Lao Air Traffic Management
Department of Civil Aviation
Ministry of Public Works and Transport
The Lao People's Democratic Republic

PREPARATORY SURVEY REPORT
ON
THE MODERNIZATION OF EQUIPMENT FOR TRANSITION TO NEW CNS/ATM SYSTEMS
IN
THE LAO PEOPLE' S DEMOCRATIC REPUBLIC

MARCH 2013

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)
JAPANAIRPORT CONSULTANTS, INC.
NIPPON KOEI CO., LTD

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey for the Modernization of Equipment for Transition to New CNS/ATM Systems in the Lao People's Democratic Republic (Lao PDR) and entrust the survey to joint venture consisting of Japan Airport Consultants, Inc. and Nippon Koei Co., Ltd.

The survey team held a series of discussions with the officials concerned of the Government of Lao PDR, and conducted a field investigation. 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 Lao PDR for their close cooperation extended to the survey team.

March, 2013

Kazunori Miura
Director General
Economic Infrastructure Department
Japan International Cooperation Agency

Summary

1. Outline of the Country

According to the International Monetary Fund (IMF), the Lao PDR is categorized as Least Developed Countries (LDCs) based on the assessment of United Nations and its GDP was 7.8 billion US dollars in 2011. It is estimated that 60% of Lao's nationals equal to 4.12 million people are living within two (2) dollars per day according to the data published by ADB in 2011.

The growth rate of GDP in the first half of year 2008/2009 was reduced to 7.1 % from 7.9% in 2007/2008 due to economic down turn. Government revenue of Lao PDR was estimated further to shrink by declining of notional economic growth and financial deficit in 2008/2009 was assumed to be 5% of GDP.

The Loa PDR is the only country where there is no coastal line in Southeast Asian. The country stretches from south to north for 1,700km, and the land from east to west is 500km as widest area while the narrowest area is 140km. The three quarter of the land is mountainous or highland area, and the average elevation of the northern part is approximately 1,500m. The highest mountain is Mt. Phou Bia with elevation of 2,817m. Two third of border with Thailand is separated by the Mekong River, and 51% of downstream area of the Mekong River would be suitable for producing hydroelectric power.

The climate of Lao PDR is tropical monsoon and has typically two seasons with rainy and dry period. The rainy season is approximately from May to November while the dry season is from December to April. The average annual temperature is approximately 28 degree Celsius and the highest temperature approximately 38 degree Celsius in April and May.

2. Buck ground and outline of the Project

As Lao PDR has a relatively large territory as compared to its population, the air transport has been playing very important role in movements of passengers and goods as well as in regional development. The airspace in Lao PDR (Vientiane Flight Information Region) has several busy air routes connecting eastern and western capital city with dense flight in South-East Asia, Growth rate of over flight from 2009 to 2010 is about 17%. However, this growth rate was caused that the number of over flight in 2009 fell off due to economic depression assumed by the Lehman shock, and then it recovered in 2011 with high value. The average of growth rate from 2008 to 2011 is 10% while the number of taking-off and landing shows an average of about 30% as high growth.
Provision of proper air traffic management services for the Lao PDR is recognized imperative in order to improve air traffic control (ATC) capability, ensure safe and efficient aircraft operations. However, the status of existing ATC and Nav-aids system in Lao PDR is not sufficiently developed at present.

In order to solve this sort of problems arising all over the world, ICAO requires the contracting states to introduce a new technology for air traffic management and control, namely "New CNS/ATM Systems".

The Lao PDR is implementing economic development plan as a national strategy for every five years. The 7th National Economic Development Plan (NSEDP), which is targeted from 2011 to 2015, announced accelerating national economy by strengthening of industrial modernization, and set a target for becoming independent developing country. For development of the aviation sector, it is aimed to improve the ability of air traffic management in order to deal with increasing of air traffic demand, and set several concepts such as ensuring safety and modernization of ATC, increment of passenger by expanding of medium and long distance air route, and increase of 4.5 to 6.5% of annual domestic flights and increase of 8 to 10 % of annual air traffic volume.

In line with the back ground above mentioned, JICA implemented the master plan study named

"Master Plan Study on the Development of the New CNS/ATM Systems in Cambodia, Lao PDR and Vietnam" (JICA M/P) to formulate the introduction plan for new CNS/ATM systems in 2009. This Grant Aid Project (hereinafter referred to as the "Project") is planned by request from Lao PDR prepared based on the JICA M/P as an overall goal to modernize CNS/ATM facilities in Lao PDR, and is aimed to promote introduction of new CNS/ATM systems.

3. Outline of the Study and Contents of the Project

JICA dispatched a Preparatory Survey Team to Lao PDR from 6 June to 2 July 2012, and the survey team held discussions with officials concerned of the Lao PDR, confirmed equipment/systems included in the request, and conducted field surveys at the Project sites. In order to finalize the project scope, an assessment of appropriateness of contents of the request, which was confirmed during the field survey, was made in Japan, and an outline design was prepared. JICA dispatched to Lao PDR the Outline Design Explanation Team from 12 November to 17 November 2012, and the team explained the Outline Design Draft Report and Equipment Specifications (Draft) to officials concerned of the Lao PDR. The Lao side agreed and accepted in principle the contents of the report, specifications and plan.

Table shows a comparison between changes on the requests from Lao PDR before and after the site survey. There are four major changes as summarized below:

- Regarding the Aeronautical Fixed Telecommunication Network (AFTN)/ ATS Message Handling System (AMHS), Lao PDR has already introduced AMSS (Aeronautical Message Switching System) by the agreement with CIT Lao Ltd. for installation of the AMHS, as a next generation of message switching system, and therefore AMHS has been excluded from the Project scope.

- Regarding the en-route air to ground communications, additional provision of one RCAG station at Paksong site was requested in order to improve radio propagation coverage in Sector 2 (southern air space of Vientiane FIR). Provision of additional RCAG station at Paksong will realize a perfect coverage and therefore the request was accepted. At Paksong site, a Secondary Surveillance Radar (SSR) is to be installed under another project, and land acquisition as well as site clearance (removal of land mines, tree cutting) were already completed by the Lao PDR.

- In relation to the additional provision of RCAG and SSR station at Paksong, the site for VSAT communication has been changed from Pakse to Paksong.

- The technical assistance for equipment operations of new AIS Automation System was requested by the Lao side as a soft component under the Project. However, the AIS technical training requested by the Lao side is keen to the special function and performance of AIS system. Therefore, it is not suitable and insufficient to implement within the soft component by the consultant. From this point of view, the operational training should be included in the procurement specification of AIS Automation System as an item of "Operational Guidance" to realize more effective training by the AIS manufacture, and this soft component is excluded in the scope of the works.

List of Scrutinizing Requests from Lao PDR and Subsequent Changes

No.	Requested Items	Request as Original		Request at the Survey Period		Change of Scope	Remarks
		Q'ty	Site	Q'ty	Site		
1	AIS Automation System	1 set	Vientiane (Terminal: Vientiane, Luang Phabang, Xieng Khouang, Savannakhet, Pakse, Paksong)	1 set	Vientiane (Terminal: Vientiane, Luang Phabang, Xieng Khouang, Savannakhet, Pakse, Paksong)	No changed	Lao side excluded it from their project and the system will be implemented by JP side.
2	AFTN/AMHS	1 set	Vientiane	1 set	Vientiane	Excluded	Already installed by the Lao side.
3	RCAG (En-route)	3 sites	Vientiane (sector 1 & 2) Savannakhet (sector 2) Xieng Khouang (sector 1 & 2)	3 sites	Vientiane (sector 1 & 2) Savannakhet (sector 2) Xieng Khouang (sector 1 & 2) Paksong (sector 2)	Changed	Addition Paksong site for improvement of Pakse RCAG coverage.
4	VHF A/G (Aerodrome/Approach)	5 sites	Vientiane (Aerodrome/Approach) Savannakhet (Aerodrome) Pakse (Aerodrome) Luang Phabang (Aerodrome) Xieng Khouang (Aerodrome)	5 sites	Vientiane (Aerodrome/Approach) Savannakhet (Aerodrome) Pakse (Aerodrome) Luang Phabang (Aerodrome) Xieng Khouang (Aerodrome)	No changed	
5	VHF A/G (Distress)	5 sites	Vientiane (Replacement) Savannakhet (New) Pakse (New) Luang Phabang (New) Xieng Khouang (New)	5 sites	Vientiane (Replacement) Savannakhet (New) Pakse (New) Luang Phabang (New) Xieng Khouang (New)	No changed	To clarify the number of requested equipment, VHF for distress showed separately.
6	VSAT System	3 lines	Vientiane - Xieng Khouang Vientiane - Savannakhet Vientiane - Pakse	3 lines	Vientiane - Xieng Khouang Vientiane - Savannakhet Vientiane - Paksong	Changed	VSAT station for RCAG and Radar was changed from Pakse to Paksong.
7	ILS	1 set	Vientiane	1 set	Vientiane	No changed	
8	Flight Procedure Design System	1 set	Vientiane	1 set	Vientiane	No changed	
9	Soft Component	1 set	Assistance for Equipment Operations	1 set	Assistance for Equipment Operations	Changed	Operational Guidance by the Manufacture.

The outline design is carried out following basic principles;

- Procured equipment should be necessary to satisfy the ICAO requirements.
- Procured equipment should have the same functionality and characteristic as existing equipment.
- Replacement and installation of the equipment are implemented at the same site basically.

The bidding for procurement of the systems and equipment is carried out as one package since equipment procured in the Project is only a part of CNS/ATM systems and no building construction or procurement of special vehicles are included in the scope of the Project.

Outline of specification and configuration for major equipment are shown below;

Major specification/configuration

Equipment	Major specification/configuration	Q'ty
AIS Automation System	• Flight Plan Processing, Validation, Distribution and retrieval Management Function • MET Data Processing, Validation, Distribution and retrieval Management Function • NOTAM Operation and Data Management Function • e-AIP Generation and Management Function • Basic/Static Data management Function • Web Function – NOTAM	1 set
VHF Air to Ground Communication for En-route (RCAG)	Frequency: 118 – 137MHz, Output : 50W	Transmitter :12 sets Receiver :12 sets

Equipment	Major specification/configuration	Q'ty
VHF Air to Ground Communication for Aerodrome/Approach/Distress)	Frequency :118 – 137MHz, Output : 5W～50W	Transmitter :22 sets Receiver :22 sets
VSAT System	Frequency :C band, Antenna for hub station: 3.8m, Antenna for remote station: 2.4m (3 stations)	1 set
Instrument Landing System	Localizer, Glide Path, Terminal DME	1 set
Flight Procedure Design System	The System shall be able to design the flight procedure in accordance with ICAO PANS-OPS Volume 2 Fifth Edition Amendment Number 2.	1 set

Responsibility of the works to be implemented by the Lao PDR is as follows;

- Site preparation including building construction at Paksong Radar Site
- Construction of new control tower at Luang Phabang
- Construction of new office building at Pakse
- Construction of new RCAG building at Savannakhet
- Dismantle, relocation, power feeder and communication line for Equipment

4. Implementation Schedule and Cost of the Project

The project implementation schedule for detailed design is four months and for procurement/installation of equipment, commissioning and taking over of the equipment is seven teen months. The cost of works, which needs to be conducted by Lao side when the Project is to be implemented, is a total of 62,000,000 Kip.

5. Project Evaluation

The result of verification for relevance and expected quantitative and qualitative effectiveness by implementing the Project are as follows:

(1) Relevance

1) The Subject of Benefit

The direct subject for benefit of the Project is the aircraft which flies Vientiane FIR and domestic airports including passenger and air cargo, and the entire Lao PDR nation is the beneficiary on the society and economy by trade and international exchange indirectly.

2) Project Objective

The project objective is to promote introduction of new CNS/ATM Systems to modernize existing ATC and Nav-aid in Lao PDR based on the JICA M/P which recommends improvement in the throughput of air traffic management, strengthening of air safety and efficient aircraft operation by carrying out development of CNS/ATM Systems with the pace of development by neighboring countries, and the Project contributes the stability of public welfare and better life for the nation widely through securing safety of gateway, which is able to interact with foreign countries directly.

3) Consistency with Medium and Long Term Objectives

The Project will be implemented in accordance with the objective of aviation sector specified in the 7th National Economic Development Plan (NSEDP) such as ensuring safety and modernization of ATC, increment of passenger by expanding of medium-long

distance air route, and increase of 4.5 to 6.5% of annual domestic flights and increase of 8 to 10 % of annual air traffic volume.

4) Consistency with Japan's ODA Policy

JICA M/P was carried out from 2009 to 2010 and formulated development plan required for introduction of a new system, human-resources development and proposed technical standard for maintenance, etc. are supported. Further, technical cooperation program "The Project for the Capacity Development for Transition to the New CNS/ATM Systems in Cambodia, Lao PDR and Vietnam" is being implemented from 2010 to support human-resources development as a main purpose. From this point of view, the Project is consistent with those series of aid policy and plan by Government of Japan.

(2) Quantitative Effectiveness

Quantitative Effectiveness

Items of Index	Basis (year 2011)	Target (year 2017) 【3 years after completion】
The number of over flight aircraft (1000/year)	118.4	154.4
The number of departure and approach aircraft at airports (1000/year)	27.8	36.9
Reliability of ILS at Vientiane International Airport (Antenna VSWR)	70%	More than 95%
Reliability of ATC communication channel	92.6%	99.9%

(3) Qualitative Effectiveness

Expected qualitative effectiveness by introduction of major system equipment in the Project is as follows:

① Possible to avoid making mistake and enhance AIS operational efficiency by unified information management.

② Possible to secure aircraft operational safety by enhance reliability of air to ground communication.

③ Possible to deal with demand of increasing flight within the region by establishing efficient air route.

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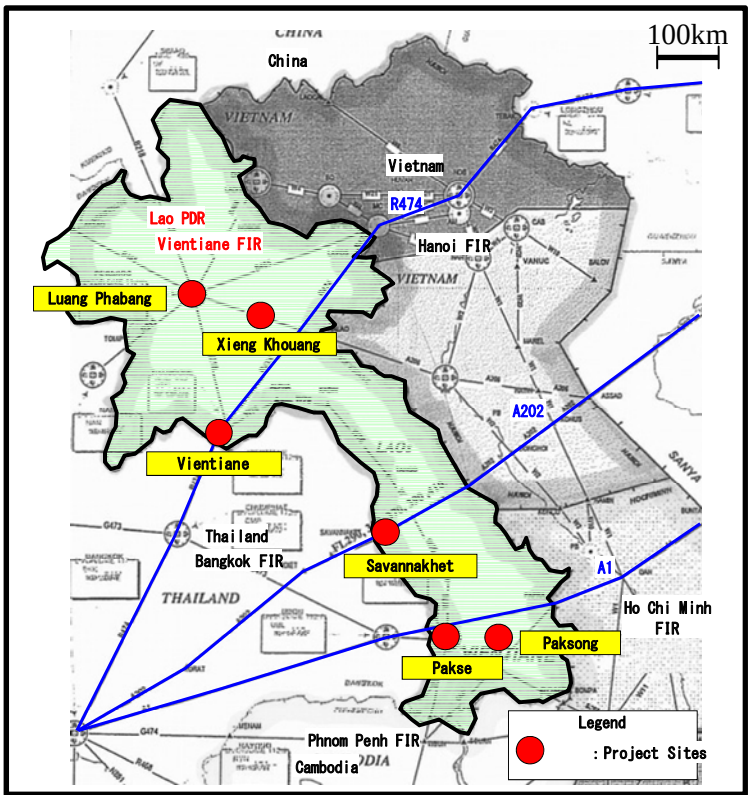
Location Map

Location Map



Project Sites

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Abbreviations

A	
A/G	Air-Ground
ACC	Area Control Center
AFTN	Aeronautical Fixed Telecommunication Network
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
AMHS	Aeronautical Message Handling System
APP	Approach Control
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Services
C	
CNS	Communications, Navigation, Surveillance
D	
DME	Distance Measuring Equipment
F	
FIR	Flight Information Region
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
M	
MSSR	Monopulse SSR
N	
NM	Nautical Mile
P	
PSR	Primary Surveillance Radar
R	
RCAG	Remote Center Air to Ground
R/W	Runway
S	
SSR	Secondary Surveillance Radar
V	
VHF	Very High Frequency
VOR	VHF Omni directional Radio-Range
VSAT	Very Small Aperture Terminal
VCCS	Voice Communication and Control System

Chapter 1
Background of the Project

Chapter1 Background of the Project

The Lao PDR is landlocked country with the area of 236,800 square kilometers. Most of the land is mountainous area and a lot of abundant forest resources remain in the country compare to neighboring countries. The Mekong River flows through the country and is not only the border with Thailand but is utilized for water transportation for the people. The population of the Lao PDR is 6.56 million in 2011 and is increasing at the pace of 100 thousand per annual from 2000.

The climate of Lao PDR is tropical monsoon and has typically two seasons with rainy and dry period. The rainy season is approximately from May to November while the dry season is from December to April. The average annual temperature is approximately 28 degree Celsius and the highest temperature approximately 38 degree Celsius in April and May. The lowest temperature at capital of the Lao PDR, Vientiane, is 19 degree Celsius while mountainous area becomes 14 or 15 degree Celsius in winter and below zero sometime at night time. The southern part of Lao PDR is the highest rainfall area, and more than 3,000mm of annual precipitation is recorded in Annamite Range. In Vientiane, precipitation is approximately from 1,500 to 2,000mm while northern part of Lao PDR is approximately from 1,000 to 1,500mm.

As Lao PDR has a relatively large territory as compared to its population, the air transport has been playing very important role in movements of passengers and goods as well as in regional development. The airspace in Lao PDR (Vientiane Flight Information Region) has several busy air routes connecting eastern and western capital city with dense flight in South-East Asia, Growth rate of over flight from 2009 to 2010 is about 17%. However, this growth rate was caused that the number of over flight in 2009 fell off due to economic depression assumed by the Lehman shock, and then it recovered in 2011 with high value. The average of growth rate from 2008 to 2011 is 10% while the number of taking-off and landing shows an average of about 30% as high growth.

Provision of proper air traffic management services for the Lao PDR is recognized imperative in order to improve air traffic control (ATC) capability, ensure safe and efficient aircraft operations. However, the status of existing ATC and Nav-aids system in Lao PDR is not sufficiently developed at present.

In order to solve this sort of problems arising all over the world, ICAO requires the contracting states to introduce a new technology for air traffic management and control, namely “New CNS/ATM Systems”.

The Lao PDR is implementing economic development plan as a national strategy for every five years. The 7th National Economic Development Plan (NSEDP), which is targeted from 2011 to 2015, announced accelerating national economy by strengthening of industrial modernization, and set a target for becoming independent developing country. For development of the aviation sector, it is aimed to improve the ability of air traffic management in order to deal with increasing of air traffic demand, and set several concepts such as ensuring safety and modernization of ATC, increment of passenger by expanding of medium and long distance air route, and increase of 4.5 to 6.5% of annual domestic flights and increase of 8 to 10 % of annual air traffic volume.

In line with the back ground above mentioned, JICA implemented the master plan study named “Master Plan Study on the Development of the New CNS/ATM Systems in Cambodia, Lao PDR and Vietnam” to formulate the introduction plan for new CNS/ATM systems in 2009.

The overall goal of the Project is that improve the safety of aircraft operation, increase

airspace capacity by selecting efficient flight course and improve reliability of ATC can be realized by modernization of CNS/ATM Systems in Lao PDR.

This Grant Aid Project (hereinafter referred to as the “Project”) is planned by request from Lao PDR prepared based on the JICA M/P as an overall goal to modernize CNS/ATM facilities in Lao PDR, and is aimed to promote introduction of new CNS/ATM systems.

Chapter 2
Contents of the Project

Chapter2 Contents of the Project

2.1 Basic Concept of the Project

(1) Overall Goal and Project Objective

The overall goal of the Project is that improve the safety of aircraft operation, increase airspace capacity by selecting efficient flight course and improve reliability of ATC can be realized by modernization of CNS/ATM Systems in Lao PDR. The Project is planned by request from Lao PDR prepared based on the JICA M/P, and its objective is to promote introduction of new CNS/ATM Systems to modernize existing ATC and Nav-aid in Lao PDR.

(2) Summary of the Project

The Project will be implemented as Japan's grant aid for procurement and installation of new system equipment for major airports and educational training for maintenance staff based on the preliminary survey result and in close cooperation with the ongoing technical cooperation program "The Project for the Capacity Development for Transition to the New CNS/ATM Systems in Cambodia, Lao PDR and Vietnam".

Introduction of the New CNS/ATM Systems and educational training would make it possible to reduce separation distances between aircrafts as well as to dualize air routes, thus tremendously increasing the aircraft handling capacity of the air routes and enabling more efficient flight routes between origins and destinations. Furthermore, enhancement of more reliable ATC operation will be expected by introduction of VSAT system and replacement of existing aged equipment.

Based on the expected results above mentioned, the Project will achieve overall goal.

Expected results by introduction of new system equipment in the Project are shown below, and all facilities are scheduled to be operational in early 2015 after installation.

- Increment of flight capacity and efficiency on the en-route
  - AIS Automation System : 1 set
  - Flight Procedure Design System : 1 set
  - Operational Guidance for AIS Automation : Two months training
- Enhancement of Reliable ATC Operation and Flight Safety
  - Instrument Landing System : 1 set (replacement)
  - VSAT System : 4 stations (new)
  - VHF Air to Ground Communication for En-route (RCAG) : 3 stations (replacement), 1 set (new)
  - VHF Air to Ground Communication for Aerodrome and Approach : 5 stations (replacement)
  - VHF Air to Ground Communication for Distress : 5 stations (new/replacement)

The Project site is Vientiane, Luang Phabang, Xieng Khouang, Savannakhet, Pakse and Paksong.

Figure 2.1-1 shows the project site and Vientiane FIR & major international ATS routes.

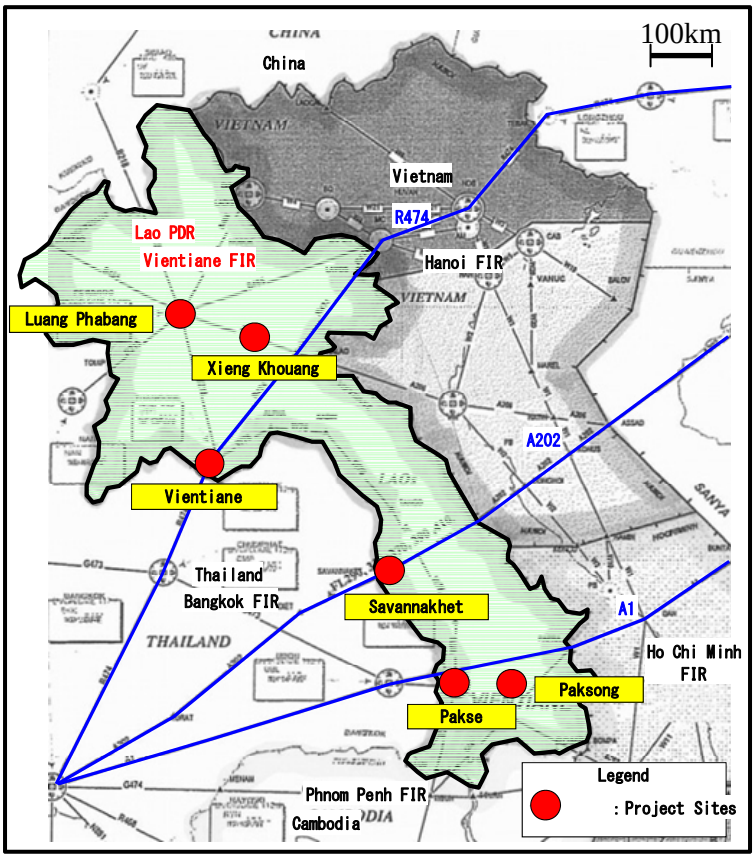

Figure 2.1-1 Project Site

2.2 Outline Design of the Japanese Assistance

2.2.1 Design Policy

(1) Design Principle

Since the project objective is to modernize existing CNS/ATM Systems, following principles should be taken into account by scrutinizing procurement items, which are requested by the Lao PDR.

- Be necessary to satisfy the ICAO requirements
- Contribute to the improvement of flight safety, enhancement of air traffic efficiency and increasing air traffic capacity
- Avoid duplication of scope of works against other project
- Implement continuous operation and maintenance for future by the budget of DCA and LATM

(2) Natural Conditions

The Lao PDR does not have its official Building Design Code established taking into account of the natural conditions inherent to Lao PDR such as earthquake: vibration, typhoon: wind speed, weather: outside temperature and humidity, etc.), and they have never experienced large scale earthquakes and typhoon passing though the country in Lao PDR, so that Lao PDR has moderate natural conditions comparatively.

Therefore, Japanese design conditions related to the natural conditions is used as the design basis in this Preparatory Study. Any commercial off-the-shell (readymade) products (COTS) should meet manufacturers' own standards.

The measure for power supply and lightning for operational equipment in Lao PDR adopts standard lightning measure, which is same method as specified "standard of Nav-aids facility installation in Japan", and there is no track record in particular faults for the system equipment. Therefore, Japanese design standard for Nav-aids should be used for the power supply system (stabilized power supply unit etc.) and lightning measure (double decentralization grounding etc.) as a design policy.

(3) Socio-economic Conditions

There is no specific constraint related to local customs, historic and cultural tradition, religion, building architecture, economy for the Project.

(4) Special Construction/Procurement/Commercial Practices

Development of CNS/ATM facility in Lao PDR is formulated by the project assistance from each country and entrusted procurement of the system equipment and maintenance work to the private company complicatedly, so that the scope of the project shall be decided by careful coordination and survey to avoid duplication of scope implemented by other donors, and system interface such as data protocol between existing and new system shall be secured and integrated technically.

(5) Utilization of Local Contractors and Consultants

Local contractors specializing in construction and electrical works who possess common and skilled labors as well as electricians will be utilized. Although there is no electrical contractor specializing in CNS/ATM system works, local contractors may be employed for the equipment installation and wiring under supervision of engineers dispatched from the main contractor in Japan or else.

(6) Operation and Maintenance

LATM who will be responsible for operation, maintenance and repair of the system/equipment to be provided under the Project possesses technical capability for the CNS/ATM Systems as a whole and positive sense of responsibility. Therefore, ILS and VHF air to ground facilities, which will be replaced by the Project, can be operated, maintained and repaired based on the current technical knowledge and personnel capability of LATM. The Aeronautical Information Service (AIS) automation system is the only new system constituting a part of the ICAO New CNS/ATM Systems. Operational guidance for AIS automation will be provided to LATM personnel by the manufacture of the Project for proper operation and maintenance of the new system. Since system operation cost such as telecommunication link fee etc. shall be paid by LATM after completing the system installation works, system design and selection of equipment type should be considered budgetary balance of LATM to implement proper system operation continuously.

(7) Design Grade of Facilities and Materials

Although the international standards and recommendations shall apply to the specifications of major systems and equipment to be procured under the Project, the specifications of Japan Civil Aviation Bureau will be applied from the procurement of Japanese product point of view. With regard to the standards related to quality and environment regulation, the specifications of Japan Civil Aviation Bureau will also be

applied. For the quality in particular, any commercial off-the-shell (readymade) products should be utilized to reduce maintenance costs after commencement of the operations as a worldwide trend in CNS/ATM Systems development.

(8) Method of Construction/Procurement and Work Scheduling

Some communication systems between ATC controller and pilot will be included in the scope of the Project. These systems need to be operational 24 hours a day to ensure safety of air traffic. Therefore, until switching over to a new system, the existing (old) system needs to be kept operational. The switching over should be conducted in the shortest time as long as possible.

With regard to the ILS at Vientiane International Airport, the ILS approach procedure cannot be available for a certain period of time during replacement. During such period of time, VOR/DME approach procedure should be utilized instead of ILS; however the approach minima will need to be downgraded from that of ILS, resulting in higher risk of flight cancelation and/or delay. In order to minimize such risk, the period of "ILS out of service" should be scheduled during the dry season (from June to October) as much as possible.

2.2.2 Basic Plan (Equipment Plan)

(1) Scrutinizing Requests from Lao PDR and Subsequent Changes

Table 2.2-1 shows a comparison between changes on the requests from Lao PDR before and after the site survey. There are four major changes as summarized below:

- Regarding the Aeronautical Fixed Telecommunication Network (AFTN)/ ATS Message Handling System (AMHS), Lao PDR has already introduced AMSS by the agreement with CIT Lao Ltd. for installation of the AMHS, as a next generation of AFTN/AMHS, and therefore AMHS has been excluded from the Project scope.

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- In relation to the additional provision of RCAG and SSR station at Paksong, the site for VSAT communication has been changed from Pakse to Paksong.

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Table 2.2-1 List of Scrutinizing Requests from Lao PDR and Subsequent Changes

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2	AFTN/AMHS	1 set	Vientiane	1 set	Vientiane	Excluded	Already installed by the Lao side.
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5	VHF A/G (Distress)	5 sites	Vientiane (Replacement) Savannakhet (New) Pakse (New) Luang Phabang (New) Xieng Khouang (New)	5 sites	Vientiane (Replacement) Savannakhet (New) Pakse (New) Luang Phabang (New) Xieng Khouang (New)	No changed	To clarify the number of requested equipment, VHF for distress showed separately.
6	VSAT System	3 lines	Vientiane - Xieng Khouang Vientiane - Savannakhet Vientiane - Pakse	3 lines	Vientiane - Xieng Khouang Vientiane - Savannakhet Vientiane - Paksong	Changed	VSAT station for RCAG and Radar was changed from Pakse to Paksong.
7	ILS	1 set	Vientiane	1 set	Vientiane	No changed	
8	Flight Procedure Design System	1 set	Vientiane	1 set	Vientiane	No changed	
9	Soft Component	1 set	Assistance for Equipment Operations	1 set	Assistance for Equipment Operations	Changed	Operational Guidance by the Manufacture.

(2) Design Policy for Specific System

1) AIS Automation System

AIS facility will be developed at Vientiane ATC center.

a) Outline Design Policy

Most of the information to be handled by AIS such as the flight plans, weather information and NOTAM are provided through AMHS. Therefore AMHS needs to be connected with AIS, and the interface specification of AIS needs to be compatible with preceding AMHS. Normally, a general interface common as a de facto standard such as ICAO Doc. 9880 is used. However, there are several cases reported that the manufacturer of a preceding system who used its own undisclosed interface required some payment for license, resulting in lengthy negotiation and delayed schedule. AMHS was already installed in Lao PDR, and proper interface, to be compatible with the already installed AMHS, should be provided to the new AIS to be installed under the Project. A general interface should in principle be in conformity with ICAO standard (ICAO Doc. 9880), and in case disclosure of the interface specification of and modification to the preceding AMHS are required, Lao side shall be responsible therefor.

In order to avoid risk of conflict between specifications of AIS (the Project) and existing AMHS, improvement of technical capability on overall system design including function of AMHS as well as AIS/AMHS general interface for LATM personnel is required and to be incorporated into the operational guidance implemented by the AIS manufacture.

b) Specifications

Table 2.2-2 shows major specifications of AIS, and Figure 2.2-1 presents a system diagram.

Table 2.2-2 Major Specifications for AIS Automation System

1. System Configurations

The AIS Automation System will consist of but not limited to the following components:

(1)	AIS Database / Management Server	:2 sets
(2)	Web Server	:2 sets
(3)	AIP Workstation	:2 sets
(4)	NOTAM Workstation	:2 sets
(5)	MET Workstation	:2 sets
(6)	AIS Terminal	:9 sets
(7)	System Management Workstation	:2 sets
(8)	UPS (500VAx2 and 3000VAx1)	:1 set
(9)	Shared Network Printer	:8 sets
(10)	GPS Clock	:2 sets
(11)	Redundant Fast Ethernet LAN	:1 lot
(12)	Firewall	:1 set
(13)	Load Balancer	:1 set
(14)	Internet Router	:1 set
(15)	Network Peripheral Switch	:2 sets
(16)	VPN Router	:5 sets
(17)	Rack	:1 lot
(18)	Desk/Chair	:17 sets
(19)	LAN Cable	:4 lots

2. Major Functions

Major function will be as follows:

(1) Flight Plan Processing, Validation, Distribution and retrieval Management Function
(2) MET Data Processing, Validation, Distribution and retrieval Management Function
(3) NOTAM Operation and Data Management Function
(4) e-AIP Generation and Management Function
(5) Basic/Static Data management Function
(6) Web Function – NOTAM

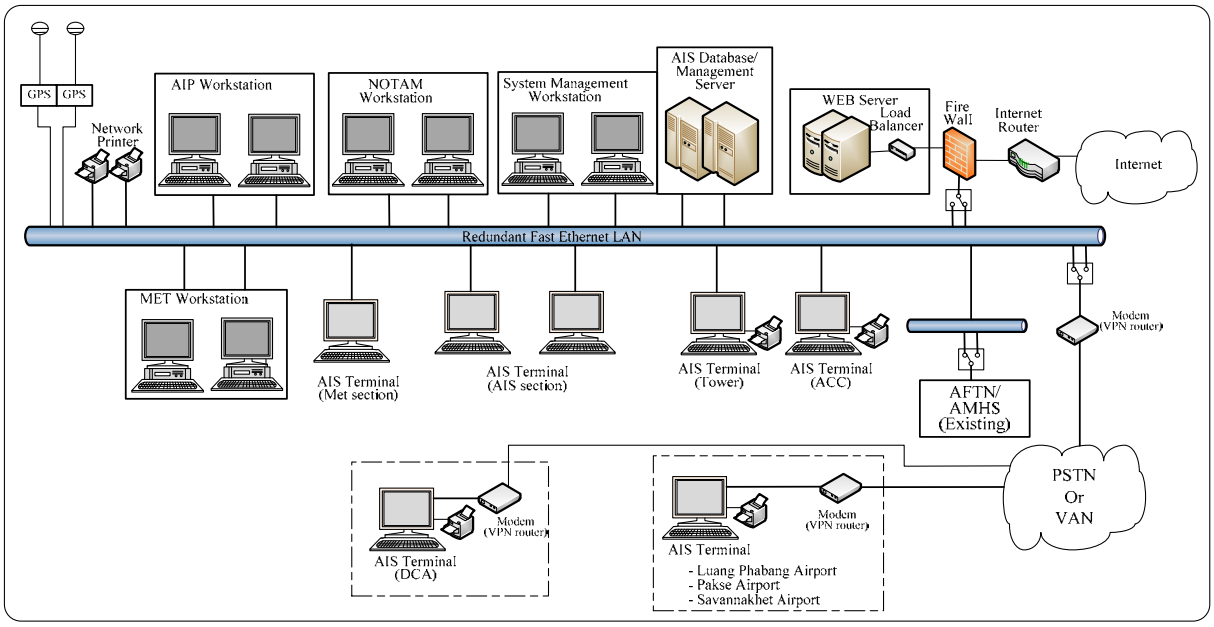


Figure 2.2-1 System Diagram of AIS Automation System

2) Remote Center Air to Ground (RCAG) for En-route

RCAG and VSAT systems will be provided at Xieng Khouang, Paksong, Savannakhet and Vientiane.

a) Outline Design Policy

- Equipment for the en-route air-to-ground communications shall be those specified in ICAO Annex 10 with range of VHF between 117.975 MHz and 137 MHz. Specifically, two frequencies, namely 124.1 MHz for the northern sector and 128.3 MHz for the southern sector should be used as their use was already coordinated with surrounding countries.

- The en-route air-to-ground communications cover the northern sector by 124.1 MHz and the southern sector by 128.3 MHz respectively and the en-route control is being done at Vientiane ACC. However, during off-peak hours such as night time, the frequency of 128.3 MHz only is to be used for entire Vientiane FIR. Therefore, two frequencies are to be provided to Vientiane and Xieng Khouang while single frequency (128.3 MHz) only is to be provided to Paksong and Savannakhet.

- The electrical characteristics (frequencies and their spacing, spurious radiation, output power, receiving performance, etc.) of VHF transmitters/receivers shall be in conformity with specification of ICAO Annex 10 or of Japan Civil Aviation Bureau.

- For receiving of voice signals from Xieng Khouang, Savannakhet and Paksong as well as transmission of voice signals from Vientiane ACC to other RCAG stations, dual network lines, consisting of VSAT and the existing ground line of the existing telephone company should be provided.

- When receiving voices through VSAT, a delay of signal occurs. In order to synchronize with voices from Vientiane, signal delay units should be provided to receivers at Vientiane ACC.

- VHF transmitters and receivers should be such that they can be housed in 19-inch rack, and their location should be determined through coordination with LATM.

- As the existing communication antenna towers at each RCAG site still have vacant spaces, the new VHF antennas will be provided to the existing antenna towers.
- Intermodulation problem will not arise as there are two frequencies to be used; however adequate separation distances between antennas will need to be provided taking into account horizontal and vertical separation distance requirements.

b) Specifications

Table 2.2-3 shows major specifications of RCAG system and Figure 2.2-2 presents system diagram of RCAG including VSAT satellite link.

Table 2.2-3 Major Specifications for RCAG

1. System Configurations

The RCAG will consist of the following components:

(1) VHF Antenna : 12sets
1) VHF Omni-directional Dipole Antenna : 12ea
2) Coaxial Arrester : 12ea
3) Coaxial Feeder Cable : 12ea

(2) VHF AM Transmitter/Receiver Equipment : 12sets
1) VHF AM Transmitter : 12ea
2) VHF AM Receiver : 12ea
3) ANT Changeover or Coaxial Switch/RF Divider : 12ea
4) Remote Control Equipment (Main) : 1ea
5) Remote Control Equipment (Site) : 4ea
6) UPS : 4ea
7) Equipment Rack : 4ea
8) Interconnecting Cables : 4lots

2. Major Technical Specifications

(1) VHF Antenna
1) Antenna Type : Broadband dipole –Omni-directional
2) Frequency : Aircraft band 118 to 137 MHz
3) Input Impedance : 50 ohms
4) VSWR : <1.5:1
5) Gain : 0dBd
6) Polarization : Vertical

(2) VHF AM Transmitter
1) RF Power Output
The RF carrier output power shall be adjustable in 1W steps from 5W to 50 W (as an option, the maximum selectable power can be limited).
2) Channel Spacing
The transmitters shall have the capability of both 25 kHz channel spacing and 8.33 kHz channel spacing.
3) Harmonic Outputs
Second harmonic outputs shall be less than -36dBm, third harmonic outputs shall be less than -46dBm and fourth harmonic outputs and above up to 4GHz, shall be less than -56dBm.

(3) VHF AM Receiver

1) Sensitivity
118 to 136.975MHz 12dB SINAD for -107dBm 30% modulated.
112 to 117.975MHz 12dB SINAD for -105dBm 30% modulated.
2) Channel Spacing AM-voice Mode : 25kHz, or 8.33kHz.
3) Audio AGC
The audio AGC compresses a 30% to 90% variation in input modulation depth to an audio output power change of 1dB or less.

