there. In the central area of the site the geological investigations indicate the N-value is 58 at 2.45m depth, and very hard rock courses of 750t/m^2 compressive strength at 5.75m and deeper levels. In the west, the lowest area of the site the geological investigations also indicate extremely hard rock courses of 1,000t/m^2 compressive strength near the surface only 2.5m deep and below. Based on these geological investigation results, the direct foundations down to GL-1.0 to -1.2 m depth as the foundation bottom layer will be designed.

b) Regional Vaccine Depots

i) Kakamega site

The geological investigations in the Kakamega site ground indicate red clay layers commonly known as red coffee soil. The soil bearing capacity (N value) is 13 at -1.95m depth, 6 at -2.95m depth and recovers to over 14 in the layers between -3.95 m and -5.95 m. Based on this investigation result, the direct foundations down to GL-1.0 to 2.0 m depth as the foundation bottom layer will be designed.

ii) Meru site

Similar to Kakamega site, the geological investigations in the site ground indicate red clay layers common known as red coffee soil. The soil bearing capacity (N value) is 11 at -1.95m depth and 14 at -2.95m depth and below. Based on this investigation result, the direct foundations down to GL-1.0 to 2.0 m depth as the foundation bottom layer will be designed.

iii) Garissa site

The geological investigations in the site ground indicate sandy clay soil layers. The soil bearing capacity (N value) is 19 at -1.45m depth, 16 at -2.45m depth and recovers to 18 at -3.35m and 20 at -4.45m and continues over 20 in the layers below. Based on this investigation result, the direct foundations down to GL-1.0 to 2.0 m depth as the foundation bottom layer will be designed.

⑤ Structural Materials and Construction Methods

a) Concrete

Concrete needs to be manufactured by erecting a concrete plant at the site, because ready mixed concrete does note seem available in Meru, Kakamega or Garissa. Aggregate such as sand gravel are available near each site, while cement, reinforcing steel and other construction materials need to be procured in Nairobi.

The design strength of concrete (Fc) will be set at 21 N/mm^2 in consideration of the skill of civil engineers in rural areas.

b) Reinforcing Steel

Twisted bars (reinforcing steel made by twisting square bars) and plain bars are

commonly used in Kenya, whose quality is not so reliable including their strength. Since this project is to construct public facilities, deformed bars which are stronger and more reliable will be used.

c) Steel Frame

Many of steel frames available in Kenya are imports from South Africa and have no serious defects, however, the welding technology level does not seem so reliable. Steel frames to be used for the roof truss will be procured locally for the purpose of cost saving. Their quality and reliability will be ensured by deliberate inspections of welded joints at the factory as well as the inspections of all the steel frames at the time of their delivery to the site.

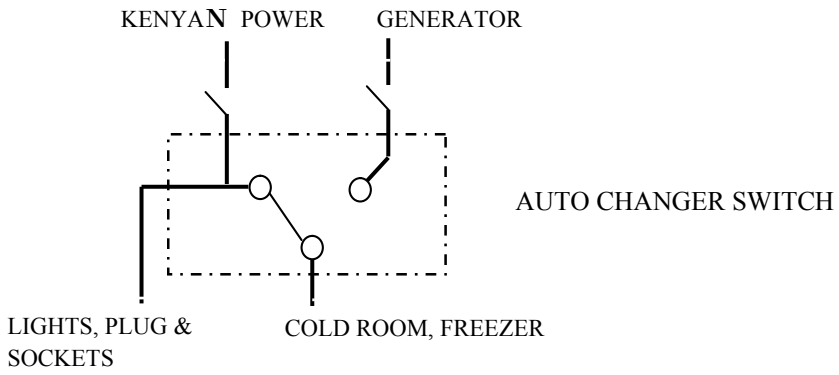
5) Electrical Planning

Proper electric systems should be planned to realize a sustainable supply system of electrical power to the electrical installations in the regions where power conditions are not reliable, and to create work environment suitable to the types of works in the project buildings.

① Power Incoming Installations

The power supply system up to the boundary limit of the site premises will be the responsibility of Kenyan side. In this project electric power of 3-phase 415W 50Hz will be supplied from the electric pole in the site premises to the distribution panels in the buildings.

The power incoming system will be planned with an assumption of 4kw contract ampere at Meru and Garissa sites, 6kW at Kakamega site and 30kW at Nairobi site. In order to ensure continuous power supply at the time of power failure, distribution panels will be equipped with automatic changer switch system connected to the generator system.



② Generator System

A generator system to have sufficient capacity to supply power for all the operation demand will be installed at Nairobi, Meru and Garissa sites in the event of a conventional

power failure. Kakamega site will not be equipped with a new generator, because emergency power will be supplied from the existing generator system installed outside of the site premises. This existing generator (50KVA) was installed as the emergency power source to supply power to cold rooms and refrigerators for vaccines. Since these cold rooms and refrigerators are to be moved into the project building after the completion of the project, there seems no problem regarding the generator capacity.

<Specifications of generator system>

Engine : Diesel engine
Fuel : Kerosene
Type : Outdoor package type
Output voltage : 3-phase 415V 50Hz

Table-2 Generator Output

Site	Load (KVA)	Contract Demand* (kw)	Generator Output* (KVA)
Nairobi	78.0	30.0	135
Meru	10.6	4.0	24
Garissa	10.3	4.0	24

*(Assumed)

③ Lights

Lights with sufficient illuminance and brightness for the purpose of the rooms should be selected at each site. Safety and cost-saving should also be considered. Cable wiring system of 240V will be applied to the lighting circuit.

Table-3 Lights in Each Room

Room	Light	Illuminance (lx)	Room	Light	Illuminance (lx)
Support Staff Room	Strip light	500	Loading Bay	Bracket type with acryl cover	100
Office	Flush mounted, louvered	500	W.C（M, F）	Strip light	100
Secretary Room	Flush mounted, louvered	400			
Office in charge of Vaccine Depot	Flush mounted, louvered	500			
Store	Strip light	200			
Warehouse	Strip light (with guard cover)	300			

④ Receptacles

In each site, receptacles for a single-phase, 240 V cable with 2P15A grounding will be installed for common use and for freezers. Local switches for a 3-phase 415 V cable will be installed for the cold rooms.

⑤ Telephones

The telephone wiring up to the site boundary will be the responsibility of the Kenyan side. In this project, two lines; one for telephone system and the other for internet system will be installed at Meru, Kakamega and Garissa sites. Telephone receivers are planned to be installed in the Offices. An automatic switching system of incoming call, FAX and extension call will be planed for Nairobi site.

⑥ Intelligent Piping System

A piping system will be planned for establishing LAN of the personal computers in each room. Provision of LAN cabling and HUB system will be the responsibility of the Kenyan side.

⑦ Automatic Fire Alarm System

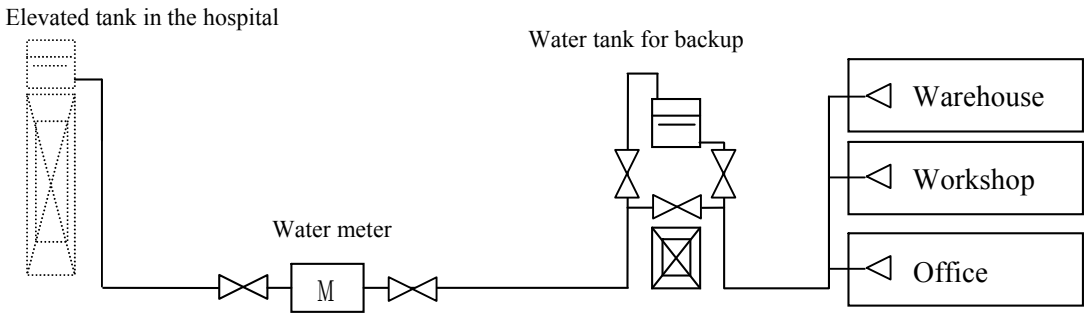
Fire detectors will be installed in each room to enable early detection of fires. An alarm signal receiver will be planned in the Secretary Room which is always occupied with the staff.

6) Mechanical Planning

① Water Supply System

a) Nairobi National Vaccine Depot

A branch pipe of 65mm diameter will be drawn from the secondary side of the elevated water tank in the adjacent hospital. A water meter will be placed inside the boundary line, and water will be pumped up to the elevated water tank, and then distributed by gravity down to the designed consumption points. A back-up water tank will be planned to deal with disrupted water supply.



b) Regional Vaccine Depots

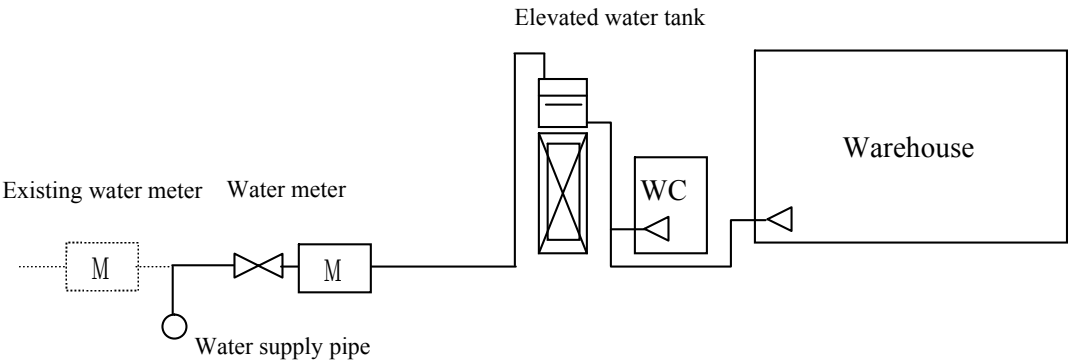
i) Kakamega Regional Vaccine Depot

Similar to Meru site, a branch pipe of 20mm diameter will be drawn at the primary side of water meter for the existing water supply pipe in the adjacent premises. A water meter will be placed near the site boundary line, and water will be pumped up to

the elevated water tank by the building, and then distributed by gravity down to the designed consumption points.

