Department of Meteorology
The Democratic Socialist Republic of Sri Lanka

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN
THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

November 2016

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

INTERNATIONAL METEOROLOGICAL CONSULTANT INC.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to International Meteorological Consultant Inc. (IMC).

The survey team held a series of discussions with the officials concerned of the Government of the Democratic Socialist Republic of Sri Lanka, and conducted field investigations. As a result of further studies in Japan, the present report was finalized.

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

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Democratic Socialist Republic of Sri Lanka for their close cooperation extended to the survey team.

November, 2016

Kunihiro Yamauchi
Director General,
Global Environment Department
Japan International Cooperation Agency

Summary

Summary

The Democratic Socialist Republic of Sri Lanka (hereinafter referred to as Sri Lanka) is suffering from floods and landslides annually which are caused by torrential rains. The torrential rain that occurred in May 2003 caused serious floods and landslides inflicting damage to about 140,000 households and resulted to the loss of 235 lives. Property damage amounted to about 56 million U.S. dollars which is equivalent to 0.3% of the country's GDP. Furthermore, there were 38 recorded cases of floods and landslides in 2006. In both 2008 and 2011, large-scale and devastating occurrences of flooding happened 3 times for each year. In the past close to 20 years (1996-2015), more than 66% of the total population of 20.35 million (2012) people which is approximately 13.5 million people are recorded to have been affected by the major disasters caused by hazardous meteorological phenomena. In addition, it is a situation that has induced the expenditure of a considerable amount of resources for recovery efforts from the damage caused by these disasters. It has also become a major factor that inhibits the socio-economic development of the country. In recent years, there is a tendency that the frequency of the occurrence of these events or accidents that cause serious disaster will increase. There is a growing concern that climate change due to global warming will increase the frequency and scale of these disasters and create more adverse impact in Sri Lanka. Since more than 90% of the major disasters in Sri Lanka were caused by hazardous meteorological phenomena, meteorology has indeed become a matter of life or death in Sri Lanka. As such, the role of the Department of Meteorology (DOM), the only meteorological organization in the country, is crucial and important. In order for the DOM to mitigate the damages generated by the disasters caused by hazardous meteorological phenomena, it is a priority issue to detect hazardous meteorological phenomena which may create massive damages and disseminate highly accurate forecasts/warnings to the public more appropriately and promptly before the risk of disasters further escalate. However, the DOM is not able to adequately and quickly detect hazardous meteorological phenomena since there is no operational meteorological radar system in Sri Lanka as of the present.

Since meteorology has indeed become a matter of life or death in Sri Lanka, the role of the DOM, the only meteorological organization in the country, is crucial and important. In order for the DOM to mitigate the damages caused by natural disasters, it is a priority issue to disseminate highly accurate forecasts/warnings to the public more appropriately and promptly by making good use of the equipment to be provided and the facilities to be established as part of its disaster prevention infrastructure including the meteorological radar systems.

Even 10 years after the "Trust Fund Project for the Installation of a Doppler Radar at Gongala" was commenced on July 2006 under the supervision of the World Meteorological Organization (WMO), the installation work of the radar system is not yet completed. Under this circumstance, currently the DOM does not have any method to observe precipitation in the whole area of Sri Lanka. Due to a lack of financial and technical capabilities, the Government of Sri Lanka, in 2014, has requested the Government

of Japan to procure and install the required equipment as well as to provide the relevant systems and facilities under Japan's Grant Aid Assistance scheme.

In response to this request, the Government of Japan decided to conduct a Preparatory Survey for the Project for the Establishment of a Doppler Radar Network (hereinafter referred to as the "Preparatory Survey"). The Japan International Cooperation Agency (hereinafter referred to as "JICA") sent the Preparatory Survey Team to Sri Lanka in order to conduct the Preparatory Survey from February 18 to March 22, 2016. The Team had a series of discussions with the officials concerned from the Government of Sri Lanka, conducted surveys and collected the necessary and pertinent information and data for the Project. In addition, the Team conducted further studies, including a feasibility study focusing on the justification and scope of the Project, paying particular attention to the present situation in Sri Lanka from various perspectives such as the operational & maintenance capabilities of the DOM, appropriate equipment arrangement plan, etc.

JICA sent the Preparatory Team again to Sri Lanka from September 13 to September 28, 2016 and also November 04, 2016 in order to explain and discuss the outline design & draft survey report. In the course of the discussions and field survey, it was confirmed that the requested items are required for the Project in consideration of the Project's objectives and effects. As a consequence of further studies on the requested items in Japan, it has been decided that the following components indicated in the table attached hereunder are the objective items of the Preparatory Survey for the Project.

Table 1: Objective Items of the Preparatory Survey

Component	DOM Puttalam Observatory (Puttalam Radar Observation Station)	DOM Pottuvil Observatory (Pottuvil Radar Observation Station)	National Meteorological Centre (NMC) at DOM Head Office	DOM Aviation Meteorological Office in the Colombo International Airport	DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport
Procurement and Installation of Equipment					
C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar System including Isolation Transformer, Power Supply Capacitor, Power Back-up System, Lightning System Measuring Equipment and Spare Parts	1	1	-	-	-
Meteorological Radar Central Processing System	-	-	1	-	-
Meteorological Radar Data Display System	1	1	1	1	1
Meteorological Data Satellite Communication System	1	1	1	-	-
Construction of Radar Tower Building					
Radar Tower Building	1	1	-	-	-
Technical Training	Initial operation guidance in the contract of manufacturer				
Soft Component					

In Sri Lanka, major disasters (floods, landslides, droughts, storms, tropical cyclones and etc.) caused by hazardous weather phenomena bring about massive damages to both people and the economy due to the destruction of important infrastructures and properties. In addition, the aftermath of such a situation requires the expenditure of a significant amount of money and resources for restoration projects which negatively affects the socio-economic development of the country. Given these circumstances, the key objective of the Project is the effective mitigation of the devastation generated by disasters caused by hazardous meteorological phenomena through the improvement of the weather information and forecasts & warnings released by the DOM by means of strengthening their monitoring capability of hazardous weather phenomena in the entire area of Sri Lanka through the provision of technical support and the procurement of C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Doppler Meteorological Radar Systems, Meteorological Radar Central Processing System, Meteorological Radar Data Display Systems and Meteorological Data Communication Systems under the Project.

Since disaster risk reduction is even more important today as Sri Lanka embarks on a rapid development trajectory where natural disasters can erode development gains unless Disaster Risk Reduction measures are factored into development planning and frequency of occurrence of natural disasters is in an increasing trend, the Sri Lanka Comprehensive Disaster Management Programme (SLCDMP) 2014-2018 has been developed by the Ministry of Disaster Management in accordance with the National Policy on Disaster Management issued last February 2013. The goal of the SLCDMP is "to ensure the "safety of Sri Lanka" by reducing potential disaster risks and impacts on people, property and the economy." In addition, the overarching objective is "to create and facilitate the enabling environment for a multi-hazard, multi-sector, multi-agency partnership oriented disaster management programme, using risk knowledge as the base, in line with global conventions and frameworks."

Unequivocally, the following specific objectives of the Programme supports and justifies the necessity of the implementation of this Project.

1. Integrate disaster risk information based approaches in the development agenda
2. Prevent/mitigate the impacts of frequently occurring disasters on life and properties

For development to be sustainable, it is important to mitigate the effects of natural disasters among other things. The enhancement of technical capacity and capability in the area of weather forecasting and early warning will pave the way for the prompt mitigation of the effects of weather-related natural disasters by way of providing timely and accurate information on impending hazards. Thereby, this project is in line with the Government's policy framework.

In addition, prior to his election as the 7th Executive President of Sri Lanka last 9 January 2015, His Excellency Maithripala Sirisena released his manifesto, entitled "A Compassionate Maithri Governance - A Stable Country." Under Chapter 4 on Food Security and Sustainable Development of his manifesto, he assured to "formulate a national policy that could face modern ecological challenges." Furthermore, His Excellency Maithripala Sirisena assured that programmes will be activated to minimize various disasters and accidents caused by climate changes such as drought, forest fires, floods, landslides, typhoons, tornadoes and sea erosion. In order to identify and implement the required methodologies to minimize

disasters, the Disaster Management Centre units were proposed to be systematically established at each Divisional Secretary Office so that a productive alliance could be maintained with the relevant agencies.

The implementation of this Project which is also in accordance with Japan's aid policy of "overcoming social vulnerability," supports this vision of His Excellency. To mitigate the damages brought about by tropical cyclones and floods, it is quite important to promptly transmit accurate weather information/warnings to each disaster prevention organizations, local governments and the mass media. Since the information issued by the DOM is a trigger for the first of many actions for each disaster prevention organization, the improvement of the DOM's monitoring capability of meteorological phenomena is highly indispensable and necessary.

Moreover, in order to reduce the DOM's operational and maintenance costs, the equipment was designed to minimize the need for spare parts and consumables. Since the biggest expected recurrent cost of the Project is electricity, the equipment and facilities were designed in such a way so as to minimize power consumption. As a result, the DOM's budget is expected to be able to cover the Sri Lanka portion of the capital and recurrent costs of the Project. In conclusion, the implementation of the Project is considered to be an appropriate, suitable and worthwhile endeavor.

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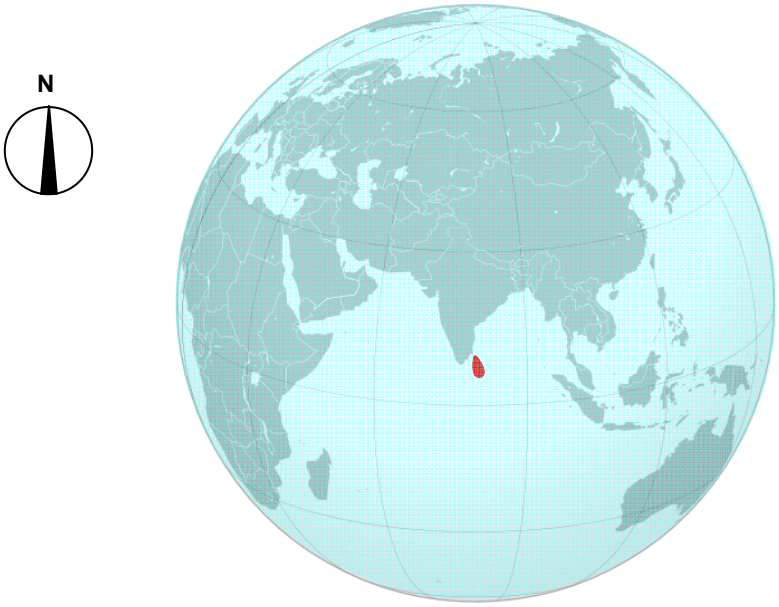
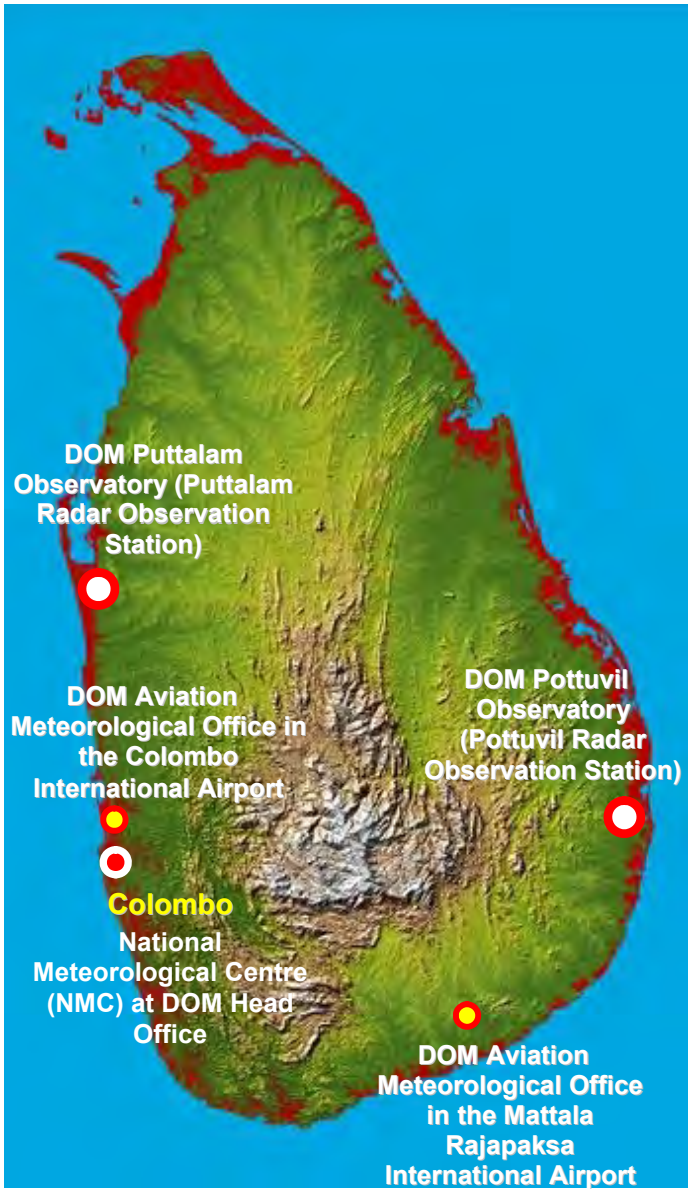
■ Democratic Socialist Republic of Sri Lanka





Puttalam Meteorological Radar Tower Building

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ABBREVIATIONS

AIJ : Architectural Institute of Japan
A/P : Authorization to Pay
ASEAN : Association of Southeast Asian Nations
ASTM : American Society for Testing and Materials
AVR : Automatic Voltage Regulator
AWS : Automatic Weather Observation System
CAPPI : Constant Altitude Plan Position Indicator
CEB : Ceylon Electricity Board
DMC : Disaster Management Center
DOM : Department of Meteorology
EIA : Environmental Impact Assessment
E/N : Exchange of Notes
G/A : Grant Agreement
GDP : Gross Domestic Product
IMF : International Monetary Fund
IP-VPN : Internet Protocol Virtual Private Network
JGS : Japanese Geotechnical Society
JICA : Japan International Cooperation Agency
LED : Light-Emitting Diode
MTBF : Mean Time Between Failure
MTTR : Mean Time To Repair
NCDM : National Council for Disaster Management
NDRSC : National Disaster Relief Services Center
NMC : National Meteorological Centre
PVC : Polyvinyl Chloride
TRC : Telecommunications Regulatory Commission
UBC : Uniform Building Code
VAT : Value Added Tax
VSAT : Very Small Aperture Terminal
WMO : World Meteorological Organization

Chapter 1
Background of the Project

Chapter 1 Background of the Project

1-1 Background of the Project

The Democratic Socialist Republic of Sri Lanka (hereinafter referred to as Sri Lanka) is suffering from floods and landslides annually which are caused by torrential rains. The torrential rain that occurred in May 2003 caused serious floods and landslides inflicting damage to about 140,000 households and resulted to the loss of 235 lives. Property damage amounted to about 56 million U.S. dollars which is equivalent to 0.3% of the country's GDP. Furthermore, there were 38 recorded cases of floods and landslides in 2006. In both 2008 and 2011, large-scale and devastating occurrences of flooding happened 3 times for each year. In the past 20 years (1996-2015), more than 66% of the total population of 20.35 million (2012) people, which is approximately 13.5 million people, are reported to have been affected by major disasters caused by hazardous meteorological phenomena. It is, therefore, an urgent task for Sri Lanka to mitigate the damages and untoward consequences caused by meteorological disasters associated with torrential rains.

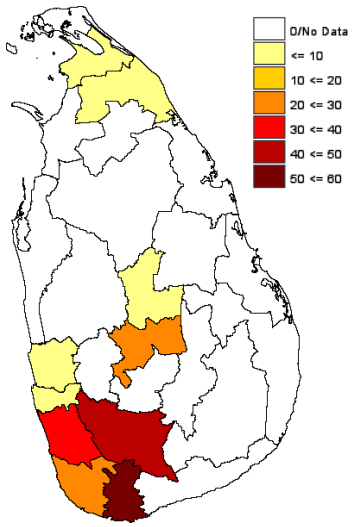


Figure 1: Deaths and Injured by Flood for 30 years (1985-2014)
Source: The United Nations Secretariat for International Strategy for Disaster Reduction (UNISDR)

While most of the northern areas are composed of flat lands, there lie mountains as much as 2,000 meters high in the southern areas, represented by the Pidurutalagala (2,524m) in the central southern area, the highest peak in Sri Lanka. Rivers flow into the sea radially from the central highland. The upper basins of those rivers are precipitous and the middle and lower basins are extremely gradual. Therefore, landslides frequently occur in the upper basins where numerous waterfalls and rapid flows are formed on the steep slopes and cliffs. On the other hand, the middle and lower basins are easily flooded in case of heavy rain since the river waters flow too slowly to be drained smoothly into the sea.

The rainfall of Sri Lanka is greatly influenced by its topography. The figure located on the right side is the annual average precipitation distribution of Sri Lanka. Since the Southwest Monsoon (from May to September) blows in the southwestern slope of the mountains ranging in the southern part of Sri Lanka, there is a great deal of precipitation in the area. The annual mean

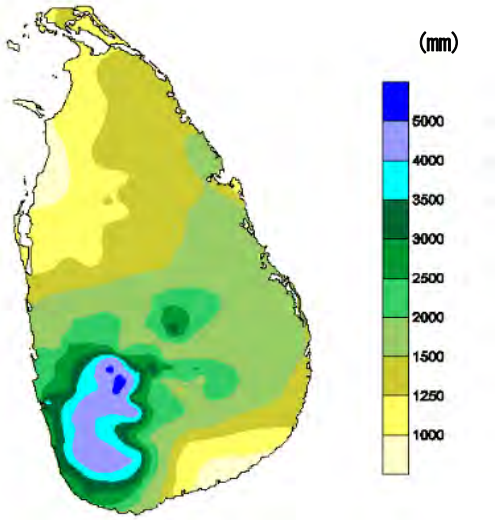


Figure 2: Annual Mean Precipitation Distribution
Source: The United Nations Secretariat for International Strategy for Disaster Reduction (UNISDR)

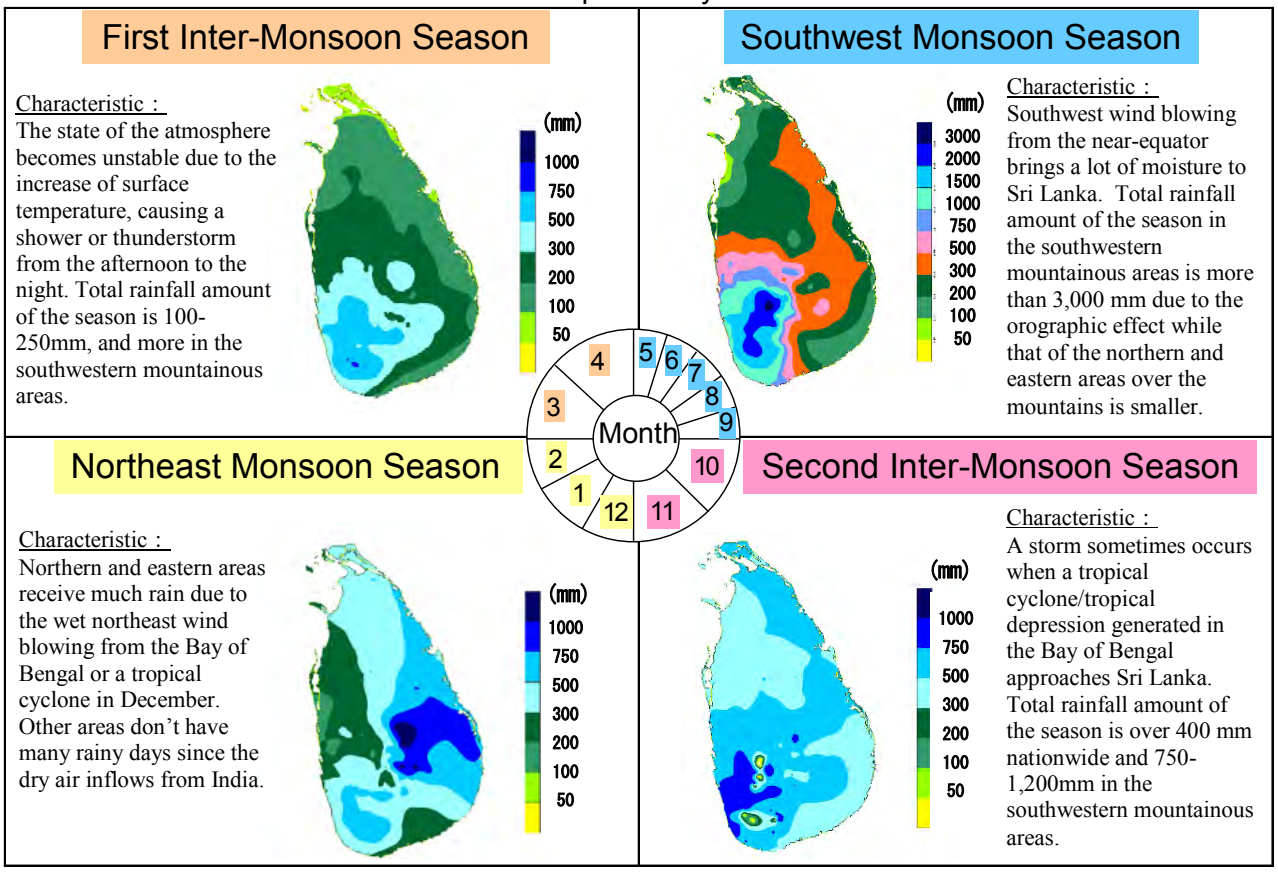
precipitation is more than 3,000mm and there is even a place in the country where it reaches 5,000 mm. In addition, the amount of precipitation in the eastern part of Sri Lanka increases due to the Northeast Monsoon (from December to February) wherein the annual mean precipitation is more than 2,000mm. The rain distribution of Sri Lanka greatly changes by the direction where a monsoon blows in the Central Highlands and local heavy rains may occur under the influence of the country's topography.

Since meteorology has indeed become a matter of life or death in Sri Lanka, the role of the Department of Meteorology (DOM), the only meteorological organization in the country, is crucial and important. In order for the DOM to mitigate the damages caused by natural disasters, it is a priority issue to disseminate highly accurate forecasts/warnings to the public more appropriately and promptly by making good use of the equipment to be provided and the facilities to be established as part of its disaster prevention infrastructure including the meteorological radar systems.

1-2 Characteristics of the Climate in Sri Lanka

The climate of Sri Lanka is categorized into four seasons due to the influences of the southwest monsoon, northeast monsoon, tropical cyclones, etc. The areas and amount of precipitation vary from season to season. The following table shows the characteristics, amount and distribution of precipitation and the actual rainfall events brought by each season.

Table 2: Characteristics of Precipitation by Each Season in Sri Lanka



1-3 Meteorological disasters in Sri Lanka

As shown in the figure on the right, various meteorological disasters occur in Sri Lanka throughout the year. The areas where these disasters happen are different seasonally and locally due to the topographic features of the country. Therefore, a timely and quantitative observation network which covers the entire country is essential in order to monitor disaster occurrence.

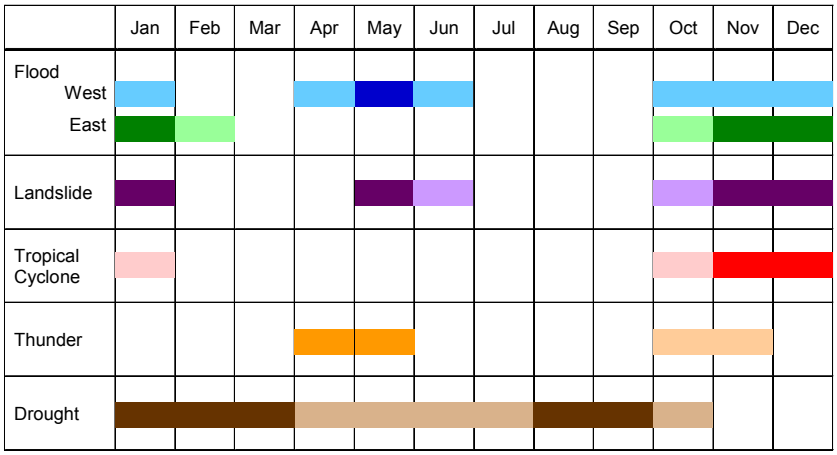


Figure 3: Meteorological Disaster Calendar in Sri Lanka
Source: Disaster Information Management System, Sri Lanka

In Sri Lanka, the meteorological disasters which bring about massive damages to the people and economy are floods or landslides caused by heavy rains which are attributed to the monsoon or tropical cyclones. A significant disaster killing more than 10 people has happened almost every year since 2006 and the frequency of its occurrence tends to increase.

Table 3: Meteorological Disasters in Sri Lanka during 2003-Middle of 2016
(Number of Killed or Missing Person: Over 10)

Year/Month	Season	Type of Disaster	Killed/Missing	Total Affected	Estimated Damage (US$ Million)
May 2003	Southwest Monsoon	Flood	235	695,000	29
October- November 2006	Second Inter-Monsoon	Flood	25	333,002	3
January 2007	Northeast Monsoon	Flood	18	35,000	—
May 2007	Southwest Monsoon	Flood	15	121,000	0.05
May-June 2008	Southwest Monsoon	Flash Flood	25	362,582	—
November 2008	Second Inter-Monsoon	Tropical Cyclone	15	360,000	—
May 2010	Southwest Monsoon	Flood	20	75,000	105
January 2011	Northeast Monsoon	Flood	47	1,060,324	200
February 2011	Northeast Monsoon	Flood	18	225,000	300
November 2011	Second Inter-Monsoon	Storm	22	35,041	—
December 2012	Northeast Monsoon	Flood	53	447,021	1.2
January 2013	Northeast Monsoon	Flood	52	56,747	—
June 2013	Southwest Monsoon	Flood	58	17,214	—
February 2014	Northeast Monsoon	Flood	27	—	—
June 2014	Southwest Monsoon	Flood	27	104,009	—
October 2014	Second Inter-Monsoon	Land Slide	38	330	—
October 2014	Second Inter-Monsoon	Land Slide	196	1,067	—
December 2014	Northeast Monsoon	Flood	41	1,100,020	—
May 2016	Southwest Monsoon	Flood	245	500,000	2,000

Source: WHO Collaborating Centre for Research on the Epidemiology of Disasters (CRED)
Emergency Events Database (EM-DAT)

<Lightning Strike>

Many lightning strike accidents occur every year in Sri Lanka. The death toll caused by lightning strikes annually has increased to more than 20 people in the recent decade and the death toll in 2012 reached 68 people. In later years, it has been observed that there is a tendency for the death toll and damages to increase as a result of such accidents. The lightning strike accidents in Sri Lanka occurs severely from March to April of the First Inter-Monsoon Season and subsequently occurs frequently from October to November for the Second Inter-Monsoon Season. The temperature of the ground is increased a lot by the sunshine during the day in the Inter-Monsoon Seasons. As a result, the atmospheric state becomes unstable, and a thundercloud often occurs in the afternoon. Lightning strike accidents in the country often occur within the whole area but the number of the outbreak has been significantly increasing as the development of thunderclouds is strengthened at the slope of the Central Highlands due to a topography-related upward flow.

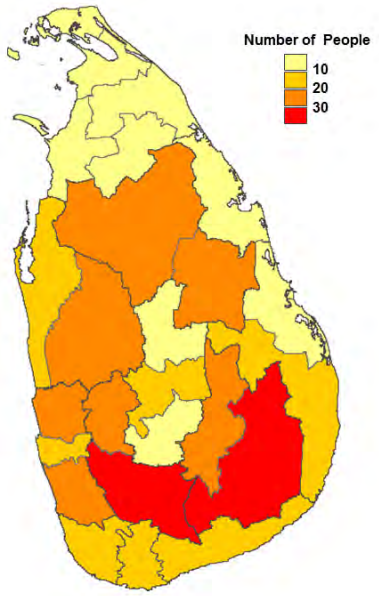


Figure 4: Deaths and Injured by Lightening for 30 years (1985-2014)
Source: The United Nations Secretariat for International Strategy for Disaster Reduction (UNISDR)

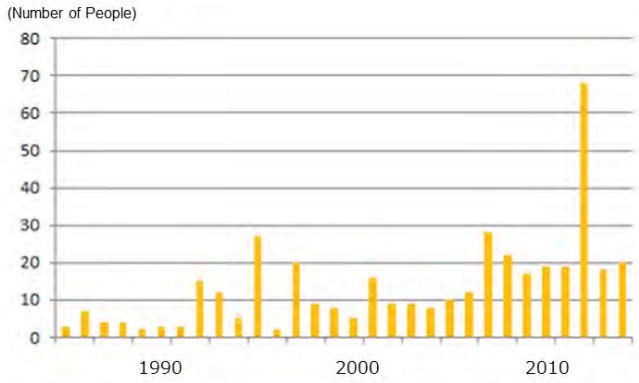


Figure 5: Annual Death Toll by Lightning Strike Accidents (1985-2014)
Source: The United Nations Secretariat for International Strategy for Disaster Reduction (UNISDR)

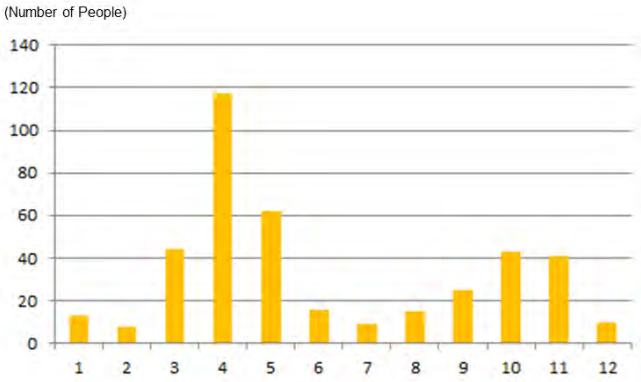


Figure 6: Monthly Total of Death Toll by Lightning Strike Accidents (1985-2014)
Source: The United Nations Secretariat for International Strategy for Disaster Reduction (UNISDR)

1-4 Negative Impact on the Development of the Sri Lanka Economy

An agricultural sector centered on rice and the plantation crops of tea, rubber, and coconut has traditionally driven the development of the market economy of Sri Lanka. A GDP (gross domestic product) growth rate of more than 10% was achieved due to the expansion of the manufacturing and wholesale and retail industry under the government policy for economic development adopted in 1990. Since 1991, a GDP growth rate of 4.0% to 6.0% has been constantly maintained and a high rate of 8.0% in

2010 and 8.3% in 2011 were achieved due to the further intensification of economic activities which accelerated since the end of a quarter of a century civil war in 2009.

Throughout the course of the robust economic development achieved by Sri Lanka, negative impacts on the economy have been observed due to natural disasters as shown in the table attached below. The widespread drought indicated in the table hereunder which persisted until September 2001 (rainy season: from October to December in previous years) caused serious negative impacts to the district of Puttalam which has a thriving agricultural and fisheries industry and is considered to be a place of strategic importance for the Sri Lankan economy as well as to the district of Badulla which is one of the major tea production regions in the country. From a 6.0 percent GDP growth rate in the previous year, a significant negative GDP growth rate of -1.6% was recorded with a total of one million affected people.

In 2008 when a GDP growth rate of 6.0% was recorded, it suddenly dropped to 3.5% in 2009. A similar case was observed during 2012 when the GDP growth rate dropped to 6.3% from 8.0% in 2011. In both instances, large-scale and devastating occurrences of river flood and flood happened 3 times in each year and approximately 0.8 million people were affected in 2008 while 1.3 million people were affected in 2011. Thus, there is a real and significant tendency that widespread and persistent disasters such as droughts and floods caused by weather phenomenon will induce a major negative impact in the economic activity in Sri Lanka. It should be noted that the reduced impact on the GDP growth rate caused by an extensive tsunami disaster created by an earthquake in the Indian Ocean off Sumatra on December 26, 2004 is attributed to the intensification of international assistance and investments for reconstruction in the devastated areas.

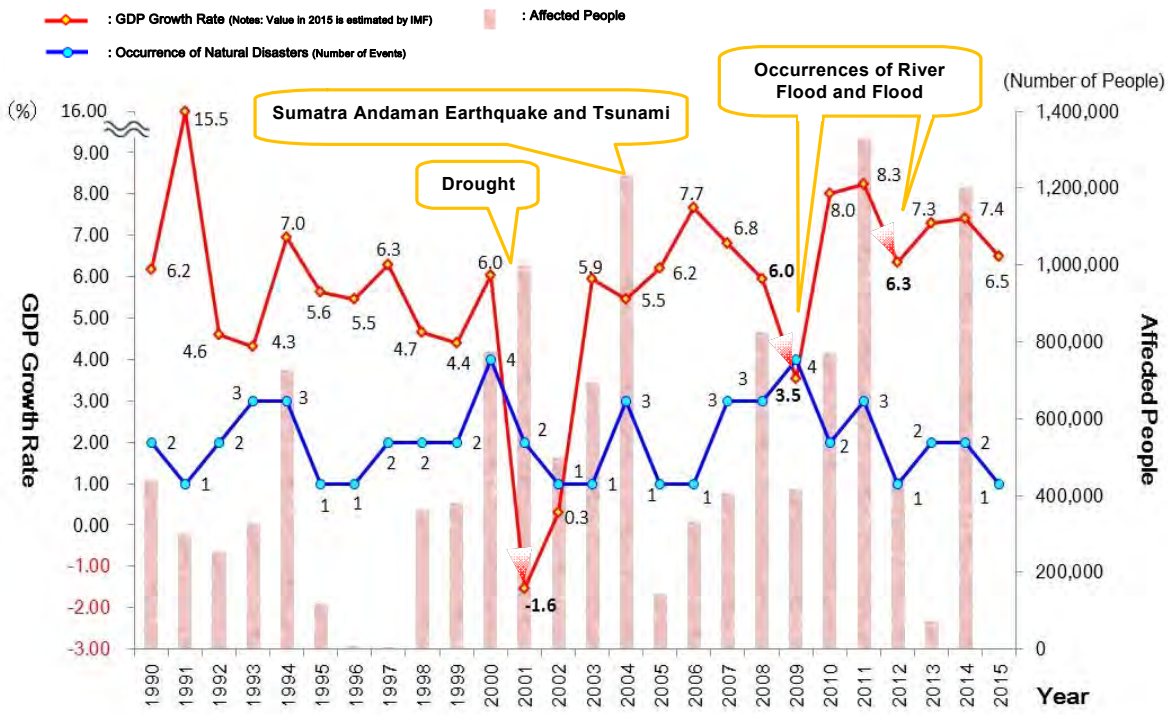


Figure 7: Meteorological Disaster, Number of Affected People by Disaster and GDP Growth Rate (1990-2015)

Source: IMF（International Monetary Fund）and EM-DAT: OFDA/CRED International Disaster Database

1-5 Brief Summary on the Request for the Project by Sri Lanka

Even 10 years after the "Trust Fund Project for the Installation of a Doppler Radar at Gongala" was commenced on July 2006 under the supervision of the World Meteorological Organization (WMO), the installation work of the radar system is not yet completed. Under this circumstance, currently the DOM does not have any method to observe precipitation in the whole area of Sri Lanka. Due to a lack of financial and technical capabilities, the Government of Sri Lanka, in 2014, has requested the Government of Japan to procure and install the required equipment as well as to provide the relevant systems and facilities under Japan's Grant Aid Assistance scheme.

In response to this request, the Government of Japan decided to conduct a Preparatory Survey for the Project for the Establishment of a Doppler Radar Network (hereinafter referred to as the "Preparatory Survey"). The Japan International Cooperation Agency (hereinafter referred to as "JICA") sent the Preparatory Survey Team to Sri Lanka in order to conduct the Preparatory Survey from February 18 to March 22, 2016. The Team had a series of discussions with the officials concerned from the Government of Sri Lanka, conducted surveys and collected the necessary and pertinent information and data for the Project. In addition, the Team conducted further studies, including a feasibility study focusing on the justification and scope of the Project, paying particular attention to the present situation in Sri Lanka from

various perspectives such as the operational & maintenance capabilities of the DOM, appropriate equipment arrangement plan, etc.

JICA sent the Preparatory Team again to Sri Lanka from September 13 to September 28, 2016 and also November 04, 2016 in order to explain and discuss the outline design & draft survey report. In the course of the discussions and field survey, it was confirmed that the requested items are required for the Project in consideration of the Project's objectives and effects. As a consequence of further studies on the requested items in Japan, it has been decided that the following components indicated in the table attached hereunder are the objective items of the Preparatory Survey for the Project.

Table 4: Objective Items of the Preparatory Survey

Component	DOM Puttalam Observatory (Puttalam Radar Observation Station)	DOM Pottuvil Observatory (Pottuvil Radar Observation Station)	National Meteorological Centre (NMC) at DOM Head Office	DOM Aviation Meteorological Office in the Colombo International Airport	DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport
Procurement and Installation of Equipment					
C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar System including Isolation Transformer, Power Supply Capacitor, Power Back-up System, Lightning System Measuring Equipment and Spare Parts	1	1	-	-	-
Meteorological Radar Central Processing System	-	-	1	-	-
Meteorological Radar Data Display System	1	1	1	1	1
Meteorological Data Satellite Communication System	1	1	1	-	-
Construction of Radar Tower Building					
Radar Tower Building	1	1	-	-	-
Technical Training	Initial operation guidance in the contract of manufacturer				
Soft Component					

During the study period indicated above, a comparison between a steel structure and a reinforced concrete structure for a radar tower building was conducted since steel structure radar tower buildings for a C band radar system are available in Japan and other overseas countries. Key points considered were construction cost, undertakings to be borne by the Sri Lankan side, possible technical issues during construction works, construction period and etc. As a consequence of the comparison, it was decided that a reinforced concrete structure will be the best option to be used for the construction of the Puttalam and Pottuvil Radar Tower Buildings due to the following reasons: (1) a steel structure building is uncommon in the country; (2) an 80-ton crane for assembling the steel pipe truss structure is not available in Sri Lanka; (3) construction cost and expenditures for the Sri Lankan side will be cheaper; (4) construction period is shorter; (5) and, finally, taking into account the Government of Sri Lanka's expressed eagerness to use a reinforced concrete structure.

Table 5: Comparison between a Steel Structure and a Reinforced Concrete Structure for Radar Tower Building

Items of Comparison	Steel Structure Radar Tower Building	Reinforced Concrete Structure Radar Tower Building
Structure	Steel pipe truss structure is required (Total Weight: 200-250 Tons).	Reinforced concrete structure which is commonly used in Sri Lanka.
Procurement of the Main Structural Materials	Import of main structural materials from Japan or Third Countries (south-eastern Asia) is required.	100% local procurement.
Utilization of a Local Construction Company for the Radar Tower Building Construction	No possibility to utilize a local construction company as a sub-construction company under a Japanese prime contractor for the construction of the main structure of the Radar Tower Building.	Since the reinforced concrete structure is commonly used in Sri Lanka, the utilization of a local construction company as a sub-construction company under a Japanese prime contractor for the construction of all of the Radar Tower Building is highly possible.
Necessity of Marine Transportation of the Main Structural Materials	Marine transportation of the main structural materials from overseas is indispensable.	Not required.
Custom Clearance & Duty	Custom clearance and duty exemption or paying tax by the recipient country is required	Not required.
Inland Transport in Sri Lanka for Construction Materials	Since inland transport of the steel pipe truss structure (Total Weight: 200-250 Tons) from the Colombo Seaport is required, inland transportation cost is quite high.	Since aggregate (sand and gravel) can be procured near the project site, inland transport cost is not high.
Construction Cost	Higher than the Reinforced Concrete Structure	Lower than the Steel Structure
Total Construction Period after signing of the contract	18-19 months	18 months
Refractory Structure	Steel Structure is not the refractory structure	Reinforced Concrete Structure is the refractory structure
Salt Corrosion on the Main Structures including Stairs Structures	Due to the provision of high corrosion treatment to the steel materials and appropriate supervision, salt corrosion on the main structures is less likely.	Due to appropriate supervision, salt corrosion is less likely.
Periodic Painting	Periodic painting to the construction materials (bolts, nuts, connection parts, etc.) which are not provided high corrosion treatment is required.	Periodic painting is not indispensable.
Availability of Crane Vehicle	Since a steel structure building is not common and a more than 80 tons crane is not available in Sri Lanka, the rental of a 100-120 tons sized crane from overseas is required for assembling the steel pipe truss structure.	Since a compact/middle size crane vehicle and a tower crane are widely utilized for the construction of reinforced concrete structure buildings, it will be more economically feasible as these cranes are readily available for hire in Sri Lanka.
Construction of the Radar Tower Building at the DOM Puttalam and Pottuvil Observatories	Since the carrying in of a larger size truck for the steel structures and a 100-120 tons sized crane into the project sites are quite challenging due to lower overhead low/high voltage cables set along the main roads of both project sites, the construction of the Steel Structure Radar Tower Buildings at the DOM Puttalam and Pottuvil Observatories is difficult.	Construction of the Reinforced Concrete Structure Radar Tower Buildings at the DOM Puttalam and Pottuvil Observatories is not going to be a significant problem.

1-6 Project Site Location Information

Table 6: Project Site Location Information

Name of Site	DOM Puttalam Observatory (Puttalam Radar Observation Station)	DOM Pottuvil Observatory (Pottuvil Radar Observation Station)	National Meteorological Centre (NMC) at DOM Head Office	DOM Meteorological Briefing Room in Colombo International Airport	DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport
Latitude	N08º 01' 37.47"	N06º 51' 38.61"	N06 º 54' 18.00"	N07 º 10' 52.00"	N 06 º 17' 20.00"
Longitude	E79º 50' 28.67"	E81º 49' 57.52"	E79 º 52' 19.30"	E79 º 53' 01.00"	E 81 º 07' 25.00"
Altitude	5m	4m	12m	11m	49m

1-7 Stability of Commercial Power

Commercial power stability tests were conducted at each site using a power quality analyzer with the results indicated in the following table. As a consequence of these tests, it was confirmed that power back-up systems such as engine generators, automatic voltage regulators, etc. are indispensable for the proposed DOM Puttalam Observatory (Puttalam Radar Observation Station) and DOM Pottuvil Observatory (Pottuvil Radar Observation Station) since the fluctuation of the electrical voltage on site against the nominal voltage is approximately 6% to 11% and the frequency of electric outage is 1 to 2 times/day (approx. 5 minutes - a few hours/time).

Table 7: Stability of Commercial Power (Measured by Power Quality Analyzer)

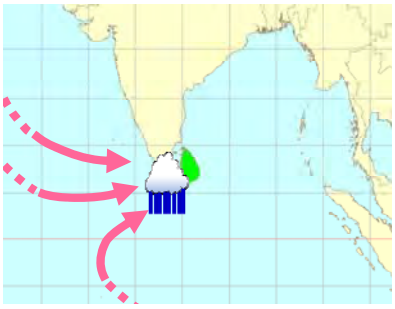
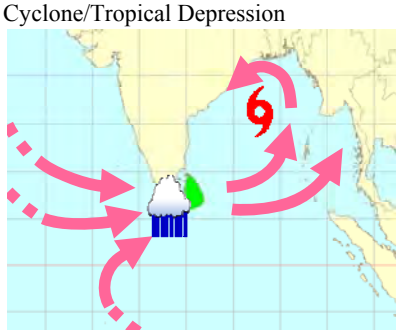
Name of Site		DOM Puttalam Observatory (Puttalam Radar Observation Station)	DOM Pottuvil Observatory (Pottuvil Radar Observation Station)	National Meteorological Centre (NMC) at DOM Head Office
Commercial Power (Voltage: Nominal)		230V, 50Hz, single phase 2-wire	230V, 50Hz, single phase 2-wire	400V, 50Hz, 3-phase 4-wire
Voltage (Nominal: 230V)*	Max.	245.5	237.6	241.0
	Min.	215.2	203.8	224.0
Frequency (Hz)	Max.	50.7	50.4	50.9
	Min.	49.4	49.7	49.0
Frequency of Electric Outage		1-2 times/day (approx. 5 minutes - 3hour/time)	1-2 times/day (approx. 5 minutes - 2 hour/time)	0-1 times/2day (approx. 1 minute/time)

*Result of measuring that nominal 400V 3-phase power divided into 3 lines × 230V Single-phase

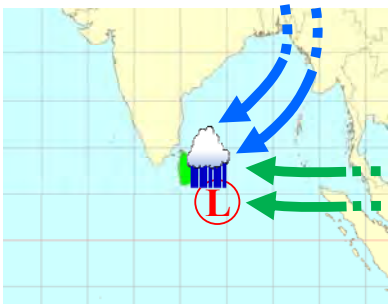
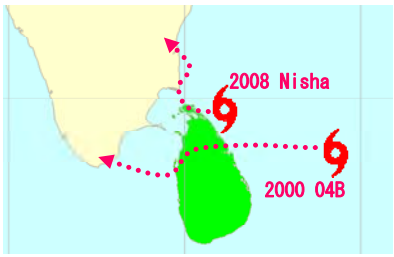
1-8 Meteorological Phenomena which cause heavy rainfall in Sri Lanka

It is a key point to understand the meteorological phenomena which cause heavy rain in Sri Lanka and detect their signals as soon as possible for the effective mitigation of disasters. The table below shows the details of the typical meteorological phenomena in Sri Lanka, the southwest monsoon, northeast monsoon and tropical cyclone.

Table 8: Meteorological Phenomena which cause Heavy Rain in Sri Lanka

<table>
<tr><td colspan="2">(1) Southwest Monsoon</td></tr>
<tr><td>A. Southwest Monsoon
 
B. Southwest Monsoon + Tropical Cyclone/Tropical Depression
  </td><td>Precipitation caused by the Southwest Monsoon intensifies in May which is the onset of the monsoon season. The convergence of the southwest winds (monsoon) forms the monsoon trough and develops convection clouds around Sri Lanka. The stronger the southwest monsoon is, the larger the amount of precipitation. It brings about heavy rain especially in the southwestern slopes of the mountains. (Figure A)

In addition, in case that a tropical cyclone/tropical depression is located in the Bay of Bengal, the southwest monsoon is forced to be blown into a tropical cyclone/tropical depression. This intensifies the southwest monsoon and causes a large amount of rain around Southwestern Sri Lanka. (Figure B)

347mm/day (Ratnapura, 16-May-2003)
263mm/day (Elston, 28-Apr-2008)</td></tr>
<tr><td colspan="2">(2) Northeast Monsoon</td></tr>
<tr><td>  </td><td>When the northeast wind blowing from the Siberian High and the east wind from the Pacific High converge around Sri Lanka, the conviction clouds develop and bring about heavy rain in the northeastern slopes of the mountains. In case that a low pressure system is formed around Sri Lanka, the rainfall in the central highlands and southern area increases.
312mm/day (Batticaloa, 8-Jan-2011)
316mm/day (Kurunagala, 17-Dec-2012)</td></tr>
<tr><td colspan="2">(3) Tropical Cyclone</td></tr>
<tr><td> 
Track of cyclones which made landfall on Sri Lanka</td><td>Tropical cyclones are likely to approach Sri Lanka in November and December. Although landfall frequency is relatively low, one every five years, the tremendous damages occur once it directly hits the country. Recently, tropical cyclones made landfalls in December 2000 and November 2008, both of which caused heavy rain and storm around the northern areas.
390mm/day (Jaffna, 25-November-2008)</td></tr>
</table>

1-9 Topographic and Geotechnical Surveys

At the proposed DOM Puttalam Observatory (Puttalam Radar Observation Station) and DOM Pottuvil Observatory (Pottuvil Radar Observation Station), which are the proposed sites for the construction of the new radar tower buildings, the topographic and geotechnical surveys indicated in the following tables were implemented by a local contractor consigned by the Preparatory Survey Team.

Table 9: Topographic Survey

Required Works	• Position of the existing building, observation facility, observation field • Bearing survey of the magnetic north • Calculation of the area planned
	• Plane surveying (0.5m contour line) - Position of the existing facilities (electrical lines, water lines, telephone lines, sewage, public roads, fences, vegetation, trees: more than 4m height, streetlights, manholes and other features)
	• Longitudinal profile and cross section - Indication of ground level at intervals of 10m - Public roads, ponds, river and each water level - Setting bench marks
Required Products	• Plane surveying map • Longitudinal profile and cross section • AutoCAD data file in CD-ROM

Table 10: Geotechnical Survey

Boring (All core boring)	Required number of borings: 3 Maximum depth of borings: 50m (Borings shall be extended to a more suitable bearing layer for a building construction even if borings have reached more than a depth of 50m. After reaching the bearing layer, borings shall be continued to a depth of at least 5m.)
Collecting soil samples	• Undisturbed soil sampling: 3 samples (at different levels) × 3 holes • Disturbed soil sampling: 3 samples (at different levels) × 3 holes • Adoption of standard: ASTM or JGS-Japanese geotechnical society
Standard Penetration Test	At intervals of every 1m till the bottom of each borehole
Laboratory Testing	Density Test of Soil Particle, Particle Size Distribution, Specific Gravity, Water Content , Liquid Limits, Plastic Limits, Unconfined Compression Test and Consolidation Test
Required Products	Geotechnical Survey Report: expected soil bearing capacity and calculation of consolidation coefficient

Table 11: Geotechnical Survey Result of DOM Puttalam Observatory (Puttalam Radar Observation Station)

Boring No.	Depth (m)	Soil Type	N-value	Core Recovery (%)	RQD (%)
BH-1	0.0 - 1.3	Fine Sand	8	-	-
	1.3 - 6.0	Very Stiff Clay	12 - 21	-	-
	6.0 - 6.8	Stiff Clay	21 - 60	-	-
	6.8 - 10.5	Fine sand	> 60	-	-
	10.5 - 16.5	Hard Clay	> 60	-	-
	16.5 - 21.5	Hard Clay	52	-	-
	21.5 - 22.0	Weathered Rock	34 - 60	-	-
	22.0 - 24.0	Hard Clay	> 60	-	-
	24.0 - 24.5	Coase Sand	> 60	-	-
	24.5 - 24.7	Weathered Rock	> 60	-	-
	24.7 - 37.8	Limestone	-	57 - 99	10 - 70
	37.8 - 39.4	Weathered Rock	-	-	-
	39.4 - 40.9	Gneiss	-	94	68
	40.9 - 42.5	Gneiss	-	99	69
	42.5 - 44.0	Gneiss	-	94	79
	44.0 - 50.0	Gneiss	-	83 - 97	10 - 60

BH-2	0.0 - 0.8	Fine Sand	17	-	-
	0.8 - 5.5	Stiff Clay	16 - 27	-	-
	5.5 - 14.6	Hard Clay	> 60	-	-
	14.6 - 16.8	Fine Sand	> 60	-	-
	16.8 - 24.6	Coarse Sand	> 60	-	-
	24.6 - 39.1	Limestone	-	55 - 98	9 - 57
	39.1 - 39.4	Gneiss	-	60	50
	39.4 - 50.0	Gneiss	-	85 - 98	58 - 82
BH-3	0.0 - 0.7	Coarse Sand	-	-	-
	0.7 - 12.1	Hard Clay	> 60	-	-
	12.1 - 18.0	Medium Sand	> 60	-	-
	18.0 - 20.5	Coarse Sand	> 60	-	-
	20.5 - 36.2	Limestone	-	46 - 77	7 - 22
	36.2 - 50.0	Gneiss	-	59 - 100	16 - 62

Table 12: Geotechnical Survey Result of DOM Pottuvil Observatory
(Pottuvil Radar Observation Station)

Boring No.	Depth (m)	Soil Type	N-value	Core Recovery (%)	RQD (%)
BH-1	0.0 - 2.7	Fine Sand	4	-	-
	2.7 - 8.2	Medium Sand	12 - 30	-	-
	8.2 - 11.0	Fine Sand	30 - 52	-	-
	11.0 - 13.1	Silty Sand	> 60	-	-
	13.1 - 18.0	Hard Clay	> 60	-	-
	18.0 - 27.9	Medium Sand	> 60	-	-
	27.9 - 29.7	Weathered Rock	> 60	-	-
	29.7 - 60.0	Gneiss	-	75 - 100	37 - 97
BH-2	0.0 - 2.5	Fine Sand	4	-	-
	2.5 - 5.1	Medium Sand	8 - 25	-	-
	5.1 - 9.0	Medium Sand	25 - 30	-	-
	9.0 - 14.0	Silty Sand	34 - 49	-	-
	14.0 - 16.1	Hard Clay	> 60	-	-
	16.1 - 30.0	Medium Sand	> 60	-	-
	30.0 - 32.2	Fine Sand	> 60	-	-
	32.2 - 37.9	Gneiss	-	95 - 97	81 - 93
	37.9 - 60.0	Gneiss	-	87 - 98	59 - 97
BH-3	0.0 2.4	Fine Sand	4	-	-
	2.4 - 7.0	Medium Sand	8 - 32	-	-
	7.0 - 8.9	Fine Sand	38	-	-
	8.9 - 13.1	Silty Sand	42 - 46	-	-
	13.1 - 16.0	Hard Clay	> 60	-	-
	16.0 - 29.3	Medium Sand	> 60	-	-
	29.3 - 33.7	Gneiss	-	96 - 100	48 - 94
	33.7 - 36.2	Gneiss	-	97	86
	36.2 - 39.2	Gneiss	-	100	97
	39.2 - 42.2	Gneiss	-	100	96
	42.2 - 60.0	Gneiss	-	90 - 97	85 - 92

1-10 Existing Facility and Equipment

<Existing Gongala Radar Tower Buildings>

Pictures of the existing Gongala Radar Tower Building is attached hereunder.

Picture: Current Situation of the Existing Gongala Meteorological Radar Tower Building

	
Overview of the Existing Gongala Meteorological Radar Tower Building	Water leakage from concrete cracks at the wall corner
	
Cable Rack	Radar Transmitter/Receiver
	
Radar Antenna and Pedestal	Radome
	
Water leakage from the window	Concrete pavement exfoliation of the access road

1-11 Consideration for Environmental Conservation

In order to implement the Project, it was confirmed by the DOM that the submission of an Environment Report to the Central Environmental Authority is required instead of an Environmental Impact Assessment (EIA) permit. The required procedures are indicated in the Chapter 3 of this report.

Chapter 2
Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

Major disasters such as floods, landslides, droughts, storms, tropical cyclones and etc., in Sri Lanka caused by hazardous meteorological phenomena bring about massive damages to both people and the economy due to the destruction of important infrastructures and properties. As shown in the table below, in the past close to 20 years (1996-2015), more than 66% of the total population of 20.35 million (2012) people which is approximately 13.5 million people are recorded to have been affected by the major disasters caused by hazardous meteorological phenomena. In addition, it is a situation that has induced the expenditure of a considerable amount of resources for recovery efforts from the damage caused by these disasters. It has also become a major factor that inhibits the socio-economic development of the country. In recent years, there is a tendency that the frequency of the occurrence of these events or accidents that cause serious disaster will increase. There is a growing concern that climate change due to global warming will increase the frequency and scale of these disasters and create more adverse impact in Sri Lanka.

Table 13: Disaster Records of Sri Lanka for Close to 20 Years (1996-2015)

Disaster	Frequency	Deaths	Affected People	Damage (US$)
Drought	3	0	4,600,000	25,000,000
Flood	4	39	16,426	0
Flash Flood	9	301	2,217,775	29,050,000
Riverine Flood	22	439	6,151,817	612,620,000
Landslide	2	203	1,467	0
Convective Storm	1	22	35,041	0
Tropical Cyclone	4	21	501,339	57,000,000
Total	45	1,025	13,523,865	723,670,000

Source: Emergency Events Database EM-DAT

Since more than 90% of the major disasters in Sri Lanka were caused by hazardous meteorological phenomena, meteorology has indeed become a matter of life or death in Sri Lanka. As such, the role of the DOM, the only meteorological organization in the country, is crucial and important.

In order for the DOM to mitigate the damages generated by the disasters caused by hazardous meteorological phenomena, it is a priority issue to detect hazardous meteorological phenomena which may create massive damages and disseminate highly accurate forecasts/warnings to the public more appropriately and promptly before the risk of disasters further escalate. However, the DOM is not able to adequately and quickly detect hazardous meteorological phenomena since there is no operational meteorological radar system in Sri Lanka as of the present.

Given the circumstances indicated above, the key objective of the Project is the effective mitigation of the devastation generated by disasters caused by hazardous meteorological phenomena such as heavy rain, tropical cyclone and etc., through the improvement of the weather information and forecasts & warnings released by the DOM by means of strengthening their monitoring capability of hazardous weather phenomena through the provision of technical support and the procurement of C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Doppler Meteorological Radar Systems, Meteorological

Radar Central Processing System, Meteorological Radar Data Display Systems and Meteorological Data Communication Systems under the Project.

2-2 Outline Design of Japanese Assistance

2-2-1 Design Policy

(1) Basic Design Policy of the Project

a) To design a meteorological observation system that can contribute to disaster prevention in Sri Lanka.
b) To enable the DOM to provide weather information, forecasts, advisories and warnings necessary for the protection of people's lives and properties from natural disasters and the improvement of socio-economic conditions in Sri Lanka.
c) To enable the DOM to monitor weather conditions around-the-clock on a real time basis.
d) To enable the DOM to promptly issue a weather information and/or a warning to the public.
e) To ensure the improvement of the DOM's overall function and capacity in reducing human loss and economic setback brought about by tropical cyclones through the upgrading of the DOM's monitoring capabilities of meteorological phenomena including tropical cyclones.
f) To determine and establish the size and components of the Project to match with the technical, operational and maintenance capabilities of the DOM.

[1] Design Policy of the Equipment

a) To ensure that the equipment is compatible with and meets the technical requirements of the World Meteorological Organization (WMO).
b) To ensure that the equipment is suitable for the routine observation and forecasting work of the DOM.
c) To design the Puttalam and Pottuvil Meteorological Radar Systems with functions relevant to quantitative rainfall observation and air-turbulence observation capabilities that enhances and upgrades the accuracy of the weather forecasts made by the DOM.
d) To design the Meteorological Radar Systems to acquire constant altitude information from 3-dimensional raw data obtained by scans of the radar system at multiple elevations to ensure wider coverage and detection of rainfall distribution at each altitude.
e) To design the system in such a way that all the data produced by the Puttalam and Pottuvil Meteorological Radar Systems are delivered to the National Meteorological Centre (NMC) at the DOM Head Office every 10 minutes.

f) To install a new radome strengthened with a honeycomb structures core-mat in the interlayer which can withstand a survival wind speed of 90m/s.
g) To design the system so that it is within the DOM's capability to operate, maintain and repair.
h) To select equipment for which spare parts and consumables can be easily procured and replaced.
i) To select reliable and durable equipment suitable for the local environment.
j) To minimize the recurrent costs of the DOM for the operation, maintenance and repair of the equipment.
k) To ensure the accuracy of radar data through meticulous adjustment and proper calibration (optimization of radar ZR relation parameter for rainfall calculation).
l) To design the equipment so as to minimize lightning damage.
m) To have the necessary power supply back-up equipment (diesel generator, radar power backup unit, auto voltage regulator, etc.) for performing around-the-clock meteorological services 24 hours a day, 365 days a year.
n) To design the equipment to operate using 230V Single Phase 2-Wire/415V 3-Phase 4-Wire ±20%, 50Hz power.

[2] Design Policy of the Radar Tower Building

The aim is to construct a meteorological radar tower building that will ensure the appropriate and effective operation of the system as well as accommodate the required systems, equipment and personnel. It is basic policy that the designed Radar Tower Buildings satisfies the following requirements:

a) To ensure, as much as possible, that the height of the radar tower buildings is free of obstructions (e.g. surrounding mountains, existing facilities) to avoid blind areas during radar observations.
b) To select the most suitable foundation structures to ensure that the permissible horizontal deflection of the radar tower buildings is not more than 1/1000 of the height of radar tower building (approx. 0.05 degree which is 5% of beam angle of an antenna to be manufactured).
c) To ensure that the working environment for the DOM's 24-hour/day work schedule of observations is conducive to ensuring effective and efficient performance.
d) To be sufficiently robust enough to withstand extreme weather and ensure uninterrupted radar observation and continuous provision of weather forecasts & warnings to the public, even during the occurrence of a natural disaster.
e) To make use of local building materials for the easy maintenance of the radar tower buildings by the DOM.
f) To design the equipment so as to minimize lightning damage.

(2) Design Policy on Environmental Conditions

1) Temperature/Humidity

Air-conditioning systems are required for the rooms (radar equipment room, radar observation room, spare parts room, electricity room, etc.) where the equipment is to be installed since Sri Lanka has a hot and humid climate throughout the year.

2) Rainfall

A maintenance staircase is located at the center of the building, covered by an upper concrete slab, to enable the DOM personnel to easily reach each room for the regular maintenance of the radar equipment without getting wet during rainy days.

3) Flood

Puttalam is located in areas which are subject to risks of flooding. Therefore, the ground floor of the radar tower building will be built high enough to minimize any possible damage due to flooding.

4) Tsunami

The earthquake and subsequent tsunami in the Indian Ocean on December 2004 had a devastating effect on Pottuvil's coast facing the East in the Indian Ocean (Indonesia side) in December 2004. Since the Pottuvil Observatory, one of the proposed project sites, is located approximately 200m from the coastline, a 4-5m high tsunami hit and destroyed all the DOM's facilities in the observatory. Therefore, the ground floor of the new radar tower building will be built more than 5m high to minimize any possible damage due to tsunami.

5) Lightning

Frequent lightning occurs especially during the rainy season. A lightning protection and grounding system (see the drawing of Lightning Protection & Grounding System) are, therefore, indispensable to prevent damage to the building and to the equipment.

- Installation of lightning rod(s) at the top of the Radome
- Installation of roof-ridge lightning conductors at the Radome Roof and the Observation Deck
- Installation of a down grounding conductor at the center of the Radar Tower Building
- Installation of a down lightning conductor at each of the 4 major columns of the Radar Tower Building
- Adoption of a Ring Earth Electrode Method

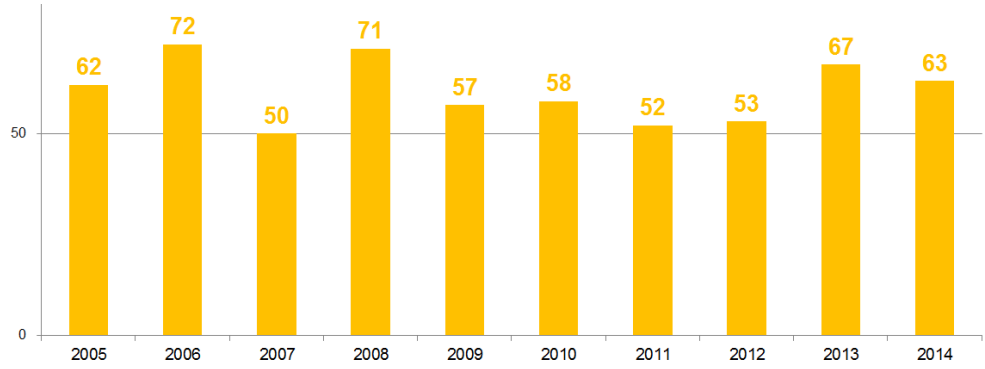


Figure 8: Number of Annual Thunder Days in Puttalam
(Observation Data of Thunder Days in Pottuvil: not available due to no observation)

6) Wind

For calculating the design wind load of the proposed Radar Tower Buildings, the basic wind speed will be applied in accordance with the recorded maximum wind speed in Sri Lanka 160m/h (45m/s).

7) Earthquake

There is no general policy on the inclusion of seismic factors in building structural calculations in Sri Lanka. Therefore, the seismic load is generally not incorporated into the structural design and calculation of buildings to be constructed in Sri Lanka. However, since there is an existing earthquake record and safety is of utmost priority, the seismic load will be factored in the radar tower building structural calculation.

8) Load Bearing Layer

The structural design of the radar tower building including piles and foundations is to be implemented according to the results of the geotechnical survey done by a local contractor consigned by the Preparatory Survey Team. The foundation type of the radar tower buildings are as follows:

Table 14: Foundation of the Puttalam and Pottuvil Meteorological Radar Tower Buildings

	Puttalam Meteorological Radar Tower Building	Pottuvil Meteorological Radar Tower Building
Foundation	Pile foundation (cast in site concrete: 1.2m diameter)	Pile foundation (cast in site concrete: 1.2m diameter)

(3) Design Policy for Construction Work

1) Environmental Regulation

Waste water discharged from the radar tower building must undergo initial treatment before filtering the treatment into the soil at the site.

2) Use of Locally Procurable Materials

Most of the construction materials can be procured from the local market. For the Project, durable

maintenance materials not containing asbestos will be selected from locally available materials.

3) Use of Local Construction Methods and Local Workers

Laborers are classified according to their skills (e.g. as carpenters, plasterers, steel fitters, etc.) and skill level is variable in Sri Lanka. In order to be able to utilize local laborers as often as possible, reinforced concrete structures, which local workers are familiar with, will be used.

(4) Policy for Use of Local Construction Companies

1) Construction Work of the Radar Tower Building

Generally, in Sri Lanka, the technical skills and competence of the major local construction companies are adequate enough. Thus, they will be used for the construction of the radar tower building.

2) Equipment Installation Work

Under the supervision of a Japanese engineer, a local electrical work contractor will be used in the installation work of the equipment.

(5) Design Considerations to Simplify Operation and Maintenance for the DOM

1) User-friendly equipment

The equipment to be supplied under the Project will be used to support the DOM's routine work as the national meteorological agency for natural disaster prevention. As such, a variety of data processing, analysis, display and communications capabilities must be readily available for the DOM using simple operational procedures.

2) Easy maintenance and affordable recurrent costs of the equipment

The equipment must be designed in such a way so as to minimize the spare parts and consumables required and to simplify regular maintenance. Replacement parts must be quickly and readily available. The biggest recurrent cost of the Project is expected to be electricity; therefore, the equipment and facility should be designed to minimize power consumption.

3) Consideration of minimizing operational & maintenance costs

In order for the DOM to meet the increased operational and maintenance costs of the system, the following measures have been included in the plan for the equipment and the radar tower buildings:

- The ability to restrict the operation of the air-conditioning systems and the electricity supply in the operational rooms within the radar tower building only.
- The utilization of natural light to reduce energy requirements by minimizing the hours of artificial lighting required.

- Usage of LED for artificial lighting.
- Incorporation of solid-state parts into the radar system to reduce the cost and frequency of parts replacement.

(6) Design Policy for Equipment & Building Grade

To ensure the uninterrupted dissemination of forecasts and warnings to the public, the equipment and the radar tower building must be sufficiently robust enough to withstand very heavy rains, local severe storms and lightning strikes to enable the provision of meteorological services 24 hours per day.

(7) Design Policy regarding Construction/Procurement Method and Schedule

The equipment for the Project must be durable, reliable, of high technical level and cost effective. Though the equipment to be installed in the radar tower building, such as the specialized power backup systems and meteorological equipment are not available in the local market, locally procurable materials and local construction methods must be used in the building design. The pulse compression solid state Doppler radar system, which has already been put into practical use for meteorological observation and has confirmed its reliability, durability, accuracy and performance, is only available and made in Japan. In addition, the annual number of days with rainfall of over 10mm/day as well as public holidays, Sunday, Saturday, the Sinhala & the Tamil New Year holidays must be considered and added into the implementation timeline/schedule of any works to be done during the project period.

2-2-2 Basic Plan

The finalized components in the basic design for the Project are as follows.

Table 15: Objective Equipment and Facilities of the Preparatory Survey

Component	DOM Puttalam Observatory (Puttalam Radar Observation Station)	DOM Pottuvil Observatory (Pottuvil Radar Observation Station)	National Meteorological Centre (NMC) at DOM Head Office	DOM Aviation Meteorological Office in the Colombo International Airport	DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport
Procurement and Installation of Equipment					
C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar System including Isolation Transformer, Power Supply Capacitor, Power Back-up System, Lightning System Measuring Equipment and Spare Parts	1	1	-	-	-
Meteorological Radar Central Processing System	-	-	1	-	-
Meteorological Radar Data Display System	1	1	1	1	1

Meteorological Data Satellite Communication System	1	1	1	-	-
Construction of Radar Tower Building					
Radar Tower Building	1	1	-	-	-
Technical Training	Initial operation guidance in the contract of manufacturer				
Soft Component					

(1) Equipment Plan

1) C-Band Pulse Compression Solid State Dual Polarization Meteorological Doppler Radar System

A meteorological radar system is the only system able to observe in real time the occurrence, movement, distribution and intensity of rainfall, and meteorological phenomena related to rainfall, and to provide quantitative measurements over a large area in real time. In order to ensure stable operation, there is a strong demand that a meteorological radar uses solid state components instead of klystrons and magnetrons which are currently being used and which requires periodic replacement and maintenance & inspections due to their shorter operation life.

A meteorological Doppler radar system transmits a single type of radio wave and measures the Doppler frequency in addition to the amplitude information, from which the Doppler velocity of raindrops to the radar system is able to be measured. A dual polarization meteorological Doppler radar system enables the transmission of two types of radio waves which are vertical and horizontal in polarization and obtains various parameters from the signals that are reflected from the raindrops for accurate rainfall estimates, as polarization parameters are closely related with raindrop shape and their drop-size distribution.

Frequency of the C-Band Pulse Compression Solid State Dual Polarization Meteorological Doppler Radar System (wave length: approx. 5cm) designed to be able to observe a rain cloud in the theoretical observation range with 300km radius is the Center Frequency (either C-Band or extended C-Band), ±5MHz band width allocated by the Telecommunications Regulatory Commission (TRC) for the DOM. Technical features of the proposed C-Band Pulse Compression Solid State Dual Polarization Meteorological Doppler Radar Systems are as follows.

Table 16: Major Features of the proposed C-Band Pulse Compression Solid State Dual Polarization Meteorological Doppler Radar Systems

To be allocated Frequency by the TRC	Either C-Band or Extended C-Band
Frequency Band Width	10 MHz (Center Frequency ±5 MHz)
Wavelength	Approx. 5 cm
Detectable Maximum Range of Precipitation Intensity 1mm/h	300 km or more
Detectable Maximum Range of Wind Velocity	150 km
Observable Maximum Wind Speed	More than 45 m/s
Transmission Peak Power	5 kW + 5 kW
Dual-polarization Function	Available
Doppler Function	Available
Accumulated Rainfall	Available
Rainfall Data by using Dual-polarization Function	0 - 250 mm/h rainfall intensity quantitative data

In an attempt to accomplish the project target, the radar system must be furnished with the following essential functions.

[1] Doppler Mode

The meteorological radar system is designed to work in Doppler mode, which detects the wind motion and wind patterns of severe weather phenomena such as tropical cyclones, local severe storms and tornadoes within a 150km radius. This will help the DOM to monitor the movement and development of severe weather systems in preparation for a more accurate and timely weather forecast and warning. The Doppler mode is essential to allow for more accurate forecasting and longer forecast prediction times.

[2] CAPPI (Constant Altitude PPI (Plan Position Indicator)) Mode

In order to obtain accurate observation rainfall data during meteorological radar observation, it is recommended to conduct radar observations at lower antenna angles closer to the ground surface. The continuous automatic observation done in multiple elevations during a CAPPI observation enable the collection of echo intensity data in three different dimensions. It is possible to eliminate the disadvantages described above by converting the data observed from a constant altitude surface and the data obtained from CAPPI observation into rainfall data. In order to be able to produce an estimation of heavy rain amounts, it is especially necessary to use a high degree of 2km or 3km CAPPI product. Therefore, in this Project, it will be necessary to provide for a CAPPI function with automatic multiple elevation angle observation for CAPPI product creation.

Figure of the “Composite Picture of the Proposed Meteorological Radar Observation Network in Sri Lanka” after completion of the Project are attached hereunder.