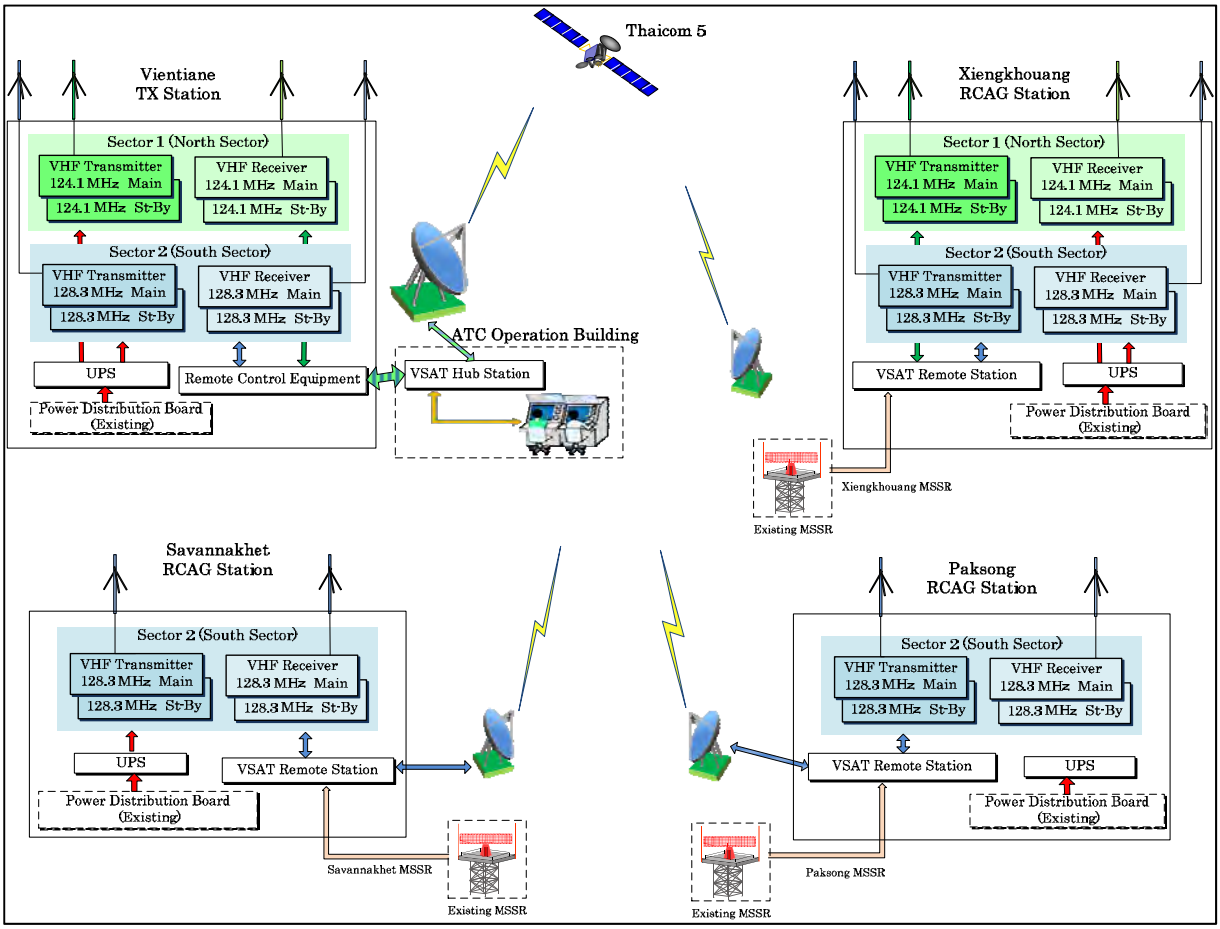
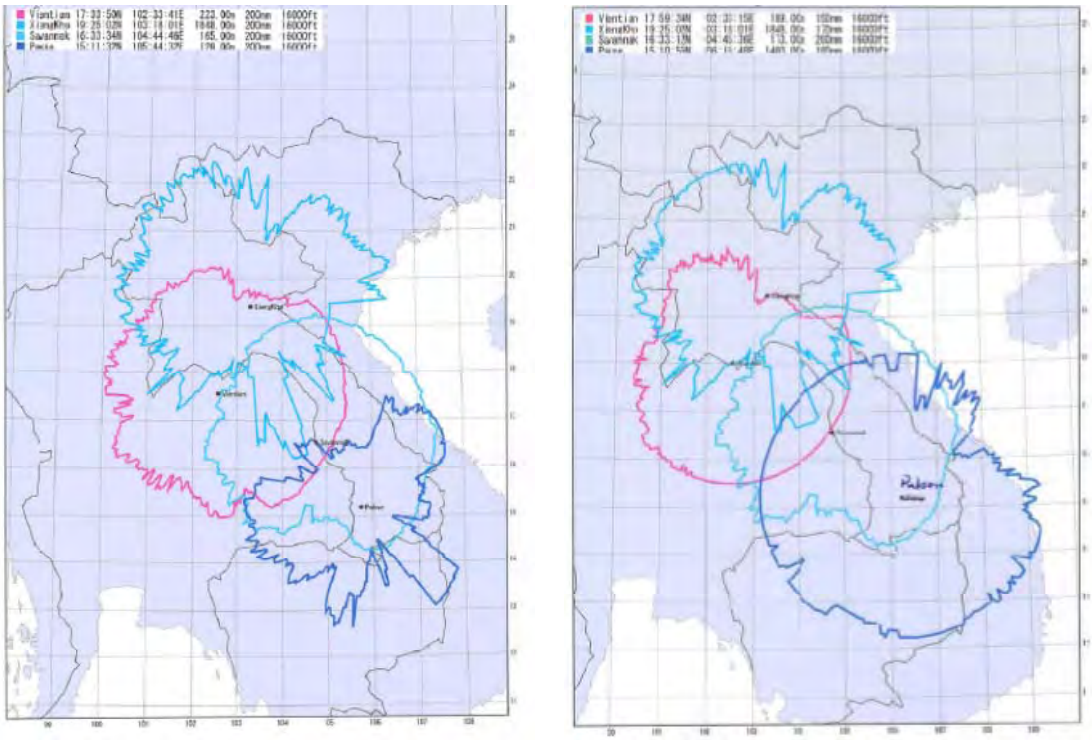


Figure 2.2-2 System Diagram of RCAG and VSAT System

c) Examination on Addition of RCAG Station at Paksong

RCAG station for the southern airspace of Vientiane FIR is located at Pakse. However, due to the surrounding terrain, a part of the southeastern airspace of the FIR is not covered by the RCAG service at Pakse, and LATM has been trying to solve this problem. Currently, LATM is constructing MSSR station at Paksong, and LATM conveyed its request to add another RCAG station there to the Survey Team. Careful examination by the Survey Team on the line of sight coverage revealed that the site at Paksong located on high elevation area can offer almost perfect coverage as shown in Figure 2.2-3. RCAG for direct communication between ATC personnel and pilots is a vital infrastructure to ensure safety of aircraft and efficient air traffic management, and improvement of air-to-ground communication coverage in the southern airspace of Vientiane FIR contributes to improving safety of air traffic. Therefore, the request has been accepted.



Pakse RCAG Coverage (Blue Line)　　Paksong RCAG Coverage (Blue Line)

Figure 2.2-3 Comparison of RCAG Coverage at Pakse and Paksong

3) Air to Ground Communications for Aerodrome/Approach and Distress

Air to Ground Communications Facility (Terminal/Approach and Distress): Vientiane International Airport

Air to Ground Communications Facility (Terminal and Distress): Luang Phabang, Xieng Khouang, Savannakhet and Pakse Airports

a) Outline Design Policy

- Equipment for the air-to-ground communications shall be those specified in ICAO Annex 10 with range of VHF between 117.975 MHz and 137 MHz. Specific frequency should be allocated to each of the airports after domestic coordination in Lao PDRs (118.1 MHz for terminal and 119.7 MHz for approach at Vientiane, 118.5 MHz for approach at Luang Phabang, Xieng Khouang, Savannakhet and Pakse). A frequency of 121.5 MHz is to be allocated to each of the airports for distress.

- The electrical characteristics (frequencies and their spacing, spurious radiation, output power, receiving performance, etc.) of VHF transmitters/receivers shall be in conformity with specification of ICAO Annex 10 or of Japan Civil Aviation Bureau.

- VHF transmitters and receivers should be such that they can be housed in 19-inch rack, and their location should be determined through coordination. A remote control unit for ATC personnel to control the VHF transmitters/receivers should be provided in a control tower.

- VHF antenna should be installed at high position where line-of-sight obstruction should not exit, and the roof of control tower has been chosen for VHF antenna

installation.

- Intermodulation problem will not arise as there are two frequencies to be used, however adequate separation distances between antennas will need to be provided taking into account horizontal and vertical separation distance requirements.

b) Specifications

Table 2.2-4 shows major specifications of the air to ground communications for aerodrome/approach and distress while Figure 2.2-4 shows a system diagram.

Table 2.2-4 Major Specification of Air to Ground Communications (Aerodrome/Approach and Distress)

1. System Configurations

The Aerodrome/Approach/Emergency VHF air to ground communication system will consist of the following components:

(1) VHF Antenna	:	22sets
1) VHF Omni-directional Dipole Antenna	:	22ea
2) Coaxial Arrester	:	22ea
3) Coaxial Feeder Cable	:	22ea
(2) VHF AM Transmitter/Receiver Equipment	:	22sets
1) VHF AM Transmitter	:	22ea
2) VHF AM Receiver	:	22ea
3) ANT Changeover or Coaxial Switch/RF Divider	:	22ea
4) UPS(1500VA)	:	2ea
5) UPS(1000VA)	:	2ea
6) Remote Control Unit (Main)	:	4ea
7) Remote Control Unit (Site)	:	4ea
8) Equipment Rack	:	6ea
9) Interconnecting Cable6	:	6lots

2. Major Technical Specifications

(1) VHF Antenna

1)	Antenna Type	: Broadband dipole –Omni-directional
2)	Frequency	: Aircraft band 118 to 137 MHz
3)	Input Impedance	: 50 ohms
4)	VSWR	: <1.5:1
5)	Gain	: 0dBd
6)	Polarization	: Vertical

(2) VHF AM Transmitter

1) RF Power Output
The RF carrier output power shall be adjustable in 1W steps from 5W to 50 W (as an option, the maximum selectable power can be limited).

2) Channel Spacing
The transmitters shall have the capability of both 25 kHz channel spacing and 8.33 kHz channel spacing.

3) Harmonic Outputs
Second harmonic outputs shall be less than -36dBm, third harmonic outputs shall be less than -46dBm and fourth harmonic outputs and above up to 4GHz, shall be

less than -56dBm.

(3) VHF AM Receiver

1) Sensitivity
118 to 136.975MHz 12dB SINAD for -107dBm 30% modulated.
112 to 117.975MHz 12dB SINAD for -105dBm 30% modulated.

2) Channel Spacing AM-voice Mode : 25kHz, or 8.33kHz.

3) Audio AGC
The audio AGC compresses a 30% to 90% variation in input modulation depth to an audio output power change of 1dB or less.

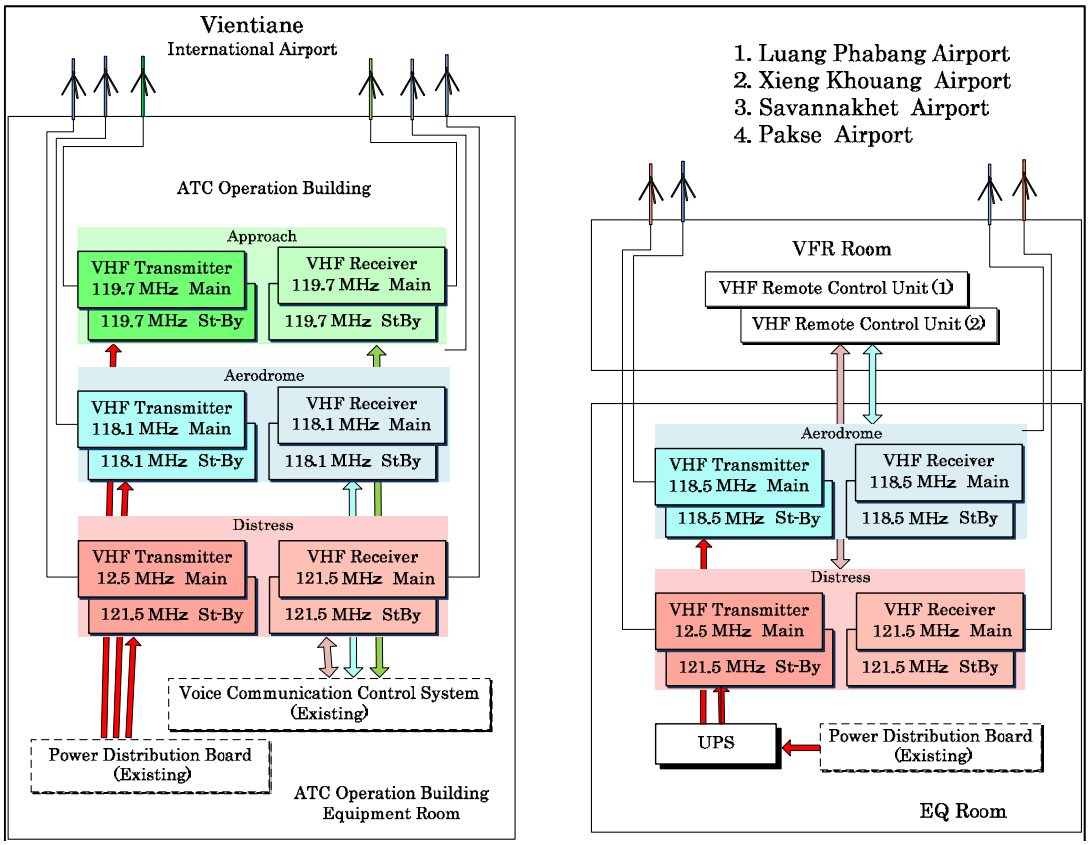


Figure 2.2-4 System Diagram for Air to Ground Communications (Aerodrome/Approach and Distress)

4) Communication Link Channel (VSAT)

Number of lines for each of the communication pairs is as follows:

- Between Vientiane and Xieng Khouang: 3CH
  RCAG (128.3MHz) One channel
  RCAG (124.1MHz) One channel
  Radar (MSSR) One channel
- Between Vientiane and Savannakhet: 2CH
  RCAG (124.1MHz) One channel
  Radar (MSSR) One channel
- Between Vientiane and Paksong: 2CH
  RCAG (124.1MHz) One channel
  Radar (MSSR) One channel

a) Outline Design Policy

- Air to ground communication voice between controller and pilot by each RCAG site and aircraft surveillance data from each radar site are transmitted though communication link such as optic-fiber cable and microwave radio link of telecommunication service providers in Lao PDR. However, the air traffic control has some safety issues since this communication link has cut off instantly sometimes due to low reliability channel. According to the statics of communication failure by LATM, reliability of communication link (cut-off time/operation hours) was 92.6% of annual average in 2011. After completion of the Project, 99.9% of communication reliability will be expected by dual operation, which consists of new VSAT link and existing telecommunication link.
- A satellite for VSAT shall meet equipment specifications compatible with Thaicom 5.
- The VSAT system shall consist of one hub station at Vientiane and three substations at Xieng Khouang, Savannakhet and Paksong.
- There are two bands of satellite frequency; Ku band (10.6 GHz to 15.7 GHz) and C band (3.4 GHz to 7.0 GHz), of which choice should be made based on specification offered by a service provider. Parabola antenna diameter should be decided based on a design result by the service provider.
- There are two types of VSAT communication link; dedicated (or exclusive) and random. As the radar data and ATC communications are to be maintained 24 hours a day for aviation safety and use of the dedicated line is recommendable.
- The VSAT transmitters and receivers as well as satellite modem should be placed in the equipment room. Exact location should be coordinated with LATM. At Vientiane, an antenna should be installed on the roof of second floor of the operation building, while at Xieng Khouang, Savannakhet and Paksong, the antennas will be installed on the ground through coordination with LATM.

b) Specifications

Table 2.2-5 shows major specifications of VSAT.

Table 2.2-5 Major Specifications of VSAT

1. System Configurations

The VSAT System will consist of but not limited to the following components:

(1) VSAT HUB Station Equipment : 1 set

1)	Antenna (3.8φ)	:	1ea
2)	Transceiver(C-Band) 50W	:	1ea
3)	LNA (Low Noise Amplifier)	:	1ea
4)	Satellite Modem (7CH)	:	1ea
5)	Accessories	:	1ea

(2) VSAT Remote Station Equipment : 3 set

1)	Antenna (2.4φ)	:	3ea
2)	Transceiver (C-Band) 20W	:	3ea
3)	LNA (Low Noise Amplifier)	:	1ea
4)	Satellite Modem (3CH)	:	1ea
5)	Satellite Modem (2CH)	:	2ea
6)	Accessories	:	3ea

2. Major Technical Specifications

(1) Antenna
1) Size : 2.4m and 3.8m (Circular)
2) Operation Frequency Receive : 3.625 – 4.2 GHz
Transmit : 5.850 – 6.425 GHz
3) VSWR : 1.3:1 max.

(2) Transceiver

Transmit
1) Frequency RF : 5845 to 6425 MHz
2) Frequency IF : 70 MHz ±18MHz
3) Output Power : 20W (43dBm), 25W (44dBm) 50W (47dBm)

Receiver
1) Frequency RF : 3625 to 4200 MHz
2) Frequency IF : 70 MHz ±18MHz
3) Gain, without LNA : 45dB

5) Instrument Landing System (ILS)

ILS will be installed at Vientiane International Airport.

a) Outline Design Policy

- The existing ILS, consisting of Localizer (LLZ), Glide Path (GP) and Terminal Distance Measuring Equipment (T-DME), was installed 14 years ago, and some problems such as error in the standing wave ratio (VSWR) of GP antenna are observed. The manufacturer of this ILS already stopped manufacture of this type of equipment, and spare parts are not available. Therefore, LLZ/GP/T-DME equipment as well as the antennas should be replaced under the Project.

- Deterioration such as rust is observed on the existing GP antenna mast. The mast may be further utilized after repainting on site. In order to minimize the ILS unserviceable period, the existing foundations of LLZ/GP/T-DME antennas should be reutilized.

- According to information from LATM, power supply cubicle (power incoming panel) and power cables have been working well. Generally, power supply equipment and cable have relatively long life cycle, and the existing ones could still be utilized further (high voltage fuses, circuit breakers, low voltage circuit breakers are to be provided as spare parts). However, the power supply units for LLZ and GP/TDME which house batteries, etc. should be renewed so that system integrity can be ensured.

- The communication network between LLZ/GP/T-DME and a remote control and monitoring system should be of radio link in order to reduce the cabling works and minimize system closure inherent to this work.

b) Specifications

Table 2.2-6 shows major specifications of ILS and Figure 2.2-5 shows its system diagram.

Table 2.2-6 Major Specification of ILS

1. System Configurations

The ILS will consist of but not limited to the following components:

(1) Localizer : 1 set
1) Transmitter unit : 1ea
2) LPD antenna : 1set
3) Power Supply Unit (Battery) : 1ea

(2) Glide path : 1 set
1) Transmitter Unit : 1ea
2) GP antenna : 1set
3) Monitor Antenna : 1set
4) Power Supply Unit (Battery) : 1ea

(3) Terminal DME : 1 set
1) Transponder unit (100W) : 1ea
2) DME antenna : 1set

(4) Remote Maintenance Monitoring System (RMMS): 1 set

(5) Remote Control and Status Unit (RCSU) : 1 set

(6) Remote Control Wireless System : 2 sets

2. Major Technical Specifications

This fully solid-state ILS shall compliant with ICAO Annex 10 standards and recommendations. The each subsystem will be of dual configuration. One transmitter will designate main and the other standby.

(1) Localizer Subsystem
1) Single frequency or Two-frequency localizer subsystem
2) Frequency
a. Range :108 to 111.975MHz, 50 kHz spacing
b. Stability :0.001% or less

(2) Glide Path Subsystem
1) Two-frequency glide path subsystem
2) Carrier two-frequency
a. Range :328.6 to 335.4MHz, 50 kHz spacing
b. Stability :0.001% or less

(3) Terminal DME
1) Frequency range :960MHz to 1,215MHz
2) Frequency setting :Synthesizer controlled
3) Channels :252 (X and Y mode)

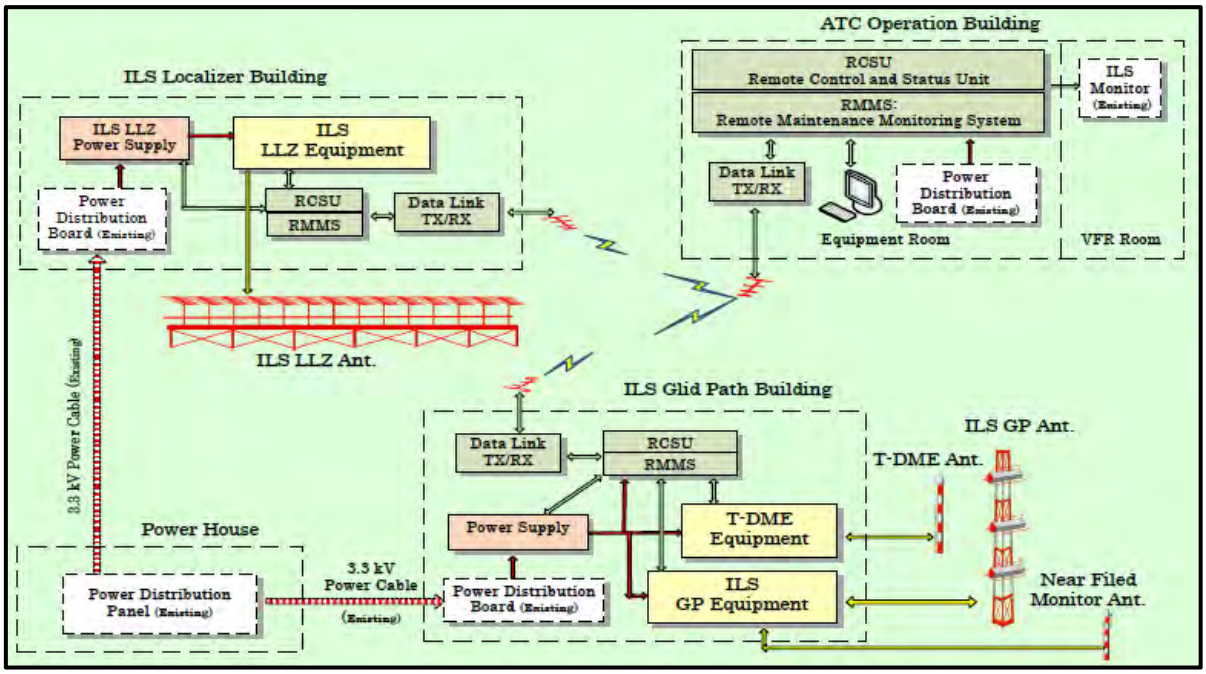


Figure 2.2-5 ILS System Diagram

6) Flight Procedure Design System

The Lao PDR requested provision of one set of software for design of the Performance-Based Navigation (PBN) flight procedure. As a result of examination, it has been concluded that the software to be provided to the Lao PDR should be the same as one used in Hanoi where LATM personnel were trained and got familiarized. Reasons are described below.

a) Outline Design Policy

Under the "Project for the Capacity Development for Transition to the New CNS/ATM Systems in Cambodia, Lao PDR and Vietnam", software for design of PBN flight procedure has been provided to the Flight Procedure Center in Hanoi and JICA experts were dispatched there as a part of JICA Technical Cooperation Project who have been in charge of practical training for design of the PBN flight procedures. Trainees are invited to learn in Hanoi from Vietnam, Lao PDR and Cambodia. At present, two long-term experts dispatched by JICA are staying in Hanoi to provide the training. Comments from two long-term experts of JICA are listed below.

- Hanoi Education Center is capable of providing training for ATC personnel from Vietnam, Lao PDR and Cambodia.
- Data base of airports in Vietnam, Lao PDR and Cambodia were installed in the PBN Flight Procedure Design Software.
- During JICA Technical Cooperation Project period, updating the software in accordance with recommendations of ICAO is to be conducted at the expense of the JICA Project, but after its completion, updating and maintaining the software including database should be carried out by recipient countries.
- Training covers wide range starting from basic PBN design to the maintenance and management of the software for PBN design.

- It is considered desirable to provide PBN design software exclusive for LATM as the software should be maintained by each of the recipient countries after completion of the Technical Cooperation Project. Ideally, two sets of the software should be obtained, one for procedure design and the other for verification of the designed procedure.
- The software developed by NTT Data of Japan is being used for training in Hanoi. As trainees dispatched by LATM are already familiar with the software, it is considered desirable to procure the same software for LATM.

It should be noted that because the cost for maintaining software after procurement is very high, number of the software is limited to one.

b) Specifications

Table 2.2-7 shows major specification of PBN flight procedure design system.

Table 2.2-7 Major Specification of PBN Flight Procedure Design System

1. System Configurations

The Flight Procedure Design System will consist of the following components:

(1) Flight Procedure Design Software	:	1 set
(2) CAD/GIS Software	:	1 set
(2) PC Terminal	:	1 set
(3) Monitor Display	:	1 set
(4) Switching Hub	:	1 set
(5) Firewall	:	1 set
(6) Printer	:	1 set
(7) UPS	:	1 set

2. Major Requirements and Technical Specifications

- The System shall be able to design the flight procedure in accordance with ICAO「PANS-OPS Volume 2 Fifth Edition Amendment Number 2」.
- The System shall be able to design conventional flight procedure, RNP flight procedure and RNP APCH AR.

1) PC Terminal

(1) CPU	:	Intel(R) Xeon(R) W5580
(2) Memory	:	4GBHDD: 1.5TB RAID1
(3) Graphic Controller	:	NVIDIA(R) Quadro (R) FX3800 1GB DDR3

2) Monitor Display : 19 inch TFT monitor

(3) Policy for Equipment Installation at Sites

1) Vientiane International Airport and ACC

a) Scope of Works

List of the equipment to be installed at Vientiane International Airport and Area Control Center and their locations are shown in Table 2.2-8 and Figure 2.2-6 respectively.

Table 2.2-8 List of Major Equipment for Vientiane International Airport and ACC

Subsystem	Equipment	Q'ty	unit	Location	Remarks
AIS Automation System	AIS Database/management server	1	set	ATC Ope-Build. FIC room	Redundant Config.
	Web Server	1	set	ATC Ope-Build. FIC room	Redundant Config.
	System Management Workstation	1	set	ATC Ope-Build. FIC room	Redundant Config.
	Internet Router	1	set	ATC Ope-Build. FIC room	
	Firewall	1	set	ATC Ope-Build. FIC room	
	GPS Clock	1	set	ATC Ope-Build. FIC room	Redundant Config.
	AIP Workstation	1	set	ATC Ope-Build. AIS room	Redundant Config.
	NOTAM Workstation	1	set	ATC Ope-Build. AIS room	Redundant Config.
	MET Workstation	1	set	ATC Ope-Build. AIS room	Redundant Config.
	AIS Terminal	6	set	ACC, Tower, AIS room(2),Met room, DCA	
	Fast Ethernet LAN	1	set	ATC Operation Building	Redundant Config.
	AIS Printer	5	set	ATC Operation Building	
	Modem (VPN Router)	2	set	ATC Ope-Build. FIC room	
	UPS	2	set	AIS room (2), DCA	3kVA-1, 500VA-1
RCAG （En-Route）	VHF Transmitter/Antenna Changer	2	set	RCAG Building	Main-Standby 50W
	VHF Receiver/Antenna Changer	2	set	RCAG Building	Main-Standby
	VHF Antenna	4	set	RCAG Building	Including coaxial arrester, cable
	Remote Control Unit	1	set	RCAG Building	
	Best Signal Selection/Delay unit	1	set	RCAG Building	
	UPS	1	set	RCAG Building	1kVA
	Main Remote Control Equipment	1	set	ATC Ope-Build. EQ room	
VHF A/G （Aerodrome /Approach）	VHF Transmitter/Antenna Changer	1	set	ATC Ope-Build. EQ room	Main-Standby 10W
	VHF Transmitter/Antenna Changer	1	set	ATC Ope-Build. EQ room	Main-Standby 50W
	VHF Receiver/Antenna Changer	2	set	ATC Ope-Build. EQ room	Main-Standby
	VHF Antenna	4	set	ATC Ope-Build. top roof	Including coaxial arrester, cable
VHF A/G （distress）	VHF Transmitter/Antenna Changer	1	set	ATC Ope-Build. EQ room	Main-Standby 50W
	VHF Receiver/Antenna Changer	1	set	ATC Ope-Build. EQ room	
	VHF Antenna	2	set	ATC Ope-Build. Top roof	Including coaxial arrester, cable
VSAT system	VSAT Transceiver	1	set	ATC Ope-Build. EQ room	Capacity：7CH more
	Satellite Modem	1	set	ATC Ope-Build. EQ room	Capacity：7CH more
	VSAT Antenna	1	set	ATC Ope-Build. Top roof	
ILS	LLZ Equipment	1	set	LLZ site	
	LLZ Antenna	1	set	LLZ site	
	GP Equipment	1	set	GP/T-DME site	2 frequency type
	GP Antenna with monitor antenna	1	set	GP/T-DME site	
	T-DME Equipment	1	set	GP/T-DME site	
	T-DME Antenna	1	set	GP/T-DME site	
	LLZ Power Supply (Battery)	1	set	LLZ site	

Subsystem	Equipment	Q'ty	unit	Location	Remarks
	GP/T-DME Power Supply(Battery)	1	set	GP/T-DME site	
	S Remote Control & Monitoring System	1	set	ATC Ope-Build. EQ room	
	ILS Remote Control Wireless System	2	set	LLZ/GP/T-DME site, Tower	Including modem
	Load Break Switch/Fuse	1	set	LLZ/GP/T-DME site	Spear Parts
	Low-voltage Breaker	1	set	LLZ/GP/T-DME site	Spear Parts
	Air Conditioner	4	set	LLZ/GP/T-DME site	
Flight Procedure Design System	Flight Procedure Design Software	1	set	DCA	
	Database Server/ PC terminal /Display	1	set	DCA	
	Switching Hub	1	set	DCA	
	Firewall	1	set	DCA	
	Printer	1	set	DCA	
	UPS	1	set	DCA	1500VA

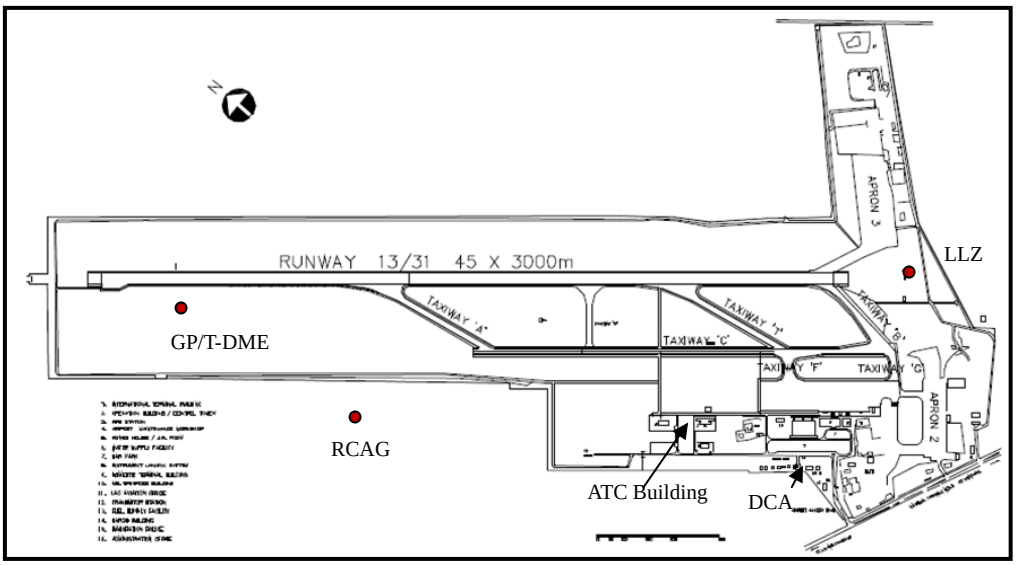


Figure 2.2-6 Vientiane International Airport Layout Plan

b) Items of Consideration for Installation Works

The policy of installation works for requested equipment and the works of responsibility which is implemented by the Lao side are as follows:

- Each subsystem of AIS Automation System such as Database Management Server, System management Workstation and Web Server will be installed at FIC room in the second floor of ATC Operation Building, and each Workstation for NOTAM, AIP and MET will be installed at AIS room in the first floor of ATC Operation Building.

Scope of Responsibility by the Lao side No.1:

Since there are several equipment which do not operate at the equipment room and FIC room, those equipment and office desks should be dismantled or relocated by the Lao side to make installation space for AIS system. Necessary power feeders (3kVA and 0.5kVAx2) for the new system equipment at each room should be provided.

- Transmitters and receivers for RCAG will be installed at equipment room in the RCAG building, and antennas will be installed on the top of existing antenna tower. Main remote control equipment of RCAG will be installed at equipment room in the ATC operation building.

Scope of Responsibility by the Lao side No. 2:

Cable installation and connection for VHF voice in-output signal between RCAG remote control equipment and existing VCCS at equipment room in the ATC operation building will be implemented by the Japanese side. Collaboration with Lao side will be needed for the above works.

- VSAT transceiver will be installed in the RCAG main remote control equipment rack.

Scope of Responsibility by the Lao side No. 3:

Since there are several equipment which do not operate at the equipment room, those equipment should be dismantled or relocated by the Lao side to make installation space for VSAT equipment. Cable installation and connection for output of radar data and VHF voice line from the VSAT communication equipment should be carried out by the Lao side.

- Transmitters and receivers of VHF air to ground communication facility for Aerodrome & Approach control and distress will be installed at equipment room in the ATC operation building 2nd floor.
- VHF Antennas for Aerodrome & Approach control and Distress will be installed at antenna yard of ATC operation building 2nd floor roof. VSAT antenna will also be installed at ATC operation building 2nd floor roof.
- A policy to development ILS is as follows:
  - The existing LLZ, GP and T-DME were installed 14 years ago, and they require renewal of equipment and antenna. However the existing antenna foundations and power supply system will be further utilized to minimize the cost as well as the works period during which ILS will not be operational.
  - Significant deterioration such as rust is observed on the existing GP antenna pole. The pole may be further utilized after repainting on site. In order to minimize the ILS unserviceable period, the existing foundations of LLZ/GP/T-DME antennas should be reutilized.
  - According to information from LATM, power supply cubicle (power distribution frame) and power cables have been working well. Generally, power supply equipment and cable have relatively long life cycle, and the existing ones could still be utilized further (high voltage fuses, circuit breakers, low voltage circuit breakers are to be provided as spare parts). However, the power supply units for LLZ and GP/TDME which house batteries, etc. should be renewed so that system integrity can be ensured.
  - The communication network between LLZ/GP/T-DME sites and a remote control and monitoring system in the ATC operation building should be of radio link in order to reduce work period and minimize ILS unserviceable period.

Scope of Responsibility by the Lao side No. 4:

Existing ILS equipment including antennas should be dismantled by the Lao side before installing new ILS equipment. Necessary power feeders (LLZ 0.7kVA, GP/T-DME 1 kVA) for the new equipment should be provided.

2) Luang Phabang International Airport

a) Scope of Works

List of the equipment to be installed at Luang Phabang International Airport and their locations are shown in Table 2.2-9 and Figure 2.2-7 respectively.

Table 2.2-9 List of Major Equipment for Luang Phabang International Airport

Subsystem	Equipment	Q'ty	unit	Location	Remarks
AIS Automation System	AIS Terminal	1	set	Operation room in new control tower	
	AIS Printer	1	set		
	Modem (VPN Router)	1	set		
	UPS	1	set		500VA
VHF A/G (Aerodrome)	VHF Transmitter/Antenna Changer	1	set	EQ room in new control tower	Main-Standby 10W
	VHF Receiver/Antenna Changer	1	set	EQ room in new control tower	Main-Standby
	VHF Antenna	2	set	Control tower roof top	Including coaxial arrester, cable
	VHF Remote Control Unit	2	set	VFR room	
	UPS	1	set	EQ room in new control tower	500VA
VHF A/G (distress)	VHF Transmitter/Antenna Changer	1	set	EQ room in new control tower	Main-Standby 10W
	VHF Receiver/Antenna Changer	1	set	EQ room in new control tower	
	VHF Antenna	2	set	Control tower roof top	Including coaxial arrester, cable

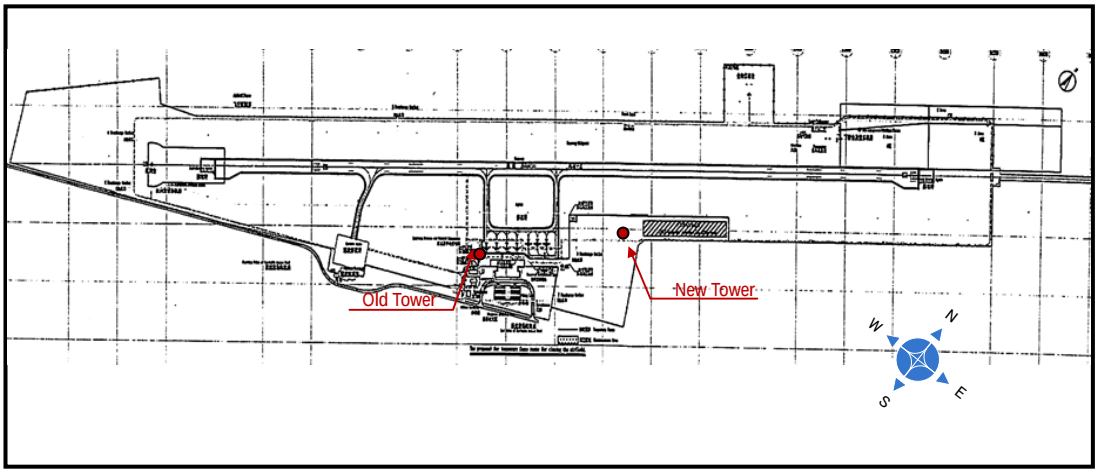


Figure 2.2-7 Luang Phabang International Airport Layout Plan

b) Items of Consideration for Installation Works

The policy of installation works for requested equipment and the works of responsibility which is implemented by the Lao side are as follows:

- AIS Terminal, printer and modem will be installed at operation room of new control

tower which will be constructed at the end of 2013.

Scope of Responsibility by the Lao side No. 5:

Connection between AIS modem and PSTN (Public Switched Telephone Networks) should be undertaken.

- Transmitters and receivers of VHF air to ground communication facility for Aerodrome & Approach control and distress will be installed at equipment room in the new control tower. VHF remote control unit will be installed at new VFR room.

Scope of Responsibility by the Lao side No. 6:

Construction of new control tower facility should be completed by the start of installation works for VHF equipment.

- VHF Antennas for Aerodrome & Approach control and Distress will be installed at top roof of new control tower.

3) Xieng Khouang Airport and RCAG Site

a) Scope of Works

List of the equipment to be installed at Xieng Khouang Airport and RCAG site and their locations are shown in Table 2.2-10 and Figure 2.2-8 respectively.

Table 2.2-10 List of Major Equipment for Xieng Khouang Airport and RCAG Site

Subsystem	Equipment	Q'ty	unit	Location	Remarks
RCAG (En-route)	VHF Transmitter/Antenna Changer	2	set	EQ room in RCAG Building	Main-Standby 50W
	VHF Receiver/Antenna Changer	2	set		Main-Standby
	VHF Antenna	4	set	Existing antenna tower	Including coaxial arrester, cable
	Site Remote Control Equipment	1	set	EQ room in RCAG Building	
	UPS	1	set		1500VA
VSAT System	VSAT Transceiver	1	set	EQ room in RCAG Building	
	Satellite Modem	1	set	EQ room in RCAG Building	3 CH
	VSAT Antenna	1	set	RCAG Site	
VHF A/G (Aerodrome)	VHF Transmitter/Antenna Changer	1	set	EQ room in control tower	Main-Standby 10W
	VHF Receiver/Antenna Changer	1	set	EQ room in control tower	Main-Standby
	VHF Antenna	2	set	Control tower roof top	Including coaxial arrester, cable
	VHF Remote Control Unit	2	set	VFR room	
	UPS	1	set	EQ room in control tower	500VA
VHF A/G (distress)	VHF Transmitter/Antenna Changer	1	set	EQ room in control tower	Main-Standby 10W

Subsystem	Equipment	Q'ty	unit	Location	Remarks
	VHF Receiver/Antenna Changer	1	set	EQ room in control tower	
	VHF Antenna	2	set	Control tower roof top	Including coaxial arrester, cable

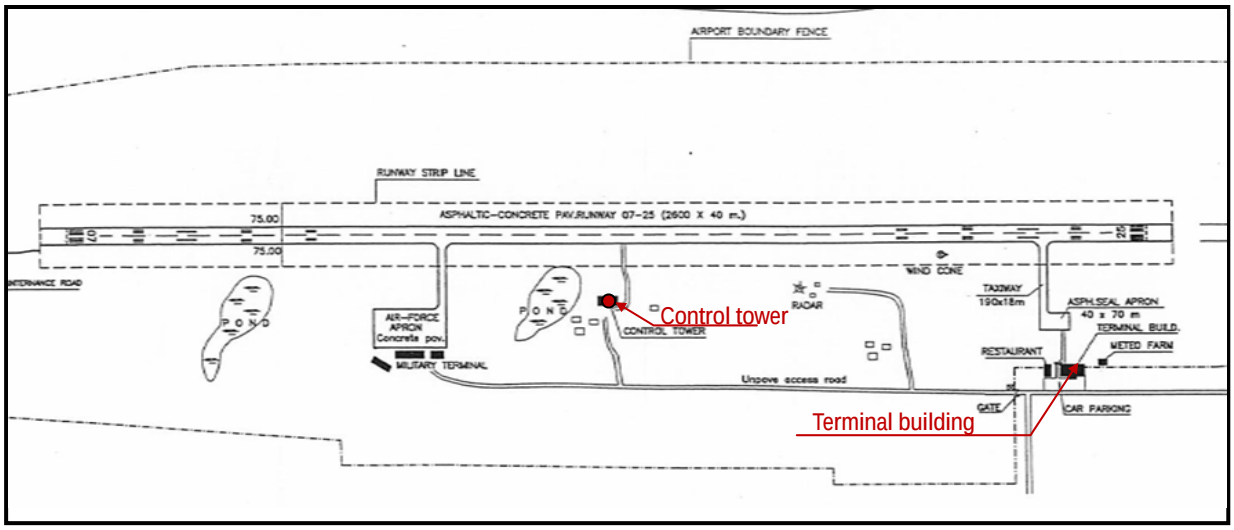


Figure 2.2-8 Xieng Khouang Airport Layout Plan

b) Items of Consideration for Installation Works

The policy of installation works for requested equipment and the works of responsibility which is implemented by the Lao side are as follows:

- VHF air to ground transmitters & Receivers for RCAG and site remote control equipment will be installed at equipment room in the RCAG building, and VHF antennas will be installed on top of existing antenna tower.

Scope of Responsibility by the Lao side No. 7:

The existing equipment and office desks should be relocated by the Lao side to make installation space for RCAG equipment. Necessary power feeders (1.5kVA) should be provided for the new transmitters & receivers at the equipment room.

- VSAT transceiver will be installed in the RCAG main remote control equipment rack.

Scope of Responsibility by the Lao side No. 8:

Cable installation and connection for input of radar data to the VSAT communication equipment should be carried out by the Lao side.

- Transmitters and receivers of VHF air to ground communication facility for Aerodrome & Approach control and distress will be installed at equipment room in the control tower. VHF remote control unit will be installed at VFR room.
- VHF Antennas for Aerodrome & Approach control and Distress will be installed at top roof of new control tower.

Scope of Responsibility by the Lao side No. 9:

The existing un-operational antennas should be dismantled or relocated by the Lao side to make installation space for new antennas.

4) Savannakhet International Airport

a) Scope of Works

List of the equipment to be installed at Savannakhet International Airport and their locations are shown in Table 2.2-11 and Figure 2.2-9 respectively.