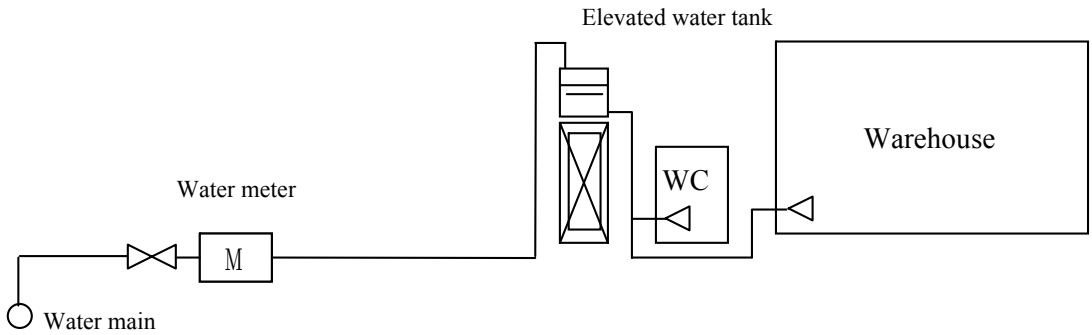
ii) Meru Regional Vaccine Depot

A branch pipe of 20mm diameter will be drawn at the primary side of water meter for the existing water supply pipe in the adjacent premises. A water meter will be placed near the site boundary line, and water will be pumped up to the elevated water tank by the building, and then distributed by gravity down to the designed consumption points.



iii) Garissa Regional Vaccine Depot

A branch pipe of 20mm diameter will be drawn from the water main embedded in the road on the southeast of the site. A water meter will be placed near the boundary line, and water will be pumped up to the elevated water tank by the building, and then distributed by gravity down to the designed consumption points.



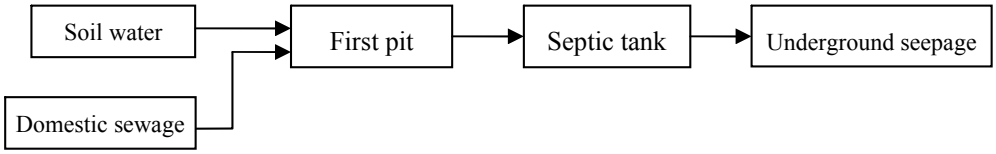
② Hot Water Supply System

An electric heater will be designed in the Workshop of Nairobi Site to supply hot water to the shower system.

③ Sewage System

a) Nairobi Site

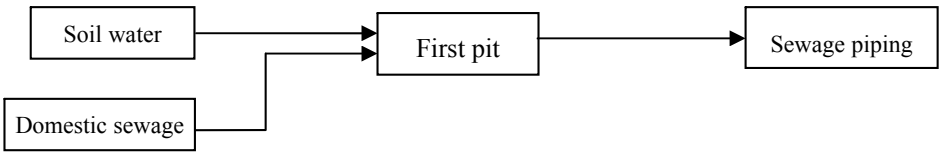
Soil water and domestic sewage water will be run separately in the building, combined in the first pit, treated in the outdoor septic tank, and seep underground.



b) Regional Vaccine Depots

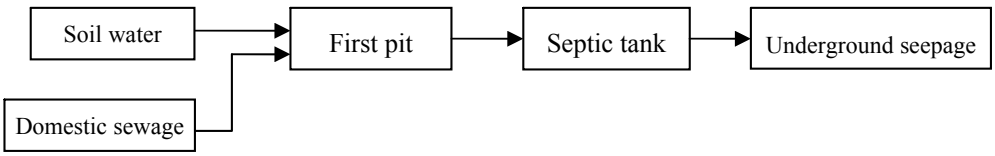
i) Kakamega site

Soil water and domestic sewage water will be run separately in the building, combined in the first pit, treated in the outdoor septic tank, and discharged into the sewage piping in the premises.



ii) Meru site

Soil water and domestic sewage water will be run separately in the building, combined in the first pit, treated in the outdoor septic tank, and seep underground.

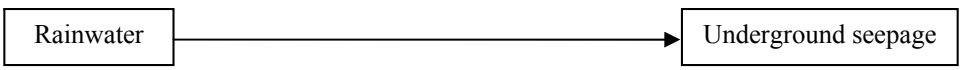


iii) Garissa site

Soil water and domestic sewage will be run separately. Soil water will be treated in the outdoor septic tank and seep underground. Domestic sewage will be discharged into the side ditch along the southeast road.

④ Rain Water Drainage

Of all the buildings at the Nairobi and the regional vaccine depots, rain water will be collected into the eaves gutter, run the downspout and discharged underground through the seepage pit.



⑤ Fire Fighting System

Indoor fire hydrant system will be planned for the Warehouse of Nairobi Depot. An indoor fire pump will be installed to supply fire water to three indoor fire hydrants.

⑥ Cooling System

In principle, room temperatures will be controlled by securing natural air ventilation. Mechanical cooling system will not be considered.

⑦ Ventilation System

Natural ventilation will be considered in principle. Forced ventilation system will be planned for a part of offices in Nairobi Depot.

7) Construction Materials Planning

Materials and products predominantly used in Kenya and easy for future maintenance will be selected. All the buildings to be constructed by the Japanese side in this project will be applied with the same exterior finishes.

In order to deal with tropical squalls in which a large amount of rain falls and to realize light frames with long spans, a folded-plate roof over the steel frame will be planned. Exterior and interior walls will be constructed of concrete blocks which are common in the locale.

Additional concrete slab will be cast on the interior floors of Warehouse where the lifters forklifts transport heavy luggage to prevent cracking. The slab will be finished with surface curing agent to reduce abrasion of concrete surface. The office floors will be applied with mortar with trowel finish and surface hardener coating that have high abrasion resistance and have no cracks or gaps where bacillus collects easily.

The following tables show the finishing schedule under consideration at present.

Table-4 Finishing Schedule

(Nairobi National Vaccine Depot: Warehouse)

Exterior Finishing

Zone	Finish
Roof	Folded plate roof (roof deck) h=85, t=0.6 (galvanized steel sheet), (color GL), w/ insulation sheet t=4.0, gradient: 2.5/10
Top light	Sheet of Polycarbonate resin h=85, t=1.5mm
Fascia board	Steel, SOP coat
Soffit	Roofing exposed
Soffit vent	Steel vent 500x100, with steel net SOP coat
Eaves gutter	PCV W=100, H=100, hanger @600 (standard product) (Loading bay side only)
Downspout	UPCV pipe (VP), 100φ (standard product) (Loading bay side only)
Exterior wall (wall)	Concrete block T=200mm, mortar base with elastic painting finish
Exterior wall (column, beam)	Mortar trowel base, with elastic painting finish
Door	Steel door: SOP finish
Window	Ordinary window: : aluminum jalousie window, anodizing finish Roof vent: aluminum louver window, anodizing finish, steel net
Window grill	Steel grill, SOP finish
Loading bay floor	Concrete with steel trowel finish, surface hardener coating, rubber cushion
Entrance porch	Mortar with trowel finish
Stairs	Mortar with trowel finish, non-slip tiling on the nosing
Baseboards	Mortar with trowel finish, h=300
Compressor space	Sloped roof: concrete slab, waterproof mortar with trowel finish Ceiling: Plywood for ordinary forms, exposed Wall outer face: concrete block T=150mm, base mortar with troweling, sprayed elastic paint finish (patterned) Wall inner face: concrete block T=150mm, mortar with trowel finish Floor: mortar with trowel finish Door: steel angle frame, wire mesh door, SOP finish (equipped with a lock system)
Berm	Gravel and interlocking tile pavement

Interior Finishing

Room	Floor Level	Floor	Baseboard (H=100)	Wall	Ceiling	Ceiling Height
Dry storage	±0	Concrete with steel trowel finish, surface hardener coating	Mortar with trowel finish	Mortar w/ joints and troweling, EP finish Partly partitioned with wire mesh	Exposed ceiling	--
Anteroom	±0	Concrete with steel trowel finish, surface hardener coating	Mortar with trowel finish	Mortar w/ joints and troweling, EP finish	Calcium silicate board t=6mm, EP coat	3,600
Cold storage	±0	Concrete with steel trowel finish, surface hardener coating	Mortar with trowel finish	Mortar w/ joints and troweling, EP finish	Exposed ceiling	--
Store - 2	±0	Concrete with steel trowel finish, surface hardener coating	Mortar with trowel finish	Mortar w/ joints and troweling, EP finish	Calcium silicate board t=6mm, EP coat	2,700
Store - 3	±0	Concrete with steel trowel finish, surface hardener coating	Mortar with trowel finish	Mortar w/ joints and troweling, EP finish	Calcium silicate board t=6mm, EP coat	2,700
Store - 4	±0	Concrete with steel trowel finish, surface hardener coating	Mortar with trowel finish	Mortar w/ joints and troweling, EP finish	Calcium silicate board t=6mm, EP coat	2,700
Office	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Medical lab technologist room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Officer in charge of vaccine depot room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700