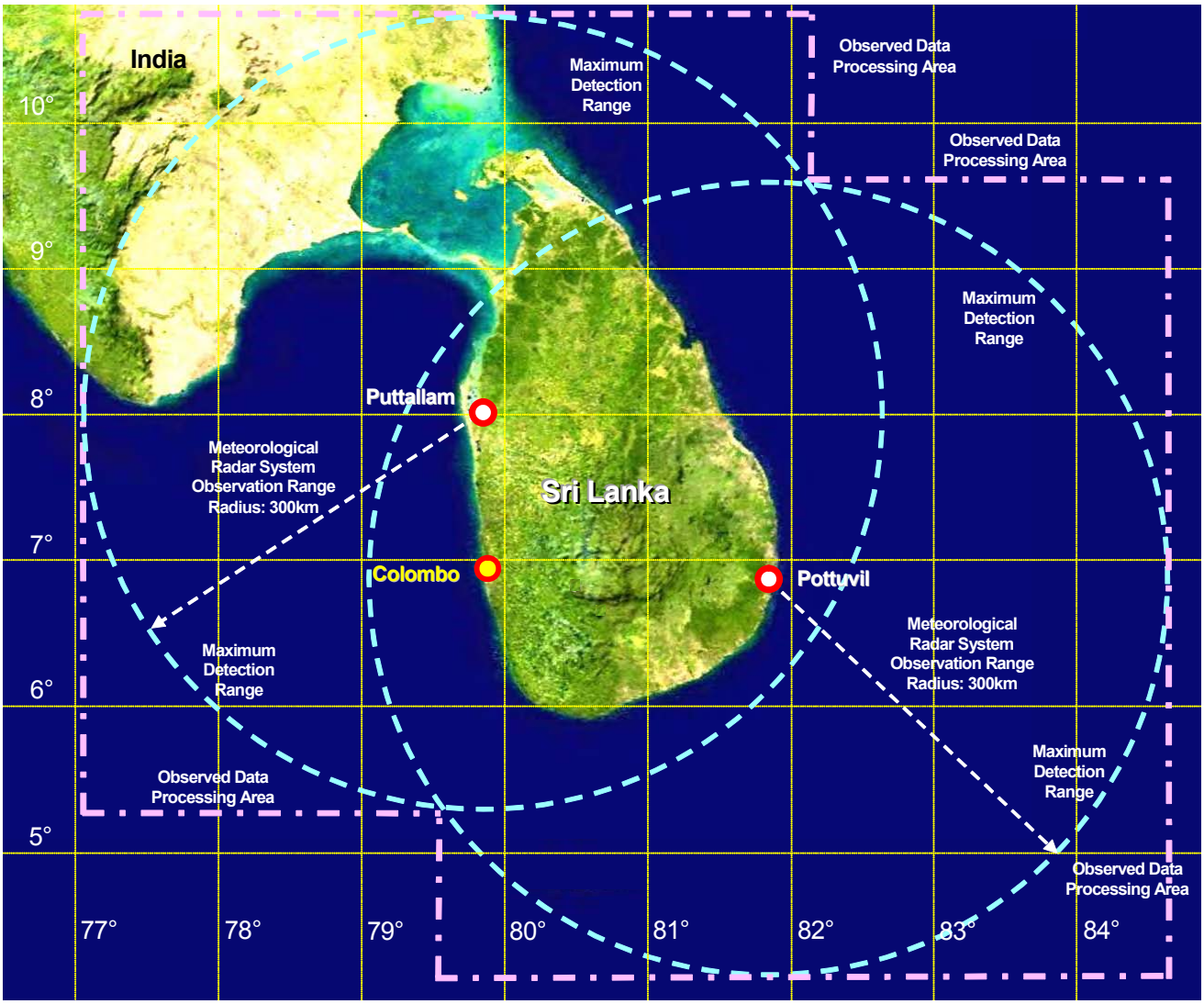


Figure 9: Composite Picture of the Proposed Meteorological Radar Observation Network in Sri Lanka

2) Meteorological Radar Central Processing System

In order to remotely operate, control and maintain the Puttalam and Pottuvil Radar Observation Stations at the National Meteorological Centre (NMC) in the DOM Head Office, a system with the following functions is indispensable.

1. Remote control of the radar system
2. Operation monitoring of the radar system
3. Monitoring of the radar observation data for quality control
4. Alteration of the radar system configurations
5. Collection and archive of all the radar observation raw data
6. Adjustment of the signal processing
7. Radar picture composition processing
8. Remote control of air conditioning systems in the radar equipment room

9. Remote control of engine generators
10. Monitoring of the operation environment (equipment and room temperature) in the radar equipment room
11. Security monitoring in the radome room and the radar equipment room
12. Provision of the radar products for posting the DOM Web site

3) Meteorological Radar Data Display System

A meteorological radar data display system must have the ability to receive and display all meteorological products in real time as the DOM's forecasters will utilize them for routine weather forecasting & warning. In addition, the DOM's forecasters are required to do a substantial amount of work in a short time so the meteorological radar data display systems are to be installed in the proposed Meteorological Radar Tower Buildings, the National Meteorological Centre (NMC) in the DOM Head Office, DOM Aviation Meteorological Office in the Colombo International Airport and the DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport so that they do not need to leave the area. Displays of the system must have minimized heat production for effective room cooling, must be of the power-saving type and must have less screen reflections for a smooth and long time operation. The meteorological radar data display system will be designed to store data files of the radar pictures as binary data of hourly accumulated precipitation data of not more than 1.0 km mesh.

4) Meteorological Data Satellite Communication System (VSAT)

In order to improve the severe weather monitoring and forecasting work and to enable the timely dissemination of products, all of the meteorological radar data produced by the proposed Puttalam and Pottuvil Meteorological Radar Systems must be delivered to the National Meteorological Centre (NMC) in the DOM Head Office every 10 minutes in view of CAPPI mode observation (to synchronize with the data transmission interval of the existing automatic weather observation systems). The required data transmission speed is at least 256kbps or more between the Puttalam and Pottuvil Meteorological Radar Systems and the National Meteorological Centre (NMC) in DOM Head Office. To facilitate this, a data acquisition system is required, employing the most suitable band for high-speed satellite communication links using C-Band, because of its low attenuation by rain. In order to collect the meteorological radar data at the National Meteorological Centre (NMC) in the DOM Head Office as much as possible and also remotely operate, control and maintain the Puttalam and Pottuvil Radar Observation Stations at the NMC, the DOM has a plan to secure 1.6MHz space segment (1,600kHz) for the Project.

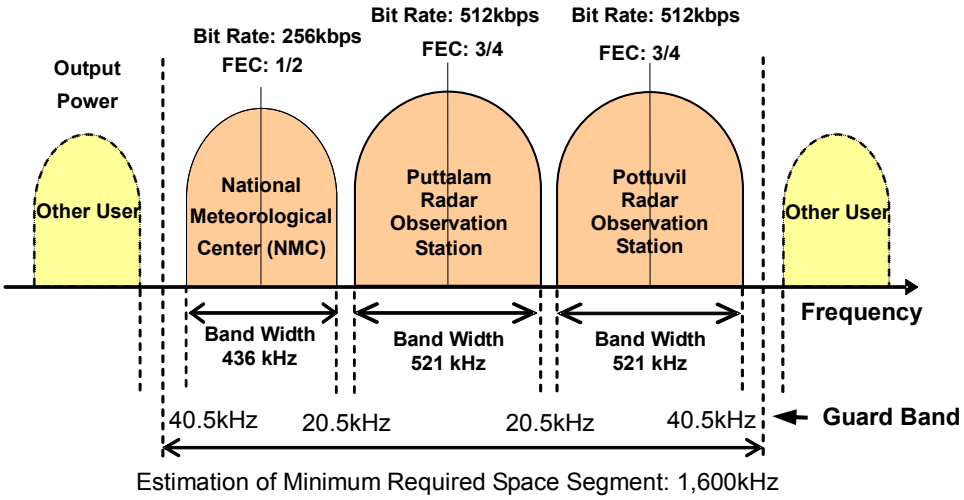


Figure 10: Estimation of Minimum Required Space Segment

For transmitting all the meteorological radar data from the proposed Puttalam and Pottuvil Meteorological Radar Systems to the National Meteorological Centre (NMC) at DOM Head Office, the transponder to be selected must satisfy the following requirements.

- ✧ Geographic Coverage : Southwest Asia area including Sri Lanka
- ✧ Satellite Beam : C-Band beam
- ✧ Frequency (C-Band) : Up Link: 5,850MHz – 6,425MHz
  Down Link: 3,625MHz - 4,200MHz
- ✧ Polarizations : Orthogonal Linear
- ✧ Satellite EIRP : more than 38 [dBW]
- ✧ Satellite G/T : more than -2 [dB/K]
- ✧ Satellite SFD : less than -92 [dBW/m2]
- ✧ Satellite Orbital Slot : 76°E - 140°E

<EIPR>
Effective Isotropic Radiated Power – This term describes the strength of the signal leaving the satellite antenna or the transmitting earth station antenna, i.e., final amplifier output power + antenna gain in dB. The unit dBW is the logarithmic expression of Power in Watt.

<G/T>
G/T is called “Figure of merit” and represents the receive system performance. G/T is the ratio of the receive antenna gain and the system thermal noise including the antenna noise.

<SFD – Saturation Flux Density>
This means the flux density at the satellite receive antenna required to saturate a satellite transponder.

In addition, in order to surely transmit the observation data from the proposed Radar Systems to the National Meteorological Centre (NMC) in the DOM Head Office as a back-up data communication method for the Meteorological Data Satellite Communication System (VSAT) and also to transmit the radar products from the National Meteorological Centre (NMC) in the DOM Head Office to the DOM Aviation Meteorological Office in the Colombo International Airport and the DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport, an Internet Protocol Virtual Private

Network (IP-VPN) established in a network of telecommunications carriers using Internet Protocol will be utilized. The DOM has a plan to establish a 1Mbps or more IP-VPN as a back-up data communication link between the proposed Radar Observation Stations and the National Meteorological Centre (NMC) in the DOM Head Office.

Since an IP-VPN has some advantages such as "definition of routing path, quick fault detection and switching alternative path" as indicated in the following figure, an IP-VPN also gives subscribers stable and fast data communication. Although the data communication speed of the IP-VPN depends upon the number of users and frequency of use, the network speed is hardly significantly affected by the usage of other subscribers since an IP-VPN is only utilized by certain subscribers of the closed network of telecommunications carriers using Internet Protocol. Furthermore, it is possible to decrease the threat of cyber attacks due to the utilization of an IP-VPN.

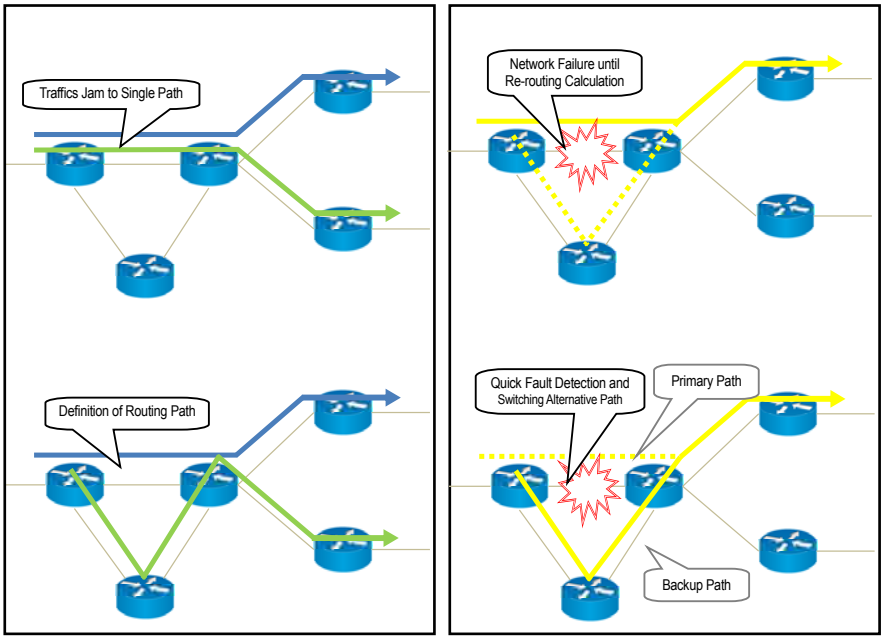


Figure 11: Definition of Routing Path and Quick Fault Detection & Switching Alternative Path

The required data communication speed, data volume of Long & Short Range Observation and duration of the radar data transmission (selectable radar observation schedule for the radar data transmission within 10 minutes) by the Meteorological Data Satellite Communication System (VSAT) and IP-VPN are indicated in the following tables.

Table 17: Required Data Communication Speed from each Proposed Radar Observation Station to the National Meteorological Centre (NMC) at the DOM Head Office

VSAT Data Communication Link		
Planned Data Communication Speed of the DOM	512 kbps	
Effective Data Communication Speed	461 kbps	(90% of Planned Data Communication Speed)
Required Data Communication Speed for the Radar Observation Data	**256 kbps**	(50% of Planned Data Communication Speed)
Required Data Communication Speed for; ■ IP Phone Voice Communication Data ■ Monitoring Data of the Radar System Equipment and the Radar Tower Building ■ Error Data Re-transmission	**205 kbps**	(40% of Planned Data Communication Speed)
IP-VPN Data Communication Link (Back-up Link)		
Planned Data Communication Speed of the DOM	1,024 kbps	
Effective Data Communication Speed	512 kbps	(50% of Planned Data Communication Speed)
Required Data Communication Speed for the Radar Observation Data	**256 kbps**	(25% of Planned Data Communication Speed)
Required Data Communication Speed for; ■ IP Phone Voice Communication Data ■ Monitoring Data of the Radar System Equipment and the Radar Tower Building ■ Error Data Re-transmission	**205 kbps**	(20% of Planned Data Communication Speed)
Margin	51 kbps	(5% of Planned Data Communication Speed)

Table 18: Data Volume of Long Range Observation (C-Band: 300km)

Azimuth Resolution Angle (Number of Azimuth Sectors)	degree	0.7 (360°/0.7=512)					1.0 (360°/1.0=360)				
Range Resolution Length (Number of Range Sectors)	m	150 (2000)	300 (1000)	450 (667)	600 (500)	750 (400)	150 (2000)	300 (1000)	450 (667)	600 (500)	750 (400)
Header Data Volume	byte	512									
Observation Data Volume (Azimuth Sectors × Range Sectors×2byte)	byte	2,048,000	1,024,000	683,008	512,000	409,600	1,440,000	720,000	480,240	360,000	288,000
Total Angle Data Volume (Azimuth Sectors × 32 byte)	byte	16,384					11,520				
Single Scan Data Volume of Long Range Observation (A)[*1]	byte	2,064,896	1,040,896	699,904	528,896	426,496	1,452,032	732,032	492,272	372,032	300,032

[*1] Single Scan Data Volume of Long Range Observation (A): Data type: Radar Reflectivity (Z)

Table 19: Data Volume of Short Range Observation (C-Band: 150km)

Azimuth Resolution Angle (Number of Azimuth Sectors)	degree	0.7 (360°/0.7=512)					1.0 (360°/1.0=360)				
Range Resolution Length (Number of Range Sectors)	m	150 (1000)	300 (500)	450 (334)	600 (250)	750 (200)	150 (1000)	300 (500)	450 (334)	600 (250)	750 (200)
Header Data Volume	byte	512									
Observation Data Volume (Azimuth & Range Sectors × 2byte)	byte	1,024,000	512,000	341,402	256,000	204,800	720,000	360,000	240,048	180,000	144,000
Total Angle Data Volume (Azimuth Sectors × 32byte)	byte	16,384					11,520				
Single Scan Data Volume of Short Range Observation (B) [*2]	byte	6,245,376	3,173,376	2,149,786	1,637,376	1,330,176	4,392,192	2,232,192	1,512,480	1,152,192	936,192
Compressed (B) [*3]	byte	4,684,032	2,380,032	1,612,339	1,228,032	997,632	3,294,144	1,674,144	1,134,360	864,144	702,144

[*2] Single Scan Data Volume of Short Range Observation (B): Radar Reflectivity (Z), Doppler Velocity (V) , Spectrum Width (W), Differential Reflectivity (ZDR), Differential Phase Shift (φDP), Polarimetric Correlation Coefficient (ρHV)

[*3] Compressed Single Scan Data Volume of Short Range Observation: (B) × 0.75 (at least 25% decrease)

Table 20: Required Time Duration of Radar Data Transmission
from each Proposed Radar Observation Station to the National Meteorological Centre (NMC) at DOM Head Office

Azimuth Resolution Angle (Number of Azimuth Sectors)		degree	0.7 (360°/0.7=512)					1.0 (360°/1.0=360)				
Range Resolution Length		m	150	300	450	600	750	150	300	450	600	750
Number of Scans		Unit	Required Time Duration									
Long Range Observation	Short Range Observation											
4	6	minute	18.5	9.4	6.3	4.8	3.9	13.0	6.6	4.5	3.4	2.8
4	7	minute	20.9	10.6	7.2	5.4	4.4	14.7	7.4	5.0	3.8	3.1
4	8	minute	23.3	11.8	8.0	6.1	4.9	16.4	8.3	5.6	4.3	3.5
4	9	minute	25.6	13.0	8.8	6.7	5.4	18.0	9.2	6.2	4.7	3.8
4	10	minute	28.0	14.2	9.6	7.3	5.9	19.7	10.0	6.8	5.2	4.2
4	11	minute	30.4	15.4	10.4	7.9	6.4	21.4	10.9	7.3	5.6	4.5
3	7	minute	19.8	10.0	6.8	5.2	4.2	13.9	7.1	4.8	3.6	3.0
3	8	minute	22.2	11.3	7.6	5.8	4.7	15.6	7.9	5.4	4.1	3.3
3	9	minute	24.6	12.5	8.4	6.4	5.2	17.3	8.8	5.9	4.5	3.7
3	10	minute	27.0	13.7	9.3	7.1	5.7	19.0	9.6	6.5	5.0	4.0
3	11	minute	29.4	14.9	10.1	7.7	6.2	20.6	10.5	7.1	5.4	4.4
3	12	minute	31.7	16.1	10.9	8.3	6.7	22.3	11.3	7.7	5.8	4.7
2	8	minute	21.2	10.7	7.3	5.5	4.5	14.9	7.6	5.1	3.9	3.2
2	9	minute	23.5	12.0	8.1	6.2	5.0	16.6	8.4	5.7	4.3	3.5
2	10	minute	25.9	13.2	8.9	6.8	5.5	18.2	9.3	6.3	4.8	3.9
2	11	minute	28.3	14.4	9.7	7.4	6.0	19.9	10.1	6.8	5.2	4.2
2	12	minute	30.7	15.6	10.6	8.0	6.5	21.6	11.0	7.4	5.7	4.6
2	13	minute	33.1	16.8	11.4	8.7	7.0	23.3	11.8	8.0	6.1	4.9
1	9	minute	22.5	11.4	7.7	5.9	4.8	15.8	8.0	5.4	4.1	3.4
1	10	minute	24.9	12.6	8.6	6.5	5.3	17.5	8.9	6.0	4.6	3.7
1	1	minute	27.3	13.8	9.4	7.1	5.8	19.2	9.7	6.6	5.0	4.1
1	12	minute	29.6	15.1	10.2	7.8	6.3	20.8	10.6	7.2	5.5	4.4
1	13	minute	32.0	16.3	11.0	8.4	6.8	22.5	11.4	7.8	5.9	4.8
1	14	minute	34.4	17.5	11.8	9.0	7.3	24.2	12.3	8.3	6.3	5.2

: None selectable Radar Observation Schedule for Radar Data Transmission within 10 minutes

: Selectable Radar Observation Schedule for Radar Data Transmission within 10 minutes

Condition: All of the meteorological radar data produced by the proposed Puttalam and Pottuvil Meteorological Radar Systems must be delivered to the National Meteorological Centre (NMC) at DOM Head Office, every 10 minutes in view of CAPPI mode observation for synchronizing with the data transmission interval of the existing automatic weather observation systems.

The “Schematic Diagram of Meteorological Radar Observation Network in Sri Lanka” is attached hereto.

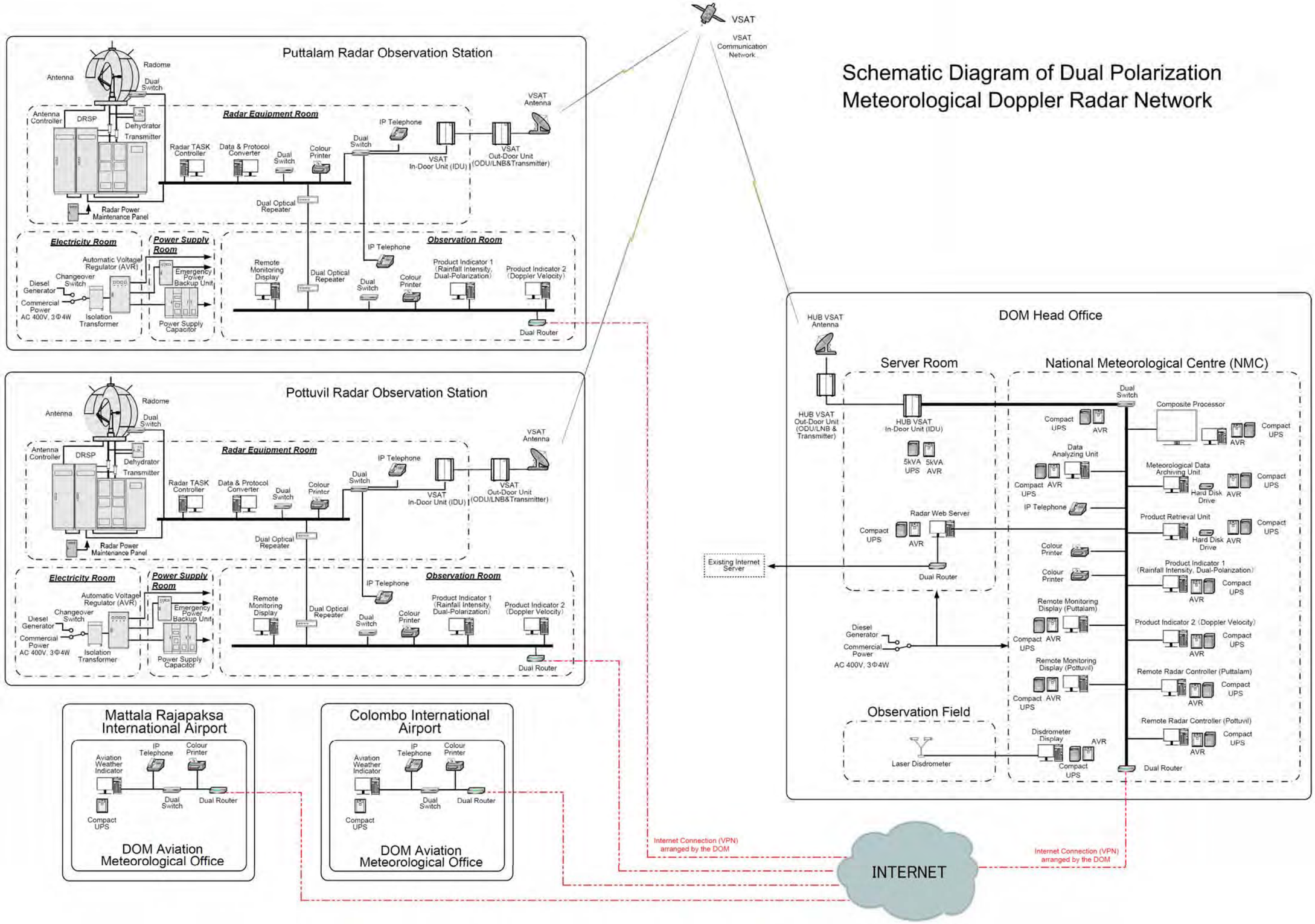


Figure 12: Schematic Diagram of Meteorological Radar Observation Network in Sri Lanka

(2) Major Equipment List

As a consequence of the basic design study, the major components of the Project are described below.

Table 21: Main Equipment Components

Component	DOM Puttalam Observatory (Puttalam Radar Observation Station)	DOM Pottuvil Observatory (Pottuvil Radar Observation Station)	National Meteorological Centre (NMC) at DOM Head Office	DOM Aviation Meteorological Office in the Colombo International Airport	DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport
Procurement and Installation of Equipment					
C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar System including Isolation Transformer, Power Supply Capacitor, Power Back-up System, Lightning System Measuring Equipment and Spare Parts	1	1	-	-	-
Meteorological Radar Central Processing System	-	-	1	-	-
Meteorological Radar Data Display System	1	1	1	1	1
Meteorological Data Satellite Communication System	1	1	1	-	-

Major Equipment List

C-Band Pulse Compression Solid State Dual Polarization Meteorological Doppler Radar System

Name of Site: Puttalam Radar Observation Station		
Equipment	Quantity	Purpose
Radome	1 set	To protect the radar antenna assembly (a parabolic dish reflector) and the maintenance personnel from severe weather conditions and lightning strikes.
Antenna	1 set	To radiate radar beam into the atmosphere and receive scatter waves while rotating the parabola antenna in azimuth and elevation direction.
Antenna Controller	1 set	To rotate the parabolic dish reflector and to control the antenna in azimuth and elevation by both horizontal and vertical drive motor units.
Transmitter	1 set	To amplify pulse-modulated power with stable frequency and transmit the power to the antenna.
Digital Receiver and Signal Processor (DRSP)	1 set	To receive pulse compression and processing echo signal from the Antenna. To suppress unnecessary echo such as clutter signals reflected from the ground. For sending ingest data to the radar TASK controller.
Dehydrator	1 set	To supply dried and pressurized air into the wave-guide to reduce wave propagation loss.
Wave-guide Configuration	1 set	For the feeder line propagation of the wave traveling between the antenna and TX/RX.
Radar TASK Controller	1 set	To operate the radar system, monitor the condition of the radar system and generate raw product data. Control and monitoring items: Radiate control/status, Azimuth/elevation position control/status, TX standby status, Pulse width control/status and Antenna local/maintenance mode status.
Data & Protocol Converter	1 set	To send raw data to the central system according to specified intervals.
Radar Power Maintenance Panel	1 set	To distribute and supply AC power to the radar system.
Dual Switch	2 sets	To supply back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure.
Color Printer	1 set	To print radar image.

Dual Optical Repeater		1 set	To convert electrical signal and optical signal on LAN for protection against surges.
Isolation Transformer		1 set	To protect each equipment from surges in voltage in the main power.
Automatic Voltage Regulator (AVR)		1 set	To supply constant or regulated voltage to the radar system.
Power Supply Capacitor		1 set	To supply uninterrupted power by Electric Dual Layer Capacitor energy to the radar system when power failure occurs.
Polarimetric Test Horn Device		1 set	For the maintenance of the system.
Spectrum Analyzer		1 set	
Test signal Generator		1 set	
Power Meter		1 set	
Power Sensor		1 set	
Frequency Counter		1 set	
Detector		1 set	
Attenuator Set		1 set	
Terminator for Detector		1 set	
Oscilloscope		1 set	
Digital Multimeter		1 set	
CW Converter		1 set	
Portable Power Supply Unit		1 set	
Network Camera		1 set	
Tool Kit		1 set	
Extension Cable		1 set	
Leveler		1 set	
Step Ladder		1 set	
Clump Current Meter		1 set	
Vacuum Cleaner		1 set	
Radar Antenna Maintenance Deck		1 set	
Spare Parts	Timing belt for antenna (for azimuth drive)	1 set	For the maintenance of the system.
	Timing belt for antenna (for elevation drive)	1 set	
	Encoder for antenna (for azimuth angle signal)	1 set	
	Encoder for antenna (for elevation angle signal)	1 set	
	Motor for antenna (for azimuth drive)	1 set	
	Motor for antenna (for elevation drive)	1 set	
	Servo unit for antenna controller (for azimuth drive)	1 set	
	Servo unit for antenna controller (for elevation drive)	1 set	
	Power supply unit for antenna controller	1 set	
	Power supply unit for transmitter	1 set	
	Power supply unit for digital receiver and signal processor	1 set	
	Solid-state power amplifier	1 set	
	Fan unit for radar equipment	2 sets	
	LAN Arrester	2 sets	
	Obstruction light	2 sets	
Consumables	Grease with pump and oil with jug for antenna	1 set	For the maintenance of the system.
	Antenna carbon brush for power	1 set	
	Antenna carbon brush for signal	1 set	
Service Manuals		2 sets	For the maintenance of the system.

C-Band Pulse Compression Solid State Dual Polarization Meteorological Doppler Radar System

Name of Site: Pottuvil Radar Observation Station			
Equipment		Quantity	Purpose
Radome		1 set	To protect the radar antenna assembly (a parabolic dish reflector) and the maintenance personnel from severe weather conditions and lightning strikes.
Antenna		1 set	To radiate radar beam into the atmosphere and receiving scatter waves while rotating the parabola antenna in azimuth and elevation direction.
Antenna Controller		1 set	To rotate the parabolic dish reflector and for controlling the antenna in azimuth and elevation by both horizontal and vertical drive motor units.
Transmitter		1 set	To amplify pulse-modulated power with stable frequency and transmitting the power to the antenna.
Digital Receiver and Signal Processor (DRSP)		1 set	To receive pulse compression and processing echo signal from the Antenna. To suppress unnecessary echo such as clutter signals reflected from the ground. For sending ingest data to the radar TASK controller.
Dehydrator		1 set	To supply dried and pressurized air into the wave-guide to reduce wave propagation loss.
Wave-guide Configuration		1 set	For the feeder line propagation of the wave traveling between the antenna and TX/RX.
Radar TASK Controller		1 set	To operate the radar system, monitor the condition of the radar system and generate raw product data. Control and monitoring items: Radiate control/status, Azimuth/elevation position control/status, TX standby status, Pulse width control/status and Antenna local/maintenance mode status.
Data & Protocol Converter		1 set	To send raw data to the central system according to specified intervals.
Radar Power Maintenance Panel		1 set	To distribute and supply AC power to the radar system.
Dual Switch		2 sets	To supply back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure.
Color Printer		1 set	To print radar image.
Dual Optical Repeater		1 set	To convert electrical signal and optical signal on LAN for protection against surges.
Isolation Transformer		1 set	To protect each equipment from surges in voltage in the main power.
Automatic Voltage Regulator (AVR)		1 set	To supply constant or regulated voltage to the radar system.
Power Supply Capacitor		1 set	To supply uninterrupted power by Electric Dual Layer Capacitor energy to the radar system when power failure occurs.
Polarimetric Test Horn Device		1 set	For the maintenance of the system.
Spectrum Analyzer		1 set	
Test signal Generator		1 set	
Power Meter		1 set	
Power Sensor		1 set	
Frequency Counter		1 set	
Detector		1 set	
Attenuator Set		1 set	
Terminator for Detector		1 set	
Oscilloscope		1 set	
Digital Multimeter		1 set	
CW Converter		1 set	
Portable Power Supply Unit		1 set	
Network Camera		1 set	
Tool Kit		1 set	
Extension Cable		1 set	
Leveler		1 set	
Step Ladder		1 set	
Clump Current Meter		1 set	
Vacuum Cleaner		1 set	
Radar Antenna Maintenance Deck		1 set	
Spare Parts	Timing belt for antenna (for azimuth drive)	1 set	For the maintenance of the system.
	Timing belt for antenna (for elevation drive)	1 set	
	Encoder for antenna (for azimuth angle signal)	1 set	

	Encoder for antenna (for elevation angle signal)	1 set	
	Motor for antenna (for azimuth drive)	1 set	
	Motor for antenna (for elevation drive)	1 set	
	Servo unit for antenna controller (for azimuth drive)	1 set	
	Servo unit for antenna controller (for elevation drive)	1 set	
	Power supply unit for antenna controller	1 set	
	Power supply unit for transmitter	1 set	
	Power supply unit for digital receiver and signal processor	1 set	
	Solid-state power amplifier	1 set	
	Fan unit for radar equipment	2 sets	
	LAN Arrester	2 sets	
	Obstruction light	2 sets	
Consumables	Grease with pump and oil with jug for antenna	1 set	For the maintenance of the system.
	Antenna carbon brush for power	1 set	
	Antenna carbon brush for signal	1 set	
Service Manuals		2 sets	For the maintenance of the system.

Meteorological Radar Central Processing System

Name of Site: National Meteorological Centre (NMC) at DOM Head Office			
Equipment		Quantity	Purpose
Composite Processor		1 set	To generate composite pictures from incoming data of all the radar stations.
Meteorological Data Archiving Unit		1 set	To store radar and weather information to a selected media.
Product Retrieval Unit		1 set	To retrieve and display radar data.
Remote Radar Controller		2 sets	To control radar observation
Remote Monitoring Display		2 sets	To monitor the radar tower building and radar system
Radar Web Server		1 set	To output radar product to the Web.
Colour Printer		2 sets	To print radar image.
IP Telephone		1 set	For voice communication through the IP network.
Dual Switch		1 set	To connect all the computer equipment with LAN.
Dual Router		2 sets	To forward data packets between computer networks.
Automatic Voltage Regulator (AVR)		10 sets	To supply constant or regulated voltage to the radar system.
Compact UPS		10 sets	To supply back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure.
Diesel Engine Generator		1 set	To supply AC power to equipment in case of power failure.
Laser Disdrometer		1 set	For the maintenance of the system.
Spare Parts	LAN Arrester	8 sets	For the maintenance of the system.
Service Manuals		2 sets	For the maintenance of the system.

Meteorological Radar Data Display System

Name of Site: Puttalam Radar Observation Station			
Equipment		Quantity	Purpose
Product Indicator 1 (Rainfall Intensity, Dual-Polarization)		1 set	To generate radar products (Rainfall Intensity, Dual-Polarization) from observed radar data and displaying.
Product Indicator 2 (Doppler Velocity)		1 set	To generate radar products (Doppler Velocity) from observed radar data and displaying.
Colour Printer		1 set	To print radar image.
Dual Switch		1 set	To connect all the computer equipment with LAN.
Dual Optical Repeater		1 set	To convert electrical signal and optical signal on LAN for surge protection.
Dual Router		1 set	To forward data packets between computer networks.
Remote Monitoring Display		1 set	To monitor the radar tower building and radar system
IP Telephone		2 sets	For voice communication through the IP network.
Spare Parts	LAN Arrester	3 sets	For the maintenance of the system.

Service Manuals	2 sets	For the maintenance of the system.

Meteorological Radar Data Display System

Name of Site: Pottuvil Radar Observation Station		
Equipment	Quantity	Purpose
Product Indicator 1 (Rainfall Intensity, Dual-Polarization)	1 set	To generate radar products (Rainfall Intensity, Dual-Polarization) from observed radar data and displaying.
Product Indicator 2 (Doppler Velocity)	1 set	To generate radar products (Doppler Velocity) from observed radar data and displaying.
Colour Printer	1 set	To print radar image.
Dual Switch	1 set	To connect all the computer equipment with LAN.
Dual Optical Repeater	1 set	To convert electrical signal and optical signal on LAN for surge protection.
Dual Router	1 set	To forward data packets between computer networks.
Remote Monitoring Display	1 set	To monitor the radar tower building and radar system
IP Telephone	2 sets	For voice communication through the IP network.
Spare Parts LAN Arrester	3 sets	For the maintenance of the system.
Service Manuals	2 sets	For the maintenance of the system.

Meteorological Radar Data Display System

Name of Site: National Meteorological Centre (NMC) at DOM Head Office		
Equipment	Quantity	Purpose
Product Indicator 1 (Rainfall Intensity, Dual-Polarization)	1 set	To generate radar products (Rainfall Intensity, Dual-Polarization) from observed radar data and displaying.
Product Indicator 2 (Doppler Velocity)	1 set	To generate radar products (Doppler Velocity) from observed radar data and displaying.
Data Analyzing Unit	1 set	To analyze weather phenomena from observed radar data.
Automatic Voltage Regulator (AVR)	3 sets	To supply constant or regulated voltage to the radar system.
Compact UPS	3 sets	To supply back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure.
Spare Parts LAN Arrester	3 sets	For the maintenance of the system.
Service Manuals	2 sets	For the maintenance of the system.

Meteorological Radar Data Display System

Name of Site: DOM Aviation Meteorological Office in the Colombo International Airport		
Equipment	Quantity	Purpose
Aviation Weather Indicator	1 set	To monitor aviation weather by using various radar products.
Colour Printer	1 set	To print radar image.
IP Telephone	1 set	For voice communication through the IP network.
Dual Switch	1 set	To connect all the computer equipment with LAN.
Dual Router	1 set	To forward data packets between computer networks.
Compact UPS	1 set	To supply back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure.
Spare Parts LAN Arrester	1 set	For the maintenance of the system.
Service Manuals	2 sets	For the maintenance of the system.

Meteorological Radar Data Display System

Name of Site: DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport		
Equipment	Quantity	Purpose
Aviation Weather Indicator	1 set	To monitor aviation weather by using various radar products.
Colour Printer	1 set	To print radar image.
IP Telephone	1 set	For voice communication through the IP network.
Dual Switch	1 set	For connecting all the computer equipment with LAN.
Dual Router	1 set	To forward data packets between computer networks.
Compact UPS	1 set	To supply back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure.
Spare Parts LAN Arrester	1 set	For the maintenance of the system.
Service Manuals	2 sets	For the maintenance of the system.

Meteorological Data Satellite Communication System

Name of Site: Puttalam Radar Observation Station			
Equipment		Quantity	Purpose
VSAT Out-door Unit (ODU/Transmitter)		1 set	Transmitter for radar data transmission via satellite.
VSAT Out-door Unit (ODU/LNB)		1 set	Receiver for radar data transmission via satellite.
VSAT Antenna		1 set	Antenna for radar data transmission via satellite.
VSAT In-Door Unit (IDU)		1 set	Modulator/Demodulator for radar data transmission via satellite.
Arrester Box		1 set	To protect the VSAT equipment from lighting strikes.
Emergency Power Backup Unit		1 set	To supply back-up AC power to the VSAT equipment for uninterrupted or continued VoIP communication to the Head Office in case of power failure.
Dual Switch		1 set	For connecting all the computer equipment with LAN.
Maintenance Terminal		1 set	For the maintenance of the system.
Directional Coupler		1 set	
Spare Parts	Arrester Terminal Set	1 set	For the maintenance of the system.
Service Manuals		2 sets	For the maintenance of the system.

Meteorological Data Satellite Communication System

Name of Site: Pottuvil Radar Observation Station			
Equipment		Quantity	Purpose
VSAT Out-door Unit (ODU/Transmitter)		1 set	Transmitter for radar data transmission via satellite.
VSAT Out-door Unit (ODU/LNB)		1 set	Receiver for radar data transmission via satellite.
VSAT Antenna		1 set	Antenna for radar data transmission via satellite.
VSAT In-Door Unit (IDU)		1 set	Modulator/Demodulator for radar data transmission via satellite.
Arrester Box		1 set	To protect the VSAT equipment from lighting strikes.
Emergency Power Backup Unit		1 set	To supply back-up AC power to the VSAT equipment for uninterrupted or continued VoIP communication to the Head Office in case of power failure.
Dual Switch		1 set	For connecting all the computer equipment with LAN.
Maintenance Terminal		1 set	For the maintenance of the system.
Directional Coupler		1 set	
Spare Parts	Arrester Terminal Set	1 set	For the maintenance of the system.
Service Manuals		2 sets	For the maintenance of the system.

Meteorological Data Satellite Communication System

Name of Site: National Meteorological Centre (NMC) at DOM Head Office			
Equipment		Quantity	Purpose
HUB VSAT Out-door Unit (ODU/Transmitter)		1 set	Transmitter for radar data transmission via satellite.
HUB VSAT Out-door Unit (ODU/LNB)		1 set	Receiver for radar data transmission via satellite.
HUB VSAT Antenna		1 set	Antenna for radar data transmission via satellite.
HUB VSAT In-Door Unit (IDU)		1 set	Modulator/Demodulator for radar data transmission via satellite.
Arrester Box		1 set	To protect the VSAT equipment from lighting strikes.
5kVA UPS		1 set	To supply uninterrupted power to VSAT system in case of power failure.
5kVA Automatic Voltage Regulator (AVR)		1 set	To supply constant or regulated voltage to the system.
Spectrum Analyzer		1 set	For the maintenance of the system.
Maintenance Terminal		1 set	
Power Meter		1 set	
Power Sensor		1 set	
Frequency Counter		1 set	
Directional Coupler		1 set	
Spare Units	Transmitter	1 set	For the maintenance of the system.
	LNB	1 set	
	Modem (for HUB IDU)	1 set	
	Modem (for VSAT IDU)	1 set	
	Arrester Terminal Set	1 set	
	Battery (for 5kVA UPS)	1 set	
Service Manuals		2 sets	For the maintenance of the system.

(3) Basic Plan of the Facility

1) Site and Facility Layout Plan

The outline and current situation of the existing infrastructures in the proposed Meteorological Radar Observation Stations are as follows.

Table 22: Outline and Current Situation of Existing Infrastructures at the Proposed Project Sites for the Establishment of Meteorological Radar Observation Stations

	DOM Puttalam Observatory (Puttalam Radar Observation Station)	DOM Pottuvil Observatory (Pottuvil Radar Observation Station)
Site Picture		
Latitude (N) Longitude (E)	N08º 01'37.47" E79º 50'28.67"	N06º 51'38.61" E81º 49'57.52"
Altitude	5m	4m
Site Status	DOM Puttalam Observatory	DOM Pottuvil Observatory
Area of Property (inside the existing fence/boundary wall)	10,148.61m^2	4,257.67m^2
Space availability for the construction of the proposed radar tower building	Enough space is available	Enough space is available
Height of the existing observation building	4m	9m
Access Road	Poses no problem for the construction of the proposed radar tower building.	Poses no problem for the construction of the proposed radar tower building.
Description/Outline of the Premises	Land cleared and leveled	Land cleared and leveled
Commercial Power	415V, 3-phase 4-wire, 50Hz	415V, 3-phase 4-wire, 50Hz
Water Supply	Public Water Supply	Public Water Supply
Waste water and Sewage	Septic tank and seepage pit are required	Septic tank and seepage pit are required
Telephone	Available	Available
Internet Connection	Available (Mobile Telephone Network)	Available (Mobile Telephone Network)
Mobile phone in the property area	Service is available	Service is available

2) Architectural Design

[1] Floor Plan

The floor plan is virtually symmetrical, making possible a structural design that is safe and avoids any kind of eccentricity. The floor plan for the central portion of the radar tower building allows the various rooms to be arranged with great flexibility, since there are no obstructing structures such as columns and beams protruding into the internal staircase (which will also serve as an evacuation route). Construction methods and materials follow local practice and the building is of standard grade in Sri Lanka.

The floor area of each room, the number of working staff, the room's function and the method of calculation of the size of each room are presented in the following tables.

Table 23: Calculation Base of Each Room in the Proposed Meteorological Radar Tower Buildings

Name of Room	Puttalam Meteorological Radar Tower Building Floor Area (m^2)	Pottuvil Meteorological Radar Tower Building Floor Area (m^2)	Room Function	Calculation Base
Radome Room	30.19	30.19	Installation space for radar antenna apparatus.	Maintenance space for radar antenna apparatus. Room area depends upon radome base of 6.2m in diameter.
Radar Equipment Room (including Spare Parts Storage)	81.82	81.82	Installation space for antenna controller, transmitter, solid state power amplifier, digital receiver, signal processor, dehydrator, wave-guide configuration, radar task controller, power distribution box, optical repeater, compact link transmitter/receiver, maintenance box, maintenance cabinet, measuring instrument cabinet, air-conditioning units, etc.	Operation and maintenance space for all the apparatuses described in the left column. For installation of all the required equipment, at least $77m^2$ is required.
Observation Room	112.79	112.79	For the following equipment and furniture. • weather observation terminals • data analysis terminal, • VoIP exchange • optical repeater • dual switch • printer • IP telephone • UPS for PCs • desk for the terminal • filing cabinets • white board • data storage cabinets for keeping observation records and observed data of the radar system for analysis • cabinets for maintenance instruments and operation & maintenance manuals	• Radar observation space • Installation space for all the equipment described in the left column • Space for data analysis terminal, desk and data storage cabinets • Working space • Space for keeping all data secured • Space for maintenance instruments, measuring equipment • Space for spare parts and consumables of the equipment
Electricity & Power Supply Room	49.24	49.24	For isolation transformers, power distribution boards, cable rack, test terminals, AVR, etc. For radar power back-up unit and control rack.	Installation, operation and maintenance space and cabling space for all the apparatuses described in the left column.
Maintenance Room	12.55	12.55	For maintenance of the equipment.	Maintenance space for various type of the equipment.
Toilet & SK	15.09	15.09	European Style Commode: M1+F1, Wash Basin: M1+F1, Urinal: 1, Slop Sink: 1	—
Tea Kitchen	10.68	10.68	Kitchen: 1	—
Changing Room	2.62	2.62	Changing space for taking shower	—
Shower Room	3.25	3.25	Space for taking shower	—

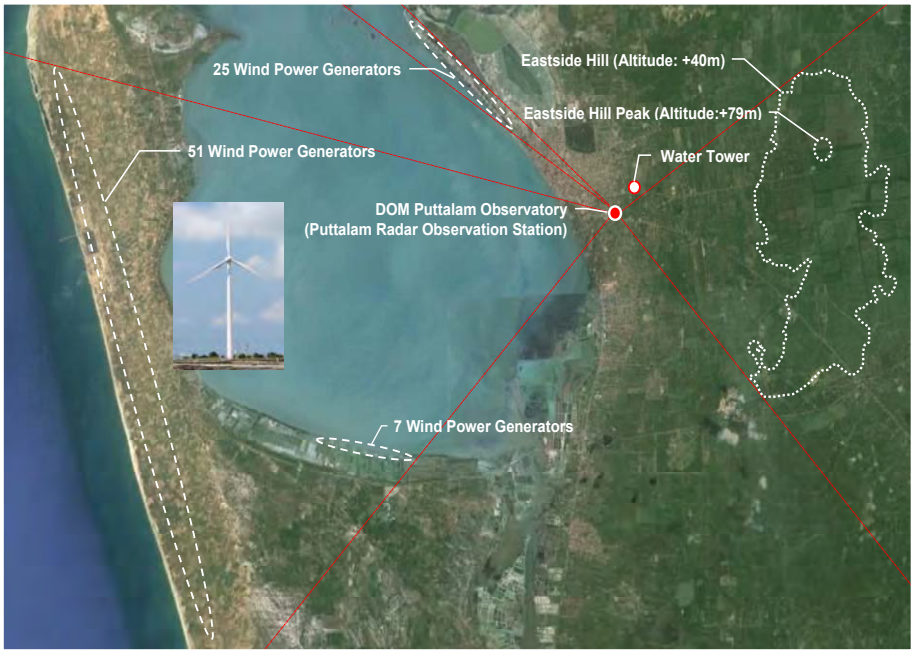
Storage 1	5.13	5.13	Storage space for spare materials and miscellaneous goods.	—
Storage 2	3.13	7.18	Storage space for spare materials and miscellaneous goods.	—
Storage 3	2.54	2.54	Storage space for spare materials and miscellaneous goods.	—
Storage 4	5.91	5.91	Storage space for spare materials and miscellaneous goods.	—
Engine Generator Room	51.67	62.30	Operation and maintenance space for 75kVA engine generators: 2, oil tank & oil pump: 1, automatic change-over switch, etc.	Installation, operation and maintenance space and cabling space for all the apparatuses described in the left column.
Oil Storage	12.51	12.73	Oil pumps: 2	For space of oil storage: approx. 12 m^2 is required.
Pump Room	14.08	12.16	Pump for water reservoir tank: 1 Well pumps: 2	For maintenance space and installation space for pumps: approx. 12 m^2 is required.
Security Office	8.61	8.42	Working space for security guard.	Working space for 1 security personnel.
Toilet & Shower Room	4.89	5.51	Local Style Commode: 1 Wash Basin: 1 Space for taking shower	—

[2] Sectional Plan

I. Height of the Radar Tower Buildings

- Proposed Puttalam Meteorological Radar Tower Building

The required radar antenna center height for the proposed radar system in the Puttalam Meteorological Radar Observation Station is at least 45m. In case that the radar antenna center height is 45m and the radar beam angle is 0.5 degree, it is expected that the radar beam bottom line will probably not come into contact with the top of the water tower.



Satellite Picture of the Surrounding Area of the DOM Puttalam Observatory

Picture Source: Google

In addition, several telecommunication steel towers which are unsurpassable and unavoidable

obstructions for radar observation can be found in Puttalam. Since these telecommunication steel towers are not completely solid structures, they are not considered major obstructions for radar observation.

The Lakvijaya Power Station located approximately 13.4km west (265°) of the DOM Puttalam Observatory and also there are several Wind Power Generators and the Eastside Hill located approximately 5km east of the DOM Puttalam Observatory, as indicated in the above satellite picture, which are unfortunately unsurpassable and unavoidable obstructions for radar observation and cannot be included in the required radar antenna center height planning.

It is technically possible to complement the shadow areas created by the identified obstructions in the radar detection range as indicated in the following table with the CAPPI (Constant Altitude PPI (Plan Position Indicator)) data. It is unfortunately an inescapable fact that the radar observation range will become shorter due to the higher elevation angle of the radar antenna to eliminate the shadow areas caused by the above identified obstructions.

Table 24: Existing Obstructive Facility to the Radar Observations in Puttalam (as of March, 2016)

Location Map No.	**1**	
Name of Facility	Water Tower	
Picture	 	
Number of Stories	16	
Height	Approx. 35m	
Latitude(N) Longitude(E)	N08º 01'56.55" E79º 50'45.88"	
Altitude	Approx. 15m	
Distance from the DOM Puttalam Observatory	Approx. 0.83km	
Direction from the DOM Puttalam Observatory	Approx. 42º	
Approximate ground level difference	Approx. 15m-5m= 10m Ground level is 10m m higher than the DOM Puttalam Observatory	
Name of Obstruction	Eastside Hill	25 Wind Power Generators
Height	-	90m at the blade top
Altitude	Approx. 79m (Peak)	Approx. 1m
Distance from the DOM Puttalam Observatory	Approx. 5km	Approx. 3.7km-6.9km
Direction from the DOM Puttalam Observatory	Approx. 57º-137º (GL+40m)	Approx. 307º-310º
Approximate ground level difference	Approx. 79m (Peak) -5m= 74m Ground level is 74m higher than the DOM Puttalam Observatory	Approx. 1m-5m= -4m Ground level is 4m lower than the DOM Puttalam Observatory
Name of Obstruction	7 Wind Power Generators	51 Wind Power Generators
Height	Approx. 90m at the blade top	Approx. 90m at the blade top
Altitude	Approx. 1m	Approx. 7m
Distance from the DOM Puttalam Observatory	Approx. 7.7km-8.8km	Approx. 13.7km-14.4km
Direction from the DOM Puttalam Observatory	Approx. 225º-235º	Approx. 228º-281º
Approximate ground level difference	Approx. 1m-5m= -4m Ground level is 4m lower than the DOM Puttalam Observatory	Approx. 7m-5m= 2m Ground level is 2m higher than the DOM Puttalam Observatory

As a result of the discussions with the Puttalam Urban Council as of March 2016, it was confirmed that, excluding Government projects, the building height restriction in Puttalam is 30m. It was also confirmed that

there are no existing plans to construct a high rise building, which will become an unavoidable obstruction for radar observation, around the DOM Puttalam Observatory (Puttalam Radar Observation Station).

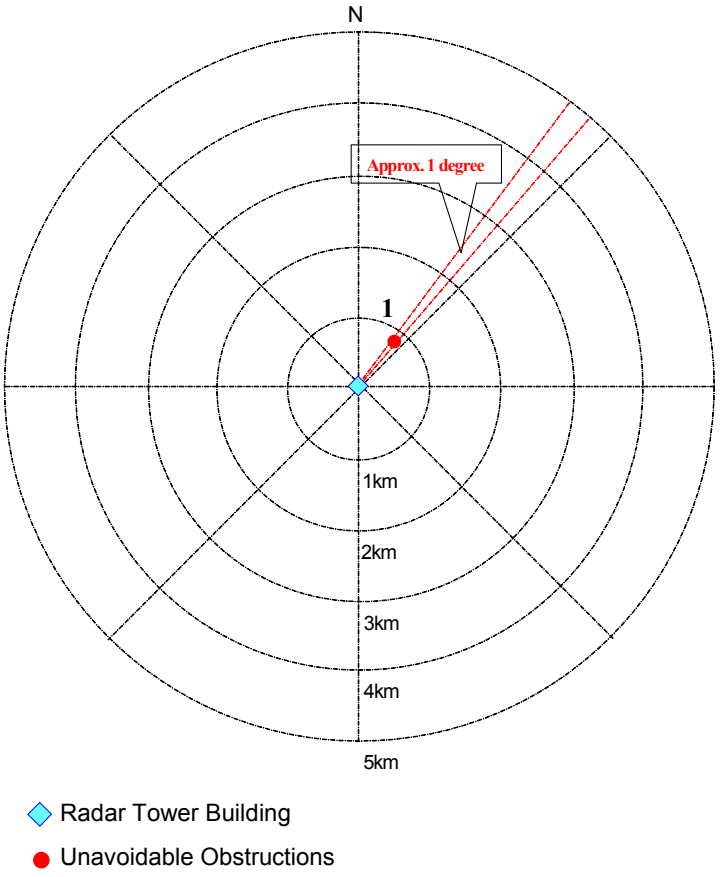
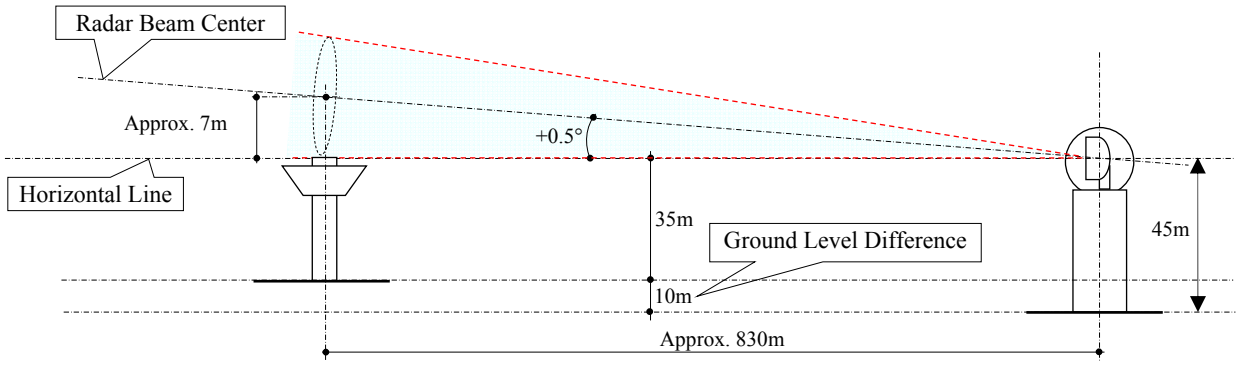


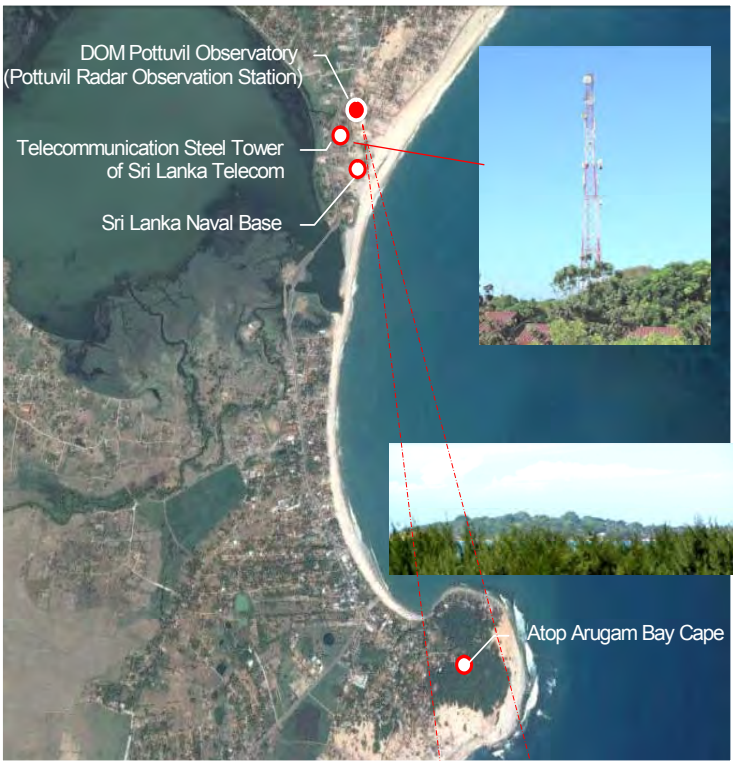
Figure 13: Location Map of the Existing Obstructions around the Puttalam Observatory



- Proposed Pottuvil Meteorological Radar Tower Building

There is a 70m high telecommunication steel tower owned by Sri Lanka Telecom approximately 160m south of the DOM Pottuvil Observatory (Pottuvil Radar Observation Station). In addition, several

telecommunication steel towers which are unsurpassable and unavoidable obstructions for radar observation can be found in Pottuvil. Since these telecommunication steel towers are not completely solid structures, they are not considered major obstructions in radar observation. Furthermore, in the Sri Lanka Naval Base in Pottuvil, an X band marine radar system is in routine operation. It was confirmed that its frequency is completely different from the proposed Meteorological Radar System; as such, this is no damaging issue for both radar systems. In terms of radar observation, the Arugam Bay Cape is an unsurpassable and unavoidable obstruction, as its altitude is approximately 25m higher than the DOM Pottuvil Observatory and there are approximately 20 m high tropical rainforests on the cape.

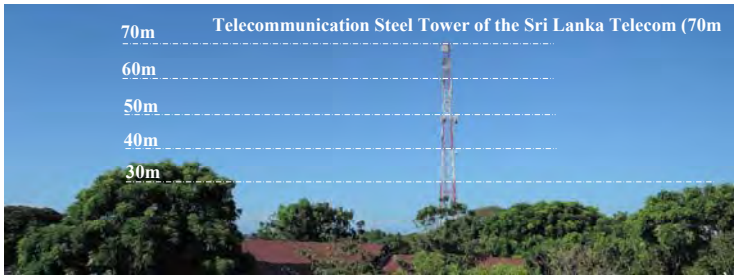


Satellite Picture of Surrounding Area of the DOM Pottuvil Observatory

Picture Source: Google

Around the DOM Pottuvil Observatory, approximately 20-35m high tropical rainforests may be found in the city. Therefore the consideration of the heights of these rainforests should be included in the planning.

As such, the required radar antenna center height of the proposed radar system in the Pottuvil Meteorological Radar Observation Station should be at least 40m. In case that the radar antenna center height is 40m and the radar beam angle is 0.5 degree, a part of the radar beam slightly come into contact with the tropical rainforests atop Arugam Bay Cape as indicated in the following figure. However, it is not a serious issue as the Arugam Bay Cape is located in the Southside of the DOM Pottuvil Observatory, which is not a very significant radar observation area for meteorological observation.



It is technically possible to complement the shadow areas created by the identified obstructions in the radar detection range as indicated in the following table with the CAPPI (Constant Altitude PPI (Plan Position Indicator)) data. It is unfortunately an inescapable fact that the radar observation range will become shorter due to the higher elevation angle of the radar antenna to eliminate the shadow areas

caused by the above identified obstructions.

Table 25: Existing Obstructive Facilities to the Radar Observation in Pottuvil (as of March, 2016)

Location Map No.	1	2
Name of Obstruction	Telecommunication Steel Tower of the Sri Lanka Telecom (70m high)	Arugam Bay Cape
Latitude (N) Longitude (E)	N06º 51'33.42" E81º 49'56.12"	N06º 50'15.25" E81º 50'14.31"
Altitude (DOM Pottuvil Observatory: 4m)	Approx. 5m	Approx. 29m
Distance from the DOM Pottuvil Observatory	Approx. 0.16km	Approx. 2.57km
Direction from the DOM Pottuvil Observatory	Approx. 195º	Approx. 169º
Details	• Mobile Phone Communication: 800MHz, 900MH, 1.8GHz, 2.4GHz Band • Naval Radio Communication: 30MHz-300MHz Band	

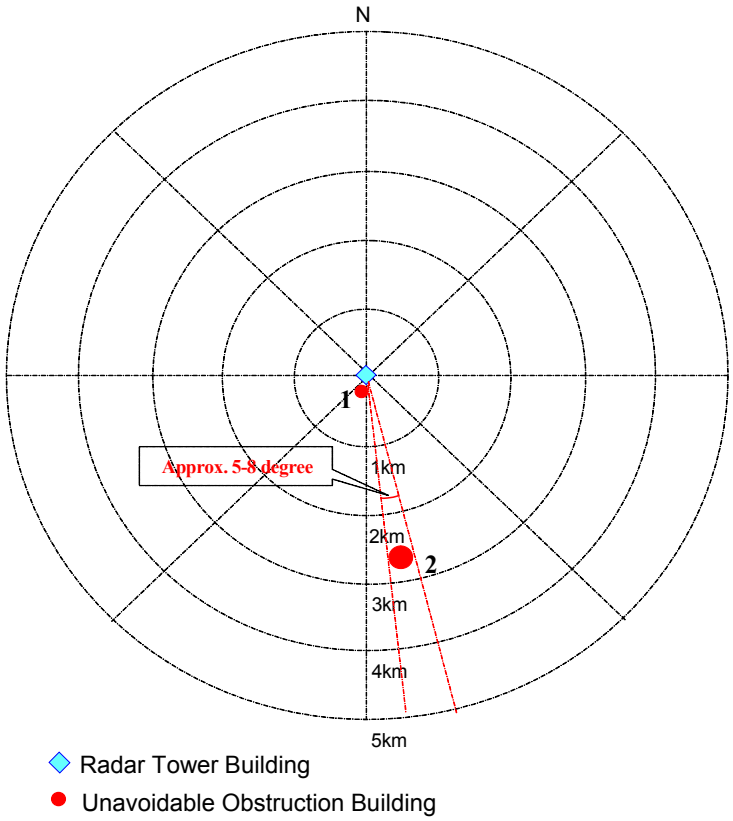
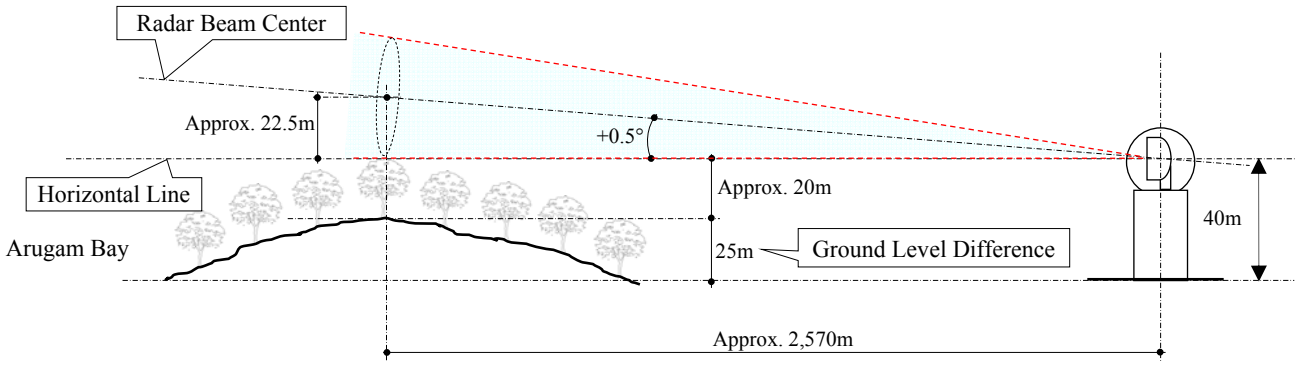


Figure 14: Location Map of the Existing Obstructions around the Pottuvil Observatory



As a result of the discussions with the Pottuvil Divisional Council as of March 2016, it was confirmed that there are no plans to construct a high rise building, which will become an unavoidable obstruction for radar observation, around the DOM Pottuvil Observatory (Pottuvil Radar Observation Station).

II. Ground Level

During the course of the topographic survey work at the project sites, a benchmark was identified to be the reference ground level. Such reference will be used for the construction of the radar tower buildings.

III. Equipment Installation

In order to install all the equipment inside the radar equipment room, a large opening would be needed to allow equipment ingress. However, the large opening would be undesirable from the standpoint of air-tightness and dust proofing. The equipment will, therefore, be brought in via a loading balcony through the adjacent staircase room. For lifting the equipment, a lifting hook with a capacity of 2-tons will be installed on the upper part of this balcony.

[3] Elevation Plan

The structural columns and beams will extend outside the buildings, enhancing the building design. Given that the columns and beams will not intrude into the staircase, the staircase will be able to comfortably handle traffic in both directions.

[4] Internal and External Finishing Plan

I. Finishing of Major Rooms (Radar Equipment Room and Observation Room)

a) Floor

The radar equipment room and the observation room will have an access floor with a clearance of 150mm for easy wiring of power and signal cables, trouble-free maintenance and simple future expansion. An anti-static, heavy-duty access floor has been selected for the radar equipment room in which a high power radar transmitter weighing about 1 ton would be installed.

b) External Walls

To combat the effects of local temperature and humidity, the external walls of the radar equipment room are designed as cavity walls with a glass wool or urethane foam sandwiched in between for heat insulation. Because of the thermal insulation provided by the building design, the recurrent cost to the

DOM for air-conditioning systems will be minimized.

c) Ceiling

The radar equipment cable rack, which is located in the radar equipment room and the observation room (the major rooms in the proposed radar tower buildings), must be protected against dust. In addition, so as to improve the air tightness of these rooms and to reduce equipment noise, the ceilings will be finished with acoustic boards. Since both of these rooms are to be air-conditioned, the use of ceiling boards will also improve the efficiency of air-conditioning.

d) Window

The sustained wind pressures of the Radar Tower Buildings are as follows. A laminated glass with reinforced film will be used. In order to ensure double protection from wind and rain water entering into the room, two aluminum windows will be individually installed inside and outside.

- Puttalam Meteorological Radar Tower Building: 4,300N/m^2 (Height of windows of the Radar Observation Room from the ground level: approx. 31m)
- Pottuvil Meteorological Radar Tower Building: 4,245N/m^2 (Height of windows of the Radar Observation Room from the ground level: approx. 27m)

II. Material Plan

Materials specified for both the exterior and interior finishing, which are all available locally, have been selected with a view to ease maintenance for the DOM and are stated as follows.

Table 26: Finishing Materials of the Proposed Meteorological Radar Tower Buildings

		Finishing Materials
Exterior Finishing	**Observation Deck**	Cement sand mortal base, Asphalt waterproofing, Insulation, Protection concrete
	Roof Floor	Cement sand mortal base, Asphalt waterproofing, Insulation, Protection concrete
	Walls	Concrete blocks Cement sand mortar base, Spray tile finish
Interior Finishing	**Floors**	Carpet tiles Vinyl tiles Porcelain tiles Cement sand mortal base, Epoxy resin paint finish
	Skirtings	Wooden skirting, Synthetic resin oil paint finish Cement sand mortar, Vinyl paint finish Cement sand mortar, Epoxy resin paint finish Porcelain tiles
	Walls	Cement sand mortal base, Vinyl paint finish Glazed ceramic tiles Glass wool with glass cloth
	Ceilings	Acoustic panels (Grid ceiling system) Cement board (Grid ceiling system) Cement sand mortar base Emulsion paint finish Glass wool with glass cloth
Window and Door	**Exterior**	Aluminum windows Aluminum grilles Aluminum doors Stainless Steel doors

	Interior	Aluminum doors, Steel doors, Wooden doors

Table 27: Bases for Adoption of Materials of the Proposed Meteorological Radar Tower Buildings

		Bases for adoption of materials	Procurement
Exterior Finishing	**Roof Floor**	Since external temperatures are high (reaching over 35 degrees), an insulation board t=30mm will be required. Asphalt waterproofing is the most reliable waterproofing material to be protected by protection concrete, cement sand mortal and cement tiles.	To be procured locally
	Walls	Reinforced concrete blocks or bricks will be applied. Concrete blocks or bricks are generally used locally and are considered highly reliable in terms of both ease and accuracy of construction.	
Interior Finishing	**Floors**	Materials will be selected on the basis of superior durability and ease of maintenance. Vinyl tiles around offices, corridors and staircases will be applied. In rooms where dust must be avoided, a dust-proof paint finish will be specified.	
		In the offices where computer systems will be installed, access floors shall be applied for cabling under the floor.	
	Walls	Cement sand mortal (trowel-coated) will be applied primarily for its durability, and vinyl paint will be applied to avoid dirt. Glazed ceramic tiles will be laid in the toilets and the slop sink booth.	
	Ceilings	In order to enhance the environment and efficiency of air-conditioning, non-asbestos acoustic mineral boards will be used. Other rooms which will not require any ceiling board will be directly applied with emulsion paint finish on the cement and sand mortal.	
Window and Door	**Exterior**	Aluminum and stainless steel will be chosen all throughout for reasons of durability, ease of handling and accuracy.	
	Interior	Wooden and steel with synthetic oil resin paint will be employed all throughout for its handling ease during construction and from a maintenance standpoint.	

[5] Structural Plan

I. Structural Design Standard

In order to formulate and develop the structural design of the proposed radar tower buildings, the Sri Lanka National Building Code is mainly applied with the Building Standard Law of Japan, the Standard of Architectural Institute of Japan (AIJ) and the Uniform Building Code (UBC) of the USA used as references, if so required.

II. Soil Condition and Foundation Plan

To ensure radar observation accuracy, building robustness is important and the permissible horizontal deflection of the building must not be more than 1/1000 of the height of radar tower building. Due to this, the foundation structures must prevent the building differential settlement. The bearing layer and foundation of the Proposed Meteorological Radar Tower Buildings are indicated in the following table.

Table 28: Bearing Layer, Pile and Foundation of the Proposed Meteorological Radar Tower Buildings

	Puttalam Meteorological Radar Observation Station	Pottuvil Meteorological Radar Observation Station
Depth of Bearing Layer	GL-26.3m	GL-24.8m
N value of Bearing Layer	60	60
Piling	Required	Required
Designed Pile Length	23.0m	22.0m
Required Number of the Designed Pile	16 pcs	16 pcs
Diameter of the Designed Pile	1.2m	1.2m
Foundation type	Pile foundation (cast in site concrete)	Pile foundation (cast in site concrete)

III. Structure Type

Reinforced concrete has been selected as the construction material for the proposed radar tower buildings because reinforced concrete construction is the most typical structural type in Sri Lanka. The floor slabs are to be reinforced concrete while the exterior walls and partition walls are made out of locally procured blocks.

IV. Design Load

a) Dead load

The weight of all the structural and finishing materials has been included in the dead weight calculation for the radar tower buildings. The following combined weight as a special dead load will be considered.

Table 29: Weight of Meteorological Radar System Unit

Installation Place (Room Name)	Name of Meteorological Radar System Unit	Weight
Roof Top	Radome, Antenna and Pedestal	5.8 tons
Radar Equipment Room	Transmitter/Receiver, Signal Amplifier, Signal Processor, Antenna Controller, etc.	3.0 tons
Electricity Room	Isolation Transformer, Auto Voltage Regulator (for Equipment and Building) and Capacitor	4.0 tons

b) Live load

Since virtually most of all the major rooms in the radar tower buildings are equipment installation spaces, the live load of the radar tower buildings is deemed to be identical to that of telecommunication equipment rooms in Japan.

c) Wind load

The Basic Wind Speed of Puttalam and Pottuvil indicated in the "Design Building for High Winds" are as follows.

Basic Wind Speed (m/s)

- Puttalam: ZONE 3 (22m/s)
- Pottuvil: ZONE 1 (28m/s)

However, the recorded maximum wind speed in Sri Lanka is 160km/h (approximate 45m/s) from the tropical cyclone November 17-24 in 1978 at Batticaloa. In order to calculate the wind load of the proposed Radar Tower Buildings, this recorded maximum wind speed will be used as the Basic Wind Speed (45m/s) and the combined height, exposure and safety factor will be applied.

Figure 15: Wind Loading Zone Map
Source: Design Building for High Winds

d) Seismic load

There is no standard general policy on the inclusion of seismic factors in building structural calculation in Sri Lanka. Therefore, the seismic load is generally not incorporated into the structural design and calculations of the buildings to be constructed in Sri Lanka. However, since there is an existing earthquake record and safety is of utmost priority, the following parameters of the seismic load will be factored in the structural design and calculation for the radar tower building and the importance factor will be 1.25 because the radar tower building has a task to conduct anti-disaster measures operation such as weather observation and observation data transmission to the DOM Head Office during disaster occurrence period.

- Base shear coefficient: 0.1
- Zone coefficient for seismic load: 0.7

V. Structural Building Material

All the materials for the building structure will be procured in Sri Lanka.

- Concrete (conventional concrete): specified concrete strength Fc= 21N/mm^2, quality standard concrete strength Fq= 24N/mm^2
- Cement: American Society for Testing and Materials (ASTM) or equivalent
- Deformed reinforcing bars : ASTM Grade 60 or equivalent

[6] Electrical Facility Design

I. Power intake facility

Table 30: Power Intake Facility

	Puttalam Meteorological Radar Tower Building	Pottuvil Meteorological Radar Tower Building
Intake Power (Nominal Voltage)	415V, 3-phase 4-wire, 50Hz	415V, 3-phase 4-wire, 50Hz

II. Power generating facility

Table 31: Power Generating Facility

	Puttalam Meteorological Radar Tower Building	Pottuvil Meteorological Radar Tower Building
Number of Engine Generator	2	2
Capacity	75KVA	75KVA
Output	415V, 3-phase 4-wire, 50Hz	415V, 3-phase 4-wire, 50Hz
Fuel Tank Capacity	1,000 liters×1	1,000 liters×1

III. Trunk line and power facility

Power will be distributed to the switchboard for lighting and to the electricity control panel from the

distribution panel in the electrical room. The trunk line for distribution and the power line will use suitable cabling through conduits. An alarm for the power equipment will be shown on an alarm panel in the observation room. The electrical systems for the trunk line and branch circuits are as follows.