Table 2.2-11 List of Major Equipment for Savannakhet International Airport

Subsystem	Equipment	Q'ty	unit	Location	Remarks
AIS Automation System	AIS Terminal	1	set	FOC/MET Office in the terminal building	
	AIS Printer	1	set		
	Modem (VPN Router)	1	set		
	UPS	1	set		500VA
RCAG (En-route)	VHF Transmitter/Antenna Changer	1	set	EQ room in RCAG Building	Main-Standby 50W
	VHF Receiver/Antenna Changer	1	set		Main-Standby
	VHF Antenna	2	set	Existing antenna tower	Including coaxial arrester, cable
	Site Remote Control Equipment	1	set	EQ room in RCAG Building	
	UPS	1	set		1000VA
VHF A/G (Aerodrome)	VHF Transmitter/Antenna Changer	1	set	VFR room	Main-Standby 10W
	VHF Receiver/Antenna Changer	1	set	VFR room	Main-Standby
	VHF Antenna	2	set	Control tower roof top	Including coaxial arrester, cable
	VHF Remote Control Unit	2	set	VFR room	
	UPS	1	set	VFR room	500VA
VHF A/G (distress)	VHF Transmitter/Antenna Changer	1	set	VFR room	Main-Standby 10W
	VHF Receiver/Antenna Changer	1	set	VFR room	
	VHF Antenna	2	set	Control tower roof top	Including coaxial arrester, cable
VSAT System	VSAT Transceiver	1	set	EQ room in RCAG Building	
	Satellite Modem	1	set	EQ room in RCAG Building	2 CH
	VSAT Antenna	1	set	RCAG Site	

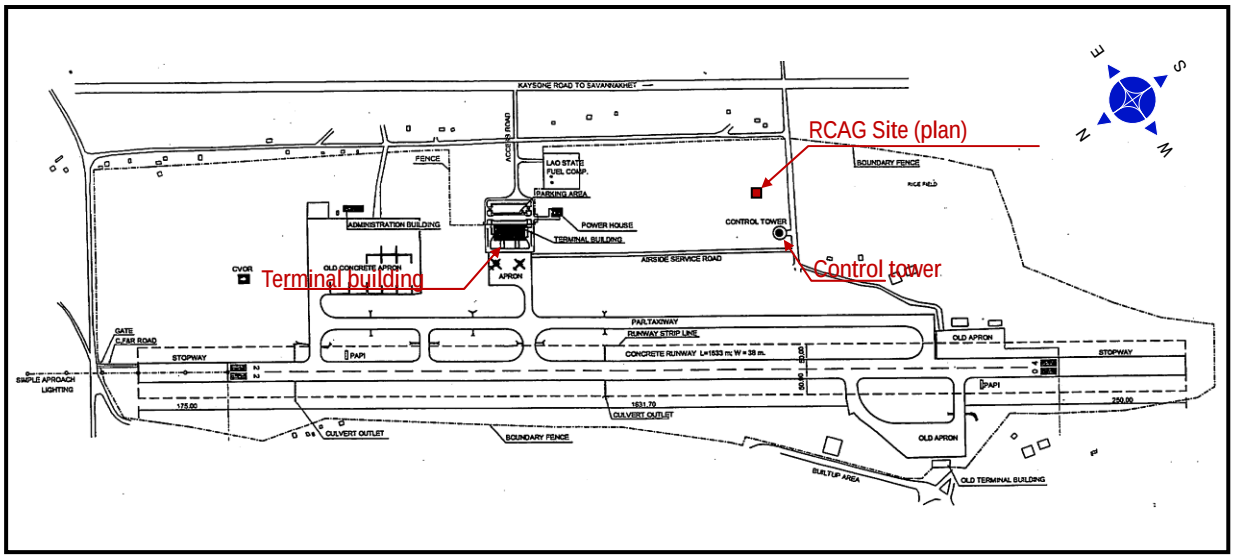


Figure 2.2-9 Savannakhet International Airport Layout Plan

b) Items of Consideration for Installation Works

The policy of installation works for requested equipment and the works of responsibility which is implemented by the Lao side are as follows:

- AIS Terminal, printer and modem will be installed at FIC/MET room in the terminal building.

Scope of Responsibility by the Lao side No. 10

Connection between AIS modem and PSTN (Public Switched Telephone Networks) should be undertaken.

- VHF air to ground transmitters & Receivers for RCAG and VSAT equipment will be installed at equipment room in the RCAG building, which will be constructed by the Lao side. Installation space for the equipment in the RCAG building will be of two sets of 19 inches rack (2 – D600mm x W600mm x H2000mm).

Scope of Responsibility by the Lao side No. 11:

The construction of new RCAG shelter must complete before installing RCAG equipment. The Lao side should coordinate with CIT Lao and provide adequate space and necessary power feeder (1kVA) for the new equipment should be provided. Cable installation and connection for input of radar data to the VSAT communication equipment should be carried out by the Lao side.

- Transmitters and receivers of VHF air to ground communication facility for Aerodrome & Approach control and distress will be installed at equipment room in the existing control tower.

Scope of Responsibility by the Lao side No. 12:

The existing un-operational equipment and antennas should be dismantled or relocated by the Lao side to make installation space for new equipment and antennas. Necessary power feeder (0.5kVA) for the new equipment should be provided.

5) Pakse International Airport

a) Scope of Works

List of the equipment to be installed at Pakse International Airport and their locations are shown in Table 2.2-12 and Figure 2.2-10 respectively.

Table 2.2-12 List of Major Equipment for Pakse International Airport

Subsystem	Equipment	Q'ty	unit	Location	Remarks
AIS Automation System	AIS Terminal	1	set	New office building	
	AIS Printer	1	set		
	Modem (VPN Router)	1	set		
	UPS	1	set		500VA
VHF A/G (Aerodrome)	VHF Transmitter/Antenna Changer	1	set	Equipment room in control tower 3F	Main-Standby 10W
	VHF Receiver/Antenna Changer	1	set		Main-Standby
	VHF Antenna	2	set	Control tower roof top	Including coaxial arrester, cable
	VHF Remote Control Unit	2	set	VFR room	
	UPS	1	set	Equipment room in control tower 3F	500VA
VHF A/G (distress)	VHF Transmitter/Antenna Changer	1	set		Main-Standby 10W
	VHF Receiver/Antenna Changer	1	set		
	VHF Antenna	2	set	Control tower roof top	Including coaxial arrester, cable

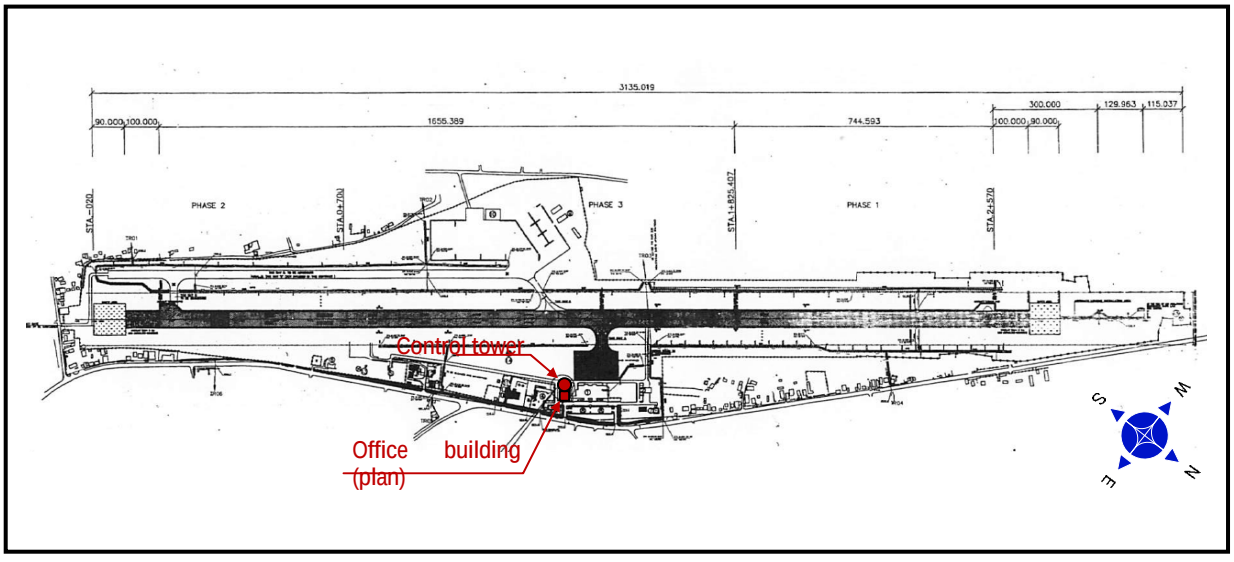


Figure 2.2-10 Pakse International Airport Layout Plan

b) Items of Consideration for Installation Works

The policy of installation works for requested equipment and the works of responsibility which is implemented by the Lao side are as follows:

- AIS Terminal, printer and modem will be installed at office building (5m x 5m) near the control tower, which will be constructed by Lao side.

Scope of Responsibility by the Lao side No.13:

Construction of new office building should be completed by the start of installation works for the AIS terminal.

- Transmitters and receivers of VHF air to ground communication facility for Aerodrome & Approach control and distress will be installed at equipment room in the existing control tower 3F.

Scope of Responsibility by the Lao side No. 14:

The existing ATIS equipment should be relocated by the Lao side to make the space for new equipment. Necessary power feeder (0.5kVA) for the new equipment should be provided.

- Antennas of VHF air to ground communication facility for Aerodrome & Approach control and distress will be installed on the roof top of the existing control tower.

Scope of Responsibility by the Lao side No. 15:

The existing un-operational antennas should be dismantled or relocated by the Lao side to make the space for new antennas.

6) Paksong Radar Site

a) Scope of Works

List of the equipment to be installed at Paksong Radar Site are shown in Table 2.2-13.

Table 2.2-13 List of Major Equipment for Paksong Radar Site

Subsystem	Equipment	Q'ty	unit	Location	Remarks
RCAG (En-route)	VHF Transmitter/Antenna Changer	1	set	EQ room in RCAG Building	Main-Standby 50W
	VHF Receiver/Antenna Changer	1	set		Main-Standby
	VHF Antenna	2	set	Existing antenna tower	Including coaxial arrester, cable
	Site Remote Control Equipment	1	set	EQ room in RCAG Building	
	UPS	1	set		1000VA
VSAT System	VSAT Transceiver	1	set	EQ room in RCAG Building	
	Satellite Modem	1	set	EQ room in RCAG Building	2 CH
	VSAT Antenna	1	set	RCAG Site	

b) Items of Consideration for Installation Works

The policy of installation works for requested equipment and the works of responsibility which is implemented by the Lao side are as follows:

- VHF air to ground transmitters & Receivers for RCAG and VSAT equipment will be installed at equipment room in the radar building, which will be constructed by the Lao side. Installation space for the equipment in the RCAG building will be of one set of 19 inches rack (D600mm x W600mm x H2000mm). Necessary electrical power capacity will be about 1 kVA.

Scope of Responsibility by the Lao side No. 16:

The construction of access road, commercial power line and communication line must complete before installing new equipment. The Lao side should provide adequate space and necessary power feeder (1kVA) for the new equipment. Cable installation and connection for input of radar data to the VSAT communication equipment should be carried out.

2.2.3 Outline Design Drawing

Refer to Attachment. The contents of drawing are as follows;

(1) System Diagram

Fig.1 AIS Automation System Diagram
Fig.2 RCAG and VSAT System Diagram
Fig.3 VHF Air to Ground System Diagram (Aerodrome/Approach/Distress)
Fig.4 Vientiane ILS Outline System Diagram

(2) Detailed Layout Plan for Each Site

1) Vientiane International Airport

Fig.1-1 Vientiane Airport Layout Plan
Fig.1-2 ILS Layout Plan
Fig.1-3 LLZ Layout Plan
Fig.1-4 LLZ Antenna Installation Plan
Fig.1-5 LLZ Building Equipment Layout Plan
Fig.1-6 LLZ Wiring Diagram
Fig.1-7 LLZ Building Power Supply System
Fig.1-8 GP / T-DME Layout Plan
Fig.1-9 GP Antenna Installation
Fig.1-10 T-DME Antenna Installation
Fig.1-11 GP Monitor Antenna Installation
Fig.1-12 GP / T-DME Building Equipment Layout Plan
Fig.1-13 GP / T-DME Wiring Diagram
Fig.1-14 GP / T-DME Power Supply System
Fig.1-15 VHF System Diagram
Fig.1-16 Control Tower and Operation Building 1F
Fig.1-17 Control Tower and Operation Building 2F, Roof Plan
Fig.1-18 Control Tower and Operation Building Elevation Plan
Fig.1-19 Operation Building 2F Equipment Layout Plan
Fig.1-20 Operation Building 1F Equipment Layout Plan
Fig.1-21 Control Tower Equipment Layout Plan
Fig.1-22 DCA Building Equipment Layout Plan
Fig.1-23 RCAG System Diagram
Fig.1-24 RCAG Building Equipment Layout Plan

2) Luang Phabang International Airport

Fig.2-1 Luang Phabang Airport Layout Plan
Fig.2-2 VHF System Diagram
Fig.2-3 VHF Antenna Layout Plan
Fig.2-4 Control Tower VHF Equipment Layout Plan
Fig.2-5 Operation Building 2F Layout Plan

3) Xieng Khouang Airport

Fig.3-1 Xieng Khouang Airport Layout Plan
Fig.3-2 VHF System Diagram
Fig.3-3 Tower Equipment Layout Plan
Fig.3-4 RCAG Site Layout Plan
Fig.3-5 RCAG Building Equipment Layout Plan
Fig.3-6 VHF Antenna Layout Plan

4) Savannakhet International Airport

Fig.4-1 Savannakhet Airport Layout Plan
Fig.4-2 VHF System Diagram
Fig.4-3 Site Layout
Fig.4-4 Control Tower VHF Equipment Layout Plan
Fig.4-5 VHF Antenna Layout Plan
Fig.4-6 VHF・VSAT Equipment Layout Plan
Fig.4-7 AIS Equipment Layout Plan

5) Pakse International Airport

Fig.5-1 Pakse Airport Layout Plan
Fig.5-2 VHF System Diagram
Fig.5-3 VHF Equipment Layout Plan
Fig.5-4 VHF Antenna Layout Plan
Fig.5-5 Control Tower and Operation Building 1F

6) Paksong Radar Site

Fig.6-1 VHF System Diagram
Fig.6-2 RCAG Building Layout Plan
Fig.6-3 VHF Antenna Layout Plan

2.2.4 Implementation Plan

2.2.4.1 Procurement Policy

- The systems and equipment to be procured under the Project are not manufactured in Lao PDR, and they can be manufactured in Japan and procured from Japan without necessary to rely on the third party country. Therefore, all systems and equipment procured in the Project consist of Japanese product.
- The bidding for procurement of the systems and equipment is carried out as one package since equipment procured in the Project is only a part of CNS/ATM systems and no building construction or procurement of special vehicles are included in the scope of the Project.
- There is no contractor specializing in CNS/ATM Systems in Lao PDR, and expert engineers and technical staff should be dispatched from Japan for equipment installation, adjustment, testing and OJT for operation and maintenance.
- When installing equipment, the manufacturer's technical staff dispatched from Japan will need to supervise local contractors capable of executing communication works in the works.
- The manufacturer's technical staff dispatched from Japan will also provide OJT to

LATM personnel for adjustment and testing as well as operation of the equipment.

2.2.4.2 Implementation Conditions

There will be no regional and/or legal specialties in Lao PDR which could adversely influence procurement of systems and equipment under the Project.

The construction/installation works, to be executed at 6 sites, should be carried out simultaneously, and necessary staff should properly be stationed at the sites.

2.2.4.3 Scope of Works

Following table shows demarcation of the scope of works between Japanese and Lao sides.

Table 2.2-14 Demarcation of the Scope of Works

Project to be covered by Japan's Grant Aid	Project to be covered by the Lao PDR
1. Procurement, Installation/Adjustment for Equipment (1) AIS Automation System (2) RCAG (En-route) (3) VHF Air to Ground (Aerodrome/Approach) (4) VHF Air to Ground (Distress) (5) VSAT System (6) ILS (7) Flight Procedure Design System 2. Flight Inspection for ILS 3. Maintenance Education & Training for Equipment 4. Marine and Inland Transportation for Equipment	1. Site Preparation, Design and Construction of Building (1) Site preparation including building construction at Paksong Radar Site (2) Construction of new control tower at Luang Phabang (3) Construction of new office building at Pakse (4) Construction of new RCAG building at Savannakhet (5) Dismantle, relocation, power feeder and communication line for Equipment 2.Coordination, application formalities with relevant organization (1) Tax exemption and customs clearance of the products (2) Application formalities for establishment of radio station 3. Transportation, storage, recycle and disposal of dismantled equipment 4. Allocation of counterpart personnel 5. Participation of equipment installation and equipment calibration including trial operation and site acceptance test

2.2.4.4 Consultant Supervision

(1) Scope of Consultant Supervision

The consultant will carry out supervision services on the quality, schedule and safety control, among others, of the equipment manufacture, transportation and installation as well as adjustment and testing to be executed by the contractor in accordance with the contract for the Project. Major scope of the works of the consultant services is described below.

1) Review and Approval of Equipment Specifications and Work Execution Plans

The contractor shall submit equipment specifications and drawings to the consultant prior to start manufacturing. The contractor shall also submit working drawings as well as work execution plan and schedule, etc. to the consultant. The consultant will review the specifications and drawings so submitted by the contractor and approve or reject them in accordance with the contract.

2) Test and Inspection of Equipment Manufacture

The consultant will inspect that the equipment has been manufactured by the contractor in

accordance with the contract by witnessing factory tests or inspecting test reports and other related documents submitted by the contractor.

3) Prior Confirmation and Coordination for Equipment Storage Yard

The consultant will confirm the status of each site and coordination with the Lao side that they has made preparation of equipment/material storage yard, construction of building to house the equipment and renovation as required by the contract.

4) Installation Supervision

The consultant will supervise the quality, safety and schedule control for the equipment installation works including transportation by the contractor in accordance with the contract. In order for the consultant to carry out the supervision works simultaneously at 6 sites, the consultant will need to assign several Japanese engineers to work with local engineers.

5) Test and Inspection of Equipment Installation

The consultant will witness and inspect tests for equipment installation including flight check for ILS, and approve or reject the works, and instruct for preparation of the test result to the contractor in accordance with the contract.

6) Inspecting Tests on Completion and Issuing Taking-Over Certificate

The consultant will witness and inspect the tests on completion to be carried out by the contractor and approve or reject the works in accordance with the contract. When the whole of the works have been completed and have satisfactorily passed any tests on completion, the consultant will coordinate with DCA/LATM and the taking-over certificate will be issued by the DCA/LATM.

(2) Role of Consultant's Personnel

Roles and timing of assignment of the consultant personnel are summarized in the Table 2.2-15. The construction/installation works, to be executed at 6 sites, should be carried out simultaneously, and necessary staff including local staff should properly be stationed at the sites to keep the quality of construction and construction progress.

Table 2.2-15 Role of Consultant Supervision

	Assignment	Period	Role
Japanese Staff	Resident Procurement Supervision Engineer	Resident (Site)	・Overall quality and schedule control of the Project. ・Coordination with DCA/LATM and contractor. ・Supervision of installation works including adjustment and testing. ・Supervision for inspecting overall completion and taking-over of the whole system.
	Procurement Supervision Engineer (Communication)	Temporary (Site)	・Review and approve manufacturer's specifications on VHF and VSAT. ・Supervision of installation works and quality and scheduling of installation works and tests.

	Assignment	Period	Role
	Procurement Supervision Engineer (Navigation)	Temporary (Site)	・Review and approve manufacturer's specifications on ILS and AIS. ・Supervision of installation works and quality and scheduling of installation works and tests including ILS flight inspection.
	Procurement Supervision Engineer (Testing and Inspection)	Temporary (Site)	・Witness of tests of all of the equipment at site before taking-over to DCA/LATM.
	Inspector	Temporary (Japan)	・Witness of factory inspection.
Local Staff	Resident Procurement Supervision Assistant Engineer	Resident	・Assistance for Resident Procurement Supervision Engineer ・Supervision of installation works and scheduling of installation works at 6 sites, and report to the Procurement Supervision Engineer
	Communication Engineer	Temporary	
	Electrical Engineer	Temporary	

2.2.4.5 Quality Control Plan

(1) Compliance with ICAO Standards

Specifications and function of the systems and equipment shall comply in principle with applicable ICAO standards.

(2) Approval of Shop Drawings for Equipment Manufacture

The contractor will be required to prepare and submit equipment specifications, work schedule and work execution plan, and the consultant will review and ensure that equipment performance and installation will comply with the contract documents.

(3) Factory Inspection

The consultant will conduct factory inspections to review and confirm that the major systems and equipment manufactured by the contractor comply with the contractual requirements. The consultant may alternatively require the contractor to submit the test data for review and confirmation of the compliance with the contractual requirements. The major systems and equipment will only be approved for transportation and shipment to the sites after the consultant's confirmations.

(4) Tests on Completion and Taking-Over

After installation and adjustment of the systems and equipment by the contractor, the consultant together with DCA/LATM will conduct the tests on completion during trial operation period based on the results of performance and inventory check data conducted by the contractor. ILS will be accepted only after the ILS systems and equipment have passed the flight check.

2.2.4.6 Procurement of Equipment/Material Plan

(1) Equipment Maintenance and Repair Services

Spare parts as well as maintenance and repair service should be taken into account when preparing the contract documents so that DCA/LATM, which possesses limited technical and financial capability, will be able to continuously operate and maintain the equipment and system.

- During one-year defects liability period, the contractor shall be responsible for repair of the systems and equipment at its own cost.
- Number of spare parts and units of the major systems and equipment should be computed based on the MTBF (Mean Time Between Failures) data of the manufactures for two-year period.

(2) Transportation Plan

The period of equipment transportation will be approximately 5 weeks including marine transport, inland transport and custom clearance.

- All systems and equipment procured in the Project will be made in Japan and transported from Japan to Vientiane. The schedule of transportation is planned as below;
  - Marine transport (approximately 3 weeks): from Japan to Laem Chabang Port in Thailand
  - Inland transport (approximately 1 week): from Laem Chabang Port in Thailand to Vientiane
- The number of days for custom clearance is assumed as below;
  - Transit custom clearance at Laem Chabang Port in Thailand: approximately 1 week.
  - The permission of import and custom clearance in Lao PDR: approximately 1 week.

2.2.4.7 Plan for Initial Operational Training and Operational Guidance

Training of LATM personnel for initial equipment operation will be conducted by Japanese engineers dispatched by the equipment manufacturers for a period of several days as On-the-Job-Training.

(1) Plan for Operational Guidance

Under the Project, VHF air to ground communications and ILS are replacement of the existing ones, while AIS and VSAT as well as the PBN Flight Procedure Design Software are to be newly installed.

LATM is already familiar with the VHF and ILS, and OJT for several days provided by the manufacturers will suffice. LATM will also become familiar enough with VSAT through OJT for several days as LATM has been fully utilizing the existing VSAT system as AFTN channels.

Additional training will be necessary for LATM to familiarize themselves with newly installed AIS, and necessary training will be provided as a part of operational guidance by the equipment manufacture.

With regard to the software for design of PBN flight procedures, some DCA/LATM

personnel have received necessary training and education in the Flight Procedure Center in Hanoi provided through JICA technical cooperation project, and therefore additional training other than OJT will not be required.

(2) AIS Operational Guidance

1) Background

Under the Project, the AIS Automation System is the only new system to be provided. As a part of the manufacturer's responsibility, an initial training for operation and maintenance of the equipment including OJT should be provided by the equipment manufacturer. In addition, LATM strongly requested provision of assistance for operation of the entire system including understanding on the technical specifications of AFTN/AMHS together with interface as well as actual equipment operation and utilization. AMHS is a new system currently being installed by CIT Lao Ltd. in accordance with a contract with LATM.

AIS is a new system proposed by ICAO as a part of the New CNS/ATM System. The on-the-job training to be provided by the equipment manufacturer will not be sufficient for LATM to maintain efficient operations, and therefore inclusion of specific training on AIS has been included in the scope of the AIS manufacture.

2) Policy of Implementation

AIS operational guidance will concentrate on the system function and interface technology. Specific scope of the operational guidance should be coordinated with the proposal of the AIS manufacturer on OJT. For AMHS, operational guidance on the basic function and interface with AIS to be installed under the Project will be necessary because the contents of CIT Lao Ltd. for AMHS were not clear.

3) Inputs and Schedule of Implementation

Number of LATM staff for ATS is 10 to 20 who are working in shifts 24 hours a day and all of them cannot convene at one time. A group of five to eight people off shift will be provided two sessions of training and education for about four weeks each (in total 2 months).

Scope of the training is shown hereunder. The training scope should be further examined and coordinated during the Project implementation period.

Table 2.2-16 AIS Training Items

Training Items	Week
1. Outline of Aeronautical Telecommunications (1 of 2) 1.1 Introduction 1.2 Existing Situation and Tendency ・Japan ・Asia Pacific Region ・Europe and USA 1.3 Related Technologies ・ATS Ground to Ground Communication Technology ・Technological Tendency of ATN ・Technological Tendency of other Communication Media 2. Outline of Aeronautical Telecommunications (2 of 2) 2.1 Application of Aeronautical Telecommunications	First week

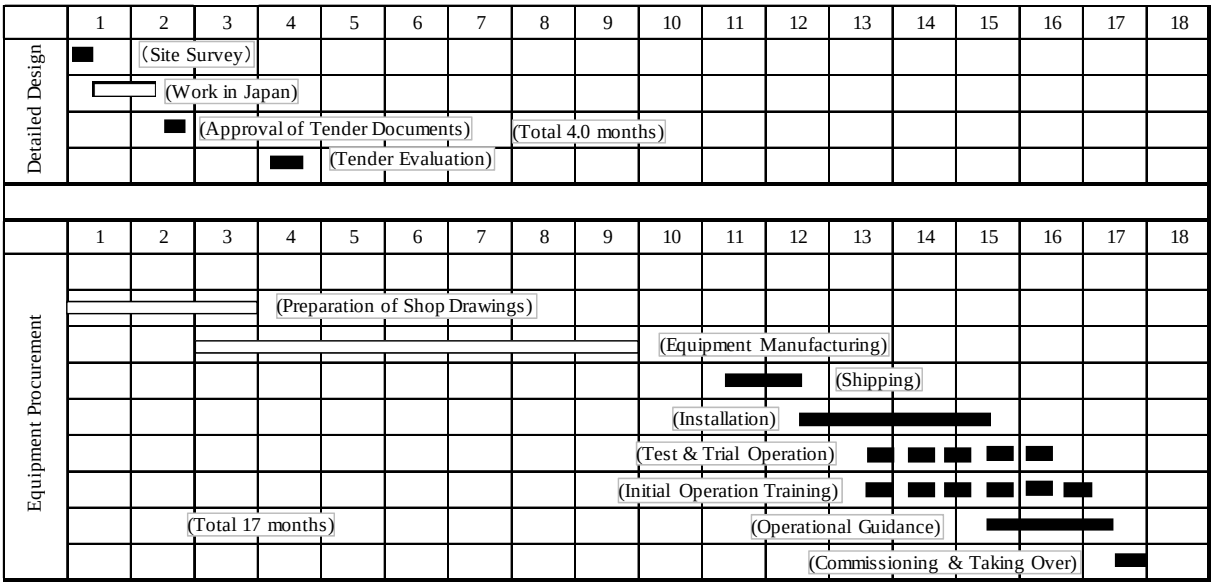
Training Items	Week
・Related to AFTN ・Related to AMHS ・Related to other communication application 2.2 International Connections ・Status of Domestic Connection ・Status of International Connection	
3. Outline of Information Management 3.1 From AIS to AIM 3.2 Related to AIXM 3.3 Related to Flight Object/FIXM 3.4Other Information Management 4. Outline of Latest ITC Technology 4.1 Cloud 4.2 Big Data 4.3 Smart Terminal 4.5 Engineering (SOA) 4.6 Other Latest Technologies	Second week
5. Outline of AIS System 5.1 Summary 5.2 Configuration 5.3 Basic Operation Procedure 6. AIS Operation Program (1 of 2) 6.1 Management of NOTAM based on the International NOTAM Operations (INO) 6.2 Management of Static Data based on the Static Data Operation (SDO) 6.3 Management of AIP based on the Static Data Operation (SDO) (1 of 2) 6.4 Management of AIP based on the Static Data Operation (SDO) (2 of 2)	Third week
7. AIS Operation Program (2 of 2) 7.1 Web Function 7.2 Flight Plan 7.3 Meteorological Data 7.4 System Management Workstation ・System Operation during System Failure 8. Program for AIS Technical Training 8.1 System Summary ・Basic Operation Procedure ・Explanation on Hardware (HW)/Software (SW) Stack 8.2 Maintenance of Hardware ・Summary ・Detail 8.3 Maintenance of Software ・Summary ・Detail 8.4 Recovery from System Failure 9. Summary	Fourth week

Training contents will be further examined and coordinated with DCA/LATM & manufacture during the implementation stage.

2.2.4.8 Implementation Schedule

The project implementation schedule including the detailed design, procurement/installation of equipment, commissioning and taking over of the equipment is shown in Table 2.2-17.

Table 2.2-17 Project Implementation Schedule



2.3 Obligations of Recipient Country

(1) General Obligations of Lao Side

1) Bank arrangement (B/A) and Authorization to Pay

The Government of Lao PDR needs promptly draw up an arrangement with a bank in Japan to open a special account into which the funds granted by the Government of Japan will be deposited and from which payments will be made to the Japanese contractor. The Government of Lao PDR also needs to issue the Authorization to Pay (A/P) that is needed for the Japanese contractor to receive the payments. The Government of Lao PDR shall bear commissions to Japanese bank for banking services based on the B/A.

2) Exemption of Taxes and Duties on Imported Equipment and Materials

The Government of Lao PDR shall ensure that the customs duties and taxes which may be imposed with respect to the import of the equipment and materials be exempted.

3) Permissions for Entrance to the Site and Works at the Site

LATM shall obtain or issue permissions necessary for entrance to and execution of the works at the site.

4) Removal of Existing Equipment for Installation of New Equipment

LATM shall remove the existing equipment, etc. to secure spaces necessary for installation of the new equipment.

5) Taxes and Fiscal Levies

The Government of Lao PDR shall bear the internal taxes and other fiscal levies which may be imposed with respect to the purchase of the products and services without using the grant.

6) Temporary Yard

LATM shall provide, at its own expense, adequate spaces at the sites necessary for the contractor to temporarily store materials and equipment, etc.

7) Providing of Existing Main Power Distribution Network

LATM shall provide the power distribution system and line to the sites at its own expense.

(2) Responsibility of the Works to be Implemented by the LAO PDR

Based on the previous paragraph 2.2.2 (3) Policy for Equipment Installation at Site, responsibility of the works to be implemented by the Lao PDR is as follows;

Table 2.3-1 Responsibility of the Works to be Implemented by the Lao PDR at each Site

1) Vientiane International Airport		
AIS Automation System	ATC OP. Building	1. Un-operational equipment at FIC room and AIS room should be dismantled or relocated to make installation space for AIS system. Necessary power feeders (3kVA, 0.5kVA x 2) for the new system equipment at each room should be provided.
RCAG	EQ room	2. Cable installation and connection for VHF voice in-output signal between RCAG remote control equipment and existing VCCS at equipment room in the ATC operation building will be implemented by the Japanese side. Collaboration with Lao side will be needed for the above works.
VSAT	ATC OP. Building	3. Un-operational equipment should be dismantled or relocated to make installation space for VSAT equipment. Cable installation and connection for output of radar data and VHF voice line from the VSAT communication equipment should be carried out.
ILS	Runway field	4. Existing ILS equipment including antennas should be dismantled before installing new ILS equipment. Necessary power feeders (LLZ 0.7kVA, GP/T-DME 1 kVA) should be provided.
2) Luang Phabang International Airport		
AIS Terminal	New Control Tower	5. Connection between AIS modem and PSTN (Public Switched Telephone Networks) should be undertaken.
VHF air to ground for aerodrome		6. Construction of new control tower facility should be completed by start of installation works for VHF equipment.

3) Xieng Khouang Airport/RCAG Site		
RCAG	RCAG Site	7. The existing equipment and office desks should be relocated to make installation space for RCAG equipment. Necessary power feeders (1.5kVA) should be provided for the new transmitters & receivers at the equipment room.
VSAT		8. Cable installation and connection for input of radar data to the VSAT communication equipment should be carried out.
VHF air to ground for aerodrome	Control Tower	9. The existing un-operational antennas should be dismantled or relocated to make installation space for new antennas.
4) Savannakhet International Airport		
AIS Terminal	Terminal building	10. Connection between AIS modem and PSTN (Public Switched Telephone Networks) should be undertaken.
RCAG	New RCAG site	11. The construction of new RCAG shelter must complete before installing RCAG equipment. Adequate space and necessary power feeder (1kVA) for the new equipment should be provided. Cable installation and connection for input of radar data to the VSAT communication equipment should be carried out.
VHF air to ground for aerodrome	Control Tower	12. The existing un-operational equipment and antennas should be dismantled or relocated to make installation space for new equipment and antennas. Necessary power feeder (0.5kVA) for the new equipment should be provided.
5) Pakse International Airport		
AIS Terminal	New Office building	13. Construction of new office building should be completed by start of installation works for AIS terminal.
VHF air to ground for aerodrome	Control Tower	14. The existing ATIS equipment should be relocated to make the space for new equipment. Necessary power feeder (0.5kVA) for the new equipment should be provided. 15. The existing un-operational antennas should be dismantled or relocated to make the space for new antennas.
6) Paksong Radar Site		
RCAG/ VSAT	New Radar building	16. The construction of access road, commercial power line and communication line should be complete before installing new equipment. Adequate space and necessary power feeders (1kVA) should be provided for the new equipment. Cable installation and connection for input of radar data to the VSAT communication equipment should be carried out.

2.4 Project Operation & Maintenance Management Plan

The scope of the Project may be grouped into following three categories and the number of staff necessary for operation, maintenance and management thereof has been estimated as shown in Table 2.4-1.

- Renewal of existing facilities; VHF air to ground communications and ILS.
- Installation of new systems and equipment; AIS, VSAT and Software for PBN Flight

Procedure Design.

- Equipment installation at new sites; VHF and VSAT installation at Paksong.

As to the operation and maintenance of the replaced equipment of the existing ones, the existing number of staff is sufficient.

In order to keep up with increase of future air transportation demand, introduction of PBN flight procedure is planned in neighboring countries, and Lao PDR is also planning to introduce PBN flight procedure design software in this project to catch up with this situation.

Regards to the establishment of flight procedure, present flight procedure design staff is able to carry out it by training, which is implementing at Hanoi flight procedure office periodically. However, staff for verification and approval of a flight procedure has to be newly assigned for actual PBN implementation to follow the ICAO regulations, so that increase of two staff is planned for this purpose.

Although the task of operation and maintenance services for VHF and VSAT at Paksong is in principle to be included in the task of staff force for operation and maintenance of the SSR system, it has been assumed that additional two staff would be necessary for operation and maintenance of individual VHF and VSAT.

For corresponding to increase of air traffic volume such as landing & departure traffic and over flight in near future, LATM adopted a total of 41 air traffic control trainees, and is conducting basic training at the civil aviation training center for them at the moment. Moreover, increase of equipment maintenance staff is also planned by LATM.

Considering this situation, increase of four staff who takes charge of PBN verification & approval at Vientiane and equipment maintenance at Paksong radar site, can be dealt with by LATM/DCA.

The number of operation and maintenance staff required is shown in the following table.

Table 2.4-1 Number of Operation and Maintenance Staff Required

Airport/Discipline		Hours of Operation	Shits per Day	Number of Staff per Shift	Number of Teams	Total	Remarks
Vientiane	AIS Automation System	24H	2	3	4	12	Existing staff force by AIS Automation System, even increasing future workload.
	AFTN/AMHS			2~3		11	Existing staff force
	Communication System			1~2		6	Existing staff force
	Navigation System			1		5	Existing staff force
	Surveillance System			2		11	Existing staff force
	Power Supply			1		3	Existing staff force
Luang Phabang		HR2300–1100UTC	2	2	2	4	Existing staff force
Xieng Khouang		24H	1	2	3	5	Existing staff force
Savannakhet		24H	1	2	2	4	Existing staff force
Pakse		HR2300–1100UTC	1	2	2	4	Existing staff force
Paksong Radar Site		24H	1	2	2	4	Two staff for new RCAG and VSAT

Operation staff for AIS system is a total of 12 people at the moment, and 1 shift consists of 3 staff as flight plan management, NOTAM management and AIP producing respectively. Although increase of AIS staff is anticipated in order to keep up with increase of air transportation demand in the Southeast Asia area, the existing number of staff is sufficient to operate AIS task since workload for AIS will be reduced by introduction of AIS automation system.

Further, sending and receiving of meteorological information is conducted by the Department of Meteorology and Hydrology, Lao PDR, and such information is connected to existing AFTN/AMHS.

2.5 Project Cost Estimation

2.5.1 Initial Cost Estimation

(1) Lao Side

The cost of works, which needs to be conducted by Lao side when the Project is to be implemented, is a total of 62,000,000 Kip as shown in paragraph 2). 12,000,000 Kip of this is LATM's burden as maintenance executing agency, and 50,000,000 Kip for bank arrangement is DCA's burden as the Project implementation organization.

Since LATM annual budget in fiscal year 2010 is 20,470,000,000 Kip and the cost of 12,000,000 Kip is 0.06% of their annual budget, it will be negligible cost and no risk to implement the Project for Lao side.

DCA annual budget in fiscal year 2010 is 1,578,000,000 Kip, and the cost of Commission for banking arrangement 50,000,000 Kip as DCA's burden is approximately 3% of their annual budget, it will also be negligible cost.

1) For Other Projects

Following projects are already being implemented in Lao PDR and Pakson new radar site is scheduled to be completed by March 2014, and others are scheduled to be completed by the end of year 2013. Their costs are not included in the cost to be borne by Lao side.

- Construction of new control tower at Luang Phabang Airport;
- Land preparation and construction of equipment building for new RCAG at Savannakhet Airport;
- Construction of office building (5m x 5m) co-located with the control tower at Pakse Airport; and
- Land preparation and construction of radar building at new radar site at Paksong.

2) For the Project

Lao side shall bear the following cost for implementation of the Project. It will be approximately 57,000,000 Kip as total.

- Commission for Banking Arrangement; approximately Yen 500,000 or 50,000,000 Kip
- Cost for removal of exiting equipment at project sites; approximately 12,000,000 Kip

Labor fee as shown in the Table 2.3-1 "Responsibility of the works to be

implemented by the Lao side at each Site"
300,000 Kip /day・person x 40 days ＝ 12,000,000 Kip

Total approximately 62,000,000 Kip

3) Conditions for Cost Estimation

① Time of Estimation :July, 2012

② Exchange Rate :1 US$ = 8,100 Kip

:1 US$ = 80.77 Yen

:1 Kip = 0.01 Yen

③ Procurement Period :Detailed design, equipment procurement and installation periods as shown in Table 2.2-17.

④ Others :Cost should be estimated in accordance with relevant rules and guidelines of Japan's Grant Aid.

2.5.2 Operation and Maintenance Cost

The estimated amount of additional operation and maintenance costs attributable to implementation of the Project is shown in below for comparison purpose.

The amount of additional operation cost attributable to implementation of the Project is 1,185,000,000 Kip annually, equivalent to about 5.3 % of the total budget of LATM in 2010 (Kip 22,278,000,000) as shown in Table 2.5-1.

LATM understands that the estimated amount of additional cost can be regarded within a range of anticipated increase of its annual budget and LATM will be capable of appropriating its budget therefor. In conclusion, the systems and equipment installed/provided under the Project can be operated and maintained by allocation of its budget in future.

As to the equipment life cycle of procured equipment in the Project, PC server for AIS automation system should be replaced 7 to 8 years and others should be replaced 15 years respectively due to lack of spare parts and low operational reliability.

(1) Additional Cost by the Project

The estimated amount of operation and maintenance cost attributable to implementation of the Project is approximately Kip 1,185,000,000 as shown below.

Exchange rates (average of past six months)

US$= 8,077 Kip – 8,100 Kip

Yen= 100 Kip

- Cost for Paksong RCAG/VSAT Personnel 240,000,000 Kip
  2 staff x 10,000,000/Month x 12 Months = 240,000,000 Kip
- Cost for VSAT Communication (US$50,000) 405,000,000 Kip
  7ch x US$600/Month x 12 Months ≒ US$50,000
- Cost for PBN Personnel 240,000,000 Kip
  2 staff x 10,000,000 Kip/Month x 12 Months ＝240,000,000Kip
- Maintenance of PBN software:

3 million Yen annually on average	300,000,000 Kip
Total	1,185,000,000 Kip

(2) Annual Budget for LATM/DCA in 2010

The total amount of annual budget for LATM and DCA in 2010 is shown in table below:

Table 2.5-1 Annual Budget for LATM/DCA in 2010

Item	LATM Budget (Million Kip)	DCA Budget (Million Kip)
Personnel expenses Salary, Overtime, Welfare	4,560	875
Administration Administrative, Water & Electricity, Office mission, Meeting	4,707	120
Outsource service charge	3,728	296
Rental charge	977	0
Maintenance and repair cost	1,596	91
Telecommunication cost	1,141	34
Quest visiting	293	163
Equipment Procurement	5,276	0
Total	22,278	1,578

Chapter 3
Project Evaluation

Chapter3 Project Evaluation

3.1 Preconditions

Preconditions for the Project implementation are as follows:

(1) Coordination, Application Formalities with Relevant Organization

- Tax exemption and customs clearance of the product
- Application formalities for establishment of radio station
- Payment of commission for banking arrangement

(2) Site Preparation, Design and Construction of Building

- Construction of new control tower at Luang Phabang airport
- Site preparation and construction of new RCAG building at Savannakhet airport
- Construction of new office building at Pakse airport
- Site preparation including building construction at Paksong radar site
- Removal and relocation of existing equipment, preparation of power supply and communication installation works
- Transportation, storage, recycle and disposal of dismantled equipment

3.2 Necessary Inputs by Recipient Country

The Lao side is recommended to struggle to the following matters for realization and continuation of the benefits of the Project.