Dry storage manager room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Assistant room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Support staff room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Corridor	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Kitchen	±0	Porcelain tile (with drainage slope)	—	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,700
WC (F)	-50	Porcelain tile (with drainage slope)	—	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,400
WC (M)	-50	Porcelain tile (with drainage slope)	—	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,400
Store - 1	±0	Mortar with trowel finish	Mortar with trowel finish	Mortar w/ joints and troweling, EP finish	Calcium silicate board t=6mm, EP coat	2,700
Security room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Kitchen	-50	Porcelain tile (with drainage slope)	—	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,400
WC (security)	-50	Porcelain tile (with drainage slope)	—	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,400
Fire pump room	±0	Exposed concrete with trowel finish	Mortar with trowel finish	Upper wall: glass wool T=50 base, covered with glass fiver cloth Wainscot: concrete block exposed H=1000	Calcium silicate board t=6mm, glass wool T=50, covered with glass fiver cloth	2,400
EPS	±0	Exposed concrete with trowel finish	Mortar with trowel finish	Concrete block, exposed	Calcium silicate board t=6mm, EP coat	2,700

(Nairobi National Vaccine Depot: Coordination Office)

Exterior Finishing

Zone	Finish
Roof	Folded plate roof (roof deck) h=85, t=0.6 (galvanized steel sheet), (color GL), w/ insulation sheet t=4.0, gradient: 2.5/10
Fascia board	Steel, SOP coat
Soffit	Roofing exposed
Soffit vent	Steel vent 500x100, with steel net SOP coat
Exterior wall (wall)	Concrete block T=200mm, mortar base with elastic painting finish
Exterior wall (column, beam)	Mortar trowel base, with elastic painting finish
Door	Steel door: SOP finish Iron grilled door: SOP finish
Window	Ordinary window: : aluminum jalousie window, anodizing finish
Window grill	Steel grill, SOP finish
Entrance porch	Mortar with trowel finish, with drainage slope
Baseboards	Mortar with trowel finish, h=300
Berm	Interlocking block pavement

Interior Finishing

Room	Floor Level	Floor	Baseboard	Wall Wainscot	Ceiling	Ceiling Height
Entrance hall	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Exposed concrete slab, flattened , EP finish	--
Secretary room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,500
Waiting space	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Exposed concrete slab, flattened , EP finish	--
Head of DVI room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Exposed concrete slab, flattened , EP finish	--
Deputy Head of DVI room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Exposed concrete slab, flattened , EP finish	--
Data room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Exposed concrete slab, flattened , EP finish	--
Office	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Exposed concrete slab, flattened , EP finish	--
Conference room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Exposed concrete slab, flattened , EP finish	--
Server room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,500
Support staff room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,500
Store -1	±0	Mortar with trowel finish	Terrazzo block	Mortar w/ joints and troweling, EP finish	Exposed concrete slab, flattened , EP finish	--
Store -2	±0	Mortar with trowel finish	Terrazzo block	Mortar w/ joints and troweling, EP finish	Exposed concrete slab, flattened , EP finish	--
Corridor	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Exposed concrete slab, flattened , EP finish	--
Kitchen	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Wall: mortar w/ joints and troweling, EP finish Sink unit: porcelain tile H=2,100 (2 units)	Exposed concrete slab, flattened , EP finish	--
WC (F)	-50	Porcelain tile (with drainage slope)	—	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,500
WC (M)	-50	Porcelain tile (with drainage slope)	—	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,500

(Nairobi National Vaccine Depot: Workshop)

Exterior Finishing

Zone	Finish
Roof	Folded plate roof (roof deck) h=85, t=0.6 (galvanized steel sheet), (color GL), w/ insulation sheet t=4.0, gradient: 2.5/10
Fascia board	Steel, SOP coat
Soffit	Roofing exposed
Soffit vent	Steel vent 500x100, with steel net SOP coat
Exterior wall (wall)	Concrete block T=200mm, mortar base with elastic painting finish
Exterior wall (column, beam)	Mortar trowel base, with elastic painting finish
Door	Steel door: SOP finish Iron grilled door: SOP finish
Window	Ordinary window: : aluminum jalousie window, anodizing finish
Window grill	Steel grill, SOP finish
Entrance porch	Mortar with trowel finish, with drainage slope
Baseboards	Mortar with trowel finish, h=300
Berm	Gravel pavement

Interior Finishing

Room	Floor Level	Floor	Baseboard (H=100)	Wall	Ceiling	Ceiling Height
Workshop	±0	Concrete with steel trowel finish, surface hardener coating	Mortar with trowel finish	Mortar w/ joints and troweling, EP finish	Exposed ceiling	--
Entrance / corridor	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm Integrated ceiling system, Steel frame	2,700
Medical engineer's room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm Integrated ceiling system, Steel frame	2,700
Chief medical engineer's room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Changing room (F)	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Shower room (F)	-50	Porcelain tile (with drainage slope)	--	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,400
WC (F)	-50	Porcelain tile (with drainage slope)	--	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,400
Changing room (M)	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Shower room (M)	-50	Porcelain tile (with drainage slope)	--	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,400
WC (M)	-50	Porcelain tile (with drainage slope)	--	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,400
Kitchen	±0	Exposed concrete with trowel finish	--	Concrete exposed	Concrete slab	--

(Nairobi National Vaccine Depot: Generator House)

Exterior Finishing

Zone	Finish
Roof	Folded plate roof (roof deck) h=85, t=0.6 (galvanized steel sheet), (color GL), w/ insulation sheet t=4.0, gradient: 2.5/10
Fascia board	Steel, SOP coat
Soffit	Roofing exposed
Soffit vent	Steel vent 500x100, with steel net SOP coat
Exterior wall (wall)	Concrete block T=200mm, mortar base with elastic painting finish
Exterior wall (column, beam)	Mortar trowel base, with elastic painting finish
Door	Steel door: SOP finish
	Iron grilled door: SOP finish
Window	Ordinary window: : aluminum jalousie window, anodizing finish
Window grill	Steel grill, SOP finish
Entrance porch	Mortar with trowel finish, with drainage slope
Baseboards	Mortar with trowel finish, h=300
Berm	Gravel pavement

Interior Finishing

Room	Floor Level	Floor	Baseboard (H=100)	Wall	Ceiling	Ceiling Height
Generator room	±0	Mortar with trowel finish	Mortar with trowel finish	Concrete block Glass fiber cloth over glass wool board t=50	Bottom of the folded-plate roof, Glass fiber cloth over glass wool board t=50	--
Switch panel room	±0	Mortar with trowel finish	Mortar with trowel finish	Exposed concrete, repaired	Bottom of the folded-plate roof	--

(Regional Vaccine Depots in Meru, Kakamega and Garissa)

Exterior Finishing

Zone	Finish
Roof	Folded-plate roof (roof deck) h=85, t=0.6 (galvanized steel sheet), (color GL), w/ insulation sheet t=4.0, gradient: 2.5/10
Top light	Sheet of Polycarbonate resin h=85, t=1.5mm
Fascia board	Steel, SOP coat
Soffit	Roofing exposed
Soffit vent	Steel vent 600x600, SOP coat, w/ steel net SOP coat
Eaves gutter	PCV W=100, H=100, hanger @600 (standard product) (Loading bay side only)
Downspout	UPCV pipe (VP), 100φ (standard product) (Loading bay side only)
Exterior wall (wall)	Concrete block T=200mm, mortar base with elastic painting finish
Exterior wall (column, beam)	Mortar trowel base, with elastic painting finish
Door	Steel door: SOP finish
	Wooden door: SOP finish
	Iron grilled door: SOP finish
Window	Ordinary window: aluminum jalousie window, anodizing finish
	Transom window: aluminum jalousie window, anodizing finish
	Roof vent: aluminum louver window, anodizing finish, steel net
Window grill	Steel grill, SOP finish
Loading bay floor	Concrete with steel trowel finish, surface hardener coating, sloped, w/ rubber cushion
Corridor	Mortar with trowel finish, sloped
Stairs	Mortar with trowel finish, sloped, non-slip tiling on the nosing
Baseboards	Mortar with trowel finish, h=300

Interior Finishing

Room	Floor Level	Floor	Baseboard (H=100)	Wall	Ceiling	Ceiling Height
Officer in charge of vaccine depot room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Secretary / Waiting room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Office	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Support staff room	±0	Mortar with trowel finish, surface hardener coating	Terrazzo block	Mortar w/ joints and troweling, EP finish	Rock wool insulation 12mm, Integrated ceiling system, Steel frame	2,700
Warehouse	±0	Concrete with steel trowel finish, surface hardener coating	Mortar with trowel finish	Mortar w/ joints and troweling, EP finish	Exposed ceiling	--
Store - 1	±0	Concrete with steel trowel finish, surface hardener coating	Mortar with trowel finish	Mortar w/ joints and troweling, EP finish	Calcium silicate board t=6mm, EP coat	2,700
Store - 2	±0	Concrete with steel trowel finish, surface hardener coating	Mortar with trowel finish	Mortar w/ joints and troweling, EP finish Partly partitioned with wire mesh	Ceiling net (exposed ceiling)	--
WC (M)	-100	Porcelain tile (with drainage slope)	—	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,400
WC (F)	-100	Porcelain tile (with drainage slope)	—	Upper wall: mortar w/ joints and troweling, EP finish Wainscot: porcelain tile, H=2,100	Calcium silicate board t=6mm, EP coat	2,400

(3) Equipment Planning

1) Changes from the Initial Request

As a result of the discussions on the equipment list, the following changes were made in the initial request.

Table-5 Requested Additional Equipment

Sites	Additional Equipment	Necessity
Nairobi National Vaccine Depot	Freezer	For storing vaccines and freezing icepacks for district depots in Nairobi Province.
	Refrigeration equipment maintenance kit	For replacing the old and damaged existing equipment.
Regional Vaccine Depots (8 depots)	Manual pallet lifter	For carrying the cold boxes with vaccines and other related materials.
	Refrigeration equipment maintenance kit	To facilitate management of cold rooms and freezers, and to reduce the maintenance costs

On the other hand, the computerized stock management system was excluded from the project because it was found during the survey that the Kenyan side had started to establish the stock management system with the support from WHO/UNICEF.