Table 32: Trunk Line and Power Facility

	Puttalam Meteorological Radar Tower Building	Pottuvil Meteorological Radar Tower Building
Trunk line for power and lighting	415V/230V, 3-phase 4-wire	415V/230V, 3-phase 4-wire
Branch power circuits	415V, 3-phase 4-wire	415V, 3-phase 4-wire
Branch lighting circuits	230V, single-phase 2-wire	230V, single-phase 2-wire
Branch equipment circuits	415V, 3-phase 4-wire	415V, 3-phase 4-wire

IV. Lighting and power outlet

The voltage required for lighting and power sockets is a single-phase 230V and all the fixtures must be grounded. Steel pipes will be used for wiring conduits. Lighting fixtures will be LED due to low power consumption. The lighting levels in the various rooms will be approximately as shown below.

Table 33: Approximate Lighting Levels in the Various Rooms

	Puttalam Meteorological Radar Tower Building	Pottuvil Meteorological Radar Tower Building
Radome Room	200 Lx	200 Lx
Radar Equipment Room	300 Lx	300 Lx
Observation Room	300 Lx	300 Lx
Engine Generator Room	200 Lx	200 Lx
Fuel Storage	200 Lx	200 Lx
Electricity & Power Supply Room	200 Lx	200 Lx
Pump Room	200 Lx	200 Lx
Entrance Hall	200 Lx	200 Lx
Other Rooms	200 Lx	200 Lx

General-purpose power outlets will be equipped with switches. Dedicated power outlets are required in the radar equipment room, the observation room (including the data analysis space and the data storage space) and the maintenance room for the computing equipment.

V. Telephone system

A service terminal box, a relay terminal box and telephone sets will be installed inside the radar tower buildings and telephone lines will be installed to outlets in those rooms requiring a telephone.

VI. Intercom system

In order to control night shift personnel and visitors, intercom systems will be installed in the various operating rooms (radar equipment room and observation room) and outside of the radar tower building entrance, as a security measure.

VII. Alarm system

An alarm panel will be installed at the observation room. The following building equipment warnings

will be provided.

- System failure of air-conditioning units in the radar equipment room
- System failure of radar power backup unit
- System failure and overheating of the engine generators
- Breaker tripping of the distribution boards for the radar tower building and the Equipment

VIII. Grounding system

Grounding cables for the equipment installed on the 2nd floor will be connected to the terminal box for earthing. All the equipment to be installed in the electricity and the power supply room will be grounded via the terminal box, while the telephone equipment will be grounded by erecting a grounding electrode and running a wire from there to the terminal box.

IX. Lightning protection system

A lightning rod will be installed on top of the radome (included in the equipment portion of the Project), with roof conductors on the concrete handrails of parapets, the roof top, and the observation deck, to protect all the equipment and the radar tower buildings. A connection box will be placed at the radome room for the lightning rod. Inside the building structure, copper tapes will be laid in a vinyl pipe and grounded via the test terminal boxes.

X. Aviation obstruction light

A connection box for two obstruction lights on the top of the radome (which is part of the equipment portion of the Project) will be placed in the radome room. Four obstruction lights (LED), to be installed at the radome roof floor, will be included in the building portion of the Project. For all of the obstruction lights, two power distribution boards will be installed on the first floor and in the radar equipment room and an automatic blinking switch will be installed on the first floor. All the aviation obstruction lights will be furnished with surge arresters. Connecting work between the obstruction lights on top of the radome and a connection box placed in the radome will be included in the equipment portion of the Project.

XI. Fire detection and alarm system

Fire detectors will be installed in the radar equipment room, the electricity & power supply room and the engine generator room, and an alarm system will be installed in the observation room.

[7] Water Supply, Drainage and Sanitary Fixture Design

I. Water supply system

Public water supply is available in Puttalam and Pottuvil so a water supply gate valve will be installed for the water inflow for the radar tower buildings. To supply the public water to the proposed radar

tower buildings, a gravity tank water service system with a water receiving tank, feed pumps and a high-level water reservoir tank will be applied.

II. Drainage system

Drainage will be divided into 2 systems - sewage and miscellaneous drainage. Sewage will primarily be treated in a septic tank and then be permeated by a seepage pit into the ground. Miscellaneous drainage will be fed directly into a seepage pit. A septic tank and a seepage pit must be constructed. The capacity of the septic tank and seepage pit for the radar tower building has been designed for 12 DOM personnel in the operations area and for some visitors.

III. Sanitary fixtures

- Closet bowl: European style
- Urinal: stall type
- Washbasin: wall-mounted type
- Slop sink: wall-mounted type

IV. Fire extinguisher

Fire extinguishers will be supplied in the following rooms.

Table 34: Fire Extinguisher

	Puttalam Meteorological Radar Tower Building	Pottuvil Meteorological Radar Tower Building
Radome Room	CO_2 type	CO_2 type
Radar Equipment Room	CO_2 type	CO_2 type
Observation Room	CO_2 type	CO_2 type
Engine Generator Room	ABC type	ABC type
Fuel Storage	ABC type	ABC type
Electricity & Power Supply Room	CO_2 type	CO_2 type
Pump Room	CO_2 type	CO_2 type
Tea Kitchen	ABC type	ABC type

[8] Air-conditioning and Ventilation System Design

Air-conditioning systems will be installed in the rooms listed below. It is essential to have a good operating environment, especially for the equipment in the radar equipment room, the observation room and the electricity & power supply room. Therefore, a substantial number of air-conditioning systems is indispensable. Package type air-conditioning systems have been selected to minimize any impact to the operation of the radar system if an air-conditioning system fails.

Table 35: Air-conditioning and Ventilation System

	Puttalam Meteorological Radar Tower Building	Pottuvil Meteorological Radar Tower Building
Radome Room	Fan forced ventilation	Fan forced ventilation
Radar Equipment Room	Air-conditioning system Heat exchange system	Air-conditioning system Heat exchange system

Observation Room	Air-conditioning system Fan forced ventilation	Air-conditioning system Fan forced ventilation
Engine Generator Room	Fan forced ventilation	Fan forced ventilation
Fuel Storage	Fan forced ventilation	Fan forced ventilation
Electricity & Power Supply Room	Air-conditioning system Fan forced ventilation	Air-conditioning system Fan forced ventilation
Pump Room	Fan forced ventilation	Fan forced ventilation
Shower Room	Fan forced ventilation	Fan forced ventilation
Toilet (M & F)	Fan forced ventilation	Fan forced ventilation
Tea Kitchen	Fan forced ventilation	Fan forced ventilation

Ceiling fan forced ventilation will be installed in the tea kitchen and the toilets. Due to the heat generated by the equipment in the radar equipment room, the engine generator room, the electricity room, pump room, etc., forced ventilation systems will be adopted. Furthermore, appropriate ventilation systems will be installed in the other rooms to meet the following conditions.

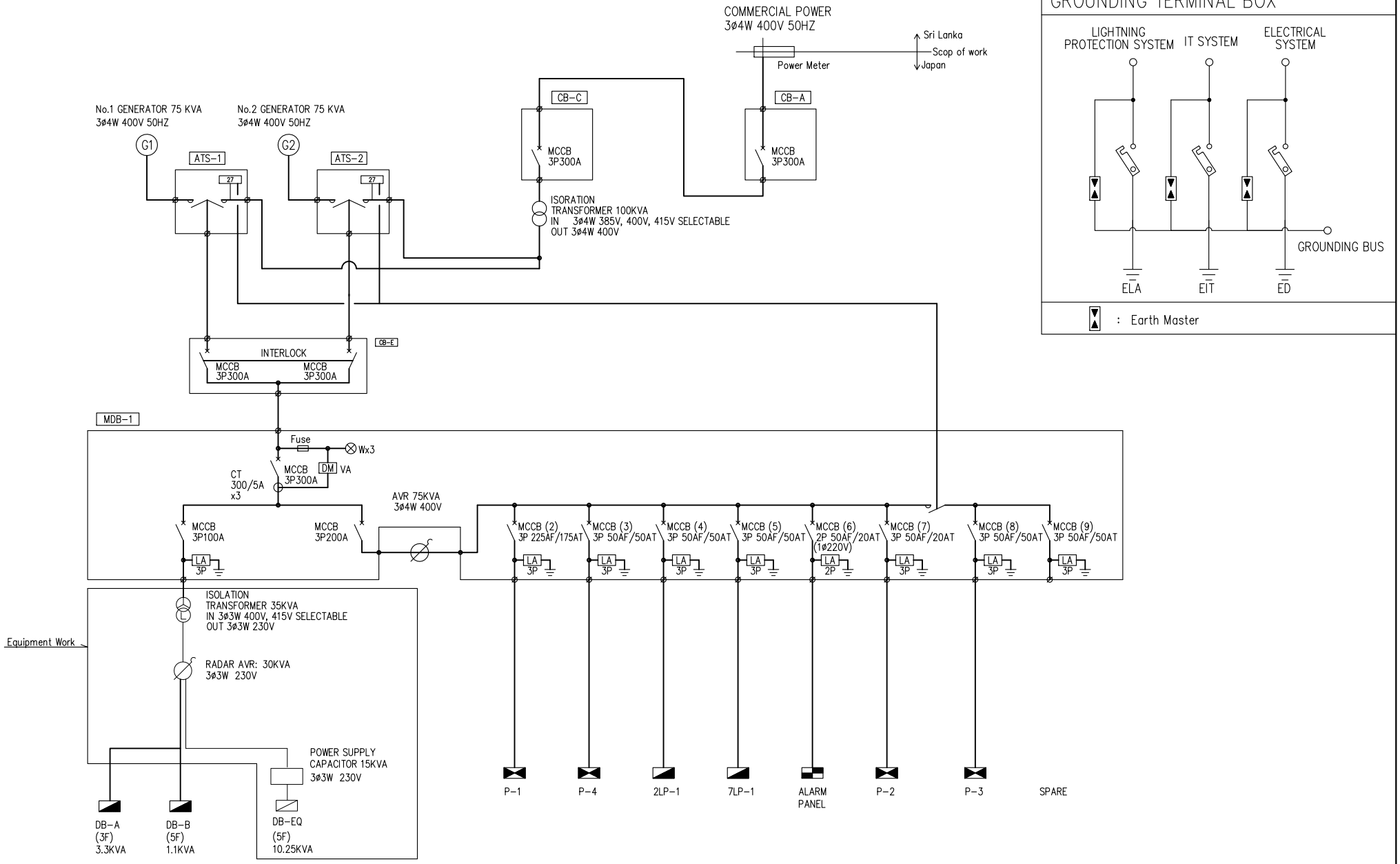
<Environmental conditions>

- Outside condition: 31°C (maximum temperature: 40°C)
- Indoor condition: temperature 20-25°C humidity 40-60% (Radar Equipment Room)

The diagrams of the building equipment plan for the radar tower buildings can be found in the subsequent pages immediately hereafter.

< Meteorological Radar Tower Building >

- Power Feeder System : SD-01
- Power Riser System : SD-02
- Interphone & Tel. System : SD-03
- Fire Alarm System : SD-04
- Alarm System : SD-05
- Lightning Protection & Grounding System : SD-06
- Obstruction Lighting System : SD-07
- Water Supply & Drainage System : SD-08
- Air-Conditioning & Ventilation System : SD-09



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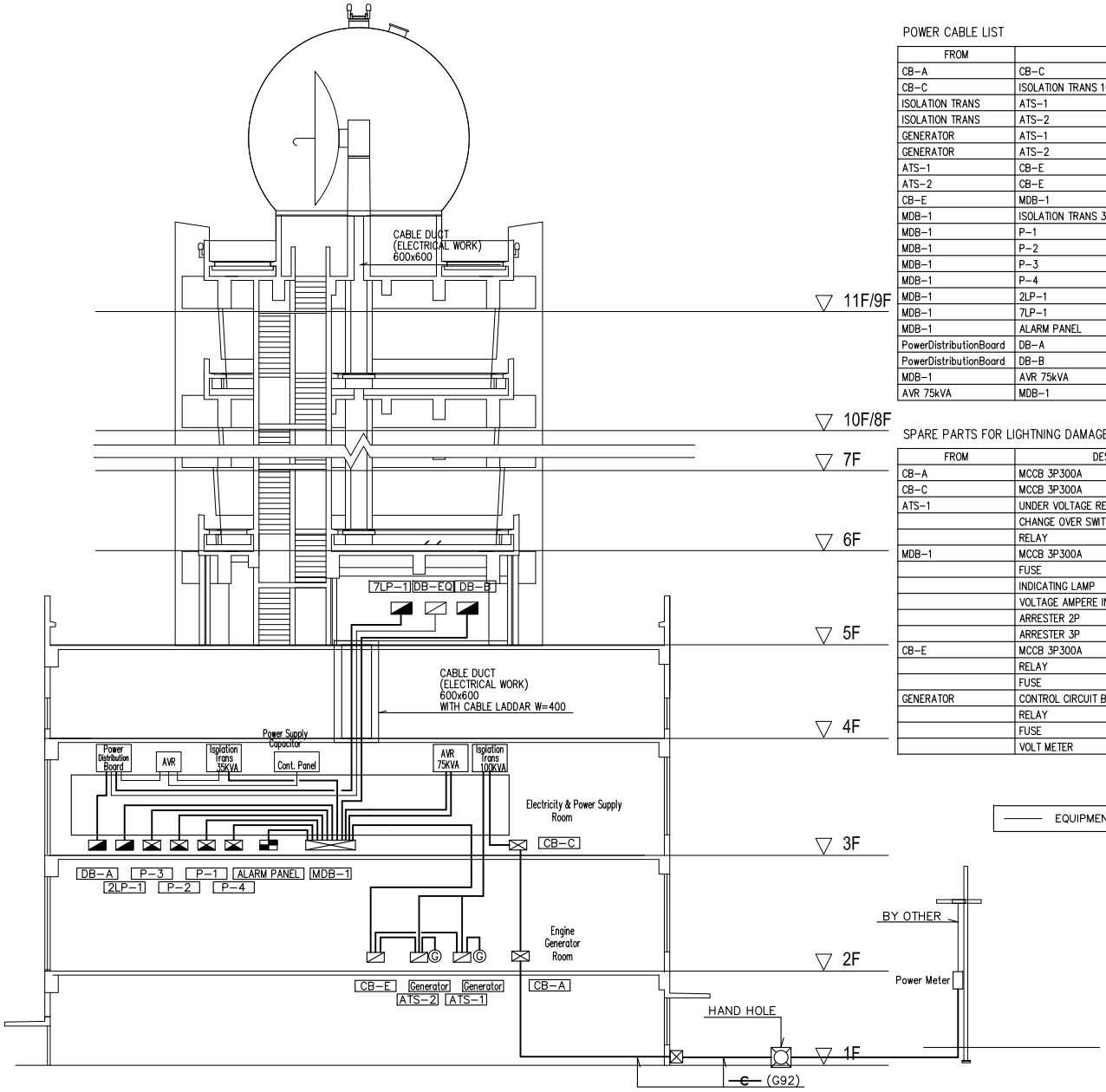
THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
METEOROLOGICAL RADAR TOWER BUILDING
POWER FEEDER SYSTEM

SCALE
NONE

DRAWING No.
SD - 01



POWER CABLE LIST

FROM	TO	CABLE SIZE	CONDUIT
CB-A	CB-C	XLPE/PVC 1C-4x120sq +E70sq	(G80) / CABLE LADDAR
CB-C	ISOLATION TRANS 100KVA	XLPE/PVC 1C-4x120sq +E70sq	(G80) / CABLE LADDAR
ISOLATION TRANS	ATS-1	XLPE/PVC 1C-4x120sq +E70sq	(G80) / CABLE LADDAR
ISOLATION TRANS	ATS-2	XLPE/PVC 1C-4x120sq +E70sq	(G80) / CABLE LADDAR
GENERATOR	ATS-1	XLPE/PVC 1C-4x120sq +E70sq	(G80) / CABLE LADDAR
GENERATOR	ATS-2	XLPE/PVC 1C-4x120sq +E70sq	(G80) / CABLE LADDAR
ATS-1	CB-E	XLPE/PVC 1C-4x120sq +E70sq	(G80) / CABLE LADDAR
ATS-2	CB-E	XLPE/PVC 1C-4x120sq +E70sq	(G80) / CABLE LADDAR
CB-E	MDB-1	XLPE/PVC 1C-4x120sq +E70sq	(G80) / CABLE LADDAR
MDB-1	ISOLATION TRANS 35KVA(EQUIP WORK)	XLPE/PVC 4C-30sq +E22sq	(G50) / CABLE LADDAR
MDB-1	P-1	XLPE/PVC 1C-4x70sq +E50sq	(G70) / CABLE LADDAR
MDB-1	P-2	XLPE/PVC 4C-16sq +E16sq	(G40) / CABLE LADDAR
MDB-1	P-3	XLPE/PVC 4C-16sq +E16sq	(G40) / CABLE LADDAR
MDB-1	P-4	XLPE/PVC 4C-16sq +E16sq	(G40) / CABLE LADDAR
MDB-1	2LP-1	XLPE/PVC 4C-16sq +E16sq	(G40) / CABLE LADDAR
MDB-1	7LP-1	XLPE/PVC 4C-16sq +E16sq	(G40) / CABLE LADDAR
MDB-1	ALARM PANEL	XLPE/PVC 2C- 6sq +E 6sq	(G32) / CABLE LADDAR
PowerDistributionBoard	DB-A	XLPE/PVC 2C-10sq +E10sq	(G40) / CABLE LADDAR
PowerDistributionBoard	DB-B	XLPE/PVC 2C-10sq +E10sq	(G40) / CABLE LADDAR
MDB-1	AVR 75kVA	XLPE/PVC 1C-4x95sq +E50sq	(G70) / CABLE LADDAR
AVR 75kVA	MDB-1	XLPE/PVC 1C-4x95sq +E50sq	(G70) / CABLE LADDAR

SPARE PARTS FOR LIGHTNING DAMAGE LIST

FROM	DESCRIPTION	UNIT
CB-A	MCCB 3P300A	1
CB-C	MCCB 3P300A	1
ATS-1	UNDER VOLTAGE RELAY	1
	CHANGE OVER SWITCH	1
	RELAY	4
MDB-1	MCCB 3P300A	1
	FUSE	6
	INDICATING LAMP	3
	VOLTAGE AMPERE INDICATOR	1
	ARRESTER 2P	2
	ARRESTER 3P	7
CB-E	MCCB 3P300A	1
	RELAY	4
	FUSE	4
GENERATOR	CONTROL CIRCUIT BOARD	1
	RELAY	4
	FUSE	4
	VOLT METER	1

EQUIPMENT WORK

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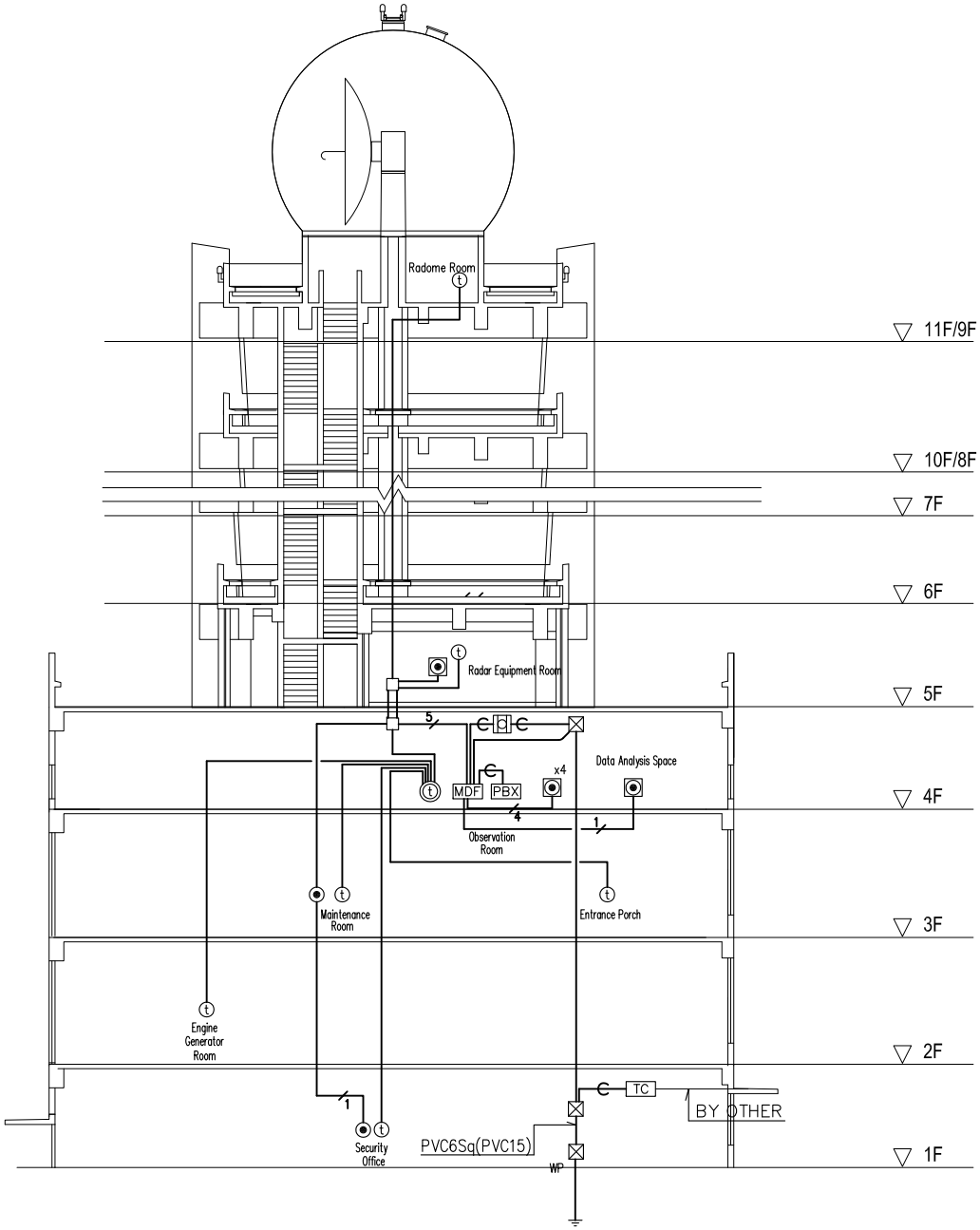
DRAWING TITLE
METEOROLOGICAL RADAR TOWER BUILDING
POWER RISER SYSTEM

SCALE
NONE

DRAWING No.
SD - 02



REMARK

- —C— : —C— (G36)
- —/— : TIEV 0.65−4C (G20)
- —/2— : TIEV 0.65−4Cx2 (G20)
- —/3— : TIEV 0.65−4Cx3 (G25)
- —/— : TIEV 0.65−4C (UNDER THE ACCESS FLOOR)
- —/2— : TIEV 0.65−4Cx2 (UNDER THE ACCESS FLOOR)
- —/3— : TIEV 0.65−4Cx3 (UNDER THE ACCESS FLOOR)
- ——— : AE 0.9−2C (G20)
- ——— : AE 0.9−2C (UNDER THE ACCESS FLOOR)
- PBX : PBX COT. 5L , EXT. 15L
- MDF : MAIN DISTRIBUTION FRAME 30P
- ◉ : TELEPHONE OUTLET (MODULAR JACK)
- ◉ : TELEPHONE OUTLET SLAB MOUNT
- ⊡ : ARRESTER
- ⓣ : INTERCOM (POWER SUPPLY FOR INTERCOM)
- ⓣ : INTERCOM
- ⊠ : PULL BOX 200x200x200 (WATER PROOF TYPE)
- TC : INCOMING TERMINAL FRAME

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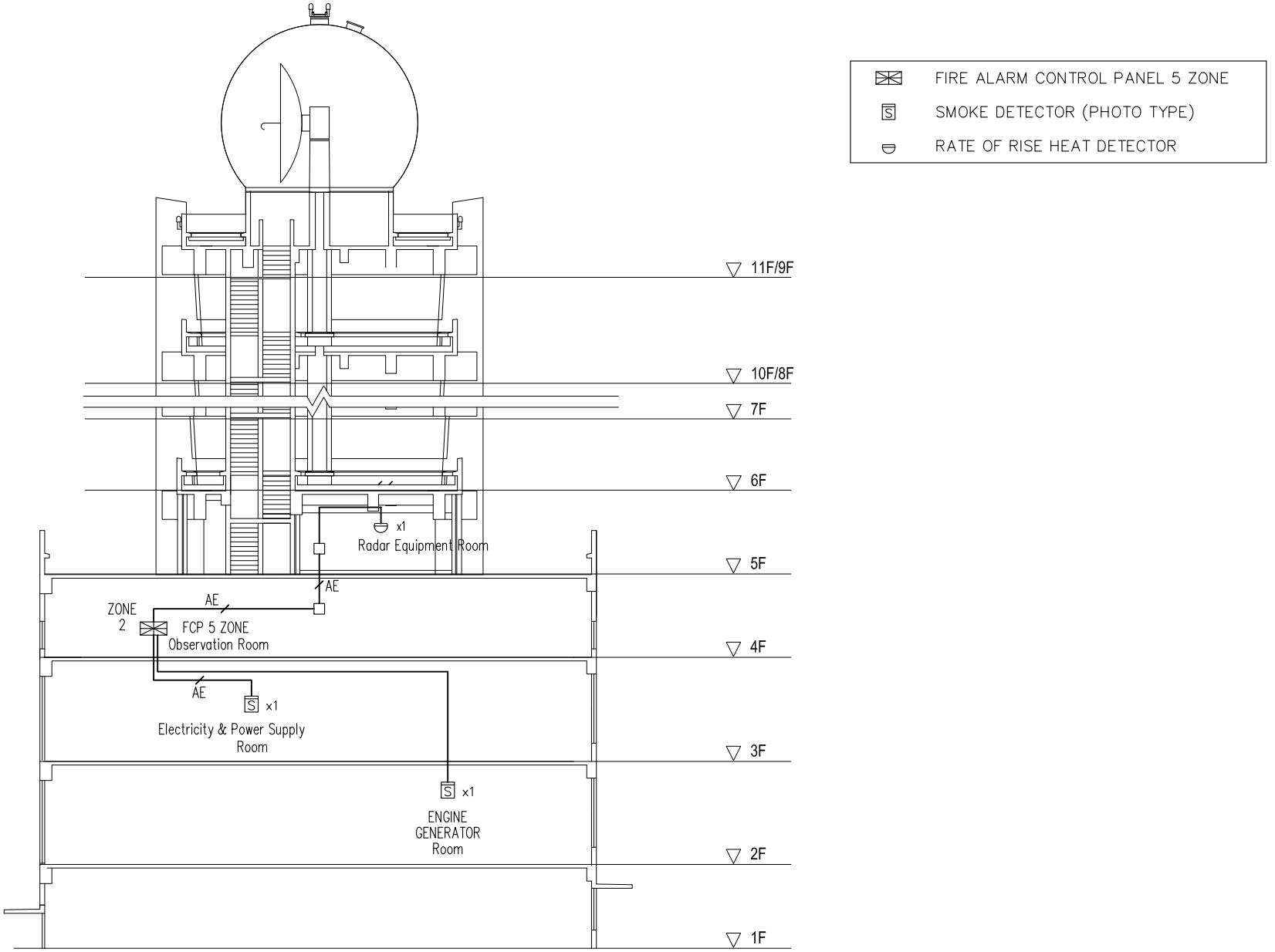
DRAWING TITLE
METEOROLOGICAL RADAR TOWER BUILDING
INTERPHONE & TEL. SYSTEM

SCALE
NONE

DRAWING No.
SD - 03



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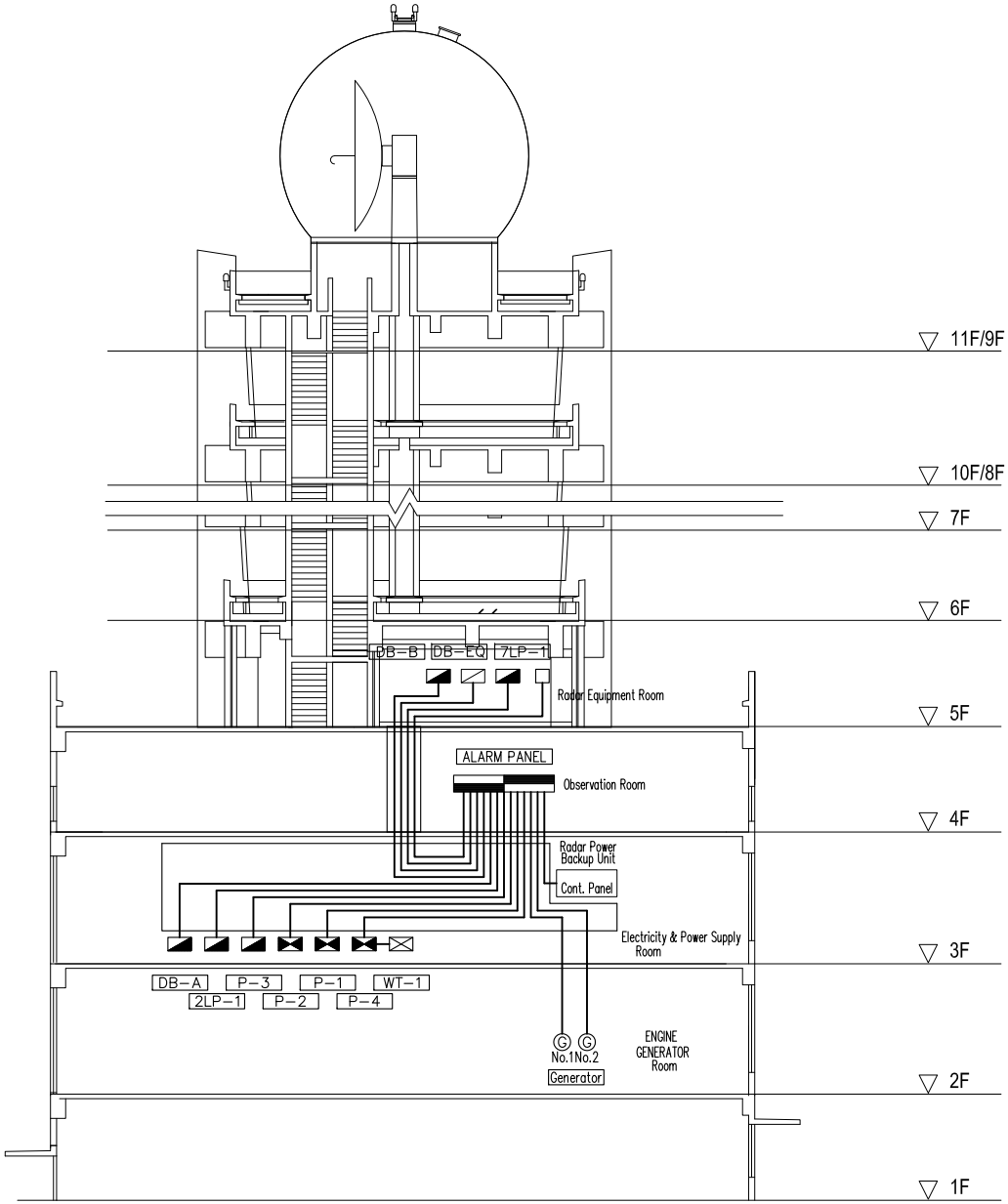

☐ TEMPERATURE SWITCH FOR ROOM TEMPERATURE ALARM

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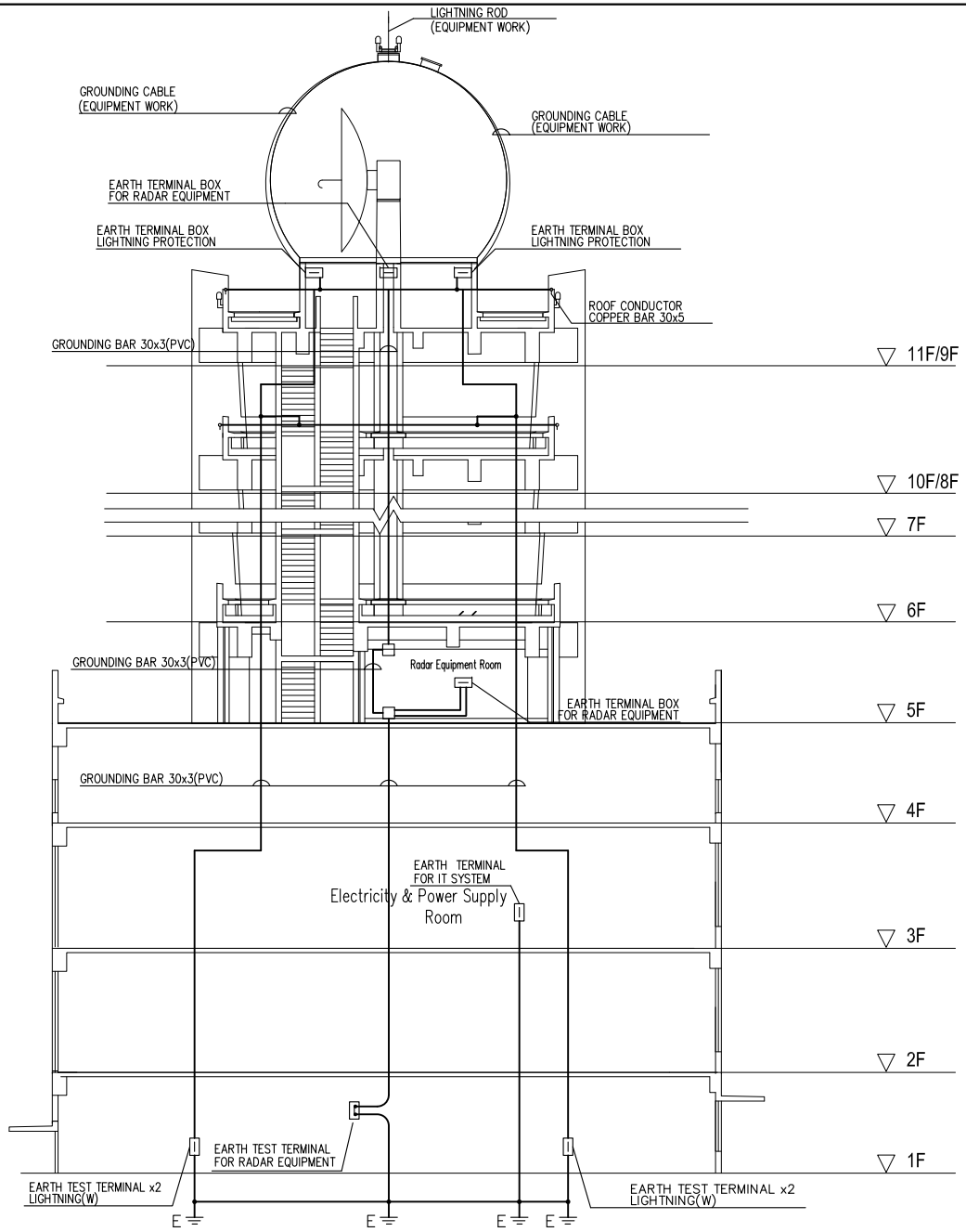

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THE PROJECT FOR

THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK

IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

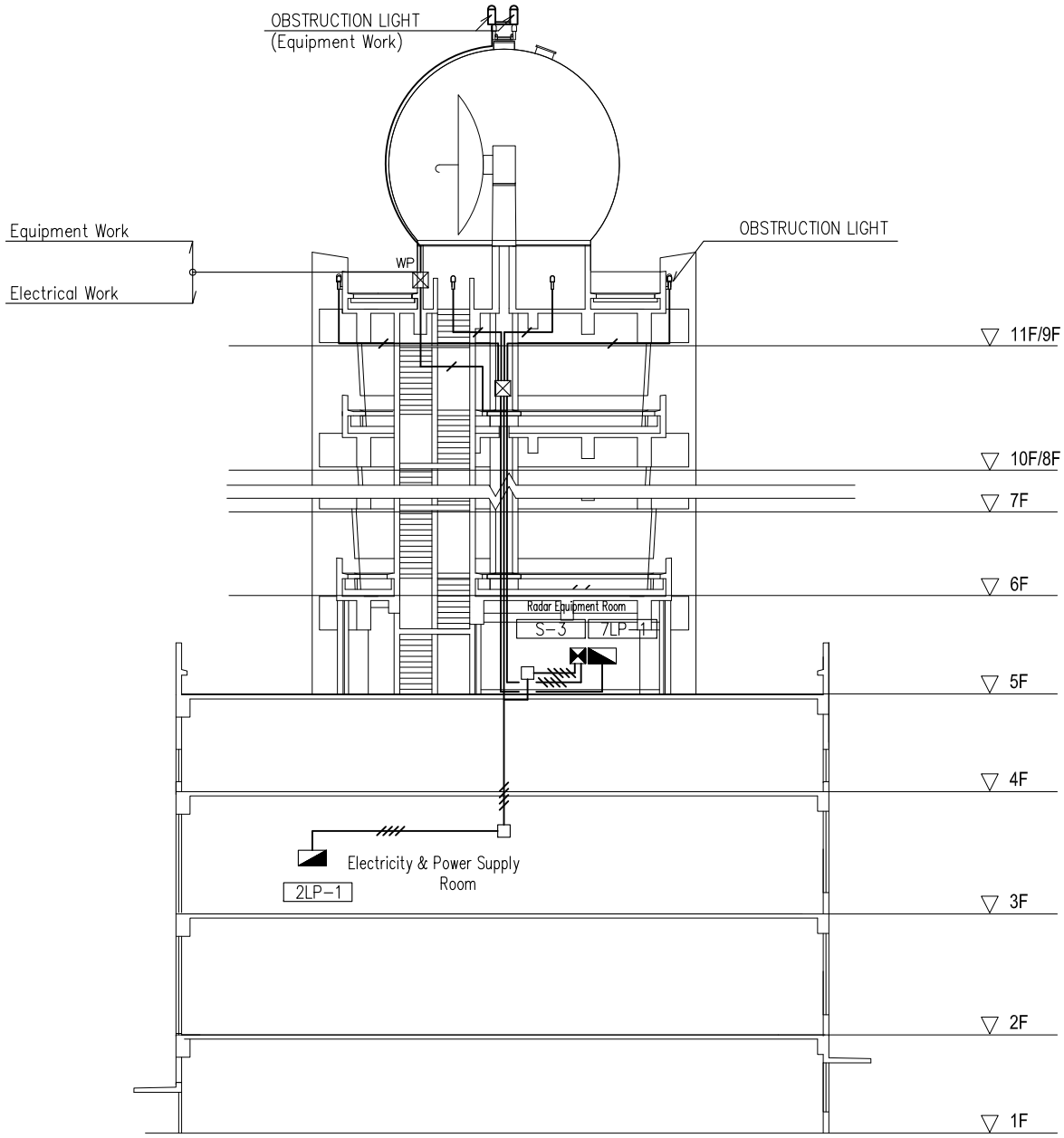
DRAWING TITLE

METEOROLOGICAL RADAR TOWER BUILDING

LIGHTNING PROTECTION & GROUNDING SYSTEM

SCALE: NONE

DRAWING No.: SD - 06



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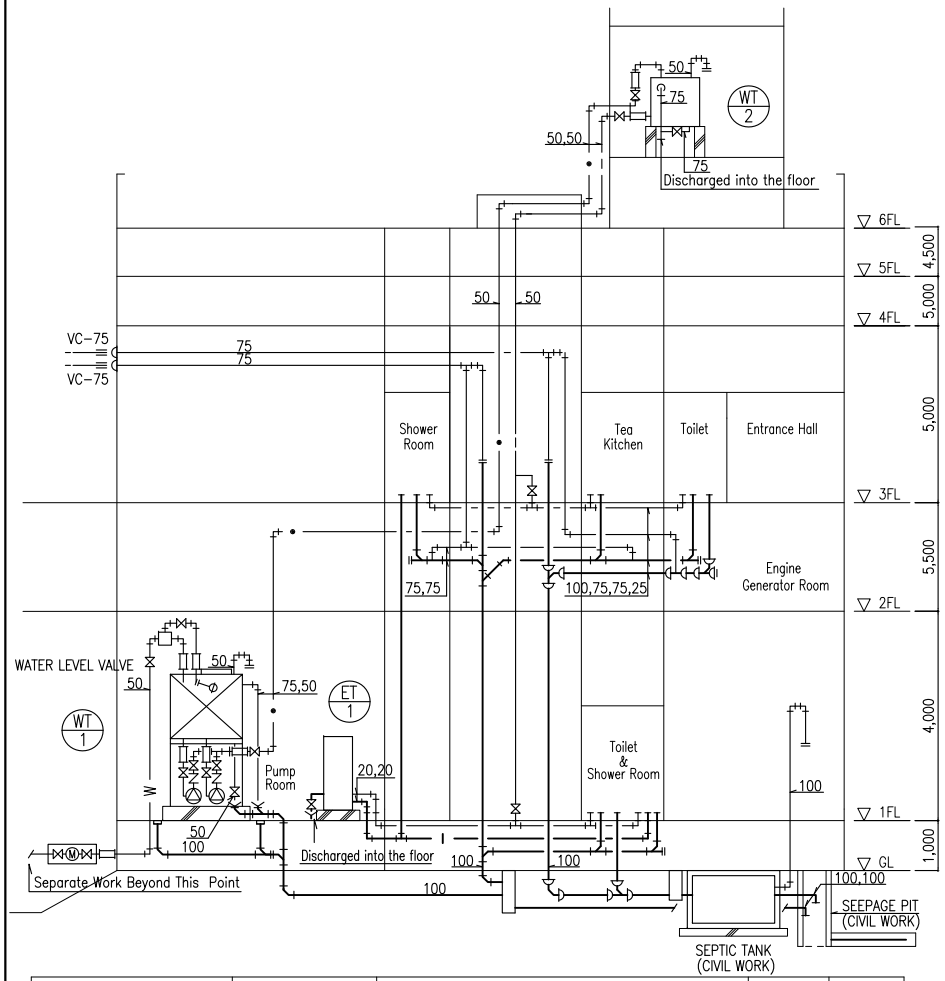

ITEM	1F		3F					TOTAL	REMARK
	TOILET & SHOWER	PUMP ROOM	TOILET(M)	TOILET(F)	SHOWER ROOM	TEA KITCHEN	SERVICE		
WATER CLOSET	1		1	1				3	
LAVATORY	1		1	1				3	
PAPER HOLDER	1		1	1				3	
FAUCET	1	1	1	1		1	1	6	
MIRROR	1		1	1				3	
SHOWER HEAD	1				1			2	
KITCHEN SINK						1		1	
URINAL			1					1	
SERVICE SINK							1	1	

NO.	NAME	SPECIFICATION	Q'TY	POWER SUPPLY					LOCATION	REMARKS
				PHASE	VOLT (V)	FREQUENCY (Hz)	MOTOR (KW)	EMERGENCY POWER SUPPLY		
WT-1	POTABLE WATER	FPR Tank	1					○	Pump Room	RC FOUNDATION
	TANK / PUMP	Rated capacity 2.5 m^3								(CIVIL WORK)
		Dimension 1,000 x 1,500 x 2,000H								1.8x1.8x0.3mH
		Accessories Manhole 600ø Breather								
		Ball tap 25A , overflow and drain pipe 40A								
		Electrode 4P								
		Constant pressure type pump	2	3	440	50	1.5			
		40 ø x 100 l/min x 270 kpa x 2 pcs (1 spare)								
		Accessories Flexible connector for suction 40A								
WT-2	POTABLE WATER	FRP tank	1						6FL Roof	RC FOUNDATION
	GRAVITY TANK	Rated capacity 1.5 m^3								(CIVIL WORK)
		Dimension 1,000 x 1,500 x 1,500H								0.4x1.4x0.5mH
		Earth quake proof 2.0G(Wind –Proof type)								
		Accessories Flat frame 150H,manhole 600 ø								
		Electrode 4P								
ET-1	ELECTRIC	Model: Indoor installation type	1	1	230	50	3.1		Pump Room	RC FOUNDATION
	WATER HEATER	Dimension:460x545x1800								(CIVIL WORK)
		Hot water storage amount:200L								
		Weight of the products:80kg,280kg(high-water level)								
		Maximum working pressure:0.1Mpa or less								
ABC	FIRE EXTINGUISHER	ABC Dry chemical, wall hang	3						Each room	
		10 Lbs Discharge time 14 sec								
CO2	FIRE EXTINGUISHER	Carbon dioxicide, wall hang	7						Each room	
		10 Lbs Discharge time 14 sec								
	SEPTIC TANK	Septic tank & Seepage pit (RC type, Civil work)	1						Out door	
	(CIVIL WORK)	Blower pump (Civil work)								

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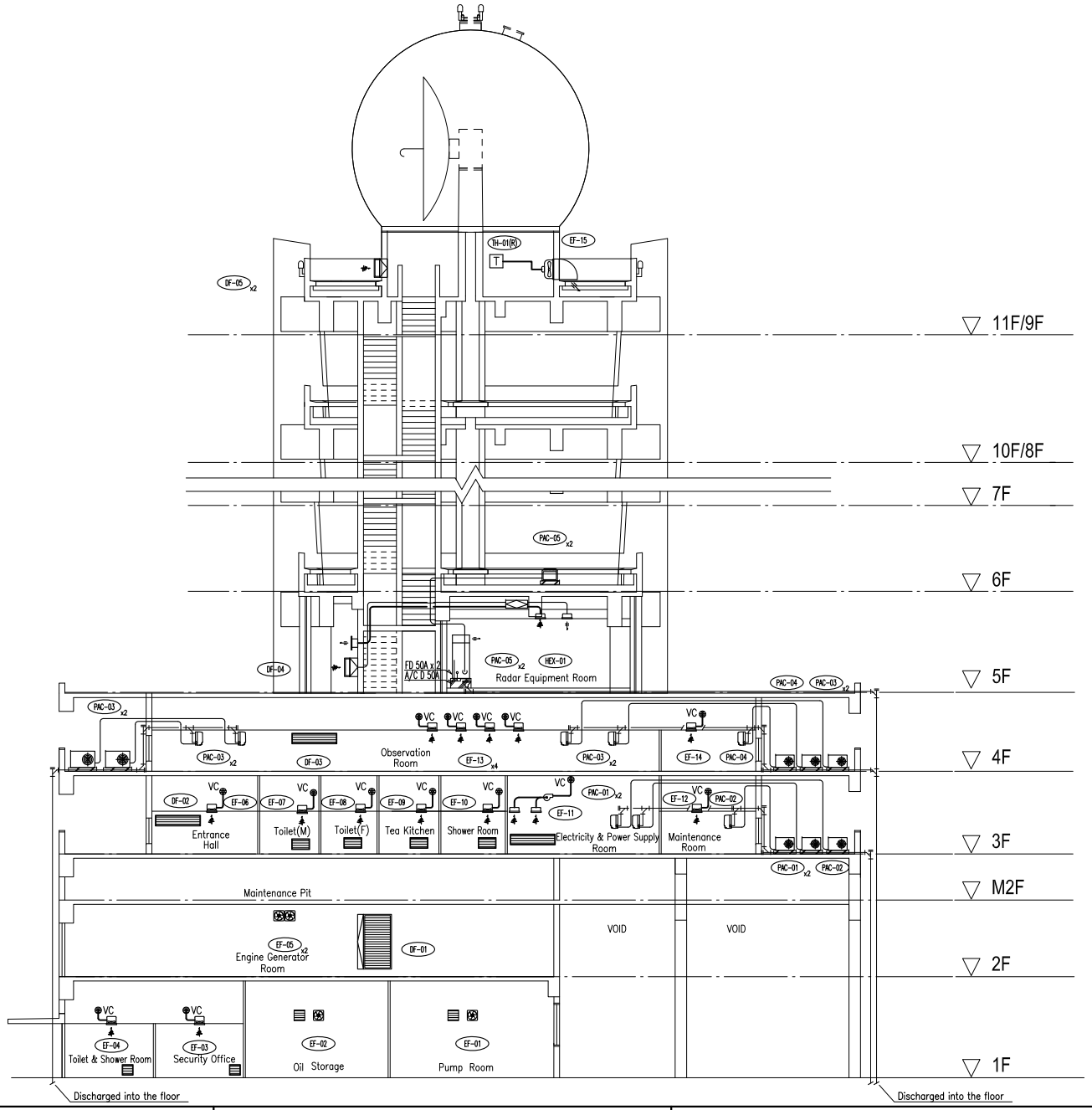
THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
METEOROLOGICAL RADAR TOWER BUILDING
WATER SUPPLY & DRAINAGE SYSTEM

SCALE
NONE

DRAWING No.
SD - 08



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2-2-3 Outline Design Drawing

The following outline design drawings for the Project are attached hereunder.

< Puttalam Meteorological Radar Tower Building >

- Site Plan : A-00(PUL)
- Floor Plan 1 : A-01(PUL)
- Floor Plan 2 : A-02(PUL)
- Floor Plan 3 : A-03(PUL)
- Floor Plan 4 : A-04(PUL)
- Floor Plan 5 : A-05(PUL)
- Floor Plan 6 : A-06(PUL)
- Floor Plan 7 : A-07(PUL)
- Floor Plan 8 : A-08(PUL)
- Elevation 1 : A-09(PUL)
- Elevation 2 : A-10(PUL)
- Section : A-11(PUL)

- Equipment Layout Plan 1 : EQ-01(PUL)
- Equipment Layout Plan 2 : EQ-02(PUL)
- Equipment Layout Plan 3 : EQ-03(PUL)
- Equipment Layout Plan 4 : EQ-04(PUL)

< Pottuvil Meteorological Radar Tower Building >

- Site Plan : A-00(POV)
- Floor Plan 1 : A-01(POV)
- Floor Plan 2 : A-02(POV)
- Floor Plan 3 : A-03(POV)
- Floor Plan 4 : A-04(POV)
- Floor Plan 5 : A-05(POV)
- Floor Plan 6 : A-06(POV)
- Floor Plan 7 : A-07(POV)
- Elevation 1 : A-08(POV)
- Elevation 2 : A-09(POV)
- Section : A-10(POV)

- Equipment Layout Plan 1 : EQ-01(POV)
- Equipment Layout Plan 2 : EQ-02(POV)
- Equipment Layout Plan 3 : EQ-03(POV)
- Equipment Layout Plan 4 : EQ-04(POV)

< National Meteorological Centre (NMC) at DOM Head Office >

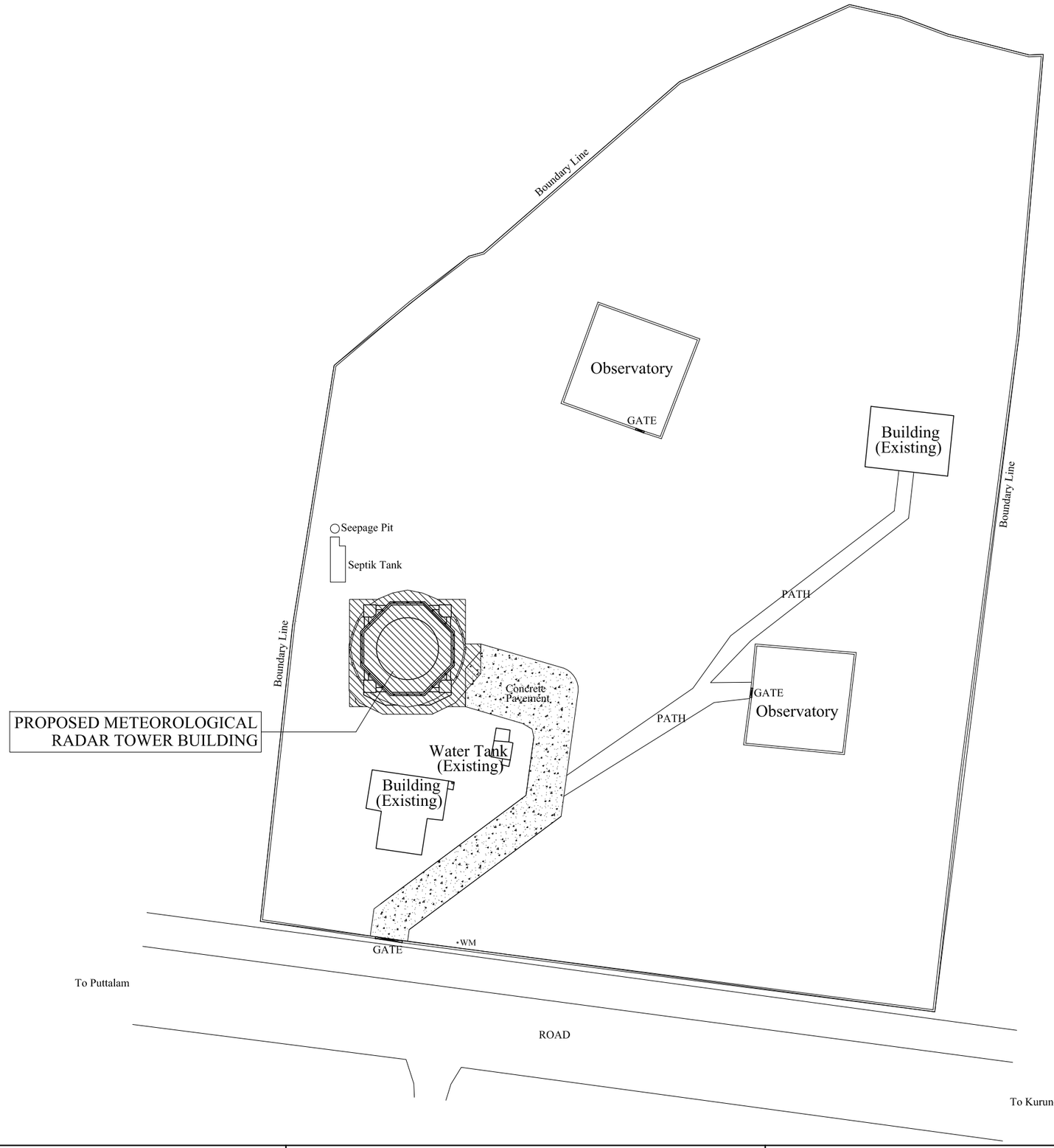
- Equipment Layout Plan 1 : EQ-01(COL)
- Equipment Layout Plan 2 : EQ-02(COL)
- Power Back-up Shed : EQ-03(COL)

< DOM Aviation Meteorological Office in the Colombo International Airport >

- Equipment Layout Plan : EQ-01(CIA)

< DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport >

- Equipment Layout Plan : EQ-01(MIA)



Area Calculations

Floor	Floor Area (m2)	Construction Area (m2)
1FL	45.25	219.06
2FL	85.70	242.65
M2FL	—	57.13
3FL	162.00	179.46
4FL	131.10	179.46
5FL	121.00	183.32
6FL	18.17	133.76
7FL	18.17	121.00
8FL	18.17	121.00
9FL	18.17	121.00
10FL	18.17	121.00
11FL	30.19	133.76
Total	666.09 m2	1,812.60 m2
Building Coverage Area	162.00 m2	—

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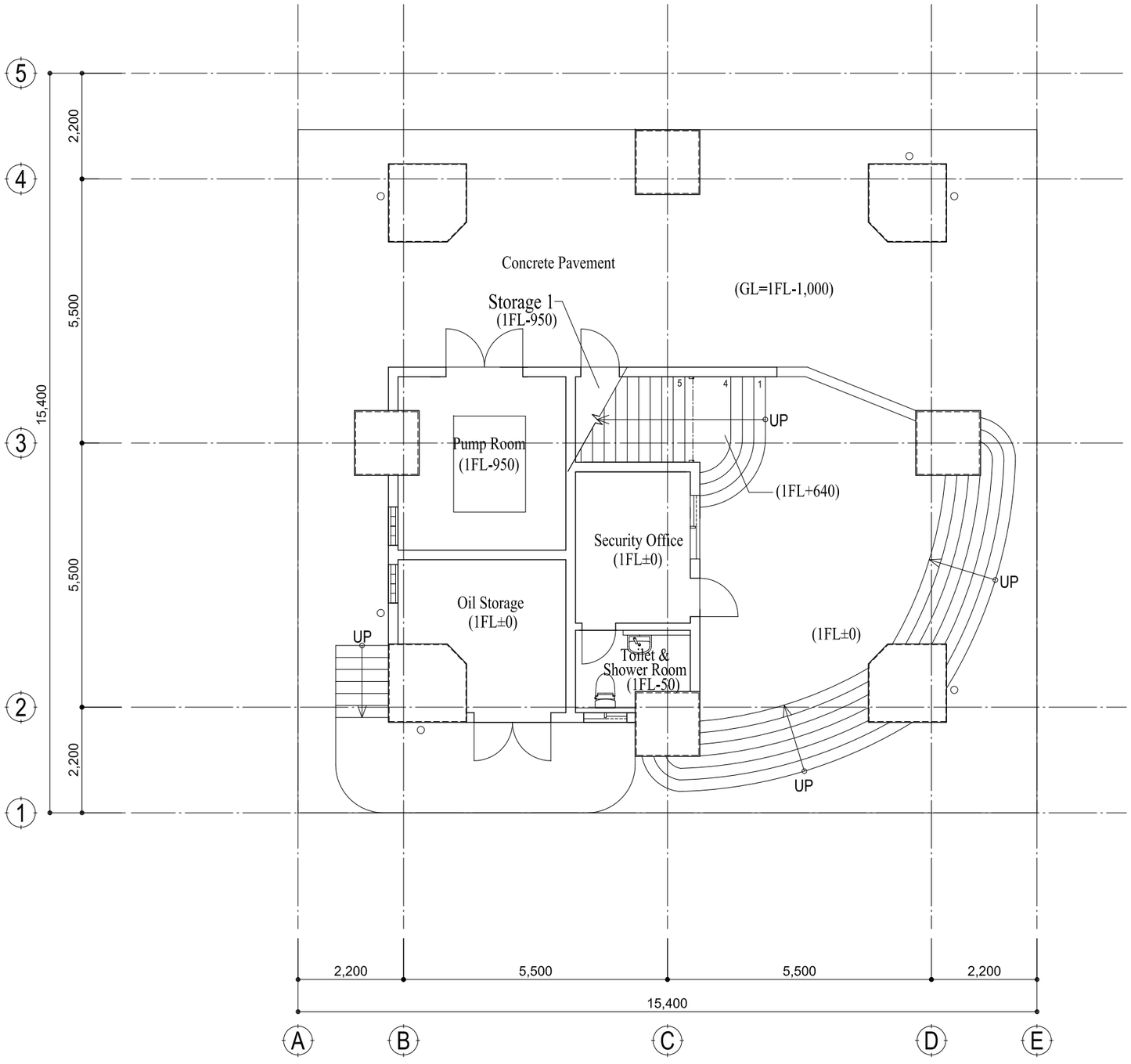
THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
PUTTALAM METEOROLOGICAL RADAR TOWER BUILDING
SITE PLAN

SCALE
1:600

DRAWING No.
A - 00 (PUL)



1FL PLAN

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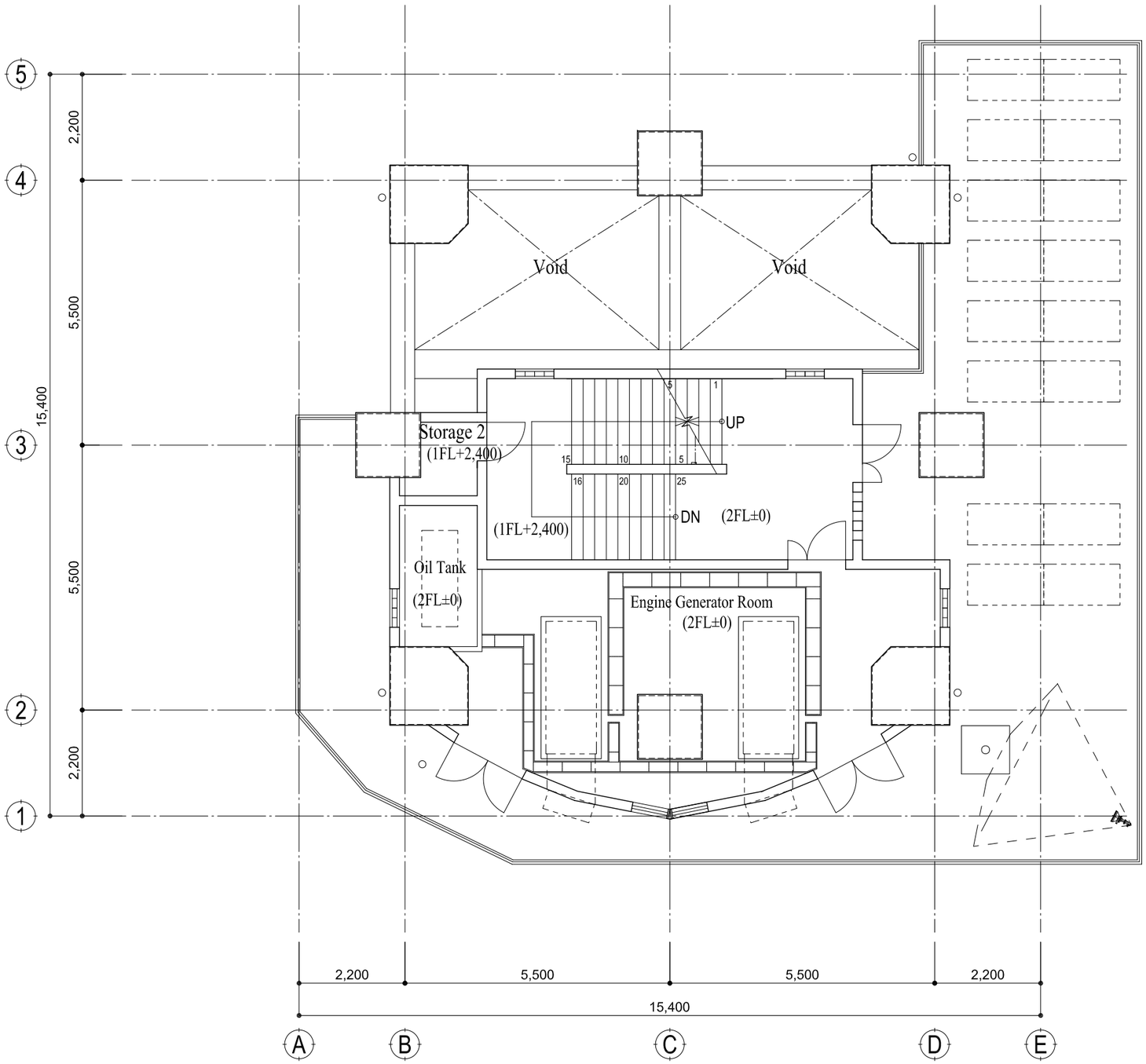

2FL PLAN

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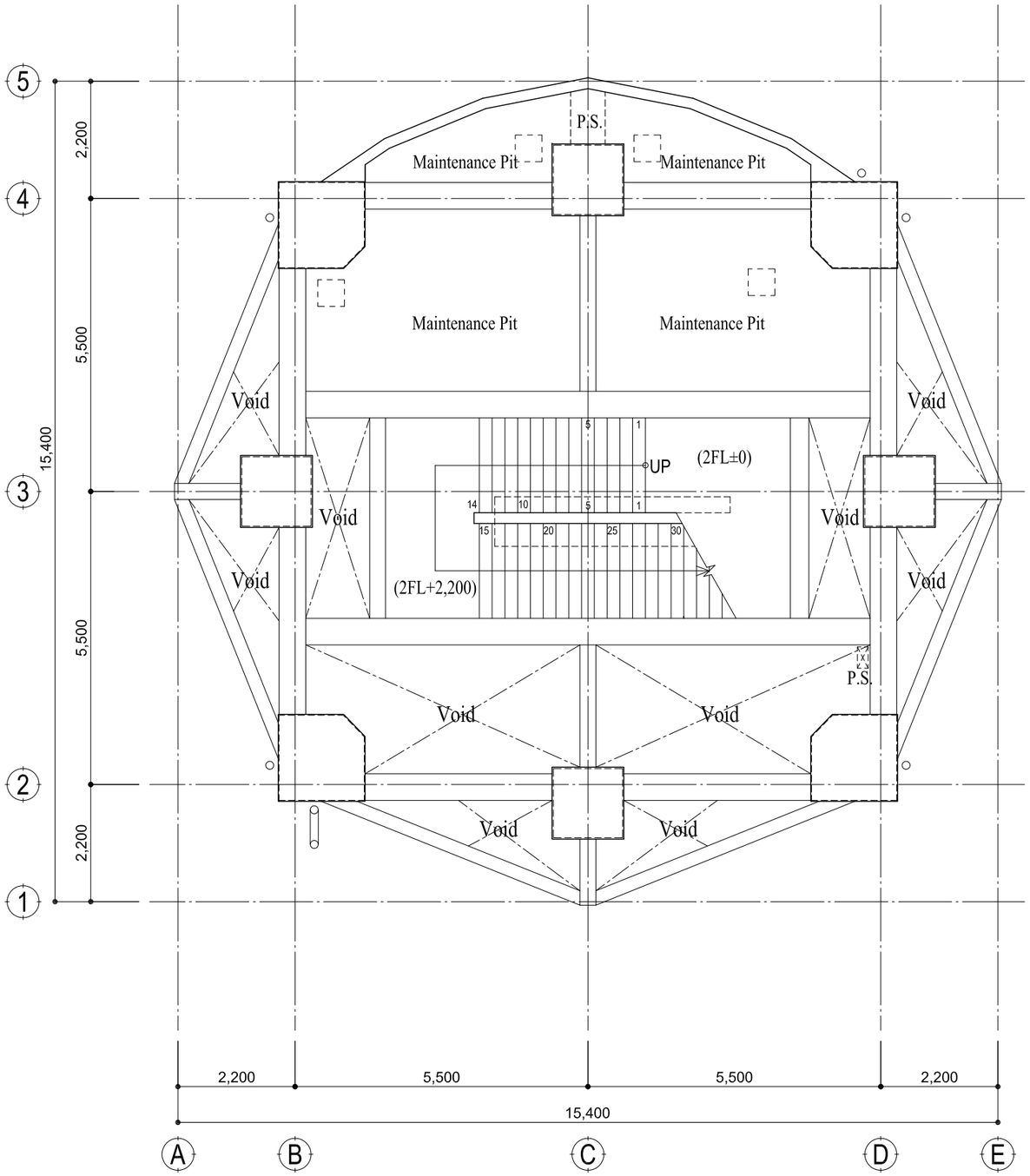
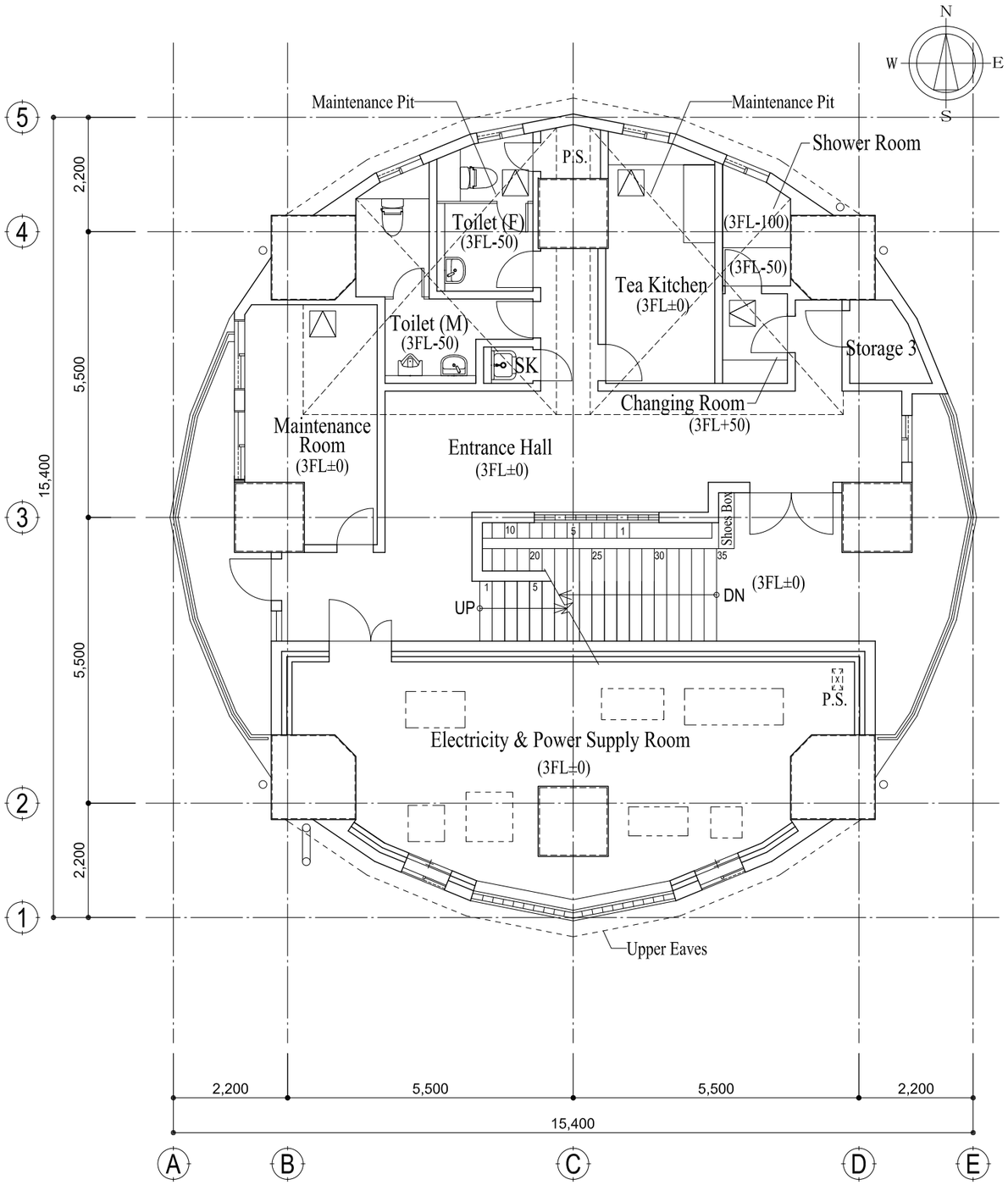


M2FL PLAN



3FL PLAN

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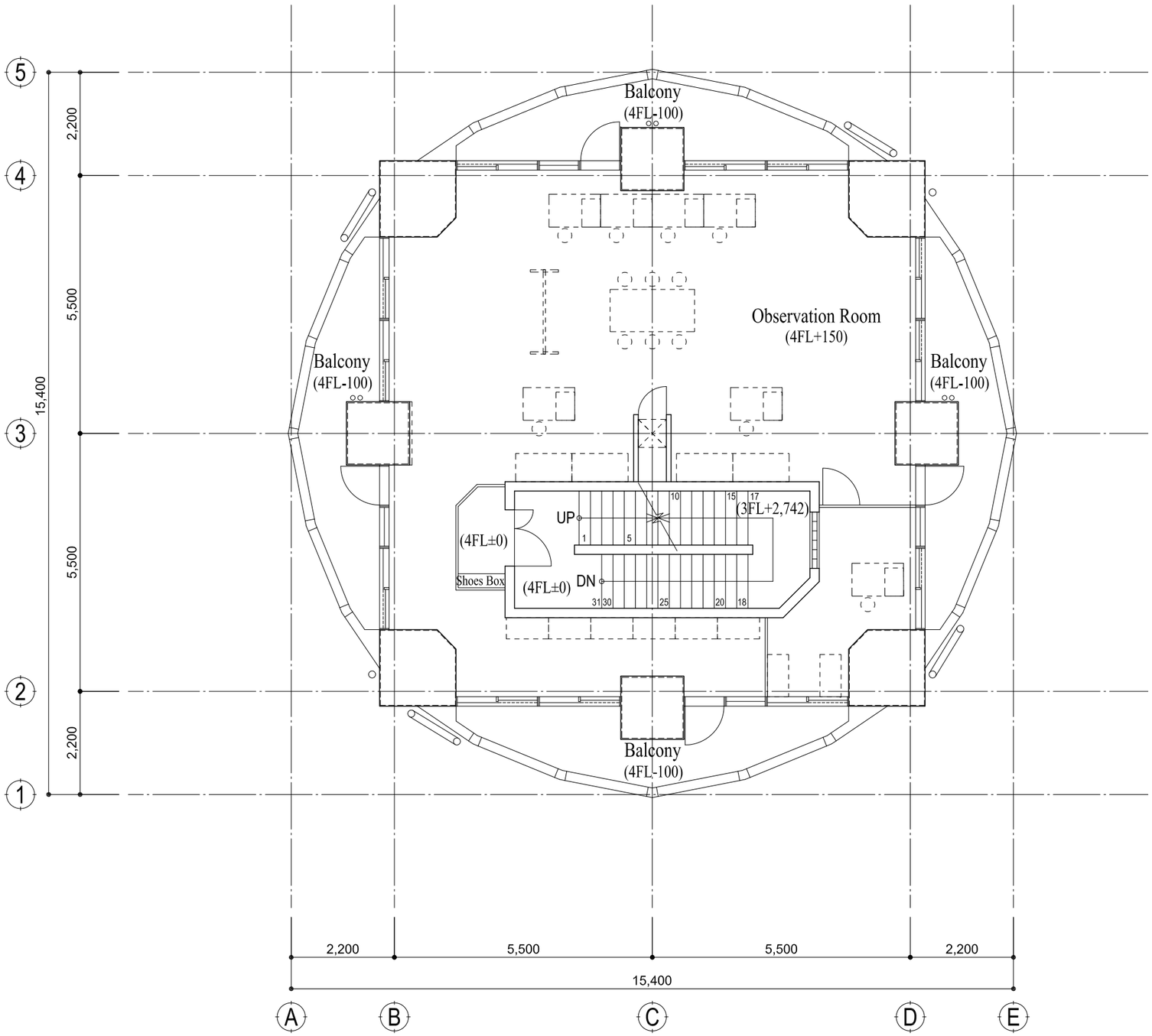