- Complete ongoing training and fill vacancy of air traffic controllers, and continue human resource development so as to avoid lack of air traffic controllers, electronic and electrical engineering staff required for operation and maintenance of the equipment related to CNS/ATM systems.
- Establish the standard maintenance procedure for CNS/ATM systems by themselves, and improve reliability, continuity and completeness of air traffic control services and CNS/ATM system operations.
- Control and manage stock of necessary spare parts for CNS/ATM equipment maintenance periodically in order to maintain proper number of spare parts as stock.

3.3 Important Assumptions

Important assumptions for maintain realization and continuation of the effectiveness of the Project are as follows:

- As preconditions, to obtain the understanding from the Ministry of Public Works and Transport who is upper organization of DCA/LATM.
- DCA/LATM should secure their budget and maintain adequate staff for operation and maintenance of CNS/ATM systems, and counterpart related to the Project should take part in improvement of air traffic safety continuously.
- To continue the development of infrastructure related to CNS/ATM systems

development according to the plan by DCA/LATM.

- Airlines should continue the improvement of air safety under the safety oversight by DCA.
- The persons concerned for air safety should continue the improvement of airport safety and airport security.

As to the ssecuring budget in order to achieve the project objectives as one of the external factors, LATM has continued to increase their budget significantly in basis of Government of Lao's strong will for introducing new CNS/ATM systems. From this point of view, the Government of Lao has a great deal of willingness toward the transition to new CNS/ATM systems, so that the external factors to achieve the project objectives will be highly satisfied.

3.4 Project Evaluation

3.4.1 Relevance

The result of verification for relevance of implementation the Project by Japan's Grant Aid is as follows:

(1) The Subject of Benefit

The direct subject for benefit of the Project is the aircraft which flies in Vientiane FIR and passenger & air cargo which utilize the airports in Lao PDR, while the entire Lao PDR nation is the beneficiary on the society and economy by trade and international exchange indirectly.

(2) Project Objective

The project objective is to promote introduction of new CNS/ATM Systems to modernize existing ATC and Nav-aid in Lao PDR based on the JICA M/P which recommends improvement in the throughput of air traffic management, strengthening of air safety and efficient aircraft operation by carrying out development of CNS/ATM Systems with the pace of development by neighboring countries, and the Project contributes the stability of public welfare and better life for the nation widely through securing safety of gateway, which is able to interact with foreign countries directly.

(3) Consistency with Medium and Long Term Objectives

The Project will be implemented in accordance with the objective of aviation sector specified in the 7th National Economic Development Plan (NSEDP) such as ensuring safety and modernization of ATC, increment of passenger by expanding of medium-long distance air route, and increase of 4.5 to 6.5% of annual domestic flights and increase of 8 to 10 % of annual air traffic volume.

(4) Consistency with Japan's ODA Policy

JICA M/P was carried out from 2009 to 2010 and formulated development plan required for introduction of a new system, human-resources development and proposed technical standard for maintenance, etc. are supported. Further, technical cooperation program "The Project for the Capacity Development for Transition to the New CNS/ATM Systems in Cambodia, Lao PDR and Vietnam" is being implemented from 2010 to support human-resources development as a main purpose. From this point of view, the Project is consistent with those series of aid policy and plan by Government of Japan.

3.4.2 Effectiveness

Expected quantitative and qualitative effectiveness by implementing the Project are as follows:

(1) Quantitative Effectiveness

The number of over flight aircraft on en-route in Vientiane FIR and departure & approach aircraft at airports is expected as shown in the following table.

VSWR (Voltage Standing Wave Ratio: transmission power eefficiency for antenna on radio frequency lines) for Glide Path antenna of ILS at Vientiane International Airport is being degraded. The transmission power efficiency for antenna will be from 70% to more than 95%, and possible to secure the reliability of ILS operation.

En-route air traffic control at Vientiane ACC consists of three Radar sites and four RCAG sites. Air to ground communication voice between controller and pilot by each RCAG site and aircraft surveillance data from each radar site are transmitted though communication link such as optic-fiber cable and micro radio link of telecommunication service providers in Lao PDR. However, the air traffic control has some safety issues since this communication link has cut off instantly sometimes due to low reliability channel. According to the statics of communication failure by LATM, reliability of communication link (cut-off time/operation hours) was 92.6% of annual average in 2011. After completion of the Project, 99.9% of communication reliability will be expected by dual operation, which consists of new VSAT link and existing telecommunication link.

Table 3.4-1 Quantitative Effectiveness

Items of Index	Basis (year 2011)	Target (year 2017) 【3 years after completion】
The number of over flight aircraft (1000/year)	118.4	154.4
The number of departure and approach aircraft at airports (1000/year)	27.8	36.9
Reliability of ILS at Vientiane International Airport (Antenna VSWR)	70%	More than 95%
Reliability of ATC communication channel	92.6%	99.9%

(2) Qualitative Effectiveness

Expected qualitative effectiveness by introduction of major system equipment in the Project is shown in Table 3.4-2.

Table 3.4-2 Expected Output and Outcome

Input/Activity	Expected Output	Expected Outcome
Replacement of ILS	Possible to maintain the minimum weather condition by continuing ILS approach procedure.	Possible to maintain aircraft service rate and punctuality.
Flight Procedure Design System (En-route)	Aircraft longitudinal separation will be reduced by establishing RNAV5 on en-route.	Possible to deal with demand of increasing over flight.

Input/Activity	Expected Output	Expected Outcome
Flight Procedure Design System (Aerodrome/Approach)	Possible to improve minimum weather condition by establishing instrument curved approach procedure to avoid obstacle along the approach area.	Possible to increase airport capacity and service level by improvement of aircraft service rate and punctuality without rely on the current nav-aids facility.
Air to Ground Communication and VSAT system	Possible to avoid lost communication between ATC controller and pilot, which will expose them to danger, by providing stable air to ground communication environment in ATC.	Possible to secure aircraft operational safety, and maintain operational punctuality and duty of air traffic as an organization of public transportation.
AIS Automation System	Managing necessary data for aircraft operations such as flight plan, NOTAM, AIRAC and MET data, and send them to concerned ATS offices automatically.	Possible to avoid making mistake and enhance AIS operational efficiency by unified information management since acquisition and providing of information for aircraft operations is conducted by each ATS office manually at present. Further, appropriate information is provided to ATC controllers and operators timely, so that this system can contribute improvement ATC efficiency and enhance ATS safety.

Attachment: Outline Design Drawings

System Diagram

Detail Layout Plan For Each Site

1.Vientiane Airport

2. Luang Phabang Airport

3. Xieng Houang Airport

4. Savannakhet Airport

5. Pakse Airport

6. Paksong Radar Site

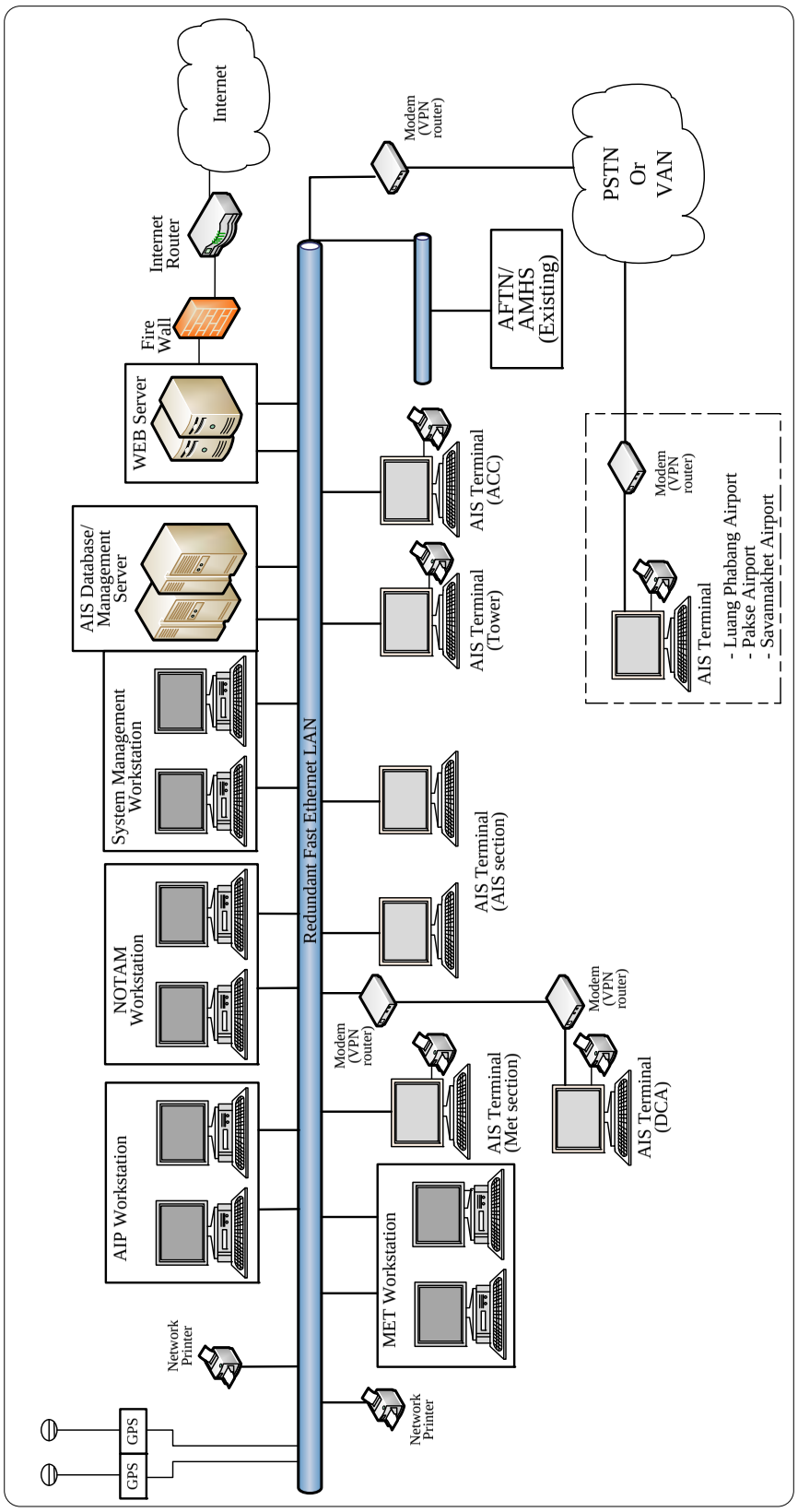


Fig.1-1 AIS Automation System Diagram

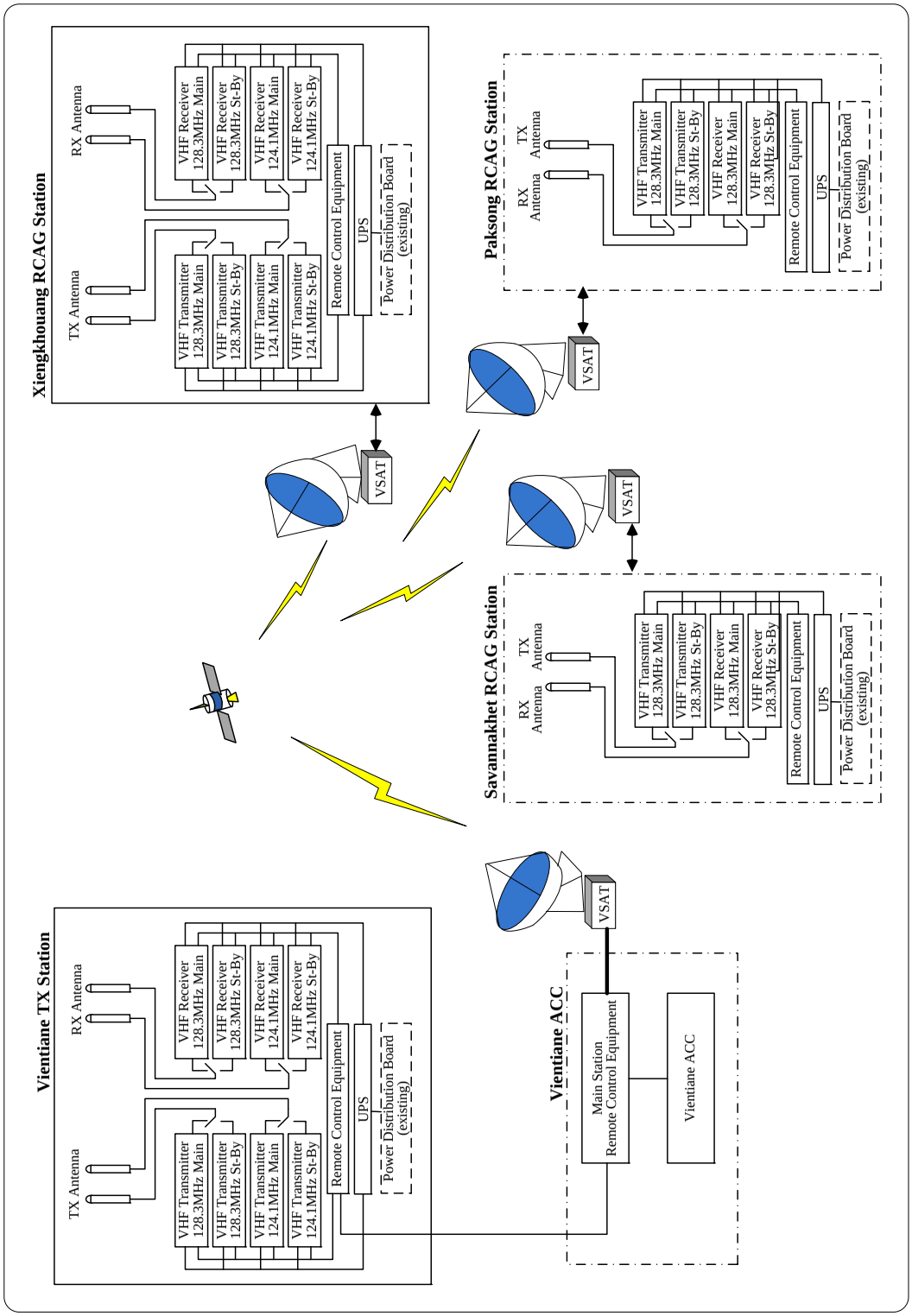


Fig.1-2 RCAG and VSAT System Diagram

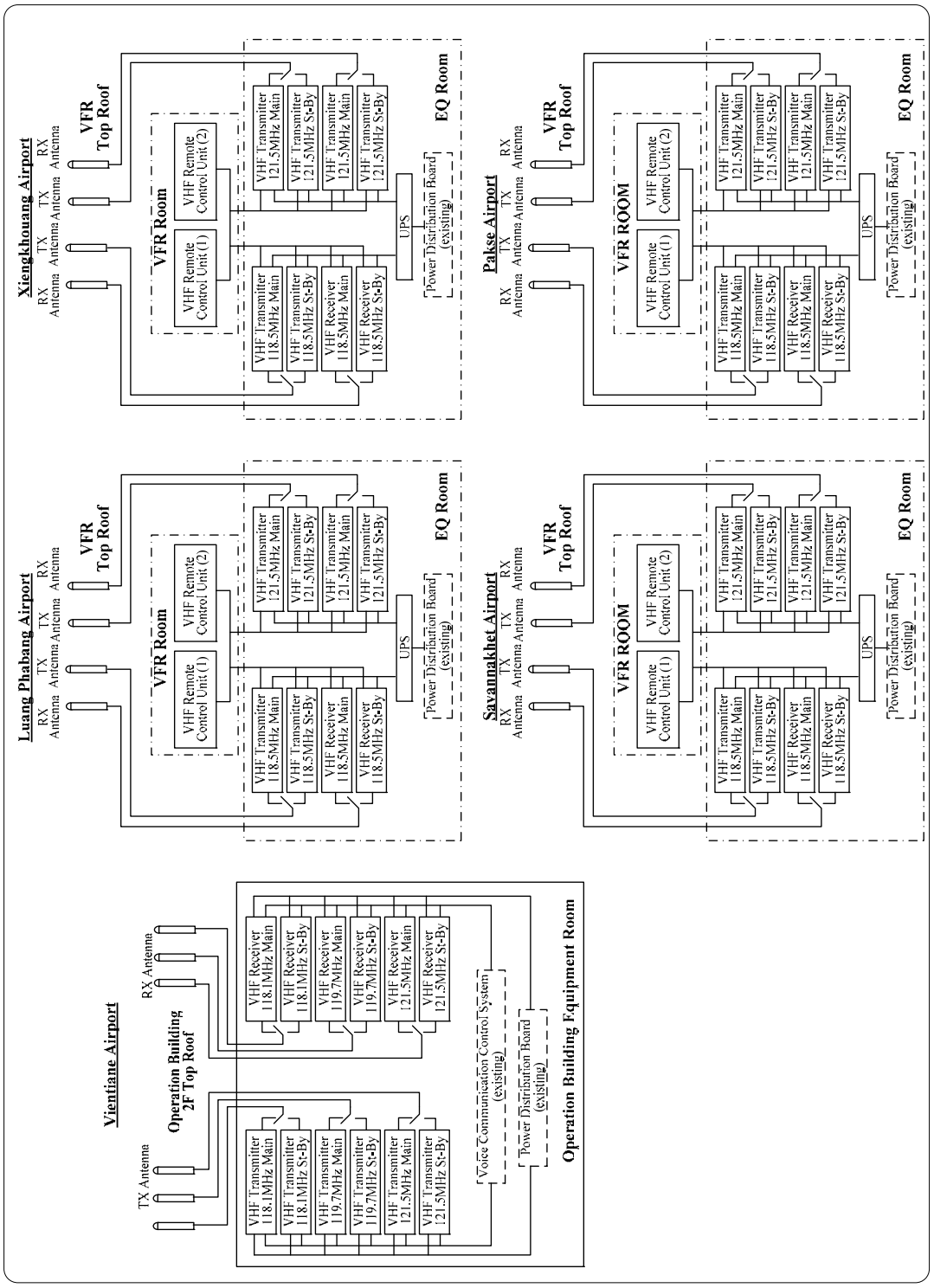


Fig.1-3 VHF Air to Ground System Diagram(Aerodrome/Approach/Distress)