2) Final List of Requested Equipment

Table-6 shows the list of requested equipment which was attached to the Minutes of Discussions signed on February 4, 2010 between the Kenyan side and the Survey Team.

Table-6 Final List of Requested Equipment

No.	Name of Equipment	Priority
(1) Nairobi National Vaccine Depot		
1	Cold room	A
2	Freezer room	A
3	Computerized fridge temperature monitoring system	B
4	Freezer	B
5	Forklift	A
6	Manual pallet lifter	A
7	Refrigeration equipment maintenance kit	B
(2) Nyeri Regional Vaccine Depot		
1	Freezer	A
2	Manual pallet lifter	B
3	Refrigeration equipment maintenance kit	B
(3) Nakuru Regional Vaccine Depot		
1	Cold room	A
2	Freezer	A
3	Manual pallet lifter	B
4	Refrigeration equipment maintenance kit	B
(4) Eldoret Regional Vaccine Depot		
1	Cold room	A
2	Freezer	A
3	Manual pallet lifter	B
4	Refrigeration equipment maintenance kit	B
(5) Kisumu Regional Vaccine Depot		
1	Freezer	A
2	Manual pallet lifter	B
3	Refrigeration equipment maintenance kit	B
(6) Mombasa Regional Vaccine Depot		
1	Cold room	A
2	Freezer	A
3	Manual pallet lifter	B
4	Refrigeration equipment maintenance kit	B
(7) Meru Regional Vaccine Depot		
1	Freezer	A
2	Manual pallet lifter	A
3	Refrigeration equipment maintenance kit	B
(8) Kakamega Regional Vaccine Depot		
1	Manual pallet lifter	A
2	Refrigeration equipment maintenance kit	B
(9) Garissa Regional Vaccine Depot		
1	Freezer	B
2	Manual pallet lifter	A
3	Refrigeration equipment maintenance kit	B

Priority:
A – It is necessary.
B – It is necessary but further study is required.

3) Study of the Requested Equipment

As the result of the discussions with the Kenyan side, the storage capacity of cold rooms and freezers should be estimated based on the stock requirement of vaccines in the year 2020, about ten years later.

The range of temperature for storing vaccines in the depots will be, in compliance with the WHO recommendations, +2˚C to + 8˚C for measles, BCG, TT, yellow fever, DPT+HpB+Hib, PCV and rotavirus and -15˚C to -25˚C for OPV.

① Nairobi National Vaccine Depot

No.	Name of Requested Equipment	Priority	Requested Q'ty	No.	Name of Requested Equipment	Priority	Requested Q'ty
1	Cold room	A	8	5	Forklift	A	1
2	Freezer room	A	2	6	Manual pallet lifter	A	2
3	Computerized fridge temperature monitoring system	B	1	7	Refrigeration equipment maintenance kit	B	1
4	Freezer	B	9				

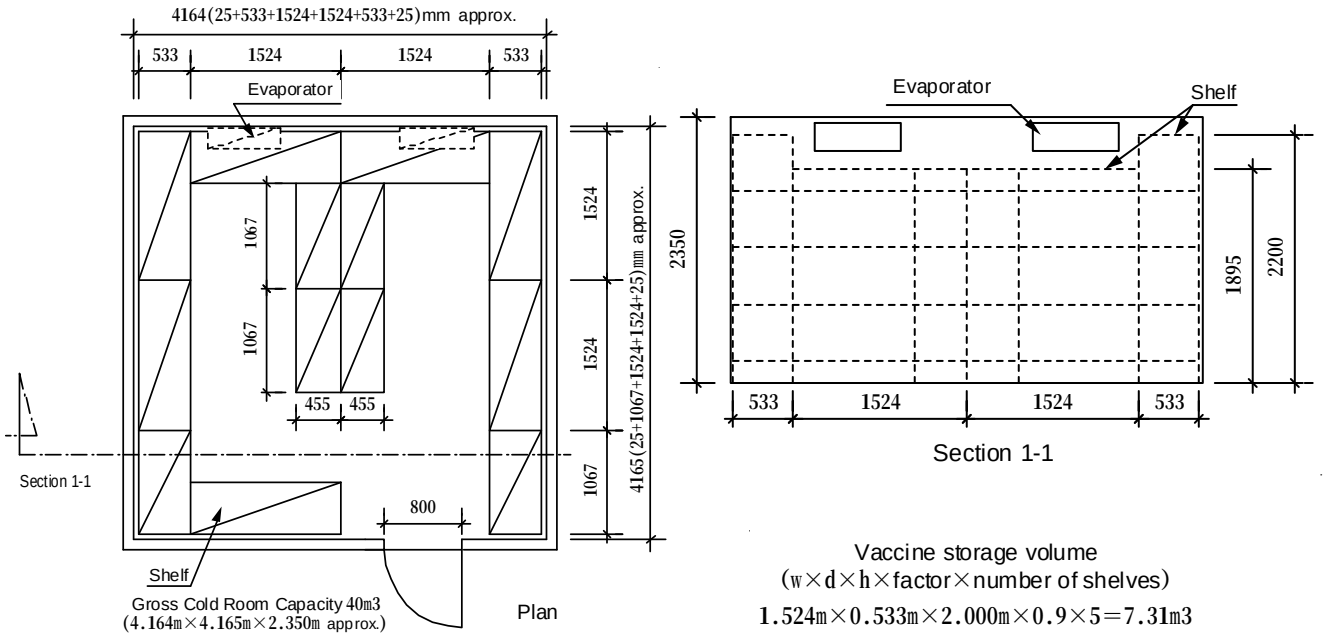
a) Storage capacity of cold rooms (at +2˚C to +8˚C) and required quantity

In order to calculate the vaccine storage volume, figures predominantly used in Kenya should be applied to the number of doses per child (pregnant woman), number of doses per vial and wastage multiplication factor (WMF). The packed volume per dose (cm^3) will be taken from the figures in WHO/IVB/08.01-Annex 5, while the same for PCV and rotavirus vaccine which will be newly considered, the latest data of DVI 12.9cm^3 and 17.1 cm^3 will be applied. In the calculation of vaccine storage volume at the Nairobi National Vaccine Depot, vaccine stock/supply period is assumed four months. Based on these data and expected number of birth/pregnant woman in the year of 2020, the storage volume of vaccines at Nairobi Depot is estimated to be 112.4m^3 as shown below.

Type of Vaccines	Number of livebirth, preg. women	No. of doses/ child, preg. women	Doses/ vial	Annual doses needed + buffer	4-month stock needed	Packed vol./dose (cm^3)	Total storage vol. (cm^3)	Total storage vol. (m^3)
A	B	C	D	E	F=E/3	G	H=FxG	I=H/10^6
Measles	2,101,174	1	10	4,727,642	1,575,881	3.5	5,515,582	5.5
BCG	2,101,174	1	20	23,638,208	7,879,403	1.2	9,455,283	9.5
TT	2,101,174	2	20	6,287,763	2,095,921	3.0	6,287,763	6.3
Yellow Fever	55,155	1	10	124,099	41,366	2.5	103,416	0.1
DPT+HpB +Hib	2,101,174	3	2	7,446,035	2,482,012	11.0	27,302,130	27.3
PCV	2,101,174	3	2	7,871,523	2,623,841	12.9	33,847,549	33.8
Rotavirus Vaccine	2,101,174	2	1	5,247,682	1,749,227	17.1	29,911,788	29.9
EPI Vaccine Total Volume (m^3)								112.4

The vaccine storage volume is approximately 15m^3 for a cold room with gross capacity of 40m^3, as shown below. EPI vaccine total volume 112.4m^3 / 15m^3＝7.49 units of cold rooms will be necessary.

Accordingly, seven cold rooms with 15m^3 vaccine storage volume will be considered in the equipment plan.



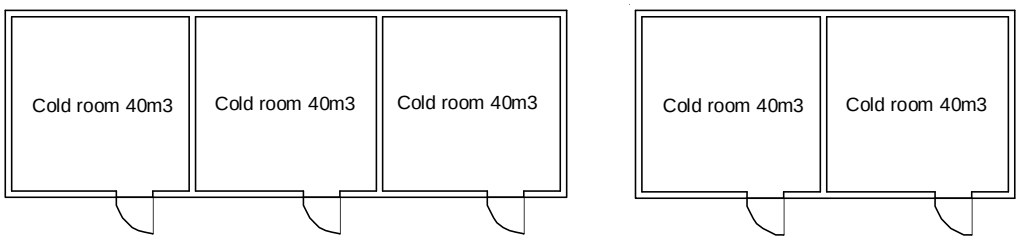
COLD ROOM 40m3
(Separate air-cooled condensing unit)

Vaccine storage volume
(w×d×h×factor×number of shelves)

1.524m×0.533m×2.000m×0.9×5=7.31m3
1.524m×0.533m×1.695m×0.9×2=2.48m3
1.067m×0.533m×2.000m×0.9×2=2.05m3
1.067m×0.455m×1.695m×0.9×4=2.96m3

Total 14.80 15m3

Based on the facility plan, the seven cold rooms mentioned above will be structured into one unit of cold room with 3-rooms and two units of cold rooms with 2-rooms as shown below.