4FL PLAN

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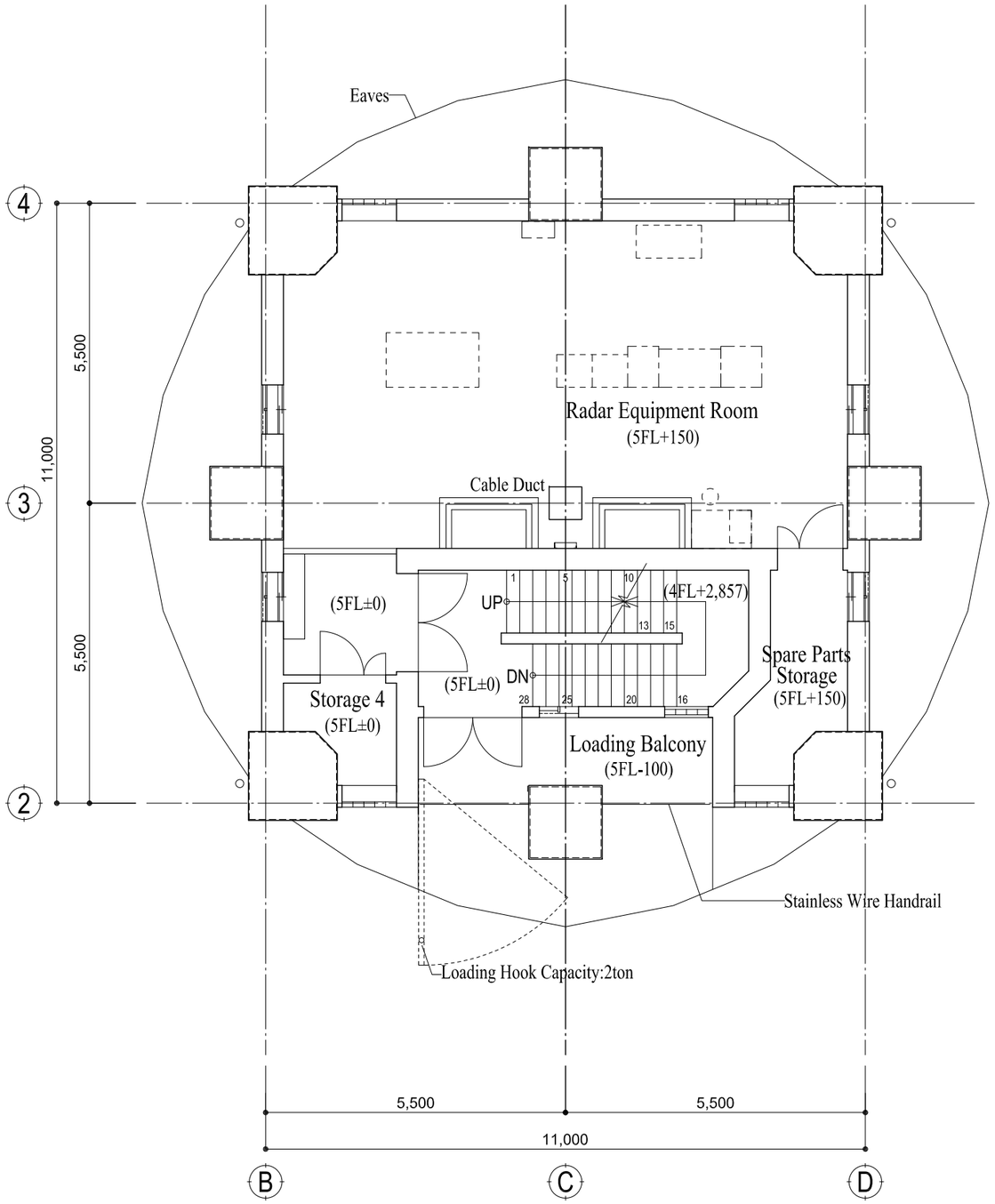
THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

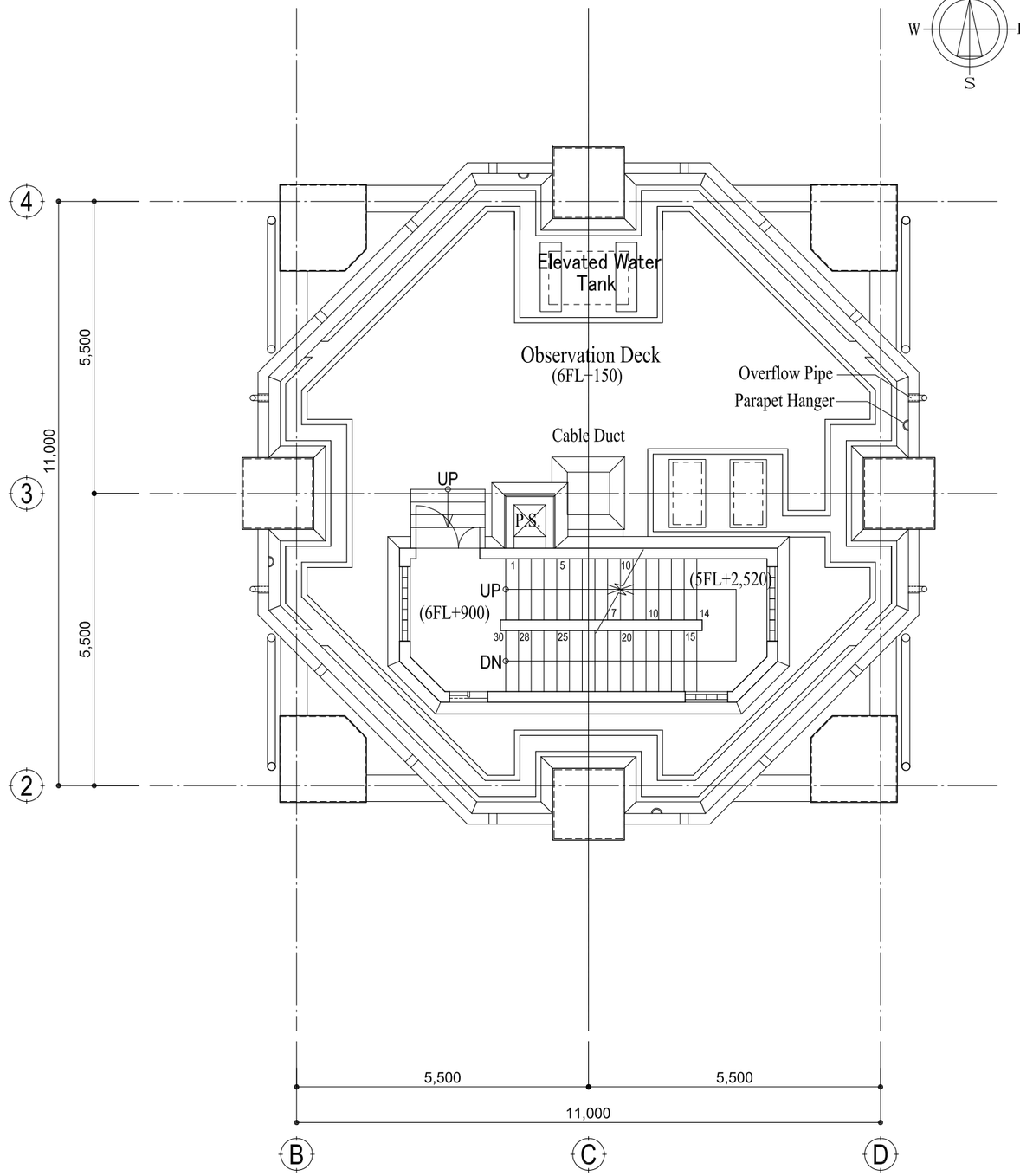
DRAWING TITLE
PUTTALAM METEOROLOGICAL RADAR TOWER BUILDING
FLOOR PLAN 4

SCALE
1:100

DRAWING No.
A - 04 (PUL)



5FL PLAN



6FL PLAN

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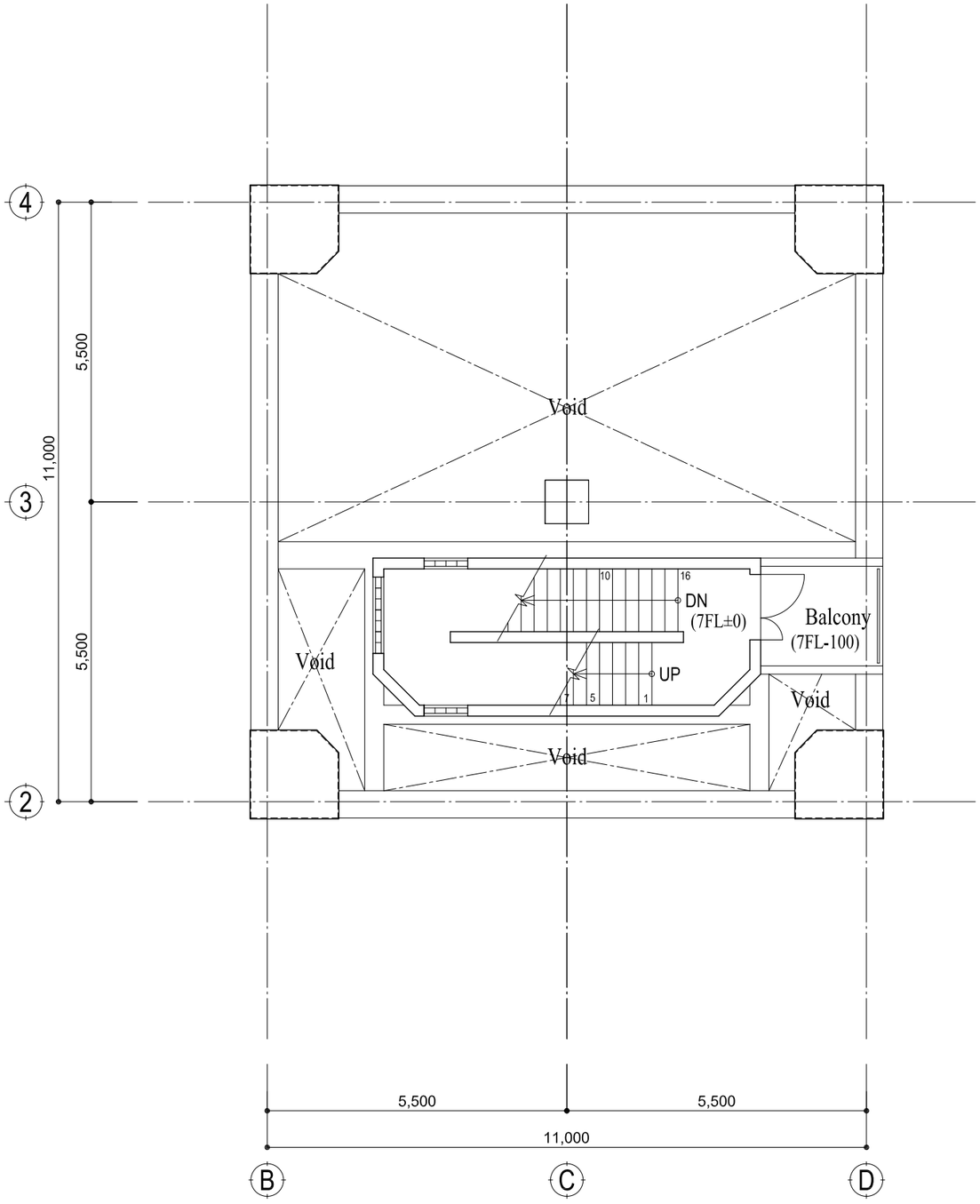
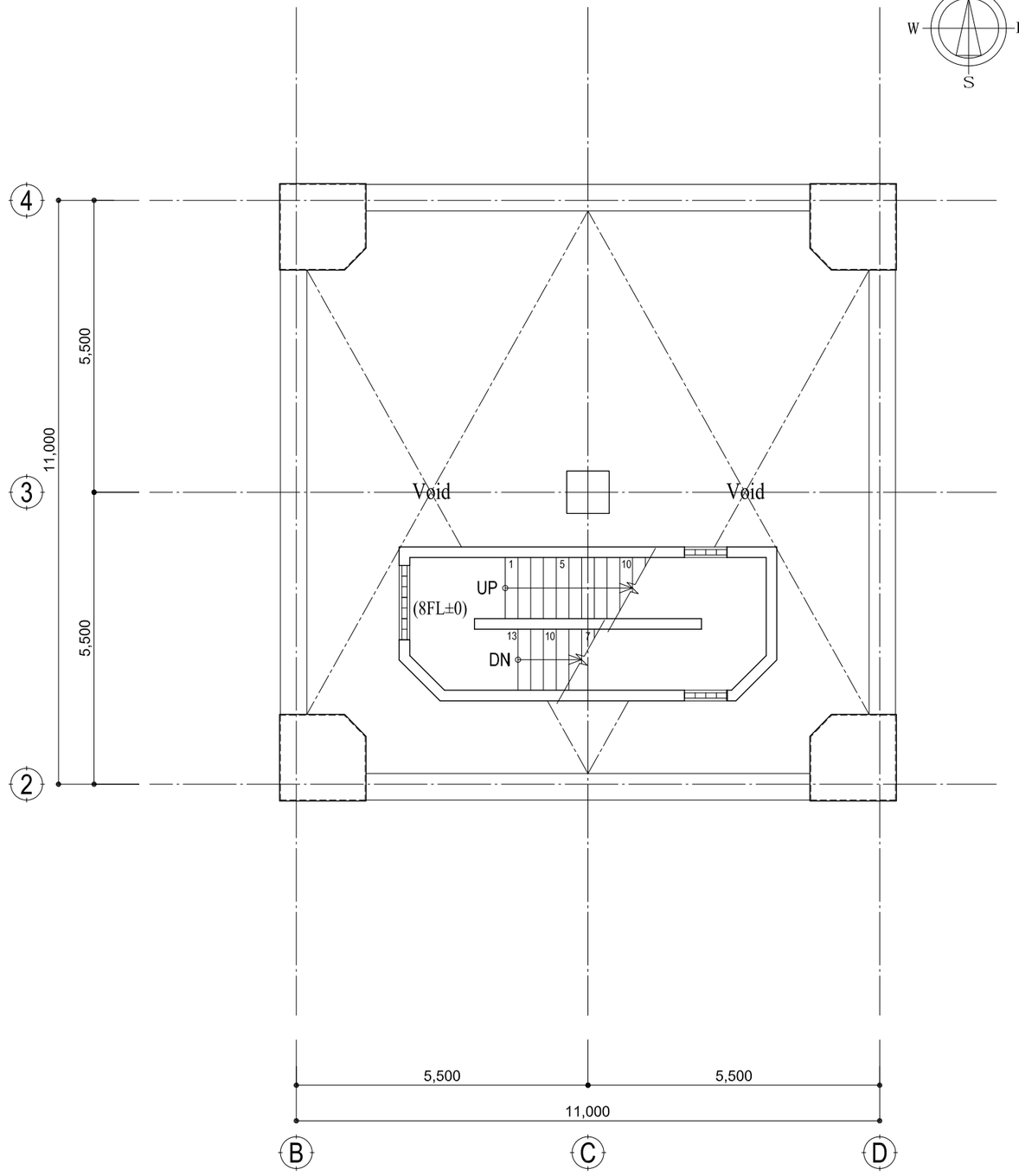


7FL PLAN



8FL PLAN

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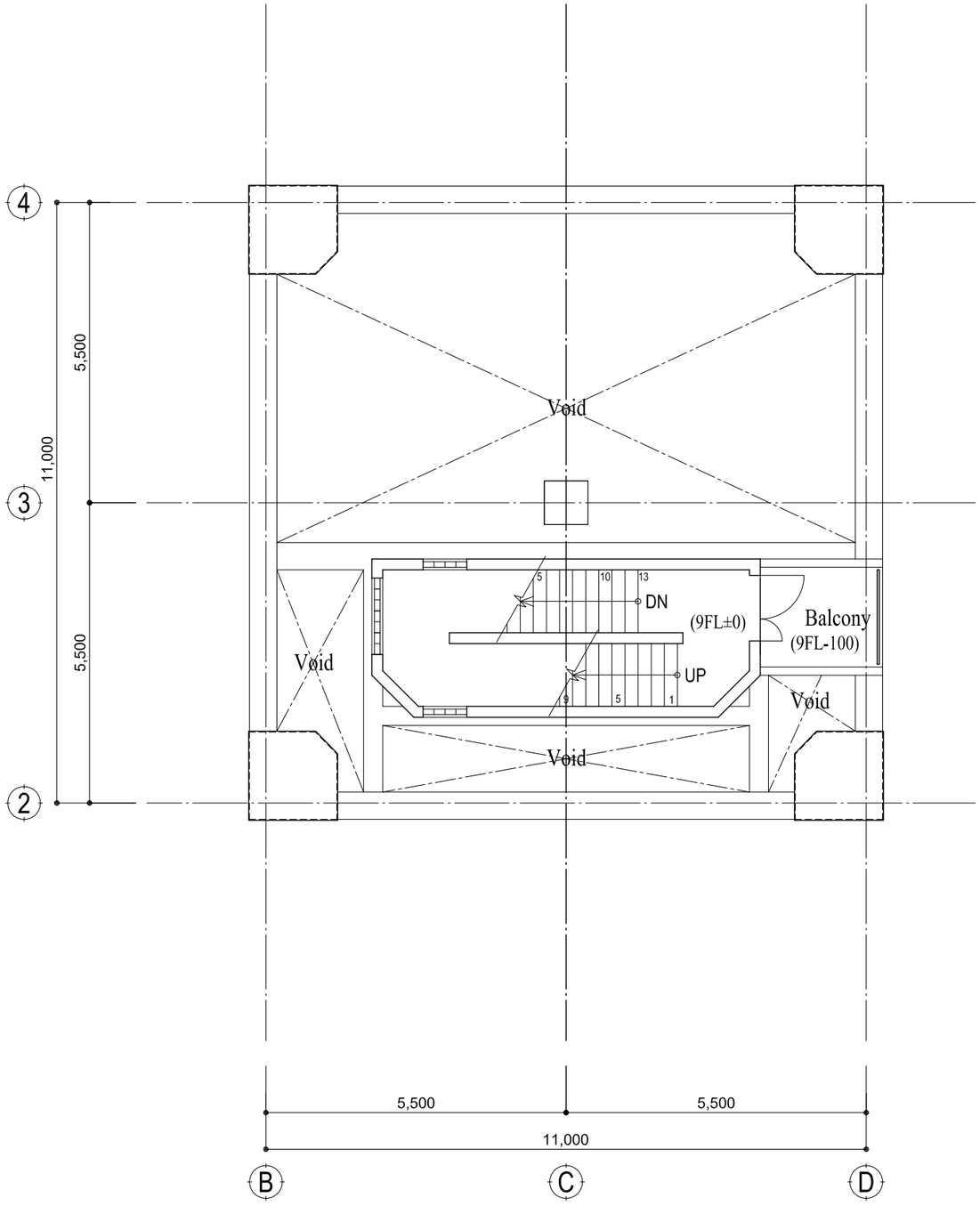
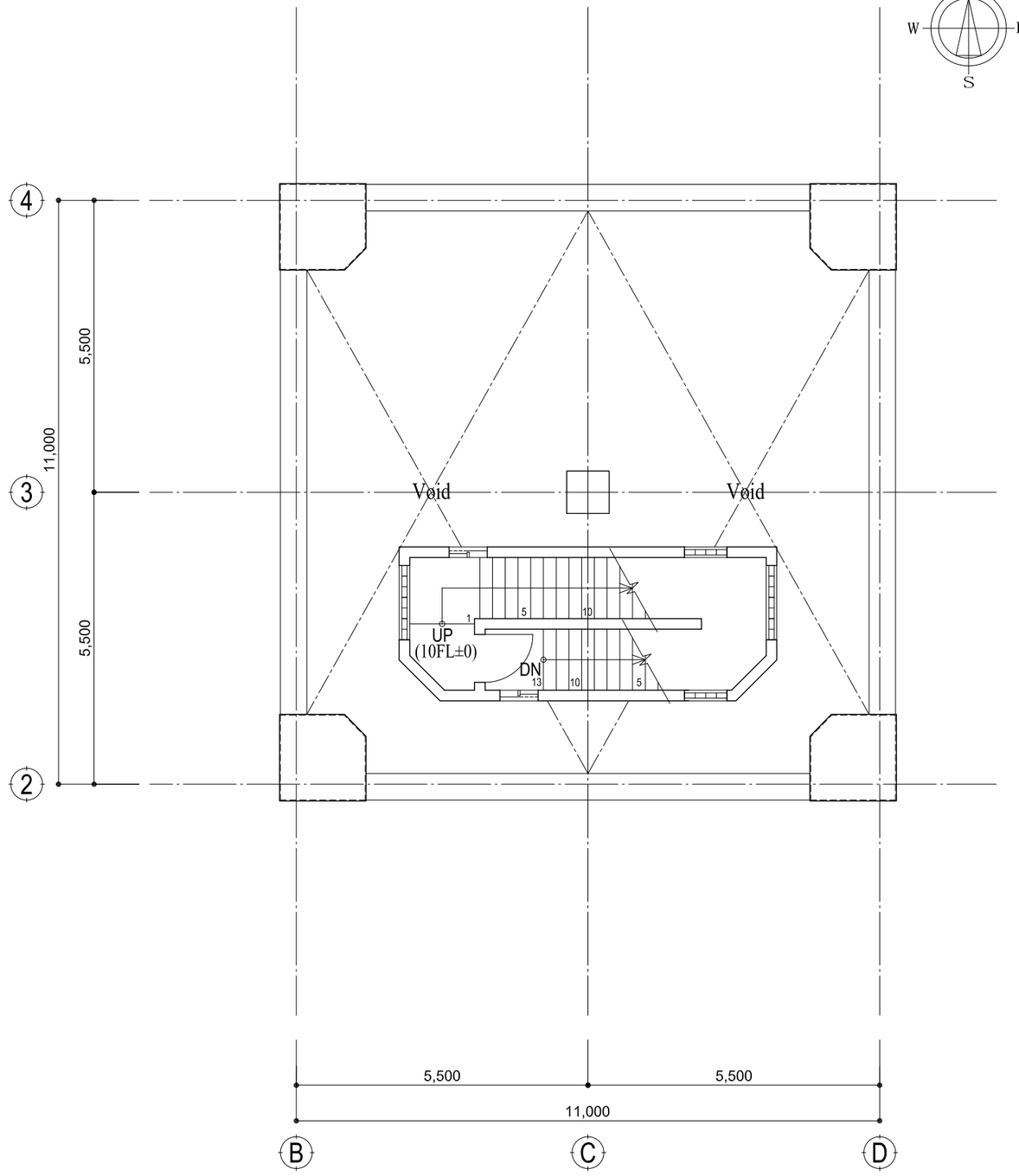


9FL PLAN



10FL PLAN

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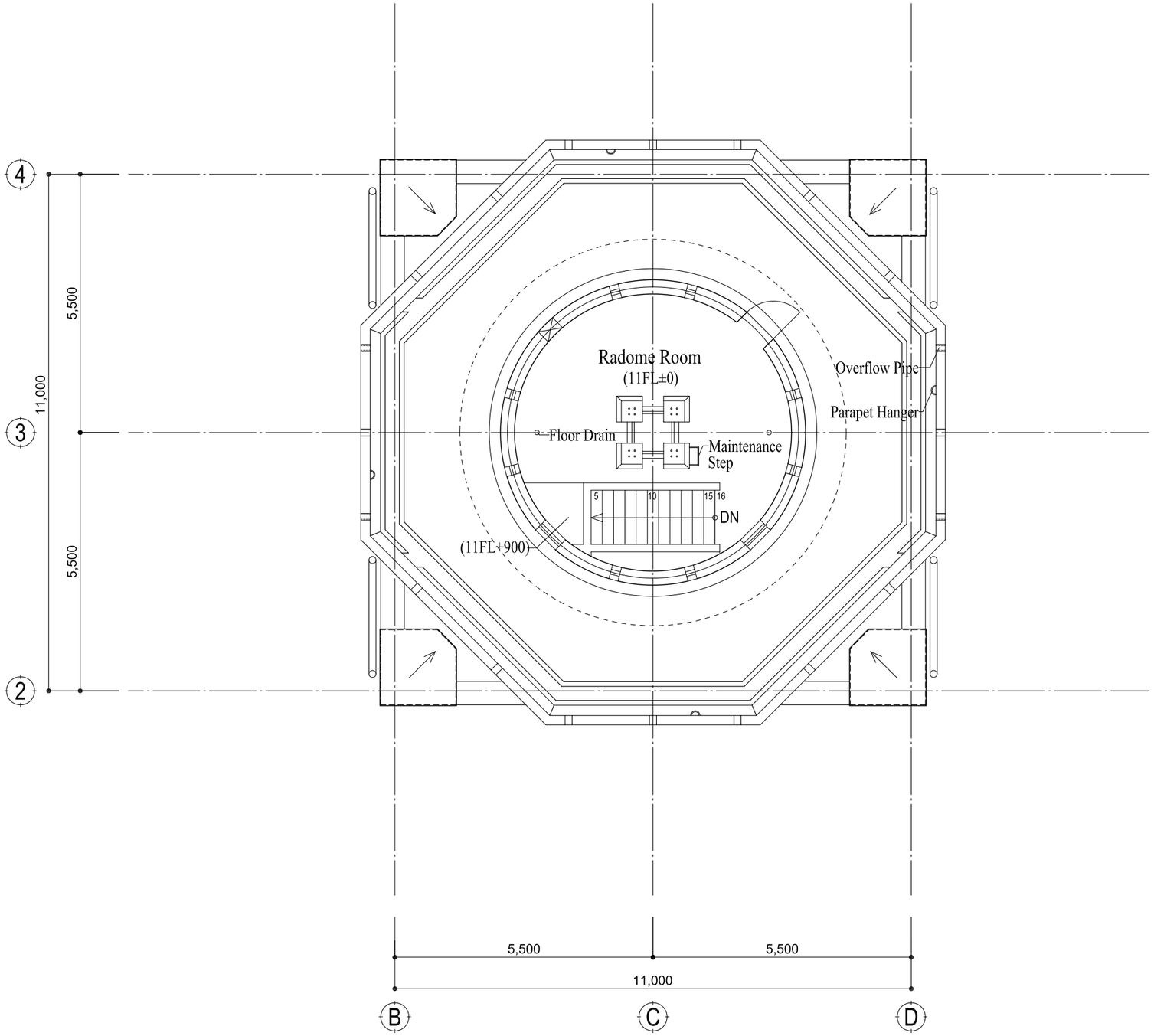

11FL PLAN

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THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

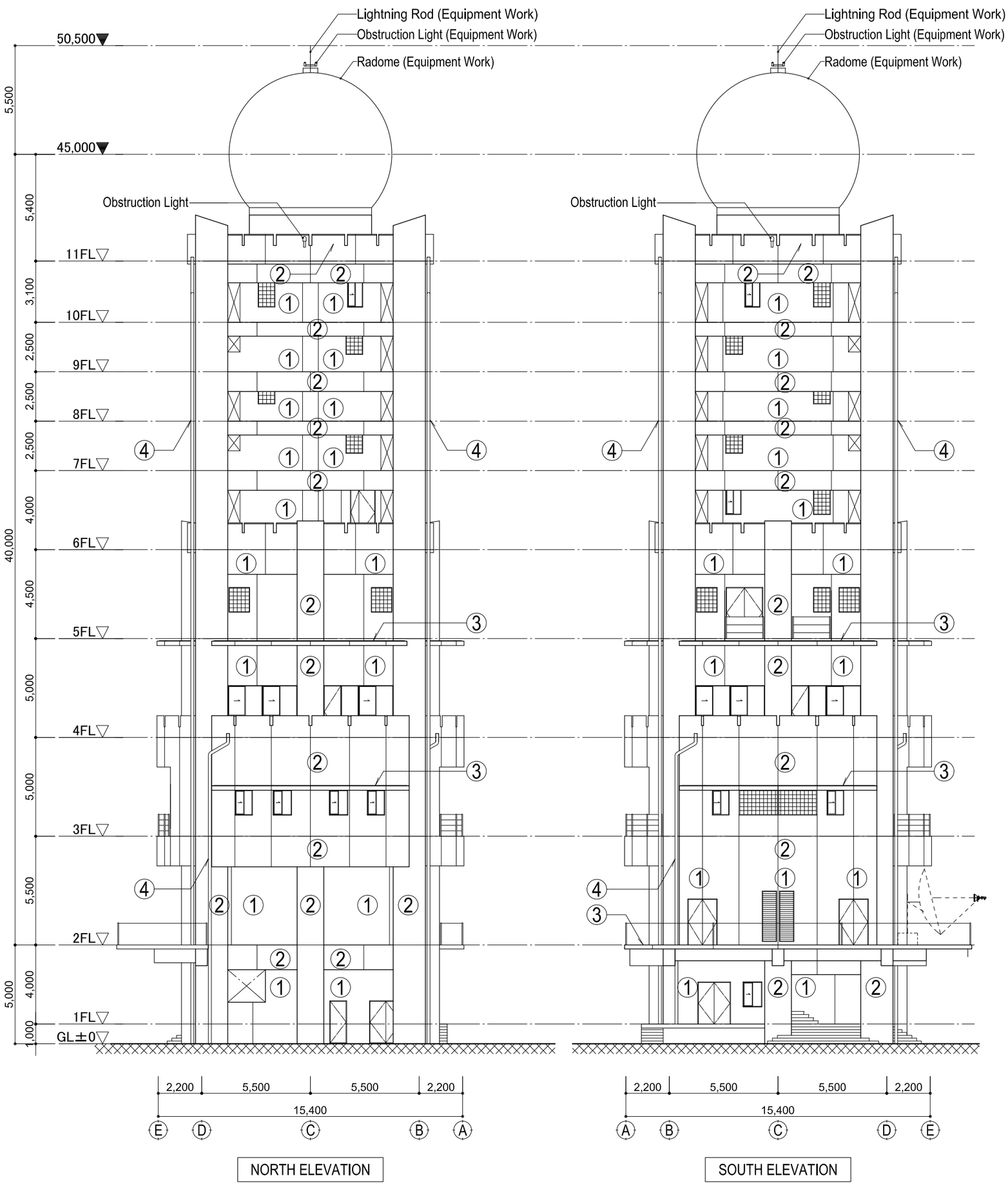
DRAWING TITLE
PUTTALAM METEOROLOGICAL RADAR TOWER BUILDING
ELEVATION 1

SCALE
1:200

DRAWING No.
A - 09 (PUL)

LEGEND

1	C.S. Mortar t=25 Spray Tile
2	Fair-faced Concrete, Mortar Mending, Spray Tile
3	Waterproof Mortar t=30, ERP
4	Rain Leader Pipe: Galvanized Steel Pipe 150A, Spray Tile
5	Overflow Pipe: Galvanized Steel Pipe 100A, Spray Tile



NORTH ELEVATION

SOUTH ELEVATION

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THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

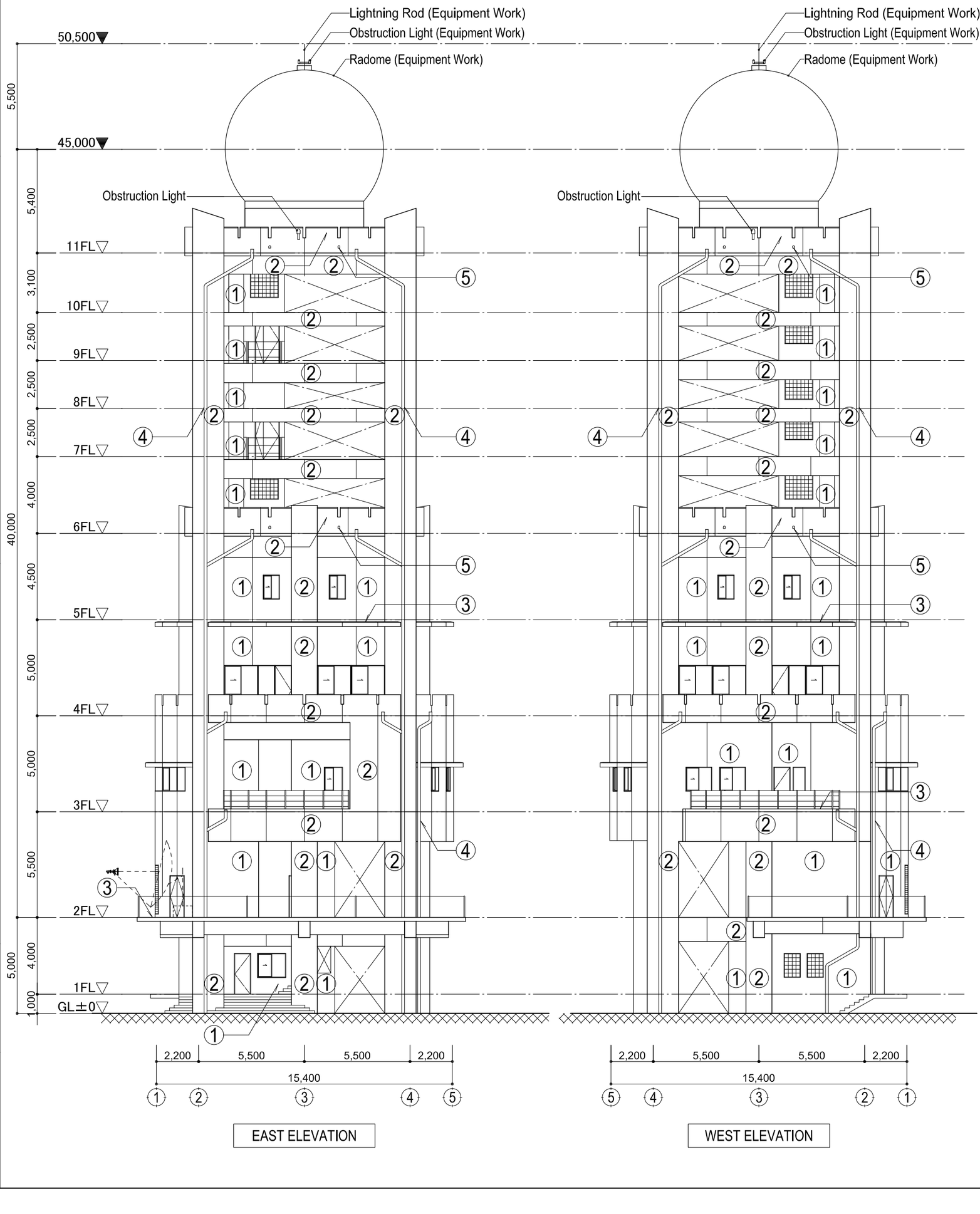
DRAWING TITLE
PUTTALAM METEOROLOGICAL RADAR TOWER BUILDING
ELEVATION 2

SCALE
1:200

DRAWING No.
A - 10 (PUL)

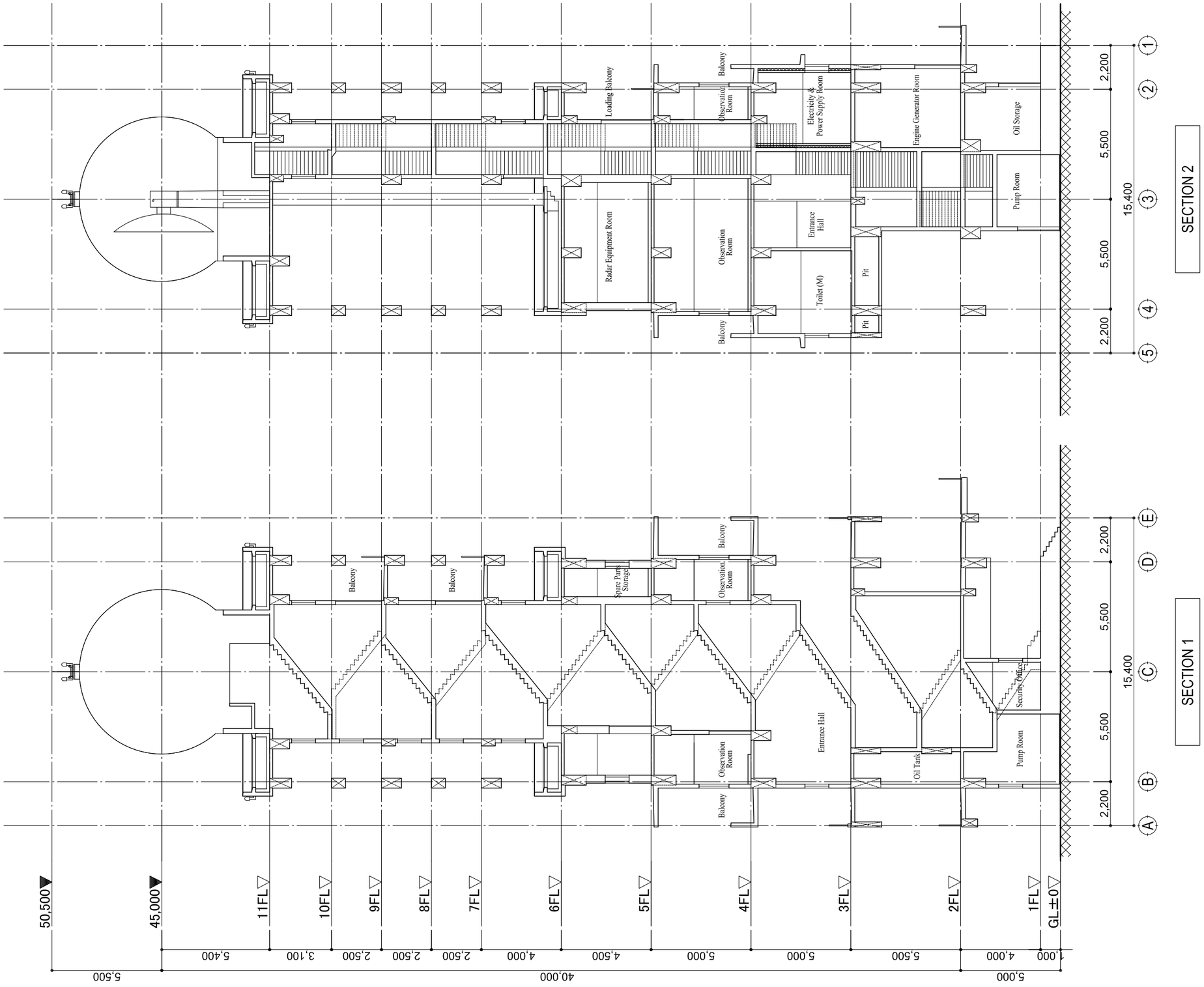
LEGEND

1	C.S. Mortar t=25 Spray Tile
2	Fair-faced Concrete, Mortar Mending, Spray Tile
3	Waterproof Mortar t=30, ERP
4	Rain Leader Pipe: Galvanized Steel Pipe 150A, Spray Tile
5	Overflow Pipe: Galvanized Steel Pipe 100A, Spray Tile



EAST ELEVATION

WEST ELEVATION



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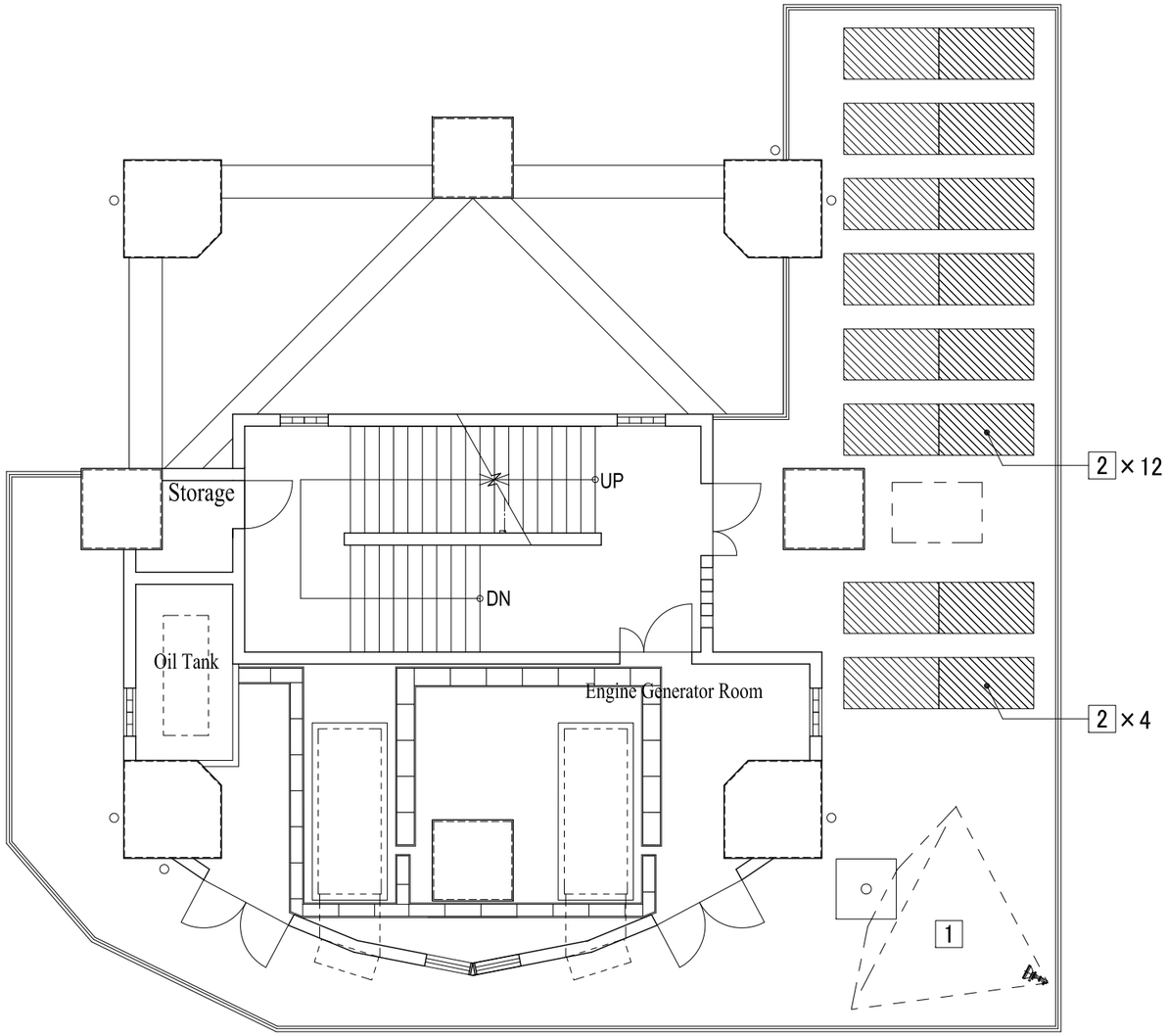

EQUIPMENT (EQUIPMENT WORK)

1	VSAT Antenna
2	Solar Panel

N
W E
S

2FL PLAN

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THE PROJECT FOR
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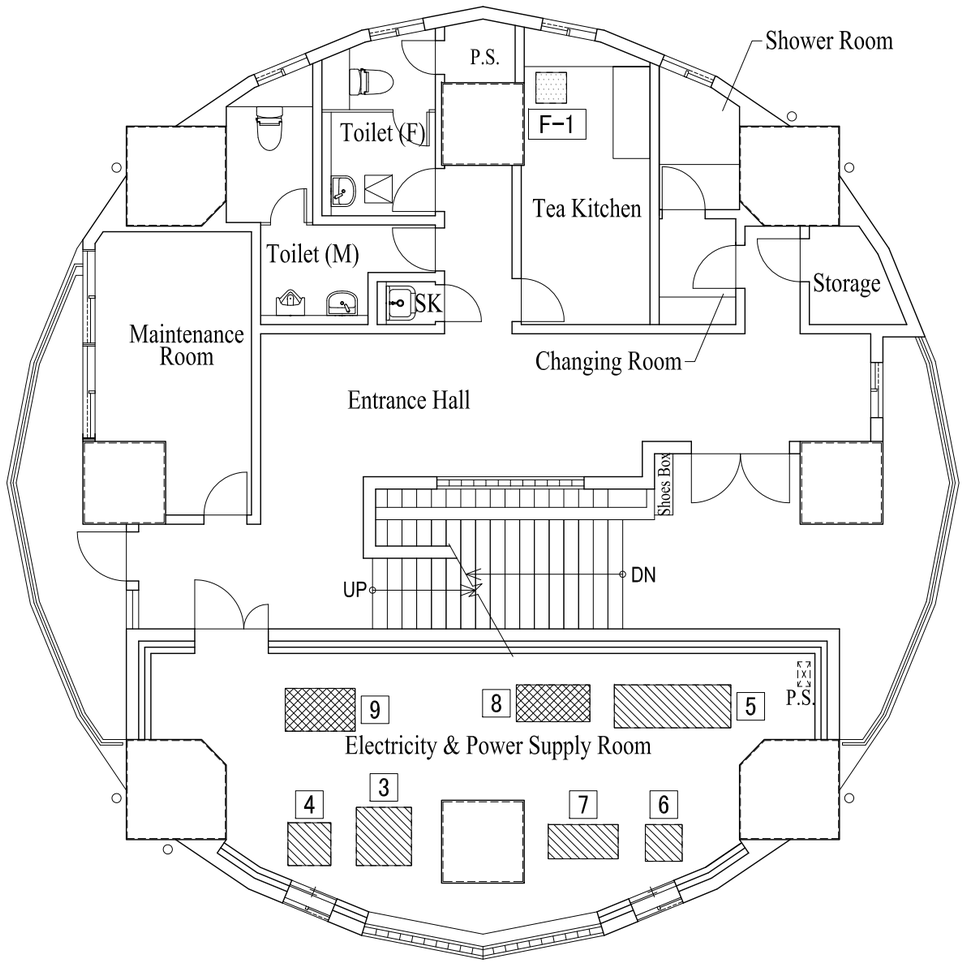
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
PUTTALAM METEOROLOGICAL RADAR TOWER BUILDING
EQUIPMENT LAYOUT PLAN 1

SCALE
1:100

DRAWING No.
EQ - 01 (PUL)



3FL PLAN

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S

EQUIPMENT (EQUIPMENT WORK)

3	Radar Automatic Voltage Regulator
4	Radar Isolation Transformer
5	Power Supply Capacitor
6	Emergency Power Backup Unit
7	Emergency Power Backup Battery

EQUIPMENT (CONSTRUCTION WORK)

8	Automatic Voltage Regulator
9	Isolation Transformer

FURNITURE (CONSTRUCTION WORK)

F-1	Water Dispenser

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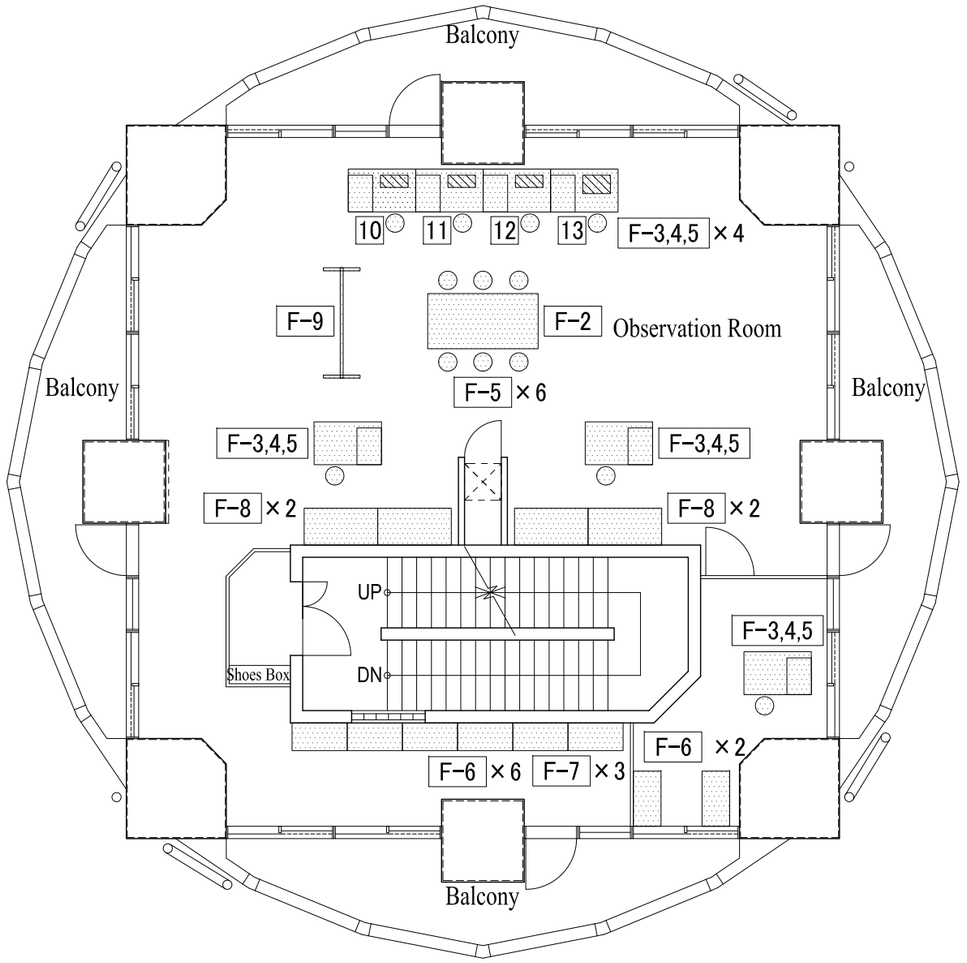
THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
PUTTALAM METEOROLOGICAL RADAR TOWER BUILDING
EQUIPMENT LAYOUT PLAN 2

SCALE
1:100

DRAWING No.
EQ - 02 (PUL)



4FL PLAN

EQUIPMENT (EQUIPMENT WORK)

10	Product Indicator 1(Rainfall Intensity,Dual-Polarization)
11	Product Indicator 2(Doppler Velocity)
12	Remote Monitoring Display
13	Colour Printer

FURNITURE (CONSTRUCTION WORK)

F-2	Meeting Table(W900×L1,800)
F-3	Pedestal-free Desk(W1,100×D700)
F-4	Drawer Unit with Casters
F-5	Chair
F-6	Lateral Filling Cabinet H1,100
F-7	Cabinet(Double Hinged Doors)H1,000
F-8	Shelves(Double Hinged Doors)H1,800
F-9	White Board : W1,800×H900

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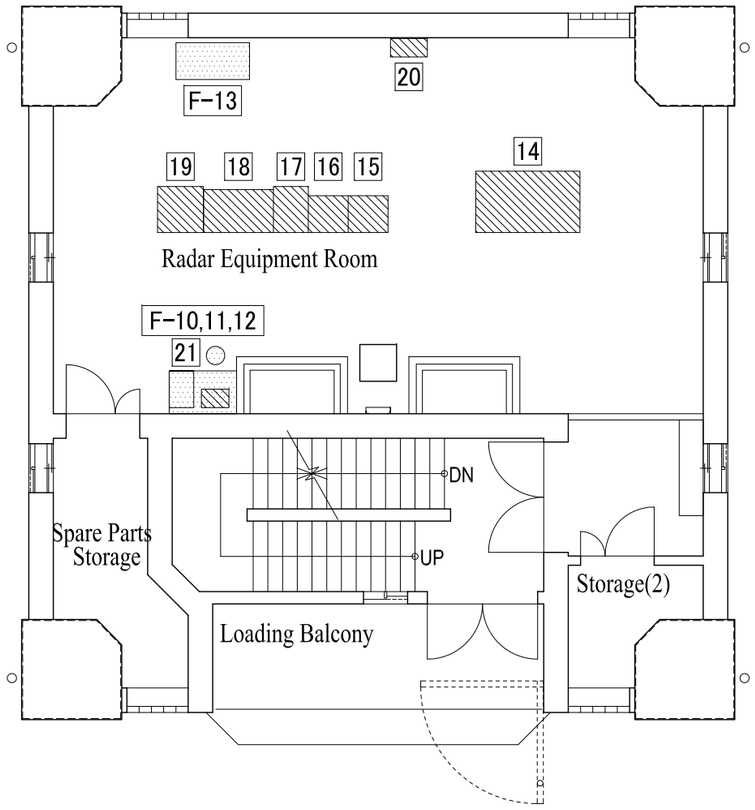
DRAWING TITLE
PUTTALAM METEOROLOGICAL RADAR TOWER BUILDING
EQUIPMENT LAYOUT PLAN 3

SCALE
1:100

DRAWING No.
EQ - 03 (PUL)



7FL PLAN

EQUIPMENT (EQUIPMENT WORK)

14	Transmitter
15	Antenna Controller & Dehydrator
16	DRSP
17	Data & Protocol Converter
18	Radar TASK Controller
19	VSAT In-Door Unit (IDU)
20	Radar Power Maintenance Panel
21	Colour Printer

FURNITURE (CONSTRUCTION WORK)

F-10	Pedestal-free Desk (W1,100 × D700)
F-11	Drawer Unit with Casters
F-12	Chair
F-13	Shelves(Double Hinged Doors) H1,800

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THE PROJECT FOR
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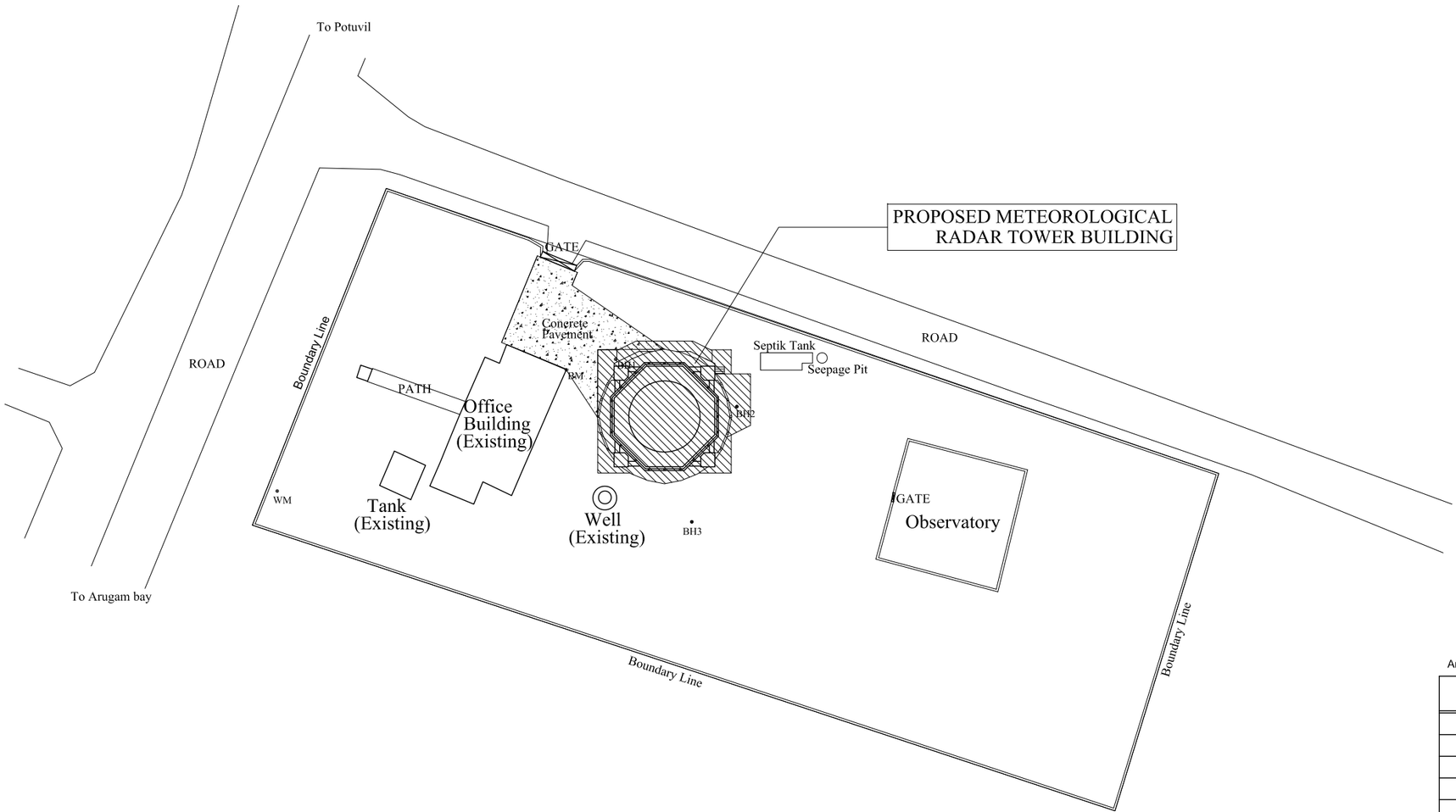
DRAWING TITLE
PUTTALAM METEOROLOGICAL RADAR TOWER BUILDING
EQUIPMENT LAYOUT PLAN 4

SCALE
1:100

DRAWING No.
EQ - 04 (PUL)



Area Calculations

Floor	Floor Area (m2)	Construction Area (m2)
1FL	43.97	219.06
2FL	100.38	242.36
M2FL	—	57.13
3FL	162.00	179.46
4FL	131.10	179.46
5FL	121.00	183.32
6FL	18.17	133.76
7FL	18.17	121.00
8FL	18.17	121.00
9FL	30.19	133.76
Total	643.15 m2	1,570.31 m2
Building Coverage Area	162.00 m2	—

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THE PROJECT FOR
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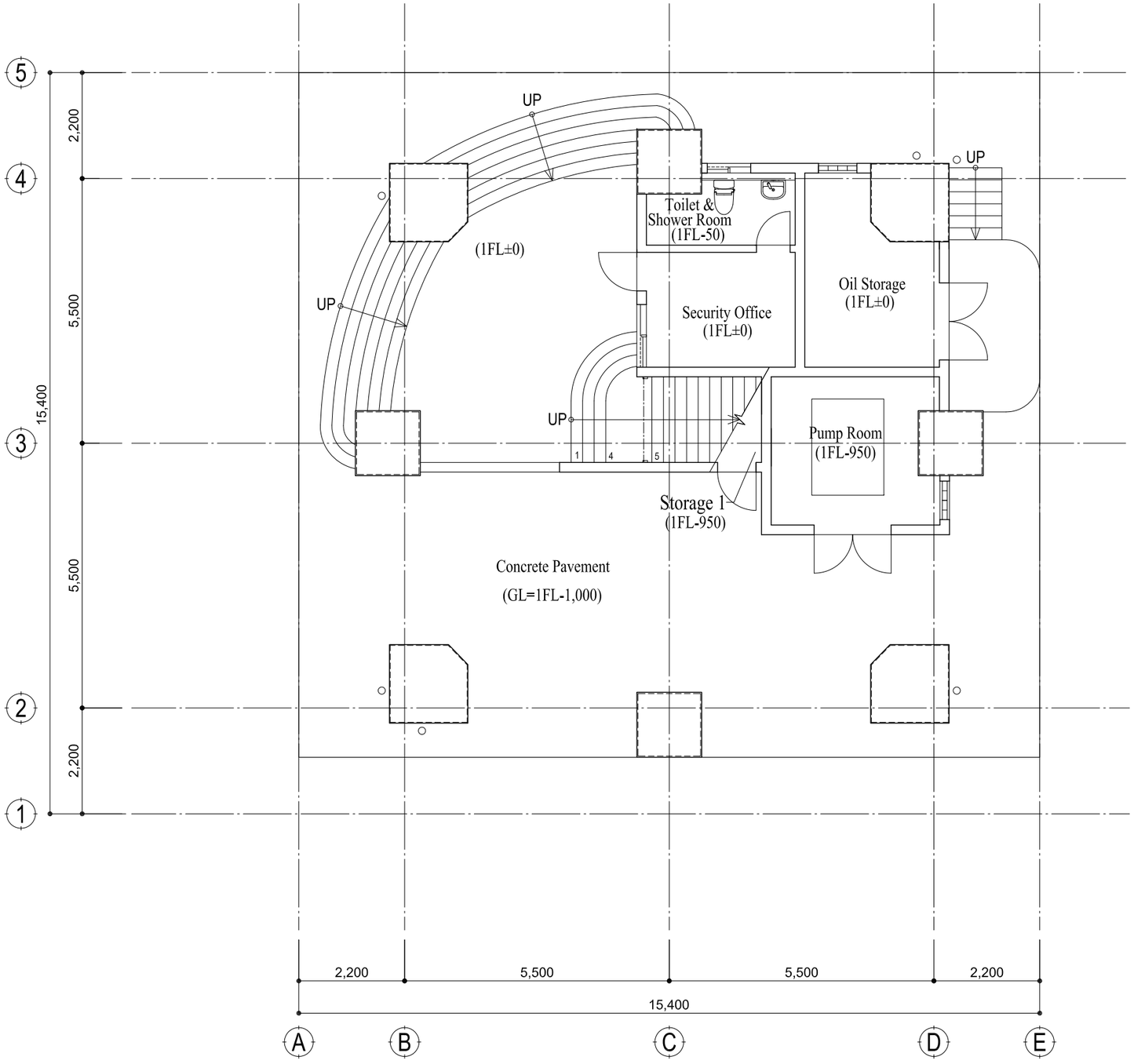
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING
SITE PLAN

SCALE
1:600

DRAWING No.
A - 00 (POV)



1FL PLAN

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THE PROJECT FOR
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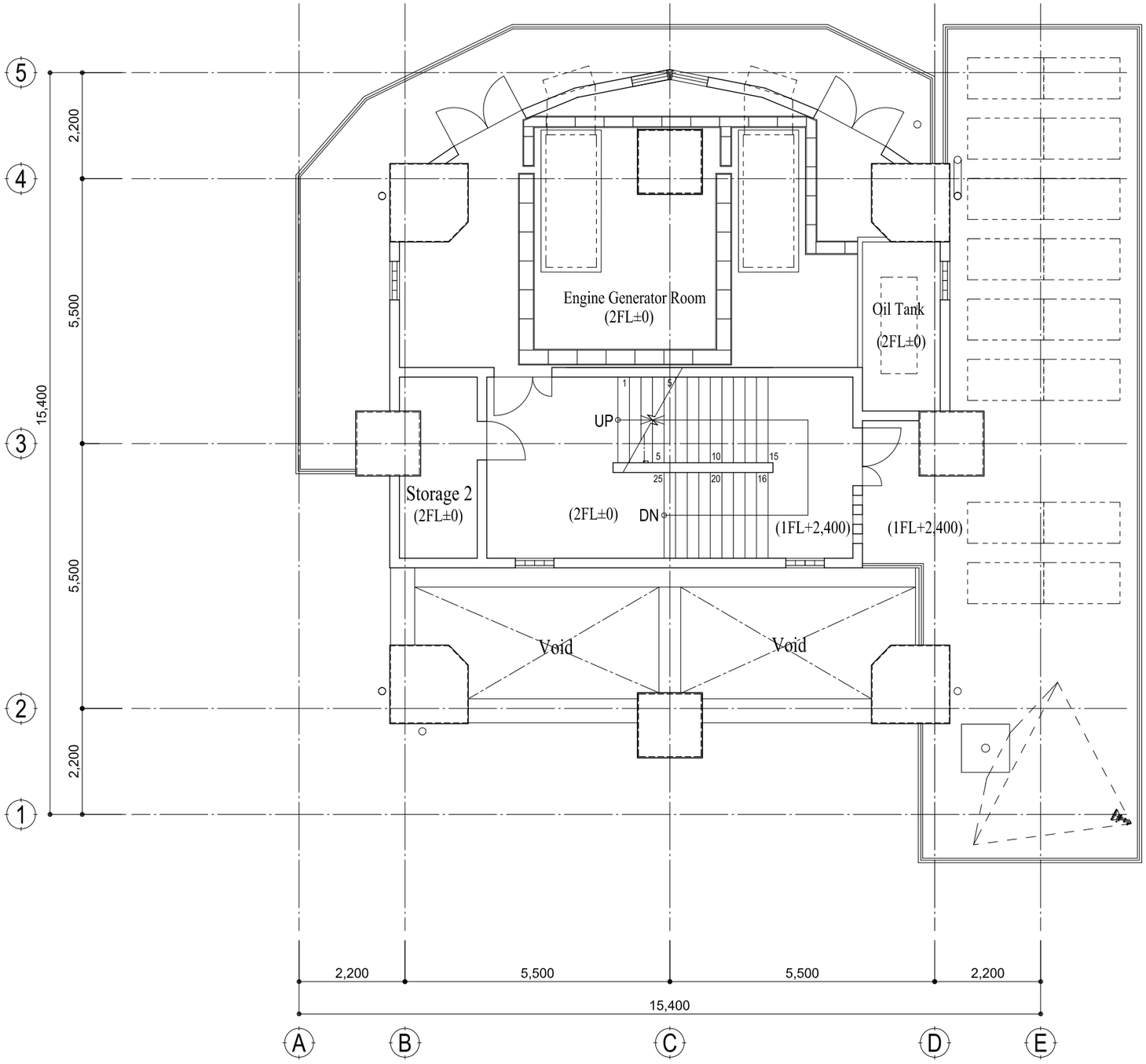
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING
FLOOR PLAN 1

SCALE
1:100

DRAWING No.
A - 01 (POV)



2FL PLAN

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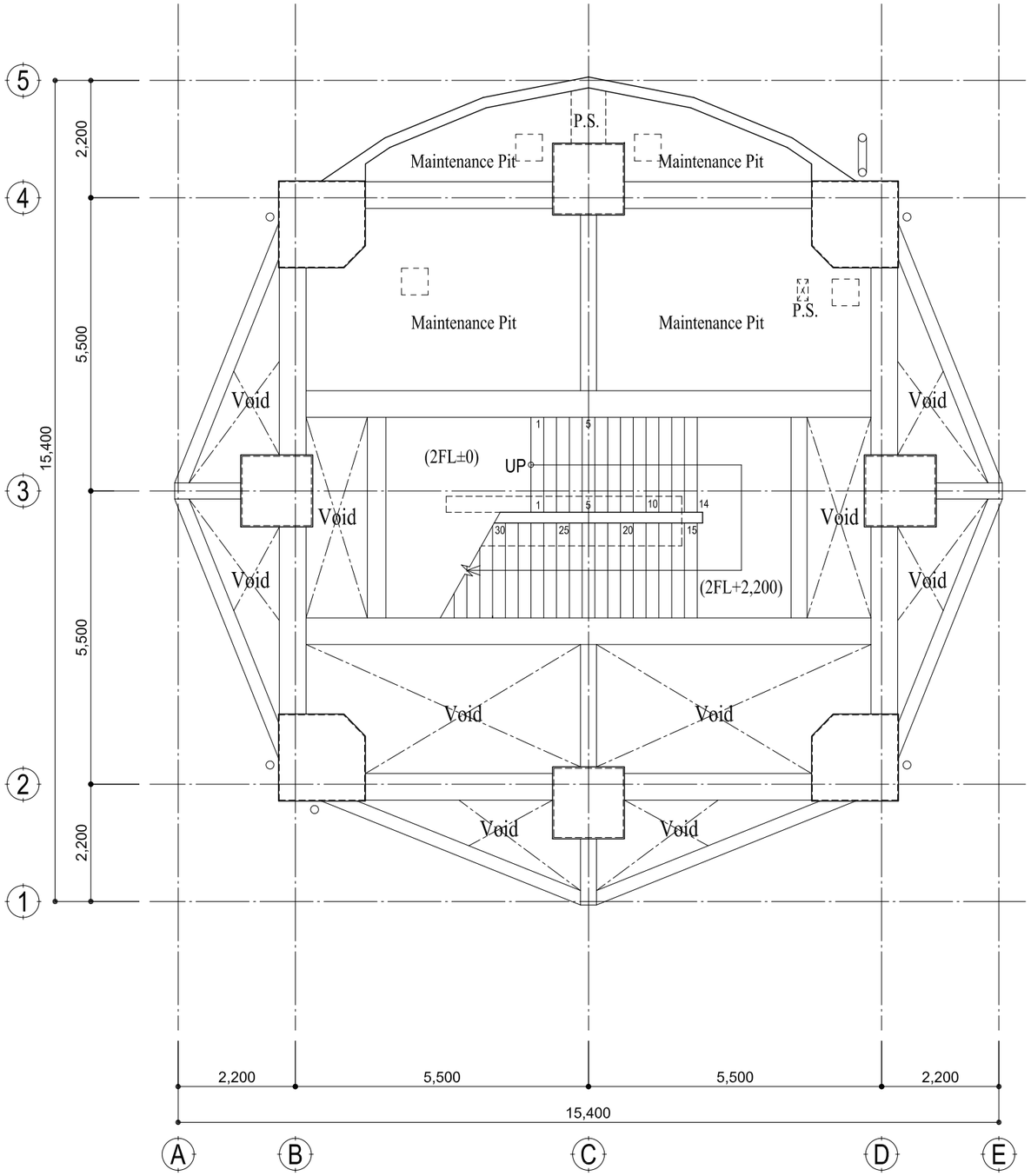
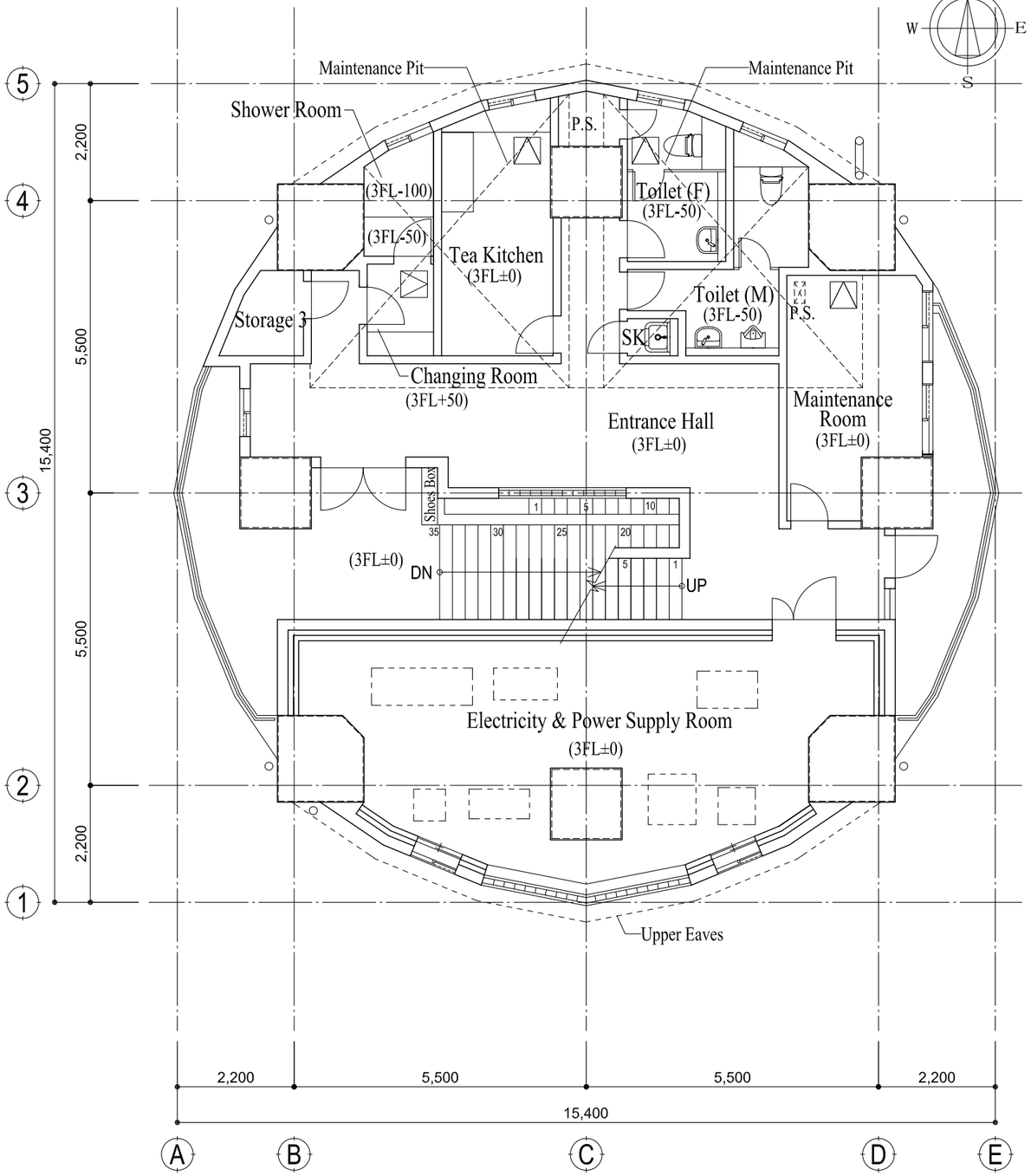
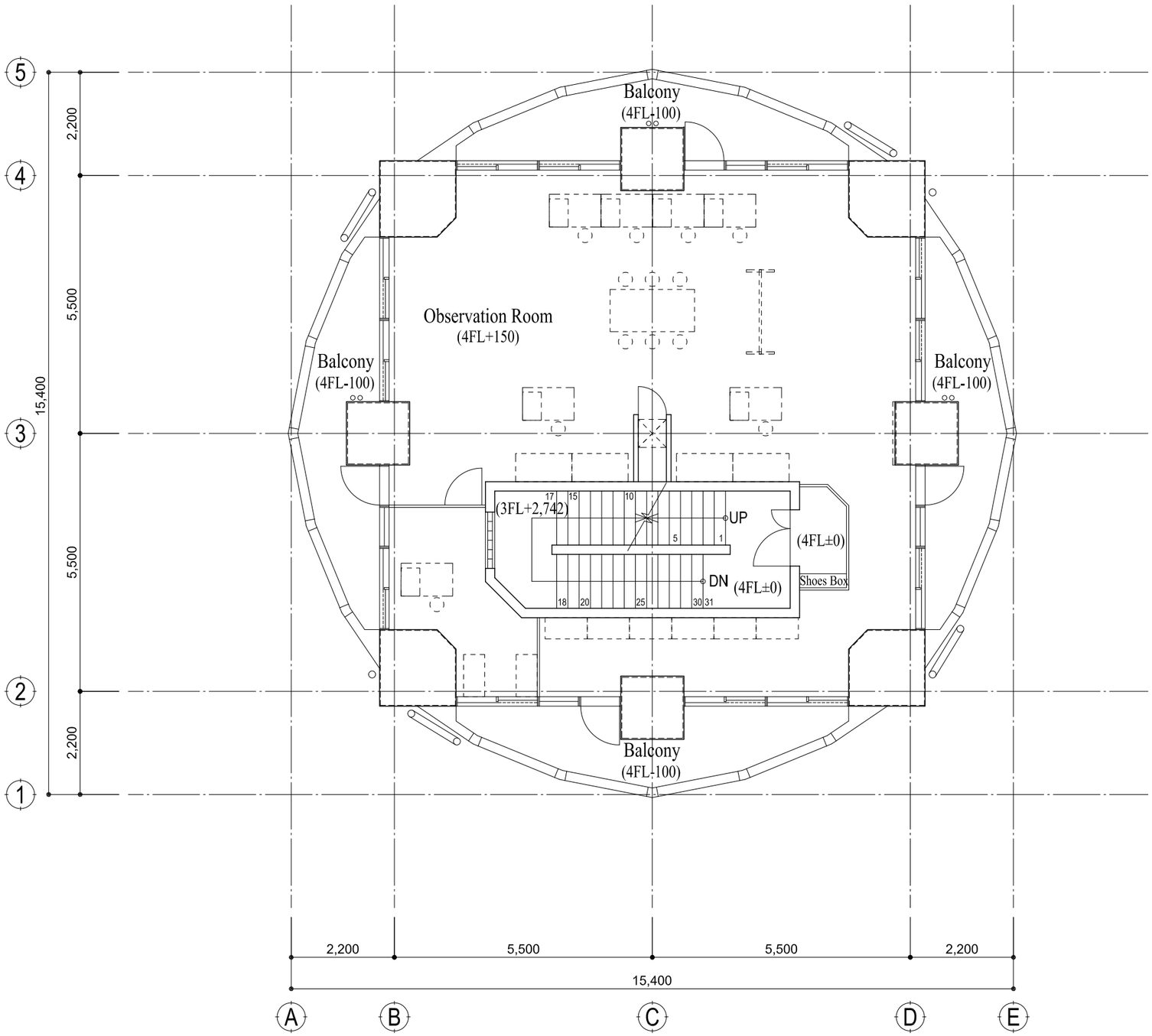


