CIVIL AVIATION AUTHORITY OF NEPAL

THE KINGDOM OF NEPAL

BASIC DESIGN STUDY REPORT

ON

THE PROJECT

FOR IMPROVEMENT OF EXISTING AIR TRAFFIC SERVICES EQUIPMENT SYSTEM UNDER THE TRIBHUVAN INTERNATIONAL AIRPORT MODERNIZATION PROJECT

IN

THE KINGDOM OF NEPAL

JULY 1999

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD., TOKYO, JAPAN

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PREFACE

In response to a request from the Government of the Kingdom of Nepal, the Government of Japan decided to conduct a basic design study on the Project for Improvement of Existing Air Traffic Services Equipment System under the Tribhuvan International Airport Modernization Project and entrusted the study to the Japan International Cooperation Agency (JICA).

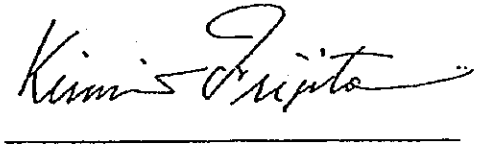
JICA sent to Nepal a study team from January 31 to February 20, 1999.

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

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

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

July 1999



Kimio Fujita

President

Japan International Cooperation Agency

July, 1999

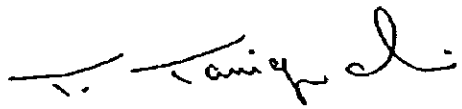
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Improvement of Existing Air Traffic Services Equipment System under the Tribhuvan International Airport Modernization Project in the Kingdom of Nepal.

This study was conducted by Nippon Koei Co., Ltd., under a contract to JICA, during the period from January 26, 1999 to July 30, 1999. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Nepal and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

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

Very truly yours,

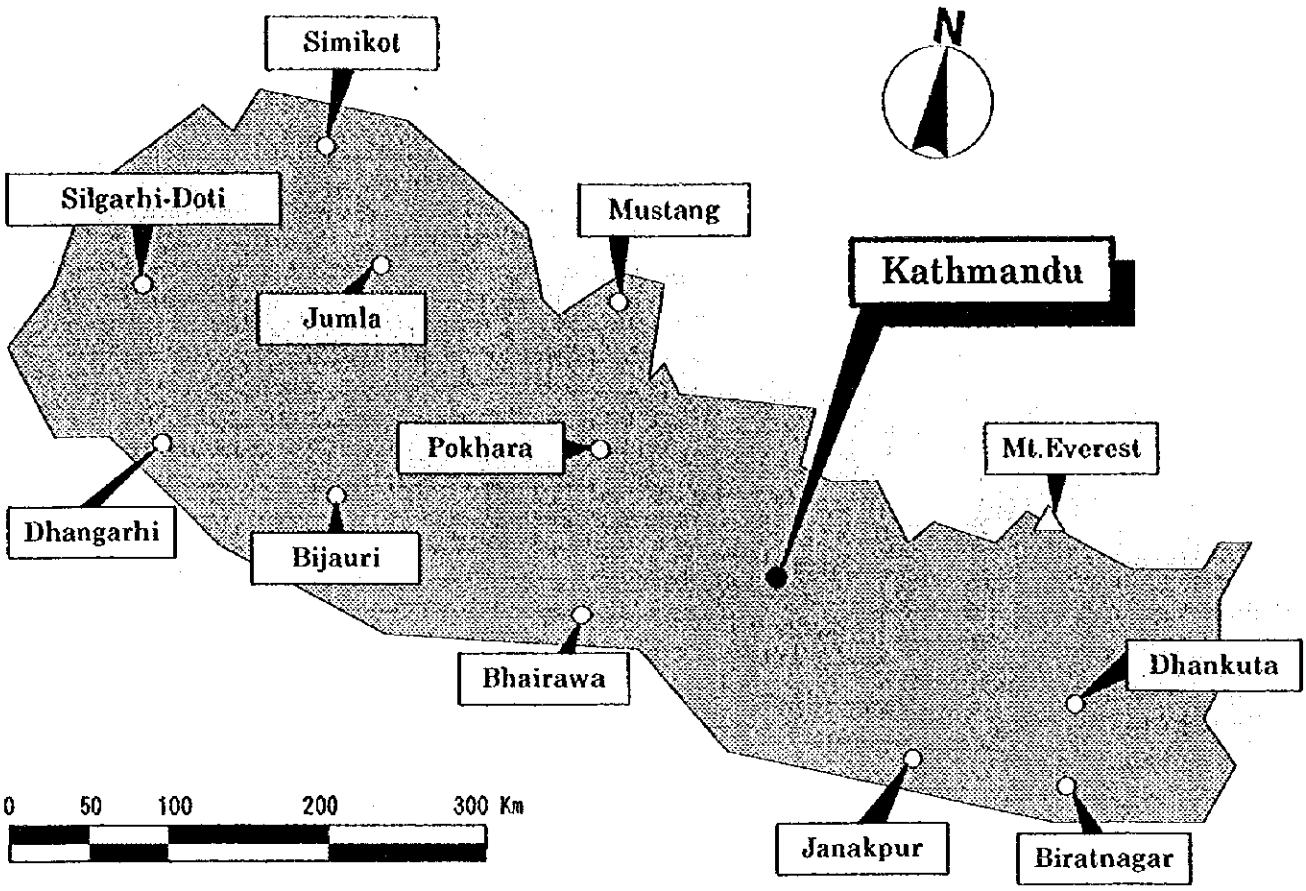


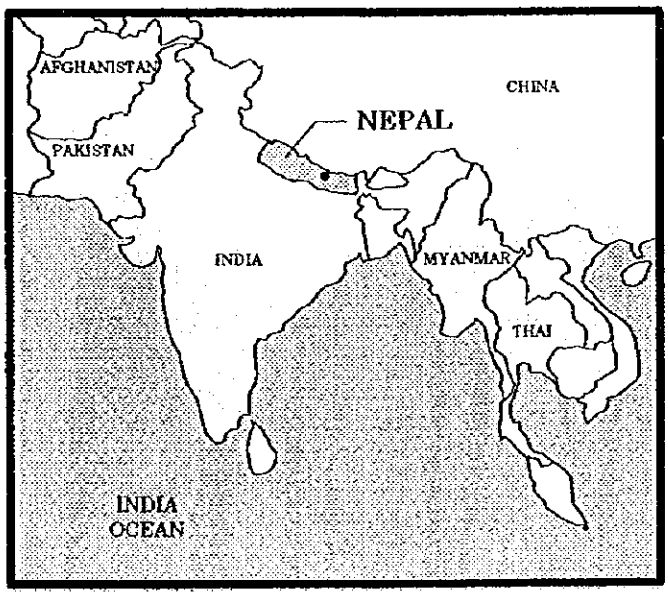
Tomotaka Taniguchi

Project manager,

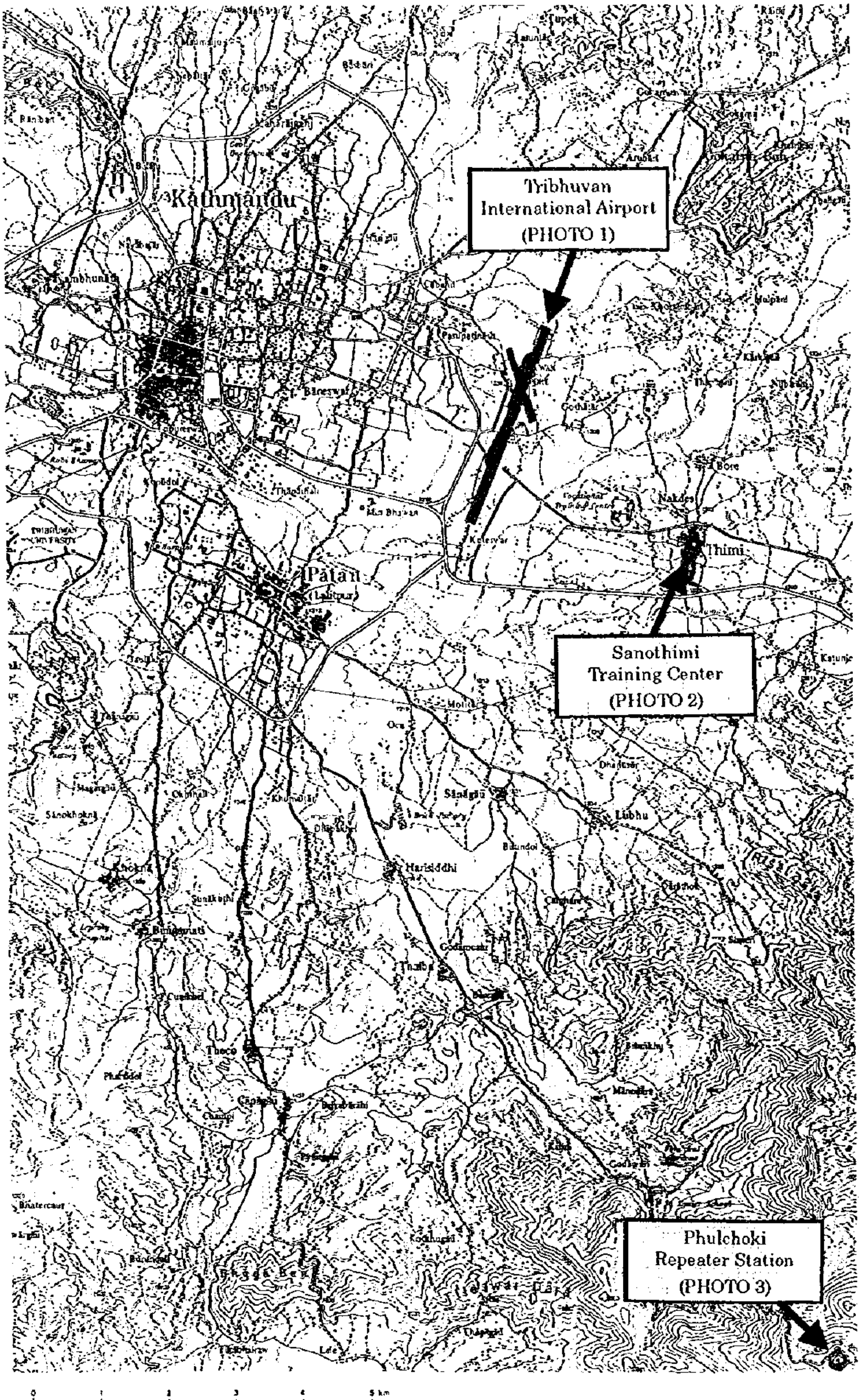
Basic design study team on
the Project for Improvement of
Existing Air Traffic Services
Equipment System under the
Tribhuvan International Airport
Modernization Project

Nippon Koei Co., Ltd.