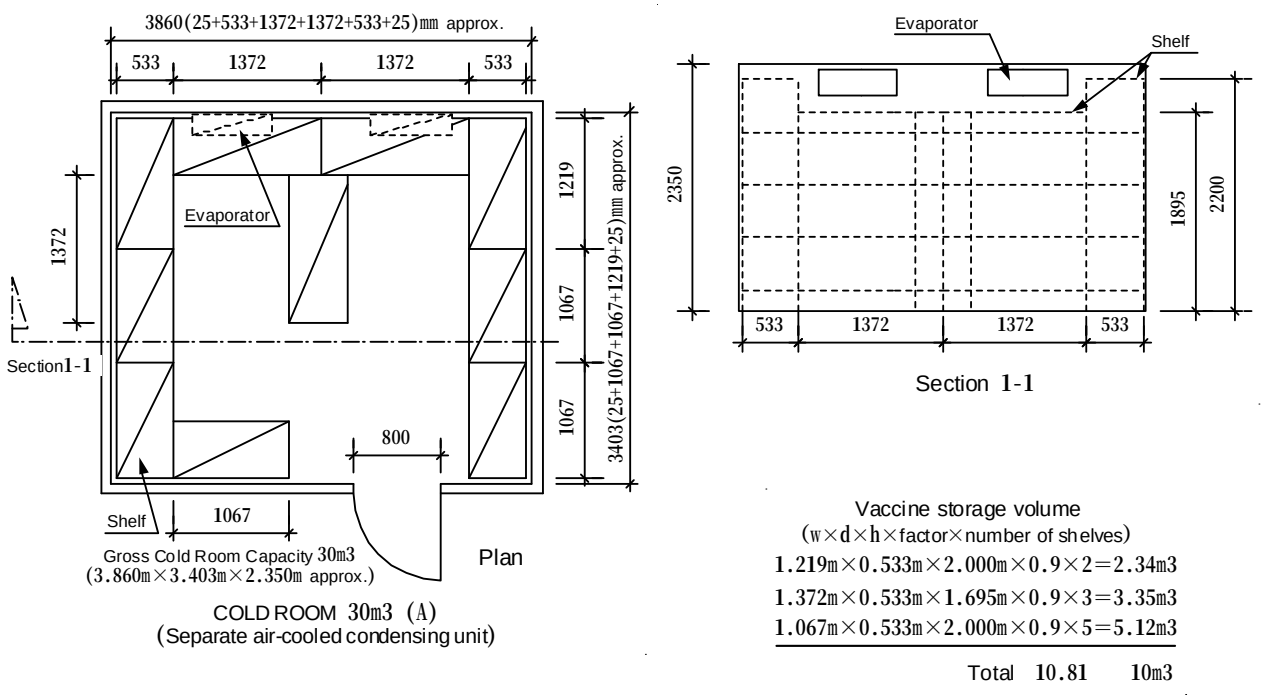
Plan for Cold Room with 3 Rooms

Plan for Cold Room with 2 Rooms

Other than the EPI vaccines, DVI is also responsible for vaccine procurement and vaccination of Non-EPI vaccines (vaccines for typhoid, yellow fever (for travelers), meningitis, anti-rabies, anti-snake venom, and hepatitis B). Another cold room will be needed for storage of these vaccines. The Non-EPI vaccine storage volume projected for the year 2020 is 9.4m^3 as shown below.

Type of Vaccines	Number of doses /person	Annual doses needed (2010)	Annual doses needed (2020)	Packed volume per dose (cm^3)	Total storage vol. (cm^3)	Total storage vol. (m^3)
A	B	C	D=1.1xC	E	F=DxE	G=F/10^6
Typhoid vaccine in single doses	1	6,510	7,161	94.2	674,566	0.7
Yellow fever vaccine	1	25,000	27,500	24.7	679,250	0.7
Anti-rabies vaccine	1	54,545	60,000	100.0	5,999,950	6.0
Anti-snake venom	1	8,000	8,800	205.8	1,811,040	1.8
Hepatitis B	1	6,000	6,600	34.4	227,040	0.2
Non-EPI Vaccine Total Volume (m^3)						9.4

Accordingly, one cold room with approximate storage capacity of 10m^3 capacity (30m^3 gross capacity) will be included in the equipment plan.



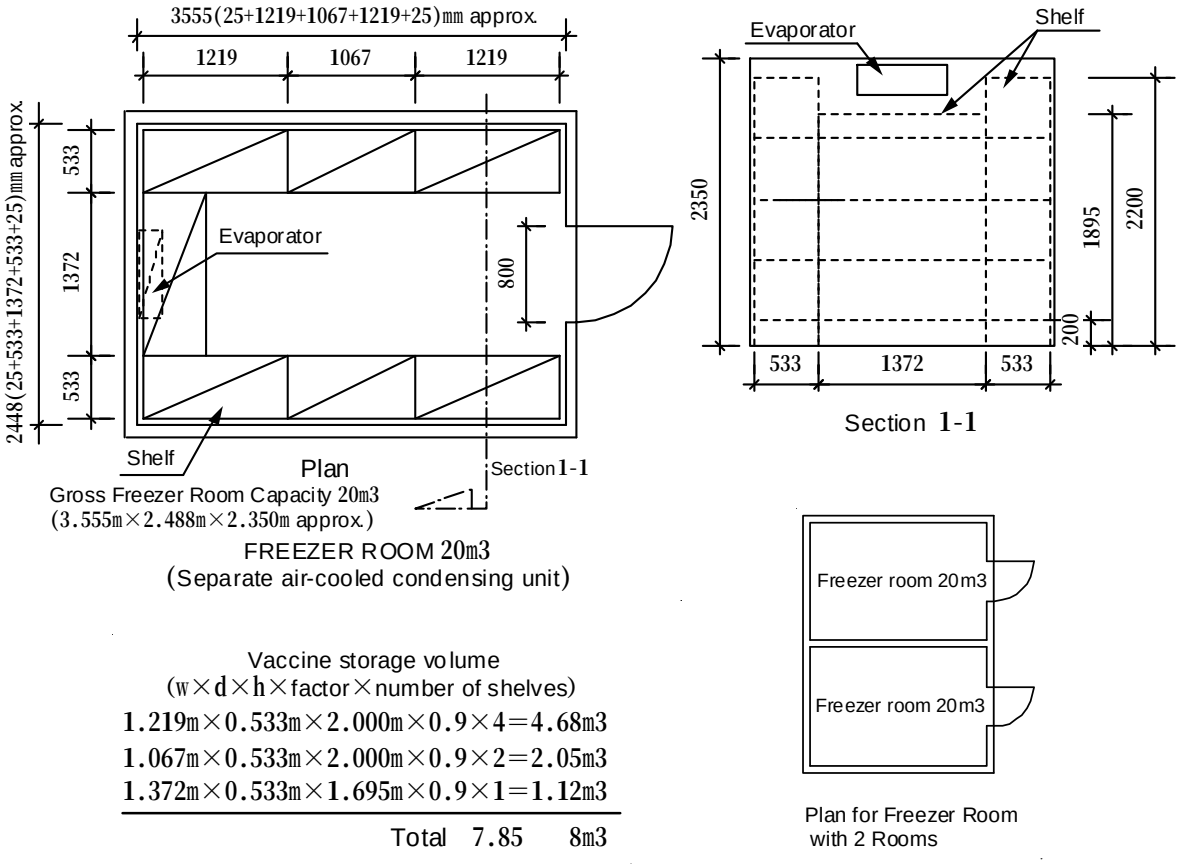
b) Storage capacity of freezer rooms (at -15˚C to -25˚C) and required quantity

Similar to calculation of the vaccine storage volume mentioned in paragraph a) above, figures predominantly used in Kenya will be applied to the number of doses per child, number of doses per vial and WMF in order to calculate the OPV storage volume. The packed volume per dose (cm^3) will be taken from the figures in WHO/IVB/08.01-Annex 5. In the calculation of vaccine storage volume at the Nairobi National Vaccine Depot, polio vaccine stock/supply period is assumed six months.

Based on these data and expected number of livebirth in 2020, the storage volume of polio vaccines at Nairobi Depot is estimated to be 10.5m^3 as shown below.

Vaccines	Number of livebirth	No. of doses/ child	Doses/ vial	Annual doses needed + buffer	6-month stock needed	Packed vol./dose (cm^3)	Total storage vol. (cm^3)	Total storage vol. (m^3)
A	B	C	D	E	F=E/2	G	H=FxG	$I=H/10^6$
OPV	2,101,174	4	20	10,495,364	5,247,682	2.0	10,495,364	10.5

The vaccine storage volume of a WHO/UNICEF-recommended freezer room with the gross capacity of $20m^3$ is approximately $8m^3$. Then, the total volume of polio vaccine $10.5m^3 / 8 = 1.31$ freezer rooms will be necessary. Since the freezer rooms are also used for storing freezing icepacks and measles vaccines at the time of measles vaccination through supplemental immunization activities (SIAs), the appropriate number of freezer rooms will be two units. Based on the facility plan, one freezer room with 2-rooms as shown below will be included in the equipment plan.



c) Cold room / freezer room temperature monitoring system

As the Nairobi National Vaccine Depot stores large amount of expensive vaccines to be used all over the country, WHO/UNICEF has recommended that DVI should establish a central temperature monitoring system of each cold room and freezer room in which eight EPI vaccines are to be stored. Following this recommendation, a set of cold room/freezer room temperature monitoring system will be planned in this project for the Nairobi National Vaccine Depot to monitor the eight cold rooms and two freezer rooms

at the medical engineer's room in the Workshop.

d) Freezer

In the existing facilities of the Nairobi National Vaccine Depot, vaccines are stored in different buildings. For example, vaccines and freezing icepacks for 28 district depots in Nairobi Province are stored in 25 freezers in a different building from the one where cold rooms and freezer rooms are installed. The request was nine new freezers to replace these old and decrepit freezers. When this project is implemented, however, the facilities will be renewed and the storage capacity of cold rooms and freezer rooms will increase, which will reduce the necessity for the freezers. Accordingly, provision of new freezers is not considered in this project. Some of the existing freezers to be operable are to be moved in the new facility for storing freezing icepacks.

e) Forklift

A forklift is indispensable for transporting vaccines coming from the airport by trucks into the warehouse and to lift relevant materials to and from the shelves.

f) Manual pallet lifter

Two manual pallet lifters will be necessary; one for carrying cold boxes containing vaccines and the other for carrying freezers in the workshop for repairs.

g) Refrigeration equipment maintenance kit

Damaged existing "refrigerant gas charging station" and "oxy-acetylene gas soldering set" need to be replaced. Also a "nitrogen gas cylinder set" is necessary. Accordingly one unit/set of these items will be included in the equipment plan.