M2FL PLAN



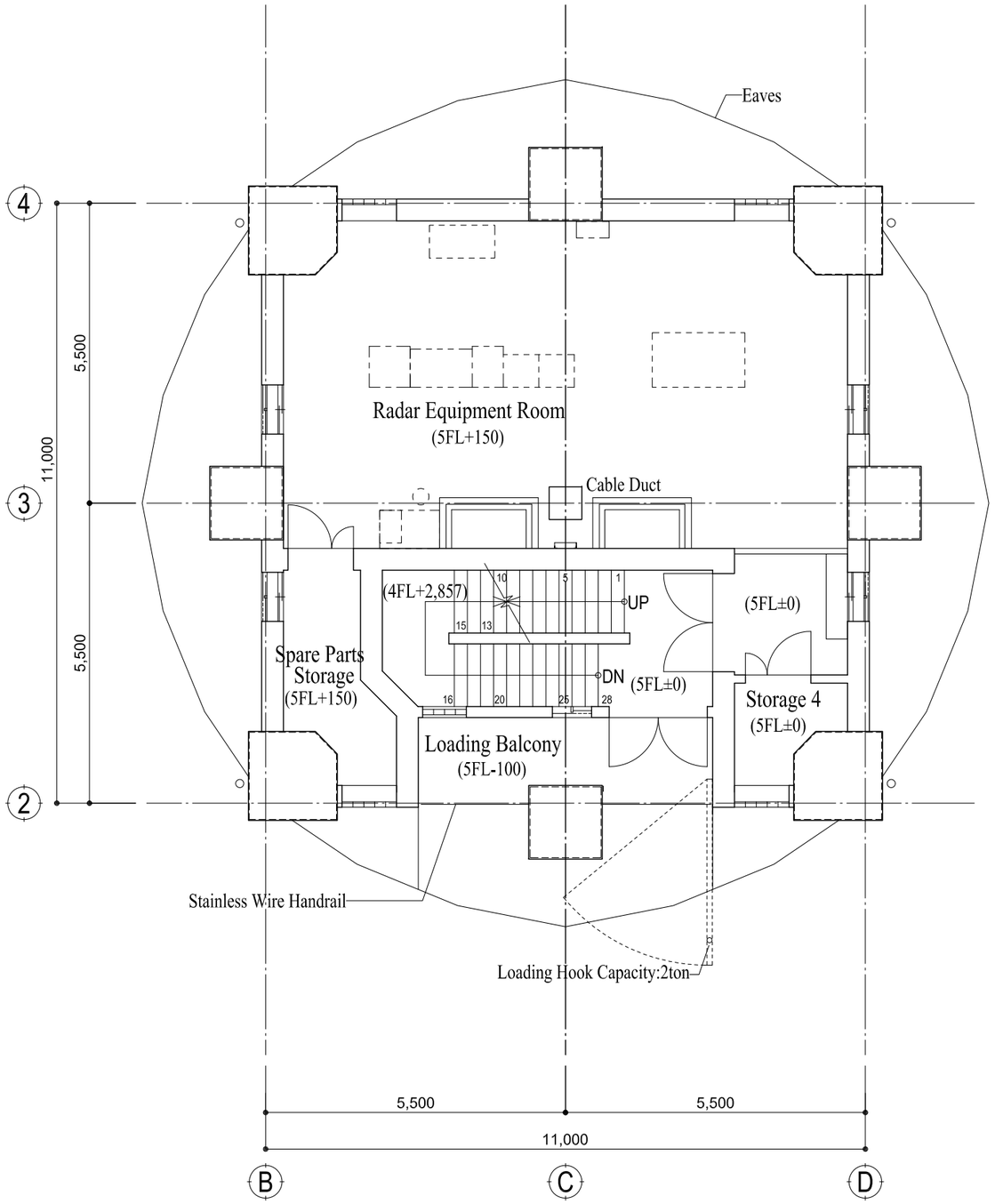
3FL PLAN

International Meteorological Consultant Inc. Sankyo Meguro Bdg. 4F, 4-5-37, Kamiosaki, Shinagawa-ku, Tokyo, 141-0021 Japan Tel. +81-3-6431-9559 Fax. +81-3-6431-9759	THE PROJECT FOR THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA	DRAWING TITLE POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING FLOOR PLAN 3	SCALE 1:100	DRAWING No. A - 03 (POV)

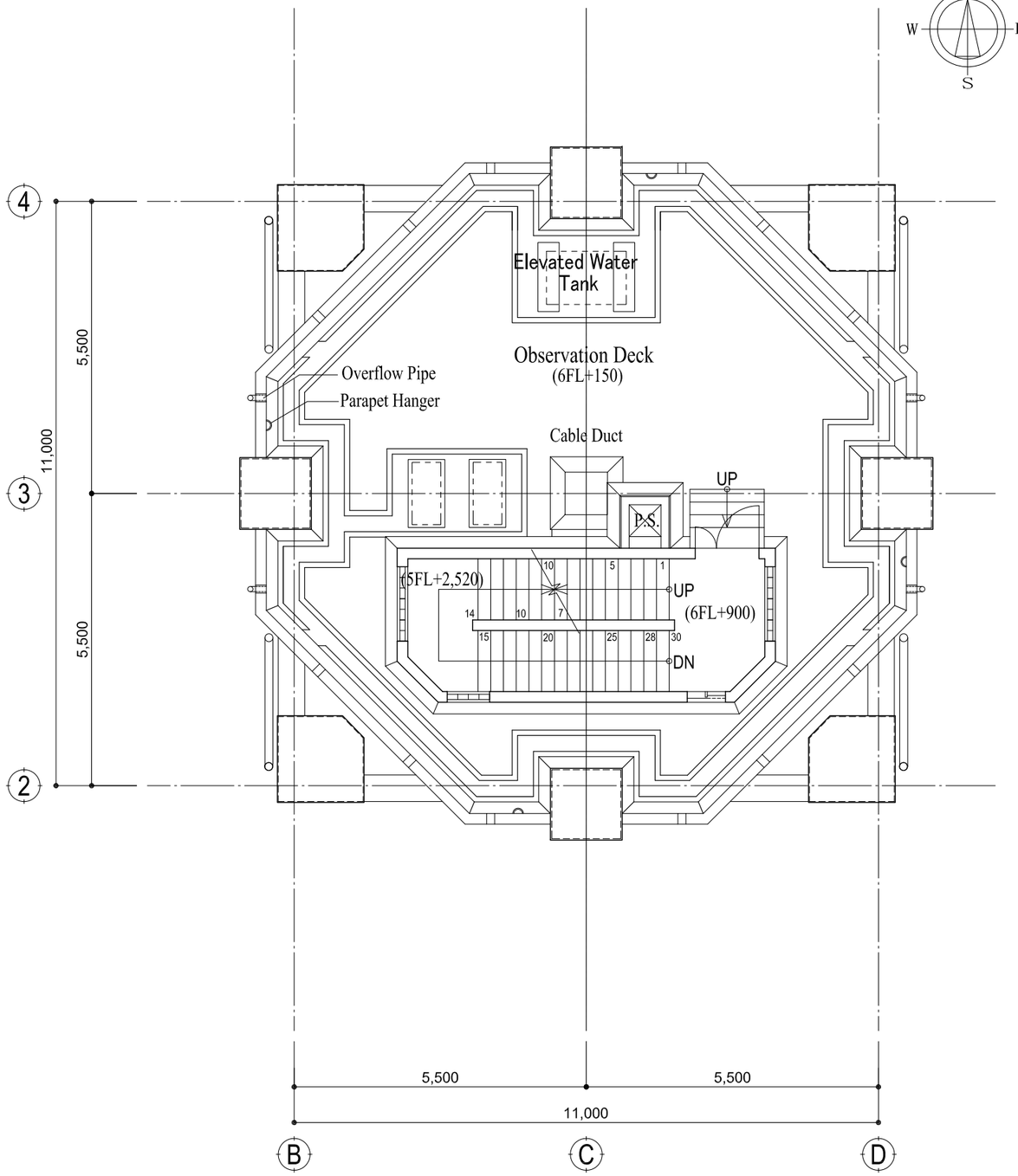


4FL PLAN

International Meteorological Consultant Inc. Sankyo Meguro Bdg. 4F, 4-5-37, Kamiosaki, Shinagawa-ku, Tokyo, 141-0021 Japan Tel. +81-3-6431-9559 Fax. +81-3-6431-9759	THE PROJECT FOR THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA	DRAWING TITLE POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING FLOOR PLAN 4	SCALE 1:100	DRAWING No. A - 04 (POV)



5FL PLAN



6FL PLAN

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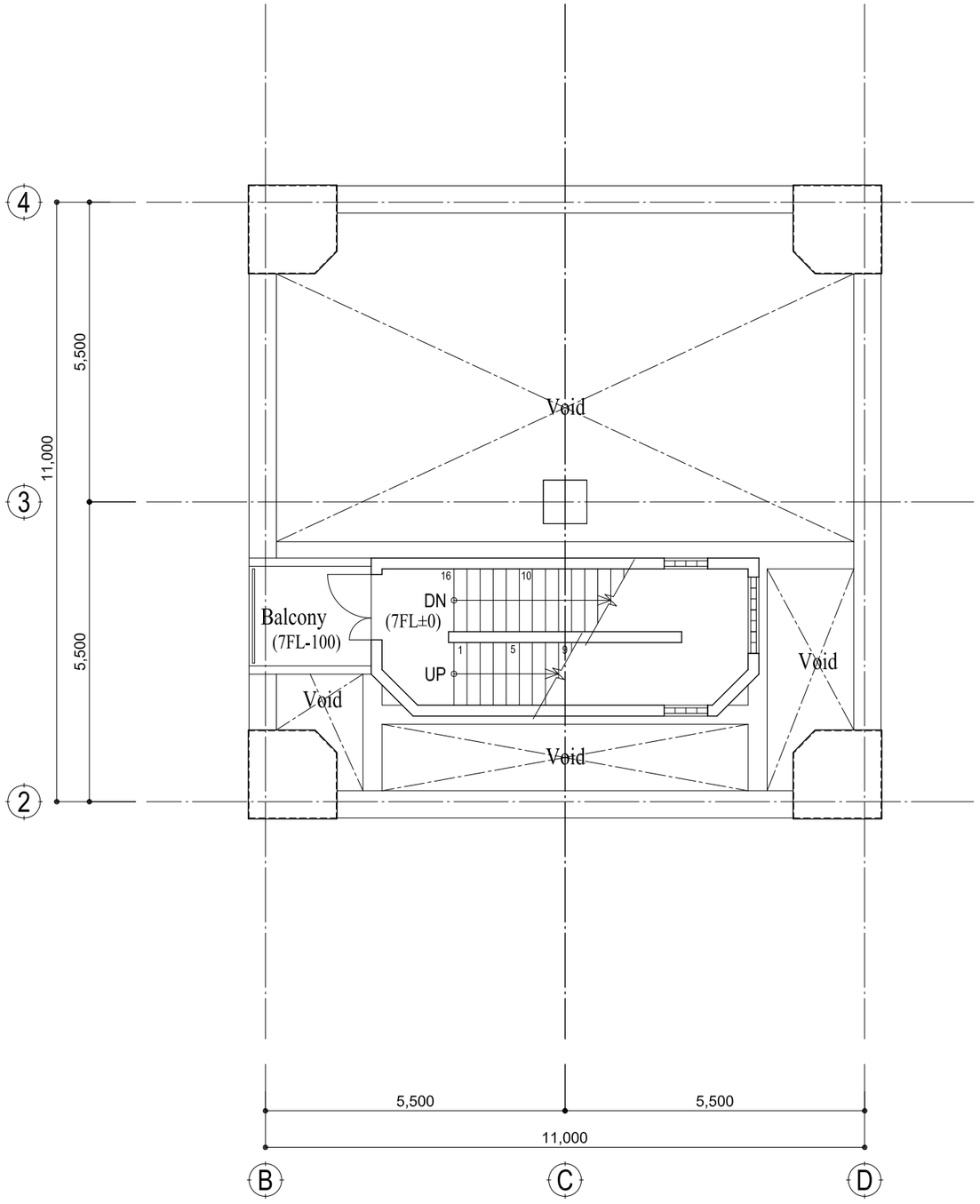
THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

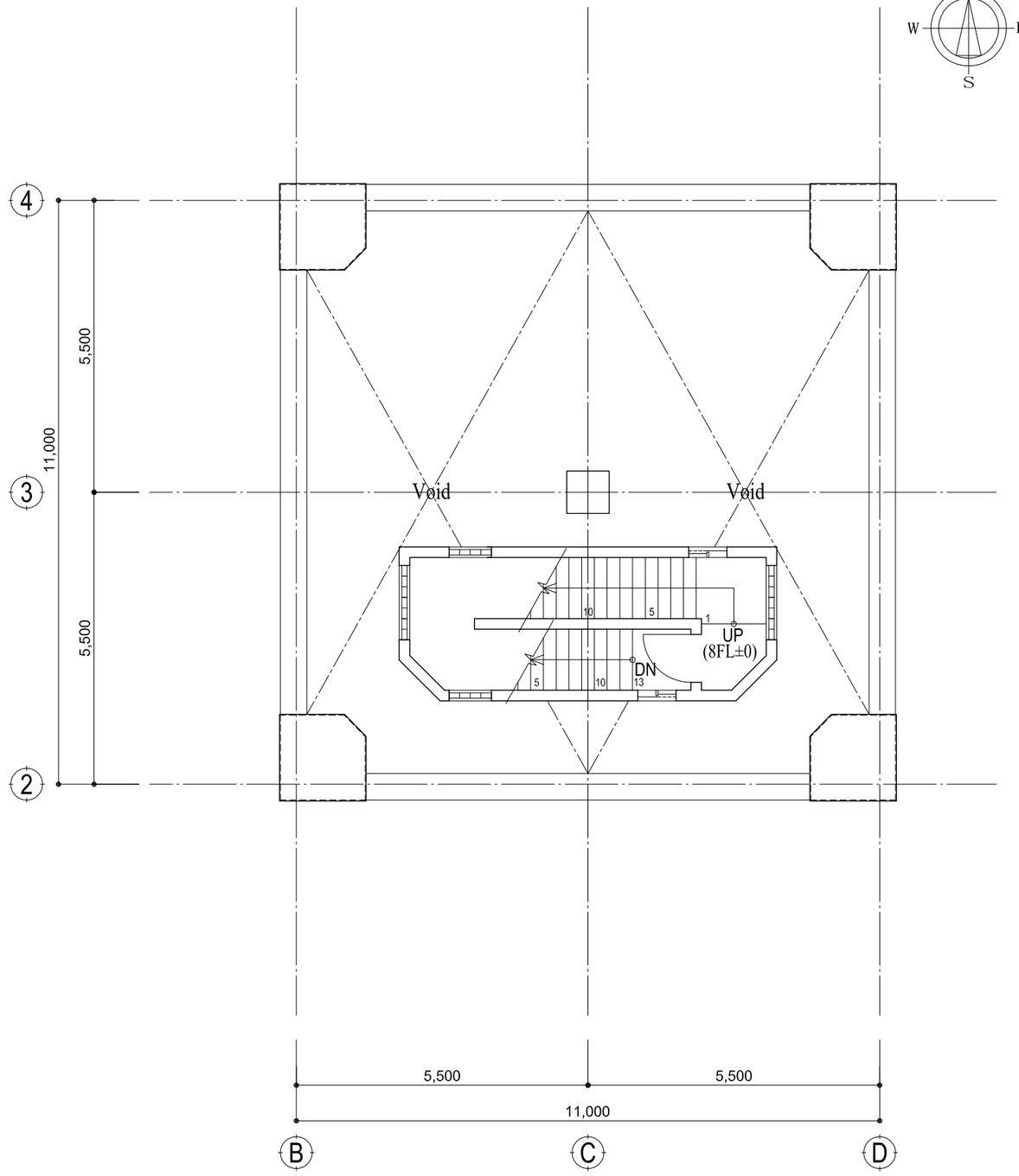
DRAWING TITLE
POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING
FLOOR PLAN 5

SCALE
1:100

DRAWING No.
A - 05 (POV)

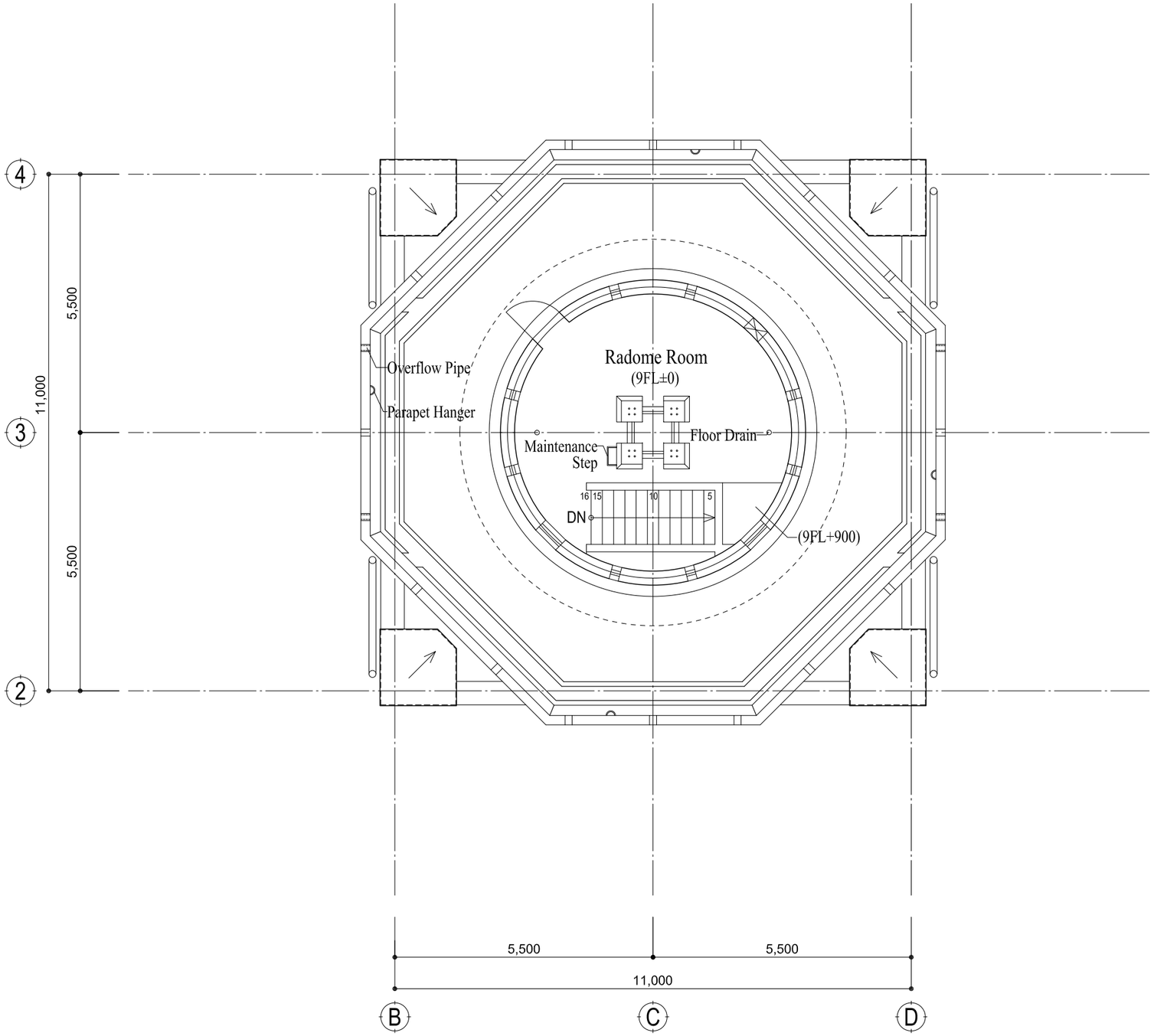


7FL PLAN



8FL PLAN

International Meteorological Consultant Inc. Sankyo Meguro Bdg. 4F, 4-5-37, Kamloosaki, Shinagawa-ku, Tokyo, 141-0021 Japan Tel. +81-3-6431-9559 Fax. +81-3-6431-9759	THE PROJECT FOR THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA	DRAWING TITLE POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING FLOOR PLAN 6	SCALE 1:100	DRAWING No. A - 06 (POV)



9FL PLAN

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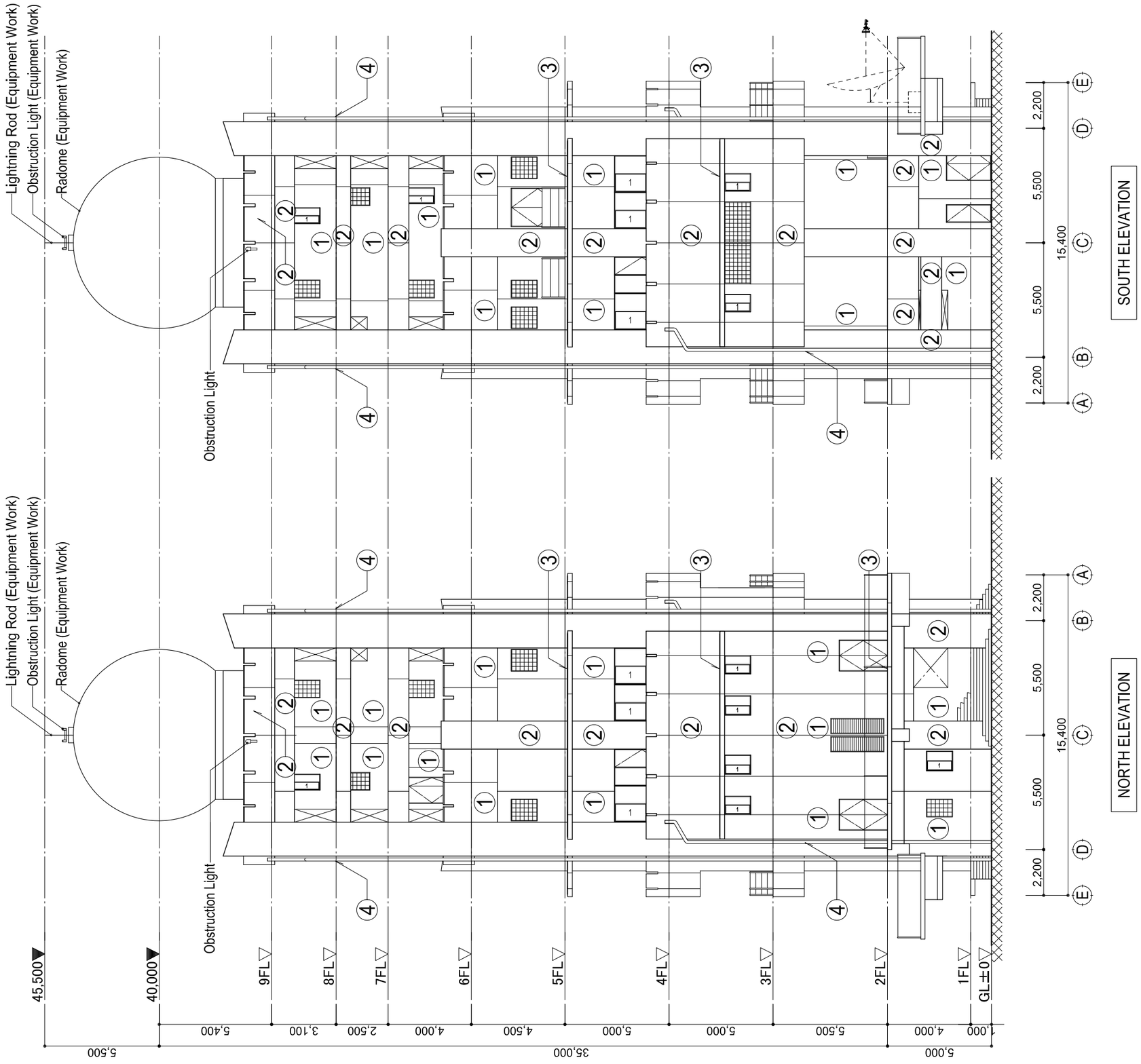

LEGEND

①	C.S. Mortar t=25 Spray Tile
②	Fair-faced Concrete, Mortar Mending, Spray Tile
③	Waterproof Mortar t=30, ERP
④	Rain Leader Pipe: Galvanized Steel Pipe 150A, Spray Tile
⑤	Overflow Pipe: Galvanized Steel Pipe 100A, Spray Tile

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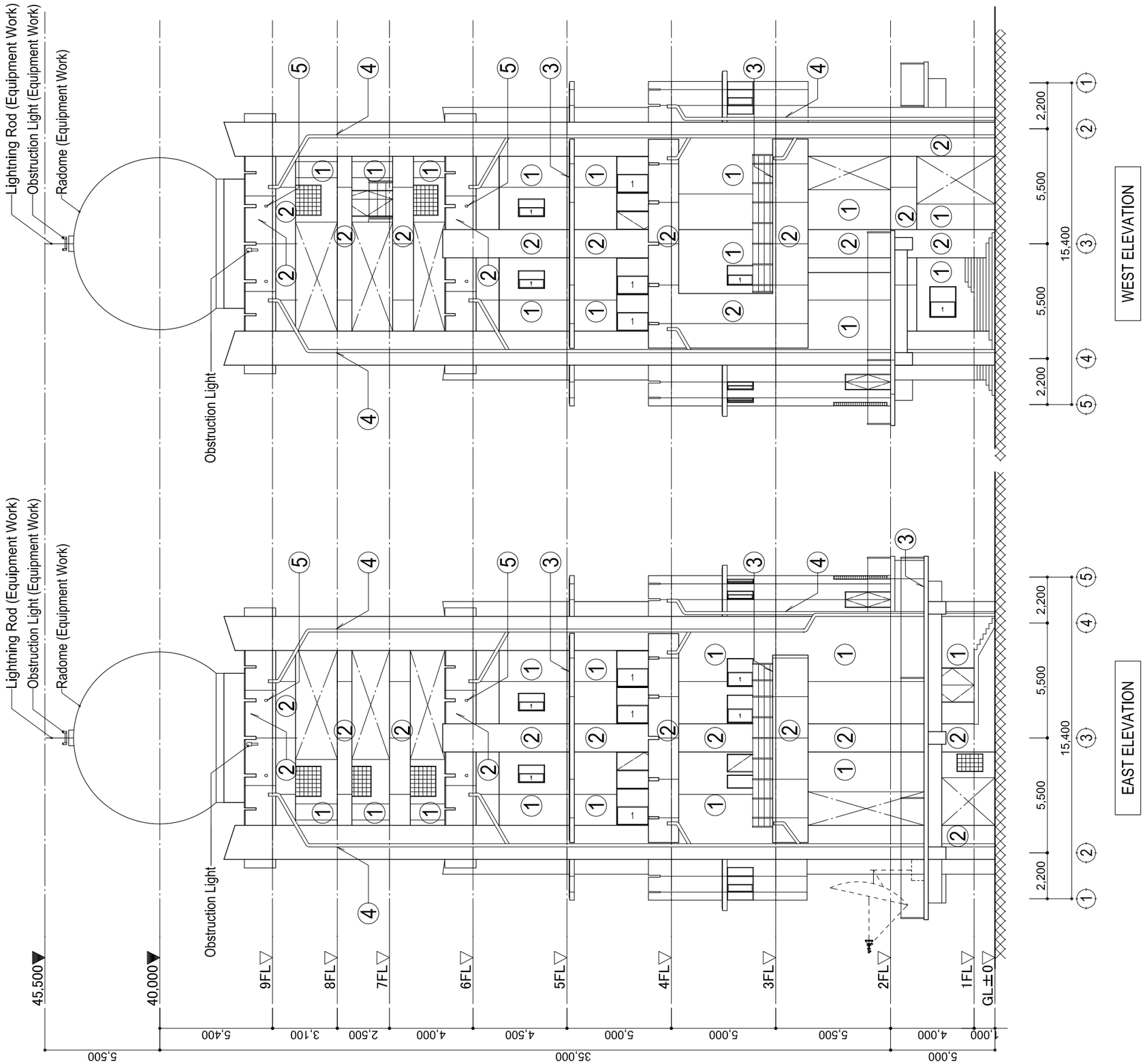
THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING
ELEVATION 1

SCALE
1:200

DRAWING No.
A - 08 (POV)



LEGEND

①	C.S. Mortar t=25 Spray Tile
②	Fair-faced Concrete, Mortar Mending, Spray Tile
③	Waterproof Mortar t=30, ERP
④	Rain Leader Pipe: Galvanized Steel Pipe 150A, Spray Tile
⑤	Overflow Pipe: Galvanized Steel Pipe 100A, Spray Tile

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THE PROJECT FOR
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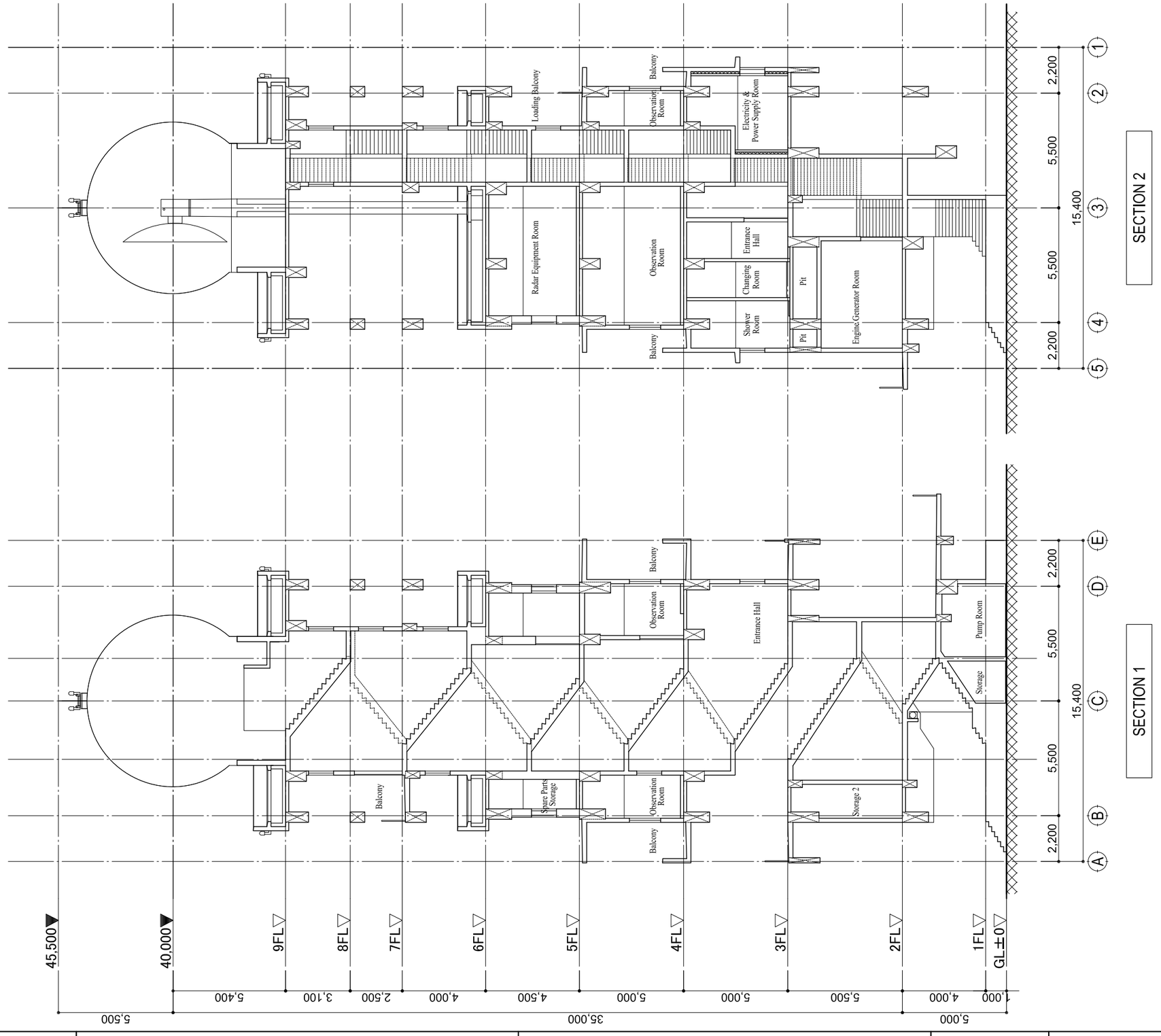
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING
ELEVATION 2

SCALE
1:200

DRAWING No.
A - 09 (POV)



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THE PROJECT FOR
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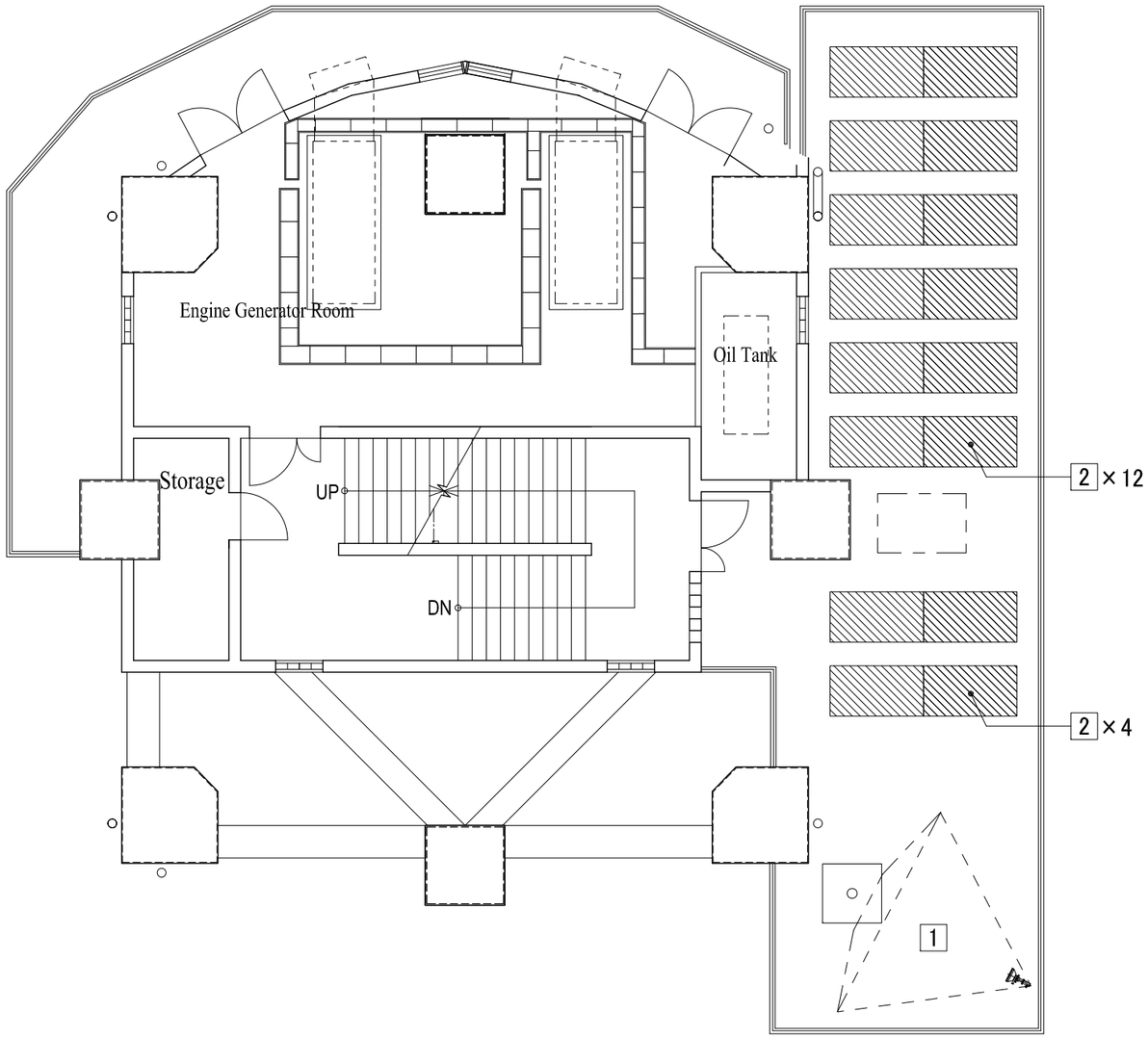
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING
SECTION

SCALE
1:200

DRAWING No.
A - 10 (POV)



EQUIPMENT (EQUIPMENT WORK)

1	VSAT Antenna
2	Solar Panel

N
W E
S

2FL PLAN

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THE PROJECT FOR
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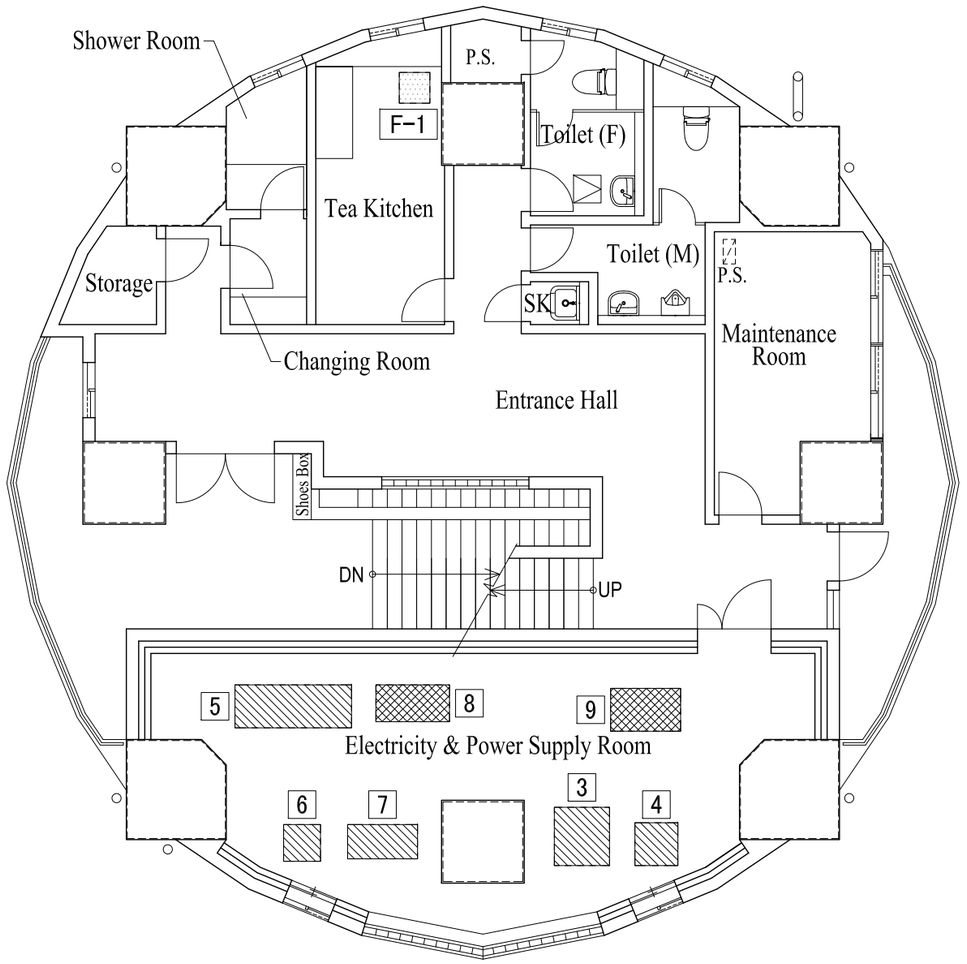
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING
EQUIPMENT LAYOUT PLAN 1

SCALE
1:100

DRAWING No.
EQ - 01 (POV)



3FL PLAN

N
W
E
S

EQUIPMENT (EQUIPMENT WORK)

3	Radar Automatic Voltage Regulator
4	Radar Isolation Transformer
5	Power Supply Capacitor
6	Emergency Power Backup Unit
7	Emergency Power Backup Battery

EQUIPMENT (CONSTRUCTION WORK)

8	Automatic Voltage Regulator
9	Isolation Transformer

FURNITURE (CONSTRUCTION WORK)

F-1	Water Dispenser

International Meteorological Consultant Inc.
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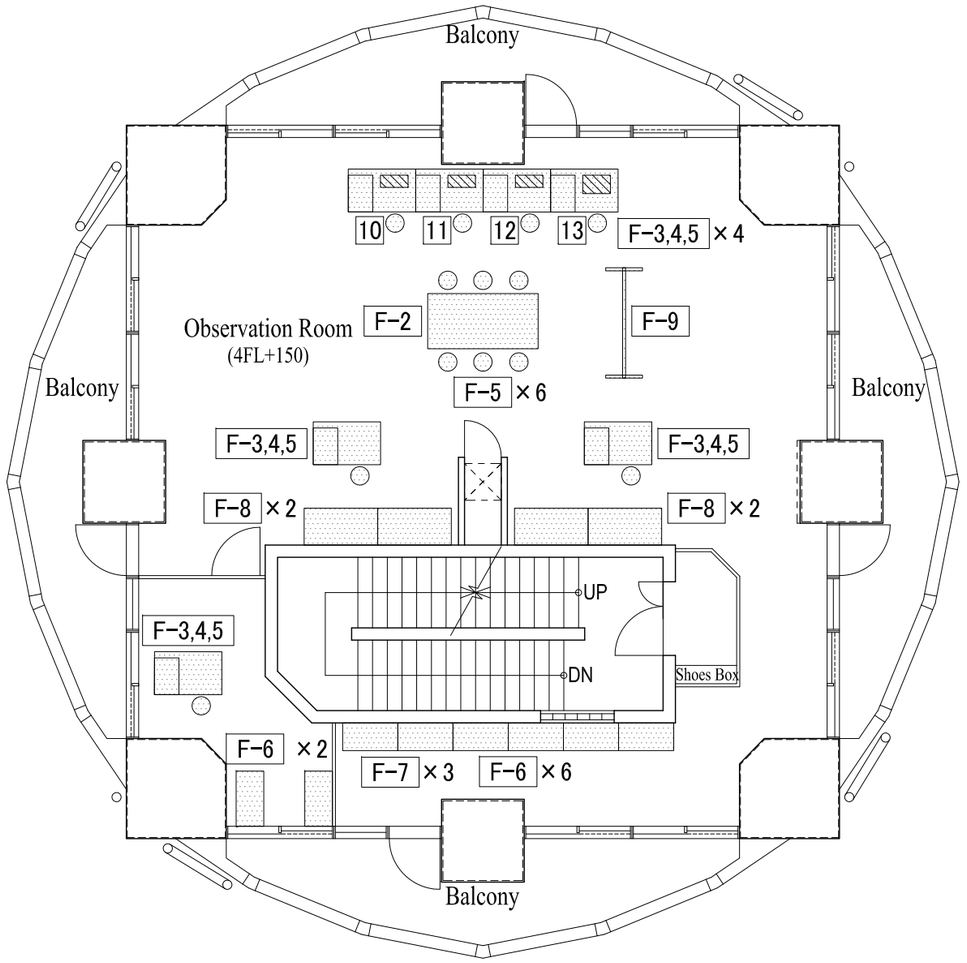
DRAWING TITLE
POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING
EQUIPMENT LAYOUT PLAN 2

SCALE
1:100

DRAWING No.
EQ - 02 (POV)



4FL PLAN

N
W
E
S

EQUIPMENT (EQUIPMENT WORK)

10	Product Indicator 1(Rainfall Intensity,Dual-Polarization)
11	Product Indicator 2(Doppler Velocity)
12	Remote Monitoring Display
13	Colour Printer

FURNITURE (CONSTRUCTION WORK)

F-2	Meeting Table(W900×L1,800)
F-3	Pedestal-free Desk(W1,100×D700)
F-4	Drawer Unit with Casters
F-5	Chair
F-6	Lateral Filling Cabinet H1,100
F-7	Cabinet(Double Hinged Doors)H1,000
F-8	Shelves(Double Hinged Doors)H1,800
F-9	White Board : W1,800×H900

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THE PROJECT FOR
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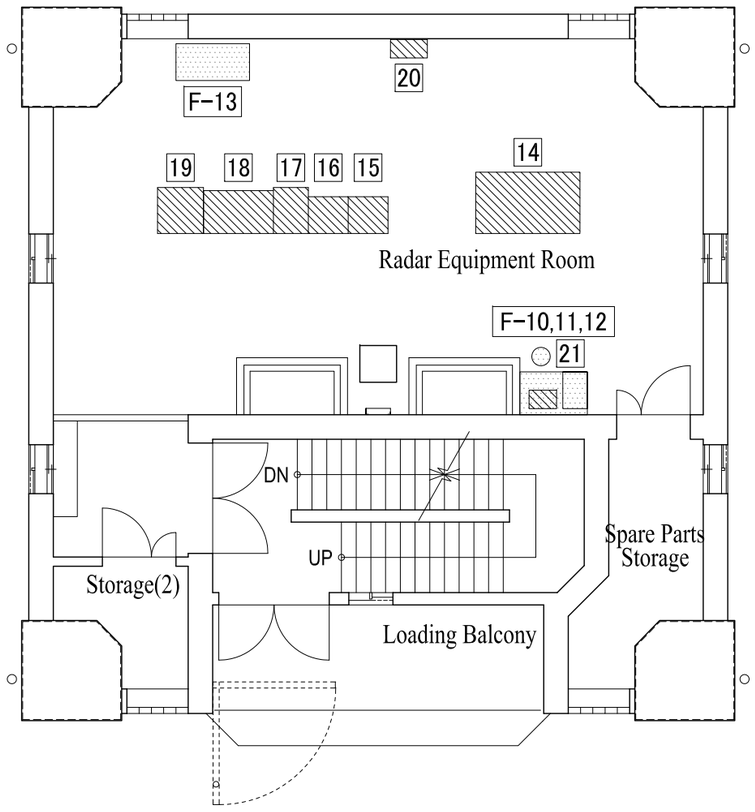
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING
EQUIPMENT LAYOUT PLAN 3

SCALE
1:100

DRAWING No.
EQ - 03 (POV)



EQUIPMENT (EQUIPMENT WORK)

14	Transmitter
15	Antenna Controller & Dehydrator
16	DRSP
17	Data & Protocol Converter
18	Radar TASK Controller
19	VSAT In-Door Unit (IDU)
20	Radar Power Maintenance Panel
21	Colour Printer

FURNITURE (CONSTRUCTION WORK)

F-10	Pedestal-free Desk (W1,100 × D700)
F-11	Drawer Unit with Casters
F-12	Chair
F-13	Shelves(Double Hinged Doors) H1,800

N
W E
S

6FL PLAN

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THE PROJECT FOR
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DRAWING TITLE
POTTUVIL METEOROLOGICAL RADAR TOWER BUILDING
EQUIPMENT LAYOUT PLAN 4

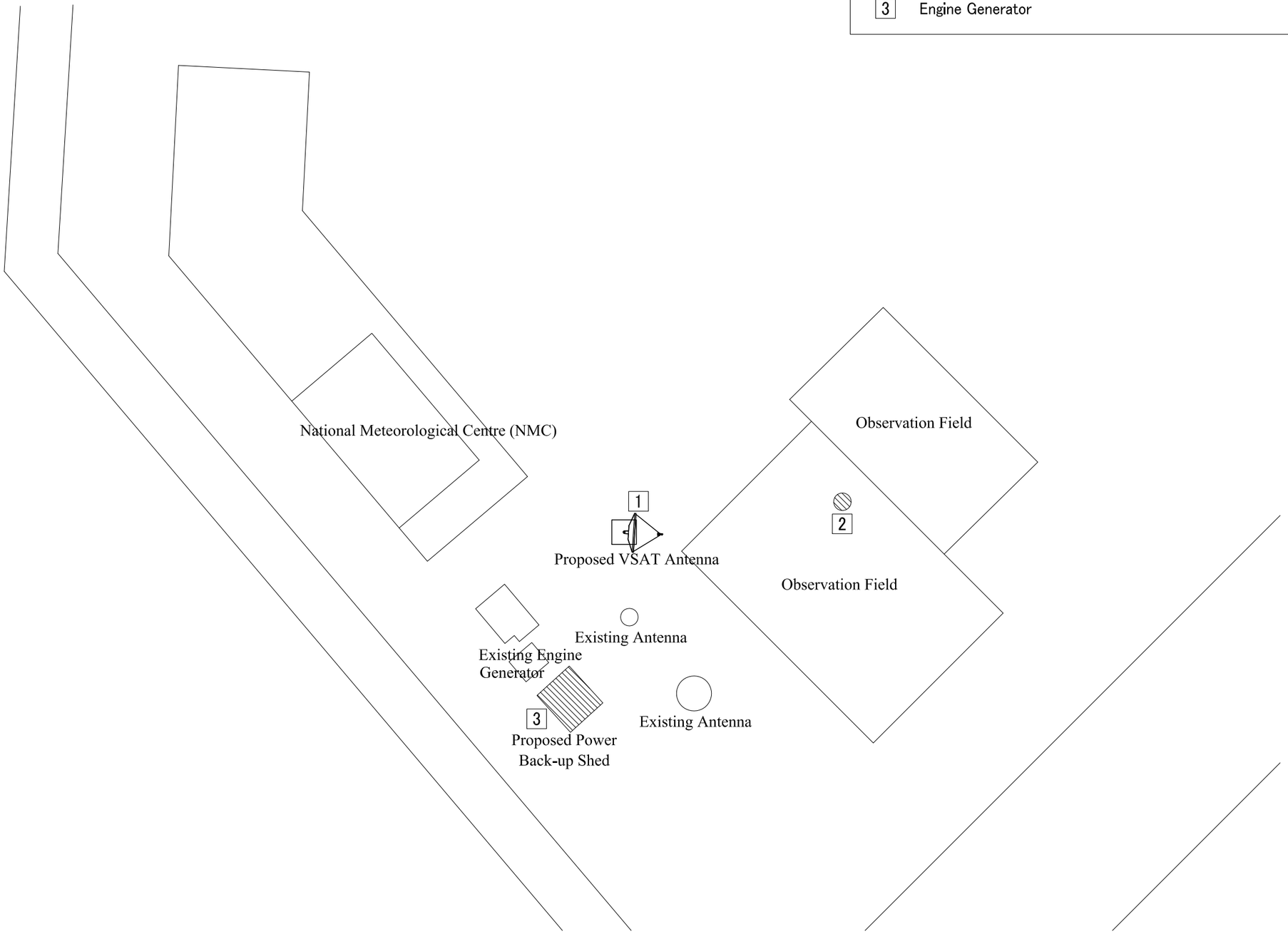
SCALE
1:100

DRAWING No.
EQ - 04 (POV)

EQUIPMENT (EQUIPMENT WORK)

1 HUB VSAT Antenna
2 Laser Disdrometer
3 Engine Generator

N
W E
S



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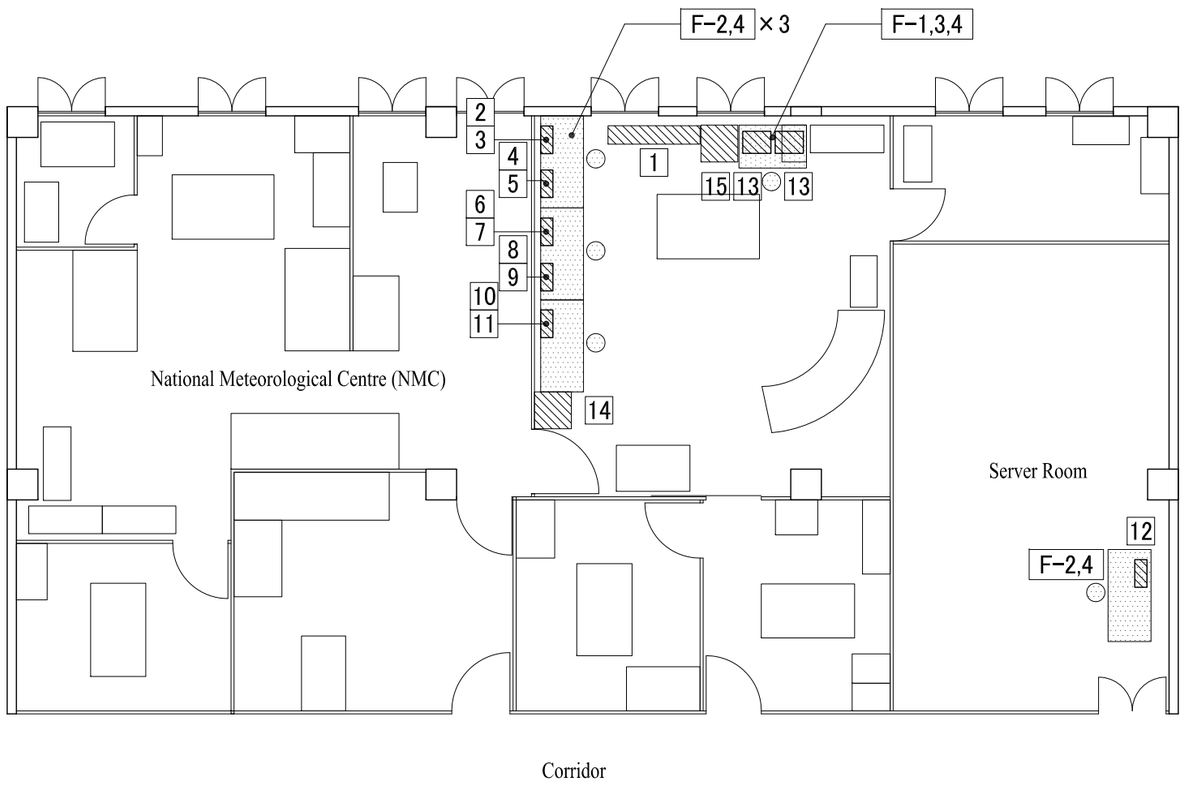
THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
NATIONAL METEOROLOGICAL CENTRE (NMC)
AT DOM HEAD OFFICE
EQUIPMENT LAYOUT PLAN 1

SCALE
1:500

DRAWING No.
EQ - 01 (COL)



EQUIPMENT (EQUIPMENT WORK)

1	Composite Processor
2	Meteorological Data Archiving Unit
3	Data Analyzing Unit
4	Product Retrieval Unit
5	Product Indicator 1(Rainfall Intensity,Dual-Polarization)
6	Product Indicator 2(Doppler Velocity)
7	Radar Task Controller (Putalam)
8	Radar Task Controller (Pottuvil)
9	Remote Monitoring Dispaly (Puttalam)
10	Remote Monitoring Dispaly (Pottuvil)
11	Disdrometer Display
12	Radar Web Server
13	Colour Printer
14	HUB VSAT In-door Unit
15	Network Device

FURNITURE (CONSTRUCTION WORK)

F-1	Pedestal Desk(W1,100 × D700)
F-2	Pedestal Desk(W1,500 × D700)
F-3	Drawer Unit with Casters
F-4	Chair

2FL PLAN

International Meteorological Consultant Inc.
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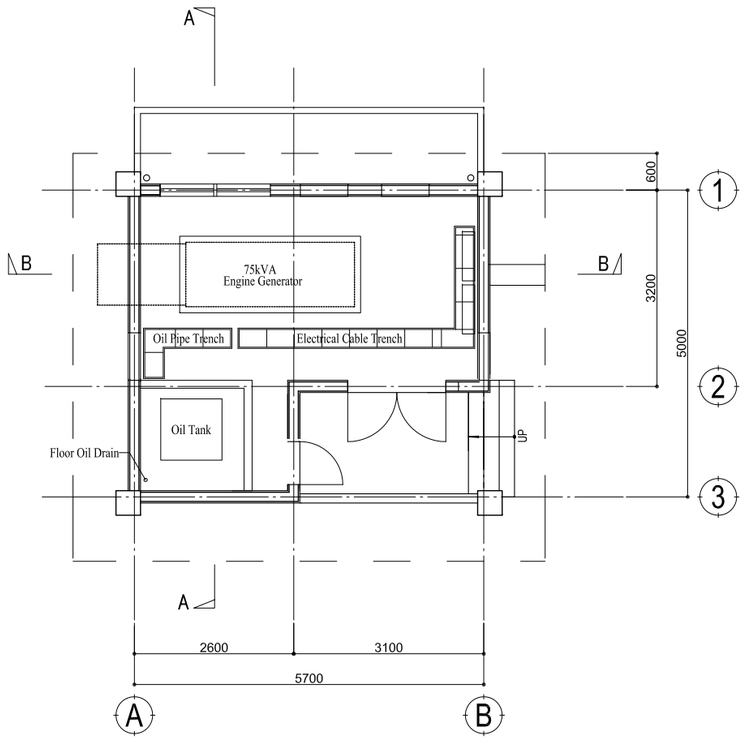
THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

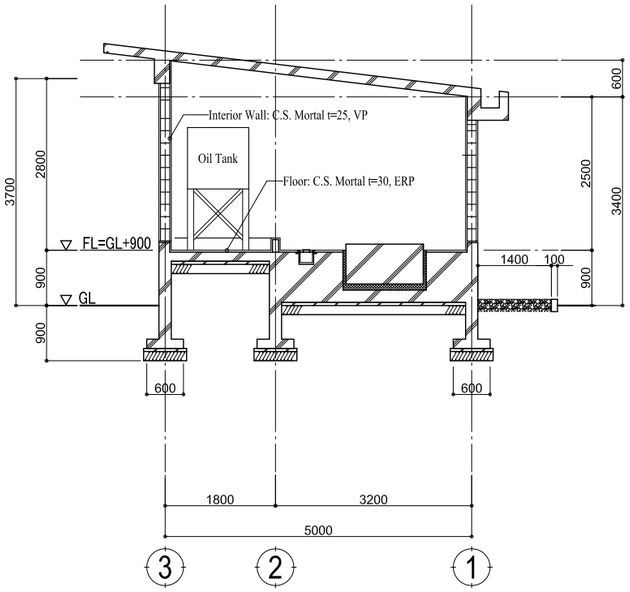
DRAWING TITLE
NATIONAL METEOROLOGICAL CENTRE (NMC)
AT DOM HEAD OFFICE
EQUIPMENT LAYOUT PLAN 2

SCALE 1:100

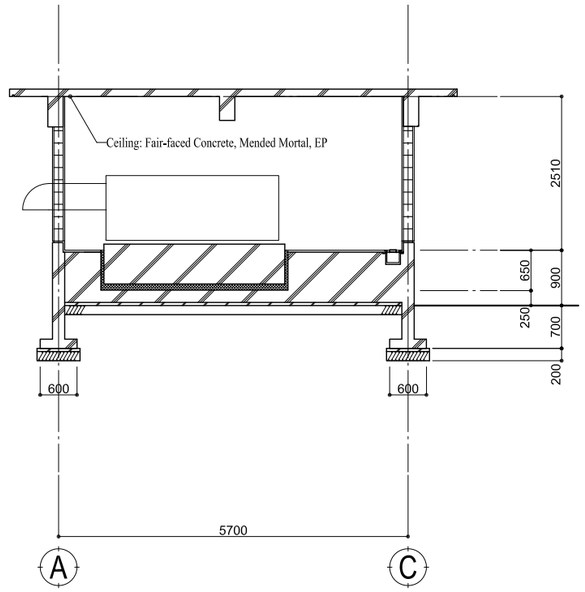
DRAWING No. EQ - 02 (COL)



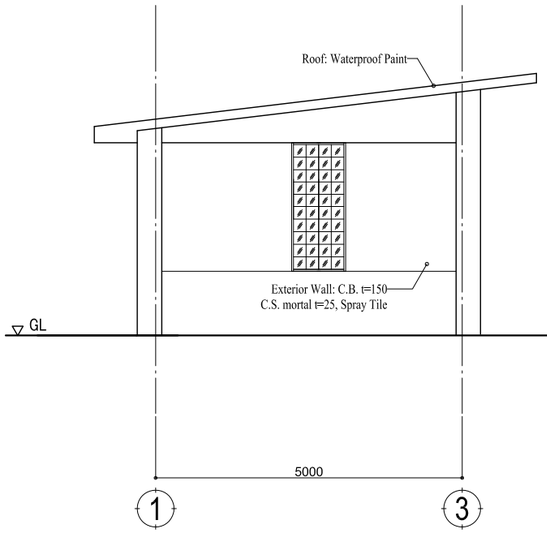
FLOOR PLAN SCALE 1:100



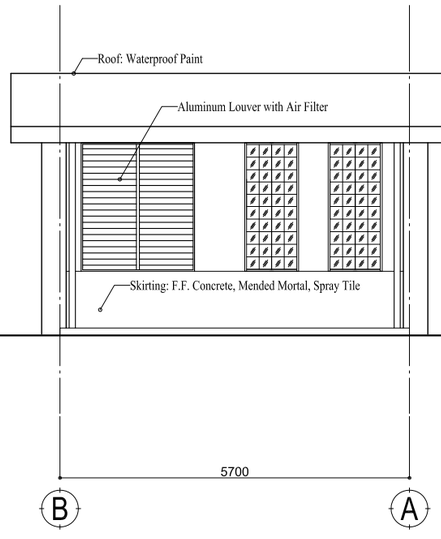
SECTION A-A SCALE 1:100



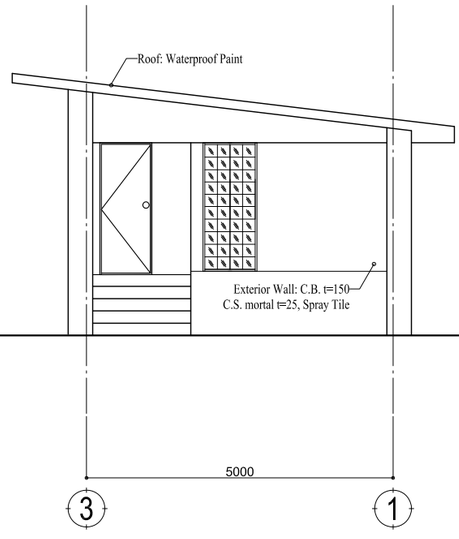
SECTION B-B SCALE 1:100



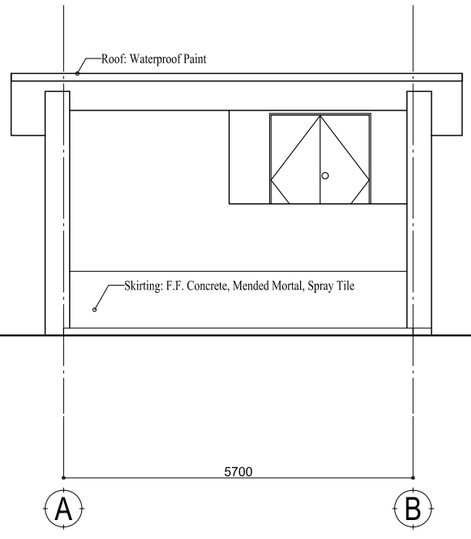
NORTH ELEVATION SCALE 1:100



WEST ELEVATION SCALE 1:100

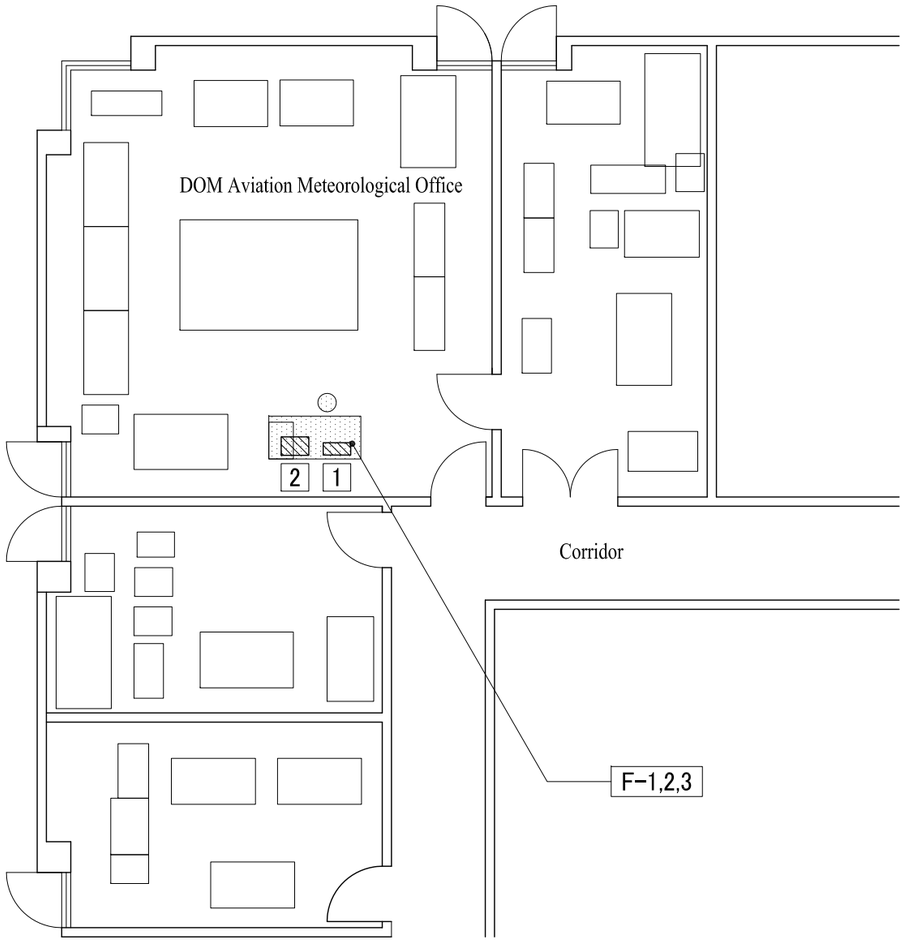


SOUTH ELEVATION SCALE 1:100



EAST ELEVATION SCALE 1:100

International Meteorological Consultant Inc. Sankyo Meguro Bdg. 4F, 4-5-37, Kamloosaki, Shinagawa-ku, Tokyo, 141-0021 Japan Tel. +81-3-6431-9559 Fax. +81-3-6431-9759	THE PROJECT FOR THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA	DRAWING TITLE NATIONAL METEOROLOGICAL CENTRE (NMC) AT DOM HEAD OFFICE POWER BACK-UP SHED	SCALE 1:100	DRAWING No. EQ - 03 (COL)



EQUIPMENT (EQUIPMENT WORK)

1	Aviation Weather Indicator
2	Colour Printer

FURNITURE (CONSTRUCTION WORK)

F-1	Pedestal Desk (W1,500 × D700)
F-2	Drawer Unit with Casters
F-3	Chair

1FL PLAN

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THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
DOM AVIATION METEOROLOGICAL OFFICE
IN THE COLOMBO INTERNATIONAL AIRPORT
EQUIPMENT LAYOUT PLAN

SCALE 1:100

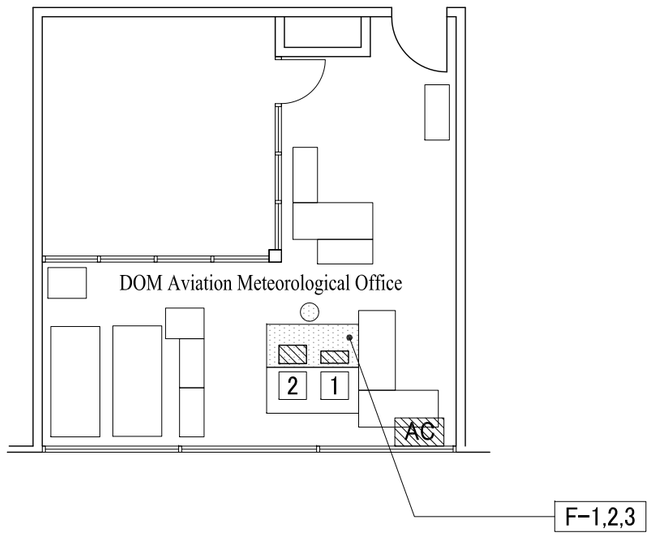
DRAWING No. EQ - 01 (CIA)

EQUIPMENT (EQUIPMENT WORK)

1	Aviation Weather Indicator
2	Colour Printer
AC	Floor Mounted and Split Type Air Conditioner Cooling capacity: 7kW or higher

FURNITURE (CONSTRUCTION WORK)

F-1	Pedestal Desk (W1,500 × D700)
F-2	Drawer Unit with Casters
F-3	Chair



1FL PLAN

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THE PROJECT FOR
THE ESTABLISHMENT OF A DOPPLER WEATHER RADAR NETWORK
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

DRAWING TITLE
DOM AVIATION METEOROLOGICAL OFFICE
IN THE MATTALA RAJAPAKSA INTERNATIONAL AIRPORT
EQUIPMENT LAYOUT PLAN

SCALE 1:100

DRAWING No. EQ - 01 (MIA)

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The Project covers many fields, including procurement and installation of meteorological and communication equipment, construction work, etc. For the successful completion of the Project, close coordination will be required among all parties. Since Sri Lanka is always in a monsoon season throughout the year, it is clear that careful attention regarding the annual number of days with rainfall of over 10mm/day must be considered and added into the implementation timeline/schedule of any works to be done during the project period. Monthly average of the number of days with over 10mm rainfall/day in Puttalam and Pottuvil is indicated in the following table.