LOCATION MAP


Tribhuvan
International Airport
(PHOTO 1)
Sanothimi
Training Center
(PHOTO 2)
Phulchoki
Repeater Station
(PHOTO 3)
Kathmandu
Patan
Thimi
Lubhu
Harisiddhi
5 km
3 miles

SITE MAP

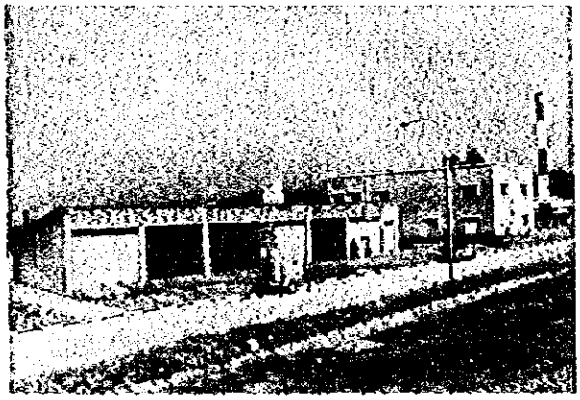


PHOTO 1 EXISTING POWER HOUSE (LEFT) AND RADAR OPERATION BUILDING (RIGHT) AT TRIBHUVAN INTERNATIONAL AIRPORT

PHOTO 2 SANOTHIMI TRAINING CENTER

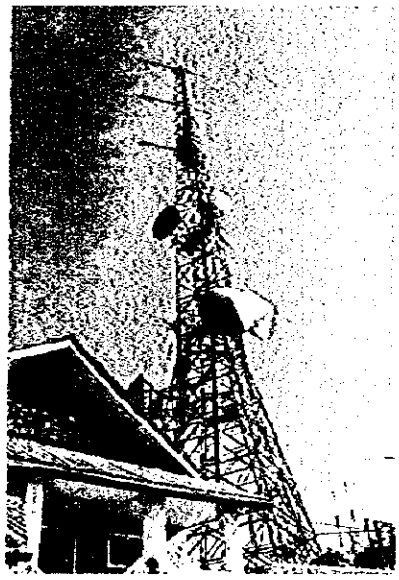


PHOTO 3 PHULCHOKI REPEATER STATION

SITE CONDITION

ABBREVIATIONS

ADB	:	Asian Development Bank
AMSS	:	Automatic Message Switching System
ATC	:	Air Traffic Control
ATIS	:	Automatic Terminal Information Service
AVR	:	Automatic Voltage Regulator
BS	:	British Standards
CAAN	:	Civil Aviation Authority of Nepal
CCU	:	Communication Control Unit
DAC	:	Development Assistance Committee
DCA	:	Department of Civil Aviation
DME	:	Distance Measuring Equipment
EIAJ	:	Electronic Industries Association of Japan
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
ICAO	:	International Civil Aviation Organization
IEC	:	International Electrotechnical Commission
IEEE	:	Institute of Electrical and Electronics Engineers
ISO	:	International Organization for Standardization
ITU	:	International Telecommunication Union
JCS	:	Japanese Cable Standards
JEC	:	Japanese Electrotechnical Committee
JEM	:	Japan Electrical Manufacturers' Association
JIS	:	Japan Industrial Standards
LLDC	:	Least among Less-developed Countries
NBCO	:	National Building Code
NEA	:	Nepal Electricity Authority
ODA	:	Official Development Assistance
RNA	:	Royal Nepal Airlines
TIA	:	Tribhuvan International Airport
UHF	:	Ultra High Frequency
UPS	:	Uninterrupted Power Supply
VAT	:	Value-Added Tax
VFR	:	Visual Flight Rules
VHF	:	Very High Frequency
VOR	:	VHF Omnidirectional Radio Range
WMO	:	World Meteorological Organization

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CHAPTER 1

BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

Tribhuvan International Airport which is an international airport in Nepal locates under the critical circumstances being surrounded by mountains. This pauses aircraft to hard navigational operations in case of landing and taking off at the airport. In fact in 1992, the crash of international aircraft at the mountain in the vicinities at the airport were happened. In order to improve these situations, a master plan study was carried out by Japanese government and an urgent improvement plan was formulated. In this urgent improvement plan, priority plan was implemented as urgent project, and resulted to install radar system facilities including radar training center under the Japanese grant aid project.

However, smooth operation of air traffic control system has been hindered from deterioration on existing equipment especially of the frequent break down of UHF link between Tribhuvan International Airport and Phulchoki repeater station, which lead to be disable the communication between air traffic controller and the pilot. This situation had been improved after carrying out follow up project by JICA, and the air to ground communication capability could be solved. Air traffic control system in Tribhuvan International Airport however can not be said to be highly reliable.

Under these condition, Nepalese government requested Japanese government by grant aid to improve present air traffic control system in Tribhuvan International Airport. Followings are requested items by Nepal.

Table 1-1 Requested Items from Nepalese Side

1. Rehabilitation of air traffic control facility such as consoles, VHF air to ground equipment and meteorological equipment,
2. Improvement of power supply equipment for radio equipment,
3. Establishment of an alternative VHF repeater station, and so on.

Among those requests, necessary equipment were to be considered as listed above item 1 and 2 in Table 1-1, in terms of effective revelation of granted effects.

In response to above request, Japanese government decided to carry out the basic design study, and JICA dispatched the Study Team to Nepal for twenty-one days from January 31 to February 20 in 1999. The Study Team had a series of discussions with Civil Aviation Authority of Nepal, and collected necessary data for basic design together with survey for conditions of existing system. After the basic design, JICA dispatched the Team again to Nepal for thirteen days from May 27 to June 8 for the explanation of the design results.

CHAPTER 2

CONTENTS OF THE PROJECT

CHAPTER 2 CONTENTS OF THE PROJECT

2 - 1 Objectives of the Project

Radio communication navigation facilities at Tribhuvan International Airport can be categorized into three systems of communications, navigation and surveillance (air traffic control). Air traffic control system so called ATC system consists of facilities of tower control, approach control and area control according to controlled air spaces. Airport surveillance radar provided by Japan's grant aid is for approach control, which is for surveillance a part of air spaces in Kathmandu flight information region (FIR). Most radio communication navigation facilities at Tribhuvan International Airport are deteriorated and less reliable. Since particularly for communications system, some equipment are permanently out of order, the operational conditions are critical.

The objective of the Project is to form reliable ATC system by replacing deteriorated facilities of the existing tower control and area control, thus ensure complete performance of the equipment that were procured under the Japanese grant aid assistance (Phase1).

2 - 2 Basic Concept of the Project

(1) Present Issues on Tribhuvan Radar System

Present issues on Tribhuvan radar system are summarized into following five items. Table2-1 shows these issues with those causes and the measures.

(a) Interfacing for unified voice communications between radar and other console is not available.

(b) No correct meteorological data on displays on radar approach consoles such as wind direction, wind speed, runway visibility and height of the cloud ceiling.

(c) Due to variation of power loads, bad effect is occurred on the radar control system.

(d) Flight plans for radar approach control can not be sometimes deliver to radar approach control room.

(e) Deviation between present ATIS system and the air space structures in Kathmandu FIR makes burden to radar controllers.

Table2-1 Present Issues on Tribhuvan Radar System (1/2)

Present Issue	Cause	Measures by this Plan
1.Interfacing for unified voice communications between radar and other consoles is not available.	Electrical interfaces with existing data transmission circuits.	Replacement of the existing consoles for tower control and for area control. Incidental to this replacement, VHF air to ground radios are also replaced.
2.No correct meteorological data on displays on radar approach consoles such as wind direction, wind speed, runway visibility, and height of the cloud ceiling.	Although the wind direction and speed sensors were already installed near the center of runway, measured data cannot be transmitted to the consoles, due to mismatching of an electrical interface. In addition to the above, data from RVR and ceilometer to consoles cannot be correctly transmitted due to the measuring equipment themselves are permanently in out of order.	Observatory sensors for the wind direction and speed are installed at both end of the runway in order to correctly obtain the meteorological conditions. Existing RVR and ceilometer are replaced.
3. Power supply system 3-1. Power supply at TIA Since fluctuation of 400V (low voltage bus) at TIA records -9.0% to +1.0%(see Appendix 6-6-1),bad effect is occurred on the radar control system. Meanwhile, two 11kV commercial power lines are fed into the airport in order to keep reliability because NEA understands that the airport is an important power consumer.	Power voltage to the radar system is supplied from the transformer (by low voltage) that feeds to other general power consumer loads.	11kV voltage T-branch on following power loads and new provision of the emergency generator can solve the issue. ・Air traffic control equipment at radar operation building ・Architectural facilities at existing operation building. ・Air traffic control equipment at existing operation building. ・The architectural facilities at existing operation building.
3-2. Power supply at Sanothimi Training Center There is a commercial power shutdown of 256 times and 272 hours a year (see Appendix6-4) at Sanothimi Training Center. Power interruption make training interruption and damage to computer hard disc.	Overload situation on the power feeder of NEA to Sanothimi is found out.	New provision of the emergency generator and of UPS that compensate the change-over time to the generator can solve the issue.