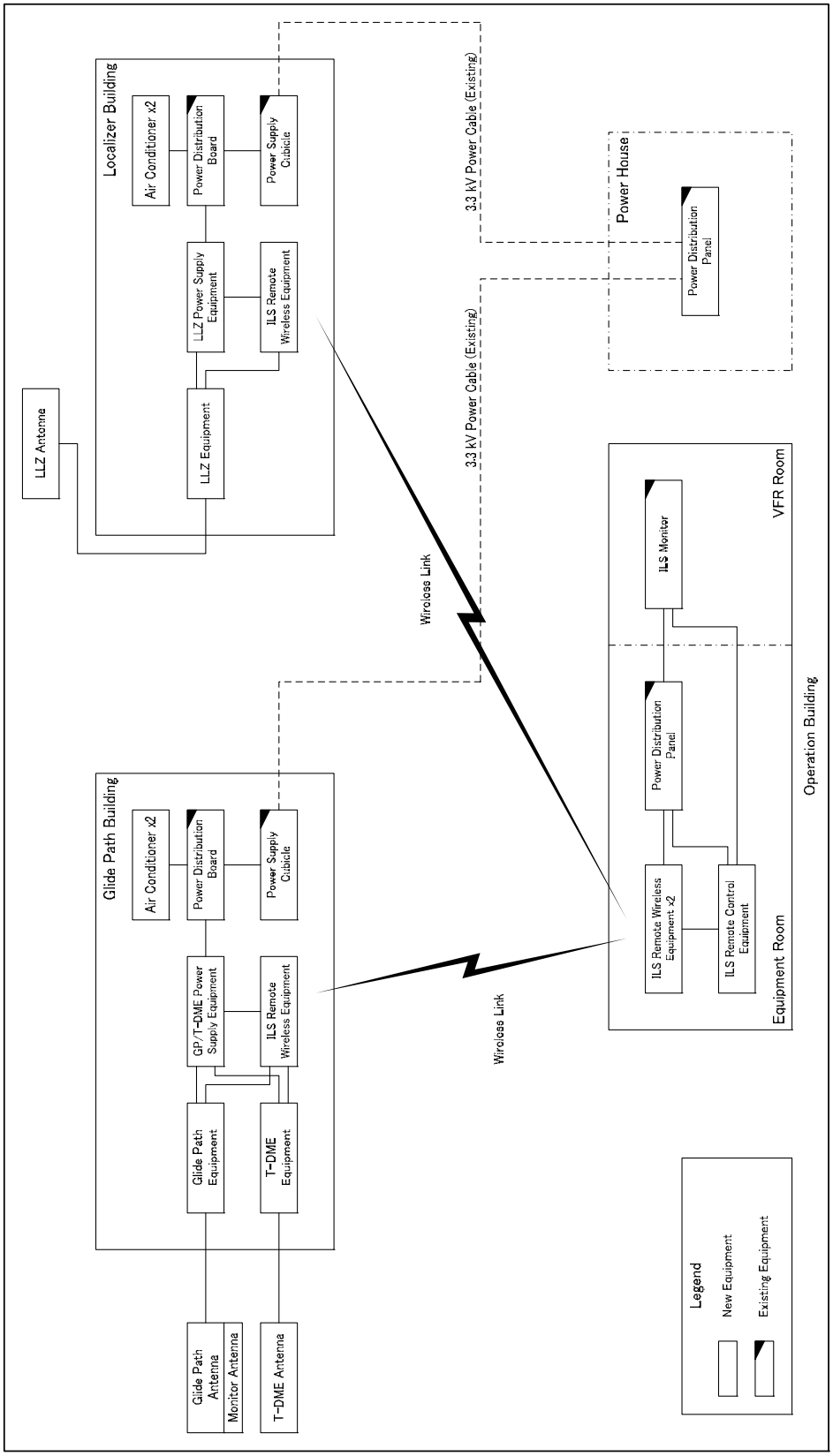


Fig.1-4 Vientiane ILS Outline System Diagram

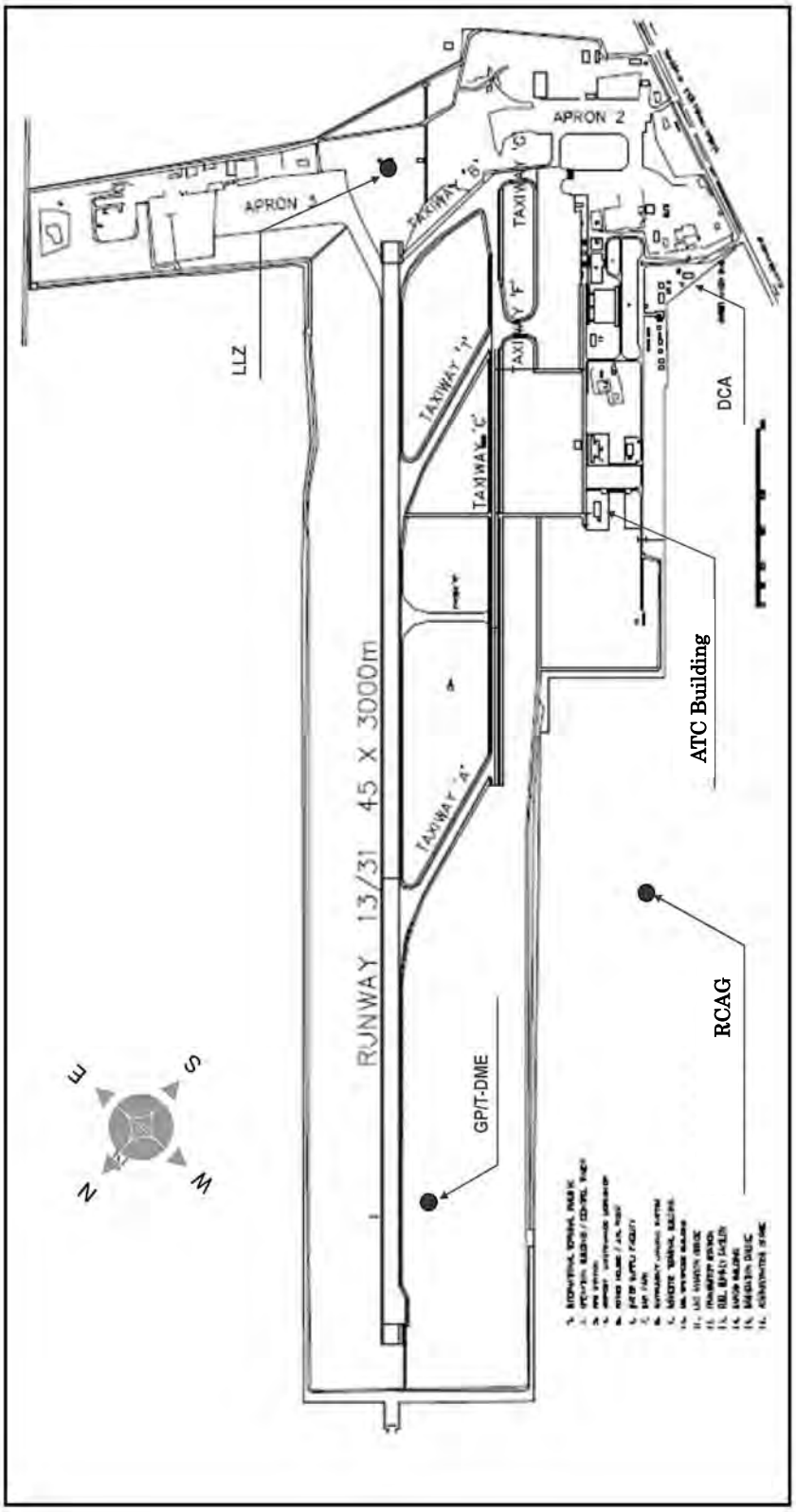


Fig.1-1 Vientiane Airport Layout Plan

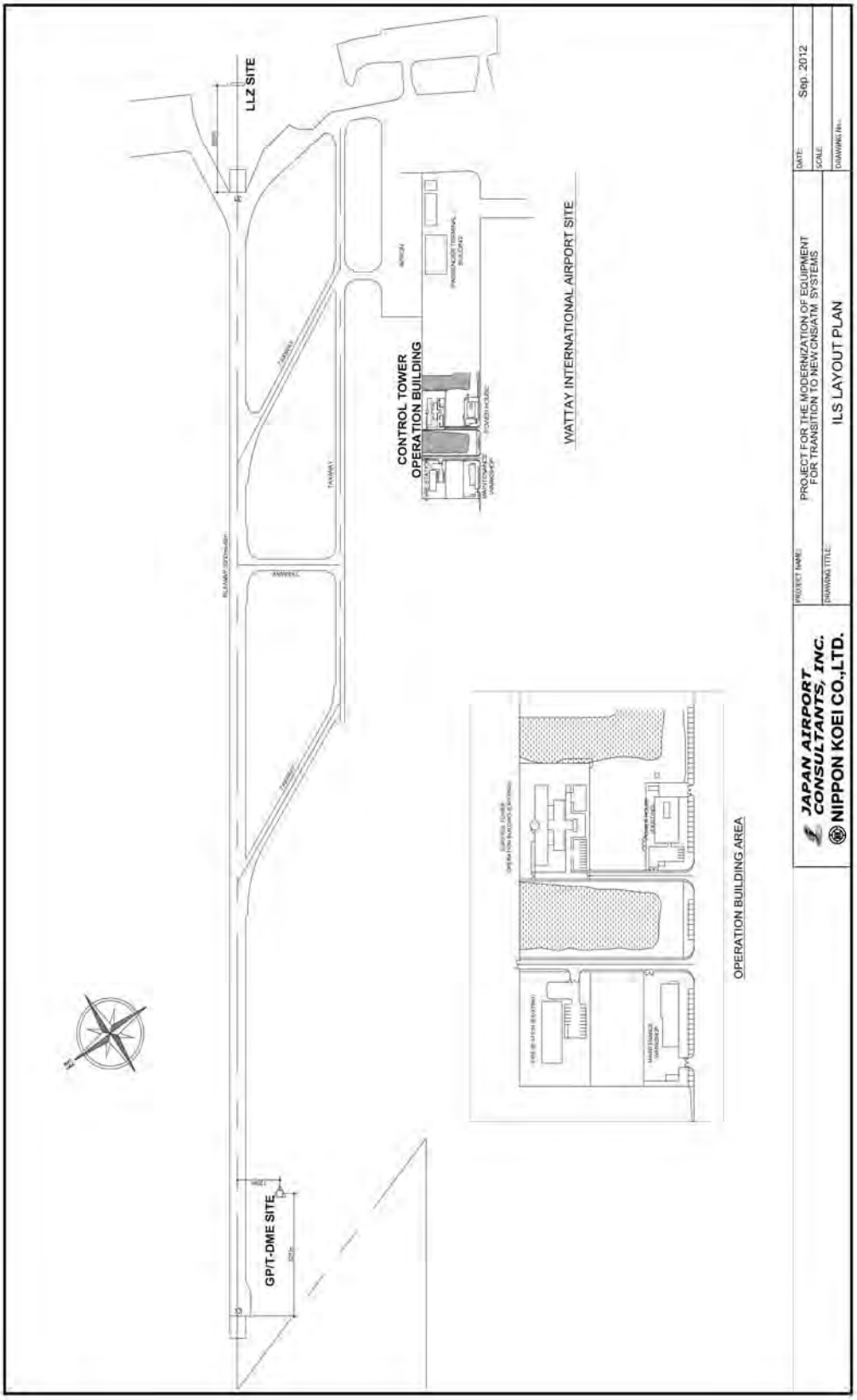


Fig.1-2 ILS Layout Plan

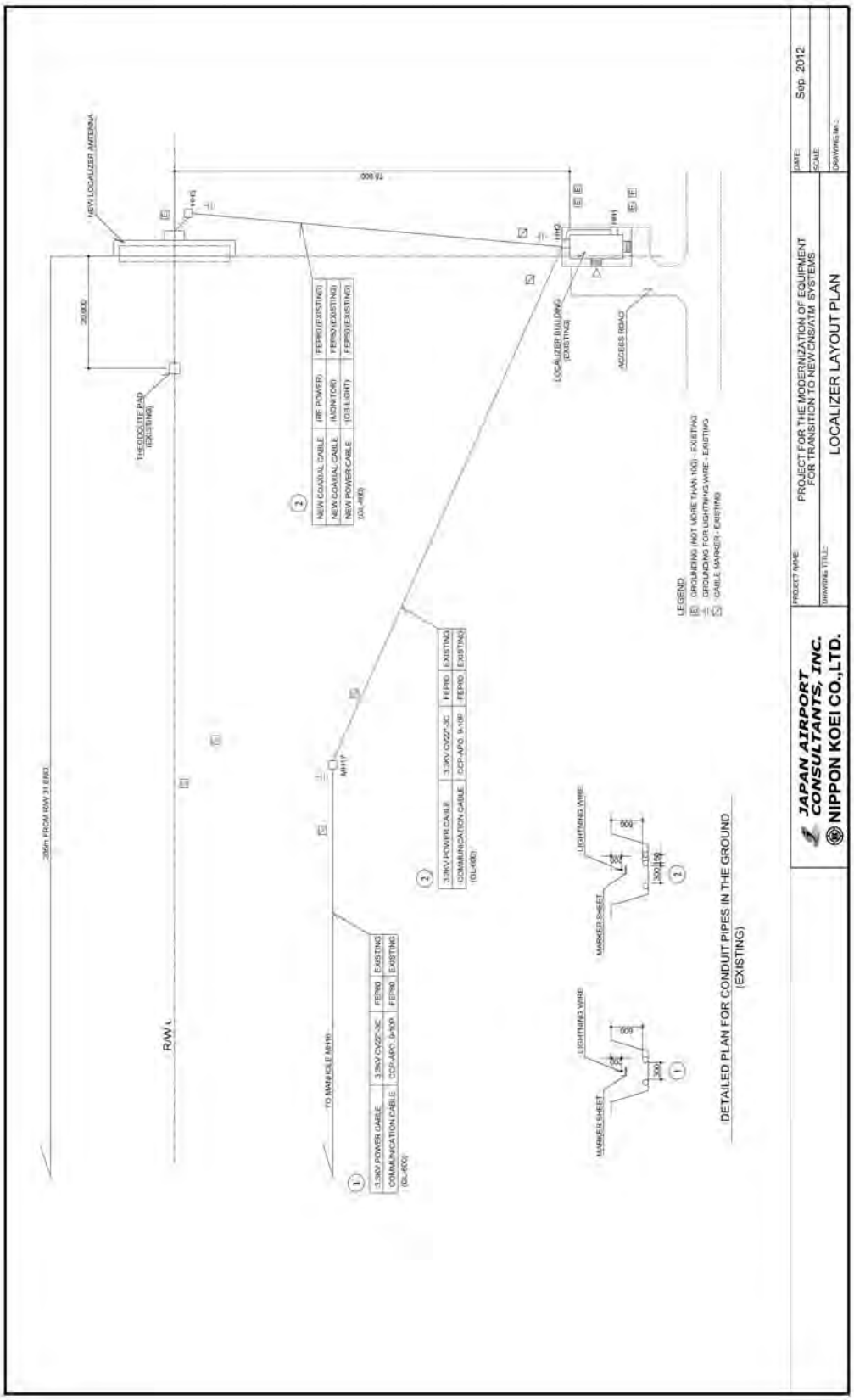


Fig.1-3　LLZ Layout Plan

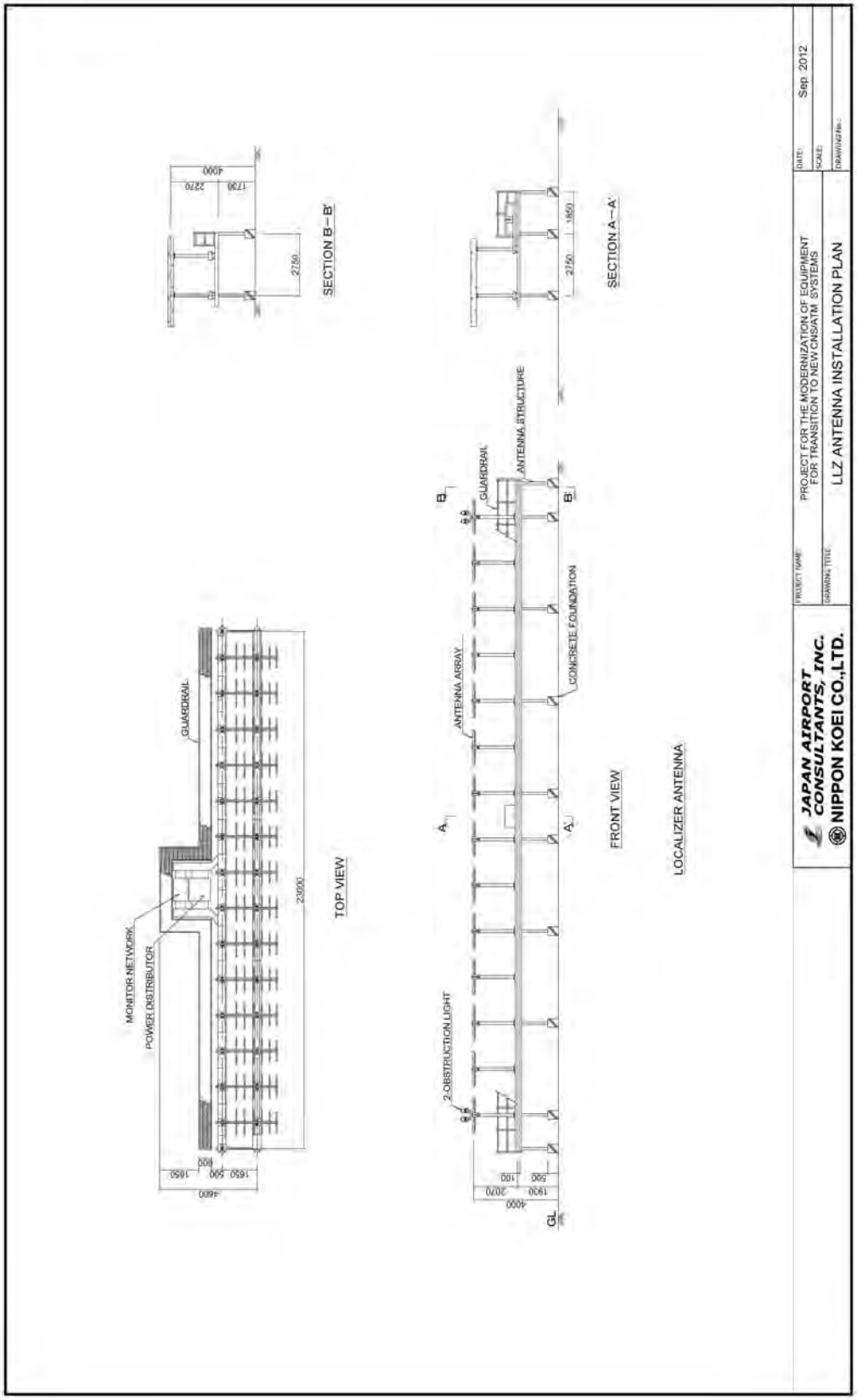


Fig.1-4 LLZ Antenna Installation Plan

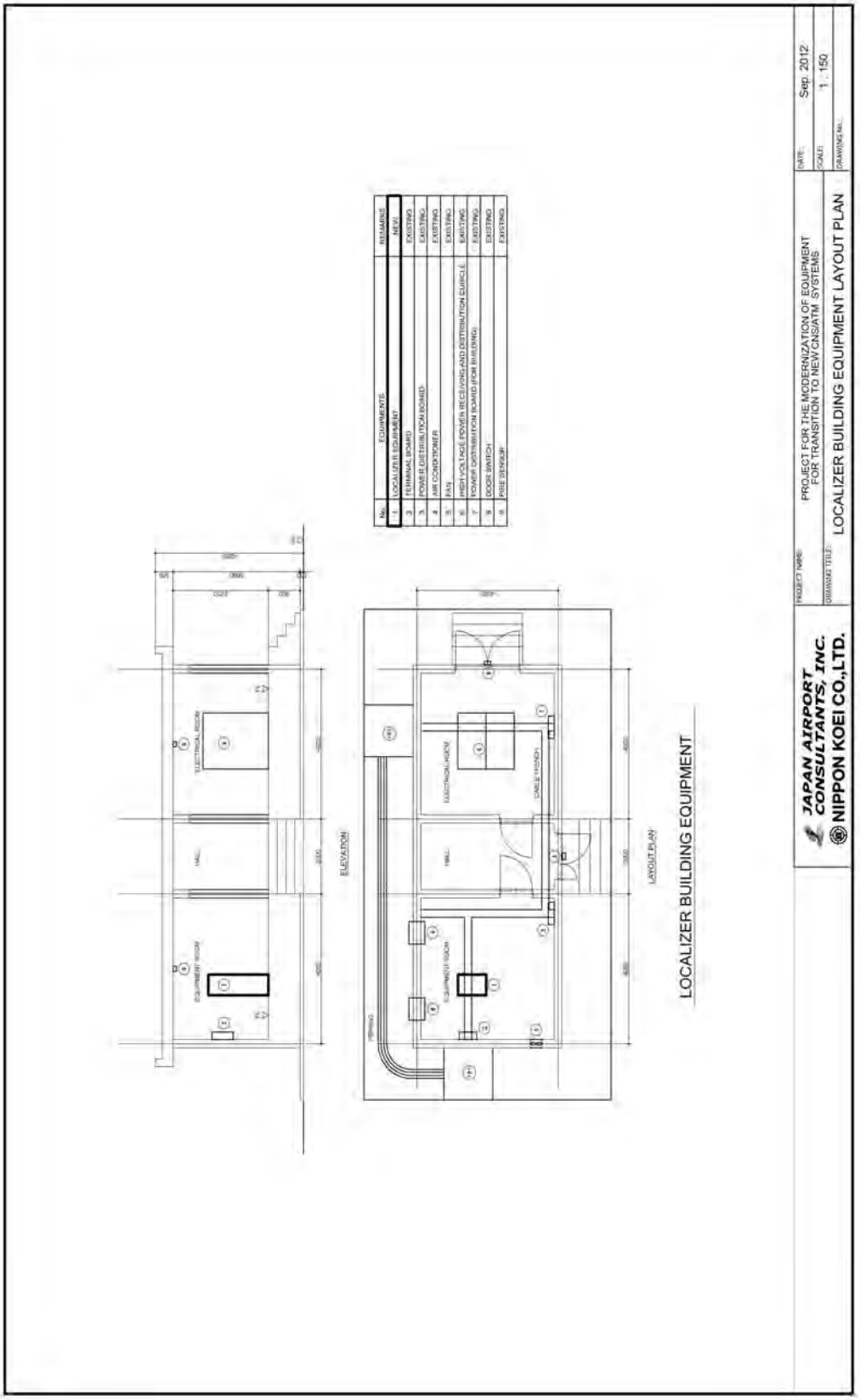


Fig.1-5 LLZ Building Equipment Layout Plan

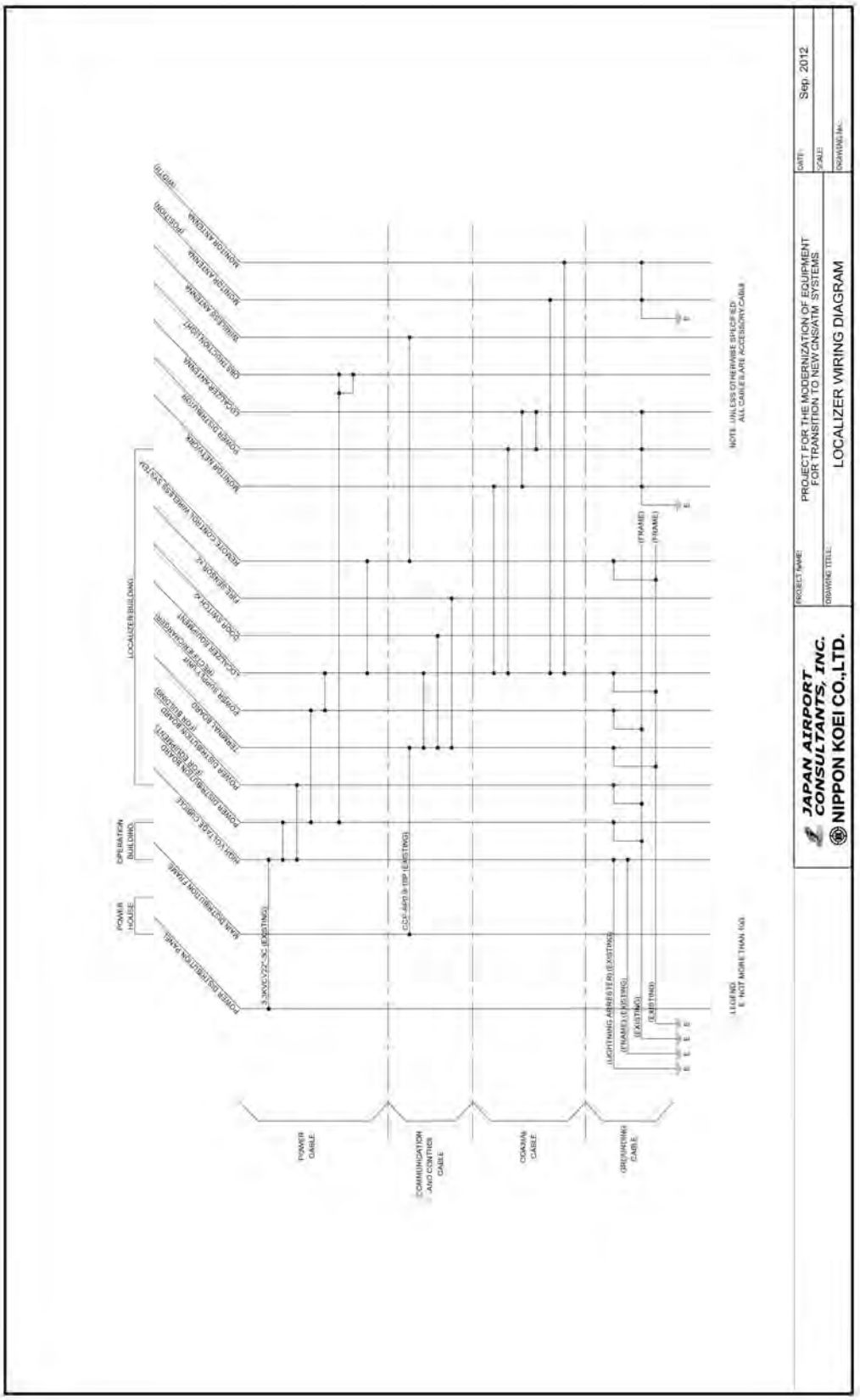


Fig.1-6 LLZ Wiring Diagram

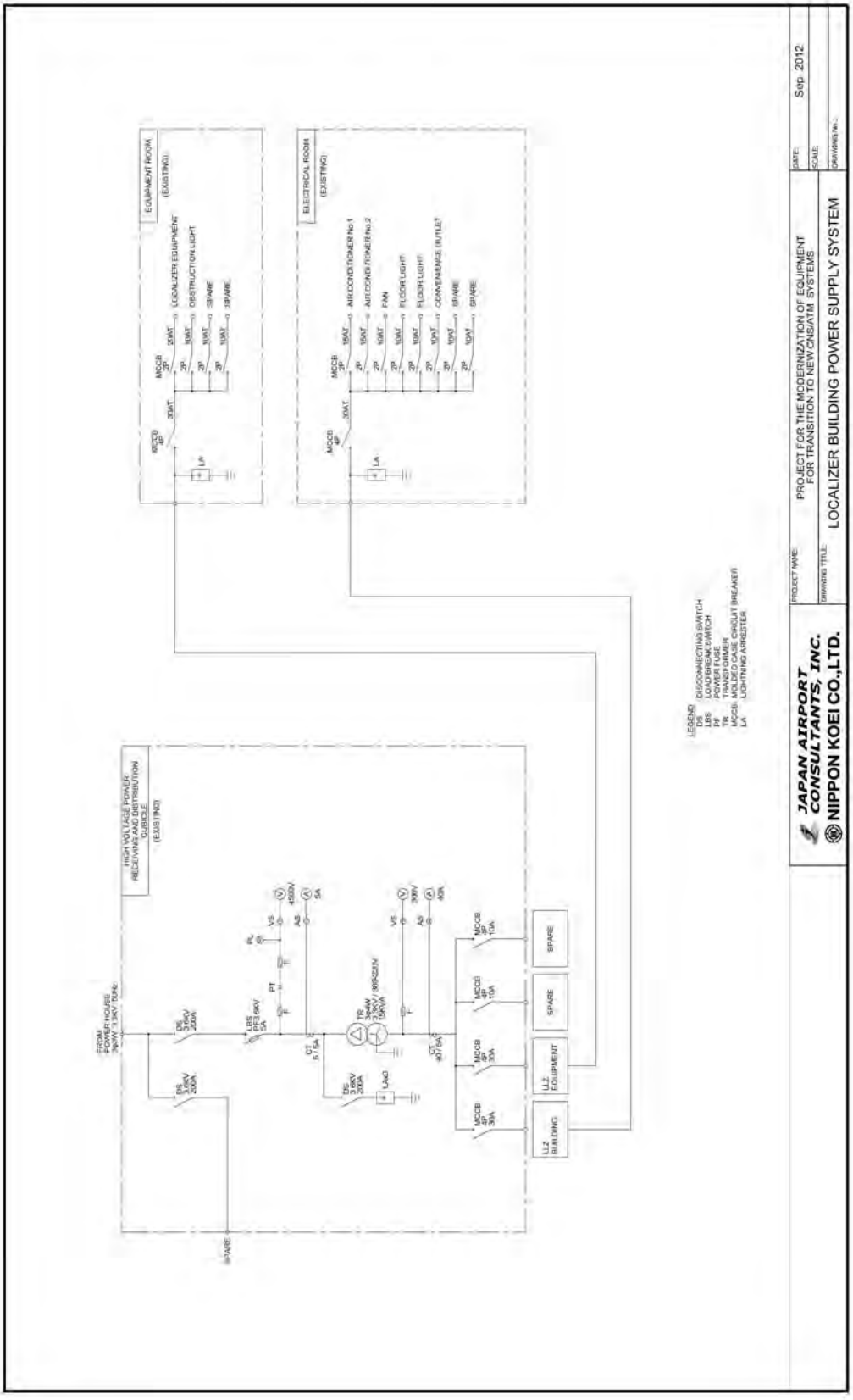


Fig.1-7 LLZ Building Power Supply System

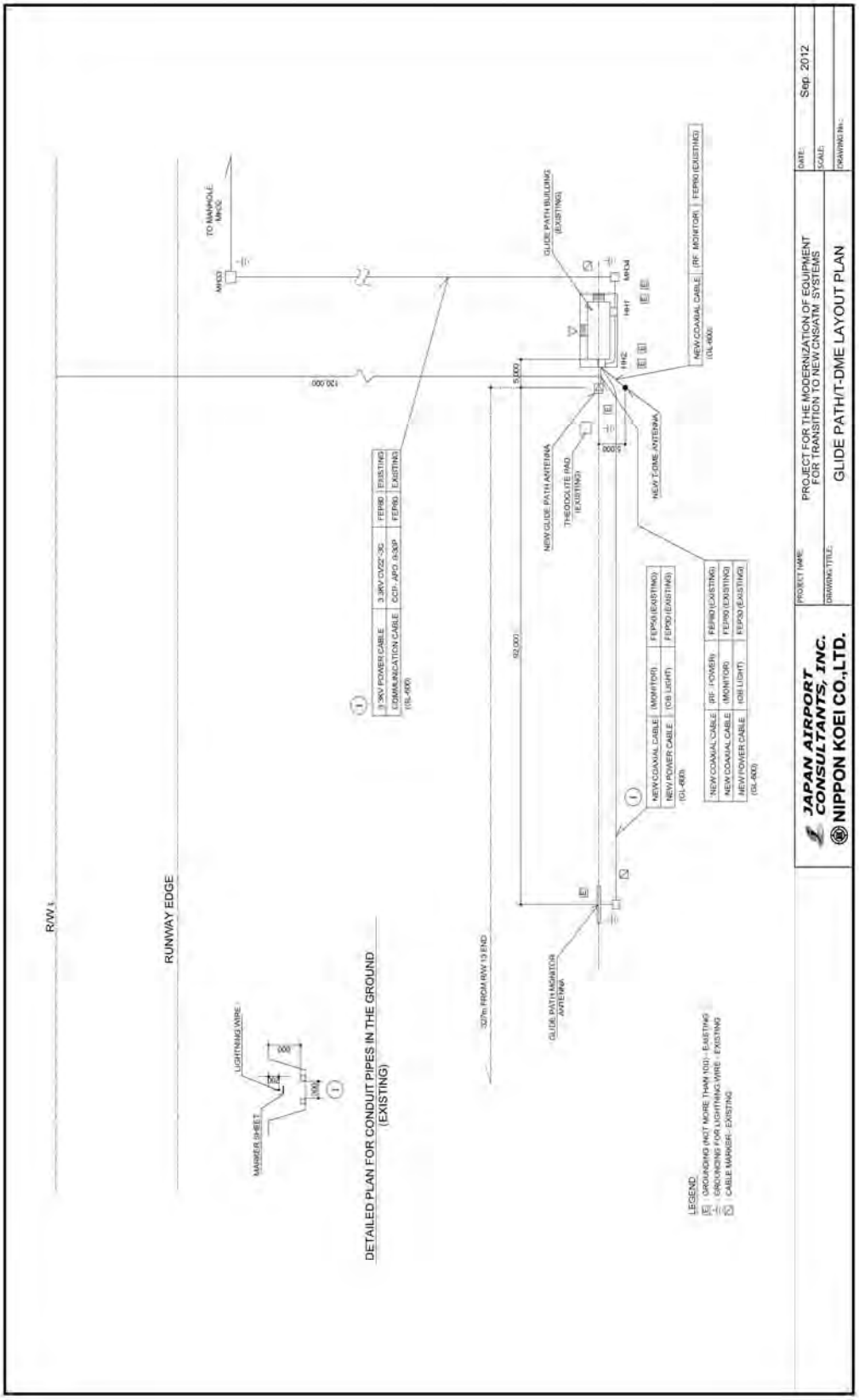


Fig.1-8 GP/T-DME Layout Plan

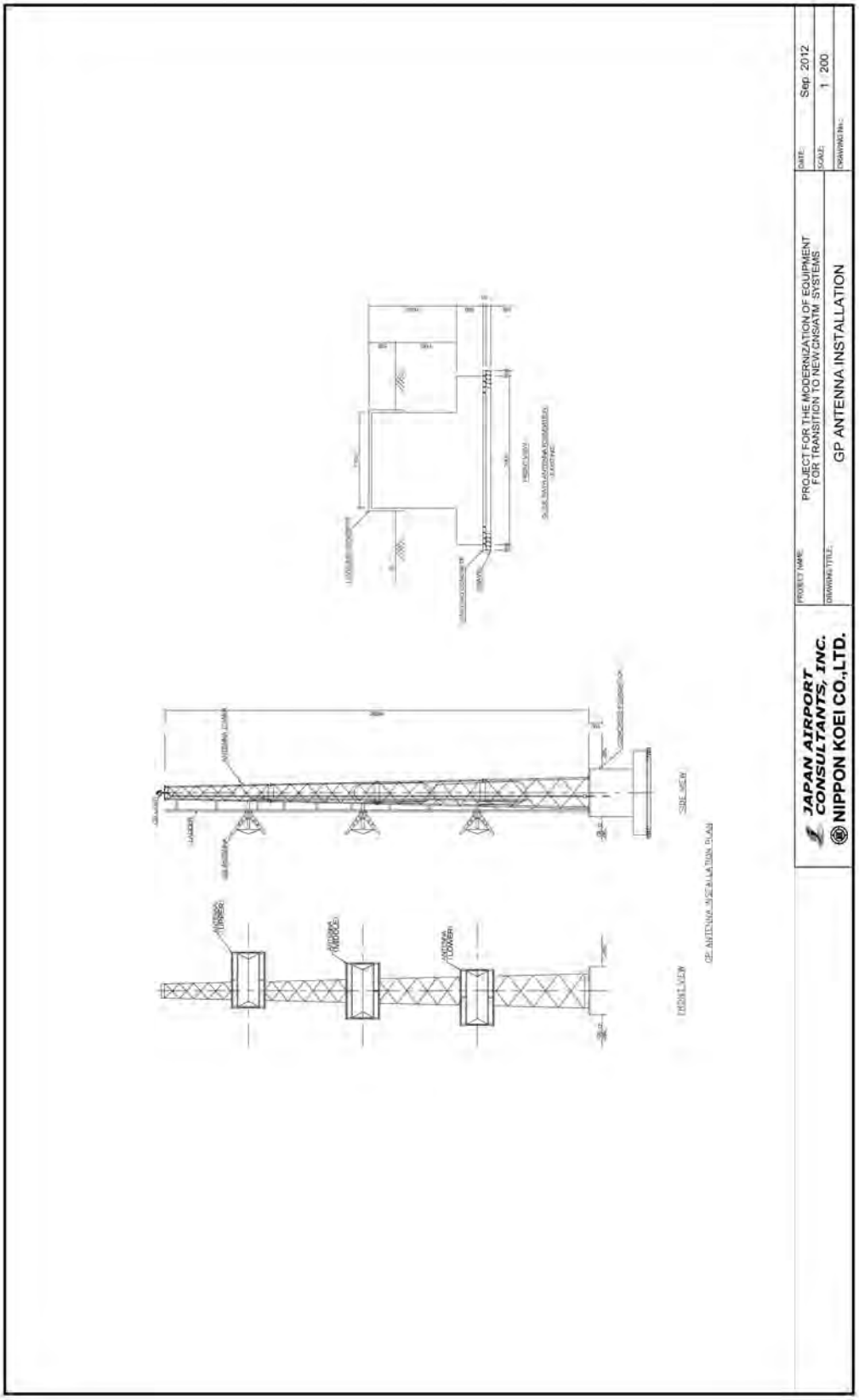


Fig.1-9 GP Antenna Installation

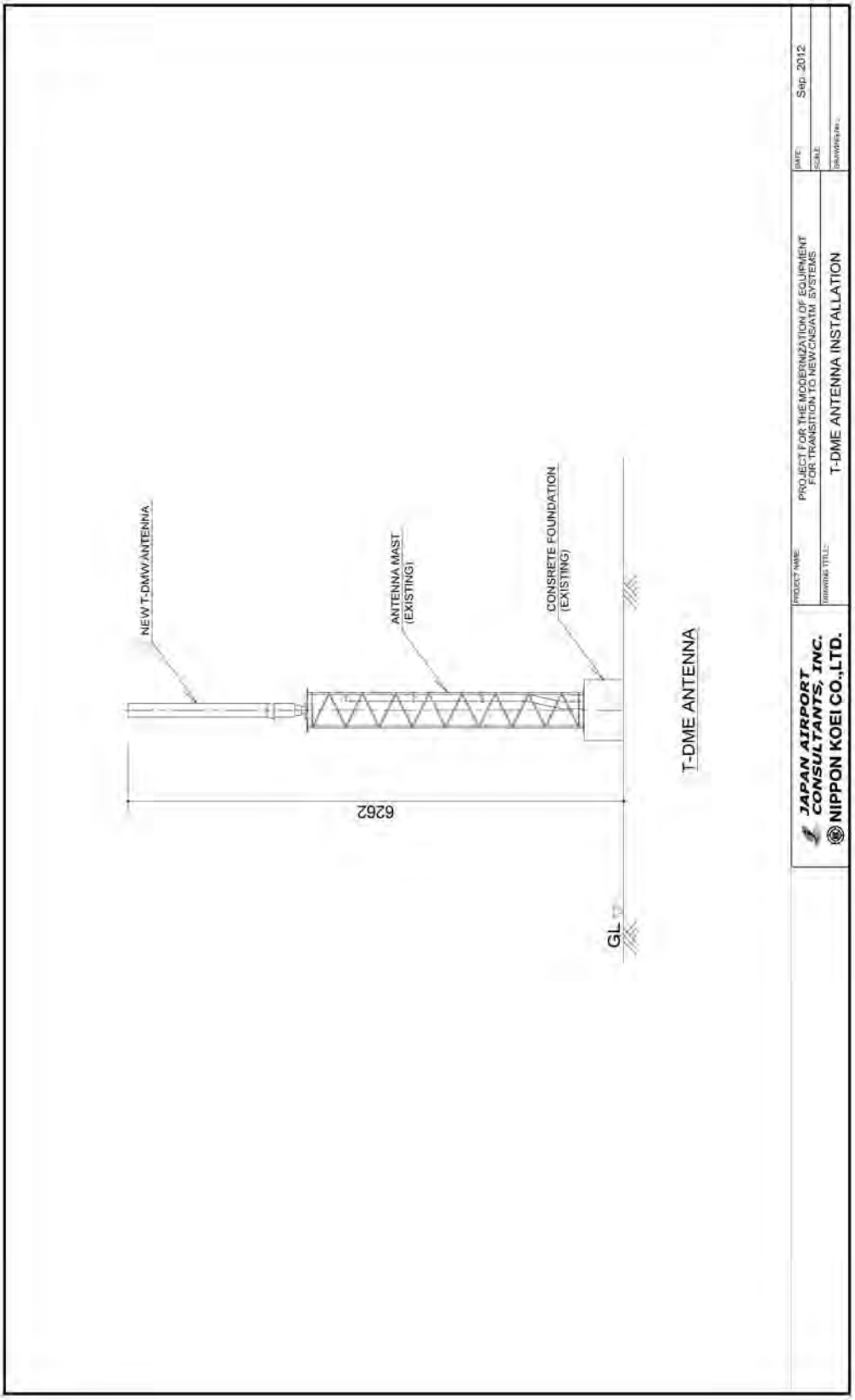


Fig.1-10 T-DME Antenna Installation

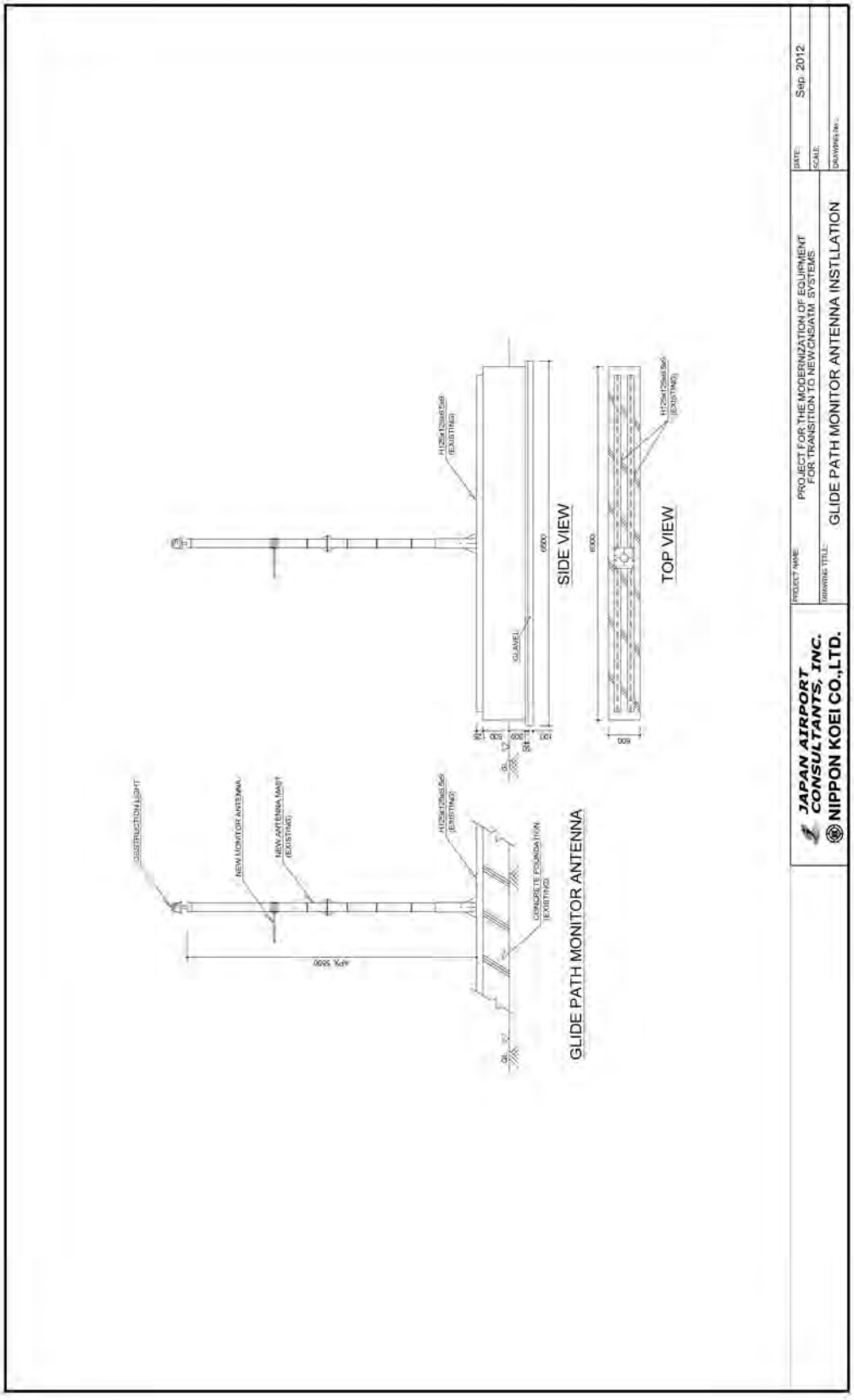


Fig.1-11 GP Monitor Antenna Installation

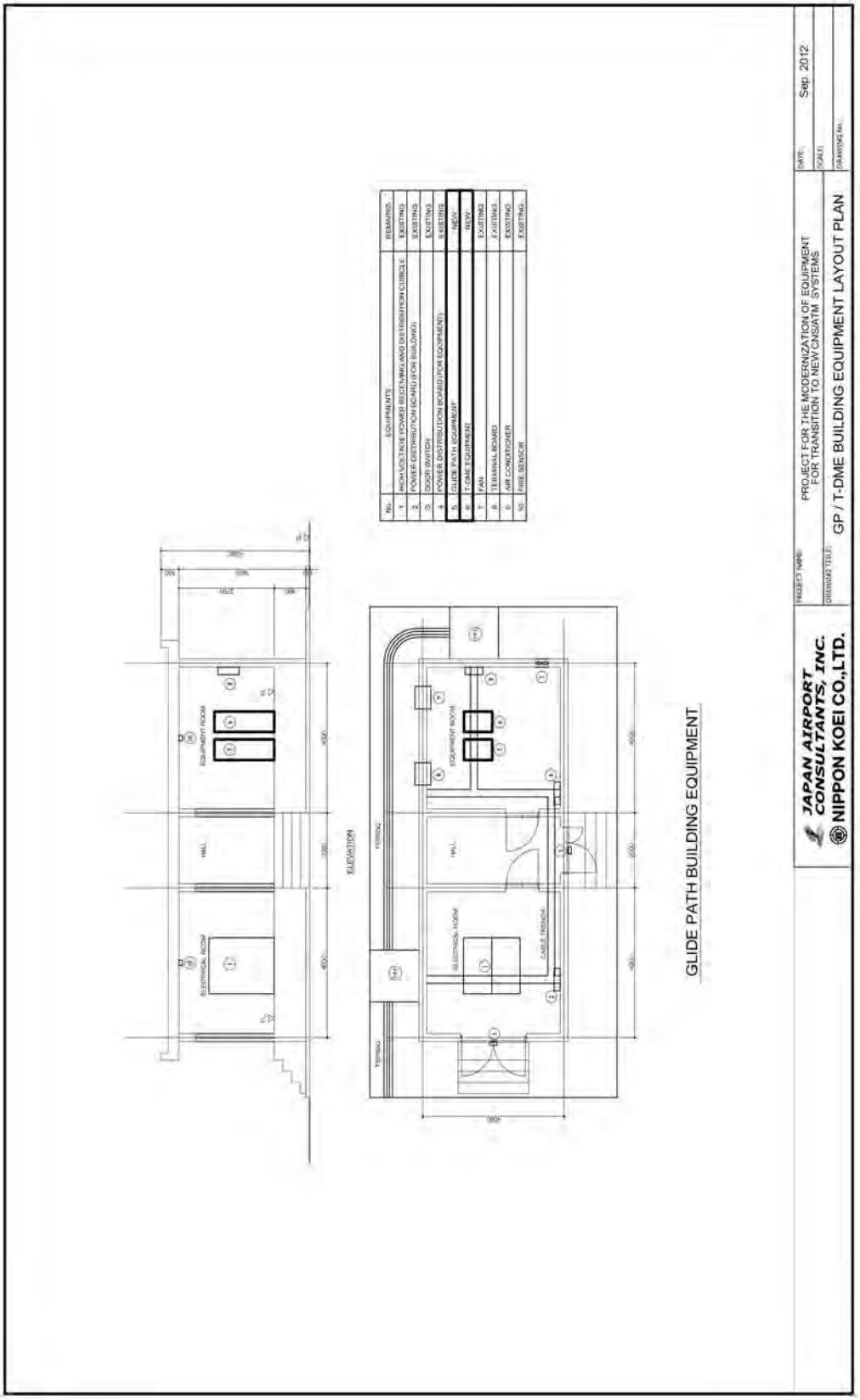


Fig.1-12 GP/T-DME Equipment Layout Plan