Table 36: Monthly average of the number of days with over 10mm rainfall/day between 2012-2014

	North-East Monsson			1st Inter Monsoon		South-West Monsoon					2nd Inter Monsoon	
Month	12	1	2	3	4	5	6	7	8	9	10	11
Puttalam	7.3	11.7	2.0	2.3	3.0	1.7	0.3	0	0.3	2.0	6.3	8.7
Pottuvil	11	4.7	3.7	4.0	0.3	0.7	0	0.3	0	2.0	4.0	6.3

There are 25 public holidays/year in Sri Lanka. Sunday is a holiday and Saturday is a half day off in a construction site. In case a public holiday overlaps with a Saturday, it is a holiday. For the Sinhala and the Tamil New Year holidays scheduled in the middle of April, the number of holidays observed is 10 days. Therefore, taking into account all the public holidays in Sri Lanka, Saturday, Sunday and the Tamil New Year, 260 days/year (approximately 71% of the year) is allotted as working days in the construction site.

- The number of Sunday/year: 52/53 days (a holiday)
- The number of Saturday/year: 52/53 days (a half day off in afternoon)
- The number of working days in a construction site: 365 days/year – {the number of Sunday/year: 52 days + the number of Saturday/year: 52/2 – (the public holidays: 25 days – the number of public holidays overlaps with a Saturday: approximate 8 days) + Tamil New Year: 10 days} = 260 days (approximately 71% of the year)

1) Implementing agency for the Project

The responsible government agency of Sri Lanka for the implementation of the Project is the DOM under the supervision of the Ministry of Disaster Management. The DOM, as the Client, will be a signatory to the Consultancy Agreement and to the Contract.

2) Consultant

After the signing of the Exchange of Notes (E/N) between the Government of Sri Lanka and the Government of Japan and the Grant Agreement (G/A) between the Government of Sri Lanka and JICA

for the Project, it is important to finalize the Agreement of Consulting Services as early as possible. The Agreement of Consulting Services will be signed by the DOM and a Japanese consulting firm, having its principal office in Japan and recommended by JICA.

The consulting firm will become the Consultant for the Project by signing the Agreement. The Consultant will then conduct a detailed design study in Sri Lanka with the DOM and, in Japan, prepare the tender documents including technical specifications, drawings, diagrams, etc. In addition, the Consultant, instead of the DOM, will conduct a tender and supervise Project implementation for the successful completion of the Project as part of Japan's Grant Aid Assistance.

3) Contractor

A contractor with the required qualifications (an equipment supplier and a construction company) incorporated and registered in Japan, having its principal office in Japan, will be selected through an open public tender, in accordance with the tender documents prepared by the Consultant and in accordance with JICA guidelines as approved by the DOM.

2-2-4-2 Implementation Conditions

<Conditions for the Installation of Equipment>

The meteorological radar system, computing equipment and other sophisticated equipment with electric and electronic circuits will be installed in the radar tower buildings. In accordance with the construction schedule, the dispatch of an electrical engineer is required during the time of the installation, adjustment and wiring of the electric power supply and power back-up equipment (AVR, radar power back-up unit, etc.). During the construction period, it is important that there should be smooth procurement of the required materials and hiring of skilled laborers to meet the construction schedule. In addition, specialized skilled engineers are needed for the installation, adjustment and commissioning of the radar system, computing equipment and the sophisticated meteorological equipment. They are essential to ensure the quality of the installation work necessary for accurate meteorological observations. Furthermore, as part of the technology transfer to the DOM staff, specialized highly skilled engineers dispatched from Japan are required to conduct on-the-job trainings on operation & maintenance of all the equipment to ensure that the DOM can operate and maintain the equipment efficiently after the Project installation.

2-2-4-3 Scope of Works

The scope of works to be undertaken by Japan's Grant Aid Assistance and the Sri Lanka side for the implementation of the Project are as follows.

Table 37: Major Undertakings to be done by Japan's Grant Aid and the Government of Sri Lanka (DOM) under Implementation of the Project

No	Items	To be covered by Japan's Grant Aid	To be covered by Sri Lanka (DOM)
	General Items		
1	To undertake all necessary institutional and juridical procedures in Sri Lanka.		●
2	To undertake the required procedures of Environmental Impact Report in Sri Lanka.		●
3	To handle duty (Tax) exemption procedures, provide requisite legal and/or administrative documentations for customs clearance to customs broker/forwarder to be employed by the Contractor and make payment of all demurrage required at the port of disembarkation for the materials and equipment imported for the Project.		●
4	To defray the Value Added Tax (VAT) imposed on the building equipment and/or the construction materials for the Puttalam and Pottuvil Radar Tower Buildings to be procured by the Contractor in Sri Lanka.		●
5	To provide necessary working spaces with Internet Connection at the DOM Head Office for the Consultant and the Contractor for the implementation of the Project.		●
6	Marine (Air) transportation of the materials and equipment imported from overseas (Japan).	●	
7	In-land transportation from the port of disembarkation in Sri Lanka to each Project site.	●	
8	To accord Japanese and other foreign nationals including their dependent/s (if any), whose services may be required in connection with the supply of products and services under the signed contracts, such facilities as may be necessary for their entry into Sri Lanka and stay therein for the smooth and uninterrupted performance of their work (i.e. to secure the Multiple Visa for more than 1 year including its extension/s required by the recipient country in connection thereof).		●
9	To exempt goods of Japanese and other foreign nationals from customs duties, internal taxes and other fiscal levies which may be imposed by the Government of Sri Lanka with respect to their supply (products) and services under the signed contracts.		●
10	To pay bank commission for the issuance of the Authorization to Pay (A/P) and amendments of A/P, if required, for the Consultant and the Contractor.		●
11	To bear all the expenses, other than those to be borne by the Japan's Grant Aid, necessary for the implementation of the Project.		●
12	To ensure the security of the whole Project site/s and of the Japanese and other foreign nationals assigned to the Project prior to the commencement of and during Project implementation.		●
	For the Construction of the Radar Tower Building		
13	To clear, level and reclaim the land prior to the commencement of construction work.		●
14	To secure sufficient spaces at the respective Project site/s for temporary facilities such as a contractor's office, workshop, building materials storage, etc. needed for the construction work.		●
15	To obtain necessary permissions from the relevant agencies for the construction of the Radar Tower Buildings in the DOM Puttalam and Pottuvil Observatories (Radar Observation Stations).		●
16	To provide the commercial power (415V, 3-phase, 4-wire, 50Hz) supply (capacity: 100kVA) along with electric poles/wires, etc. from the main supply line to the proposed site for the Puttalam and Pottuvil Radar Tower Buildings.		●
17	To install the required step-down transformer as well as service entrance connections for the commercial power supply at the Puttalam and Pottuvil Radar Tower Buildings (415V, 3-phase, 4-wire, 50Hz).		●
18	To provide incidental facilities, such as public water supply, telephone lines, Internet, etc. for Puttalam and Pottuvil Radar Tower Buildings.		●
19	To provide temporary facilities for the availability or accessibility of electricity, water, etc. for the construction work.		●
20	To construct the Radar Tower Buildings, including a) Architectural and civil works b) Electrical works including a lightning protection system	●	

	c) Air-conditioning and Ventilation works d) Plumbing works		
21	To procure and install standard furniture for the Radar Tower Buildings.	●	
22	To undertake incidental outdoor works such as gardening, fencing, gates, boundary walls and exterior lightings and to renovate the existing buildings and facilities in the DOM Puttalam and Pottuvil Observatories (Radar Observation Stations).		●
23	To shift the existing observation field, if required, in in the DOM Puttalam and Pottuvil Observatories (Radar Observation Stations).		●
24	To provide On-the-job Trainings (Initial Trainings) by the contractor on the operation and maintenance of the Radar Tower Buildings as well as its inherent facilities for the DOM.	●	
25	To ensure transport for the DOM personnel and to shoulder the dispatching cost of the trainees to the training sites, such as daily allowance, accommodation, etc.		●
26	To provide the contractor's written guarantee to the DOM for the Radar Tower Buildings constructed under the Project for a period of twelve (12) months from the completion date of the equipment installation work.	●	
	For Installation Work of the Equipment		
27	To remove and relocate the existing facilities if available for the installation of the equipment, if necessary.		●
28	To provide and allocate secure temporary storage area/room for the materials, tools and equipment needed during the installation process.		●
29	To obtain the required frequencies for the Puttalam and Pottuvil meteorological radar systems and Polarimetric Test Horn Devices.		●
30	To provide reliable and high-speed Internet environment at the DOM Head Office and each project site for establishment of Internet Protocol-Virtual Private Network (IP-VPN).		●
31	To obtain the required VSAT license from the Telecommunications Regulatory Commission (TRC) for the use of satellite communication for the meteorological data satellite communication system (VSAT) to be installed.		●
32	To obtain the required space segment for the use of satellite communication for the meteorological data satellite communication system (VSAT).		●
33	To set up new assigned IP addresses in the computing equipment supplied under the Project.		●
34	To secure ample and strategically located space/s at the existing facilities (the National Meteorological Centre at the DOM Head Office, the DOM Aviation Meteorological Office in the Colombo International Airport and the DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport for the installation of the equipment (PC terminals and peripherals) to be supplied under the Project.		●
35	Replacement of 2 existing air-conditioning systems at the National Meteorological Centre at the DOM Head Office		●
36	To procure, install and adjust the required Equipment for Project implementation	●	
37	To procure, install, and adjust furniture for the Equipment to be procured under the Project.	●	
38	To conduct the commissioning for the total system.	●	
39	To provide On-the-job Trainings (Initial Trainings) by the contractor on the operation and maintenance of the Equipment for the DOM.	●	
40	To ensure transport for the DOM personnel and to shoulder the dispatching cost of the trainees to the training sites, such as daily allowance, accommodation, etc.		●
41	To provide the contractor's written guarantee to the DOM for the Equipment and Installation Work executed under the Project for a period of twelve (12) months from the completion date of the equipment installation work.	●	
	After the completion of the Project		
42	To renovate the existing gates, boundary walls and exterior lighting in and around the sites as if and when required.		●
43	To assign the required staff for the smooth operation and maintenance of the Equipment.		●
44	To procure the required spare parts and consumables for the smooth operation and maintenance of the Equipment.		●

45	To provide adequate maintenance of the Radar Tower Buildings constructed under the Project so that they may function long lasting and effectively.		●
46	To effectively utilize the facilities constructed and the Equipment procured/installed under the Project.		●
47	To allocate the necessary budget for the smooth conduct of meteorological radar observation and forecasting works.		●
48	To take necessary steps for creating proposed new posts and recruiting the required man power immediately after the Project Completion.		●
49	To periodically update all the operation/antivirus/application software(s).		●

2-2-4-4 Consultant Supervision

1) Principal Guidelines

a) To take responsibility for expediting project implementation as well as providing smooth supervision, in accordance with the guidelines of Japan's Grant Aid Assistance and the Outline Design.
b) To communicate closely with the responsible organizations and personnel of both countries, and complete the Project in time and in accordance with the implementation schedule.
c) To provide appropriate advice to the personnel of the DOM and the contractor.
d) To ensure the safety of the project implementation as its top priority through the early/advance detection of severe weather phenomena.

2) Consultant Supervision

a) The Consultant will dispatch at least one responsible and highly capable personnel to Sri Lanka during each implementation stage in the Project.
b) Consultant technical specialists will be dispatched to Sri Lanka for installation guidance, inspection work, etc. for the installation and configuration work of the major hardware, data communication equipment, computing equipment and system software.
c) The Consultant will attend factory performance tests, configuration verifications and inspections of the equipment on behalf of and instead of the DOM.
d) Qualified engineer(s) will be dispatched for data transmission tests in Sri Lanka.

3) Scope of Work for Supervision

a) The Consultant, in coordination with the DOM, will prepare the contract in accordance with JICA standards; select a Japanese prime contractor through tendering; and recommend the nominated contractor to the Government of Sri Lanka.
b) The Consultant will inspect and approve shop-drawings, system drawings & diagrams and

material samples submitted by the contractor, and verify the performance and function of all equipment.

c) Based on a review of the implementation schedule, the Consultant will provide instructions to the contractor and submit progress reports on the implementation of the Project to the DOM, the Embassy of Japan in Sri Lanka, the JICA Sri Lanka local office, etc.

d) The Consultant will cooperate in the certification of payment, such as through the examination of notices of approval and invoices in connection with implementation cost to be disbursed during the implementation period and upon completion of the Project.

2-2-4-5 Quality Control Plan

According to past local meteorological data at the DOM Head Office in Sri Lanka, the temperature could reach up to more than 30°C. In view of this, the ambient and concrete temperature will be measured during concrete pouring to ensure correct concrete quality. The quality control plan for the main work is described in the table below.

Table 38: Quality Control Plan

Work	Work Type	Control Item	Method
Structural Work	Concrete work	Fresh concrete Concrete strength	・Slump, air volume, temperature ・Comprehensive strength test (to be conducted at each site) ・Chloride Quantity Test ・Alkali Aggregate Reactivity Test
	Reinforcing work	Reinforcing bar Arrangement	・Tensile test, mill sheet check ・Bar arrangement check ・Factory inspection sheet check
	Pile work	Material, bearing capacity	Bearing capacity check
Finishing Work	Roof work	Workmanship, leakage	Visual inspection, water spray test
	Tile work	Workmanship	Visual inspection
	Plastering work	Workmanship	Visual inspection
	Door & Window work	Products, Installation accuracy	・Factory inspection sheet check ・Visual inspection, dimension check
	Painting work	Workmanship	Visual inspection
	Interior work	Products, workmanship	Visual inspection
Electrical Work	Power receiving equipment work	Performance, operation installation check	Factory inspection sheet check; withstand voltage, megar, operation, visual inspection
	Conduit work	Bending, support check	Visual inspection, dimension
	Wiring and cable work	Sheath damage, loose connection check	・Performance sheet check ・Cleaning before laying, ・Marking after bolt fixing
	Lightning work	Resistance, conductor support pitch check	Resistance measuring, visual inspection, dimension
	Lighting work	Performance, operation, installation check	Performance sheet check, illumination measurement, visual inspection
Mechanical Work	Water Piping Work	Support pitch, leakage	Visual inspection, leakage, water pressure test
	Pump Installation	Slope, Support pitch, leakage	Visual inspection, leakage, flow test
	Air-Conditioning work	Performance, operation installation check	Performance sheet check, temperature measurement
	Sanitary Fixture	Operation, installation, leakage check	Visual inspection, flow test

2-2-4-6 Procurement Plan

(1) Equipment Procurement

Maintenance requirements and the availability of the necessary parts and consumables in Sri Lanka are two of the most important factors in selecting the equipment. The equipment procurement process must provide for sustainable maintenance after the completion of the Project. None of the meteorological equipment, such as the pulse compression solid state Doppler radar system, the meteorological radar data display system, and etc., to be supplied under the Project is produced in Sri Lanka. The C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar System which has already been put into practical use for meteorological observation and has confirmed its reliability, durability, accuracy and performance is only available and made in Japan. The designed mean time between failure (MTBF) of the transmitter for this system is more than 50,000 hours and the designed mean time to repair (MTTR) of the transmitter is 0.5 hours. In addition, since almost all the Japanese meteorological radar systems established under Japan's Grant Aid in other developing countries have been working well over the years, Japanese systems have received a high degree of confidence in the world. Therefore, it is certainly recognized, even by the WMO, that a Japanese system is the most suitable system for developing countries normally faced with operational and maintenance difficulties.

The activities of the private sector in Sri Lanka will be useful in support of the computer and other sophisticated systems. There are major computing equipment manufactures and local agents/suppliers in the country. The procurement plan for the equipment is designed with a view to achieve a maximum possible degree of standardization as well as facilitating the acquisition of spare parts and maintenance services for the chosen computing equipment.

(2) Procurement of Construction Materials

1) Procurement Policy for Construction Materials

As the main construction materials can be procured locally, they will, in principle, be procured in Sri Lanka. However, the products produced in Sri Lanka are limited to gravel, sand, fresh concrete, some secondary concrete products (blocks, floor materials, etc.) and timber for temporary works, etc. Other construction materials imported from the neighboring countries are marketed throughout Sri Lanka. As these imported materials can be easily procured locally, they are considered as part of the procurement of local products. In order to ensure the easy maintenance of the radar tower building, locally available materials will be utilized for construction.

2) Procurement Plan for Construction Materials

[1] Structural Work

The main materials for the structural work, such as fresh concrete, rebar, plywood for form works, etc., can be procured locally. Locally made concrete blocks are available and are a common material for building construction.

[2] Building Exterior and Interior Work

Timber, tiles, paint, glass, aluminum window frames, etc. used for the exterior and interior of a building are imported from ASEAN countries and, in principle, are readily available in the local market. For the proposed buildings, airtight aluminum and steel doors & windows are required.

[3] Air-Conditioning and Plumbing Work

Imported air-conditioning equipment, exhaust fans, pumps, sanitary-fixtures, etc. are popular in Sri Lanka. In principle, those products can be procured in the local market with a view to ease of repair and maintenance. However, large air-conditioning units and exhaust fans, which are unavailable in the local market, will be procured from ASEAN countries.

[4] Electrical Work

Imported and local lighting fixtures, switches, lamps, electrical wires, cables, conduits and other items are available in the local market. They will, in principle, be procured in Sri Lanka for the convenience of repair and maintenance. However, custom-made building equipment such as control panels, power distribution boards and switch boards will be procured from ASEAN countries.

Table 39: Major Materials Procurement Plan (Architectural Work)

Materials	Local Market		Procurement Plan		
	Condition	Import	Sri Lanka	Third Country	Japan
Portland cement	○		✓		
Sand, aggregate	○		✓		
Reinforcing bar	○		✓		
Form (plywood)	○		✓		
Concrete block	○		✓		
Asphalt waterproofing	△		✓		
Wood	○		✓		
Aluminum door & window	△		✓		
Steel door & window	△		✓		
Wooden door & window	○		✓		
Door handle, lock	○		✓		
Floor hinge	○		✓		
Plane glass	○		✓		
Glass block	○		✓		
Laminated safety glass	○		✓		
Access floor panel	○		✓		
Access floor panel (heavy duty type)	△		✓		
Paint	○		✓		
Gypsum board	○		✓		
Cement board	○		✓		
Rockwool acoustic board (T-bar)	○		✓		
Glass wool, glass cloth	○		✓		
Carpet tile	△		✓		

PVC tile	○		✓		
Porcelain tile	○		✓		
Ceramic tile	○		✓		
Floor maintenance hatch	○		✓		
Kitchen	○		✓		
Roof drain	○		✓		
Steel drainage pipe (galvanized)	○		✓		
Concrete pavement block	○		✓		
Spray tile	○		✓		
Caulking	○		✓		

○ : Easy to procure in Sri Lanka
△ : Available in the local market in Sri Lanka but model and quantity are limited
× : Difficult to procure in Sri Lanka

Table 40: Major Materials Procurement Plan (Mechanical and Electrical Work)

Work type	Materials	Local Market		Procurement Plan		
		Condition	Import	Sri Lanka	Third Country	Japan
Air-conditioning work	Air conditioner (salt-proof)	△		✓		
	Heat exchanger	×	ASEAN		✓	
	Exhaust fan (salt-proof)	△		✓		
Plumbing work	Sanitary fixture	○		✓		
	Pipe	○		✓		
	Fire extinguisher	○		✓		
	Water lifting pump	○		✓		
	Electric water heater	○		✓		
Electrical work	Lighting fixture (LED)	△	ASEAN		✓	
	Sunlight system	×	Japan			✓
	Obstruction light	×	Japan			✓
	Panel	△	ASEAN		✓	
	Wire, cable	○		✓		
	Conduit (PVC)	○		✓		
	Conduit (Steel)	○		✓		
	Cable-rack	○		✓		
	Telephone system	△	ASEAN		✓	
	Isolation Transformer	×	Japan			✓
	AVR	×	Japan			✓
	Fire alarm system	○		✓		
	Diesel engine generator	△	Japan			✓
	Lightening protection	○		✓		

○ : Easy to procure in Sri Lanka
△ : Available in the local market in Sri Lanka but model and quantity are limited
× : Difficult to procure in Sri Lanka

3) Transportation Plan

Transportation of the equipment from Japan would principally use container shipment. The main disembarkation point for maritime cargo to Sri Lanka is the Colombo Seaport. Transport from Japan to the Colombo Seaport takes at least 1 month including all the necessary procedures to be undertaken in Japan for exporting the equipment to Sri Lanka while custom clearance takes 15 days. The Import Duty imposed by the Colombo Customs House, Sri Lanka Customs Department will be borne by the DOM.

As a consequence of the study, the safe inland transport up to each project site has been decided to be as follows.

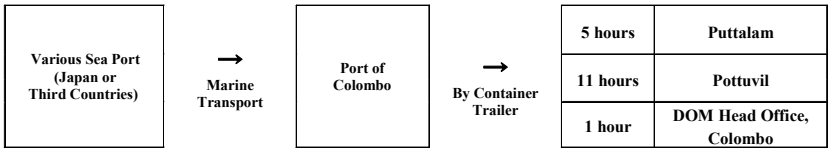


Figure 16: Inland Transport Route to Each Project Site

2-2-4-7 Operational Guidance Plan

The required operational guidance will be implemented through the practical operational simulation of each system during the course of the completion of equipment installation. During the equipment installation period, the operational guidance for cabling, piping (wave guide), unit replacement/adjustment, transmitter discharge, and etc. of the meteorological radar system will be imparted to the DOM. As such, the operational guidance of the said items will no longer be implemented after the completion of equipment installation. The operational guidance for each system will be implemented at the following places indicated in the table attached hereunder.

Table 41: Operation and Maintenance Training

Equipment	DOM Puttalam Observatory (Puttalam Radar Observation Station)	DOM Pottuvil Observatory (Pottuvil Radar Observation Station)	National Meteorological Centre (NMC) at DOM Head Office	DOM Aviation Meteorological Office in the Colombo International Airport	DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport
C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar System • Power Unit • Antenna • Radar Unit • Meteorological Radar Transmission Unit • Computer Network Unit • Power Back-up Unit • Application Software	○	○	-	-	-
Meteorological Radar Central Processing System • Power Unit • Computer Network Unit • Application Software	-	-	○	-	-
Meteorological Radar Data Display System • Power Unit • Computer Network Unit • Application Software	○	○	○	○	○
Meteorological Data Satellite Communication System (VSAT) • Power Unit • VSAT Communication Unit • Computer Network Unit • Application Software	○	○	○	-	-

Apart from the Operation and Maintenance Training, technology transfer through the practical installation and adjustment works to be carried out by the DOM staff together with the Consultant and the contractor will be necessary and quite effective if done during the installation period. If technology transfer is conducted after completion of the installation work, it is difficult to simulate training on some parts/areas located in deeper places within the system such as cabling and wiring routes, connecting points of each unit, and etc. which would require disassembling the radar system to be able to see them. In addition, repeated software installation by the DOM staff themselves is important to obtain further familiarization and technical knowledge. In case of a down in the system, disassembling the system and software reinstallation by the DOM staff may be required. Therefore, all the significant parts of technology transfer must be completed during the installation work period.

2-2-4-8 Soft Component Plan

<Soft Component>

None of the DOM's technical staff have the practical experience in operating a digital meteorological Doppler radar system which is planned to be procured under the Project. For the smooth operation and maintenance of the digital Pulse Compression Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar Systems, for the dissemination of high accuracy medium range weather forecasts to be prepared through weather guidance to the public, and for the assurance of the required sustainability of the project outcomes, the implementation of the technology transfers in the soft component mentioned below (soft component schedule is indicated in the Implementation Schedule attached hereunder) is required.

<Soft Component Target>

To enable the DOM to independently and appropriately operate the C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar Systems.

<Soft Component Indicators>

Soft Component Indicators are as follows.

Table 42: Soft Component Indicators

No.	Item	Output	Objectively Verifiable Indicators	Means of Verification
1	C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System Inspection, Adjustment, Minor Fault Finding, Remedy and Recovery and Major Fault Countermeasures	Acquisition of technical know-how on appropriate inspection, adjustment, minor fault finding, remedy and recovery.	Inspection, adjustment, minor fault finding, remedy and recovery, and major fault countermeasures (a. routine maintenance using measuring instruments and tools, b. practice of replacing spare parts into the actual system and the subsequent confirmation of system operation, c. practice of remedy, recovery and major fault countermeasures: distributing information to the Consultant and the manufacturer and receiving technical advice) are carried out appropriately by the DOM.	· Confirmation of proficiency through 1) routine maintenance using measuring instruments and tools; 2) practice of replacing spare parts into the actual system and the subsequent confirmation of system operation; 3) practice of minor fault finding, remedy and recovery; and 4) major fault countermeasures. · Visual check and technical interviews
2	Prompt and Appropriate Meteorological Doppler Radar Operation and Maintenance utilizing the Meteorological Radar System Manual Summary and the Meteorological Radar System Maintenance & Management Record Book including acquisition procedures and data table reading of Observation Raw Data	Technical knowledge on the acquisition of prompt and appropriate C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System operation and maintenance	C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System operation and maintenance utilizing the meteorological radar system manual summary and the meteorological radar system maintenance & management record book are implemented promptly and appropriately.	· Evaluation of the frequency of usage of the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual summary. · Confirmation of entries (daily, weekly, monthly) in the meteorological radar system maintenance & management record book and thorough technical interviews
3	Meteorological Data Satellite Communication System (VSAT) Inspection, Adjustment, Minor Fault Finding, Remedy and Recovery and Major Fault Countermeasures	Acquisition of technical know-how on appropriate inspection, adjustment, minor fault finding, remedy and recovery.	Inspection, adjustment, minor fault finding, remedy and recovery, and major fault countermeasures (a. routine maintenance using measuring instruments and tools, b. practice of replacing spare parts into the actual system and the subsequent confirmation of system operation, c. antenna alignment adjustment, d. practice of remedy, recovery and major fault countermeasures: distributing information to the Consultant and the manufacturer and receiving technical advice) are carried out appropriately by the DOM.	· Confirmation of proficiency through 1) routine maintenance using measuring instruments and tools; 2) practice of replacing spare parts into the actual system and the subsequent confirmation of system operation; 3) practice of minor fault finding, remedy and recovery; 4) antenna alignment adjustment; and 5) major fault countermeasures. · Visual check and technical interviews
4	Prompt and Appropriate Meteorological Data Satellite Communication System (VSAT) Operation and Maintenance utilizing the Meteorological Data Satellite Communication System Manual Summary and the Meteorological Data Satellite Communication System Maintenance & Management Record Book	Technical knowledge on the acquisition of prompt and appropriate Meteorological Data Satellite Communication System (VSAT) operation and maintenance	Meteorological Data Satellite Communication System (VSAT) operation and maintenance utilizing the meteorological radar system manual summary and the meteorological radar system maintenance & management record book are implemented promptly and appropriately.	· Evaluation of the frequency of usage of the Meteorological Data Satellite Communication System (VSAT) manual summary. · Confirmation of entries (daily, weekly, monthly) in the meteorological radar system maintenance & management record book and thorough technical interviews
5	Meteorological Radar	Appropriate	Meteorological radar observation	Confirmation of meteorological radar

	Observation in accordance with the Sequence & Schedule for Intensity Mode and Doppler Mode Sequence & Schedule	meteorological radar operation.	is implemented according to the radar observation sequence & schedule for Intensity Mode and Doppler Mode.	observation in accordance with the sequence & schedule for Intensity Mode and Doppler Mode in order to appropriately understand weather phenomena and to utilize the observed radar data for forecast operation.

<Means of Verification for Outputs Achievement>

Means of verification for outputs achievement of the Soft Component are indicated in the Table 42 attached above.

<Scheduled Activities of Soft Component>

Scheduled Activities of Soft Component are as follows.

Table 43: Scheduled Activities of Soft Component

Output	Required Technique and Field	Current Technique and Required Technique Level	Target Group	Means of Implementation	Source of Implementation	Product
1. C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System Inspection, Adjustment, Minor Fault Finding, Remedy and Recovery, and Major Fault Countermeasures	An engineer capable of meteorological radar adjustment and minor fault finding.	Since engineers in the DOM have practical experience of adjusting and fault finding in an analog meteorological radar system, it is imperative that the DOM engineers should also acquire the capability of adjusting and fault finding in a digital meteorological radar system.	Indicated in the table below	Routine maintenance using measuring instruments and tools.	<First> Expert Consultant on meteorological radar adjustment and fault finding: 1.13 man-months. (Period of Technology Transfer in Sri Lanka: 34days) Direct Support <Second> Expert Consultant on meteorological radar adjustment and fault finding: 0.73 man-months. (Period of Technology Transfer in Sri Lanka: 22days) Direct Support	Manual on routine maintenance using measuring instruments and tools.
				Practice of replacing spare parts into the actual system and the subsequent confirmation of system operation.		Manual on replacing spare parts into the actual system and the subsequent confirmation of system operation.
				Practice of countermeasure, minor fault finding, remedy and recovery.		Manual on fault finding, remedy and recovery.
				Practice of major fault countermeasures.		
				Production of operation and maintenance manual.		Manual on major fault countermeasures.
2. Preparation of C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System Manual Summary and Meteorological Radar System Maintenance &	An engineer capable of meteorological radar operation and maintenance.	Since engineers in the DOM have practical experience of operating and maintaining an analog meteorological radar system, it is imperative that the DOM engineers should also obtain the capability of operating and maintaining a digital meteorological radar system according to	Indicated in the table below	Discussion with the DOM engineers.	<First> Expert Consultant on meteorological radar operation and maintenance: 1.23 man-months (Period of Technology Transfer in Sri Lanka: 37days) Direct Support	C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual summary
				Selection of the most important points from the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual.		
				Production of the C-Band Pulse Compression Solid State Dual Polarization		Meteorological radar system maintenance & management record book • Date and time of

Management Record Book including acquisition procedures and data table reading of Observation Raw Data		the manual summary and the meteorological radar system maintenance & management record book including acquisition procedures and data table reading of Observation Raw Data		(Polarmetric) Meteorological Doppler Radar System manual summary. Production of the meteorological radar system maintenance & management record book. Utilization of the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual and the maintenance & management record book by the DOM engineers. Acquisition procedures and data table reading of Observation Raw Data	<Second> Expert Consultant on meteorological radar operation and maintenance: 0.90 man-months. (Period of Technology Transfer in Sri Lanka: 27days) Direct Support	occurrence of system failure/trouble Cause/s of system failure/trouble (abnormal noise, part degradation, etc.) Repair procedures implemented Name and quantity of replaced parts Name of engineer/s who perform/s the repair /troubleshooting Acquisition procedures and data table reading of Observation Raw Data
3. Meteorological Data Satellite Communication System (VSAT) Inspection, Adjustment, Minor Fault Finding, Remedy and Recovery, and Major Fault Countermeasures	An engineer capable of meteorological radar adjustment and minor fault finding.	Since the DOM has no other choice but to leverage on the VSAT manufacturer due to many troubles which has occurred in the existing VSAT system, the DOM has made a substantial payment to the VSAT manufacturer. In order to change the current situation, it is imperative that the DOM engineers should also acquire the capability of proper maintenance for Meteorological Data Satellite Communication System (VSAT).	Indicated in the table below	Routine maintenance using measuring instruments and tools. Practice of replacing spare parts into the actual system and the subsequent confirmation of system operation. Practice of antenna alignment adjustment. Practice of countermeasure, minor fault finding, remedy and recovery. Practice of major fault countermeasures. Production of operation and maintenance manual.	<First> Expert Consultant on Meteorological Data Satellite Communication System (VSAT) adjustment and fault finding: 0.73 man-months. (Period of Technology Transfer in Sri Lanka: 22days) Direct Support	Manual on routine maintenance using measuring instruments and tools. Manual on replacing spare parts into the actual system and the subsequent confirmation of system operation. Manual on fault finding, remedy and recovery. Manual on major fault countermeasures.
4. Preparation of the Meteorological Data Satellite Communication System (VSAT) Manual Summary and Meteorological Data Satellite Communication System Maintenance & Management Record Book	An engineer capable of Meteorological Data Satellite Communication System (VSAT) operation and maintenance.	It is imperative that the DOM engineers should obtain the capability of operating and maintaining a Meteorological Data Satellite Communication System (VSAT) according to the manual summary and maintenance & management record book.	Indicated in the table below	Discussion with the DOM engineers. Selection of the most important points from the Meteorological Data Satellite Communication System (VSAT) manual. Production of the Meteorological Data Satellite Communication System (VSAT) manual summary. Production of the Meteorological Data Satellite Communication System (VSAT) maintenance & management record	Expert Consultant on Meteorological Data Satellite Communication System (VSAT) operation and maintenance: 0.73 man-months (Period of Technology Transfer in Sri Lanka: 22 days) Direct Support	Meteorological Data Satellite Communication System (VSAT) manual summary Meteorological Data Satellite Communication System (VSAT) maintenance & management record book Date and time of occurrence of system failure/trouble Cause/s of system failure/trouble Repair procedures implemented

				book. Utilization of the Meteorological Data Satellite Communication System (VSAT) manual and maintenance & management record book by the DOM engineers.		• Name and quantity of replaced parts • Name of engineer/s who perform/s the repair /troubleshooting
5. Preparation of the Sequence & Schedule for Intensity Mode and Doppler Mode	An engineer who can identify Clutter and Blind Area by using radar observation data and prepare a sequence & schedule for meteorological radar observation which is suited to the weather phenomena in Sri Lanka	Since engineers in the DOM have no practical experience in the use of CAPPI observation due to the absence of a CAPPI function in the existing analog meteorological radar system, it is imperative that the DOM engineers should obtain the capability of preparation of sequences & schedules for meteorological radar observation.	Indicated in the table below	Discussion with the DOM engineers and lecture. Identification of Clutter of meteorological radar system and Blind Area at antenna elevation angle. Preparation of Blind Area at antenna elevation angle. Preparation of Sequence & Schedule for Intensity Mode and Doppler Mode. Implementation of radar observation using Sequence & Schedule for Intensity Mode and Doppler Mode.	Expert Consultant on meteorological radar observation: 0.97 man-month (Period of Technology Transfer in Sri Lanka: 29 days) Direct Support	Sequence & Schedule for Intensity Mode and Doppler Mode

Target personnel for each technology transfer in the Soft Component are indicated below.

Table 44: Target Personnel in the DOM for the Technology Transfer in the Soft Component (Technology Transfer of No. 1, 2 and 4)

Engineers/Staff	DOM Head Office	Puttalam Radar Observation Station	Pottuvil Radar Observation Station
Class I Electronics Engineer	1	0	0
Class II/I (II/II) Electronics Engineer	1	0	0
Senior Electronics Technical Officer	2	1	1
Class (II/A) Electronics Technical Officer	4	1	1
Class (II/B) Electronics Technical Officer	4	1	1

Table 45: Target Personnel in the DOM for the Technology Transfer in the Soft Component (Technology Transfer of No. 3 and 5)

Engineers/Staff	DOM Head Office (including National Meteorological Centre: NMC)	Puttalam Radar Observation Station	Pottuvil Radar Observation Station
Class I Electronics Engineer	1	0	0
Class II/I (II/II) Electronics Engineer	1	0	0
Senior Electronics Technical Officer	2	1	1
Class (II/A) Electronics Technical Officer	2	1	1
Class (II/B) Electronics Technical Officer	4	1	1
Operational Forecasters in NMC	11	0	0

<Soft Component Product>

Soft Component Products are as follows.

Table 46: Soft Component Products in Technology Transfer

Product Name		Submission Time	No. of Pages
Procedure papers on 1) routine maintenance using measuring instruments and tools, 2) practice of replacing spare parts into the actual system and the subsequent confirmation of system operation, 3) practice of minor fault finding, remedy and recovery, and 4) major fault countermeasure for C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar System.		After Technology Transfer	20
C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar System manual summary			30
C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar System maintenance and management record book			5
Procedure papers on 1) routine maintenance using measuring instruments and tools, 2) practice of replacing spare parts into the actual system and the subsequent confirmation of system operation, 3) antenna alignment adjustment, 4) practice of minor fault finding, remedy and recovery, and 5) major fault countermeasure for Meteorological Data Satellite Communication System (VSAT).			15
Meteorological Data Satellite Communication System (VSAT) manual summary			20
Meteorological Data Satellite Communication System (VSAT) maintenance and management record book			5
Radar observation sequence & schedule for Intensity Mode and Doppler Mode			15
Output Name	Content	Submission Time	No. of Pages
Soft Component Completion Report	• Scheduled Activities and Actual Achievement • Scheduled Outputs and Achievement • Factors which influence Achievement of Outputs • Recommendation • Outputs	Completion of Soft Component	50

2-2-4-9 Implementation Schedule

Table 47: Implementation Schedule

Month	1	2	3	4	5	6	7
Detailed Design & Tendering Procedures	Total : 7.0 months						
Detailed Design							
Tendering Procedures							

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Puttalam Radar Observation Station																															
Construction Work	Total : 18.0 months																														
Temporary/Piling/Earth Works																															
Structure Work																															
Finishing Work																															
Building Equipment																															
Equipment Work	Total : 17.0 months																														
Equipment Manufacturing																															
Equipment Transportation																															
Equipment Installation/Adjustment																															
National Meteorological Centre (NMC) at DOM Head Office																															
Equipment Work	Total : 15.0 months																														
Equipment Manufacturing																															
Equipment Transportation																															
Equipment Installation/Adjustment																															
DOM Aviation Meteorological Office in the Colombo International Airport	Total : 15.0 months																														
Equipment Work																															
Equipment Manufacturing																															
Equipment Transportation																															
Equipment Installation/Adjustment																															
DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport	Total : 15.0 months																														
Equipment Work																															
Equipment Manufacturing																															
Equipment Transportation																															
Equipment Installation/Adjustment																															
Pottuvil Radar Observation Station																															
Construction Work	Total : 17.5 months																														
Temporary/Piling/Earth Works																															
Structure Work																															
Finishing Work																															
Building Equipment																															
Equipment Work	Total : 17.0 months																														
Equipment Manufacturing																															
Equipment Transportation																															
Equipment Installation/Adjustment																															
Soft Component																															
Soft Compnent (Activity No. 1)																															
Soft Compnent (Activity No. 2)																															
Soft Compnent (Activity No. 3)																															
Soft Compnent (Activity No. 4)																															
Soft Compnent (Activity No. 5)																															

2-3 Obligations of Recipient Country

In the course of the implementation of the Project under Japan's Grant Aid Assistance, the DOM is responsible for the following tasks.

Table 48: Major Undertakings to be done by DOM under Implementation of the Project

No.	Items
	General Items
1	To undertake all necessary institutional and juridical procedures in Sri Lanka.
2	To undertake the required procedures of Environmental Impact Report in Sri Lanka.
3	To handle duty (Tax) exemption procedures, provide requisite legal and/or administrative documentations for customs clearance to customs broker/forwarder to be employed by the Contractor and make payment of all demurrage required at the port of disembarkation for the materials and equipment imported for the Project.
4	To defray the Value Added Tax (VAT) imposed on the building equipment and/or the construction materials for the Puttalam and Pottuvil Radar Tower Buildings to be procured by the Contractor in Sri Lanka.
5	To provide necessary working spaces with Internet Connection at the DOM Head Office for the Consultant and the Contractor for the implementation of the Project.
6	To accord Japanese and other foreign nationals including their dependent/s (if any), whose services may be required in connection with the supply of products and services under the signed contracts, such facilities as may be necessary for their entry into Sri Lanka and stay therein for the smooth and uninterrupted performance of their work (i.e. to secure the Multiple Visa for more than 1 year including its extension/s required by the recipient country in connection thereof).
7	To exempt goods of Japanese and other foreign nationals from customs duties, internal taxes and other fiscal levies which may be imposed by the Government of Sri Lanka with respect to their supply (products) and services under the signed contracts.
8	To pay bank commission for the issuance of the Authorization to Pay (A/P) and amendments of A/P, if required, for the Consultant and the Contractor.
9	To bear all the expenses, other than those to be borne by the Japan’s Grant Aid, necessary for the implementation of the Project.
10	To ensure the security of the whole Project site/s and of the Japanese and other foreign nationals assigned to the Project prior to the commencement of and during Project implementation.
	For the Construction of the Radar Tower Buildings
11	To clear, level and reclaim the land prior to the commencement of construction work.
12	To secure sufficient spaces at the respective Project site/s for temporary facilities such as a contractor's office, workshop, building materials storage, etc. needed for the construction work.
13	To obtain necessary permissions from the relevant agencies for the construction of the Radar Tower Buildings in the DOM Puttalam and Pottuvil Observatories (Radar Observation Stations).
14	To provide the commercial power (415V, 3-phase, 4-wire, 50Hz) supply (capacity: 100kVA) along with electric poles/wires, etc. from the main supply line to the proposed site for the Puttalam and Pottuvil Radar Tower Buildings.
15	To install the required step-down transformer as well as service entrance connections for the commercial power supply at the Puttalam and Pottuvil Radar Tower Buildings (415V, 3-phase, 4-wire, 50Hz).
16	To provide incidental facilities, such as public water supply, telephone lines, Internet, etc. for Puttalam and Pottuvil Radar Tower Buildings.
17	To provide temporary facilities for the availability or accessibility of electricity, water, etc. for the construction work.
18	To undertake incidental outdoor works such as gardening, fencing, gates, boundary walls and exterior lightings and to renovate the existing buildings and facilities in the DOM Puttalam and Pottuvil Observatories (Radar Observation Stations).
19	To shift the existing observation field, if required, in the DOM Puttalam and Pottuvil Observatories (Radar Observation Stations).
20	To ensure transport for the DOM personnel and to shoulder the dispatching cost of the trainees to the training sites, such as daily allowance, accommodation, etc.
	For Installation Work of the Equipment
21	To remove and relocate the existing facilities if available for the installation of the equipment, if necessary.

22	To provide and allocate secure temporary storage area/room for the materials, tools and equipment needed during the installation process.
23	To obtain the required frequencies for the Puttalam and Pottuvil meteorological radar systems and Polarimetric Test Horn Devices.
24	To provide reliable and high-speed Internet environment at the DOM Head Office and each project site for establishment of Internet Protocol-Virtual Private Network (IP-VPN).
25	To obtain the required VSAT license from the Telecommunications Regulatory Commission (TRC) for the use of satellite communication for the meteorological data satellite communication system (VSAT) to be installed.
26	To obtain the required space segment for the use of satellite communication for the meteorological data satellite communication system (VSAT).
27	To set up new assigned IP addresses in the computing equipment supplied under the Project.
28	To secure ample and strategically located space/s at the existing facilities (the National Meteorological Centre at the DOM Head Office, the DOM Aviation Meteorological Office in the Colombo International Airport and the DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport for the installation of the equipment (PC terminals and peripherals) to be supplied under the Project.
29	Replacement of 2 existing air-conditioning systems at the National Meteorological Centre at the DOM Head Office.
30	To ensure transport for the DOM personnel and to shoulder the dispatching cost of the trainees to the training sites, such as daily allowance, accommodation, etc.
After the completion of the Project	
31	To renovate the existing gates, boundary walls and exterior lighting in and around the sites as if and when required.
32	To assign the required staff for the smooth operation and maintenance of the Equipment.
33	To procure the required spare parts and consumables for the smooth operation and maintenance of the Equipment.
34	To provide adequate maintenance of the Radar Tower Buildings constructed under the Project so that they may function long lasting and effectively.
35	To effectively utilize the facilities constructed and the Equipment procured/installed under the Project.
36	To allocate the necessary budget for the smooth conduct of meteorological radar observation and forecasting works.
37	To take necessary steps for creating proposed new posts and recruiting the required man power immediately after the Project Completion.
38	To periodically update all the operation/antivirus/application software(s).

2-4 Project Operation Plan

(1) Operation and Maintenance Plan for the Equipment

1) Operational Plan of Meteorological Radar System

Since Sri Lanka is always in a monsoon season throughout the year and around-the-clock observation by a meteorological radar system is quite significant, the DOM has agreed to operate each meteorological radar system for 24 hours a day, every day upon completion of the Project.

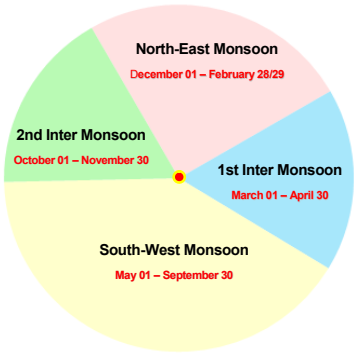


Figure 17: Monsoon Seasons of Sri Lanka

2) Operation and Maintenance Plan for the Equipment

For the appropriate operation and maintenance of the C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Doppler Meteorological Radar System, Meteorological Radar Central

Processing System, Meteorological Radar Data Display System and Meteorological Data Communication System, the following number of staff is required.

Table 49: Required Staff at each Meteorological Radar Observation Station

Position	Puttalam Radar Observation Station	Pottuvil Radar Observation Station
Senior Electronics Technical Officer (Station Leading Officer)	1	1
Electronics Technical Officer	1	1
Electronics Technical Assistant	1	1
Pion	1	1
Security Guard	1	1
Total	5	5

<Electronics Technical Officer's Operation & Maintenance and Repairing Duty>

- Electronic Equipment: Transmitter, Digital Receiver and Signal Processor, Dehydrator, Radar Power Maintenance Panel, Radar Operation Software, Power Back-up System and Building Electrical Equipment (Isolation Transformer, Power Distribution Board, Lightings, etc.), Lightening Protection System
- Data Communication Equipment: Data Communication Equipment (VSAT In-door & Out-door Units, VSAT Antenna, Dual Router, Optical Repeater, Dual Switch, Terminal (PC), Printer, Peripherals, Data Communication Software
- Mechanical Equipment: Radar Antenna, Radar Antenna Pedestal, Radome, Engine Generator, Air-conditioning Unit, Water Pump, Ventilation Duct & Fan, Door & Window, Furniture

3) Quick Response Team for Operation and Maintenance of the Equipment

In order to assist the Meteorological Radar Stations in making very prompt actions required for the quick recovery (including repairing) during the failure of significant equipment such as the meteorological radar systems, meteorological radar display system, meteorological data satellite communication system (VSAT), etc. and the trouble-shooting, the following members of the quick response team directly supervised by the DOM Director General is required.

Table 50: Quick Response Team for Radar System, VSAT Equipment, Software and Instruments located in Colombo

Position	Number of Staff
Quick Response Team Leading Engineer (Chief Electronics Engineer)	1
Quick Response Team Deputy Leading Engineer (Electronics Engineer)	1
Quick Response Team Member (Senior Electronics Technical Officer)	2
Quick Response Team Assistant (Electronics Technical Officer)	2

4) Monitoring of the Radar Systems Operation and radar observation data for quality control

In order to monitor the Radar Systems Operation and radar observation data for quality control, the following shift schedule of the National Meteorological Centre is required.

Table 51: Work Schedule of the National Meteorological Centre for monitoring of the Radar Systems Operation and radar observation data for quality control

Shift	Working Time	Working Hours	Meteorologist	Electronics Technical Officer	Meteorological Technical Officer
Day Shift	08:00-16:00	8	1	1	1
Night Shift	16:00-08:00	16	1	1	1

5) Staff Allocation and Radar Observation System Plan at the Radar Observation Stations

In connection with equipment maintenance, consideration must be given to the following.

- Technical training for the DOM staff
- Establishment of appropriate measures against system failure
- A fully documented maintenance system, with proper document control
- Scheduled replacement of parts and overhauls
- Strengthening of the operation and maintenance structure of the DOM
- Establishment of technical and financial self-reliance of the DOM

(2) Operation and Maintenance Plan for the Radar Tower Building

There are three key issues for the maintenance of the radar tower building to be implemented by the DOM: (i) daily cleaning; (ii) maintenance to cover wear and tear, damage and aging; and (iii) security measures to ensure safety and to prevent crimes.

The daily cleaning of the building gives a good impression on the visitors/users and encourages people to respect the building and the equipment in it. Cleaning is also important to ensure the equipment continues to operate correctly. It helps in the rapid detection and repair of damaged equipment and prolongs the life of the building equipment. The main repair work will be refurbishing or replacing the exterior and interior materials protecting the building structure. The required inspections are outlined below.

Table 52: Outline of Regular Inspection for the Building

	Items of Maintenance Work	Frequency
Exterior	Repair and repainting of external walls	Repair: every 5 years, Repaint: every 15 years
	Inspection and repair of roofs	Inspection: every year Repair: as required
	Regular cleaning of drain pipes and drainage systems	Monthly
	Inspection and repair of sealing of external windows and doors	Every year
	Regular inspection and cleaning of ditches and manholes	Every year
Interior	Renewal of interior finishing	As required
	Repair and repainting of partition walls	As required
	Adjustment of window and door fitting	Every year

It is important that regular preventive maintenance of the building equipment is carried out before the equipment fails or requires repair or replacement of part(s). The life of the building equipment can be significantly extended by proper operation and regular inspection, lubrication, adjustment and cleaning. These regular inspections can prevent equipment failure and accidents. The regular inspection, replacement of consumables and cleaning/replacement of filters for ventilation and air-conditioning units should be carried out in accordance with the maintenance manual.

It is essential to establish a proper maintenance structure in the DOM, involving the rigorous implementation of regular inspection and maintenance procedures. This work may be assigned to the private sector (local agents), if required. The general life expectancy of the major building equipment is

shown below.

Table 53: Life Expectancy of Building Equipment

System	Building Equipment	Life Expectancy
Electrical System	• Distribution panels • LED lamps	20 - 30 years 20,000 - 60,000 hours
Water Supply and Drainage Systems	• Pipes and valves • Sanitary fixture	15 years 25 - 30 years
Air-Conditioning System	• Pipes • Air-conditioning units and exhaust fans	15 years 15 years

2-5 Project Cost Estimate

2-5-1 Estimate of Project Cost and Capital Cost to be borne by the DOM

The required capital cost for the Project to be borne by the DOM has been estimated and is shown in the following tables.

Project Cost to be borne by the DOM

Total Project Cost: 486,650,000 Rupee (approx. 408 Million JP Yen)

Table 54: Estimated Capital Cost to be borne by the DOM

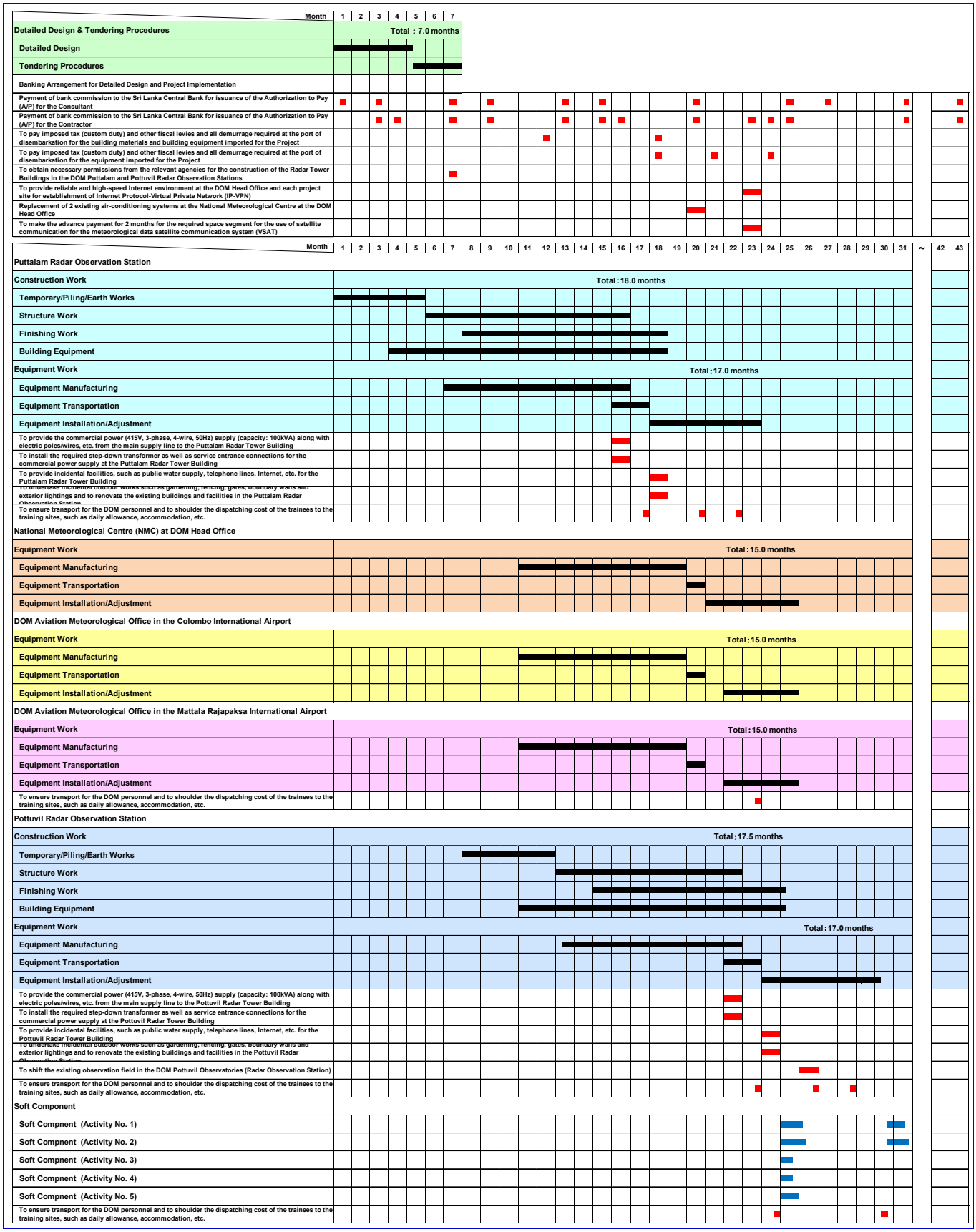
No.	Items	Capital Cost (Rupee)
1	To pay imposed tax (custom duty) and other fiscal levies and all demurrage required at the port of disembarkation for the materials and equipment imported for the Project.	250,000,000
2	To defray the Value Added Tax (VAT) imposed on the building equipment and/or the construction materials for the Puttalam and Pottuvil Radar Tower Buildings to be procured by the Contractor in Sri Lanka following the guidelines and process for the approval of the Specified Project for the Simplified Value Added Tax (VAT).	225,000,000
3	To pay bank commission for the issuance of the Authorization to Pay (A/P) and amendments of A/P, if required, for the Consultant and the Contractor.	1,550,000
4	Replacement of 2 existing air-conditioning systems at the National Meteorological Centre at the DOM Head Office.	600,000
5	To obtain necessary permissions from the relevant agencies for the construction of the Radar Tower Buildings in the DOM Puttalam and Pottuvil Observatories (Radar Observation Stations).	100,000
6	To provide the commercial power (415V, 3-phase, 4-wire, 50Hz) supply (capacity: 100kVA) along with electric poles/wires, etc. from the main supply line to the proposed site for the Puttalam and Pottuvil Radar Tower Buildings To install the required step-down transformer as well as service entrance connections for the commercial power supply at the Puttalam and Pottuvil Radar Tower Buildings.	4,400,000 (2,200,000×2 sites)
7	To provide incidental facilities, such as public water supply, telephone lines, Internet, etc. for Puttalam and Pottuvil Radar Tower Buildings.	1,400,000 (700,000×2 sites)
8	To undertake incidental outdoor works such as gardening, fencing, gates, boundary walls and exterior lightings and to renovate the existing buildings and facilities in the DOM Puttalam and Pottuvil Observatories (Radar Observation Stations).	500,000 (250,000×2 sites)
9	To shift the existing observation field in the DOM Pottuvil Observatories (Radar Observation Station).	100,000
10	To provide reliable and high-speed Internet environment at the DOM Head Office and each project site for establishment of Internet Protocol-Virtual Private Network (IP-VPN).	200,000 (100,000×2 sites)
11	To make the advance payment for 2 months for the required space segment for the use of satellite communication for the meteorological data satellite communication system (VSAT).	2,000,000

12	To ensure transport for the DOM personnel and to shoulder the dispatching cost of the trainees to the training sites, such as daily allowance, accommodation, etc.	800,000
	Total	486,650,000

Applied Exchange Rate: US$ 1 = 119.47 JP Yen, 1 Rupee = 0.839 JP Yen

The Capital Cost Disbursement Schedule of the DOM is attached hereunder.

Table 55: Capital Cost Disbursement Schedule of DOM



2-5-2 Estimate of the Recurrent Cost for the Project to be borne by Sri Lanka

(1) Recurrent Cost to be borne by the DOM

The annual recurrent costs considered as 5% of the annual inflation rate to be borne by the DOM for the first decade after the completion of the Project are attached hereunder. The recurrent costs have been calculated in accordance with the following fundamental conditions.

- Operation and maintenance to be carried out by the DOM
- Appropriate operation in accordance with the operations manuals
- Regular and proper maintenance according to the maintenance manuals

Table 56: Recurrent Cost of Puttalam Meteorological Radar Observation Station

Estimated Recurrent Cost

	Equipment	Item	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Antenna	Grease (16kgs/can, For AZ/EL)	1	0	0	0	0	28,300	0	0	0	0	36,100	Every 5 years
		Timing belt (For AZ/EL)	2	0	0	0	0	0	0	0	26,200	0	0	Every 8 years
2	Antenna controller	AC fan	3	0	0	0	0	0	0	0	0	0	70,400	Every 10 years
3	Transmitter	AC fan	36	0	0	0	0	0	0	0	0	0	845,100	Every 10 years
4	Receiver	AC fan	3	0	0	0	0	0	0	0	0	0	70,400	Every 10 years
5	Product Monitor	Blu-ray disk for data storage	12	2,500	2,600	2,800	2,900	3,100	3,200	3,400	3,500	3,700	3,900	
6	Printer	Printer ink cartridge	2	8,100	8,600	9,000	9,400	9,900	10,400	10,900	11,500	12,000	12,600	
		Paper（500sheets/1set）	4	1,900	2,000	2,100	2,200	2,300	2,400	2,500	2,600	2,800	2,900	
7	Power Supply Capacitor	AC fan	3	0	0	0	0	0	0	0	0	0	70,400	Every 10 years
		Arrester	5	0	0	0	0	0	0	0	0	0	135,400	Every 10 years
8	Diesel Engine Generator	Oil seal	2	0	4,600	4,900	5,100	5,400	5,600	5,900	6,200	6,500	6,900	Every 1 year
		Filter	2	0	0	18,000	0	19,800	0	21,800	0	24,100	0	Every 2 years
		Battery for Engine start	2	0	0	0	0	0	23,800	0	0	0	28,900	Every 5 years
		Sub total (LKR)		12,500	17,800	36,800	19,600	68,800	45,400	44,500	50,000	49,100	1,283,000	

Others

	Cost Item	Details	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Electricity Charge		1	3,170,300	3,328,800	3,495,300	3,670,000	3,853,500	4,046,200	4,248,500	4,460,900	4,684,000	4,918,200	*1
2	Fuel cost	Fuel consumption of DEG	1	101,300	123,800	130,000	136,500	143,300	150,400	158,000	165,900	174,200	182,900	*2
3	Water supply charge		1	4,000	4,200	4,400	4,600	4,900	5,100	5,400	5,600	5,900	6,200	*3
4	Special maintenance	System brush-up by the manufacture's engineer	1	0	0	1,155,000	0	0	1,337,000	0	0	1,547,800	0	For 5 days at site
5	Remote maintenance	Remote maintenance by the manufacture's engineer through the Internet	1	232,800	244,400	256,700	269,500	283,000	297,100	312,000	327,600	344,000	361,100	
6	Radome	Caulking repair	1	25,600	26,900	28,200	29,600	31,100	32,700	34,300	36,000	37,800	39,700	
7	Pest-control	Exterminating vermination	1	23,000	24,200	25,400	26,700	28,000	29,400	30,900	32,400	34,100	35,800	
		Sub total (LKR)		3,557,000	3,752,300	5,095,000	4,136,900	4,343,800	5,897,900	4,789,100	5,028,400	6,827,800	5,543,900	
		Total (LKR)		**3,569,500**	**3,770,100**	**5,131,800**	**4,156,500**	**4,412,600**	**5,943,300**	**4,833,600**	**5,078,400**	**6,876,900**	**6,826,900**	
		Total（JPY）		**¥3,066,581**	**¥3,238,918**	**¥4,408,763**	**¥3,570,876**	**¥3,790,893**	**¥5,105,928**	**¥4,152,577**	**¥4,362,887**	**¥5,907,990**	**¥5,865,034**	

Estimate of annual electricity charge

Annual power consumption	(kWh)	213,080		
Annual power consumption by commercial power (98%)	(kWh)	208,818		
Annual power consumption by DEG (2%)	(kWh)	4,262		
Annual fuel consumption	(Litter)	1,066	Fuel consumption of DEG=	0.25 Litter/kWh
*1 Annual electricity charge of commercial power	(LKR)	3,170,302	Electricity charge=	14.55 LKR/kWh
*2 Annual fuel cost of DEG	(LKR)	101,270	Fuel cost=	95.00 LKR/Litter
*3 Annual water supply charge	(LKR)	0	Exchange rate	1.164 LKR/JPY

*4 Inflation: 5%/year considered

Table 57: Recurrent Cost of Pottuvil Meteorological Radar Observation Station

Estimated Recurrent Cc

	Equipment	Item	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Antenna	Grease (16kgs/can, For AZ/EL)	1	0	0	0	0	28,300	0	0	0	0	36,100	Every 5 years
		Timing belt (For AZ/EL)	2	0	0	0	0	0	0	0	26,200	0	0	Every 8 years
2	Antenna controller	AC fan	3	0	0	0	0	0	0	0	0	0	70,400	Every 10 years
3	Transmitter	AC fan	36	0	0	0	0	0	0	0	0	0	845,100	Every 10 years
4	Receiver	AC fan	3	0	0	0	0	0	0	0	0	0	70,400	Every 10 years
5	Product Monitor	Blu-ray disk for data storage	12	2,500	2,600	2,800	2,900	3,100	3,200	3,400	3,500	3,700	3,900	
6	Printer	Printer ink cartridge	2	8,100	8,600	9,000	9,400	9,900	10,400	10,900	11,500	12,000	12,600	
		Paper（500sheets/1set）	4	1,900	2,000	2,100	2,200	2,300	2,400	2,500	2,600	2,800	2,900	
7	Power Supply Capacitor	AC fan	3	0	0	0	0	0	0	0	0	0	70,400	Every 10 years
		Arrester	5	0	0	0	0	0	0	0	0	0	135,400	Every 10 years
8	Diesel Engine Generator	Oil seal	2	0	4,600	4,900	5,100	5,400	5,600	5,900	6,200	6,500	6,900	Every 1 year
		Filter	2	0	0	18,000	0	19,800	0	21,800	0	24,100	0	Every 2 years
		Battery for Engine start	2	0	0	0	0	0	23,800	0	0	0	28,900	Every 5 years
		Sub total (LKR)		12,500	17,800	36,800	19,600	68,800	45,400	44,500	50,000	49,100	1,283,000	

Others

	Cost Item	Details	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Electricity Charge		1	3,170,300	3,328,800	3,495,300	3,670,000	3,853,500	4,046,200	4,248,500	4,460,900	4,684,000	4,918,200	*1
2	Fuel cost	Fuel consumption of DEG	1	101,300	123,800	130,000	136,500	143,300	150,400	158,000	165,900	174,200	182,900	*2
3	Water supply charge		1	4,000	4,200	4,400	4,600	4,900	5,100	5,400	5,600	5,900	6,200	*3
4	Special maintenance	System brush-up by the manufacture's engineer	1	0	0	1,155,000	0	0	1,337,000	0	0	1,547,800	0	For 5 days at site
5	Remote maintenance	Remote maintenance by the manufacture's engineer through the Internet	1	232,800	244,400	256,700	269,500	283,000	297,100	312,000	327,600	344,000	361,100	
6	Radome	Caulking repair	1	25,600	26,900	28,200	29,600	31,100	32,700	34,300	36,000	37,800	39,700	
7	Pest-control	Exterminating vermination	1	23,000	24,200	25,400	26,700	28,000	29,400	30,900	32,400	34,100	35,800	
		Sub total (LKR)		3,557,000	3,752,300	5,095,000	4,136,900	4,343,800	5,897,900	4,789,100	5,028,400	6,827,800	5,543,900	
		Total (LKR)		**3,569,500**	**3,770,100**	**5,131,800**	**4,156,500**	**4,412,600**	**5,943,300**	**4,833,600**	**5,078,400**	**6,876,900**	**6,826,900**	
		Total(JPY)		**¥3,066,581**	**¥3,238,918**	**¥4,408,763**	**¥3,570,876**	**¥3,790,893**	**¥5,105,928**	**¥4,152,577**	**¥4,362,887**	**¥5,907,990**	**¥5,865,034**	

Estimate of annual electricity charge

Annual power consumption	(kWh)	213,080	
Annual power consumption by commercial power (98%)	(kWh)	208,818	
Annual power consumption by DEG (2%)	(kWh)	4,262	
Annual fuel consumption	(Litter)	1,066	Fuel consumption of DEG= 0.25 Litter/kWh
*1 Annual electricity charge of commercial power	(LKR)	3,170,302	Electricity charge= 14.55 LKR/kWh
*2 Annual fuel cost of DEG	(LKR)	101,270	Fuel cost= 95.00 LKR/Litter
*3 Annual water supply charge	(LKR)	0	Exchange rate 1.164 LKR/JPY

*4 Inflation: 5%/year considered

Table 58: Recurrent Cost of the DOM Head Office and the DOM Aviation Meteorological Offices in the Colombo International Airport and the Mattala Rajapaksa International Airport

Estimated Recurrent Cost

	Equipment	Item	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
	Storm Warning Centre (SWC)													
1	Product Monitor	Blu-ray disk for data storage	24	5,000	5,300	5,500	5,800	6,100	6,400	6,700	7,100	7,400	7,800	
2	Printer	Printer ink cartridge	4	16,300	17,100	18,000	18,900	19,800	20,800	21,800	22,900	24,100	25,300	
		Paper（500sheets/1set）	10	5,200	5,500	5,800	6,100	6,400	6,700	7,000	7,400	7,700	8,100	
3	Compact UPS	Battery	12	0	0	137,100	0	0	158,700	0	0	183,700	0	Every 3 years
4	5kVA UPS	Battery	1	0	0	192,500	0	0	222,800	0	0	258,000	0	Every 3 years
	DOM Meteorological Office in the Colombo International Airport and Mattala Rajapaksa International Airport													
1	Compact UPS	Battery	2	0	0	22,800	0	0	26,400	0	0	30,600	0	Every 3 years
		Sub total (LKR)		26,500	27,900	381,700	30,800	32,300	441,800	35,500	37,400	511,500	41,200	

Others

	Cost Item	Details	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Electricity Charge		1	373,400	392,000	411,600	432,200	453,800	476,500	500,300	525,400	551,600	579,200	*1
2	Fuel cost	Fuel consumption of Existing DEG	1	5,100	5,400	5,700	5,900	6,200	6,500	6,900	7,200	7,600	8,000	*2
3	Frequency License Fee	for Puttalam and Pottuvil Meteorological Radar	1	1,600,000	1,680,000	1,764,000	1,852,200	1,944,800	2,042,100	2,144,200	2,251,400	2,363,900	2,482,100	
		for Puttalam/Pottuvil - DOM Head Office Satellite Communication	1	110,000	115,500	121,300	127,300	133,700	140,400	147,400	154,800	162,500	170,600	
4	Communication charge	IP-VPN (Puttalam/Pottuvil - DOM Head Office)	1	620,000	651,000	683,600	717,700	753,600	791,300	830,900	872,400	916,000	961,800	
		Satellite Service Charge (Space Segment)	1	11,532,700	12,109,400	12,714,800	13,350,600	14,018,100	14,719,000	15,455,000	16,227,700	17,039,100	17,891,100	
5	Remote maintenance	Remote maintenance by the manufacture's engineer through the Internet	1	116,400	122,200	128,300	134,700	141,500	148,600	156,000	163,800	172,000	180,600	*2
		Sub total (LKR)		14,357,600	15,075,500	15,829,300	16,620,600	17,451,700	18,324,400	19,240,700	20,202,700	21,212,700	22,273,400	
		Total (LKR)		**14,384,100**	**15,103,400**	**16,211,000**	**16,651,400**	**17,484,000**	**18,766,200**	**19,276,200**	**20,240,100**	**21,724,200**	**22,314,600**	
		Total(JPY)		**¥12,357,474**	**¥12,975,430**	**¥13,926,976**	**¥14,305,326**	**¥15,020,619**	**¥16,122,165**	**¥16,560,309**	**¥17,388,402**	**¥18,663,402**	**¥19,170,619**	

Estimate of annual electricity charge

Annual power consumption of DOM Head Office (Commercial Power)	(kWh)	21,341	*99% of power consumption
Annual power consumption of DOM Meteorological Office in the Colombo International Airport (Commercial Power)	(kWh)	2,160	
Annual power consumption of DOM Meteorological Office in the Mattala Rajapaksa International Airport (Commercial Power)	(kWh)	2,160	
Total annual power consumption (Commercial Power)	(kWh)	25,661	
Annual power consumption of DOM Head Office (DEG)	(kWh)	216	*1% of power consumption
Annual fuel consumption	(Litter)	54	Fuel consumption of DEG= 0.25 Litter/kWh
*1 Annual electricity charge of commercial power	(LKR)	373,368	Electricity charge= 14.55 LKR/kWh
*2 Annual fuel cost of DEG	(LKR)	5,130	Fuel cost= 95.00 LKR/Litter

*3 Inflation: 5%/year considered

Exchange rate 1.164 LKR/JPY

(2) Annual Budget Trends

The estimated total recurrent cost (1st year) of the Project is approximately 6% of the total amount of the DOM budget (2016). In addition, since the DOM has annually secured all the required budgets for the operation and maintenance of all the equipment procured under the implemented projects of Japan's Grant Aid, it has been assessed that there will be no problems in this regard. Furthermore, the DOM has committed to the Preparatory Survey Team to allocate the required budget for the Project.