Table2-1 Present Issues on Tribhuvan Radar System (2/2)

Present Issue	Cause	Measures by this Plan
3-3. Power supply at Phulchoki Repeater Station There is a commercial power shutdown of 311 times and 276 hours a year (see Appendix6-5) at Phulchoki repeater station. Voltage fluctuation which records –15.5% to +1.5% (see Appendix 6-6-6) is also quite large.	Distribution line to Phulchoki Repeater Station is laid beyond the design criteria and overload situation.	Measure for the commercial power shutdown: Replacement of the existing emergency generator set and of the existing D.C. power supply equipment. Measure for the voltage fluctuation: Replacement of the existing automatic voltage regulator (AVR).
In case of a lightning, power supply to the existing VHF radio equipment for the air control is cut down manually.	Reliability of lightning arrester facility of the existing VHF radio equipment is not clear (enough capacity).	Measure for lighting: Replacements of the surge suppression transformer and arrester.
4. Flight plans for radar approach control can not be sometimes deliver to radar approach control room.	Main unit of the existing automatic message switching system (AMSS) is in an out of order.	Replacement of the existing AMSS.
5. Deviation between present ATIS system and the air space structures in Kathmandu FIR makes burden to radar controllers.	The existing ATIS equipment is under the un-repairable condition. In addition to the condition, radar controllers can not help being involved due to the present ATIS system.	Replacement of the existing ATIS.

(2) **Outline of the Plan**

Following eleven points are summarized for the solutions to the constraints on present radar air traffic control system.

(a) Replacement of existing tower control console

(b) Replacement of existing air to ground radios for tower control

(c) Replacement of existing area control console

(d) Replacement of existing air to ground radios for area control

(e) Replacement of existing meteorological equipment

(f) Erection of New power house which has power transformer (11kV/400-230V) and emergency generator set for air traffic control system.

(g) New provision of an emergency generator and of an uninterrupted power supply (UPS) equipment at Sanothimi Training Center

(h) Replacement of the existing emergency generator set and the automatic voltage regulator (AVR) set at Phulchoki repeater station

(i) Replacement of the existing DC power supply equipment and the existing surge suppression transformer at Phulchoki repeater station

(j) Replacement of existing automatic message switching system (AMSS)

(k) Replacement of existing automatic terminal information service (ATIS) system

2 - 3 Basic Design

2 - 3 - 1 Design Concept

(1) Conditions and special situations for the erection works

(a) Tribhuvan International Airport

The erection works interfering with the air traffic control directly, in order to avoid the interference with the functions of the airport, shall be implemented for in the nighttime (after finishing of taking off and landing of all airplanes).

Cable installation works also shall be carried out by the suspending cable rack from the ceiling to maintain new consoles.

T-branch of 11kV power distribution shall be made from the existing bus bar of 11kV cubicle for outgoing feeder to the radar site, which was provided by the Phase1 work.

(b) Sanothimi Training Center

The emergency generator set and the UPS will be installed at this site for an improvement. An installation of the emergency generator set can be accomplished without stopping the training program. But shut down of commercial power is necessary when a modification of the automatic starter for the generator and an installation of the UPS are implemented.

Thus, the installation works shall be carried out in the nighttime and off-day.

(c) Mt. Phulchoki

Mt. Phulchoki having in elevation of 2,760 meters is the highest place in Kathmandu valley. Since it has snow in a winter season (from December to January), delivery and erection of the equipment for this site shall be made avoiding this winter season. The emergency generator shall be installed after the erection of the automatic voltage regulator (AVR) and the replacement of the existing distribution board. In addition, the temporary generator charging the existing battery shall be provided for a counter measure of the shutdown of the commercial power.

(2) Capability of the local sub-contractor and availability of the materials

The implementation works of Phase 1 work and the follow up project under the DCA (now CAAN) have accomplished by the following formation.

Phase1 work : Japanese trading and construction company as the prime contractor, Japanese manufacturer as the main vendor and the local sub-contractors as the erector.

Follow-up project : Japanese manufacturer as the prime contractor and the local sub-contractors as the erector.

We judged by the result of the facilities implemented by the sub-contractor in the past projects that the capability of the local sub contractor is adequate. Since all equipment imported from Japan were used in both projects, materials such as for this project may be procured at local markets.

(3) Procurement market besides Japan and Nepal

There is no available procurement market besides Japan and Nepal by following reasons.

(a) Necessity of interfacing with the existing facilities supplied by Phase 1.

(b)The maintenance works of the existing facilities that are installed before implementation of Phase 1 are not easy, and quality of these facilities is no good.

(4) Specifications of the equipment

Specifications for the console desk of the air traffic control and VHF radio equipment for the communication facilities shall be confirmed to the specifications of the equipment supplied by the Phase1 work. Specifications of the meteorological weather observation equipment shall be adopted to the existing facilities.

Specifications for the electrical power source shall be based on and correspond to an environmental conditions such as a height and dust at site.

(5) Applied Standards

Following standards and codes relevant to the equipment shall be applied to design of equipment, and be satisfied with the requirements in the standards and codes.

Japanese Industrial Standards (JIS), Japanese Electrotechnical Committee (JEC), Japan Electrical Manufacturer's Industry Association (JEM), International Electrotechnical Commission (IEC), Japanese Cable Standards (JCS), International Civil Aviation Organization (ICAO), World Meteorological Organization (WMO), Electronic Industries Association of Japan (EIAJ), International Telecommunication Union (ITU), Institute of

Electrical and Electronics Engineers (IEEE), International Organization of Standard (ISO), National Building Code of India (NBCO Part VI-1983) and British Standards (BS).

(6) Scope of design for the equipment

The scope of design for the equipment shall be guided by the following policies.

(a) Limited equipment to ensure complete performance of the existing facilities that was supplied by the Phase1 work.

(b) Minimum connection to the equipment except the existing facilities supplied by the Phase1 work and the follow-up project avoiding the interference.

(7) Implementation Schedule

Present issues on Tribhuvan radar system are concerned with safe flight, thus procurement and supervising work in a short period should be planned.

2 - 3 - 2 Basic Design

(1) Overview

The improvement works in this project is expected to facilitate for the smooth operation radar system. The system for automatic terminal information service so called ATIS and automatic message switching system (AMSS) are considered to be replaced in accordance with latest conditions of the existing ATIS and AMSS equipment.

(2) Equipment Planning

Main equipment of this Plan is shown in Figure2-1, and content and location of the equipment is shown in Table2-2.