The items and quantities of necessary equipment, existing equipment and that to be considered in the equipment plan for the Nairobi National Vaccine Depot are summarized in the following table.

No.	Name of Equipment	Quantity			Remarks
		Necessary quantity (Total)	Existing*	Equipment Plan	
1	Cold room with 3-rooms, $40m^3$ each	1	0	1	
2	Cold room with 2-rooms, $40m^3$ each	2	0	2	
3	Cold room, 1-room, $30m^3$ A	1	0	1	
4	Freezer room with 2-rooms, $20m^3$ each	1	0	1	
5	Cold room/freezer room temperature monitoring system	1	0	1	
6	Freezer	7	7	0	Existing freezers to be transferred to the new facility: Electrolux TC883 - 4 units Vestfrost MF314 -3 units

7	Forklift	1	0	1	
8	Manual pallet lifter	2	0	2	
9	Refrigerant gas charging station	1	0	1	
10	Oxy-acetylene gas soldering set	1	0	1	
11	Nitrogen gas cylinder set	1	0	1	

*Quantity of existing equipment that can be used continuously without replacement.

② Nyeri Regional Vaccine Depot

No.	Name of Requested Equipment	Priority	Requested Q'ty	No.	Name of Requested Equipment	Priority	Requested Q'ty
1	Freezer	A	3	3	Refrigeration equipment maintenance kit	B	1
2	Manual pallet lifter	B	1				

The same figures and factors for the number of doses per child, number doses per vial and WMF to calculate the vaccine storage volume taken for the Nairobi National Vaccine Depot will be applied (hereinafter applied to all the regional vaccine depots). Vaccines are assumed to be delivered four times a year from the Nairobi National Vaccine Depot to each regional vaccine depot, according to the 'Vaccine Management Guidelines'. Based on these conditions, the storage volume of polio vaccines in 2020 is estimated 333 liters (L) as shown below.

Vaccines	Number of livebirth	No. of doses/ child	Doses/ vial	Annual doses needed + buffer	3-month stock needed	Packed vol./dose (cm^3)	Total storage vol. (cm^3)	Total storage vol. (l)
A	B	C	D	E	F=E/4	G	H=FxG	$I=H/10^3$
OPV	133,257	4	20	665,619	166,405	2.0	332,809	333

At each regional vaccine depot, almost equal volume of vaccines and freezing icepacks are stored in the freezers. Then, the storage volume at Nyeri Depot is calculated to be 333L x 2 = 666L. Since the storage volume of requested freezer is 264L, the number of freezers necessary for Nyeri Regional Vaccine Depot is 666L / 264L = 2.5 units; that is, three freezers will be necessary. There is one freezer that can be used continuously without replacement. Therefore, two freezers will be considered in the equipment plan.

In the areas where the project regional vaccine depots are located, voltage fluctuation range is significant at the time of recovery after power failure. To protect the freezers against sharp voltage fluctuation, each freezer will be equipped with an automatic voltage regulator (AVR).

Each regional vaccine depot will be equipped with a manual pallet lifter and a set of refrigeration equipment maintenance to make the vaccine storage more efficient and maintenance of cold chain equipment easier.

The items and quantities of necessary equipment, existing equipment and that to be

considered in the equipment plan for the Nyeri Regional Vaccine Depot are summarized in the following table.

No.	Name of Equipment	Quantity			Remarks
		Necessary quantity (Total)	Existing*	Equipment Plan	
1	Cold room	1	1	0	Supplied by MOPHS in 2008.
2	Freezer	3	1	2	Existing freezer: Vestfrost MF314 - 1 unit
3	Manual pallet lifter	1	0	1	
4	Refrigerant gas charging station	1	0	1	
5	Oxy-acetylene gas soldering set	1	0	1	
6	Nitrogen gas cylinder set	1	0	1	
7	Automatic Voltage Regulator	3	0	2	For the existing freezers MOPHS should supply by its own efforts.

*Quantity of existing equipment that can be used continuously without replacement.

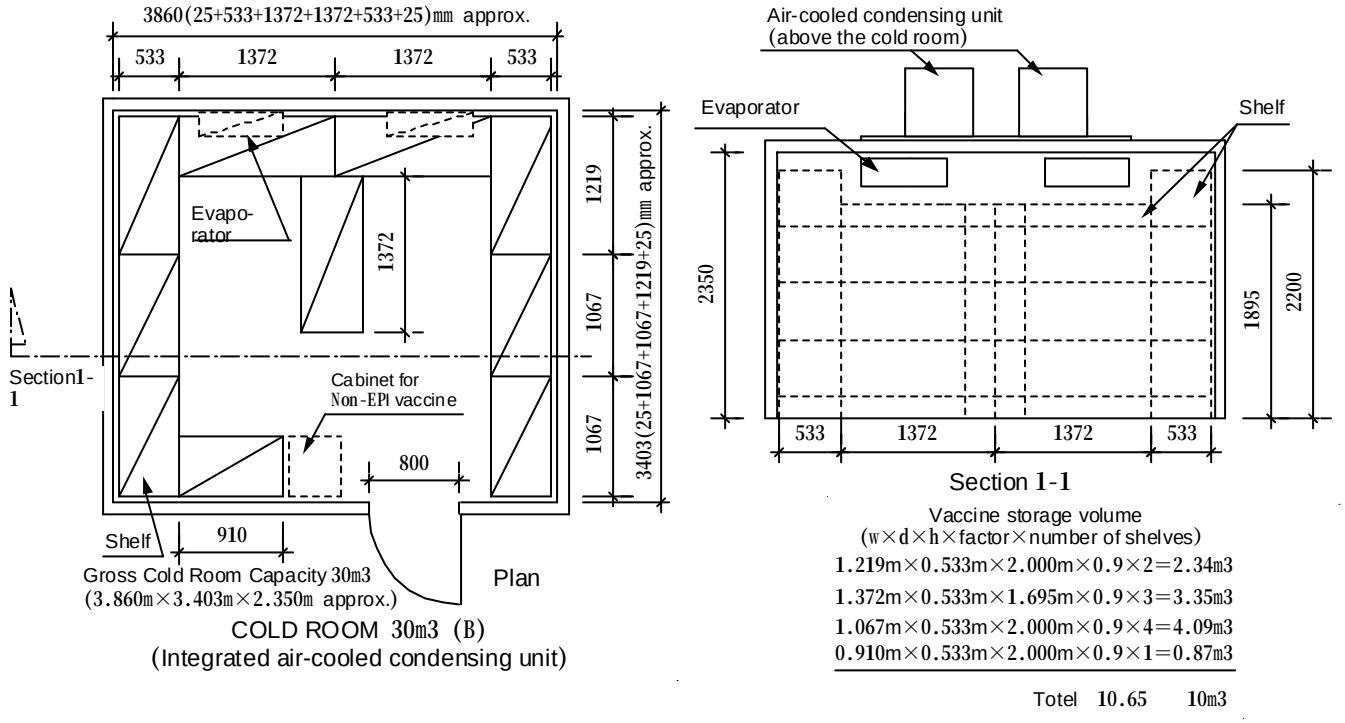
③ Nakuru Regional Vaccine Depot

No.	Name of Requested Equipment	Priority	Requested Q'ty	No.	Name of Requested Equipment	Priority	Requested Q'ty
1	Cold room	A	1	3	Manual pallet lifter	B	1
2	Freezer	A	5	4	Refrigeration equipment maintenance kit	B	1

According to the following table of vaccine storage volume, one cold room will be necessary for storing 9.4m^3 of vaccines.

Type of Vaccines	Number of livebirth, preg. women	No. of doses/ child, preg. women	Doses/ vial	Annual doses needed + buffer	3-month stock needed	Packed vol./dose (cm3)	Total storage vol. (cm3)	Total storage vol. (m3)
A	B	C	D	E	F=E/4	G	H=FxG	I=H/10^6
Measles	232,760	1	10	523,710	130,928	3.5	458,246	0.5
BCG	232,760	1	20	2,618,550	654,638	1.2	785,565	0.8
TT	232,760	2	20	696,534	174,134	3.0	522,401	0.5
Yellow Fever	16,362	1	10	36,815	9,204	2.5	23,009	0.0
DPT+HpB+ Hib	232,760	3	2	824,843	206,211	11.0	2,268,319	2.3
PCV	232,760	3	2	871,977	217,994	12.9	2,812,126	2.8
Rotavirus Vaccine	232,760	2	1	581,318	145,330	17.1	2,485,135	2.5
EPI Vaccine Total Volume (m^3)								9.4

One cold room of about 10m^3 storage capacity (30m^3 gross capacity) shown below will be considered in the equipment plan to satisfy the above vaccine storage volume.



This cold room will be also equipped with one cabinet for Non-EPI vaccines.

The storage volume of polio vaccines in 2020 is estimated 581L as shown in the following table, which means in total 581L x 2 = 1,162L will be required including the storage of freezing icepacks. 1,162L / 264L (freezer capacity) = 4.4, that is, five freezers will be considered in the equipment plan.