Table 59: Budget (Estimate) of the Department of Meteorology (1,000 Rs)

Category/Object Title	2012	2013	2014	2015	2016
RECURRENT EXPENDITURE	186,250	180,650	206,730	255,180	260,800
Personal Emoluments (Salaries and Wages, Overtime and Holiday Payments, Other Allowances)	118,900	124,750	146,850	182,238	189,500
Travelling Expenses	3,050	2,700	1,410	2,000	2,000
Supplies (Stationery and Office Requisites, Fuel, Diets & Uniforms)	16,375	13,181	10,430	10,442	10,650
Maintenance Expenditure (Vehicles, Plant, Machinery & Equipment, Buildings & Structures)	10,025	3,600	5,413	13,750	11,350
Services (Transport, Postal and Communication, Electricity & Water, Rents & Local Taxes, Other)	29,864	28,725	34,394	38,371	38,450
Transfers (Subscription and Contribution Fees, Property Loan Interest)	8,036	7,652	8,233	8,350	8,850
Other Recurrent Expenditure (Losses & Write off)	-	42	-	29	-
CAPITAL EXPENDITURE	348,119	69,285	83,795	348,000	63,200
Rehabilitation and Improvement of Capital Assets (Building & Structures)	5,500	16,600	5,600	8,150	7,000
Acquisition of Capital Assets (Vehicles, Furniture & Office Equipment, Buildings & Structures, Lands & Land Improvement)	15,450	6,297	32,185	18,000	4,000
Capacity Building (Staff Training)	400	450	2,205	4,350	3,000
Other Capital Expenditure (Investments)	600	-	-	-	-
Meteorological Equipment	10,700	9,000	6,302	14,000	11,200
Doppler Weather Radar System	10,249	22,800	-	-	-
COMS Data Receiving/Analyzing System	294,600	-	-	-	-
Automatic Weather System - Spare parts	10,000	11,250	-	-	-
Quality Management System (QMS) Workshop	620	-	-	-	-
Awareness Building	-	1,986	1,502	1,000	1,000
WMO/Escap Panel on Tropical Cyclones	-	902	-	-	-
Improving Forecasting Capabilities of the Department of Meteorology to Minimize the Impact of Frequent Weather Hazards	-	-	-	237,000	-
Development of Meteorological Observation, Weather Forecasting and Dissemination	-	-	36,000	65,500	37,000
Total Expenditure	**534,369**	**249,935**	**290,525**	**603,180**	**324,000**

Chapter 3
Project Evaluation

Chapter 3 Project Evaluation

3-1 Preconditions

The procedures required for the implementation of this Project are as follows.

Table 60: Required Procedures for the Frequencies for C-Band Solid-state Polarimetric Meteorological Doppler Radar Systems

Office Concerned	Required Documents	Approximate Period required	Applicant
Telecommunications Regulatory Commission (TRC) (Application: After signing of the Contract)	• Application Form: 1 set • Equipment Catalog: 1 set • Technical Specifications: 1 set • Certificate of the Ministry of Defence: 1 set • Certificate of the Civil Aviation Authority: 1 set	4 months	DOM

Table 61: Required Procedures for Approval of the Central Environmental Authority

Office Concerned	Required Documents	Approximate Period required	Applicant
Central Environmental Authority (Application: After signing of the Contract)	• Application Form: 1 set • Project Summary: 1 set • Summary of Meteorological Radar Technical Information: 1 set • Map of Meteorological Radar Observation Range: 1 set • Certificate of Telecommunications Regulatory Commission: 1 set • Architectural Drawings: 1 set • Site Location Drawing: 1 set	1 month	DOM

Table 62: Required Procedures for the Radar Tower Building Construction

Required Procedures	Office Concerned	Approximate Period required	Required Documents	Applicant
Development Permit for Construction of Building (Application: After signing of the Exchange of Notes)	Puttalam Urban Council	1 month	• Application Form: 1 set • Land Ownership Certificate: 1 set • Topographic Survey Plan: 1 set • Architectural Drawings: 3 sets • Assessment Tax Receipt: 1 set • Extract 30 Years: 1 set • Title Report and Pedigree: 1 set • Site Location Drawing: 1 set • Fire Certificate: 1 set	DOM
	Pottuvil Pradesiya Sabha (Pottuvil Divisional Council)	1 month	• Application Form: 1 set • Land Ownership Certificate: 3 sets • Topographic Survey Plan: 3 sets • Architectural Drawings: 3 sets • Urban Development Authority Clearance: 1 set • Coast Conservation Clearance: 1 set • Fire Certificate: 1 set	
Development Permit for Subdivision of Land for Development Permit for Construction of Building at Puttalam (Application: After signing of the Exchange of Notes)	Puttalam Urban Council	1 month	• Application Form: 1 set • Land Ownership Certificate: 1 set • Topographic Survey Plan: 3 sets • Assessment Tax Receipt: 1 set • Extract 30 Years: 1 set • Title Report and Pedigree: 1 set • Site Location Drawing: 1 set	

Urban Development Authority Clearance for Development Permit for Construction of Building at Puttalam (Application: After signing of the Exchange of Notes)	Urban Development Authority, North Western Provincial Office (Kurunegala)	1 month	• Application Form: 1 set • Land Ownership Certificate: 1 set • Topographic Survey Plan: 1 set • Architectural Drawings: 2 sets • Certificate of the Ministry of Defence: 1 set • Certificate of the Civil Aviation Authority: 1 set	
Urban Development Authority Clearance for Development Permit for Construction of Building at Pottuvil (Application: After signing of the Exchange of Notes)	Urban Development Authority, Ampara District Office	1 month	• Application Form: 1 set • Land Ownership Certificate: 1 set • Topographic Survey Plan: 1 set • Architectural and Structural Drawings: 1 set • Certificate of the Ministry of Defence: 1 set • Certificate of the Civil Aviation Authority: 1 set	
Coast Conservation Clearance for Development Permit for Construction of Building at Pottuvil (in case of a new building located within 300m landward of mean high water line) (Application: After signing of the Exchange of Notes)	Coast Conservation & Coastal Resource Management Department	1 month	• Application Form: 1 set • Project Summary: 1 set • Land Ownership Certificate: 3 sets • Topographic Survey Plan: 3 sets • Architectural Drawings: 3 sets	
Fire Certificate for Development Permit for Construction of Building at Puttalam and Pottuvil (Application: After signing of the Exchange of Notes)	Fire Service Department	1 week	• Application Form: 1 set • Architectural Drawings: 2 sets	
Application for Commercial Power Supply and Step-down Transformer Installation for the Radar Tower Buildings to be constructed at Puttalam and Pottuvil (Application: After signing of the Contract)	Ceylon Electricity Board (CEB)	2 months	• Request Letter of DOM: 1 set • Site Location Drawing: 1 set • Electrical Drawing: 1 set	

Table 63: Required Procedures before the application of a Custom Clearance for the Equipment to be procured under the Project

Required Procedures	Office Concerned	Required Documents	Approximate Period required	Remark
Request of the required Budget for Import Duty (Application: After signing of the Contract)	Ministry of Disaster Management	• Equipment Master List: 1 set (Copy) • Transport Schedule: 1 set (Copy)	-	DOM calculates the required budget for Import Duty for the Equipment to be procured under the Project and makes the budget request to the Ministry of Disaster Management for the following year.
Import License (Application: After signing of the Contract)	Telecommunications Regulatory Commission	• Application Form: 1 set (Original) • Equipment Catalog: 1 set (Copy) • Technical Specifications: 1 set (Copy)	5 days	-

Table 64: Required Procedures for the application of a Custom Clearance for the Equipment to be procured under the Project

Required Procedures	Office Concerned	Required Documents	Approximate Period required	Remark

Import Control License (Application: After signing of the Shipment)	Department of Import & Export Control	• Application Form: 1 set (Original) • Shipping Invoice: 1 set (Copy) • Packing List: 1 set (Copy) • Certificate of Origin: 1 set (Copy) • Catalog or Instruction Manual: 1 set (Copy)	5 days	-
Custom Clearance (Application: After signing of the Shipment)	Colombo Customs House, Sri Lanka Customs Department	• Application Form: 1 set (Original) • Bill of Lading: 1 set (Original) • Shipping Invoice: 2 sets (Original) • Packing List: 2 sets (Original) • Insurance Policy: 1 set (Original) • Certificate of Origin: 1 set (Copy) • No Foreign Exchange Letter: 1 set (Copy) • No Objection Certificate issued by Telecommunications Regulatory Commission (TRC) : 1 set (Copy) • Import Control License issued by the Department of Import & Export Control: 1 set (Copy) • Exchange of Notes: 1 set (Copy)	15 days	No Foreign Exchange Letter issued by the DOM for submission to the Colombo Customs House

Table 65: Required Procedures for Approval of Specified Project for Simplified Value Added Tax

Required Procedures	Office Concerned	Required Documents	Approximate Period required	Remark
Approval of the Specified Project for the Simplified Value Added Tax (VAT) (Application: After signing of the Contract)	Department of Fiscal Policy, Ministry of Finance & Planning	• Exchange of Notes: 1 set • Grant Agreement: 1 set • Cabinet Decision: 1 set • Signed Contract between DOM and Japanese Main Contractor: 1 set	15 days	Request to be made through the Ministry of Disaster Management

< Custom Duty, Value Added Tax (VAT) and Other Fiscal Levies >

Custom Duties, Value Added Taxes (VAT) and Other Fiscal Levies that might be imposed on the equipment, installation & construction materials to be procured by the main contractor of the Project to be selected in accordance with the tendering procedures of the Japan's Gant Aid Assistance will be borne by the DOM in accordance with the following procedures.

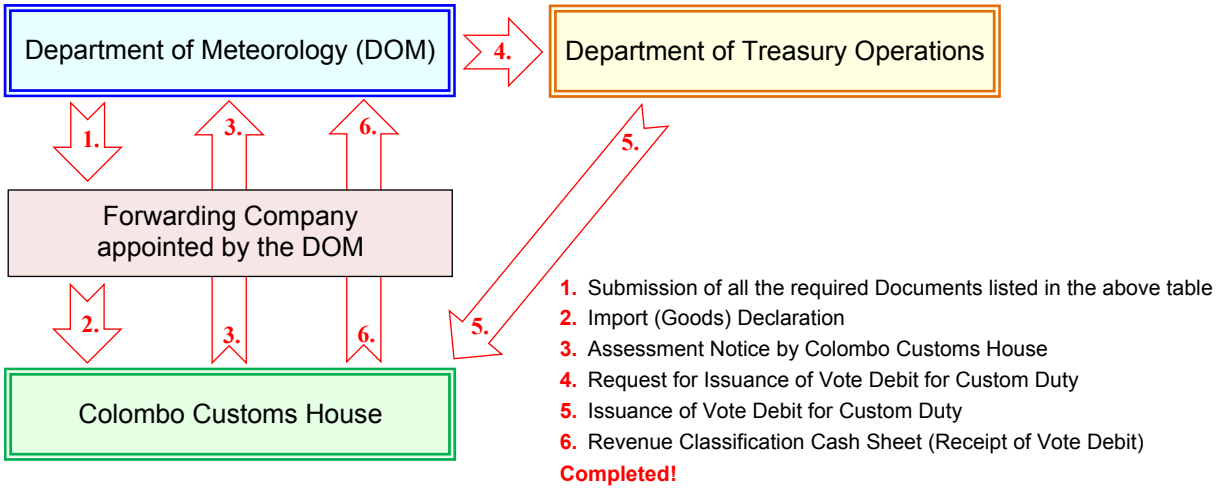


Figure 18: Payment Procedures for Custom Duty, Value Added Tax (VAT) and Other Fiscal Levies

< Annual Budgetary Request >

The DOM needs to incorporate the maintenance and operation cost of the Project into its annual budgetary request which is submitted to the Ministry of Finance and Planning (MOFP) of Sri Lanka in addition to the budget allocation needed for the smooth implementation of the Project and the allocation for taxes and levies for the Equipment to be procured under the Project. It is necessary to prepare the budgetary request for each year of the Project period before the end of August of the prior year. The Sri Lankan fiscal year starts on January 01 and ends on December 31. The procedures for applying for the budget for the following year are indicated in the Figure attached on the right hand side.

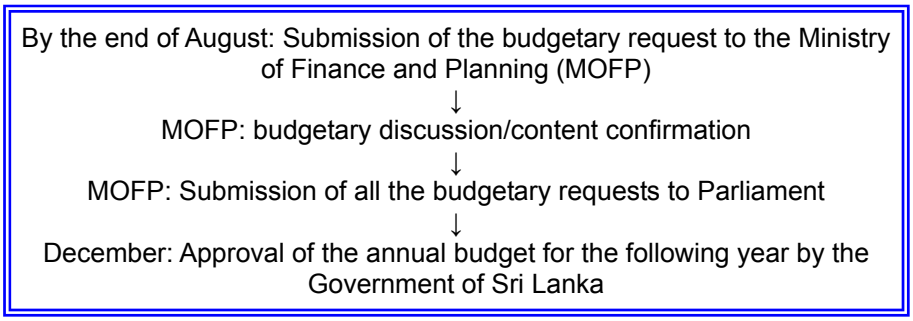


Figure 19: Procedures for applying for the budget for the following year

In case the Project is implemented, it will require the preparation of a contract for spare parts procurement between the DOM and the supplier/manufacturer who supplied the original equipment (meteorological radar systems) as they will be the only organization that can supply the required spare parts and technical services.

3-2 Necessary Inputs from the Recipient Country

In order to further enhance the benefits of this Project, the following recommendations are strongly encouraged and should be implemented accordingly.

1) Manpower Development

   a) Continuous recruitment of human resources for the next generation; and,

   b) Development of more qualified technical personnel through training and other related manpower development programs.

2) Natural Disaster Prevention and Management

   a) Setting up of redundancies in the announcement of warnings and other information dissemination methods through multi-channels to ensure reaching out to the general populace; and,

   b) Continuing educational activities for the general public in coordination with various related disaster management agencies and the mass media for a more effective natural disaster prevention and management strategy.

3) Longer Life Span of the Equipment procured and the Radar Tower Buildings constructed under the Project

   a) Regularly secure the necessary budget for the efficient operation and maintenance of the systems and building equipment, and the procurement of requisite spare parts and consumables for all the equipment to be supplied under the Project;

   b) Ensure the protection of the buildings, equipment and facilities against theft and vandalism; and,

   c) Regularly paint and caulk the caulking grooves of the Radar Tower Buildings.

3-3 Important Assumptions

1) Utilization of the meteorological information/data and forecasts/warnings by the mass media (TV, radio, newspaper), the Prime Minister's Office, Ministry of Disaster Management, Ministry of Irrigation & Water Resources Management, Ministry of Transport, Ministry of Agriculture, Civil Aviation Authority, Ministry of Health & Indigenous Medicine, Ministry of Fisheries and Aquatic Resource Development, Ministry of Highways, Ports & Shipping, Department of Police, Fire Station, other government-affiliated organizations, Sri Lanka Red Crescent Society, etc.

2) No change in global warming countermeasures, natural disaster countermeasures, and meteorological service policies as determined by the Government of Sri Lanka.

3) Maintenance of a cooperative structure among the mass media (TV, radio, newspaper), the Prime Minister's Office, Ministry of Disaster Management, Ministry of Irrigation & Water Resources Management, Ministry of Transport, Ministry of Agriculture, Civil Aviation Authority, Ministry of Health & Indigenous Medicine, Ministry of Fisheries and Aquatic Resource Development, Ministry of Highways, Ports & Shipping, Department of Police, Fire Station, other government-affiliated organizations, Sri Lanka Red Crescent Society, etc.

4) Continuance of service by a DOM staff who has received the soft component training or on-site training related to the Project.

3-4 Project Evaluation

3-4-1 Relevance

1) Population to directly benefit from the Implementation of the Project

The overall objective of the Project is to reduce the devastation arising from meteorological disasters. This could be achieved by improving the DOM's capabilities in meteorological observation and forecast/warning in preparation for heavy rains. Floods caused by heavy rains are extreme manifestations

of nature that may lead to immeasurable loss and distress for quite a number of people and have also become determining factors for the significant set-back of the national economy. Therefore, the population to be benefited both directly and indirectly by the Project will be the whole nation of Sri Lanka (approx. 20 million based on below figures). However, the number of victims will proportionally increase due to the fact the population of Sri Lanka has been slowly increasing. The following table indicates the population of the 9 respective administrative districts in Sri Lanka.

Table 66: Administrative Districts and Population in Sri Lanka

Map No.	Flag	Administrative District	Capital	Area (km²)	Population (2012)
1		Northern	Jaffna	8,884	1,061,315
2		North Western	Kurunegala	7,888	2,380,861
3		North Central	Anuradhapura	10,472	1,266,663
4		Eastern	Trincomalee	9,996	1,555,510
5		Western	Colombo	3,684	5,851,130
6		Sabaragamuwa	Ratnapura	4,968	1,928,655
7		Central	Kandy	5,674	2,571,557
8		Uva	Badulla	8,500	1,266,463
9		Southern	Galle	5,544	2,477,285
			Total	65,610	20,359,439

Source: Department of Census and Statistics, Sri Lanka

2) Objectives of the Project

In Sri Lanka, major disasters (floods, landslides, droughts, storms, tropical cyclones and etc.) caused by hazardous weather phenomena bring about massive damages to both people and the economy due to the destruction of important infrastructures and properties. In addition, the aftermath of such a situation requires the expenditure of a significant amount of money and resources for restoration projects which negatively affects the socio-economic development of the country. Given these circumstances, the key objective of the Project is the effective mitigation of the devastation generated by disasters caused by hazardous meteorological phenomena in the entire area of Sri Lanka through the improvement of the weather information and forecasts & warnings released by the DOM by means of strengthening their monitoring capability of hazardous weather phenomena through the provision of technical support and the procurement of C-Band Pulse Compression Solid State Dual Polarization (Polarimetric) Doppler Meteorological Radar Systems, Meteorological Radar Central Processing System, Meteorological Radar Data Display Systems and Meteorological Data Communication Systems under the Project.

3) Development Plan of Sri Lanka

Since disaster risk reduction is even more important today as Sri Lanka embarks on a rapid development trajectory where natural disasters can erode development gains unless Disaster Risk Reduction measures are factored into development planning and frequency of occurrence of natural disasters is in an increasing trend, the Sri Lanka Comprehensive Disaster Management Programme (SLCDMP) 2014-2018 has been developed by the Ministry of Disaster Management in accordance with the National Policy on Disaster

Management issued last February 2013. The goal of the SLCDMP is "to ensure the "safety of Sri Lanka" by reducing potential disaster risks and impacts on people, property and the economy." In addition, the overarching objective is "to create and facilitate the enabling environment for a multi-hazard, multi-sector, multi-agency partnership oriented disaster management programme, using risk knowledge as the base, in line with global conventions and frameworks."

Unequivocally, the following specific objectives of the Programme supports and justifies the necessity of the implementation of this Project.

1. Integrate disaster risk information based approaches in the development agenda
2. Prevent/mitigate the impacts of frequently occurring disasters on life and properties

For development to be sustainable, it is important to mitigate the effects of natural disasters among other things. The enhancement of technical capacity and capability in the area of weather forecasting and early warning will pave the way for the prompt mitigation of the effects of weather-related natural disasters by way of providing timely and accurate information on impending hazards. Thereby, this project is in line with the Government's policy framework.

In addition, prior to his election as the 7th Executive President of Sri Lanka last 9 January 2015, His Excellency Maithripala Sirisena released his manifesto, entitled "A Compassionate Maithri Governance - A Stable Country." Under Chapter 4 on Food Security and Sustainable Development of his manifesto, he assured to "formulate a national policy that could face modern ecological challenges." Furthermore, His Excellency Maithripala Sirisena assured that programmes will be activated to minimize various disasters and accidents caused by climate changes such as drought, forest fires, floods, landslides, typhoons, tornadoes and sea erosion. In order to identify and implement the required methodologies to minimize disasters, the Disaster Management Centre units were proposed to be systematically established at each Divisional Secretary Office so that a productive alliance could be maintained with the relevant agencies.

The implementation of this Project which is also in accordance with Japan's aid policy of "overcoming social vulnerability," supports this vision of His Excellency. To mitigate the damages brought about by tropical cyclones and floods, it is quite important to promptly transmit accurate weather information/warnings to each disaster prevention organizations, local governments and the mass media. Since the information issued by the DOM is a trigger for the first of many actions for each disaster prevention organization, the improvement of the DOM's monitoring capability of meteorological phenomena is highly indispensable and necessary.

4) Aid Policy of Japan

Japan and Sri Lanka have developed congenial bilateral relations after establishing diplomatic relations in 1952 based on Sri Lanka's traditional and strong affinity towards Japan. Japanese support for Sri Lanka is aimed towards the promotion of Sri Lanka's economic growth and the development of a business environment conducive for the activities of Japanese companies. In addition, Japan aims to contribute to the establishment of democracy and the stability of the entire South Asian region. As Sri Lanka sits in a

geopolitically important area, Japanese support has significance in ensuring the availability and safety of sea transportation routes and facilitating the development of economic relations between Japan and Middle Eastern and African countries.

In order to further encourage economic growth and stability in Sri Lanka and in line with its basic development policy, Japan supports infrastructure development for economic growth. Japan's major aid policy in Sri Lanka is the "promotion of economic growth taking into account the interests of least developed areas." For the realization of this aid policy, the Government of Japan focuses on the following three priority areas:

1. Promotion of economic growth;
2. Development assistance to least developed areas; and,
3. Overcoming social vulnerability.

Under the latter priority area, it is required to overcome vulnerability in Sri Lanka. They suffer from disasters due to heavy rains owing to the inherent characteristic of the country which is often affected by a monsoon. Specifically, the provision of aid geared towards improving disaster prevention capabilities in Sri Lanka is stated as one of Japan's important roles.

It is truly significant to strengthen the meteorological monitoring system and improve disaster prevention capabilities in the whole of Sri Lanka through the Grant Aid from Japan as it is in congruence with Japanese priorities in terms of international cooperation.

3-4-2 Effectiveness

1) Quantitative indicators

Table 67: Achievement Indicators

Indicator	Present (Baseline in 2016)	Target (2023)
Enhancement of Severe Weather Monitoring Capability	Limited capability for remote monitoring precipitation intensity and wind direction & velocity.	■ Precipitation intensity 1mm/h or more in the radar detection range: 300km radius. ■ Observation of upper wind direction & speed in the rainfall area: within a 150km radius.
	Spatial resolution and observation intervals of precipitation data of the existing automatic weather observation systems (38) in Sri Lanka: approximately 41km mesh (square root of 65,610km^2/38 AWSs) at 10 minute observation intervals.	Spatial resolution and observation intervals of precipitation data in the radar detection range: 1 km mesh at 10 minute observation intervals within a 300km radius.
	Receiving intervals of satellite images showing tropical depression and cyclone location and track: 30/60 minute intervals.	Observation intervals of rainfall intensity, location, track, wind velocity of tropical depression and cyclone in the radar detection range: 10 minute observation intervals.
Enhancement of Heavy Rain Monitoring	Limited activity of rain cloud movement monitoring.	Implementation of rain cloud movement monitoring by the radar systems.

Capability		
Enhancement of capability for weather observation around the major International Airports	Provision of manually observed information to the airport operators on weather conditions such as cumulonimbus, etc. which have a negative impact to aircraft operations in the area surrounding the major International Airports at Colombo and Mattala.	Information provision to the airport operators on weather conditions such as cumulonimbus, etc. detected by the radar systems to aircraft operations in the area surrounding the major International Airports at Colombo and Mattala.
Improvement of Dissemination Capability for Weather Information	Provision of heavy rain information/advisory/warning indicating the Province(s)/District(s) only with the existing observatory(s) has/have received rainfall of over 50mm within the last 6 hours and 100 mm within the last 12 hours to the government agencies concerned with disaster management and mass media.	Provision of heavy rain information/advisory/warning indicating the area(s) identified by the radar observation data which has/have received rainfall of over 50mm within the last 6 hours and 100 mm within the last 12 hours to the government agencies concerned with disaster management and mass media.
	Provision of still pictures of satellite for TV broadcasting.	Provision of radar animation images of the entire area of Sri Lanka for TV broadcasting.
	Provision of rainfall data (still pictures) of the major cities through the DOM Web site to the public, the government agencies concerned with disaster management and mass media.	Provision of radar animation images (rainfall) of the entire area of Sri Lanka through the DOM Web site to the public, the government agencies concerned with disaster management and mass media.
	Provision of rain cloud of severe weather, tropical depression & cyclone information indicating locations and past tracks to the government agencies concerned with disaster management and mass media.	Improvement of quality and provision frequency of DOM's information by hourly provision of forecast & warning on the cloud of severe weather and tropical depressions & cyclones located within the radar detection range indicating intensity, location and tracks (past and current) to agencies concerned with disaster management, especially to the directly affected local government units, and also to International Organizations, the Red Cross, NGOs and mass media.

2) Qualitative indicators

- Timely commencement of disaster management and evacuation support
- Reduction of damages of natural disasters caused by hazardous weather phenomena (heavy rainfall, etc.) and flood

<Project Effectiveness for the Disaster Management in Sri Lanka >

Project Effectiveness for the Disaster Management in Sri Lanka is indicated in the figure attached hereunder.

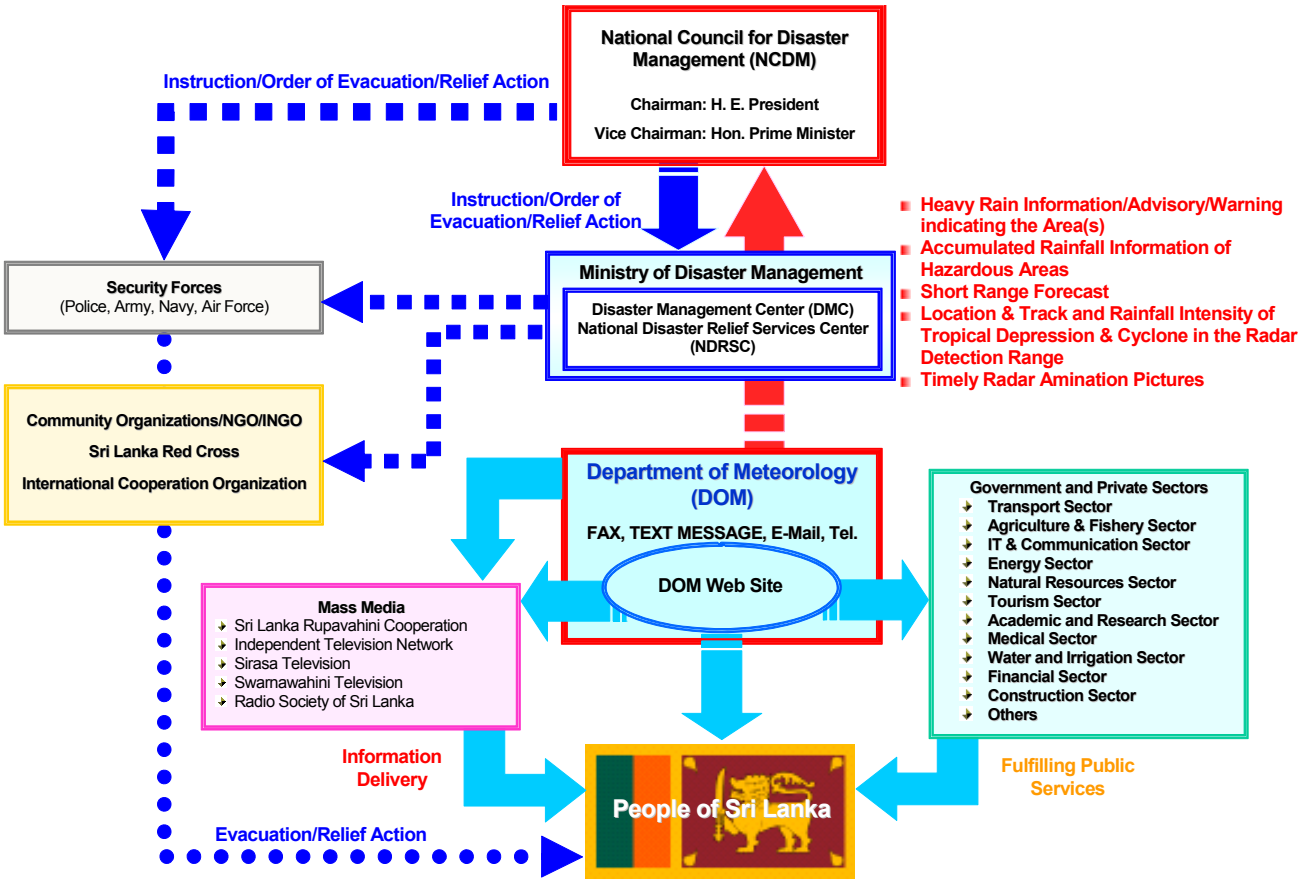


Figure 20: Project Effectiveness for the Disaster Management in Sri Lanka

As adequately pointed out in the careful and comprehensive evaluation of the effects of the Project, considerable and enhanced benefits can be achieved vis-à-vis the improvement of the DOM's capabilities in reducing human loss and the recurrent economic set-back brought about by meteorological disasters. The Project would substantially contribute to the mitigation of the adverse effects of the meteorological disasters and effectively safeguard the basic human needs of the Sri Lanka people.

Moreover, in order to reduce the DOM's operational and maintenance costs, the equipment was designed to minimize the need for spare parts and consumables. Since the biggest expected recurrent cost of the Project is electricity, the equipment and facilities were designed in such a way so as to minimize power consumption. As a result, the DOM's budget is expected to be able to cover the Sri Lanka portion of the capital and recurrent costs of the Project. In conclusion, the implementation of the Project is considered to be an appropriate, suitable and worthwhile endeavor.

Appendices

Appendix 1. Member List of the Study Team

(1) Preparatory Survey (1) Team

Mr. Yoichi INOUE	Team Leader	Disaster Management Team 1, Disaster Management Group, Global Environment Department, Japan International Cooperation Agency (JICA)
Mr. Hiroshi YAMAUCHI	Technical Advisor (Meteorological Radar System)	Observation Division, Observation Department Japan Meteorological Agency (JMA)
Mr. Kunio AKATSU	JICA Expert	Japan International Cooperation Agency (JICA)
Mr. Yoshihisa UCHIDA	Chief Consultant/Meteorological Radar Equipment Planning/Operation & Maintenance Planning	International Meteorological Consultant Inc. (IMC)
Mr. Toshihide ENDO	Data Communication Equipment Planning	International Meteorological Consultant Inc. (IMC)
Mr. Kenji MORI	Meteorological Radar Facility Planning	International Meteorological Consultant Inc. (IMC)
Mr. Hiroyuki INOMATA	Construction Planning/Natural Conditions Survey/Cost Estimation	International Meteorological Consultant Inc. (IMC)
Mr. Motohiro YAMAUCHI	Procurement Planning	International Meteorological Consultant Inc. (IMC)

(2) Preparatory Survey (2) Team

Mr. Yoichi INOUE	Team Leader	Disaster Management Team 1, Disaster Management Group, Global Environment Department, Japan International Cooperation Agency (JICA)
Mr. Yoshihisa UCHIDA	Chief Consultant/Meteorological Radar Equipment Planning/Operation & Maintenance Planning	International Meteorological Consultant Inc. (IMC)
Mr. Toshihide ENDO	Data Communication Equipment Planning	International Meteorological Consultant Inc. (IMC)
Mr. Hiroyuki INOMATA	Construction Planning/Natural Conditions Survey/Cost Estimation	International Meteorological Consultant Inc. (IMC)

Appendix 2. Study Schedule

Preparatory Survey 1

Schedule			Governmental Member			Consultant Member				
			Mr. Yoichi INOUE	Mr. Hiroshi YAMAUCHI	Mr. Kunio AKATSU	Mr. Yoshihisa UCHIDA	Mr. Toshihide ENDO	Mr. Kenji MORI	Mr.Hiroyuki INOMATA	Mr. Motohiro YAMAUCHI
2016			Team Leader	Technical Advisor (Meteorological Radar System)	JICA Expert	Chief Consultant/Meteorological Radar Equipment Planning/Operation & Maintenance Planning	Data Communication Equipment Planning	Meteorological Radar Facility Planning	Construction Planning/Natural Conditions Survey/Cost Estimation	Procurement Planning
1	18 Feb	Thu				Tokyo→Bangkok→Colombo				
2	19 Feb	Fri				Discussion with DOM Head Office, Discussion with the Local Contractor for Topographic and Geotechnical Survey, Discussion with Telecommunications Regulatory Commission (TRC)		Discussion with DOM Head Office, Discussion with the Local Contractor for Topographic and Geotechnical Survey		
3	20 Feb	Sat				Site Survey at DOM Head Office (National Meteorological Centre), Data Collection, Internal Meeting				
4	21 Feb	Sun				Data Collection, Internal Meeting				
5	22 Feb	Mon		Tokyo→Colombo		Site Survey at DOM Head Office (National Meteorological Centre), Data Collection, Internal Meeting	Site Survey at DOM Head Office (National Meteorological Centre), Data Collection, Internal Meeting	Site Survey at DOM Head Office (National Meteorological Centre), Data Collection, Internal Meeting	Tokyo→Bangkok →Colombo	
6	23 Feb	Tue	Tokyo→Colombo Discussion with DOM Head Office (Inception Report), Courtesy Call on Ministry of Disaster Management	Discussion with DOM Head Office (Inception Report), Courtesy Call on Ministry of Disaster Management		Discussion with DOM Head Office (Inception Report), Courtesy Call on Ministry of Disaster Management		Discussion with DOM Head Office (Inception Report), Discussion with the Local Contractor for Topographic and Geotechnical Survey		Data Collection, Discussion with DOM Head Office
7	24 Feb	Wed	Discussion with Department of External Resources (ERD), Site Survey at DOM Pottuvil Observatory (Pottuvil Radar Observation Station)			Site Survey at DOM Pottuvil Observatory (Pottuvil Radar Observation Station), Discussion with Pottuvil Pradesiya Sabha and Coast Conservation Department, Pottuvil Office, Site Survey at DOM Meteorological Office in the Mattala Rajapaksa International Airport				
8	25 Feb	Thu								
9	26 Feb	Fri	Discussion with DOM Head Office, Confirmation of Minutes of Discussions			Discussion with DOM Head Office, Confirmation of Minutes of Discussions		Site Survey at DOM Puttalam Observatory (Puttalam Radar Observation Station), Discussion with the Puttalam Urban Council		Site Survey at DOM Puttalam Observatory (Puttalam Radar Observation Station), Data Transmission Speed Measuring Test of the IP-VPN
10	27 Feb	Sat	Data Collection, Internal Meeting			Site Survey at DOM Meteorological Office in the Colombo International Airport, Data Collection, Internal Meeting				
11	28 Feb	Sun	Site Survey at DOM Puttalam Observatory (Puttalam Radar Observation Station)			Site Survey at DOM Puttalam Observatory (Puttalam Radar Observation Station)				
12	29 Feb	Mon	Discussion with DOM Head Office and Telecommunications Regulatory Commission (TRC)			Discussion with DOM Head Office and Telecommunications Regulatory Commission (TRC)		Site Survey at DOM Head Office (National Meteorological Centre), Data Collection		
13	1 Mar	Tue	Discussion with DOM Head Office, Confirmation of Minutes of Discussions, Report to Embassy of Japan			Discussion with DOM Head Office, Confirmation of Minutes of Discussions			Data Collection, Quantity Survey, Study for Unit Price of Construction Materials	
14	2 Mar	Wed	Discussion with DOM Head Office, Signing on Minutes of Discussions, Report to Ministry of Disaster Management, Report to JICA Sri Lanka Office			Discussion with DOM Head Office, Signing on Minutes of Discussions, Report to Ministry of Disaster Management, Report to JICA Sri Lanka Office			Discussion with DOM Head Office, Data Collection, Quantity Survey, Study for Unit Price of Construction Materials	
15	3 Mar	Thu	Colombo→Tokyo			Discussion with DOM Head Office and Central Environmental Authority	Discussion with DOM Head Office, Discussion with Internet Service Provider	Discussion with DOM Head Office and Central Environmental Authority	Site Survey at DOM Head Office (National Meteorological Centre), Data Collection	
16	4 Mar	Fri				Data Collection, Discussion with DOM Head Office		Data Collection, Topographic and Geotechnical Survey Follow-up at DOM Puttalam Observatory (Puttalam Radar Observation Station), Discussion with Puttalam Urban Council, Discussion with Urban Development Authority, North Western Provincial Office (Kurunegala)		Discussion with Department of Import & Export Control
17	5 Mar	Sat				Data Collection, Internal Meeting				
18	6 Mar	Sun				Data Collection, Internal Meeting				
19	7 Mar	Mon				Data Collection, Internal Meeting				
20	8 Mar	Tue				Discussion with DOM Head Office, Discussion with Coast Conservation & Coastal Resource Management Department, Colombo	Data Collection, Discussion with DOM Head Office, Discussion with Forwarding Company	Discussion with DOM Head Office, Discussion with Coast Conservation & Coastal Resource Management Department, Colombo	Data Collection, Quantity Survey, Study for Unit Price of Construction Materials	Data Collection, Discussion with DOM Head Office, Discussion with Forwarding Company
21	9 Mar	Wed				Data Collection, Discussion with DOM Head Office		Data Collection, Topographic and Geotechnical Survey Follow-up at DOM Pottuvil Observatory (Pottuvil Radar Observation Station), Discussion with Pottuvil Pradesiya Sabha, Discussion with Urban Development Authority, Ampara District Office		Data Collection, Discussion with DOM Head Office
22	10 Mar	Thu				Data Collection, Discussion with DOM Head Office				Data Collection, Quantity Survey, Study for Unit Price of Construction Materials
23	11 Mar	Fri				Discussion with DOM Head Office, Discussion with Department of Fiscal Policy, Ministry of Finance & Planning	Data Collection, Discussion with DOM Head Office	Discussion with DOM Head Office, Discussion with Department of Fiscal Policy, Ministry of Finance & Planning	Data Collection, Quantity Survey, Study for Unit Price of Construction Materials	Data Collection, Discussion with DOM Head Office
24	12 Mar	Sat				Data Collection, Internal Meeting				
25	13 Mar	Sun				Data Collection, Internal Meeting				
26	14 Mar	Mon				Discussion with DOM Head Office, Discussion with Internet Service Provider		Data Collection, Quantity Survey, Study for Unit Price of Construction Materials		Site Survey at DOM Pottuvil Observatory (Pottuvil Radar Observation Station)
27	15 Mar	Tue				Data Collection, Discussion with DOM Head Office				Site Survey at DOM Puttalam Observatory (Puttalam Radar Observation Station)
28	16 Mar	Wed				Data Collection, Discussion with DOM Head Office	Data Collection, Discussion with DOM Head Office,Discussion with Telecommunications Regulatory Commission (TRC)	Data Collection, Quantity Survey, Study for Unit Price of Construction Materials		Data Collection, Discussion with DOM Head Office
29	17 Mar	Thu				Data Collection, Discussion with DOM Head Office, Discussion with Central Bank of Sri Lanka	Data Collection, Discussion with DOM Head Office	Data Collection, Discussion with DOM Head Office, Discussion with Central Bank of Sri Lanka	Data Collection, Quantity Survey, Study for Unit Price of Construction Materials	Data Collection, Discussion with DOM Head Office
30	18 Mar	Fri				Data Collection, Discussion with DOM Head Office	Colombo→Bangkok→Tokyo	Data Collection, Discussion with DOM Head Office		Colombo→Bangkok→Tokyo
31	19 Mar	Sat				Data Collection, Internal Meeting		Data Collection, Internal Meeting		
32	20 Mar	Sun				Data Collection, Internal Meeting		Data Collection, Internal Meeting		
33	21 Mar	Mon				Discussion with JICA Sri Lanka Office, Discussion with DOM Head Office		Discussion with JICA Sri Lanka Office, Discussion with DOM Head Office		
34	22 Mar	Tue				Colombo→Bangkok→Tokyo		Colombo→Bangkok→Tokyo		

Appendix 2. Study Schedule

Preparatory Survey 2

Schedule 2016			Governmental Member Member	Consultant Member		
			Mr. Yoichi INOUE	Mr. Yoshihisa UCHIDA	Mr. Toshihide ENDO	Mr. Hiroyuki INOMATA
			Team Leader	Chief Consultant/Meteorological Radar Equipment Planning/Operation & Maintenance Planning	Data Communication Equipment Planning	Construction Planning/Natural Conditions Survey/Cost Estimation
1	13 Sep	Tue			Tokyo→Bangkok→Colombo	
2	14 Sep	Wed		Tokyo→Bangkok→Colombo	Discussion with DOM Head Office, Explanation of Draft Final Report	Tokyo→Bangkok→Colombo
3	15 Sep	Thu		Discussion with DOM Head Office, Explanation of Draft Final Report		
4	16 Sep	Fri		Data Collection, Internal Meeting		
5	17 Sep	Sat		Data Collection, Internal Meeting		
6	18 Sep	Sun	Tokyo→Colombo	Data Collection, Internal Meeting		
7	19 Sep	Mon	Discussion with JICA Sri Lanka Office, Courtesy Call on Ministry of Disaster Management, Discussion with DOM Head Office, Explanation of Draft Final Report	Discussion with JICA Sri Lanka Office, Courtesy Call on Ministry of Disaster Management, Discussion with DOM Head Office, Explanation of Draft Final Report		
8	20 Sep	Tue	Discussion with DOM Head Office (Minutes of Discussions)	Discussion with DOM Head Office (Minutes of Discussions)		
9	21 Sep	Wed	Discussion with DOM Head Office, Confirmation of Minutes of Discussions	Discussion with DOM Head Office, Confirmation of Minutes of Discussions		
10	22 Sep	Thu	Discussion with DOM Head Office, Signing on Minutes of Discussions, Report to Ministry of Disaster Management, Report to Embassy of Japan and JICA Sri Lanka Office	Discussion with DOM Head Office, Signing on Minutes of Discussions, Report to Ministry of Disaster Management, Report to Embassy of Japan and JICA Sri Lanka Office		
11	23 Sep	Fri	Colombo→Tokyo	Discussion with DOM Head Office		
12	24 Sep	Sat		Data Collection, Internal Meeting		
13	25 Sep	Sun		Data Collection, Internal Meeting		
14	26 Sep	Mon		Discussion with DOM Head Office, Data Collection		
15	27 Sep	Tue		Discussion with DOM Head Office, Data Collection		
16	28 Sep	Wed		Colombo→Bangkok→Tokyo	Colombo→Delhi	Colombo→Bangkok→Tokyo
17	04 Nov	Fri	Discussion with DOM and Explanation of Draft Final Report			

Appendix 3. List of Parties Concerned in the Recipient Country

- **Ministry of Disaster Management**

Mr. S. S. Miyanawala	Secretary

- **Department of Meteorology (DOM)**

Colombo Head Office

Mr. Lalith Chandrapala	Director General
Mr. K.H.M.S. Premalal	Director
Mr. S.R. Jayasekara	Director
Mr. D.A. Jayasinghearachchi	Deputy Director
Ms. Anusha Warnasooriya	Deputy Director
Mr. Channa Rodrigo	Meteorologist
Ms. Pabodini Karunapala	Meteorologist
Ms. Nadi Rupasinghe	Meteorologist
Mr. Sachith Wickramasooriya	Meteorologist
Mr. Malith Fernando	Meteorologist
Mr. Nuwan Kumarasinghe	Chief Electronic Engineer
Mr. Kelum Priyadarshana	Electronic Engineer
Mr. W.A.T.K.Palitha De Silva	Senior Telecommunication & Radar Technical Officer

DOM Puttalam Observatory (Puttalam Radar Observation Station)

Mr. Jamaldeen Mursaleen	Meteorological Officer
Mr. Aasiri Abeyratne	Meteorological Assistance

DOM Pottuvil Observatory (Pottuvil Radar Observation Station)

Mr. Mohomed Naheem	Officer in Charge of the Observatory
Mr. Rasika Rathnayaka	Officer

DOM Aviation Meteorological Office in the Colombo International Airport

Mr. Murukkuwadura Meril Prasantha Mendis	Meteorologist in Charge
Mr. Kapila Samarasooriya	Officer in Charge

DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport

Mr. Thammahetti Mudalige Nandalal Peiris	Officer in Charge
Mr. Wijesekara Widanapatirawa Dayananda	Senior Meteorological Officer
Mr. Don Mariyan Bernard Suraweera	Meteorological Officer

- **Telecommunication Regulatory Commission (TRC) of Sri Lanka**

Mr. M. C. M. Farook	Deputy Director/Spectrum Planning & Database Management
Mr. J. A. S. Gunanandana	Deputy Director/Spectrum Monitoring & Compliance

- **Pottuvil Pradesiya Sabha**

Mr. L. Mohamed Irfan	Secretary
Mr. Z.A.M. Imthiyas	Development Officer

- **Coast Conservation & Coastal Resource Management Department, Pottuvil Office**

Mr. Sameera Perera	District Project Coordinator
Mr. W. Wajira Lakmal	Planning Assistant

- **Puttalam Urban Council**

Mr. W. G. Nishantha Kumara	Secretary
Mr. R. Thangarasa	Technical Officer
Mr. K. A. Kazari	Technical Officer

- **Central Environmental Authority**

Ms. T. W. A. W. Wijesinghe	Director, Laboratory Services Division
Ms. Hiranthi Jansz	Assistant Director, Air Resource Management & Monitoring Division
Mr. Kamal Priyantha	Assistant Director, Air Resource Management & Monitoring Division

- **Urban Development Authority, North Western Provincial Office (Kurunegala)**

Mr. A. M. Senarathne	Deputy Director/Planning

- **Coast Conservation & Coastal Resource Management Department**

Mr. Nimal Sri Rajarathna	Assistant Deputy Director/Planning

- **Urban Development Authority, Ampara District Office**

Mr. J. Somasiri	Deputy Director/Planning
Mr. Chandana Karunaratne	Planning Officer

- **Department of Fiscal Policy, Ministry of Finance & Planning, the Secretariat**

Ms. H. D. Aneesha Rukshini	Assistant Director

- **Lanka Communication Services (Private) Limited**

Mr. Roshan Jaytilake	Head of pre sales
Mr. Ugantha Welikala	Head Customer Services

- **Central Bank of Sri Lanka**

Ms. Madhavi Jayasekara	Senior Accountant, Financial Department
Mr. S. H. S. Karunaratne	Senior Accountant, Financial Department

- **Department of External Resources (ERD), Ministry of National Policies and Economic Affairs**

Ms. Gayoma Senaynayake	Assistant Director (Japan and Korea Desk)

- **Embassy of Japan in Sri Lanka**

Ms. Asako Okai	Minister
Mr. Kiichiro Iwase	First Secretary, Development Cooperation Section
Mr. Takushi Otokita	Second Secretary

- **Sri Lanka Office, Japan International Cooperation Agency**

Mr. Toru Kobayakawa	Senior Representative
Mr. Hiroki Hashimoto	Representative

Appendix4-1. Minutes of Discussions

Minutes of Discussions
on
the Preparatory Survey
for
the Project for the Establishment of a Doppler Weather Radar Network

In response to the request from the Government of the Democratic Socialist Republic of Sri Lanka (hereinafter referred to as "Sri Lanka"), the Government of Japan decided to conduct a Preparatory Survey for the Project for the Establishment of a Doppler Weather Radar Network (hereinafter referred to as "the Project"), and entrusted the Preparatory Survey to Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") to Sri Lanka, headed by Mr. Yoichi Inoue, Acting Director of Disaster Risk Reduction Team 1, Global Environment Department, and is scheduled to stay in the country from 22nd February to 22nd March, 2016.

The Team held a series of discussions with the officials concerned of the Government of Sri Lanka and conducted a field survey in the Project area. In the course of the discussions, both sides have confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Preparatory Survey Report.

Colombo, 2nd March, 2016

Mr. Yoichi Inoue
Team Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Mr. S. S. Miyanawala
Secretary
Ministry of Disaster Management
The Democratic Socialist Republic of Sri Lanka

Mr. R. M. P. Rathnayake
Director General
Department of External Resources,
Ministry of National Policies and Economic Affairs, The Democratic Socialist Republic of Sri Lanka

Mr. Lalith Chandrapala
Director General
Department of Meteorology
Ministry of Disaster Management
The Democratic Socialist Republic of Sri Lanka

ATTACHMENT

1. Objective of the Project
The objective of the Project is to improve and strengthen the capacities of short range forecast by establishment of a Doppler Weather Radar Network, thereby contributing to mitigation of damages by weather-related disasters.

2. Title of the Preparatory Survey
Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for the Establishment of a Doppler Weather Radar Network".

3. Project Site
Both sides confirmed that the sites of the Project are DOM Puttalam Observatory (Puttalam Radar Observation Station), DOM Pottuvil Observatory (Pottuvil Radar Observation Station), National Meteorological Centre (NMC) at DOM Head Office, DOM Aviation Meteorological Offices in Colombo International Airport and Mattala Rajapaksa International Airport which are shown in Annex 1.

4. Line Agency and Executing Agency
Both sides confirmed the line agency and executing agency as follows:

4-1. The line agency is Ministry of Disaster Management, which would be the agency to supervise the executing agency.

4-2. The executing agency is Department of Meteorology, Ministry of Disaster Management (hereinafter referred to as "DOM"). The executing agency shall coordinate with all the relevant agencies to ensure smooth implementation of the Project and ensure that the undertakings are taken by relevant agencies properly and on time. The organization charts are shown in Annex 2.

5. Items requested by the Government of Sri Lanka

5-1. As a result of discussions, both sides confirmed that the items requested by the Government of Sri Lanka are as shown in Table below.

Table: Items requested by the Government of Sri Lanka

Component	DOM Puttalam Observatory (Puttalam Radar Observation Station)	DOM Pottuvil Observatory (Pottuvil Radar Observation Station)	National Meteorological Centre (NMC) at DOM Head Office	DOM Aviation Meteorological Office in the Colombo International Airport	DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport
Procurement and Installation of Equipment					
C-Band Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar System	1	1	-	-	-
Central Processing System	-	-	1	-	-
Meteorological Radar Data Display System	1	1	1	1	1
Meteorological Data Communication System	1	1	1	-	-
Construction of Radar Tower Building					
Radar Tower Building	1	1	-	-	-
Initial Technical Training of the equipment	Initial operation guidance in the contract of manufacturer				
Soft Component					

5-2. JICA will assess the appropriateness of the above requested items through the survey and will report findings to the Government of Japan. The final components of the Project would be decided by the Government of Japan.

6. Japanese Grant Aid Scheme

6-1. The Sri Lankan side understands the Japanese Grant Scheme and its procedures as described in Annex 3, Annex 4 and Annex 5, and necessary measures to be taken by the Government of Sri Lanka.

6-2. The Sri Lankan side understands to take the necessary measures, as described in Annex 6, for smooth implementation of the Project, as a condition for the Japanese Grant to be implemented. The detailed contents of the Annex 6 will be worked out during the survey and shall be agreed no later than by the Explanation of the Draft Preparatory Survey Report. The contents of Annex 6 will be used to determine the following:

(1) The scope of the Project.
(2) The timing of the Project implementation.
(3) Timing and possibility of budget allocation.

Contents of Annex 6 will be updated as the Preparatory Survey progresses, and will finally be the Attachment to the Grant Agreement.

7. Schedule of the Survey

7-1. The Team will proceed with further survey in Sri Lanka until 22nd March 2016.

7-2. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to Sri Lanka in order to explain its contents around the end of August 2016.

7-3. If the contents of the draft Preparatory Survey Report is accepted in principle and the undertakings are fully agreed by the Sri Lankan side, JICA will complete the final report in English and send it to the Government of Sri Lanka around December 2016.

7-4. The above schedule is tentative and subject to change.

8. Other Relevant Issues

8-1. Specifications Summary

Both sides confirmed basic specifications as follows;

1) Specifications of the requested Radar System: C-band Solid State Dual Polarization (Polarimetric) Meteorological Doppler Radar System including Isolation Transformer, Power Supply Capacitor, Power Back-up System, Lightning protection system, Measuring Equipment and Spare Parts.
2) Specifications of the major data communication to be arranged by Sri Lanka side: VSAT and/or IP/VPN with the required transmission speed(more than 512kbps continuous)
3) Specifications of the radar tower (steel or reinforced concrete tower building) will be further examined by the Team to consider necessary functions, cost and construction period

The Team will make necessary survey further and make analysis in Japan. Detailed specifications will be explained in next Mission to be scheduled around the end of August 2016.

8-2. Soft component

Both sides confirmed that initial guidance for operation and maintenance of the equipment and machinery will be included the Project to support smooth operation. Components will be studied further.

8-3. Permission of the frequency

Both sides confirmed DOM shall apply permission of the frequency of proposed C band to Telecommunications Regulatory Commission and will get permission by the beginning of August 2016.

8-4. EIA procedure

Both sides confirmed DOM shall submit Environmental Impact Report to Central Environmental Authority and get approval by the beginning of August 2016.

8-5. Land acquisition

DOM explained lands of Meteorological Observation Station in Pottuvil and Puttalam are properties of DOM and available for the Project.

8-6. Dissemination of radar data

Both sides confirmed 1) near real-time radar data/products will be provided to the public by DOM web site and also provided to other related organizations through data servers in DOM and 2) radar data will be archived and be available to other disaster management related organizations for disaster survey. The Team will survey possible means for assurance of radar data quality.

8-7 Operation room in DOM and International Airports

DOM shall secure enough space for installation of equipment in DOM and international airport offices. The Team will plan the layout of the equipment.

8-8 Necessary budget and number of staff for Operation and Maintenance

Necessary budget and number of staff for operation and maintenance of the Project after the completion will be estimated through the Survey. DOM promised to allocate necessary budget and staff for proper operation and maintenance. The Team explained that number of staff in radar tower sites will be minimized and radars will be operated from DOM headquarters.

8-9 Taxes borne by Sri Lankan side and its budget allocation

With reference to Annex-3 and Annex-6, both sides confirmed that indirect taxes and levies related to the Project implementation as well as direct taxes levied on corporations and individuals involved in the Project implementation will be borne by DOM. DOM shall secure necessary budget. The Team will provide information on estimated amount of Taxes with time plan to DOM by the end of August 2016.

8-10 Monitoring during the implementation

DOM agreed to monitor the Project every three (3) months during the implementation by using the Project Monitoring Report form as attached in Annex-7

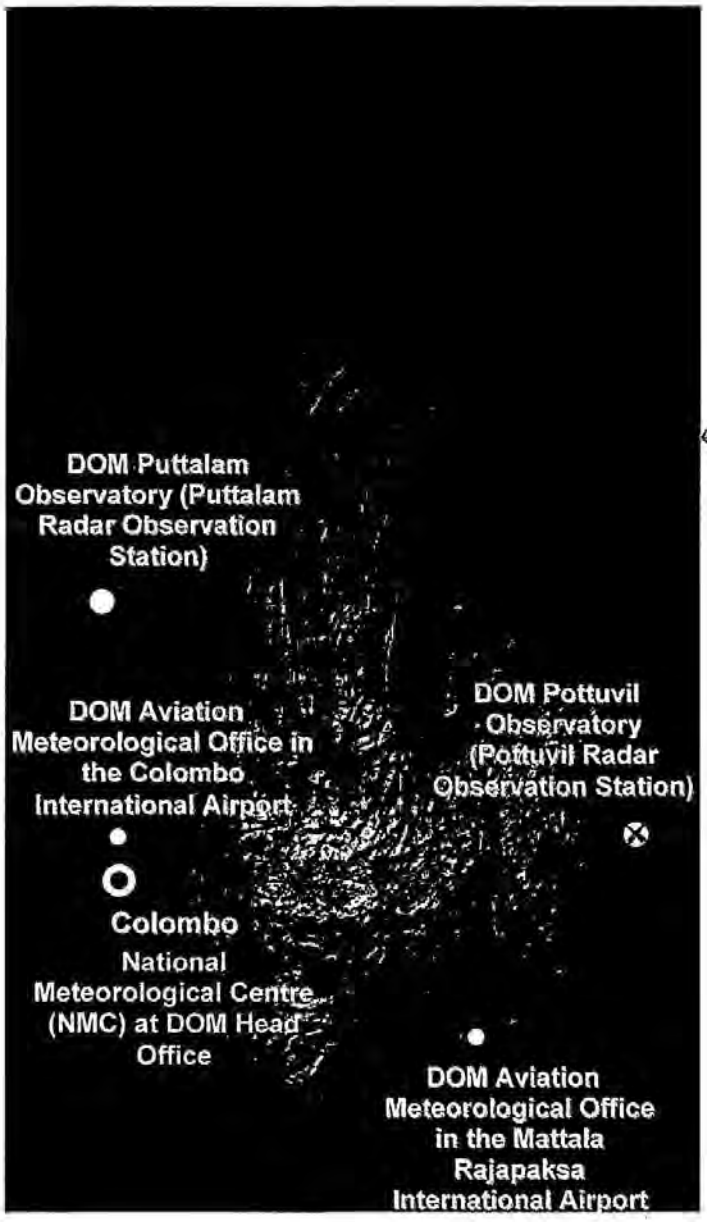
8-11 Confidentiality of the Project

The Team explained that preparatory survey report to be prepared at the end of the survey would be disclosed to the public in Japan. However, the Team also explained that a confidential part which might affect bidding process such as cost estimation should be kept undisclosed until the bidding has completed.

Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Japanese Grant
Annex 4 Flow Chart of Japanese Grant Procedures
Annex 5 Financial Flow of Japanese Grant
Annex 6 Major Undertakings to be taken by Recipient Government
Annex 7 Project Monitoring Report (template)

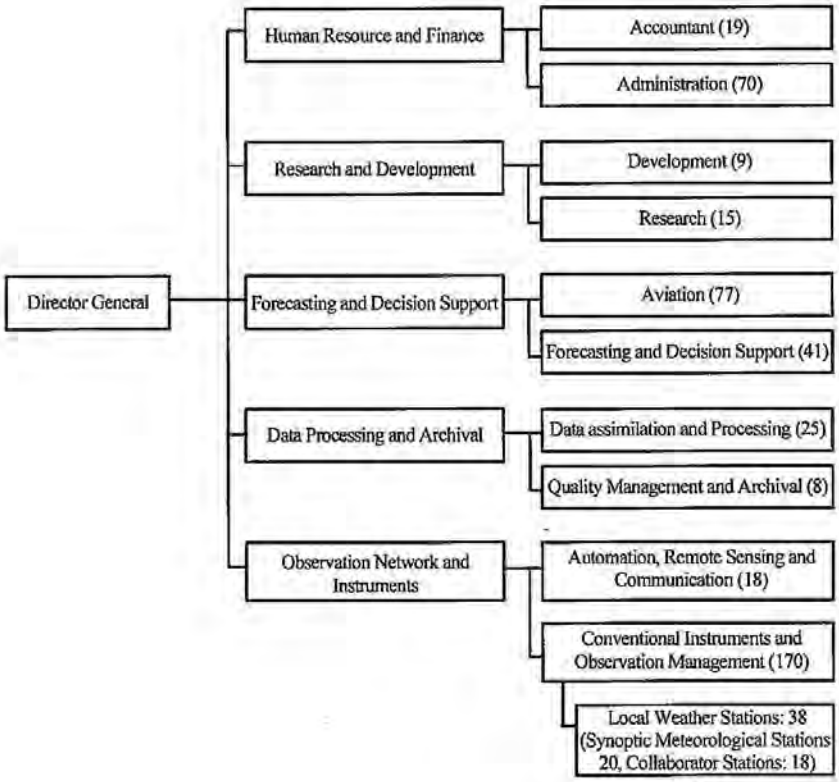
Annex 1

Project Sites



Annex 2

Organization Chart of Department of Meteorology (DOM)



Annex-3

JAPANESE GRANT

The Japanese Grant (hereinafter referred to as the "Grant") is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant is not supplied through the donation of materials as such.

Based on a JICA law which was entered into effect on October 1, 2008 and the decision of the GOJ, JICA has become the executing agency of the Japanese Grant for Projects for construction of facilities, purchase of equipment, etc.

1. Grant Procedures

The Grant is supplied through following procedures :

- Preparatory Survey
  - The Survey conducted by JICA
- Appraisal &Approval
  - -Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- Authority for Determining Implementation
  - -The Notes exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  - -Agreement concluded between JICA and a recipient country
- Implementation
  - -Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.

- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant project. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japanese Grant Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles, in accordance with the E/N, to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Grant, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. The Grant may be used for the purchase of the products or services of a third country, if necessary, taking into account the quality, competitiveness and economic rationality of products and services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals", in principle.

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals, in principle. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Project, the recipient country is required to undertake such necessary measures as Annex. The Japanese Government requests the Government of the recipient country to exempt all customs duties, internal taxes and other fiscal levies such as VAT, commercial tax, income tax, corporate tax, resident tax, fuel tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract, since the Grant fund comes from the Japanese taxpayers.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant.

(7) "Export and Re-export"

The products purchased under the Grant should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"), in principle. JICA will execute the Grant by making payments in Japanese yen, in principle, to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Environmental and Social Considerations

The Government of the recipient country must carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the recipient country and JICA Guidelines for Environmental and Social Consideration (April, 2010) .

(11) Monitoring

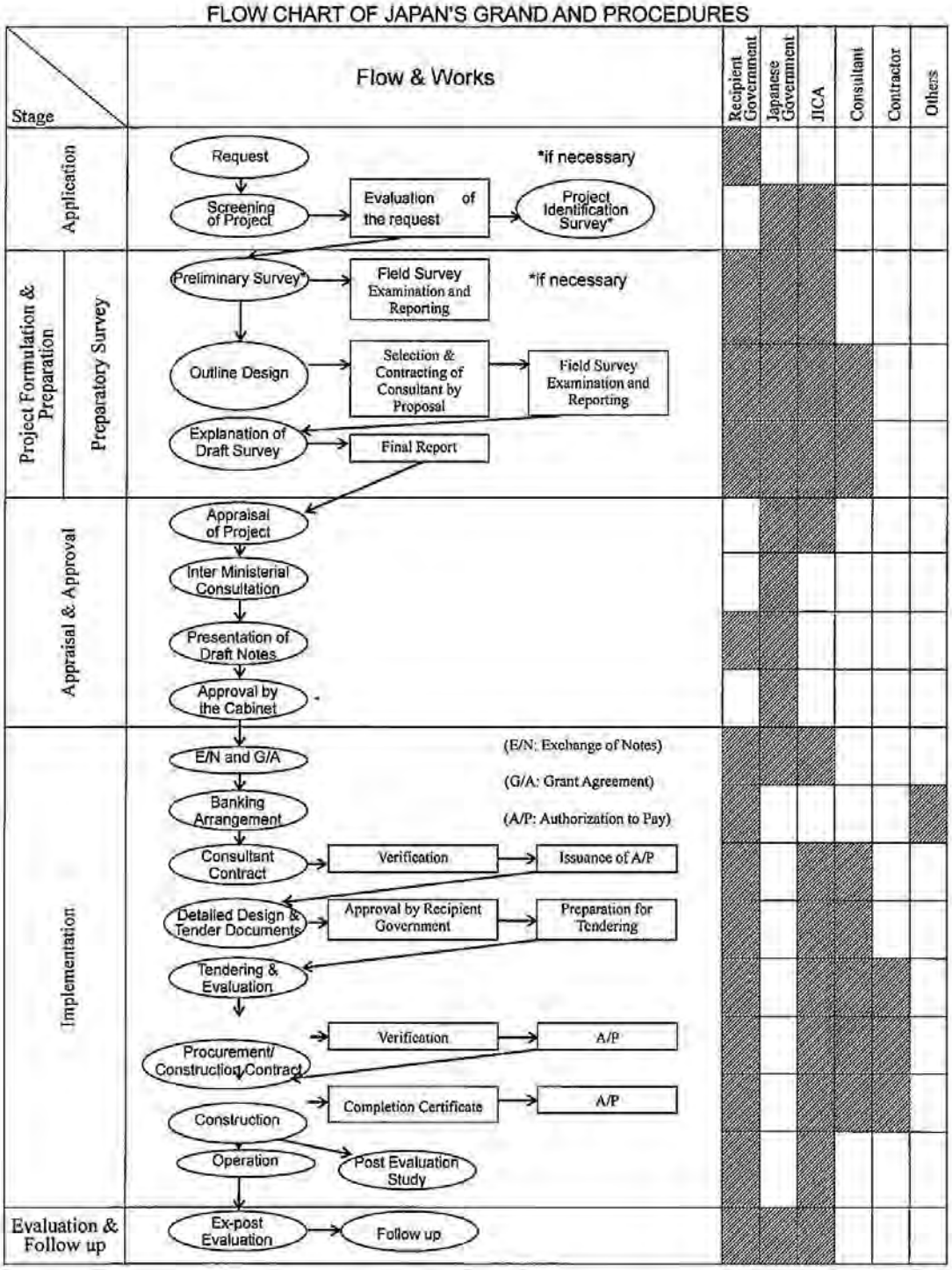
The Government of the recipient country must take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and must regularly report to JICA about its status by using the Project Monitoring Report (PMR).

(12) Safety Measures

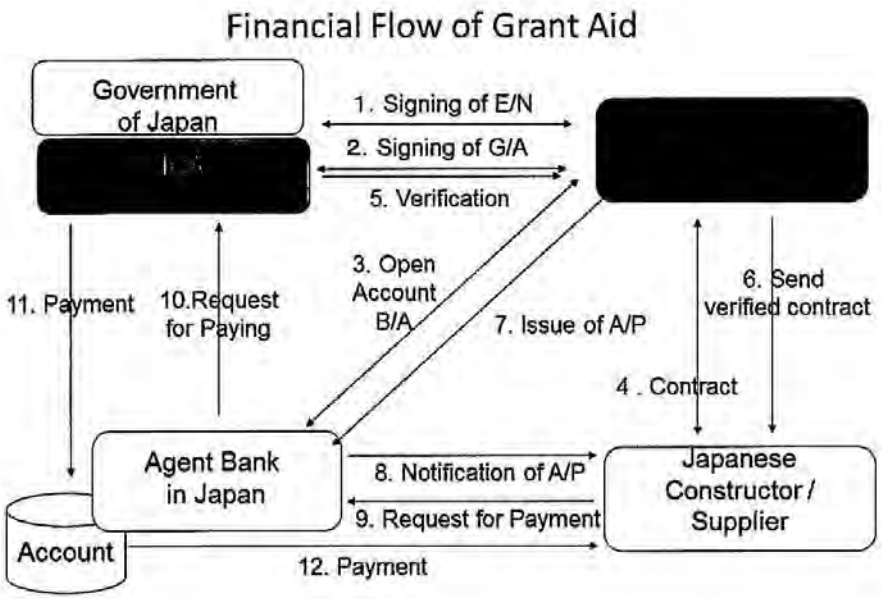
The Government of the recipient country must ensure that the safety is highly observed during the implementation of the Project.

Annex-4

FLOW CHART OF JAPAN'S GRAND AND PROCEDURES



Annex-5


Financial Flow of Grant Aid
Government of Japan
1. Signing of E/N
2. Signing of G/A
5. Verification
3. Open Account B/A
7. Issue of A/P
6. Send verified contract
4 . Contract
11. Payment
10.Request for Paying
Agent Bank in Japan
8. Notification of A/P
9. Request for Payment
Japanese Constructor / Supplier
Account
12. Payment

Annex 6

Major Undertakings to be taken by Recipient Government

1) Before the Tender

NO	Items	Deadline	In charge	Cost	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 1 month after G/A	ERD		
2	To secure sufficient spaces at the respective Project site/s for temporary facilities such as a contractor's office, workshop, building materials storage, etc. needed for the construction work.	before notice of of the Tender	DOM		
3	To obtain necessary permissions from the Puttalam Urban Council for the construction of the Radar Tower in the DOM Puttalam Observatory (Radar Observation Station)	before notice of the Tender	DOM		
4	To obtain necessary permissions from the Pottuvil Divisional Council for the construction of the Radar Tower in the DOM Pottuvil Observatory (Radar Observation Station)	before notice of the Tender	DOM		
5	To obtain the Coast Conservation Clearance from the Coast Conservation Department for the construction of the Radar Tower in the DOM Pottuvil Observatory (Radar Observation Station)	before notice of the Tender	DOM		
6	To submit the required application to the Ceylon Electricity Board (CEB) for Commercial Power Supply and Step-down Transformer Installation for the Radar Tower Buildings to be constructed in the DOM Puttalam and Pottuvil Observatories (Radar Observation Stations)	before notice of the Tender	DOM		

2) During the Project

NO	Items	Deadline	In charge	Cost	Ref.
1	To bear the following commissions to a bank of Japan for the banking services based upon the B/A				
	1) Requesting budget for the Project	at the initial occasion to request a budget for the Project	DOM		
	2) Advising commission of A/P	within 1 month after the budget of the Project gets authorized by the national congress	ERD, DOM		
	3) Payment commission for A/P	every payment	ERD, DOM		
2	To ensure prompt unloading, customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation in the country of the Recipient of the products				
	1) Marine (air) transportation of the Products from Japan to Sri Lanka	during the Project	Contractor		
	2) Tax exemption and customs clearance of the products at the port of disembarkation	during the Project	DOM		
	3) Internal transportation from the port of disembarkation to the project site	during the Project	Contractor		
3	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	during the Project	DOM		
4	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the Products and/or the Services be borne by its designated authority without using	during the Project	DOM		

	the Grant. Such customs duties, internal taxes and other fiscal levies mentioned above include VAT, commercial tax, income tax and corporate tax of Japanese nationals, resident tax, fuel tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract.				
5	To bear all the expenses, other than those to be borne by the Japanese Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment	during the Project	DOM		
6	Provision of temporary facilities for the availability or accessibility of electricity, water, etc. for the construction work	Prior to commencement of the radar tower building construction	DOM		
7	To provide facilities for distribution of electricity, water supply, drainage and other incidental facilities necessary for the implementation of the Project outside the site(s)				
	1) Electricity	before completion of the radar tower building construction			
	The Distribution line to the site		DOM		
	2) Water Supply The city water distribution main to the site		DOM		
	3) Drainage The city drainage main (for storm, sewer and others) to the site		DOM		
	4) Internet access High-speed Internet access to the site		DOM		
	5) Furniture and Equipment General Furniture		DOM		

3) After the Project

NO	Items	Deadline	In charge	Cost	Ref.
1.	To maintain and use properly and effectively the facilities constructed and equipment provided under the Japanese Grant	after completion of the Project			
	1) Allocation of maintenance cost		DOM		
	2) Operation and maintenance structure		DOM		
	3) Routine check/Periodic inspection		DOM		
	4) Others		DOM		

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

(Note) Progress of the specific obligations of the Recipient may be confirmed and updated from time to time with written agreement between JICA and the Recipient in the form other than the amendment of the G/A.

Annex-7

Project Monitoring Report
on
Project for the Establishment of a Doppler Weather Radar Network

Grant Agreement No. XXXXXXX

20XX, Month

Organization Information

Authority (Signer of the G/A)	Person in Charge _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Executing Agency	Person in Charge _____ Contacts Address: _____ Phone/FAX: _____ Email:
Line Agency	Person in Charge _____ Contacts Address: _____ Phone/FAX: _____ Email:

Outline of Grant Agreement:

Source of Finance	Government of Japan: Not exceeding JPY . Government of Sri Lanka:
Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:

1: Project Description

1-1 Project Objective

1-2 Necessity and Priority of the Project

- Consistency with development policy, sector plan, national/regional development plans and demand of target group and the recipient country.

1-3 Effectiveness and the indicators

- Effectiveness by the project

Quantitative Effect (Operation and Effect indicators)		
Indicators	Original (Yr 2016)	Target (Yr 2021)
Qualitative Effect		

2: Project Implementation

2-1 Project Scope

Table 2-1-1a: Comparison of Original and Actual Location

Location	**Original:** *(M/D)* **Attachment(s):Map**	**Actual:** *(PMR)* **Attachment(s):Map**

Table 2-1-1b: Comparison of Original and Actual Scope

Items	Original	Actual

2-1-2 Reason(s) for the modification if there have been any.

2-2 Implementation Schedule

2-2-1 Implementation Schedule

Table 2-2-1: Comparison of Original and Actual Schedule

Items	Original		Actual
	DOD	G/A	
Cabinet Approval		-	-
E/N			
G/A			
Approval of consultant contract			
Early Mobilization of consultant			
Detailed Design			
Budget Request for FY2016			
Tender Process of contractor and supplier			
Approval of contractor and supplier contract			
Budget Appropriation and Issuance of A/P			
Construction Period			
Shipment			
Custom Clearance			
Installation and acceptance Check			
Soft component			
Project Completion Date			
Defect Liability Period			

*Project Completion was defined as Completion of Soft component at the time of G/A.

2-2-2 Reasons for any changes of the schedule, and their effects on the project.

2-3 Undertakings by each Government

2-3-1 Major Undertakings

See Attachment 2.

2-3-2 Activities

See Attachment 3.

2-3-3 Report on RD

See Attachment 4.

2-4 Project Cost
2-4-1 Project Cost

Table 2-4-1a Comparison of Original and Actual Cost by the Government of Japan
(Confidential until the Tender)

Items			Cost (Million Yen)	
	Original	Actual	Original	Actual
Construction of Facilities				
Equipment				
Soft Component				
Consulting Services				
Contingency				
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =**Yen

Table 2-4-1b Comparison of Original and Actual Cost by the Government of **

Items			Cost (Thousand MMK)	
	Original	Actual	Original	Actual
				Please state not only the most updated schedule

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =(local currency)

2-4-2 Reason(s) for the wide gap between the original and actual, if there have been any, the remedies you have taken, and their results.

2-5 Organizations for Implementation

2-5-1 Executing Agency:

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original: *(M/D)*
Actual, if changed: *(PMR)*

2-6 Environmental and Social Impacts

- The environmental monitoring is not required in the Project as this project was categorized as category C in accordance with the GUIDELINES FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS of JICA as of April 2010.