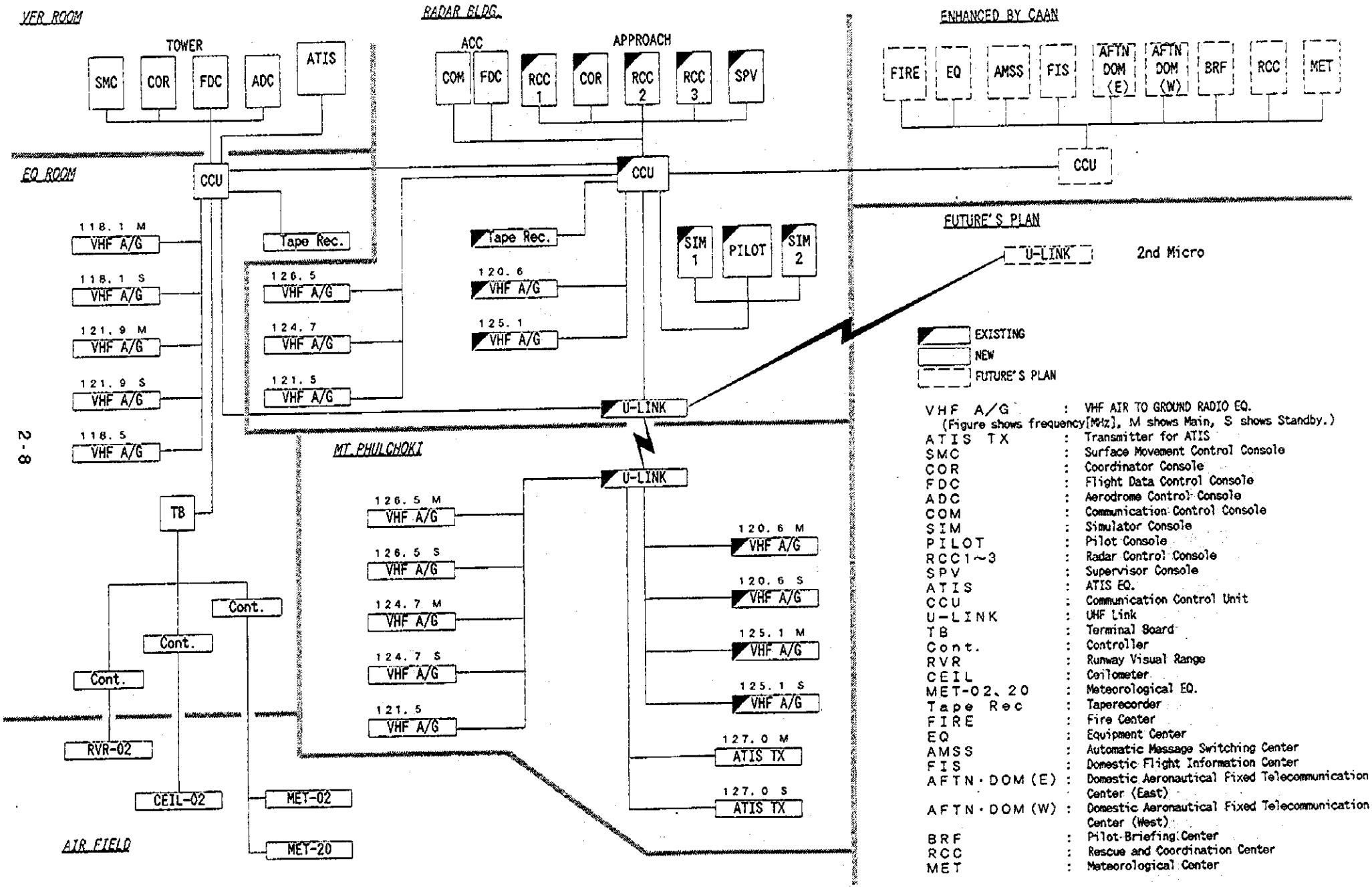


Figure2-1 SYSTEM BLOCK DIAGRAM

Table2-2 Quantity and Location of Equipment

Equipment

Equipment	Specification	Unit	Q'ty	Purpose	Location
(a) Air Traffic Control and Communication Facilities					
Tower Control Facilities					
25W VHF dual transmitter	Output Power 25W, Frequency 118~136MHz	sets	2	VHF transmitter for Tower Control	TIA Operation Building 1F New Equipment Room
25W VHF single transmitter	Output Power 25W, Frequency 118~136MHz	set	1	Standby VHF transmitter for Tower Control	TIA Operation Building 1F New Equipment Room
VHF Tx antenna with antenna mast	Wide band dipole	sets	3	Tx antenna for Tower Control	The Roof of TIA Operation Building
Wired rack for VHF transmitters	Max.4sets VHF Transmitters shall be installed	set	1	Mounting rack for VHF transmitters	TIA Operation Building 1F New Equipment Room
Dual VHF receiver	Frequency 118~136MHz	sets	2	VHF receiver for Tower Control	TIA Operation Building 1F New Equipment Room
Single VHF receiver	Frequency 118~136MHz	set	1	Standby VHF receiver for Tower Control	TIA Operation Building 1F New Equipment Room
VHF Rx antenna with antenna mast	Wide band dipole	sets	3	Rx antenna for Tower Control	The Roof of TIA Control Tower
Wired rack for VHF receivers	Max.8sets VHF Receivers shall be installed	set	1	Mounting rack for VHF receivers	TIA Operation Building 1F New Equipment Room
Multi-channel dual tape recorder	Digital recording system, 24CH	set	1	Recording of communication	TIA Operation Building 1F New Equipment Room
Multi-channel tape reproducer	Digital reproducing system, 24CH	set	1	Reproducing of communication	TIA Operation Building 1F New Equipment Room
Area Control Facilities					
50W VHF dual transmitter	Output power 50W, Frequency 118~136MHz	sets	2	VHF transmitter for Area Control	Mt. Phulchoki Equipment Room
50W VHF single transmitter	Output power50W, Frequency 118~136MHz	set	1	VHF transmitter for Area Control (Emergency)	Mt. Phulchoki Equipment Room
VHF Tx antenna with antenna mast	Wide band dipole	sets	3	Tx antenna for Area Control	Mt. Phulchoki Existing 45m Antenna Tower
Wired rack for VHF transmitters	Max.4sets VHF Transmitters shall be installed	set	1	Mounting rack for VHF transmitters	Mt. Phulchoki Equipment Room
Dual VHF receiver	Frequency 118~136MHz	sets	2	VHF receiver for Area Control	Mt. Phulchoki Equipment Room
Single VHF receiver	Frequency 118~136MHz	set	1	VHF receiver for Area Control (Emergency)	Mt. Phulchoki Equipment Room
VHF Rx antenna with antenna mast	Wide band dipole	sets	3	Rx antenna for Area Control	Mt. Phulchoki New 25m Antenna Tower
Wired rack for VHF receivers	Max.8sets VHF Receivers shall be installed	set	1	Mounting rack for VHF receivers	Mt. Phulchoki Equipment Room
25W VHF single transmitter	Output power 25W, Frequeny118~136MHz	sets	3	VHF transmitter for Area Control (Phulchoki back-up)	TIA Radar Operation Building GF Equipment Room
VHF Tx/Rx antenna with antenna mast	Wide band dipole	sets	3	Tx/Rx antenna for Area Control (Phulchoki back-up)	TIA Existing 20m Antenna Tower
Wired rack for VHF transmitters	Max.4sets VHF Transmitters shall be installed	set	1	Mounting rack for VHF transmitters (Phulchoki back-up)	TIA Radar Operation Building GF Equipment Room
Single VHF receiver	Frequency 118~136MHz	sets	3	VHF receiver for Area Control (Phulchoki back-up)	TIA Radar Operation Building GF Equipment Room
25m tower with arrester and observation light	Self-supporting square steel tower	set	1	Mounting Rx antennas for Area Control	Mt. Phulchoki
Wired rack for VHF receivers	Max.8sets VHF Receivers shall be installed	set	1	Mounting rack for VHF receivers (Phulchoki back-up)	TIA Radar Operation Building GF Equipment Room

Interface unit for existing UHF link	Voice frequency 300～2700Hz	sets	2	Connection with existing UHF link	TIA Radar Operation Building GF Equipment Room Mt. Phulchoki Equipment Room
Tower Control Consoles					
ADC	Radio, intercom, hotline, AFL, etc	set	1	Tower control	TIA VFR(control tower) room
COR	Radio, intercom, hotline, PABX, etc	set	1	Coordination	TIA VFR(control tower) room
SMC	Radio, intercom, hotline, AFL, etc	set	1	Surface movement control	TIA VFR(control tower) room
FDC	Intercom, hotline, PABX, etc	set	1	Flight data	TIA VFR(control tower) room
Area Control Consoles					
FDC	Intercom, PABX, etc	set	1	Flight data	TIA Radar Operation Building 1F New ACC Room
COM	Radio, intercom, PABX, etc	set	1	Communication	TIA Radar Operation Building 1F New ACC Room
Communication Control					
CCU	Radio communication, intercom communication, etc	set	1	Interface with each equipment	TIA Operation Building 1F New Equipment Room
Aeronautical Telecommunication Facilities					
ATIS system	Digital system	set	1	Broadcasting of airport information	TIA VFR(control tower) room, Mt. Phulchoki
AMSS	V24/V28 RS232C interface	set	1	Message switching for aeronautical information	TIA Operation Building 1F AMSS Room and others
(b) Meteorological Facilities					
RVR	Measuring range 50～2000m	set	1	Measuring of visual range	TIA runway
Ceilometer	Measuring range 0～7500m	set	1	Measuring of cloud height	TIA runway
Wind sensor	Wind speed 0～60m/s, wind direction 0～360°	sets	2	Measuring of wind speed and wind direction	TIA runway (02 side and 20side)
Temperature and humidity meter	Temperature -50～50℃, Humidity 0～100%	set	1	Measuring of temp and humidity	TIA runway
Rainfall gauge sensor	Amount 0～999.5mm	set	1	Measuring of precipitation	TIA runway
Remote weather data transmission	Available data: temp, humidity, rain and precipitation pressure	set	1	Transmitting of meteorological data	TIA runway
Weather data collecting equipment	68000CPU PC	set	1	Collecting of meteorological data	TIA Operation Building 1F New Equipment Room
Weather report editing system	Pentium PC	set	1	Editing of meteorological data	Newly extended operation/airlines (under construction) 2F MET room
Visual display unit	600×400 dots, full color CRT	sets	2	Displaying of meteorological data	TIA Operation Building 1F New Equipment Room, Newly extended operation/airlines (under construction) 2F MET room
Printer	Semiconductor laser+dry electrophotography	set	1	Printing of meteorological data	Newly extended operation/airlines (under construction) 2F MET room
Wind display	7 segments LED	sets	7	Displaying of wind speed and wind direction	TIA SMC,ADC,RCC1, RCC2,RCC3,SIM1,SIM2
RVR display	7 segments LED	sets	7	Displaying of visual range	TIA SMC,ADC,RCC1, RCC2,RCC3,SIM1,SIM2
EL/MET display	600×400dots electro-luminescence	sets	7	Displaying of meteorological data	TIA SMC,ADC,RCC1, RCC2,SIM1,ATIS,FDC