Vaccines	Number of livebirth	No. of doses/ child	Doses/ vial	Annual doses needed + buffer	3-month stock needed	Packed vol./dose (cm3)	Total storage vol. (cm3)	Total storage vol. l)
A	B	C	D	E	F=E/4	G	H=FxG	$I=H/10^3$
OPV	232,760	4	20	1,162,636	290,659	2.0	581,318	581

The items and quantities of necessary equipment, existing equipment and that to be considered in the equipment plan for the Nakuru Regional Vaccine Depot are summarized in the following table.

No.	Name of Equipment	Quantity			Remarks
		Necessary quantity (Total)	Existing*	Equipment Plan	
1	Cold room	1	0	1	
2	Freezer	5	0	5	
3	Manual pallet lifter	1	0	1	
4	Refrigerant gas charging station	1	0	1	
5	Oxy-acetylene gas soldering set	1	0	1	
6	Nitrogen gas cylinder set	1	0	1	
7	Cabinet for Non-EPI vaccine	1	0	1	
8	Automatic Voltage Regulator	5	0	5	

*Quantity of existing equipment that can be used continuously without replacement.

④ Eldoret Regional Vaccine Depot

No.	Name of Requested Equipment	Priority	Requested Q'ty	No.	Name of Requested Equipment	Priority	Requested Q'ty
1	Cold room	A	1	3	Manual pallet lifter	B	1
2	Freezer	A	6	4	Refrigeration equipment maintenance kit	B	1

The Eldoret Regional Vaccine Depot requires vaccine storage of 11.2 m^3 as shown in the following table. One cold room with 10m^3 storage capacity, the same type as that to be provided for the Nakuru Regional Vaccine Depot will be included in the equipment plan. The remaining volume 1.2m^3 is to be stored in the existing cold room.

Type of Vaccines	Number of livebirth, preg. women	No. of doses/ child, preg. women	Doses/ vial	Annual doses needed + buffer	3-month stock needed	Packed vol./dose (cm^3)	Total storage vol. (cm^3)	Total storage vol. (m^3)
A	B	C	D	E	F=E/4	G	H=FxG	I=H/10^6
Measles	277,892	1	10	625,257	156,314	3.5	547,100	0.5
BCG	277,892	1	20	3,126,285	781,571	1.2	937,886	0.9
TT	277,892	2	20	831,592	207,898	3.0	623,694	0.6
Yellow Fever	38,793	1	10	87,284	21,821	2.5	54,553	0.1
DPT+HpB +Hib	277,892	3	2	984,780	246,195	11.0	2,708,144	2.7
PCV	277,892	3	2	1,041,053	260,263	12.9	3,357,396	3.4
Rotavirus Vaccine	277,892	2	1	694,035	173,509	17.1	2,967,001	3.0
EPI Vaccine Total Volume (m^3)								11.2

The storage volume of polio vaccines in 2020 is estimated 694L as shown in the following table, which means in total 694L x 2 = 1,388L will be required including the storage of freezing icepacks. 1,388L / 264L (storage capacity of requested freezer) = 5.6 units, that is, six freezers will be included in the equipment plan.

Vaccines	Number of livebirth	No. of doses/ child	Doses/ vial	Annual doses needed + buffer	3-month stock needed	Packed vol./dose (cm3)	Total storage vol. (cm3)	Total storage vol. (l)
A	B	C	D	E	F=E/4	G	H=FxG	$I=H/10^3$
OPV	277,892	4	20	1,388,071	347,018	2.0	694,035	694

The items and quantities of necessary equipment, existing equipment and that to be considered in the equipment plan for the Eldoret Regional Vaccine Depot are summarized in the following table.

No.	Name of Equipment	Quantity			Remarks
		Necessary quantity (Total)	Existing*	Equipment Plan	
1	Cold room	1	0	1	
2	Freezer	6	0	6	
3	Manual pallet lifter	1	0	1	
4	Refrigerant gas charging station	1	0	1	
5	Oxy-acetylene gas soldering set	1	0	1	
6	Nitrogen gas cylinder set	1	0	1	
7	Cabinet for Non-EPI vaccine	1	0	1	
8	Automatic Voltage Regulator	6	0	6	

*Quantity of existing equipment that can be used continuously without replacement.

⑤ Kisumu Regional Vaccine Depot

No.	Name of Requested Equipment	Priority	Requested Q'ty	No.	Name of Requested Equipment	Priority	Requested Q'ty
1	Freezer	A	7	3	Refrigeration equipment maintenance kit	B	1
2	Manual pallet lifter	B	1				

The storage volume of polio vaccines in 2020 is estimated 839L as shown below, and the total storage volume including freezing icepacks at the Kisumu Regional Vaccine Depot will be 839L x 2 = 1,678L. There are three freezers with the storage capacity of 126L and one with 264L that can be used continuously without replacement. The shortage of storage volume is calculated as follows:

1,678L - [(126L x 3) + (264L x 1)] = 1,678L – 642L = 1,036L

1,036L / 264L (storage capacity of requested freezer) = 3.92 units

Accordingly, four freezers will be included in the equipment plan.

Vaccines	Number of livebirth	No. of doses/ child	Doses/ vial	Annual doses needed + buffer	3-month stock needed	Packed vol./dose (cm^3)	Total storage vol. (cm^3)	Total storage vol. (l)
A	B	C	D	E	F=E/4	G	H=FxG	$I=H/10^3$
OPV	336,053	4	20	1,678,585	419,646	2.0	839,292	839

The items and quantities of necessary equipment, existing equipment and that to be considered in the equipment plan for the Kisumu Regional Vaccine Depot are summarized in the following table.

No.	Name of Equipment	Quantity			Remarks
		Necessary quantity (Total)	Existing*	Equipment Plan	
1	Cold room	1	1	0	Supplied by MOPHS in 2008.
2	Freezer	8	4	4	Existing freezers: Dometic TCW3000 - 3 units Vestfrost MF314 - 1 unit
3	Manual pallet lifter	1	0	1	
4	Refrigerant gas charging station	1	0	1	
5	Oxy-acetylene gas soldering set	1	0	1	
6	Nitrogen gas cylinder set	1	0	1	
7	Automatic Voltage Regulator	8	0	4	For the existing freezers MOPHS should supply by its own efforts.

*Quantity of existing equipment that can be used continuously without replacement.

⑥ Mombasa Regional Vaccine Depot

No.	Name of Requested Equipment	Priority	Requested Q'ty	No.	Name of Requested Equipment	Priority	Requested Q'ty
1	Cold room	A	1	3	Manual pallet lifter	B	1
2	Freezer	A	4	4	Refrigeration equipment maintenance kit	B	1

The following table shows that the Mombasa Regional Vaccine Depot will require vaccine storage of 7.3 m^3 in 2020. One cold room with the storage capacity of 10m^3, the same type as that to be provided for the Nakuru Regional Vaccine Depot will be included in the equipment plan.

Vaccines	Number of livebirth, preg. women	No. of doses/ child, preg. women	Doses/ vial	Annual doses needed + buffer	3-month stock needed	Packed vol./dose (cm^3)	Total storage vol. (cm^3)	Total storage vol. (m^3)
A	B	C	D	E	F=E/4	G	H=FxG	I=H/10^6
Measles	182,225	1	10	410,006	102,502	3.5	358,755	0.4
BCG	182,225	1	20	2,050,031	512,508	1.2	615,009	0.6
TT	182,225	2	20	545,308	136,327	3.0	408,981	0.4
DPT+HpB +Hib	182,225	3	2	645,760	161,440	11.0	1,775,840	1.8
PCV	182,225	3	2	682,660	170,665	12.9	2,201,580	2.2
Rotavirus Vaccine	182,225	2	1	455,107	113,777	17.1	1,945,582	1.9
EPI Vaccine Total Volume (m^3)								7.3

The storage volume of polio vaccines in 2020 is estimated 455L as shown below, and the total storage volume including freezing icepacks will be 455L x 2 = 910L. 910L / 264 L (storage capacity of requested freezer) = 3.44 units, which means four freezers will be necessary. There are two freezers with the storage capacity of 264L that can be used continuously without replacement. Accordingly, two freezers will be considered in the equipment plan.

Vaccines	Number of livebirth	No. of doses/ child	Doses/ vial	Annual doses needed + buffer	3-month stock needed	Packed vol./dose (cm3)	Total storage vol. (cm3)	Total storage vol. (l)
A	B	C	D	E	F=E/4	G	H=FxG	$I=H/10^3$
OPV	182,225	4	20	910,214	227,553	2.0	455,107	455

The items and quantities of necessary equipment, existing equipment and that to be considered in the equipment plan for the Mombasa Regional Vaccine Depot are summarized in the following table.

No.	Name of Equipment	Quantity			Remarks
		Necessary quantity (Total)	Existing*	Equipment Plan	
1	Cold room	1	0	1	
2	Freezer	4	2	2	Existing freezers: Vestfrost MF314 - 2units
3	Manual pallet lifter	1	0	1	
4	Refrigerant gas charging station	1	0	1	
5	Oxy-acetylene gas soldering set	1	0	1	
6	Nitrogen gas cylinder set	1	0	1	
7	Cabinet for Non-EPI vaccine	1	0	1	
8	Automatic Voltage Regulator	4	0	2	For the existing freezers MOPHS should supply by its own efforts.

*Quantity of existing equipment that can be used continuously without replacement.

⑦ Meru Regional Vaccine Depot

No.	Name of Requested Equipment	Priority	Requested Q'ty	No.	Name of Requested Equipment	Priority	Requested Q'ty
1	Freezer	A	3	3	Refrigeration equipment maintenance kit	B	1
2	Manual pallet lifter	A	1				

The storage volume of polio vaccines in 2020 is estimated 336L as shown below, and the total storage volume including freezing icepacks will be 336L x 2 = 672L. 672L / 264L (storage capacity of requested freezer) = 2.55 units, which means three freezers will be necessary. There is one 264L freezer that can be continuously used without replacement.