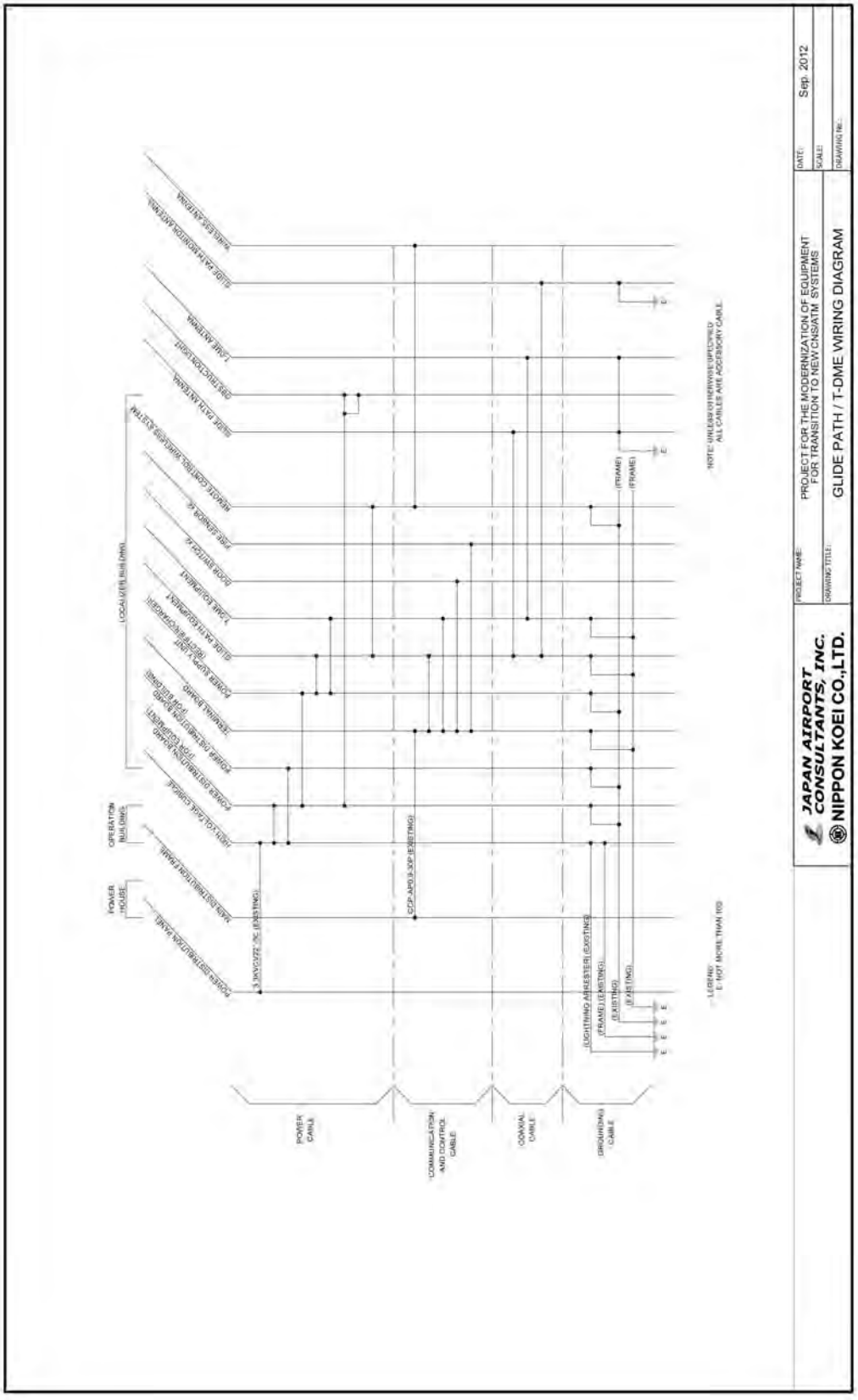


Fig.1-13 GP/T-DME Wiring Diagram

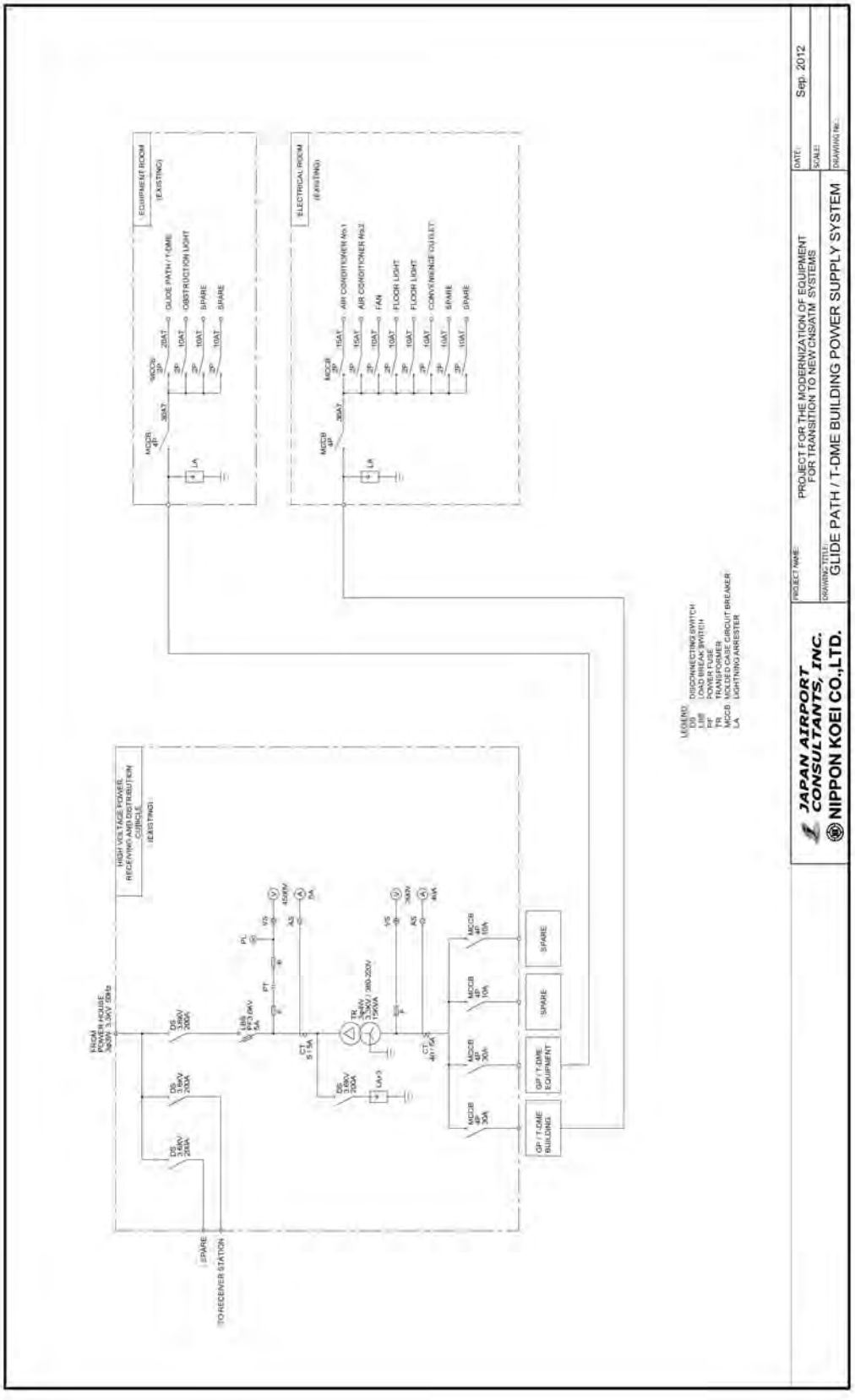


Fig.1-14 GP/T-DME Building Power Supply System

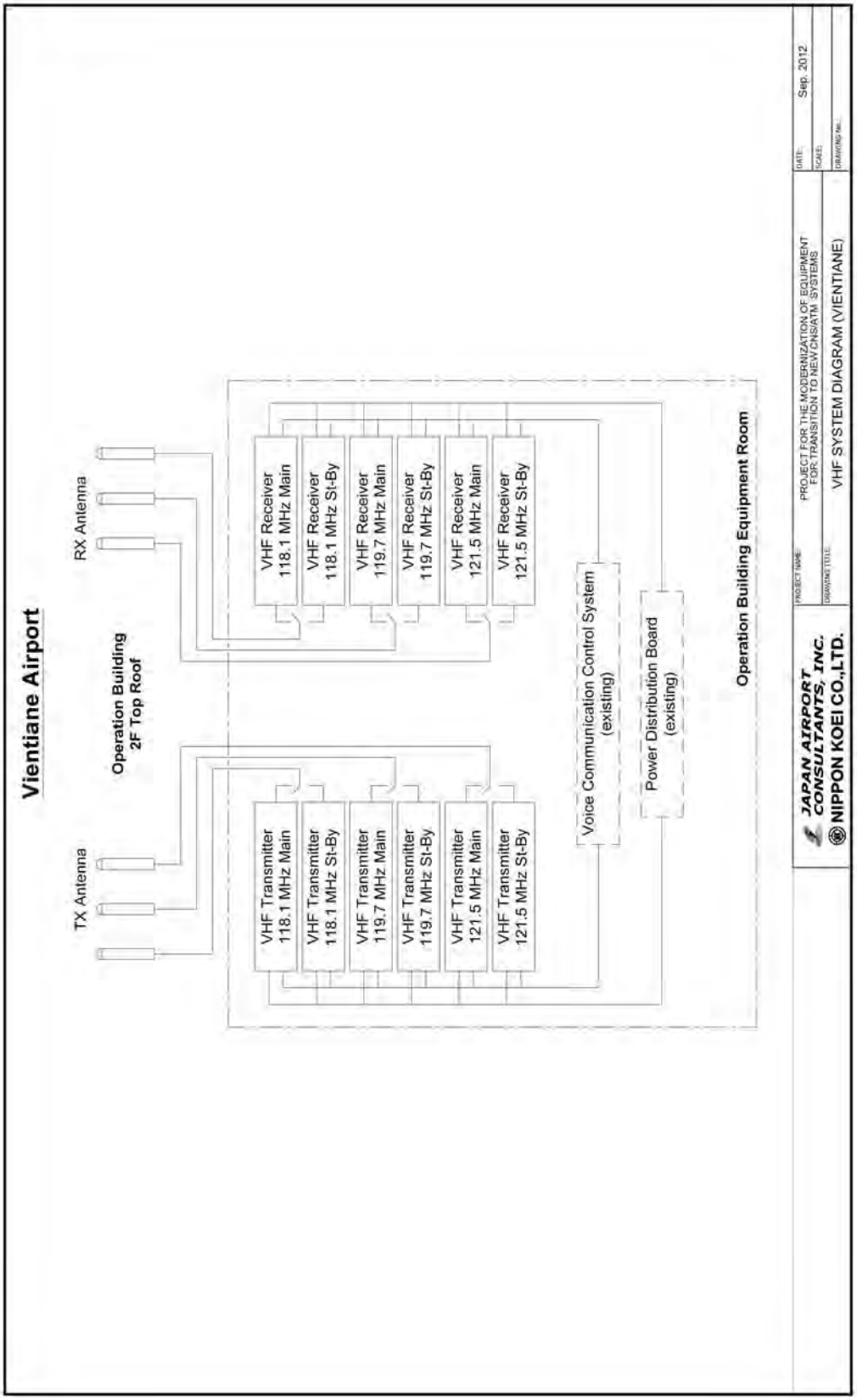


Fig.1-15 VHF System Diagram

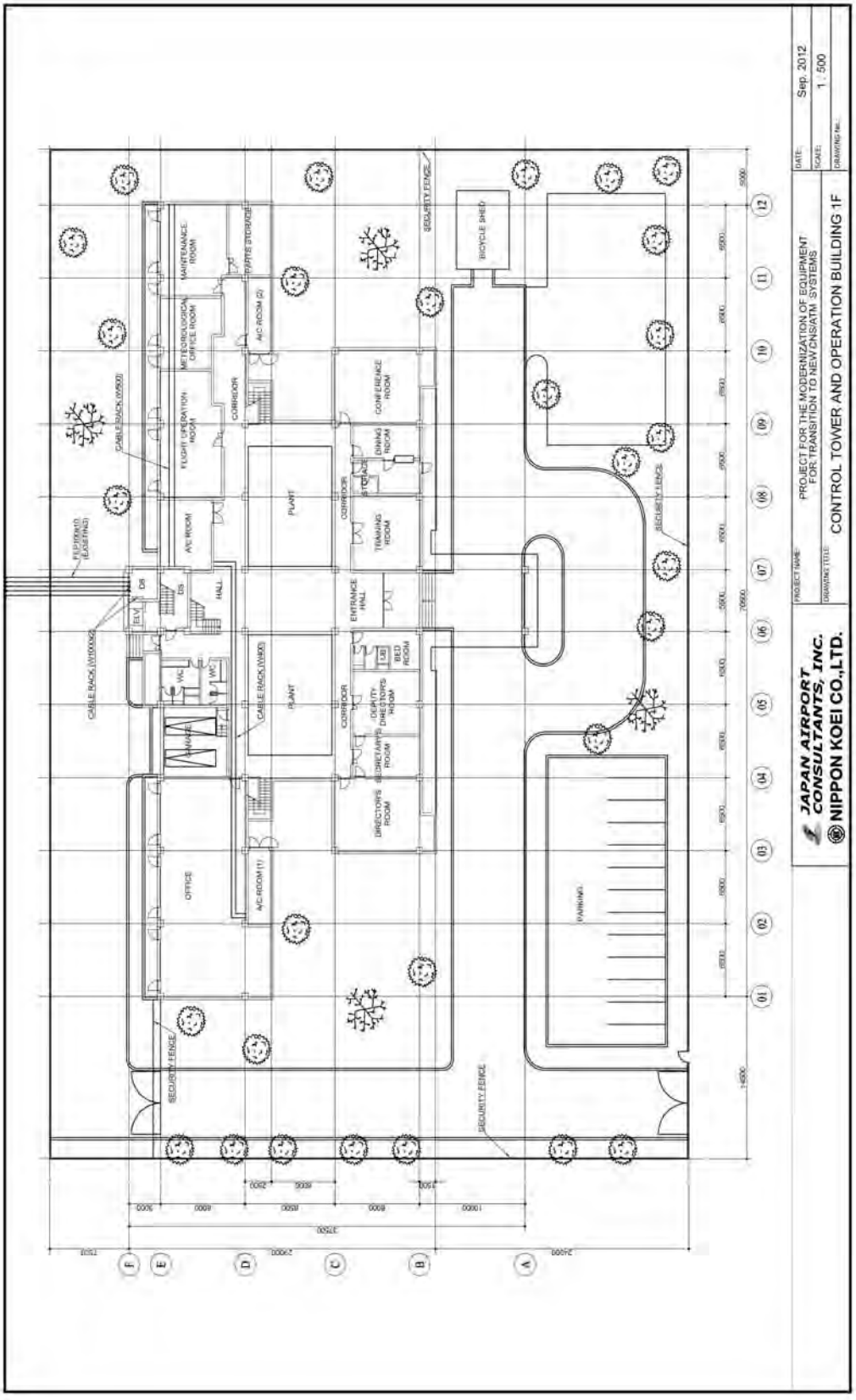


Fig.1-16 Control Tower And Operation Building 1F

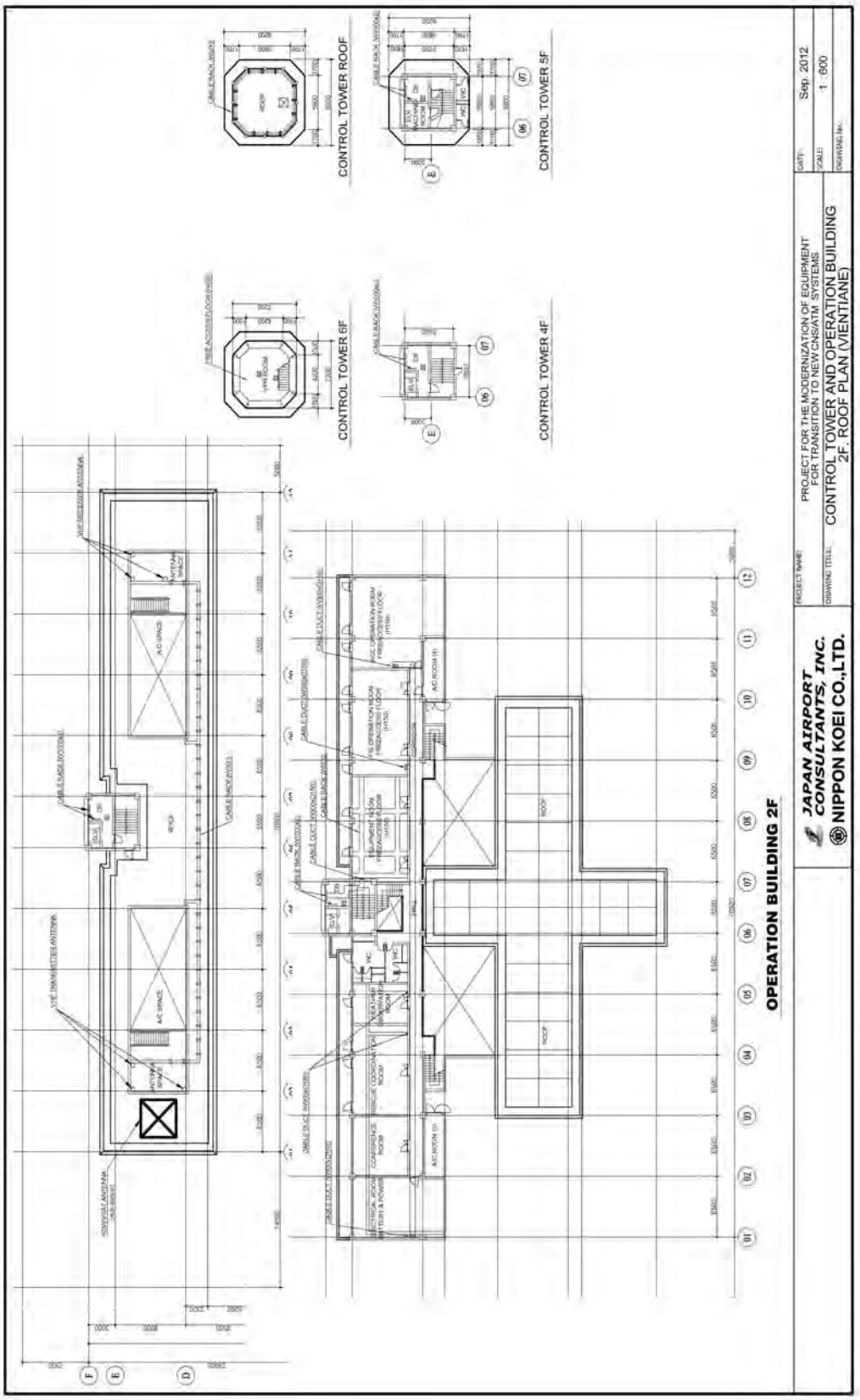


Fig.1-17 Control Tower And Operation Building 2F, Roof Plan

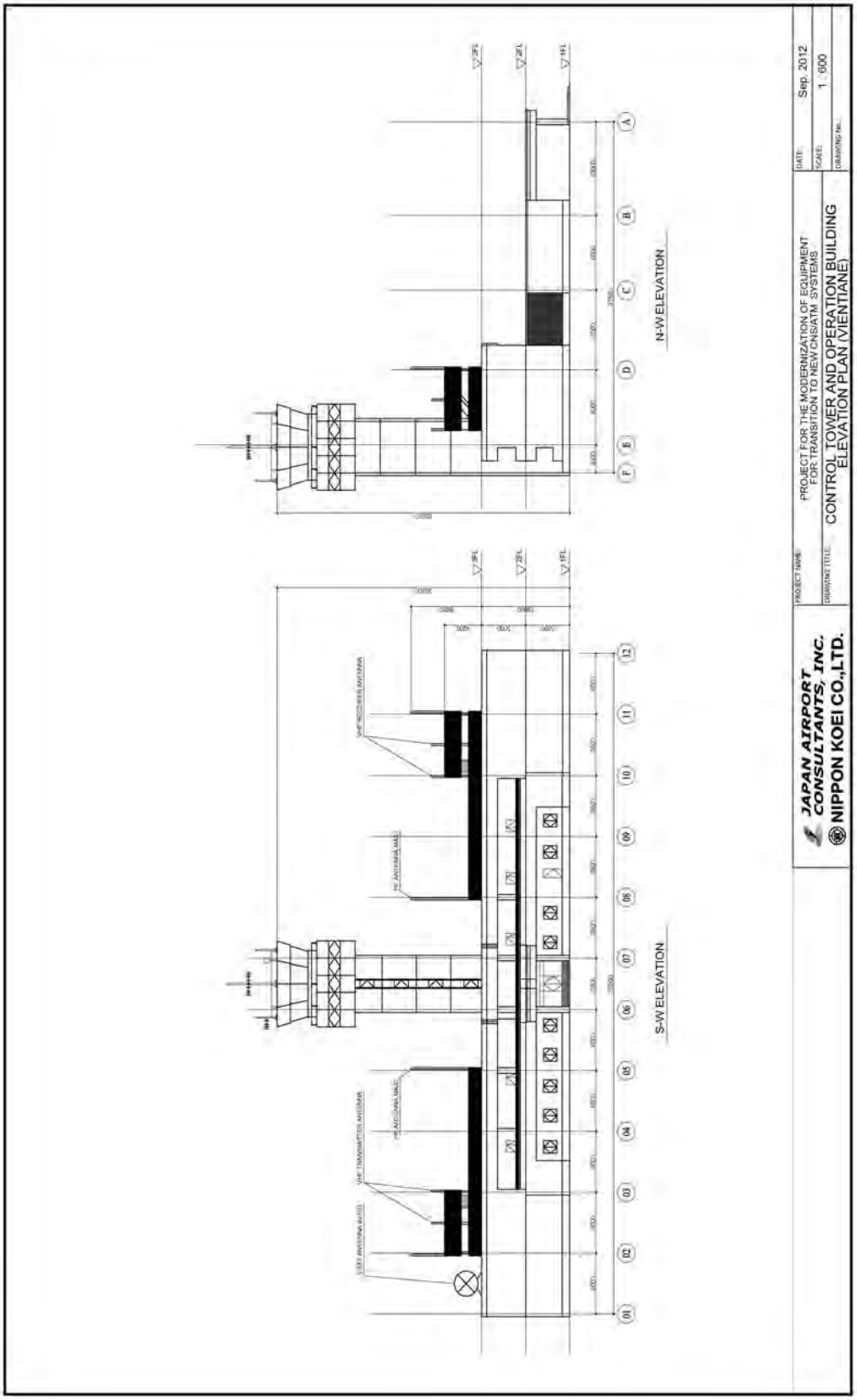


Fig.1-18 Control Tower And Operation Building Elevation Plan

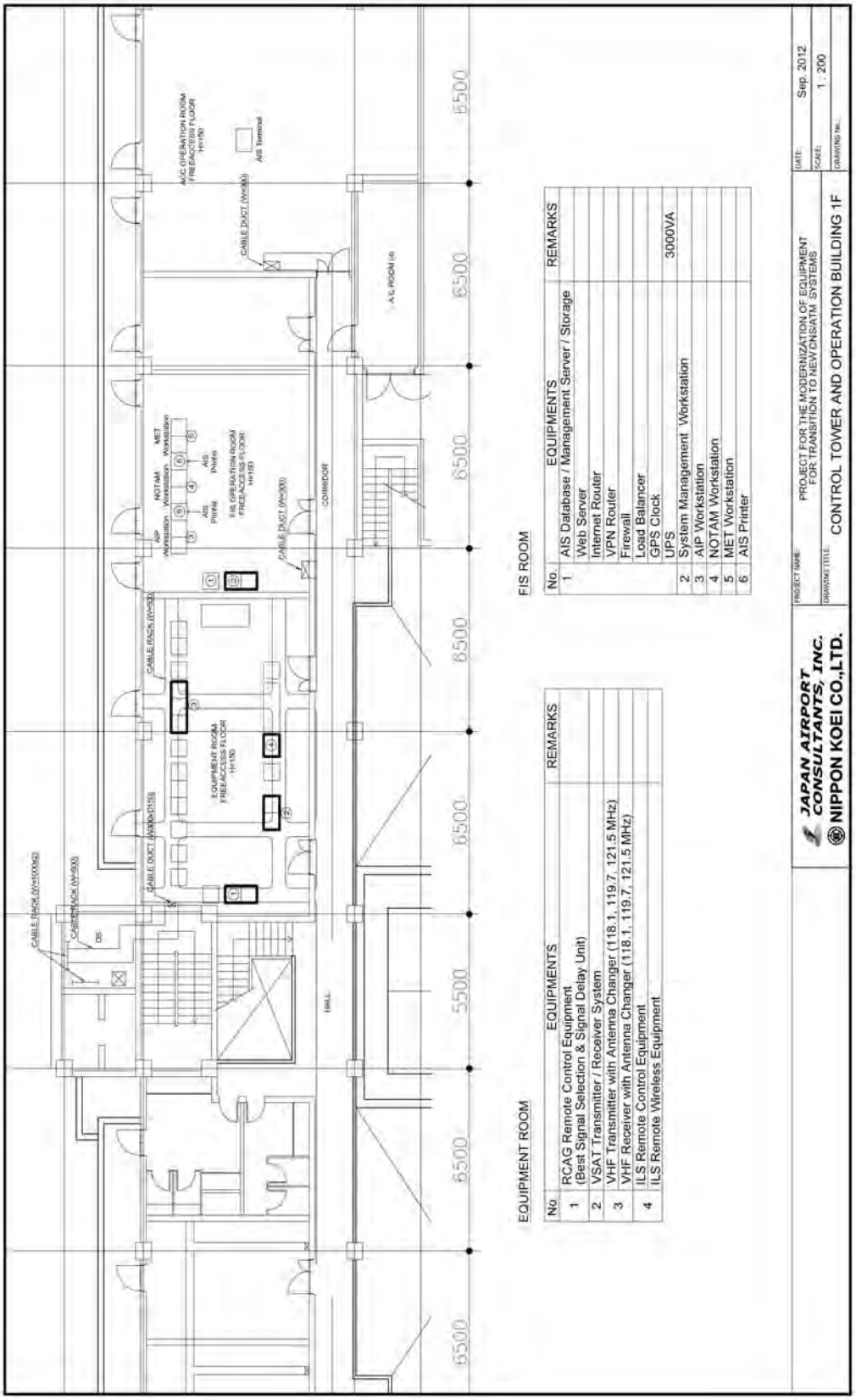


Fig.1-19 Control Tower And Operation Building 1F

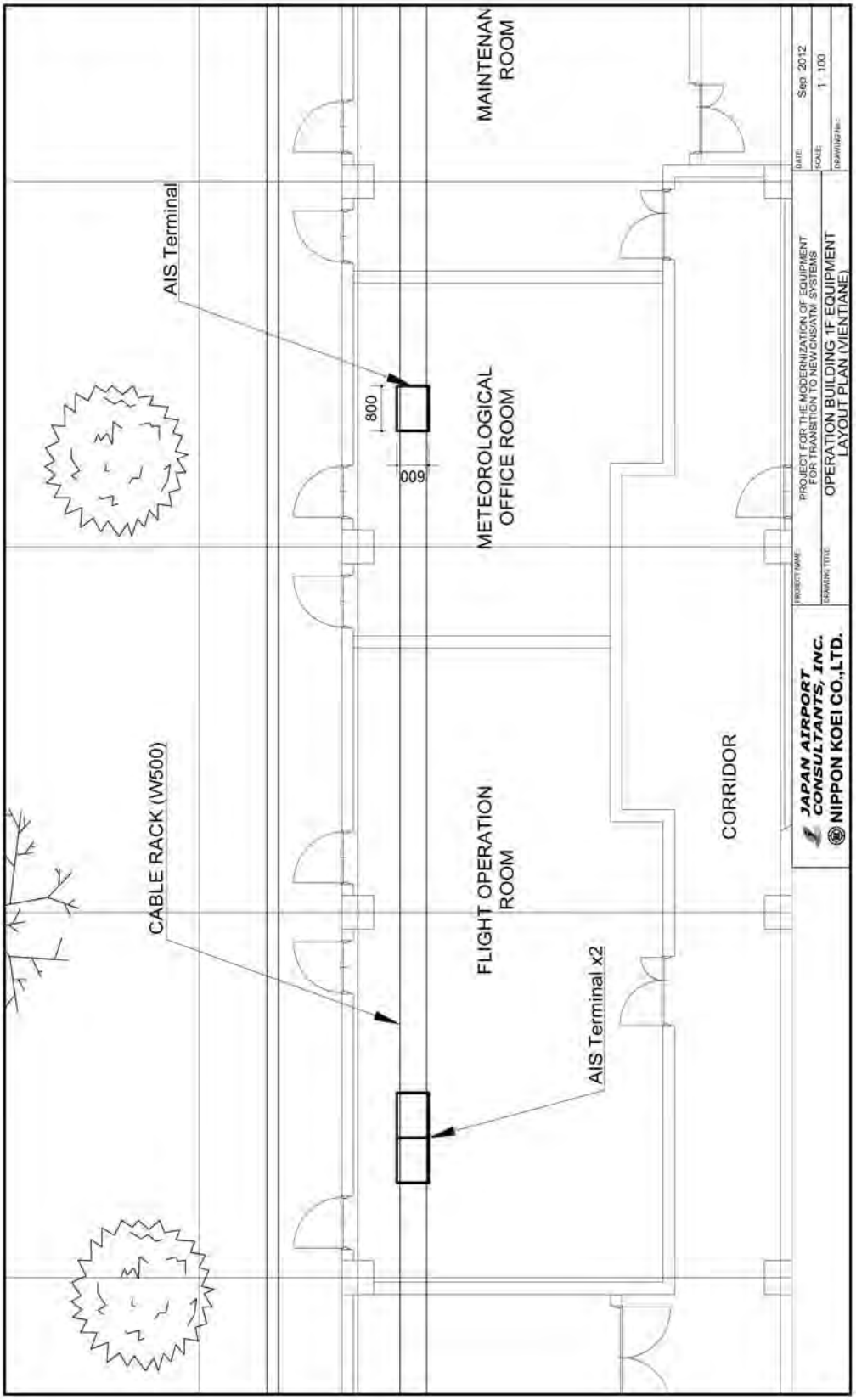


Fig.1-20 Operation Building 1F Equipment Layout Plan

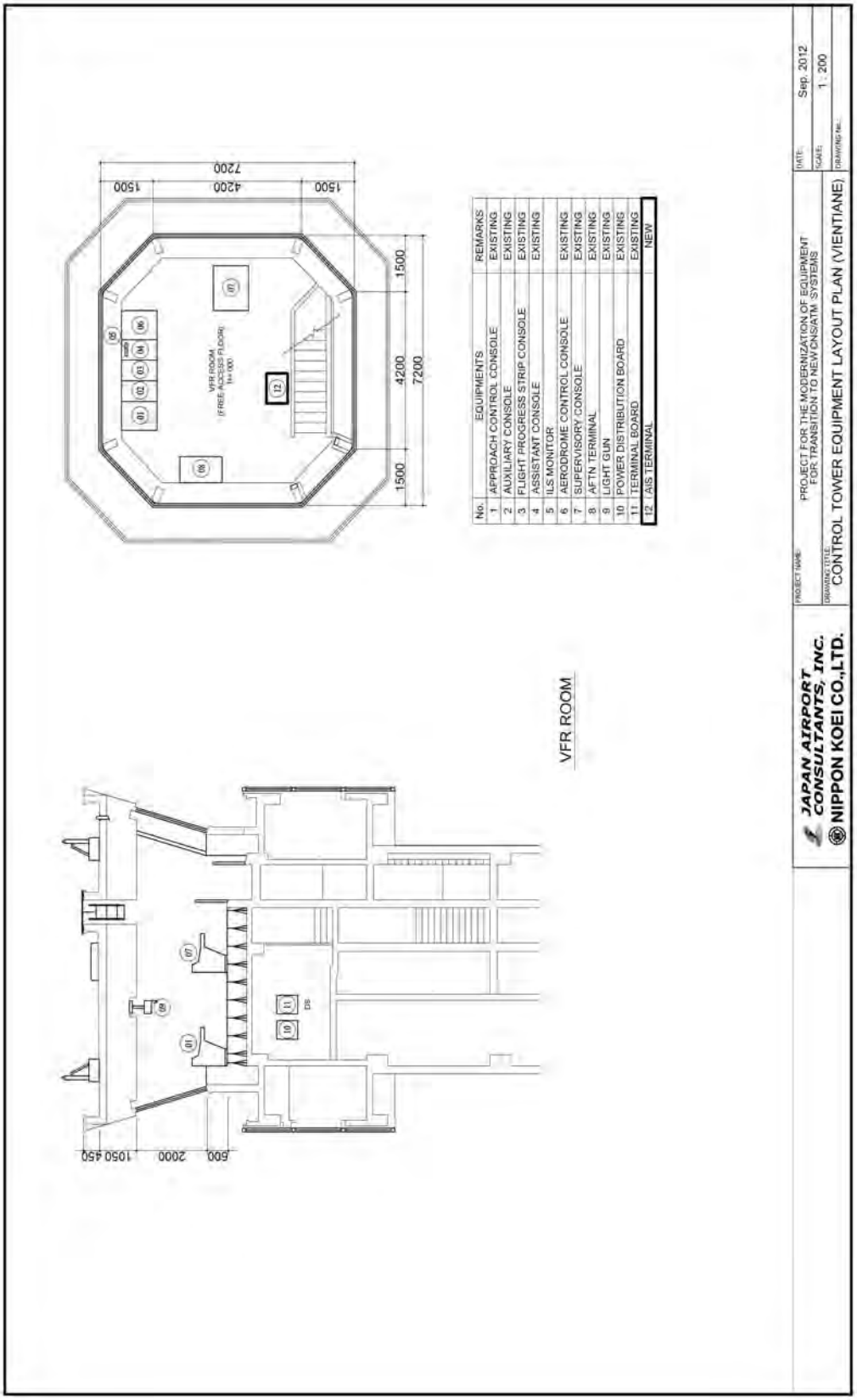


Fig.1-21 Control Tower Equipment Layout Plan

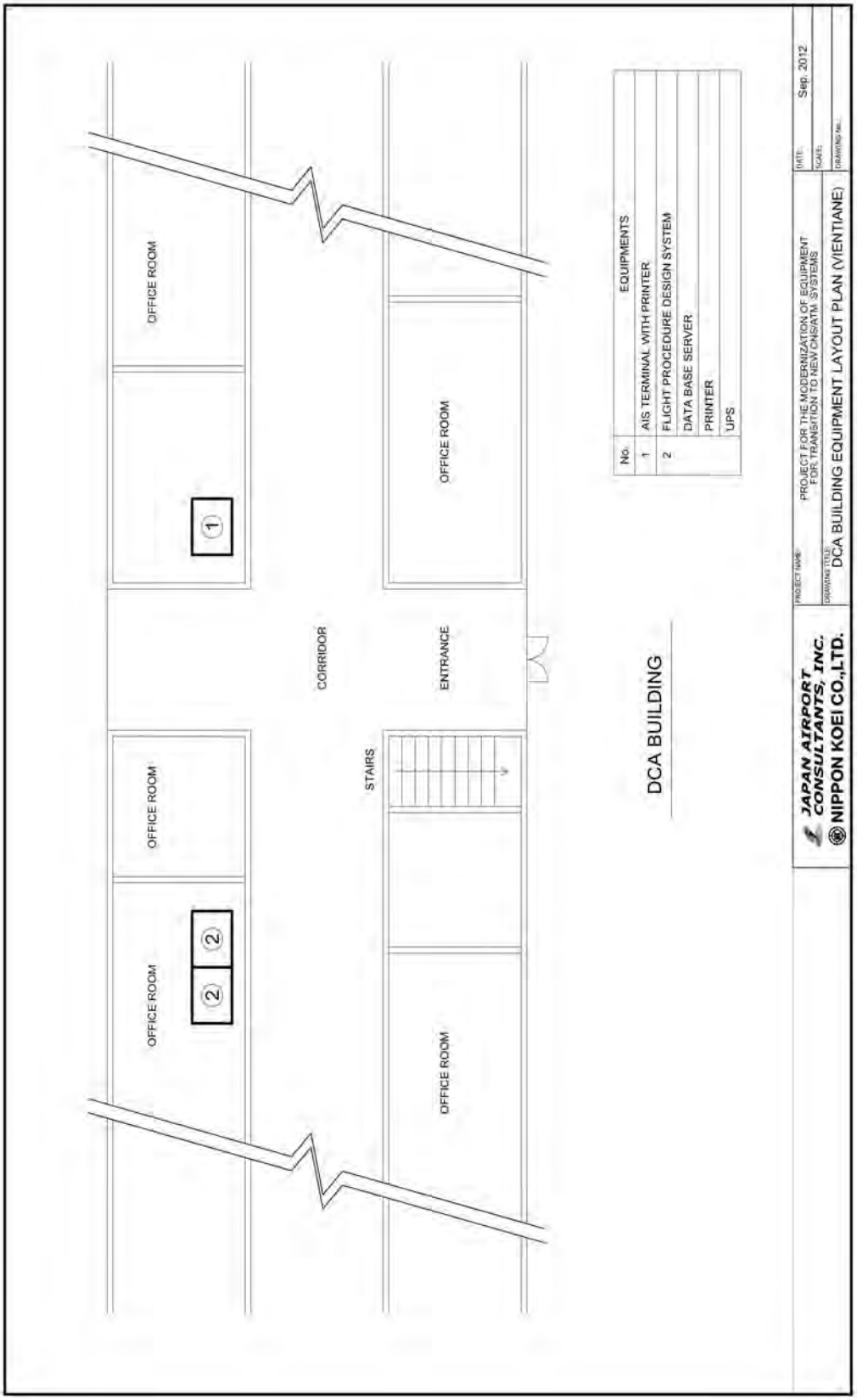


Fig.1-22 DCA Building Equipment Layout Plan

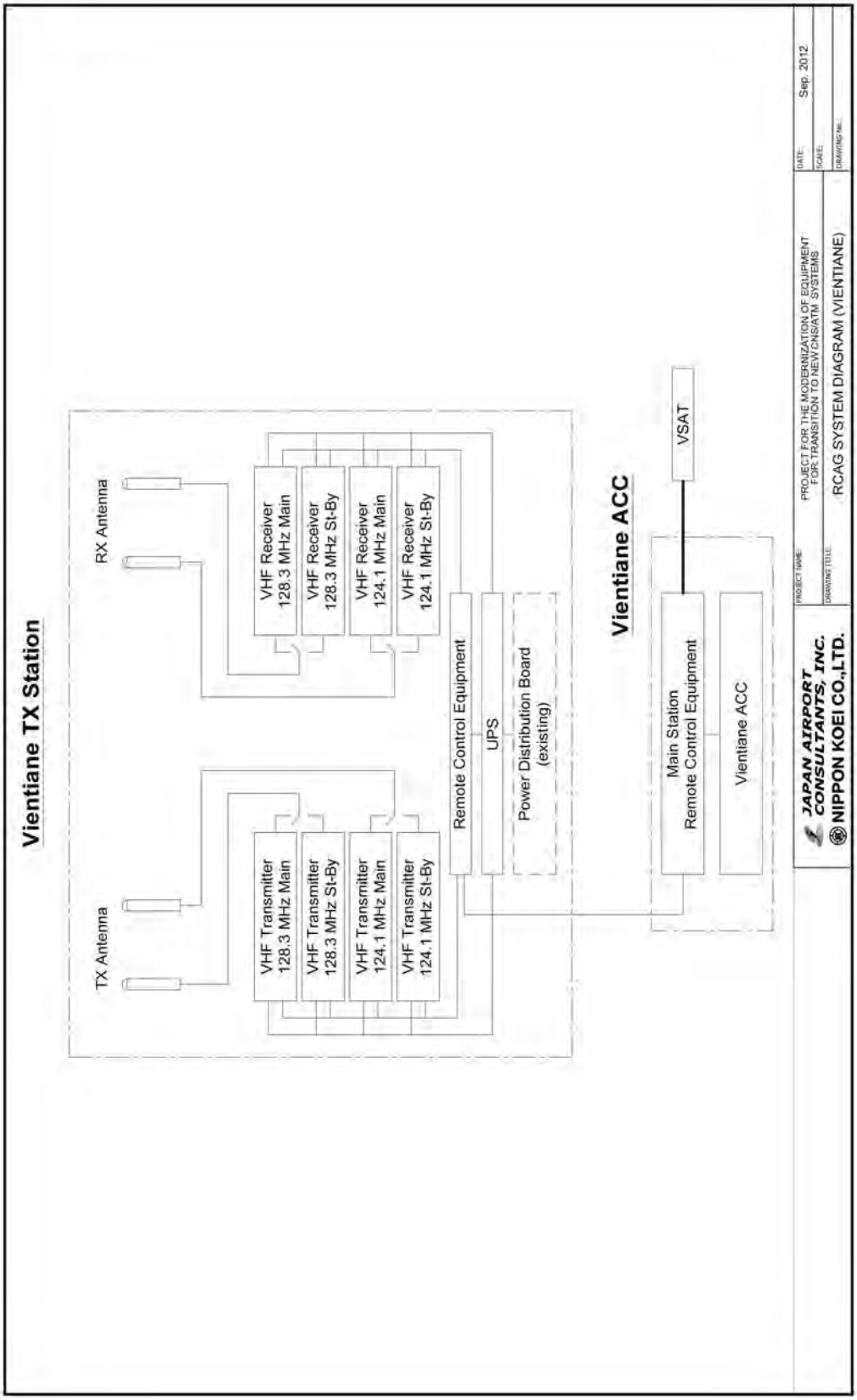


Fig.1-23 RCAG System Diagram

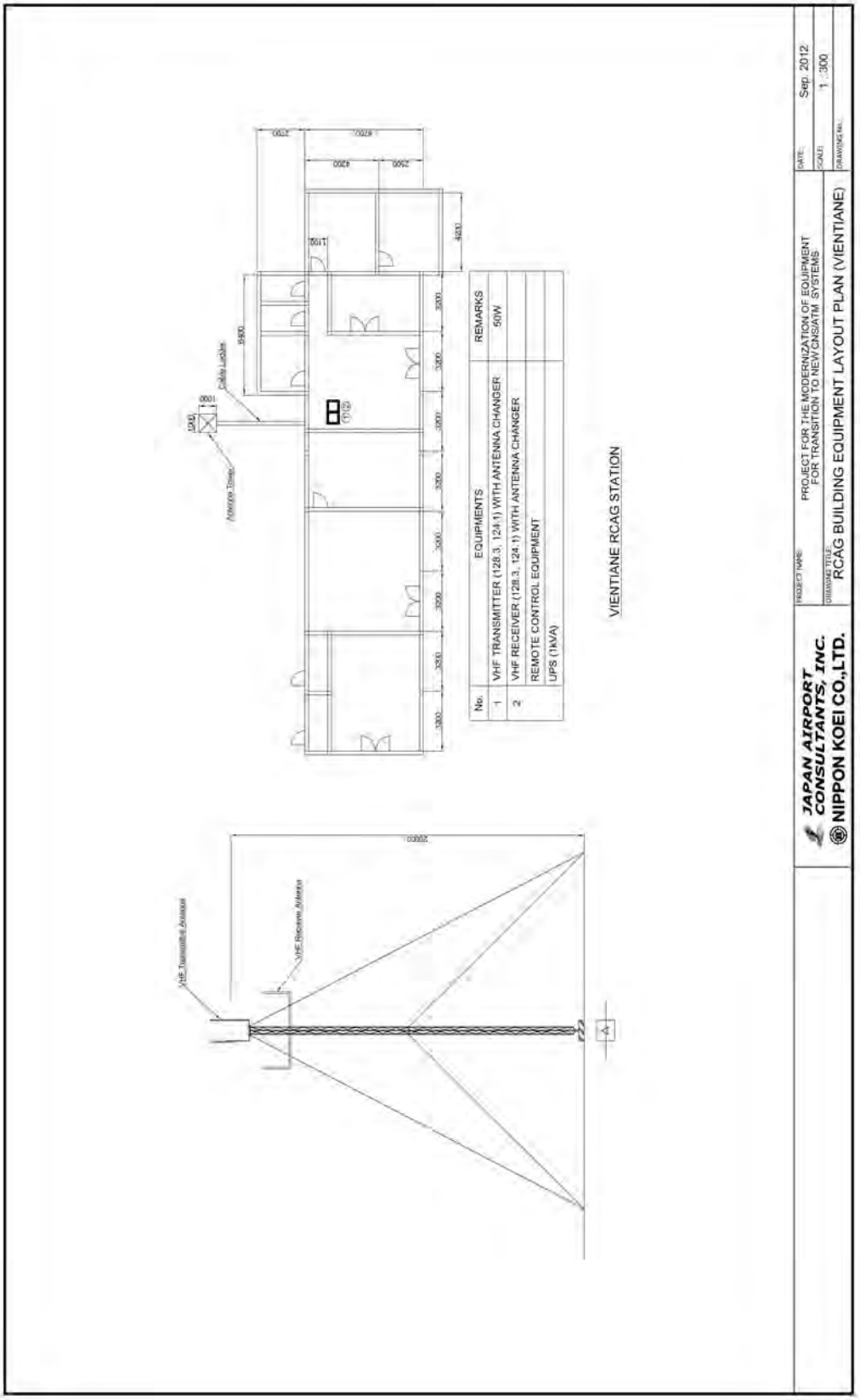