(c) Power Facilities					
Power Facilities for TIA					
11kV VCB panel	Voltage rating 12kV, current rating 630A	set	1	Breaking of short circuit current	TIA Existing Power House
11kV transformer panel	Transformer capacity 300kVA	set	1	Transformation from 11kV to 400-230V	TIA New Power House
Low voltage panel	MCCB×10	set	1	Changeover between emergency generator power and commercial power	TIA New Power House
250kV emergency diesel generator	Output capacity 250kVA	set	1	Power supply to equipment during interruption of commercial power	TIA New Power House
10kVA UPS	Output capacity 10kVA	set	1	Supply of constant AC voltage during changeover	TIA Operation Building 1F New Equipment Room
Power Facilities for Sanothimi Training Center					
150kVA Emergency diesel generator	Output capacity 150kVA	set	1	Power supply to equipment during interruption of commercial power	Sanothimi Training Center Emergency Generator Hut
Low voltage panel	MCCB×7	set	1	Changeover between emergency generator power and commercial power	Sanothimi Training Center Radar Laboratory
10kVA UPS	Output capacity 10kVA	set	1	Supply of constant AC power during changeover	Sanothimi Training Center Simulator Computer Room
Power Facilities for Phulchoki Repeater Station					
37.5kVA Emergency diesel generator	Output capacity 37.5kVA	set	1	Power supply to equipment during interruption of commercial power	Mt. Phulchoki Power Room
Low voltage panel	MCCB×15	set	1	Changeover between emergency generator power and commercial power	Mt. Phulchoki Power Room
30kVA AVR	Output capacity 30kVA	set	1	Convert fluctuated AC voltage to regular AC voltage	Mt. Phulchoki Power Room
10kVA Surge suppression transformer	Transformer capacity 10kVA	set	1	Protection of equipment against lightning	Mt. Phulchoki Equipment Room
DC power supply unit with battery charger	DC24V, 40A, dual system	set	1	DC power supply to equipment	Mt. Phulchoki Equipment Room
(d) Air Conditioner					
Air Conditioner	Output power17.9kW	set	1	For TIA Radar Operation Building 1F New ACC Room	TIA Radar Operation Building 1F New ACC Room

Building (Implemented by Nepalese contractor)

Building	Specification	Size	Unit	Q'ty	Purpose	Location
Power House	Reinforced concrete	70.0m²	lot	1	Installation of power receiving equipment	TIA
Emergency Generator Hut	Reinforced concrete	31.5m²	lot	1	Installation of emergency generator	Sanothimi Training Center

(3) Facility Planning

(a) Basic Policy

The Architectural Facilities were designed based on the following Basic Policies;

- The design will take into consideration local climate, customs and other special characteristics of the site location.
- Natural ventilation and natural lighting will be utilized as much as possible to keep maintenance costs low.
- The construction capabilities of local Nepalese contractors and availability in the local construction material markets will be fully considered to provide an easily constructed and economical design.

Based on the above Basic Policies, the following design features were adopted for the architectural facilities;

- Ventilation facilities to cope with the heat from control panels and emergency generators have been provided. Extraction ventilation fans have been provided for the TIA Power House and Sanothimi Generator Hut has designed for natural ventilation.
- The structural designs are based on calculations following the Indian National Building Code (NBCO Part VI-1983).
- Locally available construction materials and customary local construction methods have been adopted as much as possible.

TIA Power House

A Power House housing one 250 kVA emergency generator, control panel, 400 liter service oil tank, receiving cubicle with 300 kVA transformer and low tension distribution panels.

Room	m²	Equipment
Receiving Room	42	300kVA transformer, low tension distribution panel
Generator Room	28	250kVA generator, control panel, 400 liter service oil tank
Total	70	

The structure is reinforced concrete frame with fair-faced brick walls using locally produced bricks. The roof is built-up asphalt waterproofing on reinforced concrete

slab. The doors are steel for security and windows are locally made wooden type. Interiors floors are dust-proof finish on concrete slab-on-grade.

Sanothimi Training Facility Generator House

A generator house with one 150 kVA exterior type emergency generator and 1000 liter service oil tank is provided.

Facility dimensions : 4.5m×7.0m =31.5㎡

Structure : Reinforced concrete frame single story
Rock wool slate roofing sheets
Fair-faced brick walls
Steel net panels to wall openings

(b) Facility Layout

The Power House at TIA is placed next to the existing Power Building with good accessibility.

(c) Elevation and Sectional Planning

- The concrete frame is exposed and walls are of fair-faced brick.
- The roofs are asphalt waterproofing with concrete protective covering over reinforced concrete slab at Tribhuvan and rock-wool slate roof sheeting at Sanothimi.
- Height of the building is designed to allow for clearance of smokestack and exhaust ducting of generator.

(d) Finishing

- The floors are provided with dust-proof finish to protect the electrical equipment.
- The interior walls are rendered in mortar and painted. Exterior walls are exposed fair-faced brick walling.

(e) Structural Design

- The foundations are independent footings on bearing soil with 100KN/㎡ strength (approximately 10 ton/ ㎡).

• The floor slabs are slabs on grade.

• Loading

The Loading for structural calculations are as follows;

Power House (Receiving & Generator Room), Generator Hut : 5.0 KN/㎡

Roof : 1.5 KN/㎡

The load combinations is set as per Table 12 of NBCO-PartVI, Section 5,

Table2-3 Load Combination

Load combination	Limit State of Collapse			Limit State of Serviceability		
	DL	LL	WL/EL	DL	LL	WL/EL
DL+LL	1.5	1.5	-	1.0	1.0	-
DL+WL or EL	1.5 or 0.9	-	1.5	1.0	-	1.0
DL+LL+WL or EL	1.2	1.2	1.2	1.0	0.8	0.8

Where : DL = Dead Load, LL = Live Load, WL = Wind Load, EL = Earthquake Load

• Structural Materials of Foundation

Reinforced concrete : fc = 20 Mpa (28 day strength)

Brick : 12 Mpa

Steel reinforcing Bars : fy = 415 Mpa Deformed bars to BS Standards or equivalent.

(4) Drawings

The basic ideas of this Plan are summarized in Drawings. Those are attached to this Report.

CHAPTER 3

IMPLEMENTATION PLAN

CHAPTER 3 IMPLEMENTATION PLAN

3 - 1 Implementation Plan

3 - 1 - 1 Implementation Concept

The purposes of this Project make renovation of the existing air traffic control facilities and the existing power supply facilities at Tribhuvan International Airport (TIA), Sanothimi Training Center and Repeater station at Mt. Phulchoki.

The Scope of Works under this Project falls under the following different categories.

(a) Preparatory works for installation works

Before commencing the installation works, the Contractor will carefully survey for the access to the site and relocation method of the existing equipment.

(b) Installation works

The sites of the Project are TIA, Sanothimi Training Center, and Repeater Station at Mt. Phulchoki.

The Prefabrication of equipment will be applied as much as possible to minimize the construction period.

During the construction period, the Contractor is required to train TIA air traffic controllers, operators and maintenance engineer technicians on how to use and maintain the equipment.

(c) Site inspection, tests, trial operation and commissioning tests

The field test, inspection and trial operation of new equipment will be witnessed by the Consultant.

After the acceptance of new facilities by the Consultant, the existing facilities will be dismantled and removed from the site.

The principal work of the Consultant and the Contractor are mentioned below.

(1) **Works by Japanese Consultant**

Home Works

(a) Detail design of this Project

(b) Preparation of bidding documents for purchase of equipment and materials and for site installation

(c) Bidding procedures and evaluation of bids

(d) Assistance to contract negotiation and signing of contract

(e) Approval of manufacturer's drawings and documents, or preparation of comments to them

(f) Attendance to factory inspection and tests prior to shipment

(g) Issue of inspection and test certificates

(h) Explanation and reporting to JICA

Site Works

(a) Review and adjustment of construction schedules including transport, building and installation

(b) Construction supervision and progress control

(c) Safety management

(d) Approval of Drawings

(e) Preparation of monthly progress reports

(f) Issue of certificates for works performed

(g) Defects inspection after taking over (one year guarantee period)

(h) Periodical reporting to relevant organization

(2) Works by Japanese Contractors

Based on the Specification the Contractor will carry out design of equipment and materials, manufacturing, painting, factory inspection and tests, packing, transport to site, installation and taking over.

3 - 1 - 2 Implementation Conditions

The design of electrical equipment is generally specified its altitude less than 1,000m. For the implementation of the Project special attention will be paid to the following points.

(a) Mt. Phulchoki is located at an altitude of 2,760 meters. The top of mountain is sometimes covered with snow in winter season (December & January).

(b) The Tribhuvan International Airport is located at an altitude of 1,338 meters.

(c) The Sanothimi Training Center is located at about 3 kilometers east of The Tribhuvan International Airport. The altitude is the same as The Tribhuvan International Airport.

(d) During installation and assembling of diesel generators and of distribution panels, the Contractor shall execute under partial shutdown of power supply. In such case power alive portion shall be indicated clearly.

(e) During power shutdown for connection to distribution lines, system interconnection and fixing of panel apparatus etc. shall be done as fast as possible and special attention shall be paid to the preparation of works and power failure etc.

Specifications of equipment and Construction Schedule will be decided considering the above conditions. Renewal of the console at VFR room have to be carried out without any interference of air traffic control.

3 - 1 - 3 Scope of Works

In case of construction to renew any part of the equipment during normal operation of existing airport, the removal of the existing equipment will be done after commissioning of the new equipment.

Therefore, the following shall be conducted by Nepal side.

Mt. Phulchoki:

Removal of existing VHF Transmitters and Receivers which are not in use now.

3 - 1 - 4 Consultant Supervision

Under the grant aid project from Japan, the Exchange Note (E/N) is exchanged between the concerned governments, then the project execution is commenced after confirmation of appropriateness of the project by Japanese government based on the result of basic design study. In the execution of design and construction, the consultant shall take into account full understanding of the followings:

(a) Background of the project.

(b) Contents of the basic design report.

(c) Basic flows of the grant aid assistance from Japan.

(d) Contents of the Exchange Note agreed between the two countries.

(e) Conditions of installation at the site.