Accordingly, two freezers will be considered in the equipment plan.

Vaccines	Number of livebirth	No. of doses/ child	Doses/ vial	Annual doses needed + buffer	3-month stock needed	Packed vol./dose (cm^3)	Total storage vol. (cm^3)	Total storage vol. (l)
A	B	C	D	E	F=E/4	G	H=FxG	$I=H/10^3$
OPV	134,722	4	20	672,936	168,234	2.0	336,468	336

The items and quantities of necessary equipment, existing equipment and that to be considered in the equipment plan for the Meru Regional Vaccine Depot are summarized in the following table.

No.	Name of Equipment	Quantity			Remarks
		Necessary quantity (Total)	Existing*	Equipment Plan	
1	Cold room	1	1	0	Supplied by MOPHS in 2010.
2	Freezer	3	1	2	Existing freezers to be transferred to the new facility: Vestfrost MF314 – 1 unit
3	Manual pallet lifter	1	0	1	
4	Refrigerant gas charging station	1	0	1	
5	Oxy-acetylene gas soldering set	1	0	1	
6	Nitrogen gas cylinder set	1	0	1	
7	Automatic Voltage Regulator	3	0	2	For the existing freezers MOPHS should supply by its own efforts.

*Quantity of existing equipment that can be used continuously without replacement.

⑧ Kakamega Regional Vaccine Depot

No.	Name of Requested Equipment	Priority	Requested Q'ty	No.	Name of Requested Equipment	Priority	Requested Q'ty
1	Manual pallet lifter	A	1	2	Refrigeration equipment maintenance kit	B	1

The storage volume of polio vaccines in 2020 is estimated 719L as shown below, and the total storage volume including freezing icepacks at Kakamega Depot will be 719L x 2 = 1,438L. There are two freezers with the storage capacity of 126L and four with 264L that can be used continuously without replacement. The storage volume to be provided in this project is calculated as follows:

1,438L - [(126L x 2) + (264L x 4)] = 1,438L – 1,308L = 130L

With the assumption that this exceeding storage volume can be managed with the six freezers, provision of freezer will not be considered in the equipment plan.

Vaccines	Number of livebirth	No. of doses/ child	Doses/ vial	Annual doses needed + buffer	3-month stock needed	Packed vol./dose (cm^3)	Total storage vol. (cm^3)	Total storage vol. (l)
A	B	C	D	E	F=E/4	G	H=FxG	$I=H/10^3$
OPV	287,912	4	20	1,438,120	359,530	2.0	719,060	719

The items and quantities of necessary equipment, existing equipment and that to be considered in the equipment plan for the Kakamega Regional Vaccine Depot are summarized in the following table.

No.	Name of Equipment	Quantity			Remarks
		Necessary quantity (Total)	Existing*	Equipment Plan	
1	Cold room	1	1	0	Supplied by MOPHS in 2008.
2	Freezer	6	6	0	Existing freezers to be transferred to the new facility: Dometic TCW3000 - 2 units Vestfrost MF314 - 4 units
3	Manual pallet lifter	1	0	1	
4	Refrigerant gas charging station	1	0	1	
5	Oxy-acetylene gas soldering set	1	0	1	
6	Nitrogen gas cylinder set	1	0	1	
7	Automatic Voltage Regulator	6	0	0	MOPHS should supply by its own efforts.

*Quantity of existing equipment that can be used continuously without replacement.

⑨ Garissa Regional Vaccine Depot

No.	Name of Requested Equipment	Priority	Requested Q'ty	No.	Name of Requested Equipment	Priority	Requested Q'ty
1	Freezer	B	1	3	Refrigeration equipment maintenance kit	B	1
2	Manual pallet lifter	A	1				

The storage volume of polio vaccines in 2020 is estimated 293L as shown below, and the total storage volume including freezing icepacks will be 293L x 2 = 586L. 586L / 264L (storage capacity of requested freezer) = 2.22 units, which means three freezers will be necessary. There is one freezer with the storage capacity of 264L that can be used continuously without replacement. Accordingly, two freezers will be considered in the equipment plan.

Vaccines	Number of livebirth	No. of doses/ child	Doses/ vial	Annual doses needed + buffer	3-month stock needed	Packed vol./dose (cm^3)	Total storage vol. (cm^3)	Total storage vol. (l)
A	B	C	D	E	F=E/4	G	H=FxG	$I=H/10^3$
OPV	117,180	4	20	585,314	146,329	2.0	292,657	293

The items and quantities of necessary equipment, existing equipment and that to be considered in the equipment plan for the Garissa Regional Vaccine Depot are summarized in the following table.

No.	Name of Equipment	Quantity			Remarks
		Necessary quantity (Total)	Existing*	Equipment Plan	
1	Cold room	1	1	0	Supplied by MOPHS in 2010.
2	Freezer	3	1	2	Existing freezers to be transferred to the new facility: Vestfrost MF314: 1 unit
3	Manual pallet lifter	1	0	1	
4	Refrigerant gas charging station	1	0	1	
5	Oxy-acetylene gas soldering set	1	0	1	
6	Nitrogen gas cylinder set	1	0	1	
7	Automatic Voltage Regulator	3	0	2	For the existing freezer MOPHS should supply by its own efforts.

*Quantity of existing equipment that can be used continuously without replacement.

4) Equipment List

The list of equipment to be procured under this project is shown below together with the specifications and purpose of major equipment.

Table-7 Equipment List

No.	Name of Equipment	Project Sites									Total Quantity
		Nairobi National Vaccine Depot	Nyeri Regional Vaccine Depot	Nakuru Regional Vaccine Depot	Eldoret Regional Vaccine Depot	Kisumu Regional Vaccine Depot	Mombasa Regional Vaccine Depot	Meru Regional Vaccine Depot	Kakamega Regional Vaccine Depot	Garissa Regional Vaccine Depot	
1	Cold room with 3-rooms, $40m^3$ each	1									1
2	Cold room with 2-rooms, $40m^3$ each	2									2
3	Cold room, 1-room, $30m^3$ A	1									1
4	Cold room, 1-room, $30m^3$ B			1	1		1				3
5	Freezer room with 2-rooms, $20m^3$ each	1									1
6	Cold room/freezer room temperature monitoring system	1									1
7	Freezer		2	5	6	4	2	2		2	23
8	Forklift	1									1
9	Manual pallet lifter	2	1	1	1	1	1	1	1	1	10
10	Refrigerant gas charging station	1	1	1	1	1	1	1	1	1	9
11	Oxy-acetylene gas soldering set	1	1	1	1	1	1	1	1	1	9
12	Nitrogen gas cylinder set	1	1	1	1	1	1	1	1	1	9
13	Cabinet for Non-EPI vaccine			1	1		1				3
14	Automatic Voltage Regulator		2	5	6	4	2	2		2	23

Table-8 Specifications of Major Equipment

No.	Name of Equipment	Qt'y	Specification	Purpose of Use
1	Cold room with 3-rooms, 40m^3 each	1	Type: 3-room per unit Gross capacity of one room: 40m^3 approx. Vaccine storage volume of one room: 15m^3 approx. Room temperature: ＋2˚C to ＋8˚C Condensing unit: separate condensing unit installed externally	For storing 7 types of EPI vaccines: measles, BCG, TT, yellow fever, DPT+HpB+Hib, PCV and rotavirus
2	Cold room with 2-rooms, 40m^3 each	2	Type: 2-rooms per unit Gross capacity of one room: 40m^3 approx. Vaccine storage volume of one room: 15m^3 approx. Room temperature: ＋2˚C to ＋8˚C Condensing unit: separate condensing unit installed externally	Ditto
3	Cold room, 1-room, 30m^3 A	1	Type: 1-room per unit Gross capacity: 30m^3 approx. Vaccine storage volume: 10m^3 approx. Room temperature: ＋2˚C to ＋8˚C Condensing unit: separate condensing unit installed externally	For storing 5 types of non-EPI vaccines: typhoid vaccine in single doses, yellow fever, anti-rabies, anti-snake venom and hepatitis B
4	Cold room, 1-room, 30m^3 B	3	Type: 1-room per unit Gross capacity: 30m^3 approx. Vaccine volume storage: 10m^3 approx. Room temperature: ＋2˚C to ＋8˚C Condensing unit: roof-mounted or wall-mounted	For storing the 7 types of EPI vaccines and Non-EPI vaccines mentioned above.
5	Freezer room with 2-rooms, 20m^3 each	1	Type: 2-room per unit Gross capacity of one room: 20m^3 approx. Vaccine storage volume of one room: 8m^3 approx. Room temperature: -15˚C to -25˚C Condensing unit: separate condensing unit installed externally	For storing polio vaccine, etc.
6	Cold room / freezer room temperature monitoring system	1	Major components: temperature sensor, door open/close sensor, logger unit, etc. Monitoring parameters: temperature ＋2˚C to ＋8˚C/ -15˚C to -25˚C and door open/close For: 8 cold rooms and two freezer rooms Monitoring system: remote; by cable	For monitoring temperatures and door open/close of the 8 cold rooms and 2 freezer rooms.
7	Freezer	23	Type: horizontal Vaccine storage volume: not less than 260 liters Inner temperature: -15˚C to -25˚C approx.	For storing polio vaccine and freezing icepacks.
8	Forklift	1	Type: battery-drive Load capacity: not less than 1,500kg Turning radius: not bigger than 1,750mm Lifting height: not less than 5,000mm	For bringing vaccines from trucks into the facility and lifting and lifting vaccine related materials down from the shelves