Fig.1-24 RCAG Building Equipment Layout Plan

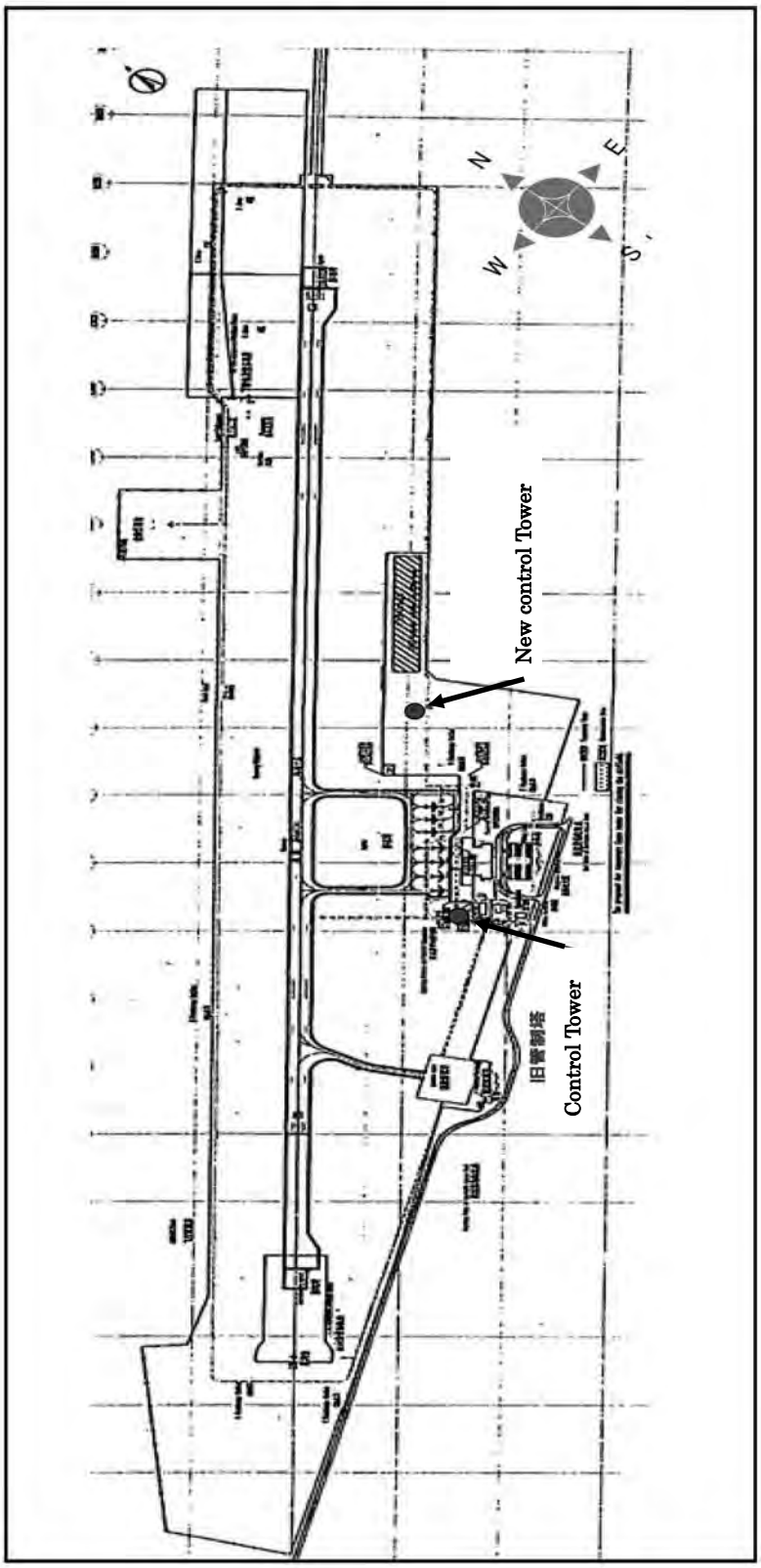


Fig.2-1 Luang Phabang Airport Layout Plan

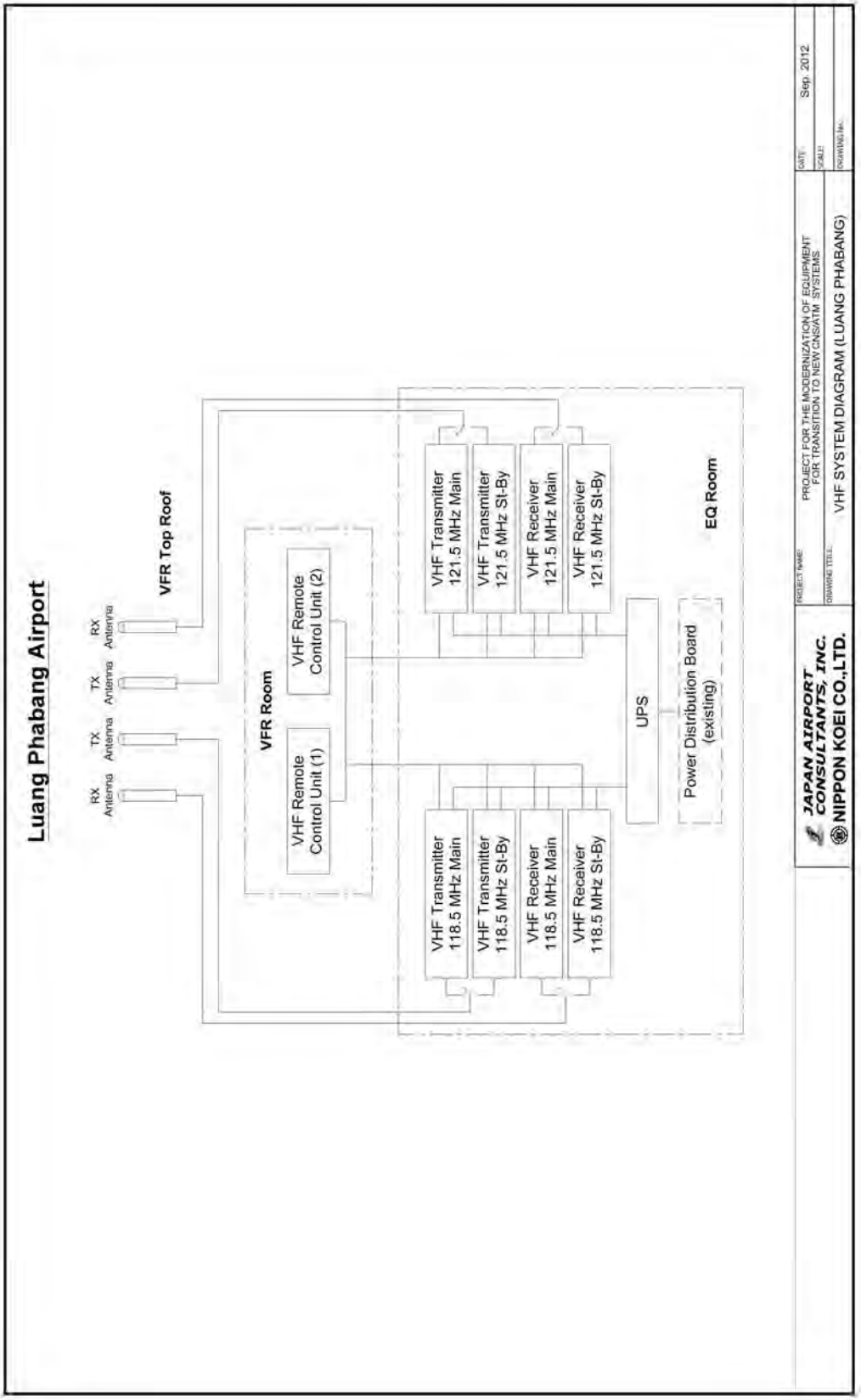


Fig.2-2 VHF System Diagram

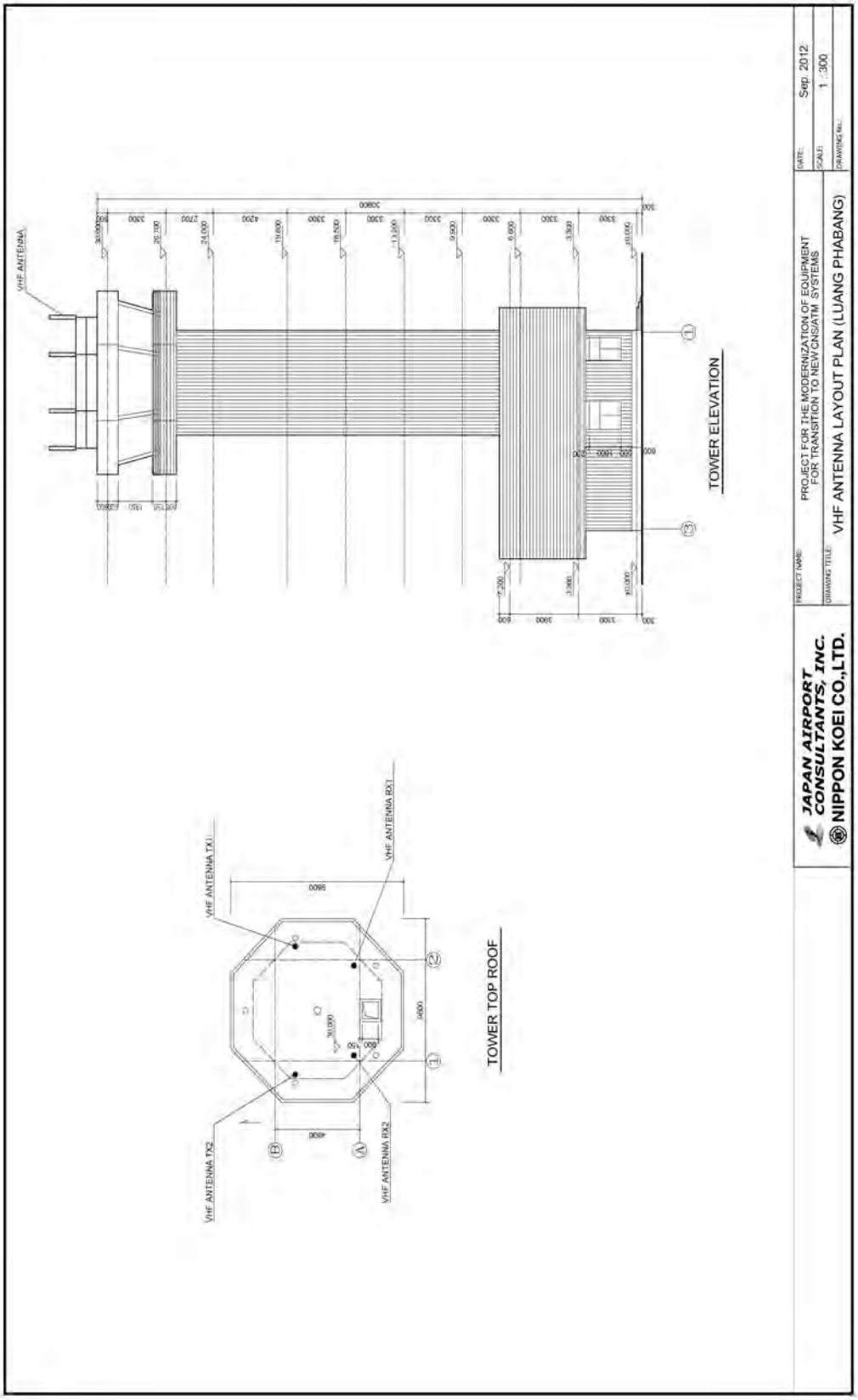


Fig.2-3 VHF Antenna Layout Plan

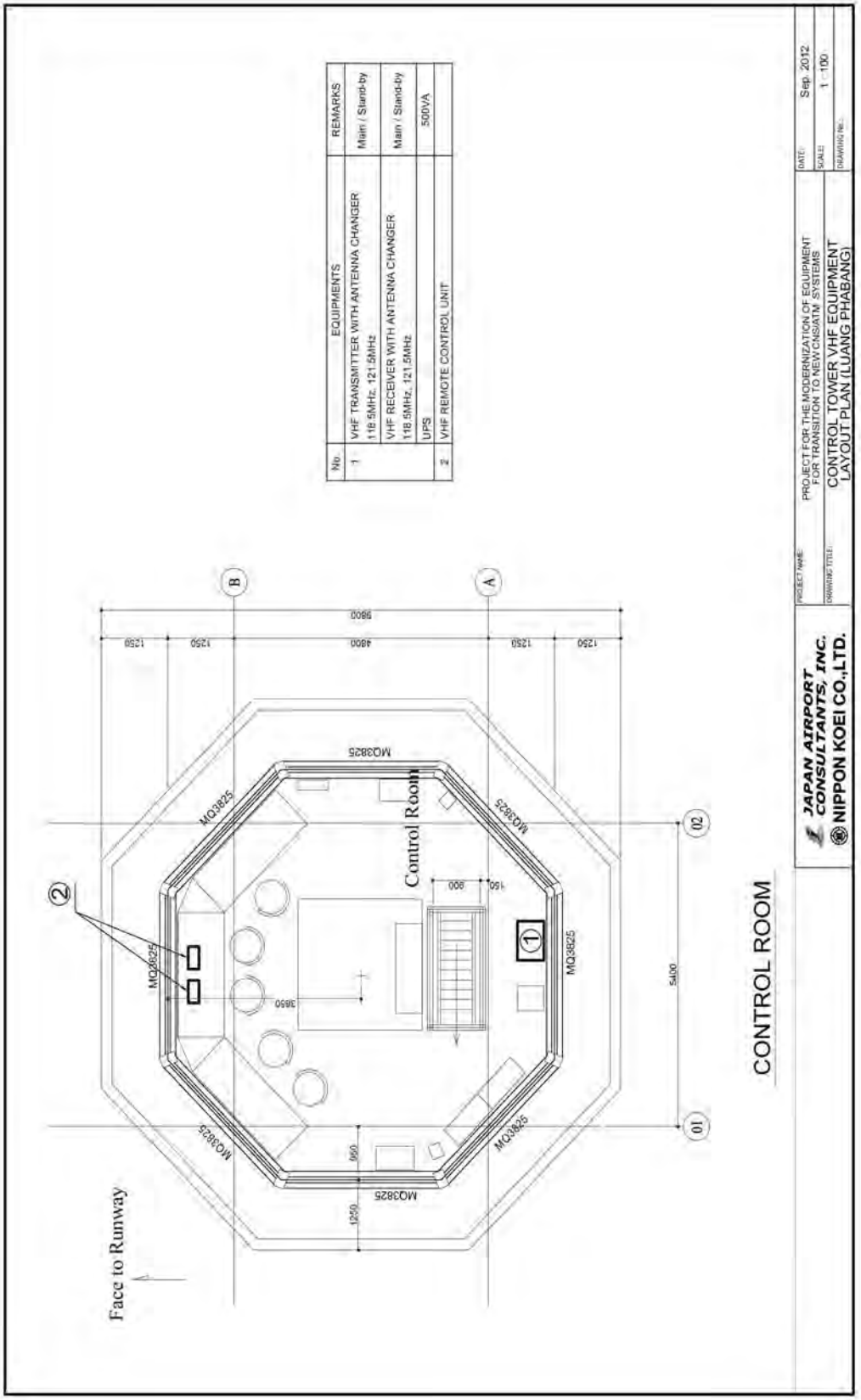


Fig.2-4 Control Tower VHF Equipment Layout Plan

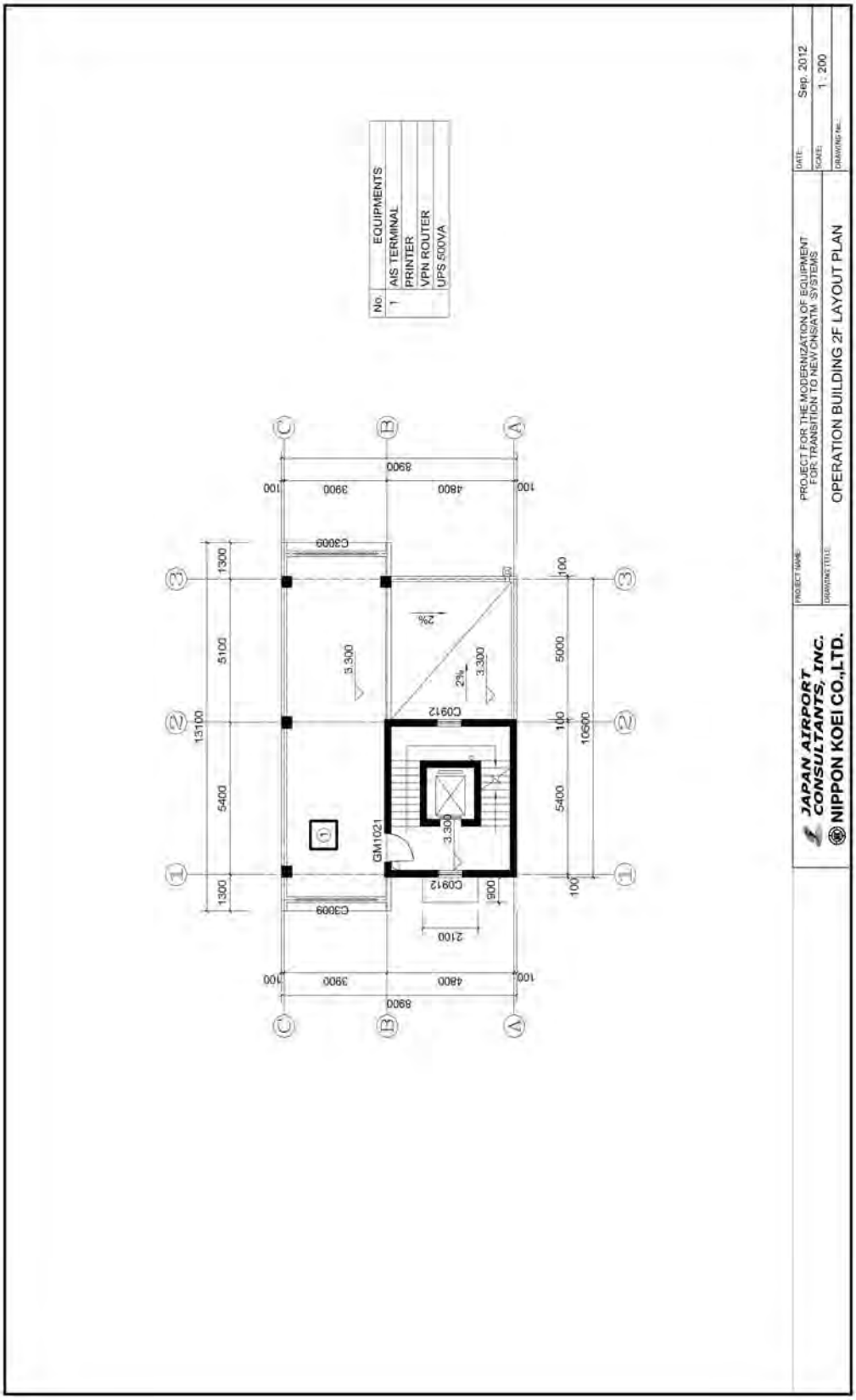


Fig.2-5 Operation Building 2F Layout Plan

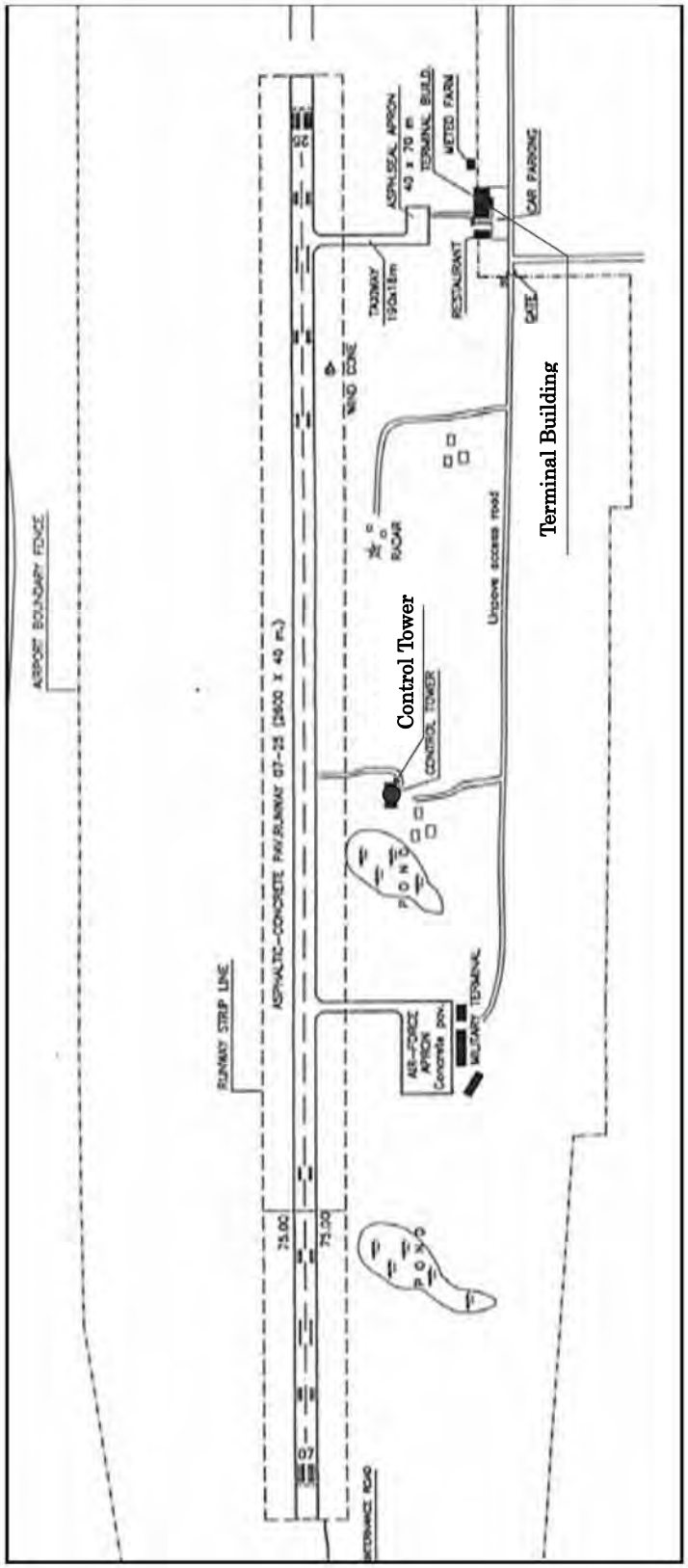


Fig.3-1 Xieng Houang Airport Layout Plan

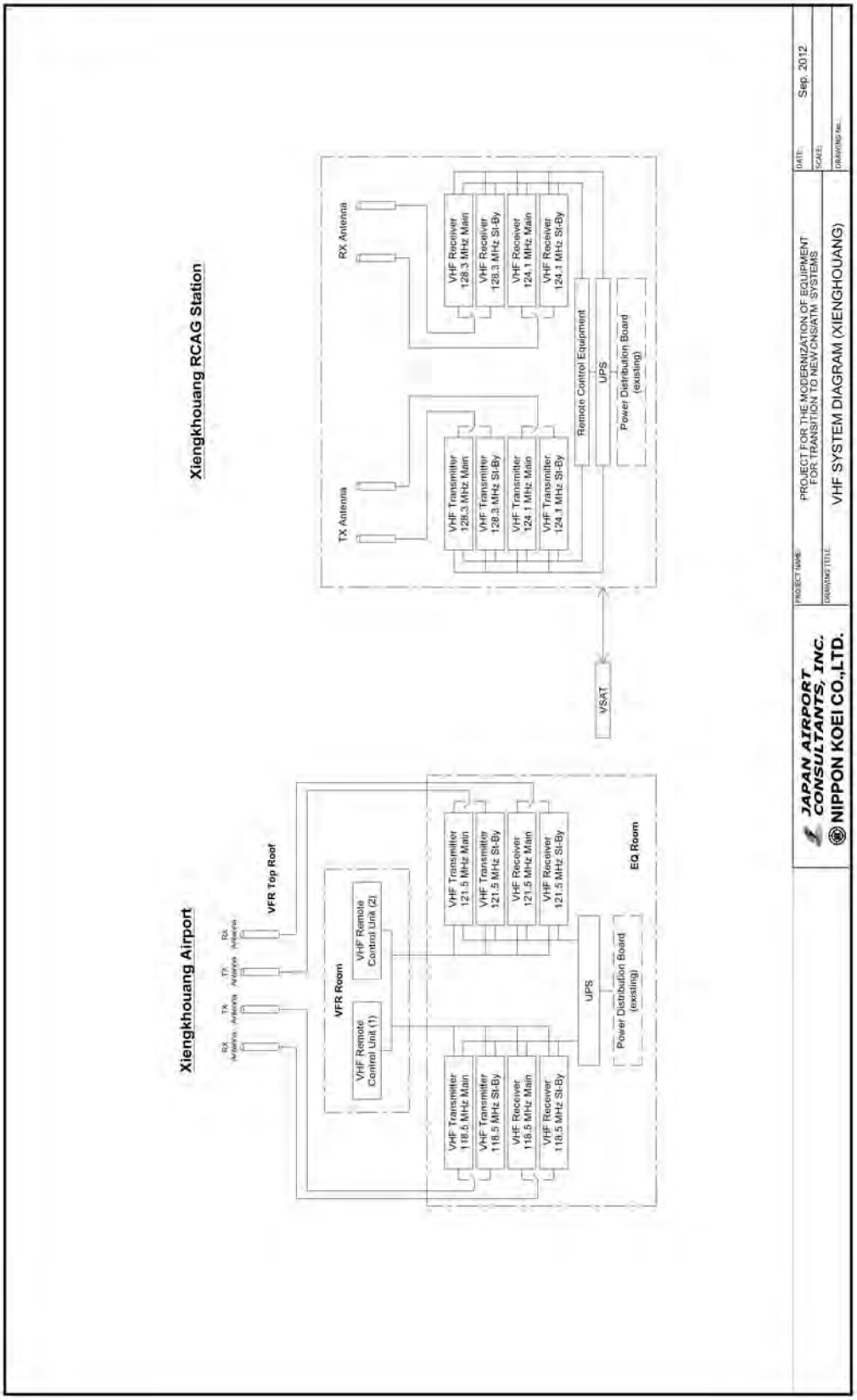


Fig.3-2 VHF System Diagram

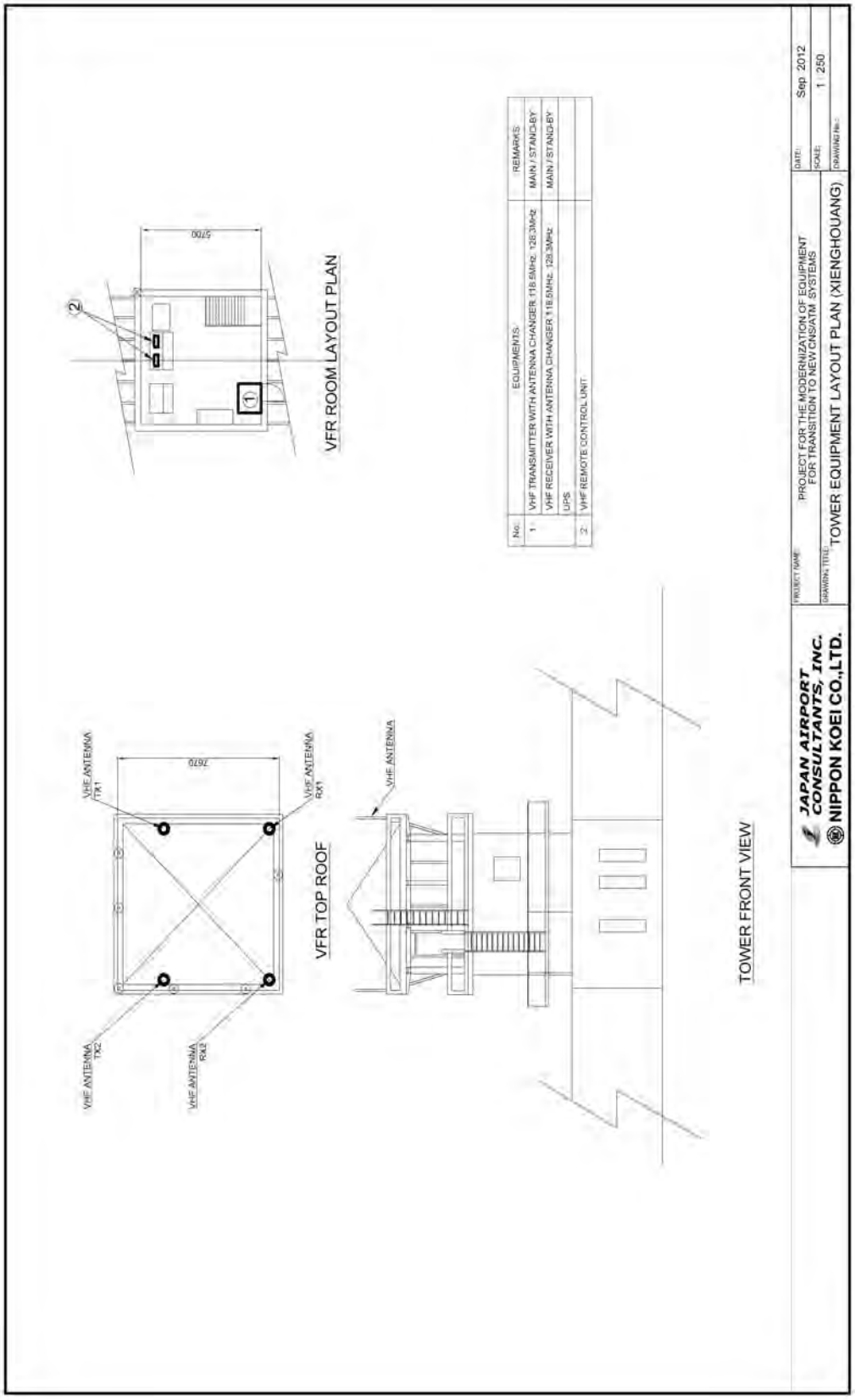


Fig.3-3 Tower Equipment Layout Plan

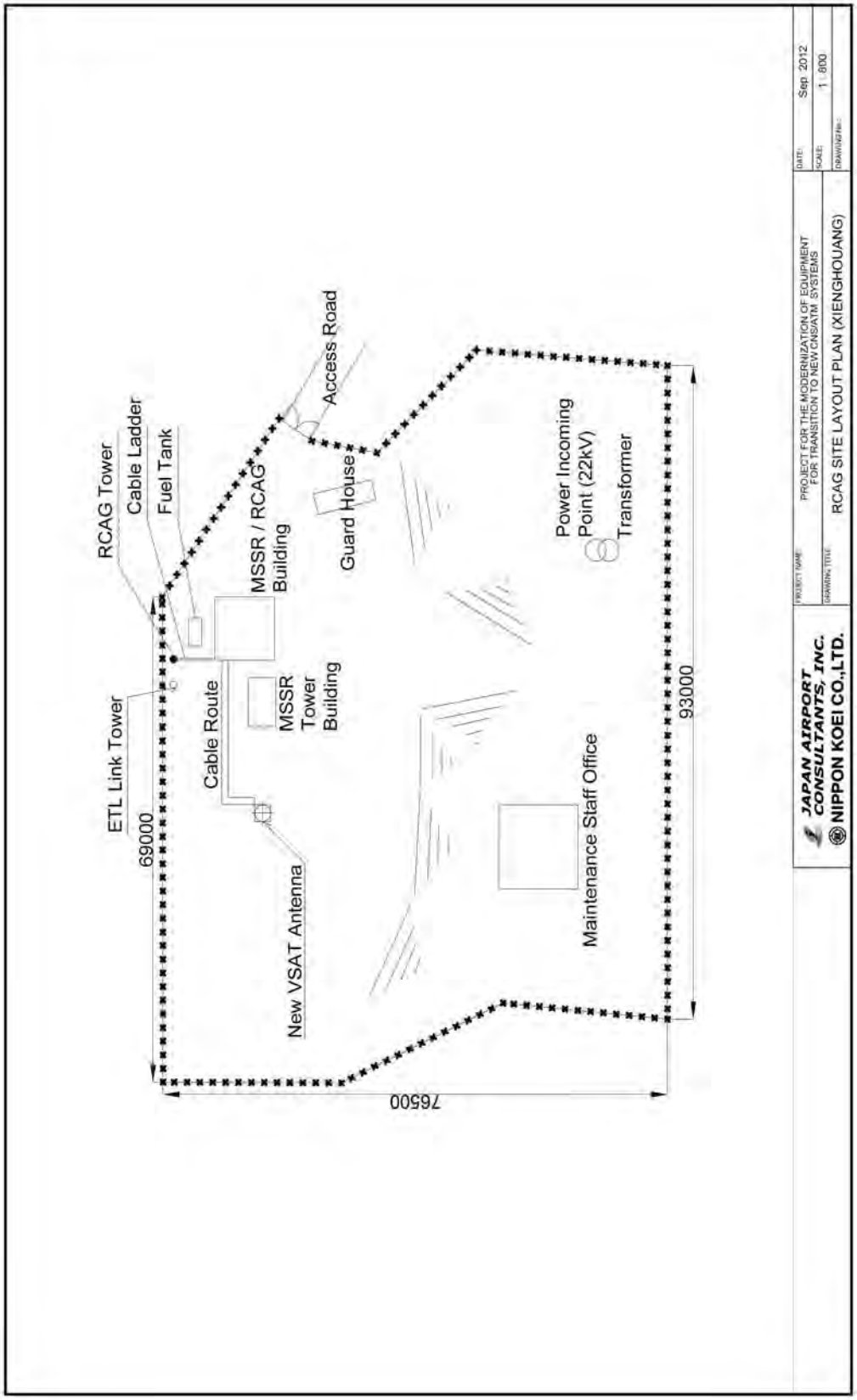


Fig.3-4 RCAG Site Layout Plan

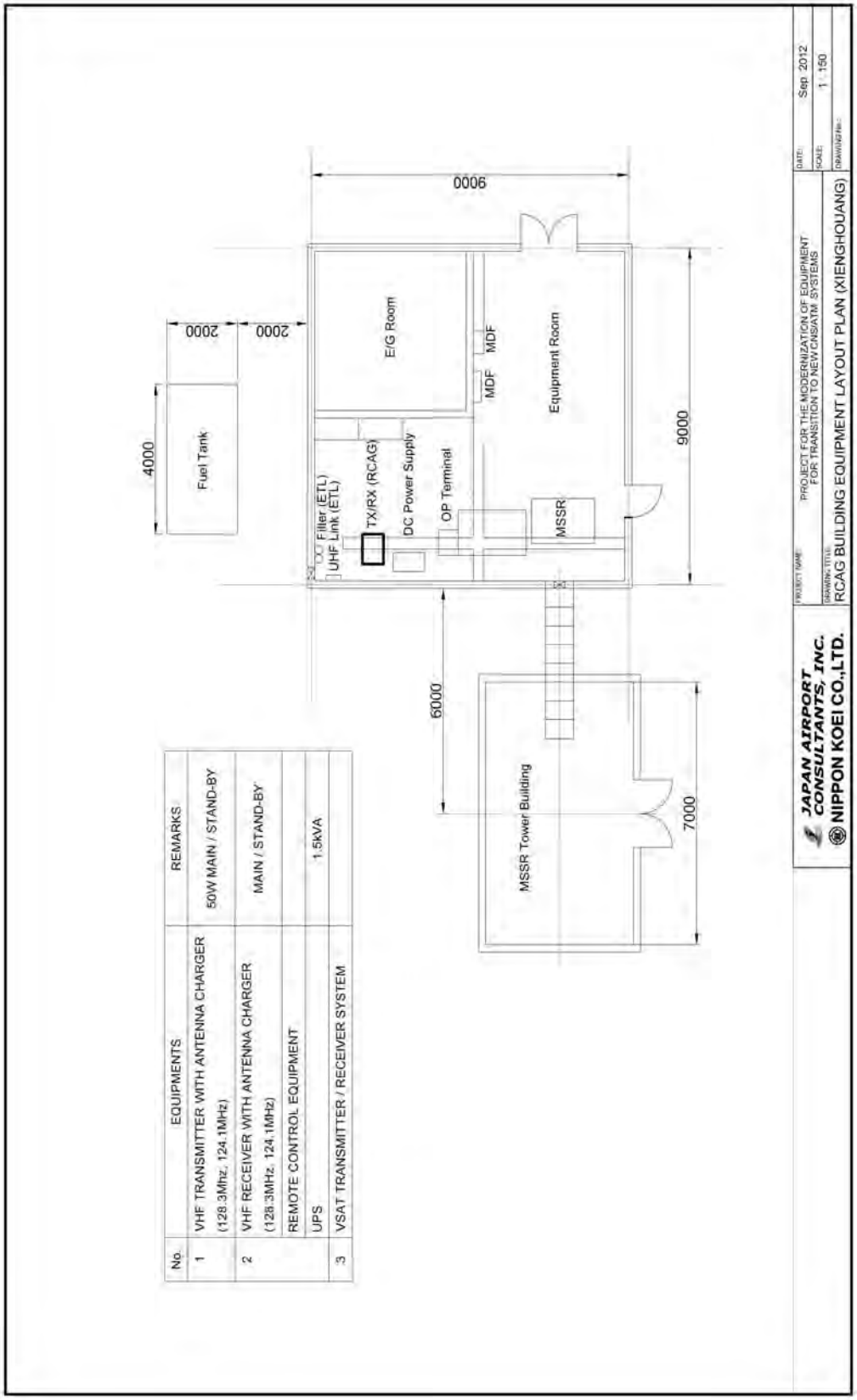


Fig.3-5 RCAG Building Equipment Layout Plan

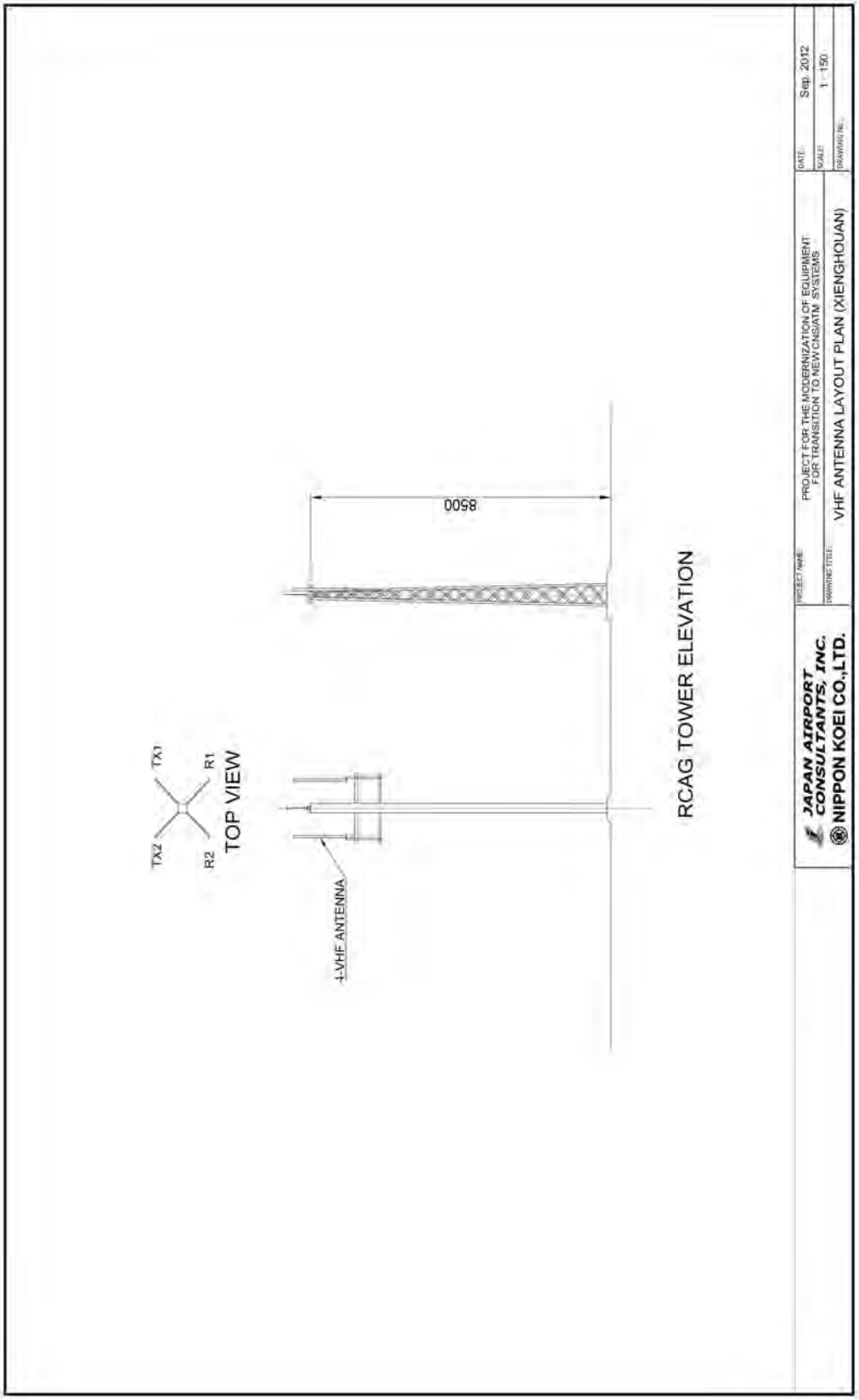


Fig.3-6 VHF Antenna Layout Plan

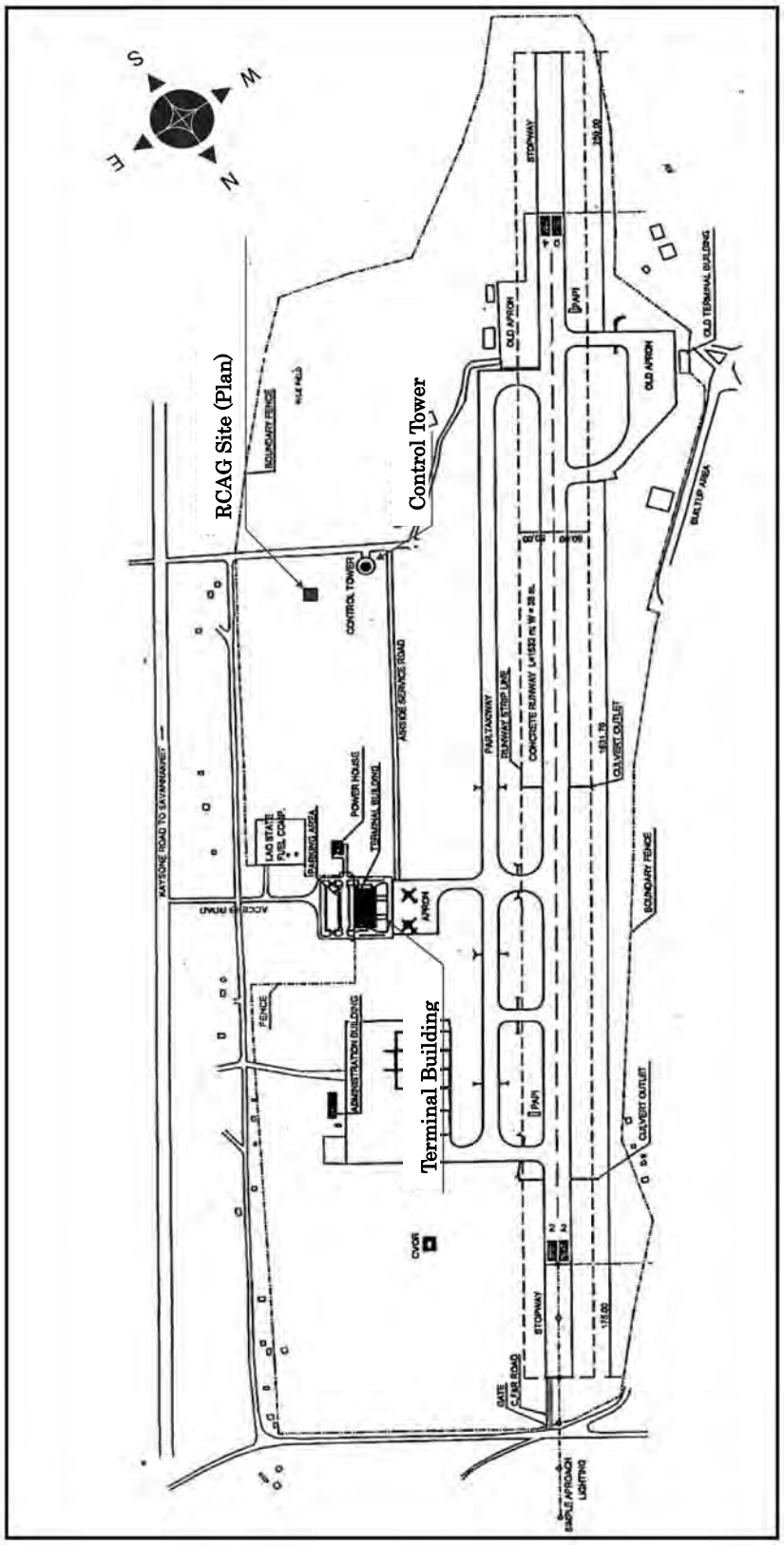


Fig.4-1 Savannakhet Airport Layout Plan