Taking the above considerations into account, conceived consult services and planning are mentioned below.

(1) Consulting Services

(a) Detail design and preparation of bidding documents

a) Detail design

According to the results of basic design study, the Consultant will submit the detail design to Nepalese side for their review before tender call.

b) Preparation of tender documents

Tender documents are prepared in consideration of the detailed design, execution plan and grant aid regulation.

(b) Construction supervision

a) Tender procedures

Announcement for Tender

Question and Answer

Attendance for Tender

Evaluation of Tender

Contract Negotiation

b) Supervision procedures

The works include to review and approval of drawings and documents, inspection and tests of equipment before shipment, the discussions among concerned parties before commencing inland transportation and installation, preparation of progress reports during the transportation and installation, issue of interim certificates, attendance to inspection and tests on completion, etc.

c) Procedures after completion of transportation and installation

The works include issue of completion and provisional taking over certificates, preparation of final report and carrying out of performance inspection after one-year operation.

(2) Consultant Engineers in Charge

To smoothly execute all different types of consulting services mentioned in the above Paragraph (1), it is required to appoint a competent Project Manager who has ample experience in similar projects and fully understand the contents of the Project. At the same time the Consultant establish a competent organization by appointing proper staff in charge for detail design, tender procedures, review of approval drawings, inspection and tests before shipment of equipment and supervision of site transportation and installation of the works.

(a) Project Manager

The Project Manager will manage overall execution of the Project with full knowledge on the purpose and background of the Project. He will review overall work schedule and make adequate advice to each engineer in charge.

(b) Engineer in charge of Detail design

Based on the basic design, the Engineer will make necessary specifications of equipment and materials for the Project, equipment layout, execution plan taking into account power interruption plan, and estimate construction costs.

(c) Engineer in charge of Tender Procedures

The Engineer will compile tender documents and carry out tender procedures including tender announcement, attendance to tender opening, evaluation of tender documents, and assistance to contract negotiation and conclusion of contract.

(d) Engineer in charge of Drawing Approval and Inspection of Products

The Engineer will review and approve or comment on drawings and documents for approval, plans for transport and installation works etc., and also inspect and test equipment and materials at manufacturer's works before shipment in Japan.

(e) Engineer in charge of Construction Supervision

Resident Engineer at the site will manage and supervise the execution of transportation and installation works. The Engineer in charge of air traffic control, architecture and electrical power will be dispatched time to time to the site when required for supervision of respective works.

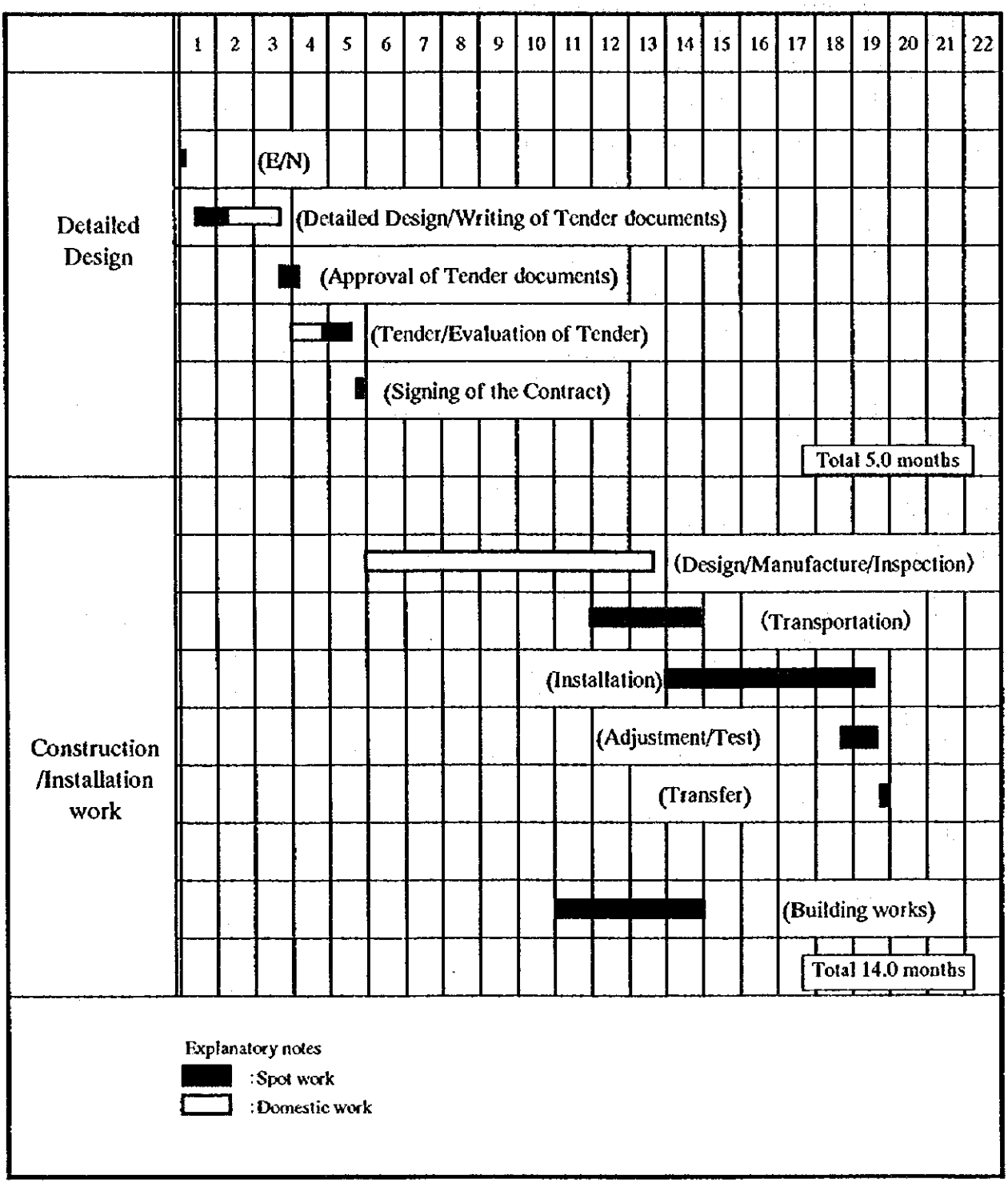
3 - 1 - 5 Procurement Plan

Equipment and materials to be procured under the Project such as air traffic control equipment (consoles and communication equipment), power supply system (diesel generators and other auxiliary equipment and materials, cabling materials with existing distribution panels) will be purchased in Japan. However, certain materials, such as sand and stone for concrete, timber, cement, reinforcing bars, etc. are purchased in Nepal.

3 - 1 - 6 Implementation Schedule

Taking into account urgency and importance of the Project, the execution of the Project is expected to be completed in 19 months from the E/N. The implementation schedule is shown in Table 3-1.

Table3-1 Implementation Schedule



3 - 1 - 7 Obligations of recipient country

(a) To provide data and information necessary for the Project.

(b) To secure land necessary for the site of the Project and clear, level and reclaim the land prior to commencement of the construction.

(c) To provide the following facilities:

1) Power distribution line to the site
2) Provision of water supply to the site
3) Provision of drainage
4) Telephone trunk line and the main distribution frame / panel of building
5) Temporary storage yard (at least 50m × 50m)
6) Provision of gas, if any

d) To remove unused equipment and facilities required for the Project.

e) To bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.

f) To ensure tax exemption, customs clearance at the port of disembarkation in Nepal.

g) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts

h) To accord Japanese nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into Nepal and stay therein for the performance of their work.

i) To provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary.

j) To maintain and use properly and effectively the equipment procured under the Project.

k) To bear all the expenses other than those to be borne by the Grant.

l) To coordinate and solve any issues related to the Project which may be raised by the third parties during the implementation of the Project.

3 - 2 Project Cost Estimation

The Cost of equipment and material are borne by Japan's Grant Aid Program so that the recipient country does not bear any cost for the Project except to bear commission to the Japanese foreign exchange bank for its banking services based upon the banking arrangement, namely the advising commission of the "Authorization to Pay" and payment commission. But the following cost is borne by Nepalese side.

> Removing existing VHF Transmitters and Receivers at Mt. Phulchoki which are not in use now.

3 - 3 Operation and Maintenance Costs

The equipment supplied and installed under this Aid Program are not new to TIA. The TIA staff can operate the equipment after having a brief explanation of operation or a few days training by the Vendor's engineer before provisional taking over. Then TIA also is responsible for ensuring the smooth and safe arrivals and departures of flights.

The number of staff also seems sufficient to operate even after the completion of Air Traffic Control Improvement Scheme.

Personnel expenses such as salary and allowance of CAAN and TIA are appropriated in the budget respectively.

As for maintenance of present radar system granted by Phase1, operational manual for the systems were prepared by effort of the experts dispatched by JICA. Maintenance and repair are carried out based on the manual in which broadly instructs from daily to yearly maintenance. Nepalese staffs can do the repairing work referencing the instruction manuals of equipment, which seems to be correctly done according to the maintenance procedures. One of the most critical constraints on equipment other than the radar system is a lack of spare parts. For this Study therefore, parts, units and the consumables, which will run a smooth operation for at least two years, will be considered to be supplied.

The estimated annual maintenance budgets for consumable parts & spare parts are shown in Table3-2.

Table3-2 Budget for Consumable Parts and Spare Parts

(Unit: 10^3Yen)

			Consumable Parts	Spare parts
Air control equipment	VHF		4,000	18,000
	ATC		5,000	18,000
	ATIS		2,700	3,300
	Tape Recorder		2,800	700
	AMSS		11,000	12,300
	MET		2,500	10,300
Power supply equipment	Emergency generator	250kVA	200	1,000
		150kVA	180	1,000
		37.5kVA	160	1,000
Total			28,540	65,600

The revenue of DCA, TIA and Local Airports for the past 5 years are shown in Table 3-3.

Table3-3 Revenue for Past 5 Years

year	currency unit	DCA / HQ (present CAAN)	TIA	Local Airports	Total
1998	(10^3N.Rupee)	8,285	622,415	16,386	647,086
	(10^3US$)	122	9,173	242	9,537
	(10^3Yen)	14,416	1,083,002	28,512	1,125,930
1997	(10^3N.Rupee)	1,434	543,365	18,608	563,407
	(10^3US$)	21	8,008	274	8,304
	(10^3Yen)	2,495	945,455	32,378	980,328
1996	(10^3N.Rupee)	4,380	520,760	7,582	532,722
	(10^3US$)	65	7,675	112	7,851
	(10^3Yen)	7,621	906,122	13,193	926,936
1995	(10^3N.Rupee)	1,153	388,156	7,443	396,752
	(10^3US$)	17	5,721	110	5,847
	(10^3Yen)	2,006	675,391	12,951	690,348
1994	(10^3N.Rupee)	605	343,268	13,043	356,916
	(10^3US$)	9	5,059	192	5,260
	(10^3Yen)	1,053	597,286	22,695	621,034

(Exchange Rate : US$1 = Yen118 , N.Rupee1 = Yen1.74)

Table3-4 List of Consumable Parts (1/3)

No.	Description	Unit	Q'ty	Remarks
ATC Tower Control Console				
1	ATC Tower control console			
	Lamp	pc.	20	ten each for 2 items
	Blower	pc.	2	one each for 2 items
2	ACC console			
	Lamp	pc.	2	one each for 2 items
	Blower	pc.	2	one each for 2 items
Tape Recorder				
1	Tape recorder			
	DDS2DAT Tape	pc.	6	six each for 1 item
	Fan	pc.	3	three each for 1 item
ATIS				
1	ATIS			
	Neon lamp	pc.	10	ten each for 1 item
AMSS				
1	AMSS			
	Printer head	pc.	120	120 each for 1 item
	Ink ribbon	pc.	120	120 each for 1 item
	Ink cartridge	pc.	20	20 each for 1 item
	Paper for serial printer	pc.	120	120 each for 1 item
	Paper for laser printer	pc.	20	20 each for 1 item
Automatic Meteorological Observation System				
3.1	RVR			
	Lamp	pc.	1	
	Recording pen/pad	pc.	4	four each for 1 item
	Recording chart	pc.	24	24 each for 1 item
3.2	Ceilometer			
	Lamp	pc.	1	
	Electric fan	pc.	1	
	Floppy diskette	pc.	1	
3.3	Temperature, humidity, rain gauge and pressure sensor			
	Lamp	pc.	1	
	Electric fan	pc.	1	

Table3-4 List of Consumable Parts (2/3)

No.	Description	Unit	Q'ty	Remarks
	Recording pen/pad	pc.	4	four each for 1 item
	Recording chart	pc.	24	24 each for 1 item
3.4	Wind observing system			
	Lamp	pc.	1	
	Recording pen/pad	pc.	4	four each for 1 item
	Recording chart	pc.	24	24 each for 1 item
Power Supply System				
4.1	11kV Panel			
4.2	DC Power Supply Unit with Battery			
4.3	UPS			
4.4	Emergency Diesel generator			
4.4.1	Diesel Generator 250kVA			
	Element kit	pc.	2	two each for 1 item
	Element air	pc.	1	
	Packing rocker	pc.	6	six each for 1 item
	Seal unit	pc.	1	
	V-Belt	pc.	1	
	V-Belt	pc.	1	
	Element kit fuel	pc.	4	four each for 1 item
	Gasket	pc.	4	four each for 1 item
	Gasket	pc.	2	two each for 1 item
	Lamp	pc.	4	four each for 1 item
	Lamp	pc.	16	16 each for 1 item
	Filter oil	pc.	2	two each for 1 item
	Gage oil	pc.	1	
4.4.2	Diesel Generator 150kVA			
	Element kit	pc.	2	two each for 1 item
	Element air	pc.	1	
	Packing rocker	pc.	6	six each for 1 item
	Seal unit	pc.	1	
	V-Belt	pc.	1	
	V-Belt	pc.	1	
	Element kit fuel	pc.	4	four each for 1 item

Table3-4 List of Consumable Parts (3/3)

No.	Description	Unit	Q'ty	Remarks
	Gasket	pc.	4	four each for 1 item
	Gasket	pc.	2	two each for 1 item
	Lamp	pc.	4	four each for 1 item
	Lamp	pc.	16	16 each for 1 item
4.4.3	Diesel Generator 37.5kVA			
	Element air	pc.	1	
	Oil filter element	pc.	2	two each for 1 item
	Fuel filter element	pc.	4	four each for 1 item
	Push Button	pc.	1	
	V-Belt	pc.	1	
	Packing rocker	pc.	1	
	Seal unit	pc.	1	
	Lamp	pc.	4	four each for 1 item
	Lamp	pc.	16	16 each for 1 item

Table3-5 List of Spare Parts (1/6)

No.	Description	Unit	Q'ty	Remarks
VHF Transmitter/Receiver				
1	VHF Transmitter			
	TX antenna changeover	pc.	1	
	Transmitter unit	pc.	1	
	25w Power amplifier unit	pc.	1	
	50w Power amplifier unit	pc.	1	
	Controller unit for ACO	pc.	1	
	Controller unit for ACO	pc.	1	
	Power supply unit	pc.	1	
	Power supply unit	pc.	1	
	VHF Transmitter for test bench	pc.	1	
	IC, Transistor and Diode	pc.	75	one each for 75 items of IC, Transistor and Diode
	Register	pc.	48	one each for 48 items
	Capacitor	pc.	30	one each for 30 items
	Relay	pc.	4	one each for 4 items
	Antenna element	pc.	1	
	Crystal oscillator	pc.	2	one pair of parts
	Fuse	pc.	40	ten each for 4 items
	LED	pc.	30	ten each for 3 items
2	VHF Receiver			
	RX antenna changeover	pc.	1	
	Receiver unit	pc.	1	
	Power supply unit	pc.	1	
	Power supply unit	pc.	1	
	Controller unit	pc.	1	
	VHF AM receiver for test bench	pc.	1	
	IC, Transistor and Diode	pc.	40	one each for 40 items of IC, Transistor and Diode
	Register	pc.	45	one each for 45 items
	Capacitor	pc.	30	one each for 30 items
	Relay	pc.	2	one each for 2 items
	Antenna element	pc.	1	
	Crystal oscillator	pc.	2	one pair of parts
	FUSE	pc.	20	ten each for 2 items
	LED	pc.	30	ten each for 3 items

Table3-5 List of Spare Parts (2/6)

No.	Description	Unit	Q'ty	Remarks
ATC Tower Control Console				
1	ATC Tower control console			
	Switch panel	pc.	1	
	Jack box	pc.	1	
	Foot light panel	pc.	1	
	Foot switch	pc.	1	
	Foot switch jack panel	pc.	1	
	Crash siren control panel	pc.	1	
	Runway display panel	pc.	1	
	Navaids monitor panel	pc.	1	
	Console control unit	pc.	1	
	Console interface unit	pc.	1	
	Radio interface unit	pc.	1	
	Landline interface unit	pc.	1	
	Hotmic interface unit	pc.	1	
	PABX interface unit	pc.	1	
	Recorder interface unit	pc.	1	
	Clock unit	pc.	1	
	Telephone interface unit 1	pc.	1	
	Telephone interface unit 2	pc.	1	
	Transformer	pc.	2	one each for 2 items
	Relay	pc.	10	ten each for 1 item
	IC	pc.	9	one each for 9 items
	Switch	pc.	10	one each for 10 items
	Power supply	pc.	5	one each for 5 items
	Arrester	pc.	4	one each for 4 items
	Headset	pc.	5	five each for 1 item
	Handset	pc.	2	two each for 1 item
2	ACC console			
	Switch panel	pc.	1	
	Jack box	pc.	1	
	Foot light panel	pc.	1	
	Foot switch	pc.	1	
	Foot switch jack panel	pc.	1	

Table3-5 List of Spare Parts (3/6)

No.	Description	Unit	Q'ty	Remarks
	Navaids monitor panel	pc.	1	
	Console control unit	pc.	1	
	Console interface unit	pc.	1	
	Radio interface unit	pc.	1	
	Landline interface unit	pc.	1	
	PABX interface unit	pc.	1	
	Recorder interface unit	pc.	1	
	Clock unit	pc.	1	
	Transformer	pc.	2	one each for 2 items
	Relay	pc.	10	ten each for 1 item
	IC	pc.	9	one each for 9 items
	Switch	pc.	10	one each for 10 items
	Power supply	pc.	5	one each for 5 items
	Arrester	pc.	4	one each for 4 items
	Headset	pc.	2	two each for 1 item
	Handset	pc.	2	two each for 1 item
Tape Recorder				
1	Tape recorder			
	Hard disc	pc.	1	
	Operation panel 1	pc.	1	
	Operation panel 2	pc.	1	
	LCD	pc.	1	
	Speaker	pc.	1	
	Power Supply Unit	pc.	1	
	Mother board	pc.	1	
	TELI/F24CH	pc.	1	
	REC, PCBA	pc.	1	
	Monitor	pc.	1	
ATIS				
1	ATIS			
	Hard disc drive	pc.	2	two each for 1 item
	Mouse	pc.	2	two each for 1 item
	Synthesizer	pc.	1	
	Recording and reproducing board	pc.	1	