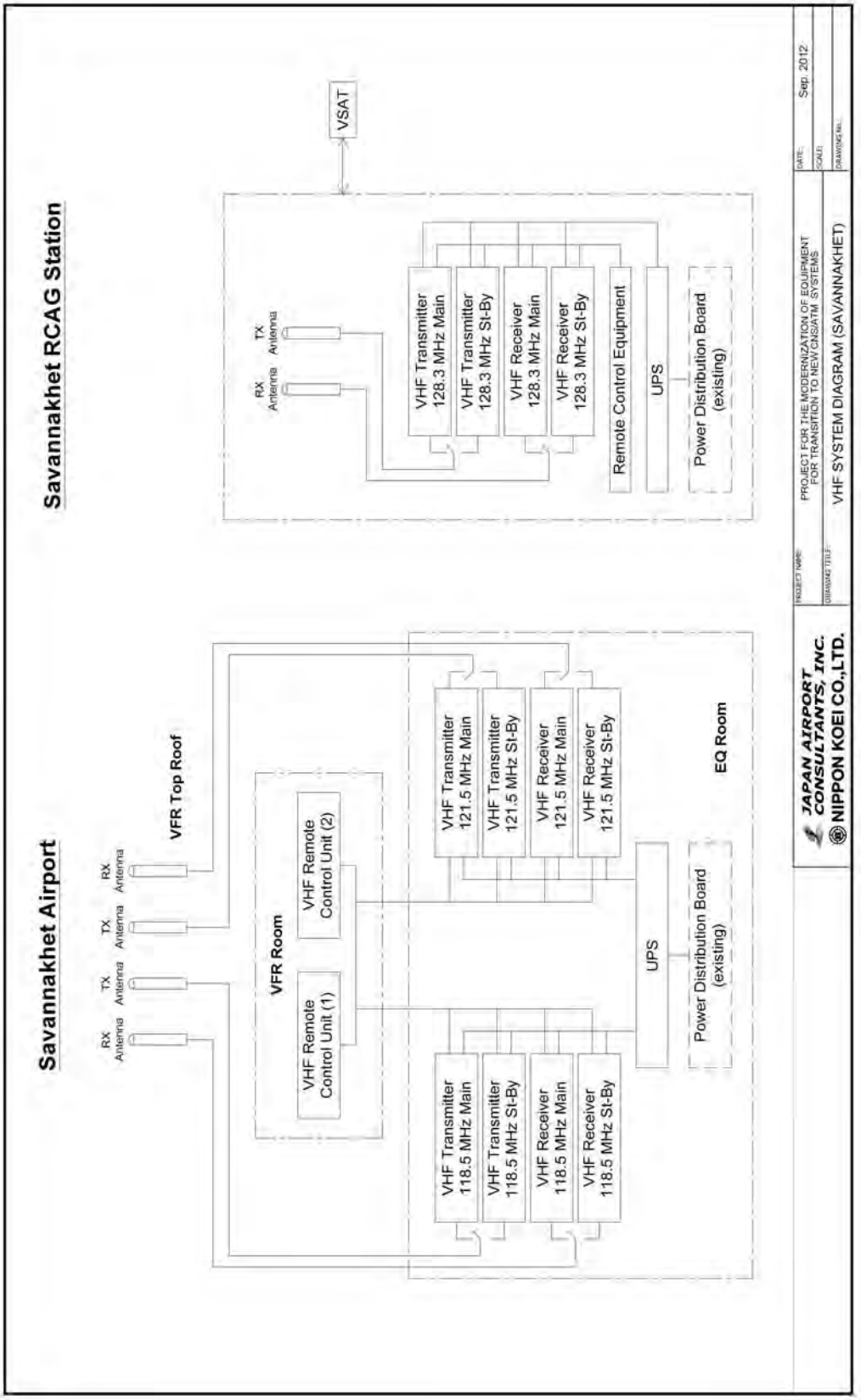


Fig.4-2 VHF System Diagram

Fig.4-3 Site Layout

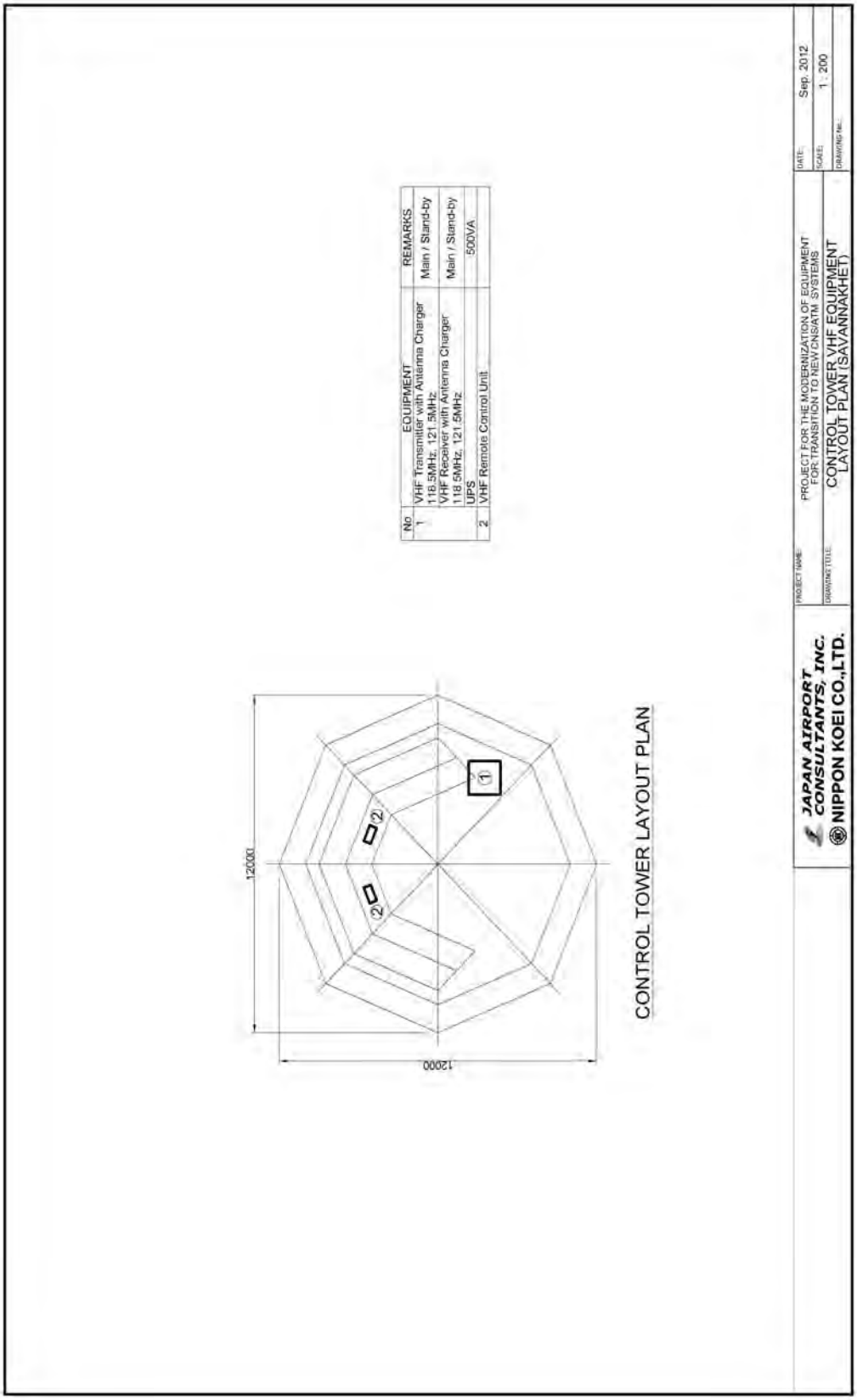


Fig.4-4 Control Tower VHF Equipment Layout Plan

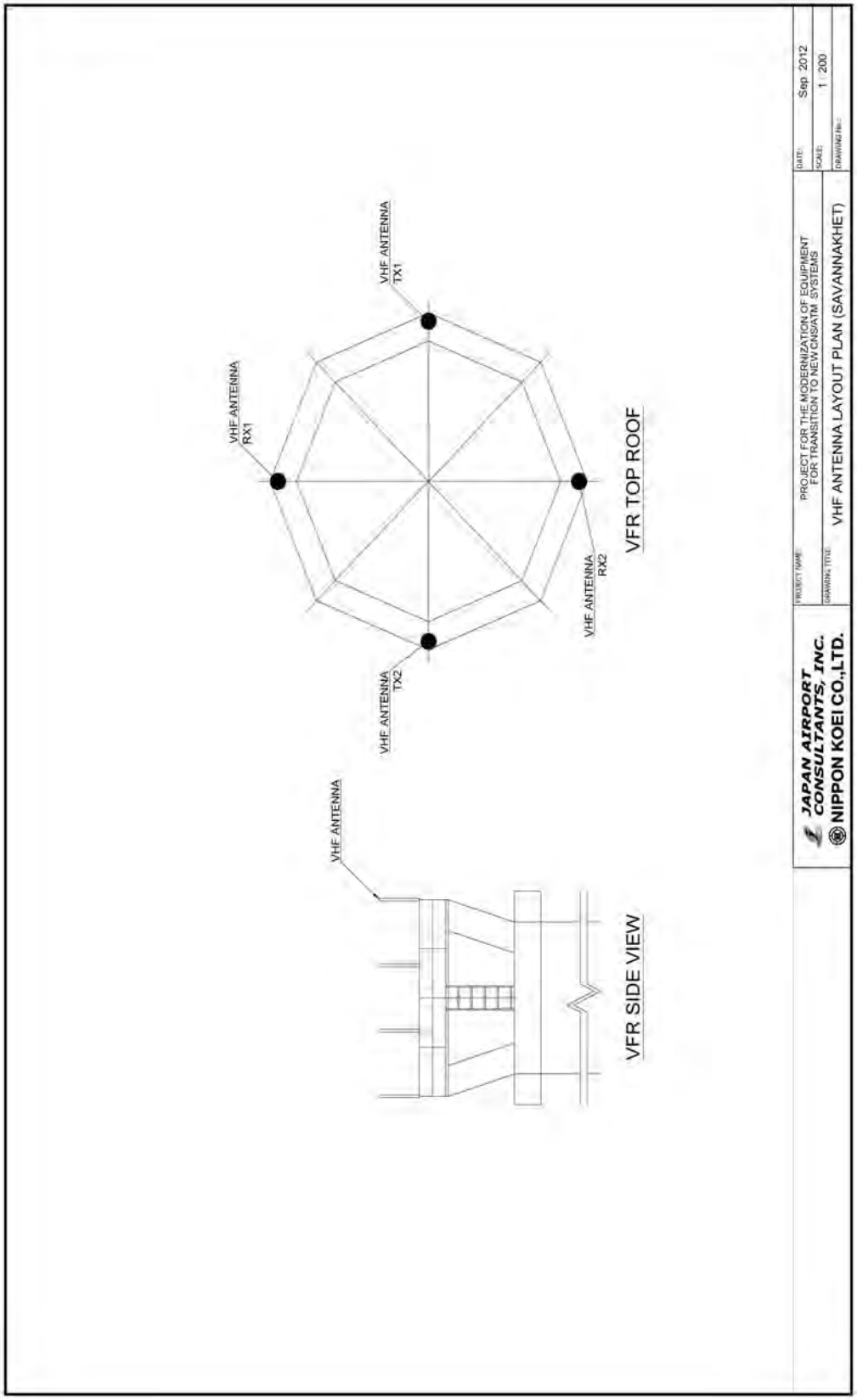


Fig.4-5 VHF Antenna Layout Plan

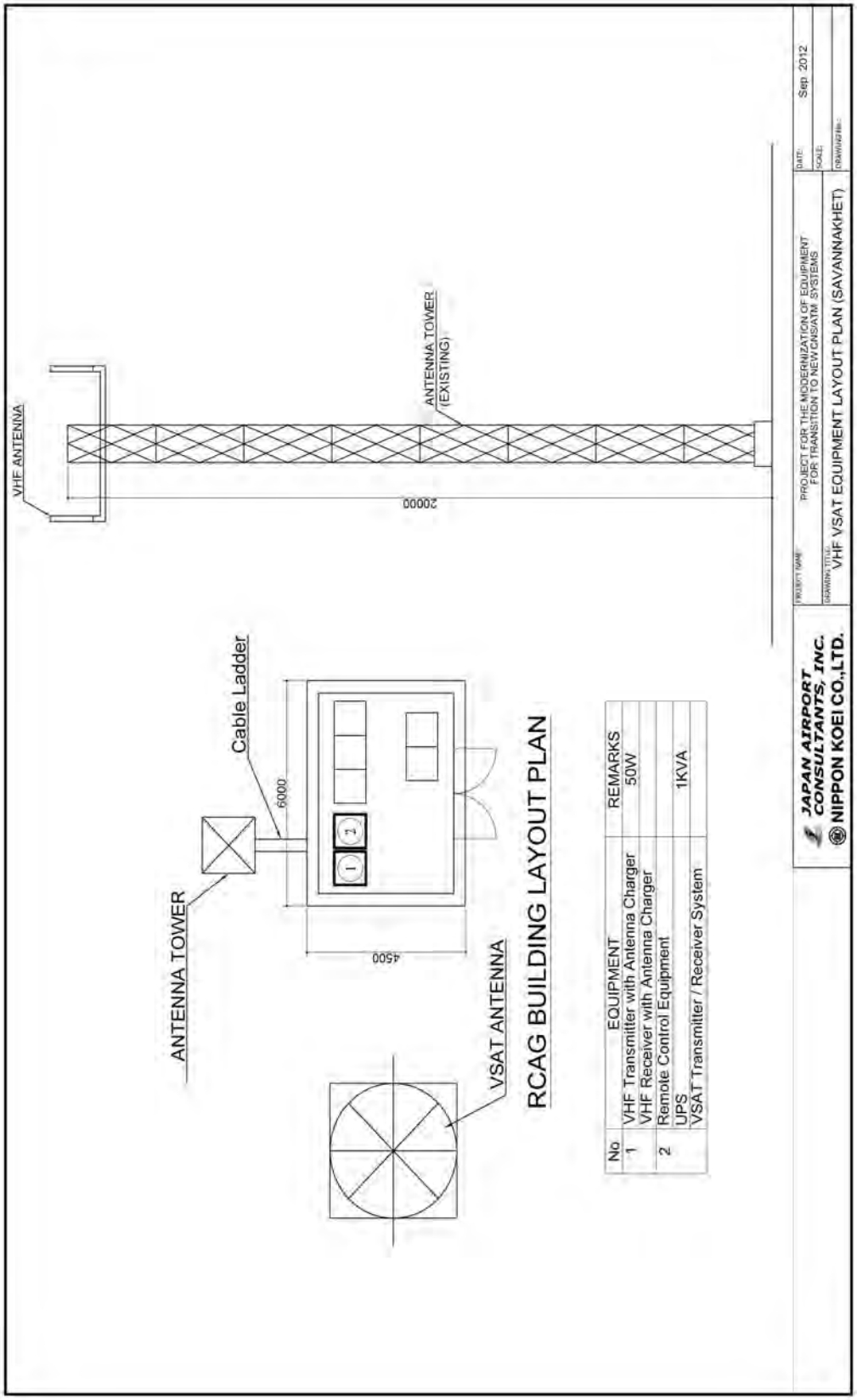


Fig.4-6 VHF・VSAT Equipment Layout Plan

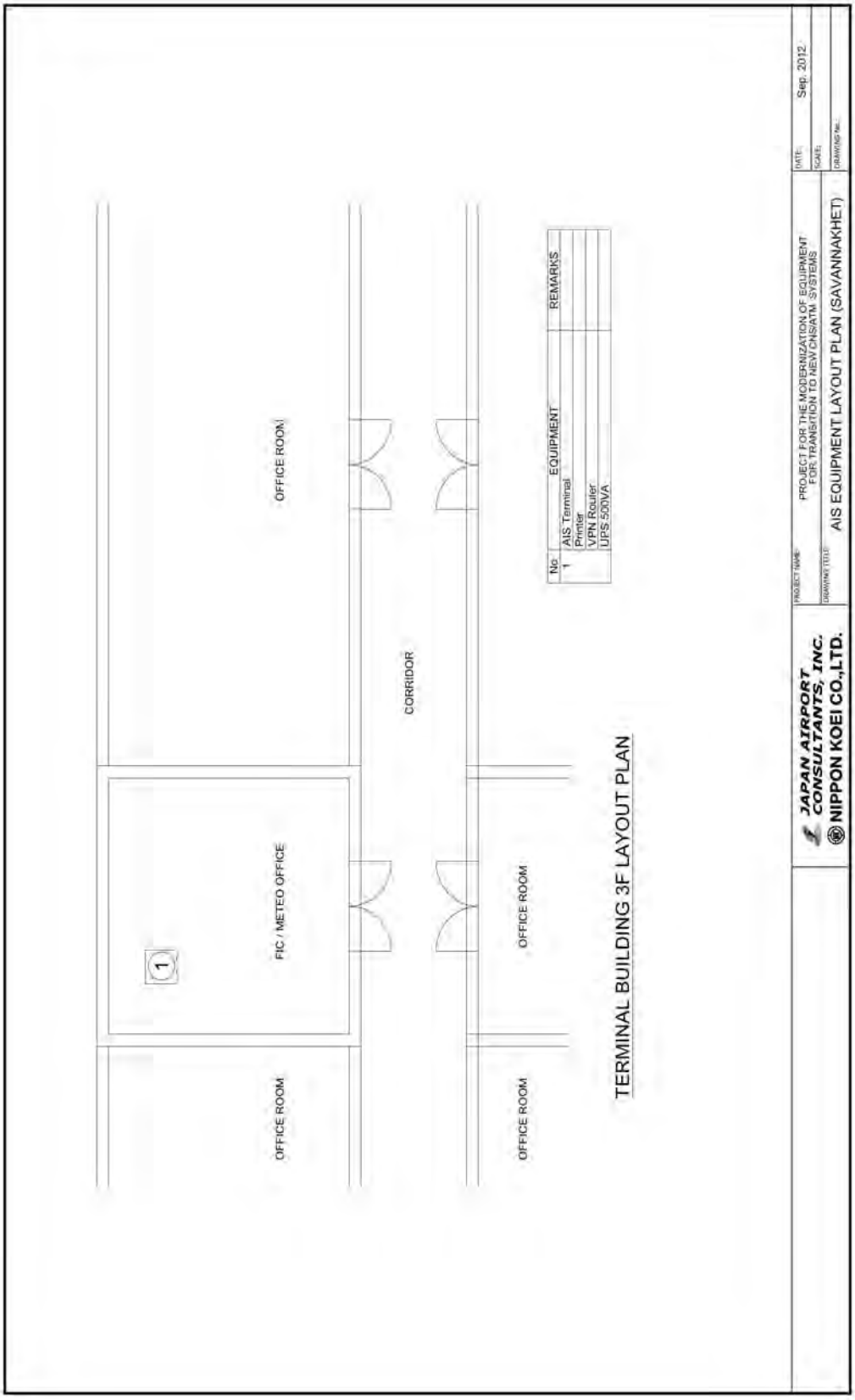


Fig.4-7 AIS Equipment Layout Plan

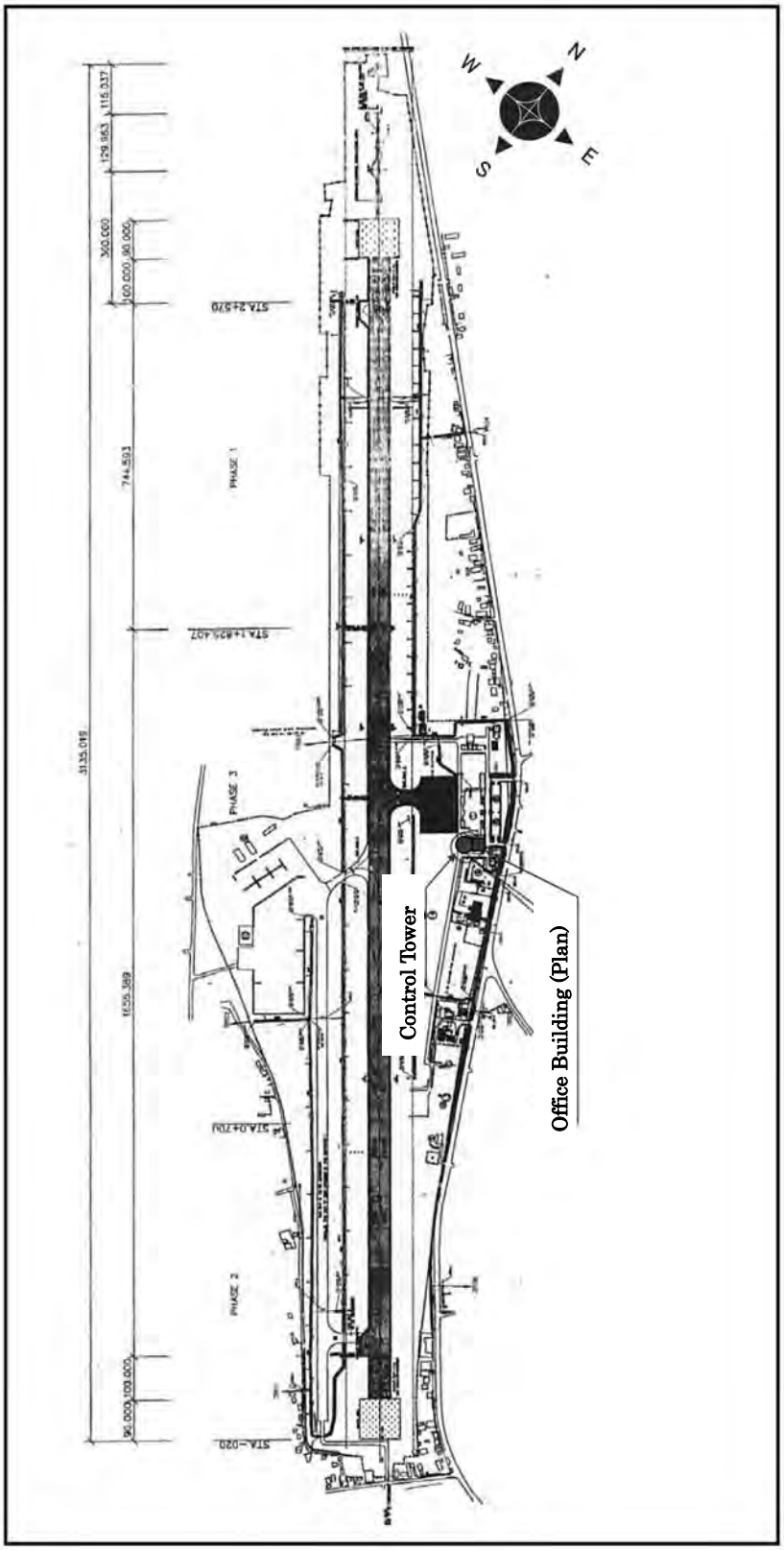


Fig.5-1 Pakse Airport Layout Plan

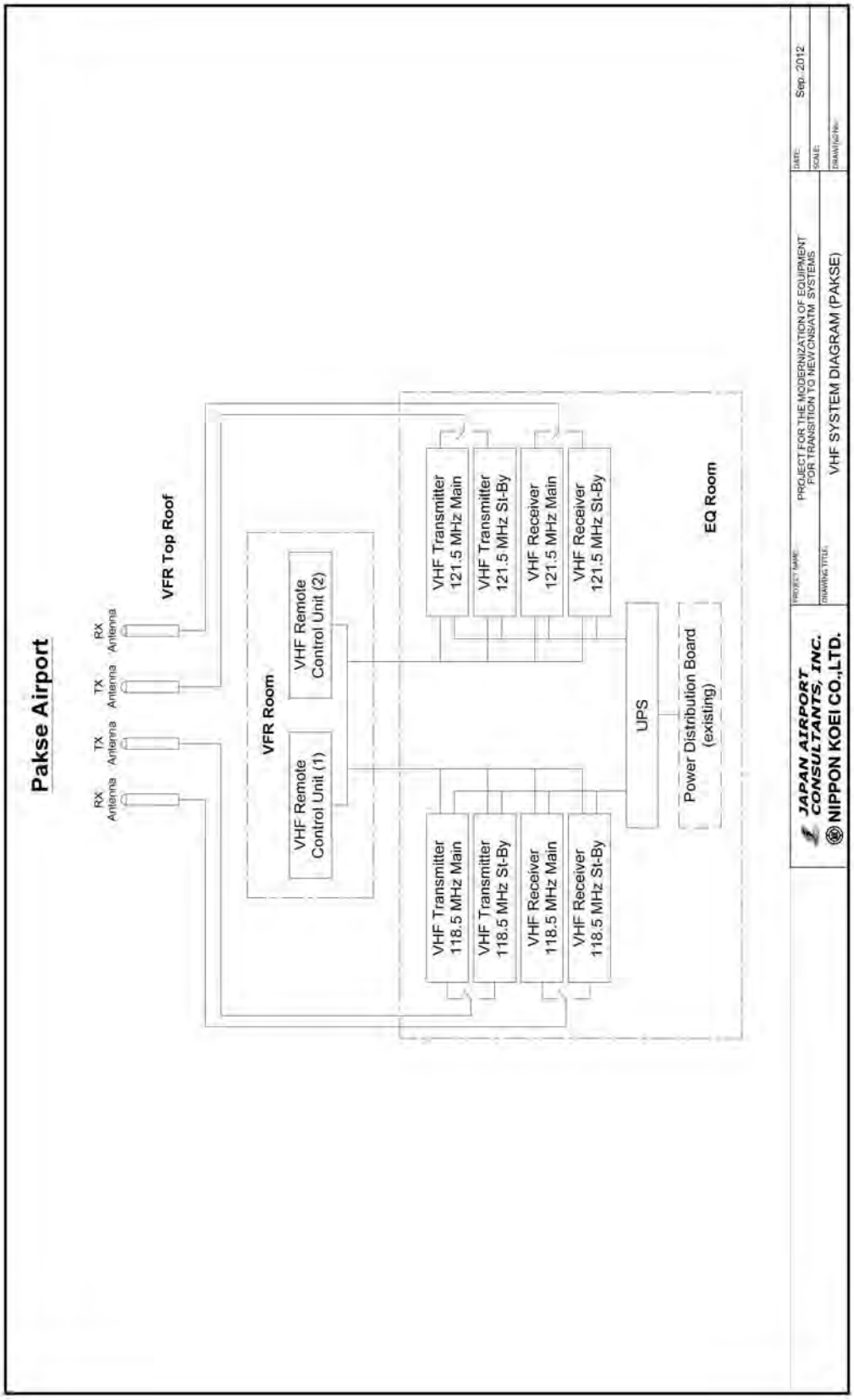


Fig.5-2 VHF System Diagram

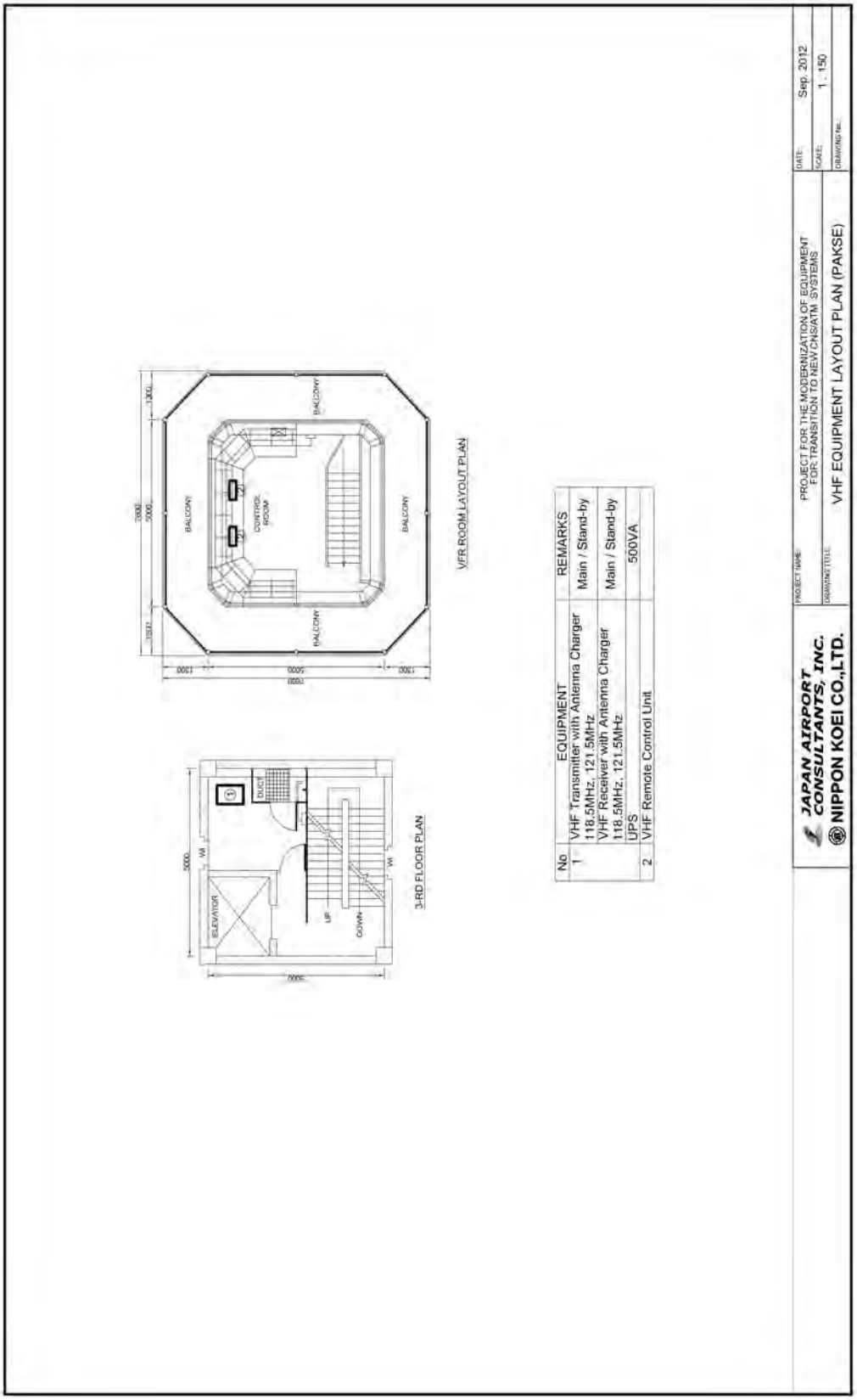


Fig.5-3 VHF Equipment Layout Plan

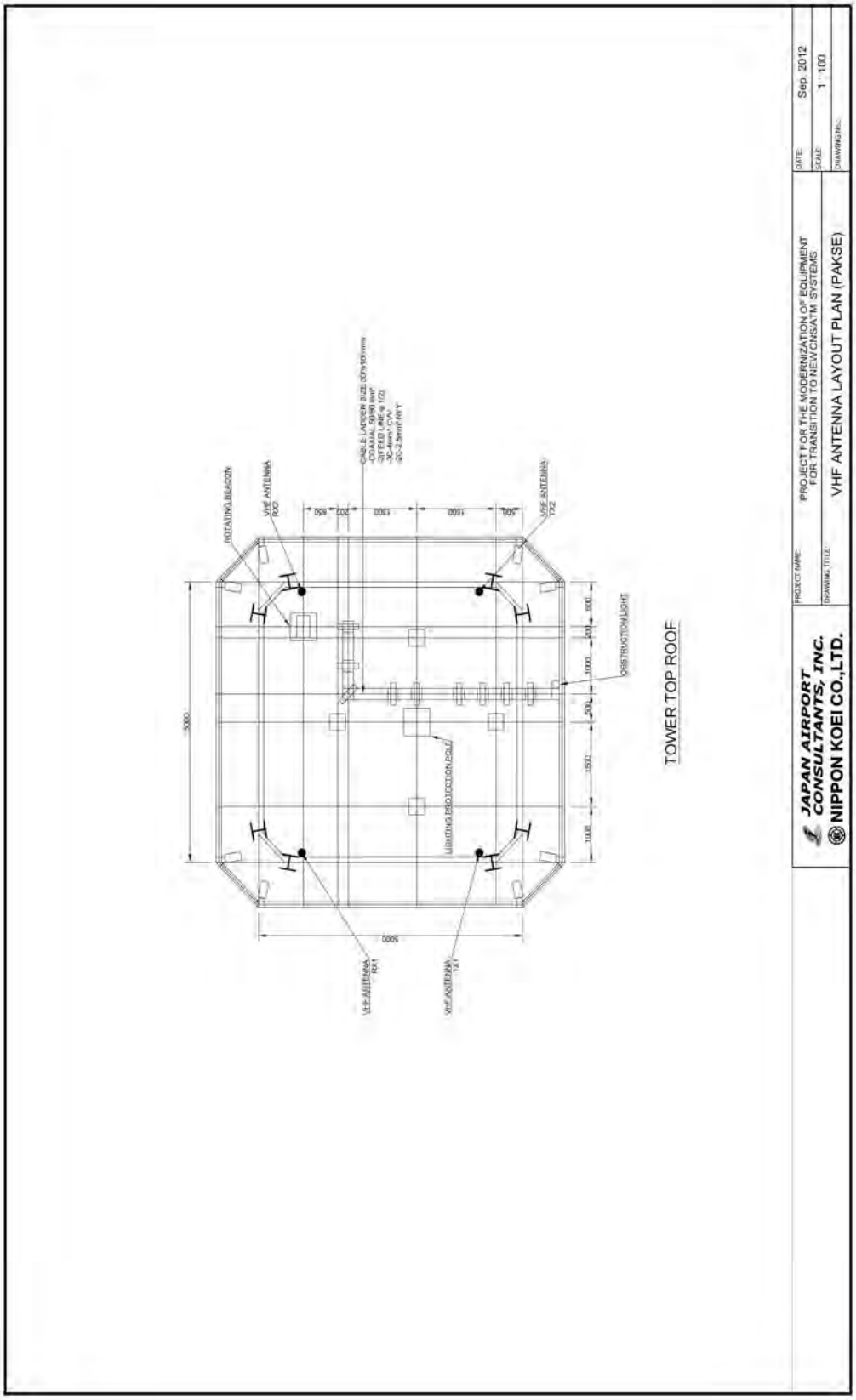


Fig.5-4 VHF Antenna Layout Plan

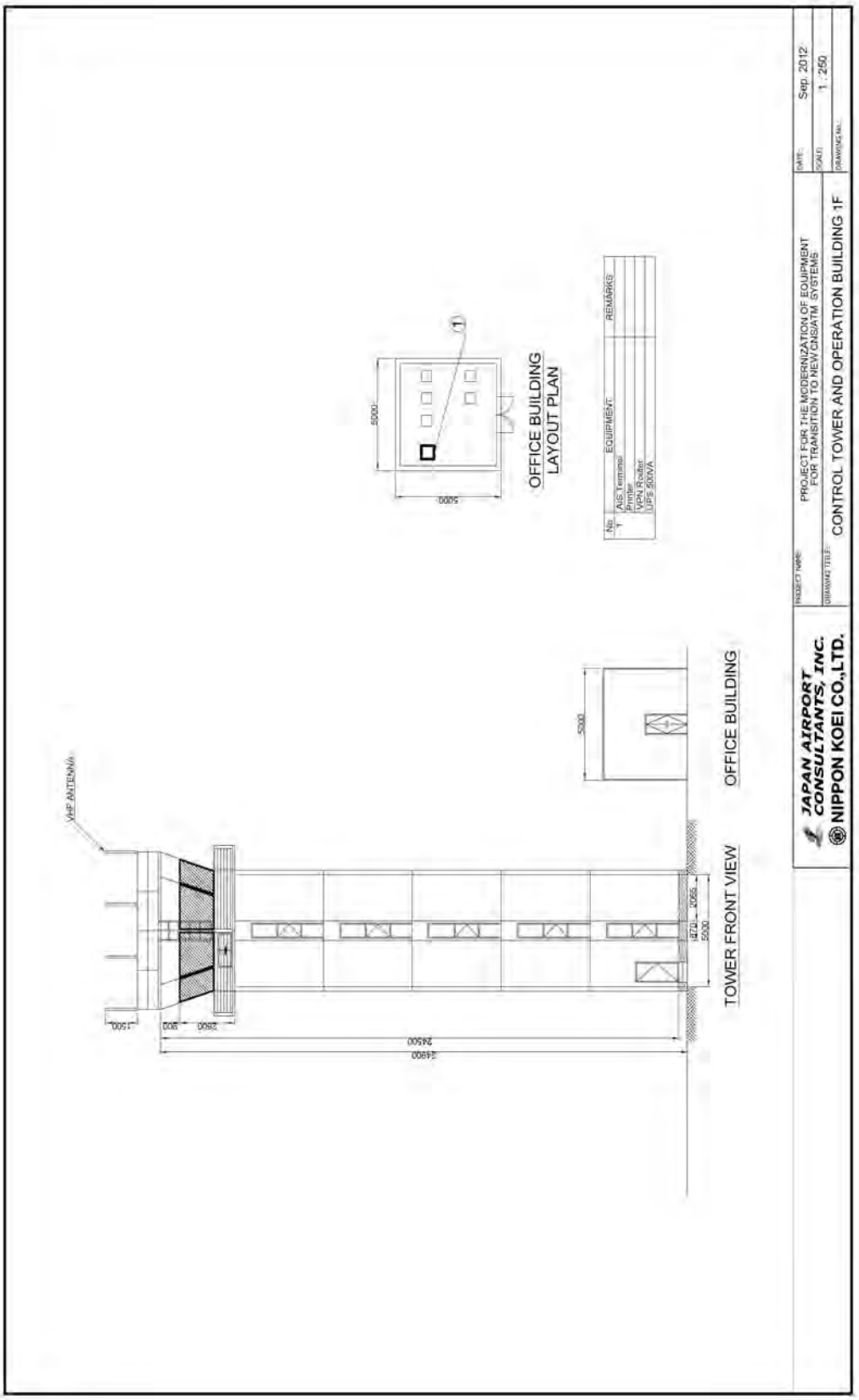


Fig.5-5 Control Tower And Operation Building 1F

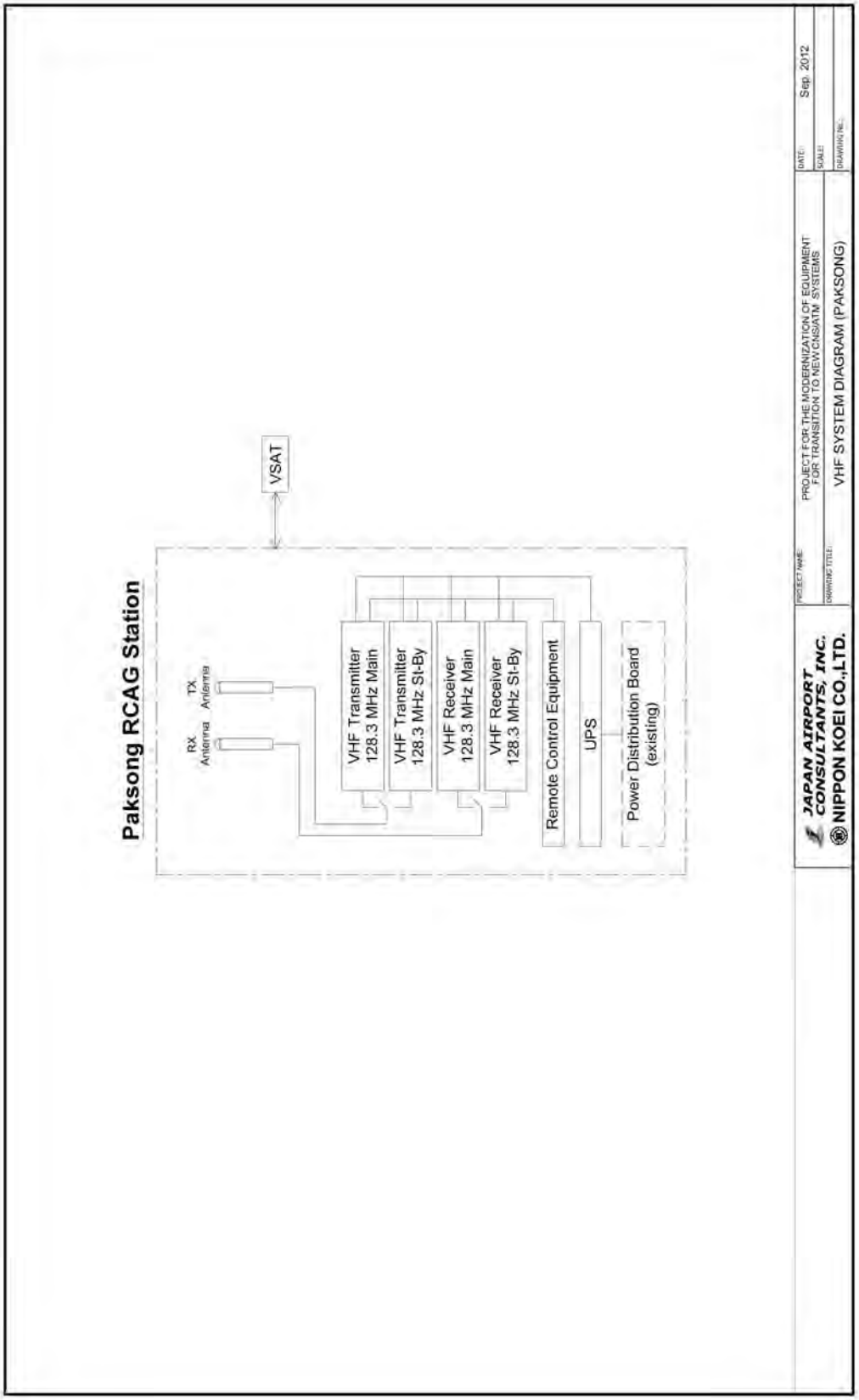


Fig.6-1 VHF System Diagram

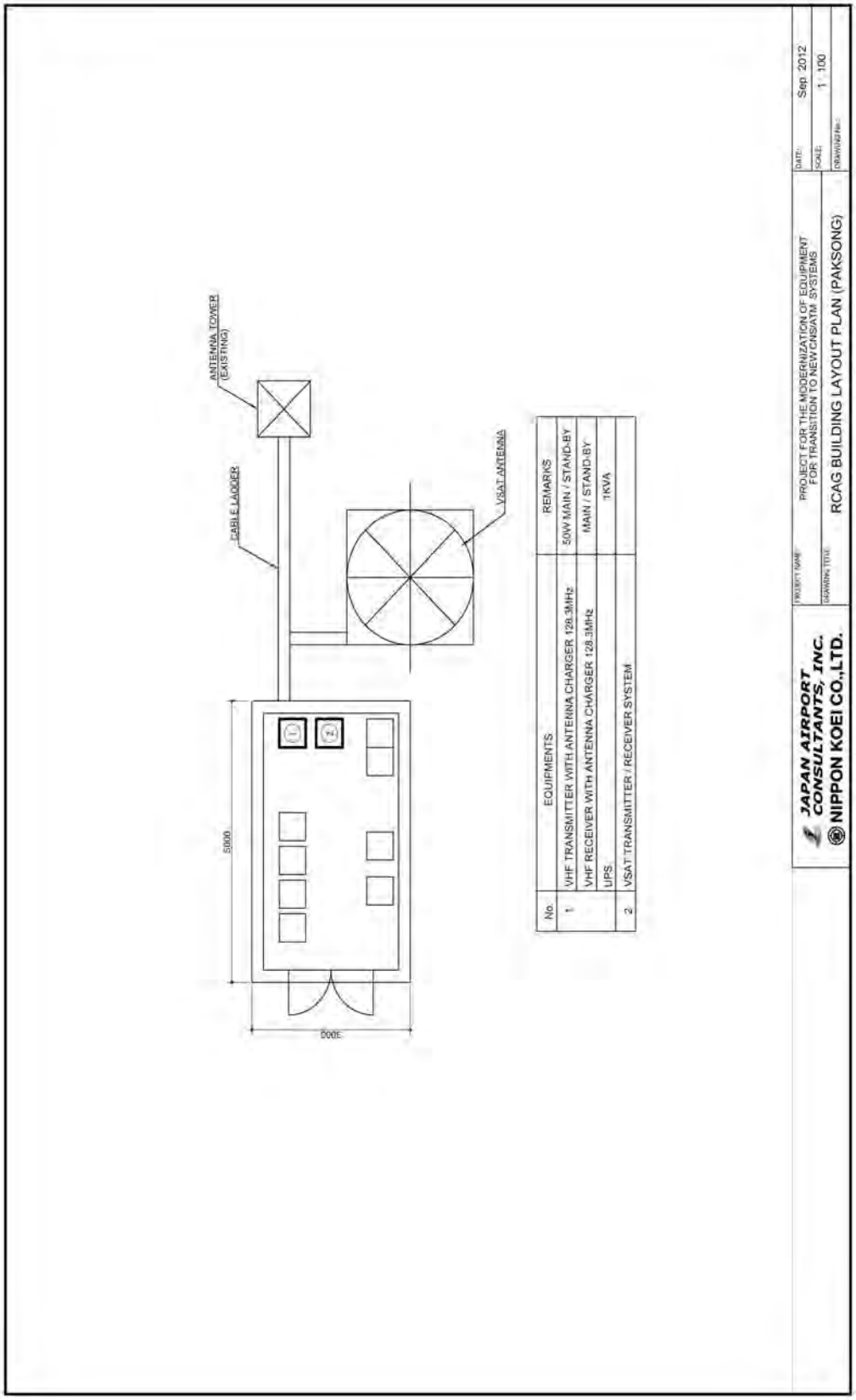


Fig.6-2 RCAG Building Layout Plan

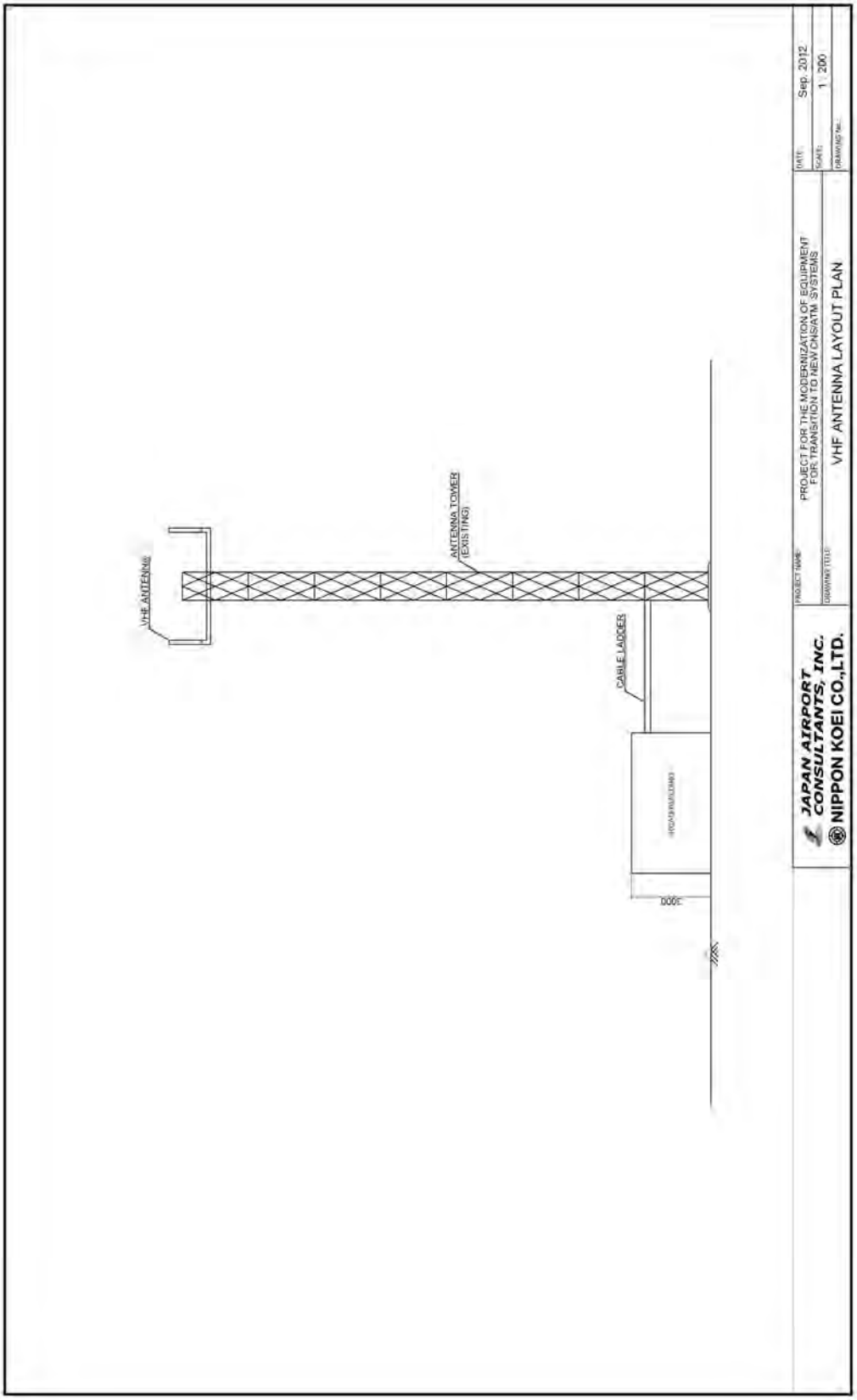


Fig.6-3 VHF Antenna Layout Plan