Table3-5 List of Spare Parts (4/6)

No.	Description	Unit	Q'ty	Remarks
	Mic amp board	pc.	1	
	Operation panel	pc.	1	
	I/F board	pc.	1	
	Headphone	pc.	2	two each for 1 item
	Microphone	pc.	2	two each for 1 item
	Power supply	pc.	1	
	Power supply	pc.	2	two each for 1 item
	Fuse	pc.	2	two each for 1 item
	LED	pc.	7	seven each for 1 item
AMSS				
1	AMSS			
	AFTN intelligent terminal with printer	pc.	1	
	Magnetic optical unit	pc.	2	two each for 1 item
	MO media	pc.	10	ten each for 1 item
	UPS	pc.	2	two each for 1 item
	Stackable HUB	pc.	2	two each for 1 item
	Link cable	pc.	2	two each for 1 item
	SCSI cable	pc.	2	two each for 1 item
	RS232C cable	pc.	2	two each for 1 item
	Intelligent interface board	pc.	2	two each for 1 item
Automatic Meteorological Observation system				
3.1	RVR			
	Projector unit	pc.	1	
	Detector unit	pc.	1	
	Modem unit	pc.	1	
	Arrester	pc.	1	
	Fuse	pc.	1	
3.2	Ceilometer			
	Signal converter	pc.	1	
	Modem board	pc.	1	
	Ceilometer processor	pc.	1	
	Arrester	pc.	1	
	CRT display	pc.	1	

Table3-5 List of Spare Parts (5/6)

No.	Description	Unit	Q'ty	Remarks
	Fuse	pc.	1	
3.3	Temperature, humidity, rain gauge and pressure sensor			
	Modem unit	pc.	1	
	Fuse	pc.	1	
	Arrester	pc.	1	
3.4	Wind observing system			
	Signal converter	pc.	1	
	Digital I/O converter	pc.	1	
	Wind converter	pc.	1	
	Modem unit	pc.	1	
	Arrester	pc.	1	
	Fuse	pc.	1	
Power Supply System				
4.1	11kV Panel			
4.2	DC Power Supply Unit with Battery			
4.3	UPS			
4.4	Emergency Diesel generator			
4.4.1	Diesel Generator 250kVA			
	Printed board	pc.	1	
	Thermostat	pc.	1	
	Rectifier	pc.	2	two each for 1 item
	Voltage Regulator	pc.	1	
	Voltage Regulator	pc.	1	
	Push Button	pc.	1	
	Magnet Switch	pc.	1	
	Auxiliary relay	pc.	3	one each for 3 items
	Time lag relay	pc.	2	one each for 2 items
	Speed Relay	pc.	1	
	Diode	pc.	2	two each for 1 item
	Charger	pc.	1	
	Fuse	pc.	2	two each for 1 item
	Fuse	pc.	2	two each for 1 item

Table3-5 List of Spare Parts (6/6)

No.	Description	Unit	Q'ty	Remarks
4.4.2	Diesel Generator 150kVA			
	Printed board	pc.	1	
	Thermostat	pc.	1	
	Rectifier	pc.	2	two each for 1 item
	Voltage Regulator	pc.	1	
	Voltage Regulator	pc.	1	
	Push Button	pc.	1	
	Magnet Switch	pc.	1	
	Auxiliary relay	pc.	3	one each for 3 items
	Time-lag Relay	pc.	2	one each for 2 items
	Speed Relay	pc.	1	
	Diode	pc.	2	two each for 1 item
	Charger	pc.	1	
	Fuse	pc.	2	two each for 1 item
	Fuse	pc.	2	two each for 1 item
4.4.3	Diesel Generator 37.5kVA			
	Printed board	pc.	1	
	Thermostat	pc.	1	
	Rectifier	pc.	2	two each for 1 item
	Voltage Regulator	pc.	1	
	Push Button	pc.	1	
	Magnet Switch	pc.	1	
	Auxiliary relay	pc.	3	one each for 3 items
	Voltage Regulator	pc.	1	
	Time-lag Relay	pc.	2	one each for 2 items
	Speed Relay	pc.	1	
	Diode	pc.	2	two each for 1 item
	Charger	pc.	1	
	Fuse	pc.	2	two each for 1 item
	Fuse	pc.	2	two each for 1 item

CHAPTER 4

PROJECT EVALUATION AND RECOMMENDATION

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION

4 - 1 Project Effect

The radar control facility granted by Japan's government has being in trouble due to deterioration of existing equipment which consists of the radar control system. The situation makes less safe conditions for annual one and a half million people who travel by air transportation.

By the implementation of this plan, the existing radar control facility can be expected to be efficiently operated, which will lead to the remarkable increase of the safety of radar control. The effects of the Plan are shown in Table4-1.

Table 4-1 Effects by Implementation of this Plan (1/2)

Present Issues	Measures by this Plan	Effect after Implementation
1.Interfacing for unified voice communications between radar and other consoles is not available.	Replacement of the existing consoles for tower control and for area control. Incidental to this replacement, VHF air to ground radios are also replaced.	Unified voice communications between consoles for aerodrome, approach and en-route are available. Since this leads to surely transfer of aircraft, radar control function can be more efficiently drawn.
2.No correct meteorological data on displays on radar approach consoles such as wind direction, wind speed, runway visibility, and height of the cloud ceiling.	Observatory sensors for the wind direction and speed are installed at both end of the runway in order to correctly obtain the meteorological conditions. Existing RVR and ceilometer are replaced.	Since meteorological data necessary for radar control can be obtained, radar control function can be more efficiently drawn.
3. Power supply system 3-1. Power supply at TIA Since fluctuation of 400V (low voltage bus) at TIA records -9.0% to +1.0%(see Appendix 6-6-1),bad effect is occurred on the radar control system. Meanwhile, two 11kV commercial power lines are fed into the airport in order to keep reliability because NEA understands that the airport is an important power consumer.	11kV voltage T-branch on following power loads and new provision of the emergency generator can solve the issue. ・ Air traffic control equipment at radar operation building ・ Architectural facilities at existing operation building. ・ Air traffic control equipment at existing operation building. ・ The architectural facilities at existing operation building.	Since existing power transformer has loads of both terminal building and air traffic control equipment including control building, the low voltage is fluctuated because of fluctuation of loads of terminal building. To establish new power supply system (transformer and emergency generator), stable and reliable power is supplied to air traffic control equipment and then contribute the improvement of reliability for air traffic control.
3-2. Power supply at Sanothimi Training Center There is a commercial power shutdown of 256 times and 272 hours a year(see Appendix6-4) at Sanothimi Training Center. Power interruption make training interruption and damage to computer hard disc.	New provision of the emergency generator and of UPS that compensate the change-over time to the generator can solve the issue.	It is possible to train continuously and no risk of damage to computer hard disc.

Table 4-1 Effects by Implementation of this Plan (2/2)

Present Issues	Measures by this Plan	Effect after Implementation
3-3. Power supply at Phulchoki Repeater Station There is a commercial power shutdown of 311 times and 276 hours a year (see Appendix6-5) at Phulchoki repeater station. Voltage fluctuation which records –15.5% to +1.5%(see Appendix6-6-6) is also quite large.	Measure for the commercial power shutdown: Replacement of the existing emergency generator set and of the existing D.C. power supply equipment. Measure for the voltage fluctuation: Replacement of the existing automatic voltage regulator (AVR).	Against frequent power shutdown and abnormal voltage fluctuation, stable and reliable power can be supplied.
In case of a lightning, power supply to the existing VHF radio equipment for the air control is cut down manually.	Measure for lightning: Replacements of the surge suppression transformer and arrester.	During lightning, VHF radio equipment can be in operation continuously.
4. Flight plans for radar approach control can not be sometimes deliver to radar approach control room.	Replacement of the existing AMSS.	Since air traffic control with sure flight plan can be available, radar control function can be more efficiently drawn.
5. Deviation between present ATIS system and the air space structures in Kathmandu FIR makes burden to radar controllers.	Replacement of the existing ATIS.	Since radar controllers can devote their works, radar facility can be efficiently used.

4 - 2 Recommendation

The Project produces to provide significant effects as mentioned above, which enable to efficient operation of present radar facility granted by Japan's government by which leads to safety air transportation. Since the Plan, however, contains some difficulties described below, it can be considered that the smooth implementation of the Plan would not be possible unless those difficulties are solved.

(1) Maintenance works for present radar system granted Japan's Government has been mostly carried out based on the five-year maintenance contract which originally made by between Nepalese side and contractor. Under this condition, Nepalese side tends to rely on the contractor and it makes less independent for maintenance works to be done by Nepalese side, and the spare parts provided for the Radar system has been hardly used. Since this Plan is for improvement on present radar system, self effort by Nepalese side for maintenance works will be essential to smoothly operate the radar system.

(2) For this Plan, the implementation schedule is prepared considering minimum period of time. In order to keep the Schedule, cooperation from Nepalese side is essential. The completion time will have to be postponed in case that timely cooperation by Nepalese side can not been obtained.

(3) There are facilities contributed to safety air transportation at Tribhuvan airport. These are facilities of communications, navigation, surveillance and power supply. Present facilities of those in Tribhuvan airport are mostly deteriorated and less reliable. Under the condition, fully implementation of this Plan were carried out, the effort by Nepalese side of improvement for the rest of the facility other than radar system will be highly requested.