3: Operation and Maintenance (O&M)

3-1 O&M and Management

- Organization chart of O&M
- Operational and maintenance system (structure and the number ,qualification and skill of staff or other conditions necessary to maintain the outputs and benefits of the project soundly, such as manuals, facilities and equipment for maintenance, and spare part stocks etc)

Original: *(M/D)*
Actual: *(PMR)*

3-2 O&M Cost and Budget

- The actual annual O&M cost for the duration of the project up to today, as well as the annual O&M budget.

Original: *(M/D)*

Actual: *(PMR)*

4: Precautions (Risk Management)

- Risks and issues, if any, which may affect the project implementation, outcome, sustainability and planned countermeasures to be adapted are below.

Original Issues and Countermeasure(s): *(M/D)*	
Potential Project Risks	Assessment
1. Delay of budget appropriation	Probability: H/M/L
	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
2.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
3.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
Actual issues and Countermeasure(s)	
(PMR)	

5: Evaluation at Project Completion and Monitoring Plan

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan for the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Undertakings to be taken by each Government
3. Monthly Report
4. Report on RD
5. Yearly disbursement plan
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)

(Final Report Only)

Appendix4-2. Minutes of Discussions

Minutes of Discussions
on the Preparatory Survey for the Project for
the Project for the Establishment of a Doppler Weather Radar Network
(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between Ministry of Disaster Manegement and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 2nd March 2016 and in response to the request from the Government ofthe Democratic Socialist Republic of Sri Lanka (hereinafter referred to as "Sri Lanka") dated 25th June 2014, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for the Establishment of a Doppler Weather Radar Network (hereinafter referred to as "the Project"), headed by Mr.Yoichi Inoue, Acting Director of Disaster Risk Reduction Team 1, Global Environment Department from 14th September to 27th September 2016.

As a result of the discussions, both sides agreed on the main items described in the attached sheets.

Colombo, 22nd September, 2016

Mr. Yoichi Inoue
Team Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Mr. S. S. Miyanawala
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ATTACHEMENT

1. Contents of the Draft Report

   After the explanation of the contents of the Draft Report by the Team, theSri Lankan side agreed to its contents.

2. Cost estimate

   Both sides confirmed that the cost estimate including the contingency described in Annex-1 is provisional and will be examined further by the Government of Japan for its approval. The contingency would cover the additional cost against natural disaster, unexpected natural conditions, etc.

3. Confidentiality of the cost estimate and technical specifications

   Both sides confirmed that the cost estimate in Annex-1 and technical specifications in the Draft Report should never be duplicated or disclosed to any third parties until all the contracts under the Project are concluded.

4. Japanese Grant Aid Scheme

   The Sri Lankan side understands the Japanese Grant Aid Scheme and its procedures as described in Annex 2, Annex 3 and Annex 4, and necessary measures to be taken by the Government of Sri Lanka.

5. Timeline for the project implementation

   The Team explained to the Sri Lankan side that the expected timeline for the project implementation is as attached in Annex 5.

6. Expected outcomes and indicators

   Both sides agreed that key indicators for expected outcomes are as follows. The Sri Lankan side will be responsible for the achievement of agreed key indicators targeted in year 2023 and shall monitor the progress based on those indicators.

Table: Quantitative indicators

Indicator	Present (Baseline in 2016)	Target (2023)
Enhancement of Severe Weather Monitoring Capability	Limited capability for remote monitoring precipitation intensity and wind direction & velocity.	▪ Observation of upper wind direction & speed in the rainfall area: within a 150km radius. ▪ Precipitation intensity 1mm/h or more in the radar detection range: 300km radius.
	Spatial resolution and observation intervals of precipitation data of the	Spatial resolution and observation intervals of precipitation data in the

	existing automatic weather observation systems (38) in Sri Lanka: approximately 41km mesh (square root of 65,610km^2/38 AWSs) at 10 minute observation intervals.	radar detection range: 1 km mesh at 10 minute observation intervals within a 300km radius.
	Receiving intervals of satellite images showing tropical depression and cyclone location and track: 30/60 minute intervals.	Observation intervals of rainfall intensity, location, track, wind velocity of tropical depression and cyclone in the radar detection range: 10 minute observation intervals.
Improvement of Dissemination Capability for Weather Information	Provision of heavy rain information/advisory/warning indicating the Province(s)/District(s) only with the existing observatory(s) has/have received rainfall of over 50mm within the last 6 hours and 100 mm within the last 12 hours to the government agencies concerned with disaster management and mass media.	Provision of heavy rain information/advisory/warning indicating the area(s) identified by the radar observation data which has/have received rainfall of over 50mm within the last 6 hours and 100 mm within the last 12 hours to the government agencies concerned with disaster management and mass media.

Table: Qualitative indicators

Indicator	Present (Baseline in 2016)	Target (2023)
Enhancement of Heavy Rain Monitoring Capability	Limited activity of rain cloud movement monitoring.	Implementation of rain cloud movement monitoring by the radar systems.
Enhancement of capability for weather observation around the major International Airports	Provision of manualy observed information to the airport operators on weather conditions such as cumulonimbus, etc. which have a negative impact to aircraft operations in the area surrounding the major International Airports at Colombo and Mattala	Information provision to the airport operators on weather conditions such as cumulonimbus, etc. detected by the radar systems to aircraft operations in the area surrounding the major International Airports at Colombo and Mattala.
Improvement of Dissemination Capability for Weather Information	Provision of still pictures of satellite for TV broadcasting.	Provision of radar animation images of the entire area of Sri Lanka for TV broadcasting.
	Provision of rainfall data (still pictures) of the major cities through the DOM Web site to the public, the government agencies concerned with disaster management and mass media.	Provision of radar animation images (rainfall) of the entire area of Sri Lanka through the DOM Web site to the public, the government agencies concerned with disaster management and mass media.
	Provision of rain cloud of severe weather, tropical depression & cyclone information indicating locations and past tracks to the government agencies concerned with disaster management and mass	Improvement of quality and provision frequency of DOM's information by hourly provision of forecast & warning on the cloud of severe weather and tropical depressions & cyclones located

	media.	within the radar detection range indicating intensity, location and tracks (past and current) to agencies concerned with disaster management, especially to the directly affected local government units, and also to International Organizations, the Red Cross, NGOs and mass media.

7. Technical assistance ("Soft Component" of the Project)
Considering the sustainable operation and maintenance of the products and services granted through the Project, following technical assistance is planned under the Project. The Sri Lankan side confirmed to deploy necessary number of counterparts who are appropriate and competent in terms of its purpose of the technical assistance as described in the Draft Report.

8. Undertakings of the Project
Both sides confirmed the undertakings of the Project as described in Annex 6.

With reference to Annex 2 and Annex 3, both sides confirmed that indirect taxes and levies related to the Project implementation as well as direct taxes levied on corporations and individuals involved in the Project implementation will be borne by Department of Meteorology (hereinafter refered to as "DOM").

The Sri Lankan side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level.
Both sides also confirmed that the Annex 6 will be used as an attachment of G/A.

The Sri Lankan side promised to secure necessary budget as described in Annex 7 (Disbursement Schedule).

9. Monitoring during the implementation
The Project will be monitored by the DOM and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 8. The timing of submission of the PMR is every six months and described in Annex 6.

10. Project completion

Both sides confirmed that the project completes when all the facilities constructed and equipment procured by the grant are in operation. The completion of the project will be reported to JICA promptly, but in any event not later than six months after completion of the Project.

11. Ex-Post Evaluation

JICA will conduct ex-post evaluation after three (3) years from the project completion, in principle, with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability). The result of the evaluation will be publicized. The Sri Lankan side is required to provide necessary support for the data collection.

12. Schedule of the Study

JICA will finalize the Preparatory Survey Report based on the confirmed items. The report will be sent to the Sri Lankan side around the middle of November 2016.

13. Environmental and Social Considerations

The Team explained that 'JICA Guidelines for Environmental and Social Considerations (April 2010)' (hereinafter referred to as "the Guidelines") is applicable for the Project. The Project is categorized as C because the Project is likely to have minimal adverse impact on the environment under the Guidelines.

14. Other Relevant Issues

14-1. Disclosure of Information

Both sides confirmed that the Preparatory Survey Report which project cost is excluded will be disclosed to the public after completion of the Preparatory Survey. The comprehensive report including the project cost will be disclosed to the public after all the contracts under the Project are concluded.

14-2. Permission of the frequency

DOM explained that permission of frequency of proposed C band is still under consideration of Telecommunication Regulatory Board (TRC) and DOM is requested to submit further information to TRC. DOM also explained that DOM confirmed permission of the frequency basically with TRC and will soon get the approval letter from TRC.

DOM promised to send permission letter on allocation of the frequency from TRC by the end of December 2016 to JICA Sri Lanka Office.

The Japanese side explained that permission of the frequency is pre-condition of

the Project and the delay of the submission of the approval letter will lead to the delay of the Project.

14-3. EIA procedure

DOM explained that Environmental Impact report was submitted to Central Environmental Authority.

DOM promised to send approval letter from Central Environmental Authority by the end of October 2016 to JICA Sri Lanka Office.

The Japanese side explained the delay of the submission of the approval letter will lead to the delay of the Project.

14-4. Necessary budget and number of staff for Operation and Maintenance

The Team explained the necessary budget and number of staff for operation and maintenance of the Project after the completion as follows

DOM promised to allocate necessary budget and staff for proper operation and maintenance.

Table: Recurrent Cost of Puttalam Meteorological Radar Observation

Estimated Recurrent Cost

	Equipment	Item	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Antenna	Grease (16kgs/can, For AZ/EL)	1	0	0	0	0	28,300	0	0	0	0	36,100	Every 5 years
		Timing belt (For AZ/EL)	2	0	0	0	0	0	0	0	26,200	0	0	Every 8 years
2	Antenna controller	AC fan	3	0	0	0	0	0	0	0	0	0	70,400	Every 10 years
3	Transmitter	AC fan	36	0	0	0	0	0	0	0	0	0	845,100	Every 10 years
4	Receiver	AC fan	3	0	0	0	0	0	0	0	0	0	70,400	Every 10 years
5	Product Monitor	Blu-ray disk for data storage	12	2,500	2,600	2,800	2,900	3,100	3,200	3,400	3,500	3,700	3,900	
6	Printer	Printer ink cartridge	2	8,100	8,600	9,000	9,400	9,900	10,400	10,900	11,500	12,000	12,600	
		Paper(500sheets/1set)	4	1,900	2,000	2,100	2,200	2,300	2,400	2,500	2,600	2,800	2,900	
7	Power Supply Capacitor	AC fan	3	0	0	0	0	0	0	0	0	0	70,400	Every 10 years
		Arrester	5	0	0	0	0	0	0	0	0	0	135,400	Every 10 years
8	Diesel Engine Generator	Oil seal	2	0	4,600	4,900	5,100	5,400	5,600	5,900	6,200	6,500	6,900	Every 1 year
		Filter	2	0	0	18,000	0	19,800	0	21,800	0	24,100	0	Every 2 years
		Battery for Engine start	2	0	0	0	0	0	23,800	0	0	0	28,900	Every 5 years
		Sub total (LKR)		12,500	17,800	36,800	19,600	68,800	45,400	44,500	50,000	49,100	1,283,000	

Others

	Cost Item	Details	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Electricity Charge		1	3,170,300	3,328,800	3,495,300	3,670,000	3,853,500	4,046,200	4,248,500	4,460,900	4,684,000	4,918,200	*1
2	Fuel cost	Fuel consumption of DEG	1	101,300	123,800	130,000	136,500	143,300	150,400	158,000	165,900	174,200	182,900	*2
3	Water supply charge		1	4,000	4,200	4,400	4,600	4,900	5,100	5,400	5,600	5,900	6,200	*3
4	Special maintenance	System brush-up by the manufacture's engineer	1	0	0	1,155,000	0	0	1,337,000	0	0	1,547,800	0	For 5 days at site
5	Remote maintenance	Remote maintenance by the manufacture's engineer through the Internet	1	232,800	244,400	256,700	269,500	283,000	297,100	312,000	327,600	344,000	361,100	
6	Radome	Caulking repair	1	25,600	26,900	28,200	29,600	31,100	32,700	34,300	36,000	37,800	39,700	
7	Pest-control	Exterminating vermination	1	23,000	24,200	25,400	26,700	28,000	29,400	30,900	32,400	34,100	35,800	
		Sub total (LKR)		3,557,000	3,752,300	5,095,000	4,136,900	4,343,800	5,897,900	4,789,100	5,028,400	6,827,800	5,543,900	
		Total (LKR)		3,569,500	3,770,100	5,131,800	4,156,500	4,412,600	5,943,300	4,833,600	5,078,400	6,876,900	6,826,900	
		Total (JPY)		¥3,066,581	¥3,238,918	¥4,408,763	¥3,570,876	¥3,790,893	¥5,105,928	¥4,152,577	¥4,362,887	¥5,907,990	¥5,865,034	

Estimate of annual electricky charge

Annual power consumption	(kWh)	213,080
Annual power consumption by commercial power (98%)	(kWh)	208,818
Annual power consumption by DEG (2%)	(kWh)	4,262
Annual fuel consumption	(Liter)	1,066
*1 Annual electricky charge of commercial power	(LKR)	3,170,302
*2 Annual fuel cost of DEG	(LKR)	101,270
*3 Annual water supply charge	(LKR)	0

*4 Inflation: 5%/year considered

Fuel consumption of DEG=	0.25	Liter/kWh
Electricity charge=	14.55	LKR/kWh
Fuel cost=	95.00	LKR/Liter
Exchange rate	1.164	LKR/JPY

Table: Recurrent Cost of Pottuvil Meteorological Radar Observation

Estimated Recurrent Cc

	Equipment	Item	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Antenna	Grease (16kgs/can, For AZ/EL)	1	0	0	0	0	28,300	0	0	0	0	36,100	Every 5 years
		Timing belt (For AZ/EL)	2	0	0	0	0	0	0	0	26,200	0	0	Every 8 years
2	Antenna controller	AC fan	3	0	0	0	0	0	0	0	0	0	70,400	Every 10 years
3	Transmitter	AC fan	36	0	0	0	0	0	0	0	0	0	845,100	Every 10 years
4	Receiver	AC fan	3	0	0	0	0	0	0	0	0	0	70,400	Every 10 years
5	Product Monitor	Blu-ray disk for data storage	12	2,500	2,600	2,800	2,900	3,100	3,200	3,400	3,500	3,700	3,900	
6	Printer	Printer ink cartridge	2	8,100	8,600	9,000	9,400	9,900	10,400	10,900	11,500	12,000	12,600	
		Paper(500sheets/1set)	4	1,900	2,000	2,100	2,200	2,300	2,400	2,500	2,600	2,800	2,900	
7	Power Supply Capacitor	AC fan	3	0	0	0	0	0	0	0	0	0	70,400	Every 10 years
		Arrester	5	0	0	0	0	0	0	0	0	0	135,400	Every 10 years
8	Diesel Engine Generator	Oil seal	2	0	4,600	4,900	5,100	5,400	5,600	5,900	6,200	6,500	6,900	Every 1 year
		Filter	2	0	0	18,000	0	19,800	0	21,800	0	24,100	0	Every 2 years
		Battery for Engine start	2	0	0	0	0	0	23,800	0	0	0	28,900	Every 5 years
		Sub total (LKR)		12,500	17,800	36,800	19,600	68,800	45,400	44,500	50,000	49,100	1,283,000	

Others

	Cost Item	Details	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Electricity Charge		1	3,170,300	3,328,800	3,495,300	3,670,000	3,853,500	4,046,200	4,248,500	4,460,900	4,684,000	4,918,200	*1
2	Fuel cost	Fuel consumption of DEG	1	101,300	123,800	130,000	136,500	143,300	150,400	158,000	165,900	174,200	182,900	*2
3	Water supply charge		1	4,000	4,200	4,400	4,600	4,900	5,100	5,400	5,600	5,900	6,200	*3
4	Special maintenance	System brush-up by the manufacture's engineer	1	0	0	1,155,000	0	0	1,337,000	0	0	1,547,800	0	For 5 days at site
5	Remote maintenance	Remote maintenance by the manufacture's engineer through the Internet	1	232,800	244,400	256,700	269,500	283,000	297,100	312,000	327,600	344,000	361,100	
6	Radome	Caulking repair	1	25,600	26,900	28,200	29,600	31,100	32,700	34,300	36,000	37,800	39,700	
7	Pest-control	Exterminating vermination	1	23,000	24,200	25,400	26,700	28,000	29,400	30,900	32,400	34,100	35,800	
		Sub total (LKR)		3,557,000	3,752,300	5,095,000	4,136,900	4,343,800	5,897,900	4,789,100	5,028,400	6,827,800	5,543,900	
		Total (LKR)		3,569,500	3,770,100	5,131,800	4,156,500	4,412,600	5,943,300	4,833,600	5,078,400	6,876,900	6,826,900	
		Total (JPY)		¥3,066,581	¥3,238,918	¥4,408,763	¥3,570,876	¥3,790,893	¥5,105,928	¥4,152,577	¥4,362,887	¥5,907,990	¥5,865,034	

Estimate of annual electricity charge

Annual power consumption	(kWh)	213,080	
Annual power consumption by commercial power (98%)	(kWh)	208,818	
Annual power consumption by DEG (2%)	(kWh)	4,262	
Annual fuel consumption	(Litter)	1,066	Fuel consumption of DEG= 0.25 Litter/kWh
*1 Annual electricity charge of commercial power	(LKR)	3,170,302	Electricity charge= 14.55 LKR/kWh
*2 Annual fuel cost of DEG	(LKR)	101,270	Fuel cost= 95.00 LKR/Litter
*3 Annual water supply charge	(LKR)	0	Exchange rate 1.164 LKR/JPY

*4 Inflation: 5%/year considered

Table: Recurrent Cost of the DOM Head Office and the DOM Aviation Meteorological Offices in the Colombo International Airport and the Mattala Rajapaksa International Airport

Estimated Recurrent Cost

	Equipment	Item	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
	Storm Warning Centre (SWC)													
1	Product Monitor	Blu-ray disk for data storage	24	5,000	5,300	5,500	5,800	6,100	6,400	6,700	7,100	7,400	7,800	
2	Printer	Printer ink cartridge	4	16,300	17,100	18,000	18,900	19,800	20,800	21,800	22,900	24,100	25,300	
		Paper(500sheets/1set)	10	5,200	5,500	5,800	6,100	6,400	6,700	7,000	7,400	7,700	8,100	
3	Compact UPS	Battery	12	0	0	137,100	0	0	158,700	0	0	183,700	0	Every 3 years
4	5kVA UPS	Battery	1	0	0	192,500	0	0	222,800	0	0	258,000	0	Every 3 years
	DOM Meteorological Office in the Colombo International Airport and Mattala Rajapaksa International Airport													
1	Compact UPS	Battery	2	0	0	22,800	0	0	26,400	0	0	30,600	0	Every 3 years
		Sub total (LKR)		26,500	27,900	381,700	30,800	32,300	441,800	35,500	37,400	511,500	41,200	

Others

	Cost Item	Details	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Electricity Charge		1	373,400	392,000	411,600	432,200	453,800	476,500	500,300	525,400	551,600	579,200	*1
2	Fuel cost	Fuel consumption of Existing DEG	1	5,100	5,400	5,700	5,900	6,200	6,500	6,900	7,200	7,600	8,000	*2
3	Frequency License Fee	for Puttalam and Pottuvil Meteorological Radar	1	1,600,000	1,680,000	1,764,000	1,852,200	1,944,800	2,042,100	2,144,200	2,251,400	2,363,900	2,482,100	
		for Puttalam/Pottuvil - DOM Head Office Satellite Communication	1	110,000	115,500	121,300	127,300	133,700	140,400	147,400	154,800	162,500	170,600	
4	Communication charge	IP-VPN (Puttalam/Pottuvil - DOM Head Office)	1	620,000	651,000	683,600	717,700	753,600	791,300	830,900	872,400	916,000	961,800	
		Satellite Service Charge (Space Segment)	1	11,532,700	12,109,400	12,714,800	13,350,600	14,018,100	14,719,000	15,455,000	16,227,700	17,039,100	17,891,100	
5	Remote maintenance	Remote maintenance by the manufacture's engineer through the Internet	1	116,400	122,200	128,300	134,700	141,500	148,600	156,000	163,800	172,000	180,600	*2
		Sub total (LKR)		14,357,600	15,075,500	15,829,300	16,620,600	17,451,700	18,324,400	19,240,700	20,202,700	21,212,700	22,273,400	
		Total (LKR)		14,384,100	15,103,400	16,211,000	16,651,400	17,484,000	18,766,200	19,276,200	20,240,100	21,724,200	22,314,600	
		Total (JPY)		¥12,357,474	¥12,975,430	¥13,926,976	¥14,305,326	¥15,020,619	¥16,122,165	¥16,560,309	¥17,388,402	¥18,663,402	¥19,170,619	

Estimate of annual electricity charge

Annual power consumption of DOM Head Office (Commercial Power)	(kWh)	21,341	*99% of power consumption
Annual power consumption of DOM Meteorological Office in the Colombo International Airport (Commercial Power)	(kWh)	2,160	
Annual power consumption of DOM Meteorological Office in the Mattala Rajapaksa International Airport (Commercial Power)	(kWh)	2,160	
Total annual power consumption (Commercial Power)	(kWh)	25,661	
Annual power consumption of DOM Head Office (DEG)	(kWh)	216	*1% of power consumption
Annual fuel consumption	(Liter)	54	Fuel consumption of DEG= 0.25 Liter/kWh
*1 Annual electricity charge of commercial power	(LKR)	373,368	Electricity charge= 14.55 LKR/kWh
*2 Annual fuel cost of DEG	(LKR)	5,130	Fuel cost= 95.00 LKR/Liter

*3 Inflation: 5%/year considered

Exchange rate 1.164 LKR/JPY

Table: Required Staff at each Meteorological Radar Station		
Position	Puttalam Radar Observation Station	Pottuvil Radar Observation Station
Senior Electronics Technical Officer (Station Leading Officer)	1	1
Electronics Technical Officer	1	1
Electronics Technical Assistant	1	1
Pion	1	1
Security Guard	1	1
Total	5	5

Table: Quick Response Team for Radar System, VSAT Equipment, Software and Instruments located in Colombo	
Position	Number of Staff
Quick Response Team Leading Engineer: Chief Electronics Engineer	1
Quick Response Team Deputy Leading Engineer: Electronics Engineer	1
Quick Response Team Member: Senior Electronics Technical Officer	2
Quick Response Team Assistant: Electronics Technical Officer	2

<Electronics Engineer and Electronics Technical Officer's Operation & Maintenance and Repairing Duty>

- Electronic Equipment: Transmitter, Digital Receiver and Signal Processor, Dehydrator, Radar Power Maintenance Panel, Radar Operation Software, Power Back-up System and Building Electrical Equipment (Isolation Transformer, Power Distribution Board, Lightings, etc.), Lightening Protection System
- Data Communication Equipment: Data Communication Equipment (VSAT In-door & Out-door Units, VSAT Antenna, Dual Router, Optical Repeater, Dual Switch, Terminal (PC), Printer, Peripherals, Data Communication Software
- Mechanical Equipment: Radar Antenna, Radar Antenna Pedestal, Radome, Engine Generator, Air-conditioning Unit, Water Pump, Ventilation Duct & Fan, Door & Window, Furniture

Table: Work Schedule of the National Meteorological Centre for monitoring of the Radar Systems Operation and radar observation data for quality control					
Shift	Working Time	Working Hours	Meteorologist	Meteorological Technical Officer	Electronics Technical Officer
Day Shift	08:00-16:00	8	1	1	1
Night Shift	16:00-08:00	16	1	1	1

14-5 Remote maintenance and Special maintenance

The Japanese side recommended that DOM should make contracts with Radar manufacturer for remote maitenance and special maintenance as described in 14-4 for stable operation. The Japanese side also explained that radar should be operated 24/7 basis and remote maintenance and special maintenance will help the 24/7 operation. DOM understood it.

14-6 Sharing of the radar observation images and animation images

DOM agreed to provide radar animation images (rainfall) of the entire area of Sri Lanka on the responsive Web site of DOM with the automatic play function of GIF animations to the Public through technical supports of the Consultant to be recommended by JICA and Information & Communication Technology Agency (ICTA), Sri Lanka.

DOM also agreed to provide hourly forecast and warning on severe weather and tropical depressions or cyclones located within the radar detection range to the agencies concerned with disaster risk reduction

14-7 Adaptation to Climate change

Due to the increase of rainfall intensity by the impact of Climate change, more frequent and severe rainfall can be expected in Sri Lanka. The project is aiming to improve and strengthen the capacities of short range weather forecasting by the establishment of a Doppler Weather Radar Network, thereby contributing to mitigation of damages by weather-related disasters. From such aspect, the Project is expected to contribute to adaptation to climate change.

Annex-1

Project Cost Estimation

1. Project Cost to be borne by Japan's Grant Aid

This item is closed due to confidentiality

JAPANESE GRANT

The Japanese Grant (hereinafter referred to as the "Grant") is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant is not supplied through the donation of materials as such.

Based on a JICA law which was entered into effect on October 1, 2008 and the decision of the GOJ, JICA has become the executing agency of the Japanese Grant for Projects for construction of facilities, purchase of equipment, etc.

1. Grant Procedures

The Grant is supplied through following procedures :

- Preparatory Survey
  - The Survey conducted by JICA
- Appraisal &Approval
  - -Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- Authority for Determining Implementation
  - -The Notes exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  - -Agreement concluded between JICA and a recipient country
- Implementation
  - -Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Scheme from a technical, financial, social and economic point of view.

- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant project. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japanese Grant Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles, in accordance with the E/N, to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Grant, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. The Grant may be used for the purchase of the products or services of a third country, if necessary, taking into account the quality, competitiveness and economic rationality of products and services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals", in principle.

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals, in principle. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Project, the recipient country is required to undertake such necessary measures as Annex. The Japanese Government requests the Government of the recipient country to exempt all customs duties, internal taxes and other fiscal levies such as VAT, commercial tax, income tax, corporate tax, resident tax, fuel tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract, since the Grant fund comes from the Japanese taxpayers.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant.

(7) "Export and Re-export"

The products purchased under the Grant should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"), in principle. JICA will execute the Grant by making payments in Japanese yen, in principle, to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its

designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Environmental and Social Considerations

The Government of the recipient country must carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the recipient country and JICA Guidelines for Environmental and Social Consideration (April, 2010) .

(11) Monitoring

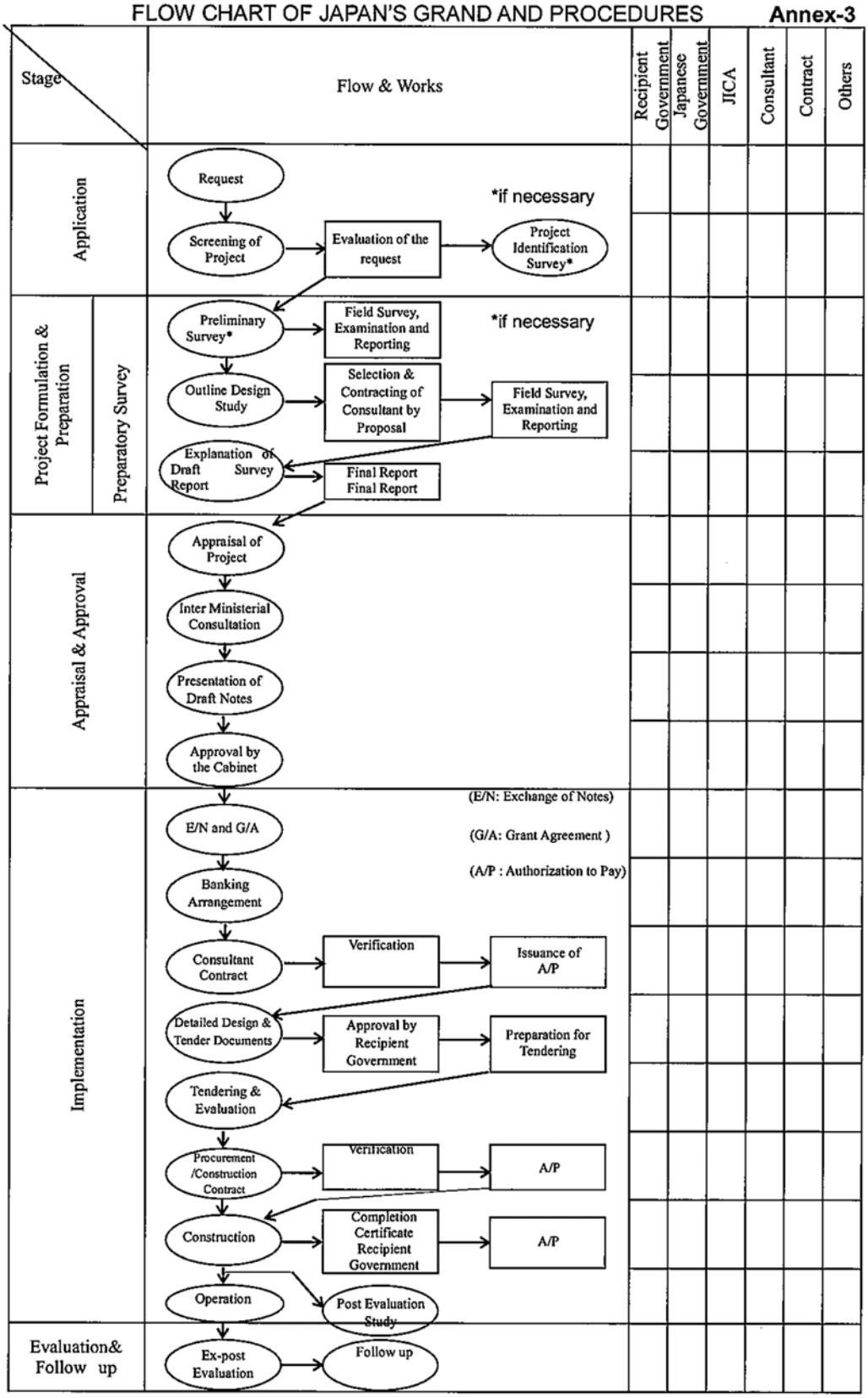
The Government of the recipient country must take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and must regularly report to JICA about its status by using the Project Monitoring Report (PMR).

(12) Safety Measures

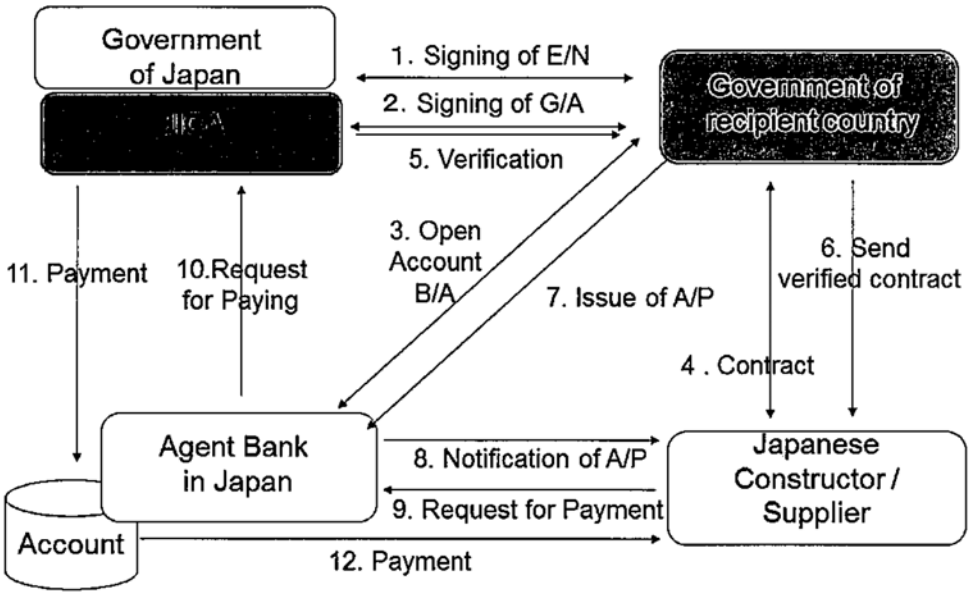
The Government of the recipient country must ensure that the safety is highly observed during the implementation of the Project.

FLOW CHART OF JAPAN'S GRAND AND PROCEDURES

Annex-3



Financial Flow of Grant Aid



Annex 5

Table: Implementation Schedule

Month	1	2	3	4	5	6	7
Detailed Design & Tendering Procedures	Total : 7.0 months						
Detailed Design							
Tendering Procedures							

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Puttalam Radar Observation Station																															
Construction Work	Total : 18.0 months																														
Temporary/Piling/Earth Works																															
Structure Work																															
Finishing Work																															
Building Equipment																															
Equipment Work	Total : 17.0 months																														
Equipment Manufacturing																															
Equipment Transportation																															
Equipment Installation/Adjustment																															
National Meteorological Centre (NMC) at DOM Head Office																															
Equipment Work	Total : 15.0 months																														
Equipment Manufacturing																															
Equipment Transportation																															
Equipment Installation/Adjustment																															
DOM Aviation Meteorological Office in the Colombo International Airport	Total : 15.0 months																														
Equipment Work																															
Equipment Manufacturing																															
Equipment Transportation																															
Equipment Installation/Adjustment																															
DOM Aviation Meteorological Office in the Mattala Rajapaksa International Airport	Total : 15.0 months																														
Equipment Work																															
Equipment Manufacturing																															
Equipment Transportation																															
Equipment Installation/Adjustment																															
Pottuvil Radar Observation Station																															
Construction Work	Total : 17.5 months																														
Temporary/Piling/Earth Works																															
Structure Work																															
Finishing Work																															
Building Equipment																															
Equipment Work	Total : 17.0 months																														
Equipment Manufacturing																															
Equipment Transportation																															
Equipment Installation/Adjustment																															
Soft Component																															
Soft Compnent (Activity No.1)																															
Soft Compnent (Activity No.2)																															
Soft Compnent (Activity No.3)																															
Soft Compnent (Activity No.4)																															
Soft Compnent (Activity No.5)																															

Annex 6

Major Undertakings to be taken by Recipient Government

1) Before the Tender

NO	Items	Deadline	In charge	Cost (Rupee)	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 1 month after G/A	ERD		
2	To secure sufficient spaces at the respective Project site/s for temporary facilities such as a contractor's office, workshop, building materials storage, etc. needed for the construction work.	before notice of the Tender	DOM		
3	To obtain necessary permissions from the Puttalam Urban Council for the construction of the Radar Tower in the DOM Puttalam Observatory (Radar Observation Station)	before notice of the Tender	DOM		
4	To obtain necessary permissions from the Pottuvil Divisional Council for the construction of the Radar Tower in the DOM Pottuvil Observatory (Radar Observation Station)	before notice of the Tender	DOM		
5	To obtain the Coast Conservation Clearance from the Coast Conservation Department for the construction of the Radar Tower in the DOM Pottuvil Observatory (Radar Observation Station)	before notice of the Tender	DOM		
6	To submit the required application to the Ceylon Electricity Board (CEB) for Commercial Power Supply and Step-down Transformer Installation for the Radar Tower Buildings to be constructed in the DOM Puttalam and Pottuvil Observatories (Radar Observation Stations)	before notice of the Tender	DOM		

2) During the Project

NO	Items	Deadline	In charge	Cost (Rupee)	Ref.
1	To obtain approval of Specified Project for Simplified Value Added Tax (VAT)	within 1 month after signing of the contract(s)	DOM	225,000,000	
2	To bear the following commissions to a bank of Japan for the banking services based upon the B/A				
	1) Requesting budget for the Project (Capital Cost to be borne by the DOM)	at the initial occasion to request a budget for the Project	DOM	486,650,000 (in Total)	
	2) Advising commission of the Authorization to Pay (A/P)	within 1 month after the budget of the Project gets authorized	ERD, DOM		
	3) Payment commission for A/P	every payment	ERD, DOM	1,550,000	
3	To ensure prompt unloading, customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation in the country of the Recipient of the products				
	1) Marine (air) transportation of the Products from Japan to Sri Lanka	during the Project	Contractor		
	2) Tax exemption and customs clearance of the products at the port of disembarkation (To pay imposed tax (custom duty) and other fiscal levies and all demurrage required at the port of disembarkation for the materials and equipment imported for the Project.)	during the Project	DOM	250,000,000	

	3) Internal transportation from the port of disembarkation to the project site	during the Project	Contractor		
4	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	during the Project	DOM		
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the Products and/or the Services be borne by its designated authority without using the Grant. Such customs duties, internal taxes and other fiscal levies mentioned above include VAT, commercial tax, income tax and corporate tax of Japanese nationals, resident tax, fuel tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract.	during the Project	DOM		
6	To bear all the expenses, other than those to be borne by the Japanese Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment	during the Project	DOM		
7	To provide temporary facilities for the availability or accessibility of electricity, water, etc. for the construction work	Prior to commencement of the radar tower building construction	DOM		
8	To provide facilities for distribution of electricity, water supply, drainage and other incidental facilities necessary for the implementation of the Project				
	1) Electricity				
	To provide the commercial power (415V, 3-phase, 4-wire, 50Hz) supply (capacity: 100kVA) along with electric poles/wires, etc. from the main supply line to the proposed site for the Puttalam and Pottuvil Radar Tower Buildings To install the required step-down transformer as well as service entrance connections for the commercial power supply at the Puttalam and Pottuvil Radar Tower Buildings.		DOM	4,400,000 (2,200,000×2 sites)	
	2) Drainage The city drainage main (for storm, sewer and others) to the site	during the radar tower building construction	DOM		
	3) Data Communication Access To provide reliable and high-speed Internet environment at the DOM Head Office and each project site for establishment of Internet Protocol-Virtual Private Network (IP-VPN).		DOM	200,000 (100,000×2 sites)	
	4) Furniture and Equipment General Furniture		DOM		
	5) Incidental Facilities To provide incidental facilities, such as public water supply, telephone lines, Internet, etc. for Puttalam and Pottuvil Radar Tower Buildings.		DOM	1,400,000 (700,000×2 sites)	
	6) Replacement of 2 existing air-conditioning systems at the National Meteorological Centre at the DOM Head Office.		DOM	600,000	
9	To obtain necessary permissions from the relevant agencies for the construction of the Radar Tower Buildings in the DOM Puttalam and Pottuvil Observatories (Radar Observation Stations).	during the Project	DOM	100,000	

10	To undertake incidental outdoor works such as gardening, fencing, gates, boundary walls and exterior lightings and to renovate the existing buildings and facilities in the DOM Puttalam and Pottuvil Observatories (Radar Observation Stations).	during the Project	DOM	500,000 (250,000×2 sites)	
11	To shift the existing observation field in the DOM Pottuvil Observatories (Radar Observation Station).	during the Project	DOM	100,000	
12	To make the advance payment for 2 months for the required space segment for the use of satellite communication for the meteorological data satellite communication system (VSAT).	during the Project	DOM	2,000,000	
13	To bear cost of DOM personnel for the Project implementation and soft component such as transportation, accomodation and daily allowance, etc.	during the Project	DOM	800,000	
14	To submit the Project Monitoring Report (PMR)	every 6 months during the Project	DOM		

3) After the Project

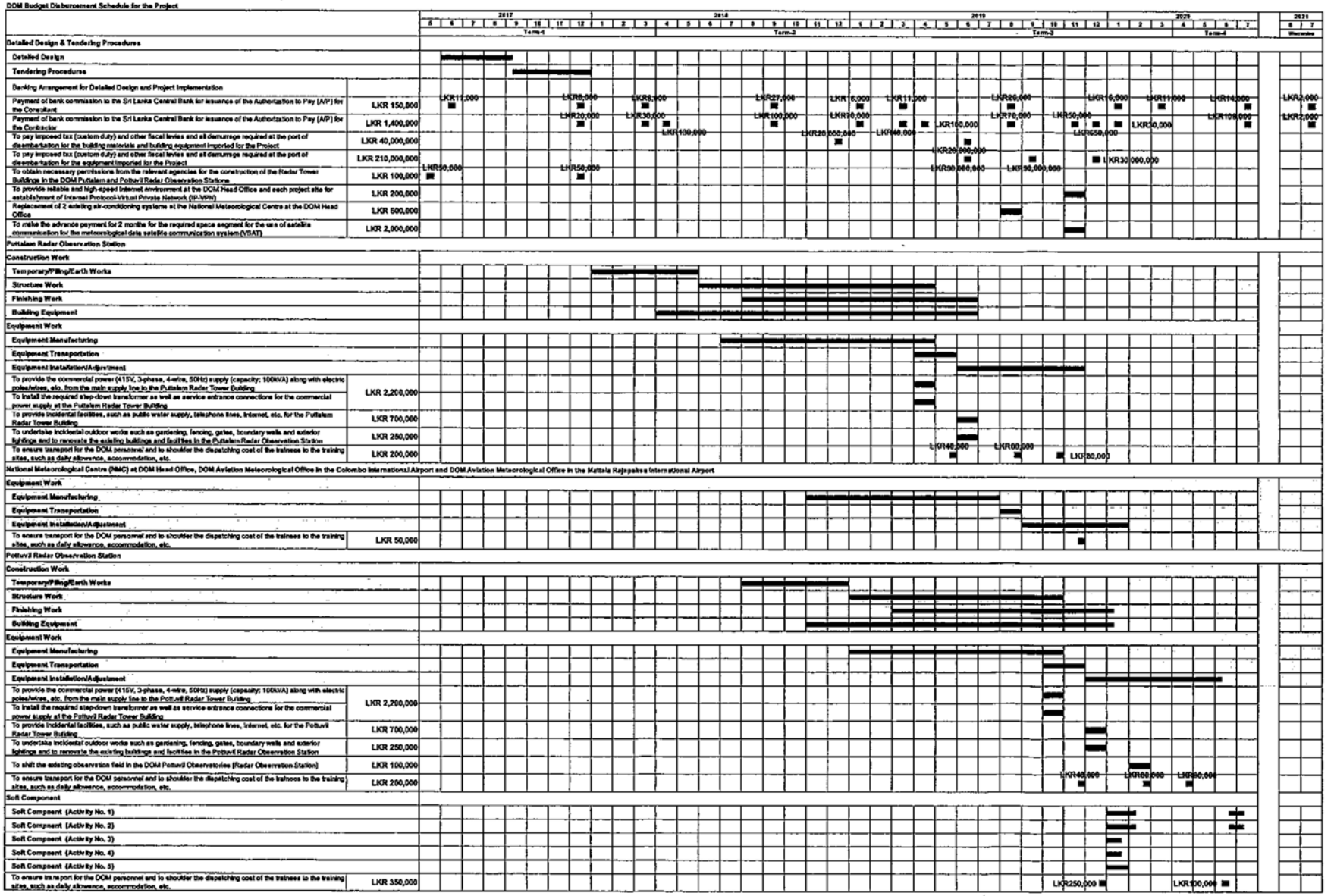
NO	Items	Deadline	In charge	Cost (Rupee)	Ref.
1.	To maintain and use properly and effectively the facilities constructed and equipment provided under the Japanese Grant	after completion of the Project			
	1) Allocation of maintenance cost		DOM		
	2) Operation and maintenance structure		DOM		
	3) Routine check/Periodic inspection		DOM		
	4) Others		DOM		

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

(Note) Progress of the specific obligations of the Recipient may be confirmed and updated from time to time with written agreement between JICA and the Recipient in the form other than the amendment of the G/A.

Annex 7 (without VAT)

DOM Budget Disbursement Schedule for the Project



APX4-2-21

Project Monitoring Report
on
Project for the Establishment of a Doppler Weather Radar Network

Grant Agreement No. XXXXXXX

20XX, Month

Organization Information

Authority (Signer of the G/A)	Person in Charge _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Executing Agency	Person in Charge _____ Contacts Address: _____ Phone/FAX: _____ Email:
Line Agency	Person in Charge _____ Contacts Address: _____ Phone/FAX: _____ Email: _____

Outline of Grant Agreement:

Source of Finance	Government of Japan: Not exceeding JPY . Government of Sri Lanka:
Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:

1: Project Description

1-1 Project Objective

1-2 Necessity and Priority of the Project

- Consistency with development policy, sector plan, national/regional development plans and demand of target group and the recipient country.

1-3 Effectiveness and the indicators

- Effectiveness by the project

Quantitative Effect (Operation and Effect indicators)		
Indicators	Original (Yr 2016)	Target (Yr 2021)
Qualitative Effect		

2: Project Implementation

2-1 Project Scope

Table 2-1-1a: Comparison of Original and Actual Location

Location	**Original:** *(M/D)* **Attachment(s):Map**	**Actual:** *(PMR)* **Attachment(s):Map**

Table 2-1-1b: Comparison of Original and Actual Scope

Items	Original	Actual

2-1-2 Reason(s) for the modification if there have been any.

2-2 Implementation Schedule

2-2-1 Implementation Schedule

Table 2-2-1: Comparison of Original and Actual Schedule

Items	Original		Actual
	DOD	G/A	
Cabinet Approval		-	-
E/N			
G/A			
Approval of consultant contract			
Early Mobilization of consultant			
Detailed Design			
Budget Request for FY2016			
Tender Process of contractor and supplier			
Approval of contractor and supplier contract			
Budget Appropriation and Issuance of A/P			
Construction Period			
Shipment			
Custom Clearance			
Installation and acceptance Check			
Soft component			
Project Completion Date			
Defect Liability Period			

*Project Completion was defined as Completion of Soft component at the time of G/A.

2-2-2 Reasons for any changes of the schedule, and their effects on the project.

2-3 Undertakings by each Government

2-3-1 Major Undertakings

See Attachment 2.

2-3-2 Activities

See Attachment 3.

2-3-3 Report on RD

See Attachment 4.

2-4 Project Cost
2-4-1 Project Cost

Table 2-4-1a Comparison of Original and Actual Cost by the Government of Japan
(Confidential until the Tender)

Items			Cost (Million Yen)	
	Original	Actual	Original	Actual
Construction of Facilities				
Equipment				
Soft Component				
Consulting Services				
Contingency				
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =**Yen

Table 2-4-1b Comparison of Original and Actual Cost by the Government of **

Items			Cost (Thousand MMK)	
	Original	Actual	Original	Actual
				Please state not only the most updated schedule

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =(local currency)

2-4-2 Reason(s) for the wide gap between the original and actual, if there have been any, the remedies you have taken, and their results.

2-5 Organizations for Implementation

2-5-1 Executing Agency:

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original: *(M/D)*
Actual, if changed: *(PMR)*

2-6 Environmental and Social Impacts

- The environmental monitoring is not required in the Project as this project was categorized as category C in accordance with the GUIDELINES FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS of JICA as of April 2010.

3: Operation and Maintenance (O&M)

3-1 O&M and Management

- Organization chart of O&M
- Operational and maintenance system (structure and the number ,qualification and skill of staff or other conditions necessary to maintain the outputs and benefits of the project soundly, such as manuals, facilities and equipment for maintenance, and spare part stocks etc)

Original: *(M/D)*
Actual: *(PMR)*

3-2 O&M Cost and Budget

- The actual annual O&M cost for the duration of the project up to today, as well as the annual O&M budget.

Original: *(M/D)*

Actual: *(PMR)*

4: Precautions (Risk Management)

- Risks and issues, if any, which may affect the project implementation, outcome, sustainability and planned countermeasures to be adapted are below.

Original Issues and Countermeasure(s): *(M/D)*	
Potential Project Risks	Assessment
1. Delay of budget appropriation	Probability: H/M/L
	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
2.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
3.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
Actual issues and Countermeasure(s)	
(PMR)	

5: Evaluation at Project Completion and Monitoring Plan

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan for the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Undertakings to be taken by each Government
3. Monthly Report
4. Report on RD
5. Yearly disbursement plan
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)

(Final Report Only)

Appendix 5. Soft Component Plan

Soft Component Plan

<Background of the Soft Component Plan>

The Democratic Socialist Republic of Sri Lanka (hereinafter referred to as Sri Lanka) is suffering from floods and landslides annually which are caused by torrential rains. The torrential rain that occurred in May 2003 caused serious floods and landslides inflicting damage to about 140,000 households and resulted to the loss of 235 lives. Property damage amounted to about 56 million U.S. dollars which is equivalent to 0.3% of the country's GDP. Furthermore, there were 38 recorded cases of floods and landslides in 2006. In both 2008 and 2011, large-scale and devastating occurrences of flooding happened 3 times for each year. In the past 20 years (1996-2015 years), more than 66% of the total population of 20.35 million (2012) people, which is approximately 13.5 million people, are reported to have been affected by major disasters caused by hazardous meteorological phenomena. It is, therefore, an urgent task for Sri Lanka to mitigate the damages and untoward consequences caused by meteorological disasters associated with torrential rains.

Since more than 90% of the major disasters in Sri Lanka were caused by hazardous meteorological phenomena, meteorology has indeed become a serious matter of life or death in Sri Lanka. Thus, the role of the Department of Meteorology (DOM), the only meteorological organization in the country, is crucial and important.

In order for the DOM to effectively mitigate the damages generated by the disasters caused by hazardous meteorological phenomena, it is a priority issue to detect and forecast hazardous meteorological phenomena which may create massive damages in advance and disseminate highly accurate forecasts/warnings to the public more appropriately and promptly before the risk of disasters escalates. However, the DOM is not able to adequately and quickly detect hazardous meteorological phenomena since there is no operational meteorological radar system in Sri Lanka as of the present.

Given these circumstances indicated above, the key objective of the Project is the effective mitigation of the devastation generated by disasters caused by hazardous meteorological phenomena such as heavy rain, tropical cyclone and etc. through the improvement of the weather information and forecasts & warnings released by the DOM by means of strengthening their monitoring capability of hazardous weather phenomena through the provision of technical support and the procurement of C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Doppler Meteorological Radar Systems, Meteorological Radar Central Processing System, Meteorological Radar Data Display Systems and Meteorological Data Satellite Communication Systems under the Project.

Nine (9) years have passed since the existing Trincomalee meteorological radar system located in the Naval Base of Sri Lanka operationally stopped in 2007. In addition, only a few engineers and technical officers have practical experience to operate the existing analog meteorological radar system that currently remains with the DOM. It is good to note, however, that the DOM's engineers and technical officers are proficient in the use of computers and computerized meteorological observation equipment. However, no engineer or technical officer of the DOM has practical experience to operate a digital meteorological radar system which is planned to be procured under the Project. For the smooth operation and maintenance of the digital C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar Systems, for the dissemination of high accuracy medium range weather forecasts to be prepared through weather guidance to the public and for the assurance of the required sustainability of the project outcomes, the implementation of technology transfers in the soft component mentioned below (with the Implementation Schedule attached hereunder) is required.

<Soft Component Objective>

To enable the DOM to independently and appropriately operate the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar Systems.

<Soft Component Indicators>

Soft Component Indicators are as follows.

Table 1: Soft Component Indicators

No.	Item	Output	Objectively Verifiable Indicators	Means of Verification
1	C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System Inspection, Adjustment, Minor Fault Finding, Remedy and Recovery and Major Fault Countermeasures	Acquisition of technical know-how on appropriate inspection, adjustment, minor fault finding, remedy and recovery.	Inspection, adjustment, minor fault finding, remedy and recovery, and major fault countermeasures (a. routine maintenance using measuring instruments and tools, b. practice of replacing spare parts into the actual system and the subsequent confirmation of system operation, c. practice of remedy, recovery and major fault countermeasures: distributing information to the Consultant and the manufacturer and receiving technical advice) are carried out appropriately by the DOM.	· Confirmation of proficiency through 1) routine maintenance using measuring instruments and tools; 2) practice of replacing spare parts into the actual system and the subsequent confirmation of system operation; 3) practice of minor fault finding, remedy and recovery; and 4) major fault countermeasures. · Visual check and technical interviews
2	Prompt and Appropriate Meteorological Doppler Radar Operation and Maintenance utilizing the Meteorological Radar System Manual Summary and the Meteorological Radar System Maintenance & Management Record Book including acquisition procedures and data table reading of Observation Raw Data	Technical knowledge on the acquisition of prompt and appropriate C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System operation	C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System operation and maintenance utilizing the meteorological radar system manual summary and the meteorological radar system maintenance & management record book are implemented promptly and appropriately.	· Evaluation of the frequency of usage of the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual summary. · Confirmation of entries (daily, weekly, monthly) in the meteorological radar system maintenance & management record book and thorough technical interviews

		and maintenance		
3	Meteorological Data Satellite Communication System (VSAT) Inspection, Adjustment, Minor Fault Finding, Remedy and Recovery and Major Fault Countermeasures	Acquisition of technical know-how on appropriate inspection, adjustment, minor fault finding, remedy and recovery.	Inspection, adjustment, minor fault finding, remedy and recovery, and major fault countermeasures (a. routine maintenance using measuring instruments and tools, b. practice of replacing spare parts into the actual system and the subsequent confirmation of system operation, c. antenna alignment adjustment, d. practice of remedy, recovery and major fault countermeasures: distributing information to the Consultant and the manufacturer and receiving technical advice) are carried out appropriately by the DOM.	· Confirmation of proficiency through 1) routine maintenance using measuring instruments and tools; 2) practice of replacing spare parts into the actual system and the subsequent confirmation of system operation; 3) practice of minor fault finding, remedy and recovery; 4) antenna alignment adjustment; and 5) major fault countermeasures. · Visual check and technical interviews
4	Prompt and Appropriate Meteorological Data Satellite Communication System (VSAT) Operation and Maintenance utilizing the Meteorological Data Satellite Communication System Manual Summary and the Meteorological Data Satellite Communication System Maintenance & Management Record Book	Technical knowledge on the acquisition of prompt and appropriate Meteorological Data Satellite Communication System (VSAT) operation and maintenance	Meteorological Data Satellite Communication System (VSAT) operation and maintenance utilizing the meteorological radar system manual summary and the meteorological radar system maintenance & management record book are implemented promptly and appropriately.	· Evaluation of the frequency of usage of the Meteorological Data Satellite Communication System (VSAT) manual summary. · Confirmation of entries (daily, weekly, monthly) in the meteorological radar system maintenance & management record book and thorough technical interviews
5	Meteorological Radar Observation in accordance with the Sequence & Schedule for Intensity Mode and Doppler Mode Sequence & Schedule	Appropriate meteorological radar operation.	Meteorological radar observation is implemented according to the radar observation sequence & schedule for Intensity Mode and Doppler Mode.	Confirmation of meteorological radar observation in accordance with the sequence & schedule for Intensity Mode and Doppler Mode in order to appropriately understand weather phenomena and to utilize the observed radar data for forecast operation.

<Means of Verification for the Achievement of Outputs >

The means of verification for the achievement of outputs of the Soft Component are also indicated in the Table 1 attached above.

<Scheduled Activities of the Soft Component>

Scheduled Activities of the Soft Component are as follows.

Table 2: Scheduled Activities of Soft Component

Output	Required Technique and Field	Current Technique and Required Technique Level	Target Group	Means of Implementation	Source of Implementation	Product
1. C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar	An engineer capable of meteorological radar adjustment and minor fault finding.	Since engineers in the DOM have practical experience of adjusting and fault finding in an analog meteorological radar system, it is imperative that the DOM engineers	Indicated in the table below	Routine maintenance using measuring instruments and tools.	<First> Expert Consultant on meteorological radar adjustment and fault finding: 1.13 man-months. (Period of	Manual on routine maintenance using measuring instruments and tools.
				Practice of replacing spare parts into the actual system and the subsequent confirmation of system		Manual on replacing spare parts into the actual system and the

System Inspection, Adjustment, Minor Fault Finding, Remedy and Recovery, and Major Fault Countermeasures		should also acquire the capability of adjusting and fault finding in a digital meteorological radar system.		operation. Practice of countermeasure, minor fault finding, remedy and recovery. Practice of major fault countermeasures. Production of operation and maintenance manual.	Technology Transfer in Sri Lanka: 34days) Direct Support <Second> Expert Consultant on meteorological radar adjustment and fault finding: 0.73 man-months. (Period of Technology Transfer in Sri Lanka: 22days) Direct Support	subsequent confirmation of system operation. Manual on fault finding, remedy and recovery. Manual on major fault countermeasures.
2. Preparation of C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System Manual Summary and Meteorological Radar System Maintenance & Management Record Book including acquisition procedures and data table reading of Observation Raw Data	An engineer capable of meteorological radar operation and maintenance.	Since engineers in the DOM have practical experience of operating and maintaining an analog meteorological radar system, it is imperative that the DOM engineers should also obtain the capability of operating and maintaining a digital meteorological radar system according to the manual summary and the meteorological radar system maintenance & management record book including acquisition procedures and data table reading of Observation Raw Data	Indicated in the table below	Discussion with the DOM engineers. Selection of the most important points from the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual. Production of the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual summary. Production of the meteorological radar system maintenance & management record book. Utilization of the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual and the maintenance & management record book by the DOM engineers. Acquisition procedures and data table reading of Observation Raw Data	<First> Expert Consultant on meteorological radar operation and maintenance: 1.23 man-months (Period of Technology Transfer in Sri Lanka: 37days) Direct Support <Second> Expert Consultant on meteorological radar operation and maintenance: 0.90 man-months. (Period of Technology Transfer in Sri Lanka: 27days) Direct Support	C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual summary Meteorological radar system maintenance & management record book • Date and time of occurrence of system failure/trouble • Cause/s of system failure/trouble (abnormal noise, part degradation, etc.) • Repair procedures implemented • Name and quantity of replaced parts • Name of engineer/s who perform/s the repair /troubleshooting • Acquisition procedures and data table reading of Observation Raw Data
3. Meteorological Data Satellite Communication System (VSAT) Inspection, Adjustment, Minor Fault Finding, Remedy and Recovery, and Major Fault	An engineer capable of meteorological radar adjustment and minor fault finding.	Since the DOM has no other choice but to leverage on the VSAT manufacturer due to many troubles which has occurred in the existing VSAT system, the DOM has made a substantial payment to the VSAT manufacturer. In order	Indicated in the table below	Routine maintenance using measuring instruments and tools. Practice of replacing spare parts into the actual system and the subsequent confirmation of system operation. Practice of antenna alignment adjustment.	<First> Expert Consultant on Meteorological Data Satellite Communication System (VSAT) adjustment and fault finding: 0.73 man-months. (Period of	Manual on routine maintenance using measuring instruments and tools. Manual on replacing spare parts into the actual system and the subsequent confirmation of system operation.

Countermeasures		to change the current situation, it is imperative that the DOM engineers should also acquire the capability of proper maintenance for Meteorological Data Satellite Communication System (VSAT).		Practice of countermeasure, minor fault finding, remedy and recovery. Practice of major fault countermeasures. Production of operation and maintenance manual.	Technology Transfer in Sri Lanka: 22days) Direct Support	 Manual on fault finding, remedy and recovery. Manual on major fault countermeasures.
4. Preparation of the Meteorological Data Satellite Communication System (VSAT) Manual Summary and Meteorological Data Satellite Communication System Maintenance & Management Record Book	An engineer capable of Meteorological Data Satellite Communication System (VSAT) operation and maintenance.	It is imperative that the DOM engineers should obtain the capability of operating and maintaining a Meteorological Data Satellite Communication System (VSAT) according to the manual summary and maintenance & management record book.	Indicated in the table below	Discussion with the DOM engineers. Selection of the most important points from the Meteorological Data Satellite Communication System (VSAT) manual. Production of the Meteorological Data Satellite Communication System (VSAT) manual summary. Production of the Meteorological Data Satellite Communication System (VSAT) maintenance & management record book. Utilization of the Meteorological Data Satellite Communication System (VSAT) manual and maintenance & management record book by the DOM engineers.	Expert Consultant on Meteorological Data Satellite Communication System (VSAT) operation and maintenance: 0.73 man-months (Period of Technology Transfer in Sri Lanka: 22 days) Direct Support	Meteorological Data Satellite Communication System (VSAT) manual summary Meteorological Data Satellite Communication System (VSAT) maintenance & management record book • Date and time of occurrence of system failure/trouble • Cause/s of system failure/trouble • Repair procedures implemented • Name and quantity of replaced parts • Name of engineer/s who perform/s the repair /troubleshooting
5. Preparation of the Sequence & Schedule for Intensity Mode and Doppler Mode	An engineer who can identify Clutter and Blind Area by using radar observation data and prepare a sequence & schedule for meteorological radar observation which is suited to the weather phenomena in Sri Lanka	Since engineers in the DOM have no practical experience in the use of CAPPI observation due to the absence of a CAPPI function in the existing analog meteorological radar system, it is imperative that the DOM engineers should obtain the capability of preparation of sequences & schedules for meteorological radar observation.	Indicated in the table below	Discussion with the DOM engineers and lecture. Identification of Clutter of meteorological radar system and Blind Area at antenna elevation angle. Preparation of Blind Area at antenna elevation angle. Preparation of Sequence & Schedule for Intensity Mode and Doppler Mode. Implementation of radar observation using Sequence & Schedule for Intensity Mode and Doppler Mode.	Expert Consultant on meteorological radar observation: 0.97 man-month (Period of Technology Transfer in Sri Lanka: 29 days) Direct Support	Sequence & Schedule for Intensity Mode and Doppler Mode

Table 3: Target Personnel in the DOM for the Technology Transfer in the Soft Component (Technology Transfer of No. 1, 2 and 4)

Engineers/Staff	DOM Head Office	Puttalam Radar Observation Station	Pottuvil Radar Observation Station

Class I Electronics Engineer	1	0	0
Class II/I (II/II) Electronics Engineer	1	0	0
Senior Electronics Technical Officer	2	1	1
Class (II/A) Electronics Technical Officer	4	1	1
Class (II/B) Electronics Technical Officer	4	1	1

Table 4: Target Personnel in the DOM for the Technology Transfer in the Soft Component (Technology Transfer of No. 3 and 5)

Engineers/Staff	DOM Head Office (including National Meteorological Centre: NMC)	Puttalam Radar Observation Station	Pottuvil Radar Observation Station
Class I Electronics Engineer	1	0	0
Class II/I (II/II) Electronics Engineer	1	0	0
Senior Electronics Technical Officer	2	1	1
Class (II/A) Electronics Technical Officer	2	1	1
Class (II/B) Electronics Technical Officer	4	1	1
Operational Forecasters in NMC	11	0	0

Details of each activity schedule are as follows.

<First Activity after the completion of the Puttalam Meteorological Radar System Installation Work>

Table 5: No. 1, No. 2 and No. 5 Activities Details of the First Schedule of the Soft Component

<table>
<tr><th></th><th>Activity No. 1</th><th>Activity No. 2</th><th>Activity No. 5</th></tr>
<tr><td>Date</td><td>C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System Inspection, Adjustment, Minor Fault Finding, Remedy and Recovery, and Major Fault Countermeasure</td><td>C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System Manual Summary and Meteorological Radar System Maintenance & Management Record Book</td><td>Preparation of Sequence & Schedule for Intensity Mode and Doppler Mode</td></tr>
<tr><td>1</td><td>Departure from Japan Sat. (Holiday)</td><td>Departure from Japan Sat. (Holiday)</td><td>Departure from Japan Sat. (Holiday)</td></tr>
<tr><td>2</td><td>Arrival in Colombo Sun. (Holiday)</td><td>Arrival in Colombo Sun. (Holiday)</td><td>Arrival in Colombo Sun. (Holiday)</td></tr>
<tr><td>3</td><td>Colombo→Puttalam
Preparatory Work at Puttalam Meteorological Radar Tower Building</td><td>Colombo→Puttalam
Preparatory Work at Puttalam Meteorological Radar Tower Building</td><td rowspan="2">Discussion with the forecasters and engineers of the DOM National Meteorological Center and lecture.</td></tr>
<tr><td>4</td><td rowspan="4">Practice of routine maintenance using measuring instruments and tools.
Production of operation and maintenance manual.</td><td rowspan="4">Discussion with the DOM engineers.
Selection of the most important points from C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual.</td></tr>
<tr><td>5</td><td rowspan="3">Identification of Clutter of meteorological radar system and Blind Area at antenna elevation angle.</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td><td>Sat. (Holiday)</td><td>Sat. (Holiday)</td><td>Sat. (Holiday)</td></tr>
<tr><td>9</td><td>Sun. (Holiday)</td><td>Sun. (Holiday)</td><td>Sun. (Holiday)</td></tr>
<tr><td>10</td><td>Production of operation and maintenance manual.</td><td rowspan="5">Production of C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual summary (Draft).
Production of meteorological radar system maintenance & management record book (Draft).</td><td rowspan="2">Preparation of Blind Area at antenna elevation angle.</td></tr>
<tr><td>11</td><td rowspan="3">Practice of replacement of spare parts to actual system and confirmation of system operation.
Production of operation and maintenance manual.</td></tr>
<tr><td>12</td><td>Preparation of Sequence & Schedule for Intensity Mode and Doppler Mode (Draft).</td></tr>
<tr><td>13</td><td rowspan="2">Implementation of radar observation using Sequence & Schedule for Intensity Mode and Doppler Mode.</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td><td>Sat. (Holiday)</td><td>Sat. (Holiday)</td><td>Sat. (Holiday)</td></tr>
<tr><td>16</td><td>Sun. (Holiday)</td><td>Sun. (Holiday)</td><td>Sun. (Holiday)</td></tr>
<tr><td>17</td><td>Production of operation and maintenance manual.</td><td rowspan="2">Production of C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual summary (Draft).</td><td>Review of Sequence & Schedule for Intensity Mode and Doppler Mode (Draft).</td></tr>
<tr><td>18</td><td rowspan="4">Practice of minor fault finding, remedy and recovery.
Production of operation and maintenance manual.</td><td rowspan="4">Implementation of radar observation using Sequence & Schedule for Intensity Mode and Doppler Mode.</td></tr>
<tr><td>19</td><td rowspan="3">Utilization of the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual (Draft) and the meteorological radar system</td></tr>
<tr><td>20</td></tr>
<tr><td>21</td></tr>
</table>

		maintenance & management record book (Draft) by the DOM engineers.	
22	Sat. (Holiday)	Sat. (Holiday)	Sat. (Holiday)
23	Sun. (Holiday)	Sun. (Holiday)	Sun. (Holiday)
24	Production of operation and maintenance manual.	Review of the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual summary (Draft) and the Meteorological radar system maintenance & management record book (Draft).	Completion of Radar observation using Sequence & Schedule for Intensity Mode and Doppler Mode.
25	Practice of major fault countermeasure		
26	Review of training by the DOM. Production of operation and maintenance manual.	Utilization of the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual and the meteorological radar system maintenance & management record book by the DOM engineers.	Production of Soft Component Completion Report.
27			
28			Technical discussion with the DOM.
29	Puttalame→Colombo Sat. (Holiday)	Puttalame→Colombo Sat. (Holiday)	Departure from Colombo and arrival in Japan
30	Sun. (Holiday)	Sun. (Holiday)	
31	Production of Soft Component Completion Report.	Preparation of acquisition procedures and data table reading paper of Observation Raw Data Review and utilization of acquisition procedures and data table reading paper of Observation Raw Data	
32			
33	Technical discussion with the DOM		
34	Departure from Colombo and arrival in Japan	Production of Soft Component Completion Report.	
35		Technical discussion with the DOM	
36		Production of Soft Component Completion Report. Sat. (Holiday)	
37		Sun. (Holiday) Departure from Colombo and arrival in Japan	

Table 6: No. 3 and No. 4 Activities Details of the Schedule of the Soft Component

	Activity No. 3	Activity No. 4
Date	Meteorological Data Satellite Communication System (VSAT) Inspection, Adjustment, Minor Fault Finding, Remedy and Recovery, and Major Fault Countermeasure	Meteorological Data Satellite Communication System (VSAT) Manual Summary and Meteorological Radar System Maintenance & Management Record Book
1	Departure from Japan Sat. (Holiday)	Departure from Japan Sat. (Holiday)
2	Arrival in Colombo Sun. (Holiday)	Arrival in Colombo Sun. (Holiday)
3	Practice of routine maintenance using measuring instruments and tools. Production of operation and maintenance manual.	Discussion with the DOM engineers. Selection of the most important points from Meteorological Data Satellite Communication System (VSAT) manual.
4		
5		
6	Practice of replacement of spare parts to actual system and confirmation of system operation. Production of operation and maintenance manual.	Production of Meteorological Data Satellite Communication System (VSAT) manual summary (Draft). Production of maintenance & management record book.
7		
8	Sat. (Holiday)	Sat. (Holiday)
9	Sun. (Holiday)	Sun. (Holiday)
10	Practice of fault finding, remedy and recovery. Production of operation and maintenance manual.	Production of Meteorological Data Satellite Communication System (VSAT) manual summary.
11		Utilization and review of the Meteorological Data Satellite Communication System (VSAT) manual and the maintenance & management

		record book by the DOM engineers.
12	Colombo→Puttalam At Puttalam Meteorological Radar Tower Building; Practice of replacement of spare parts to actual system and confirmation of system operation. Practice of fault finding, remedy and recovery. Puttalam→Colombo	Colombo→Puttalam At Puttalam Meteorological Radar Tower Building; Utilization of the Meteorological Data Satellite Communication System (VSAT) manual and the maintenance & management record book by the DOM engineers. Puttalam→Colombo
13		
14	Practice of antenna alignment adjustment. Practice of fault finding, remedy and recovery.	Utilization of the Meteorological Data Satellite Communication System (VSAT) manual and the maintenance & management record book by the DOM engineers.
15	Sat. (Holiday)	Sat. (Holiday)
16	Sun. (Holiday)	Sun. (Holiday)
17	Review of training by the DOM. Production of operation and maintenance manual.	Utilization of the Meteorological Data Satellite Communication System (VSAT) manual and the maintenance & management record book by the DOM engineers.
18		
19	Production of Soft Component Completion Report.	Production of Soft Component Completion Report.
20		
21	Technical discussion with the DOM	Technical discussion with the DOM
22	Sat. (Holiday) Departure from Colombo and arrival in Japan	Sat. (Holiday) Departure from Colombo and arrival in Japan

<Second Activity after the completion of the Pottuvil Meteorological Radar System Installation Work>

Table 7: No. 1 and No. 2 Activities Details of the Second Schedule of the Soft Component

	Activity No. 1	Activity No. 2
Date	C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System Inspection, Adjustment, Minor Fault Finding, Remedy and Recovery, and Major Fault Countermeasure	C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System Manual Summary and Meteorological Radar System Maintenance & Management Record Book
1	Departure from Japan Sat. (Holiday)	Departure from Japan Sat. (Holiday)
2	Arrival in Colombo Preparatory Work Sun. (Holiday)	Arrival in Colombo Preparatory Work Sun. (Holiday)
3	Colombo→Pottuvil	Colombo→Pottuvil
4	Preparatory Work at Pottuvil Meteorological Radar Tower Building. Practice of routine maintenance using measuring instruments and tools. Production of operation and maintenance manual (refer to Puttalam one).	Preparatory Work at Pottuvil Meteorological Radar Tower Building. Discussion with the DOM engineers and technical officers. Selection of the most important points from C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual.
5		
6		
7	Practice of replacement of spare parts to actual system and confirmation of system operation. Production of operation and maintenance manual (refer to Puttalam one).	
8	Sat. (Holiday)	Sat. (Holiday)
9	Sun. (Holiday)	Sun. (Holiday)
10	Practice of replacement of spare parts to actual system and confirmation of system operation. Production of operation and maintenance manual (refer to Puttalam one).	Production revision of C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual summary for Puttalam. Production revision of meteorological radar system maintenance & management record book for Puttalam.
11		

12	Practice of minor fault finding, remedy and recovery. Production of operation and maintenance manual (refer to Puttalam one).	Review of the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual summary (Revised) and the Meteorological radar system maintenance & management record book (Revised).
13		
14		
15	Puttalam→Colombo Sat. (Holiday)	Sat. (Holiday)
16	Sun. (Holiday)	Sun. (Holiday)
17	Practice of major fault countermeasure Review of training by the DOM. Production of operation and maintenance manual (refer to Puttalam one).	Utilization of the C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual and the meteorological radar system maintenance & management record book by the DOM engineers and technical officers.
18		
19	Production of Soft Component Completion Report.	Preparation of acquisition procedures and data table reading paper of Observation Raw Data
20		
21	Technical discussion with the DOM.	Review and utilization of acquisition procedures and data table reading paper of Observation Raw Data
22	Sat. (Holiday) Departure from Colombo and arrival in Japan	Puttalam→Colombo Sat. (Holiday)
23		Sun. (Holiday)
24		Review and utilization of acquisition procedures and data table reading paper of Observation Raw Data
25		Production of Soft Component Completion Report.
26		Technical discussion with the DOM.
27		Departure from Colombo and arrival in Japan

<Procurement Method for Soft Component Implementation Resources>

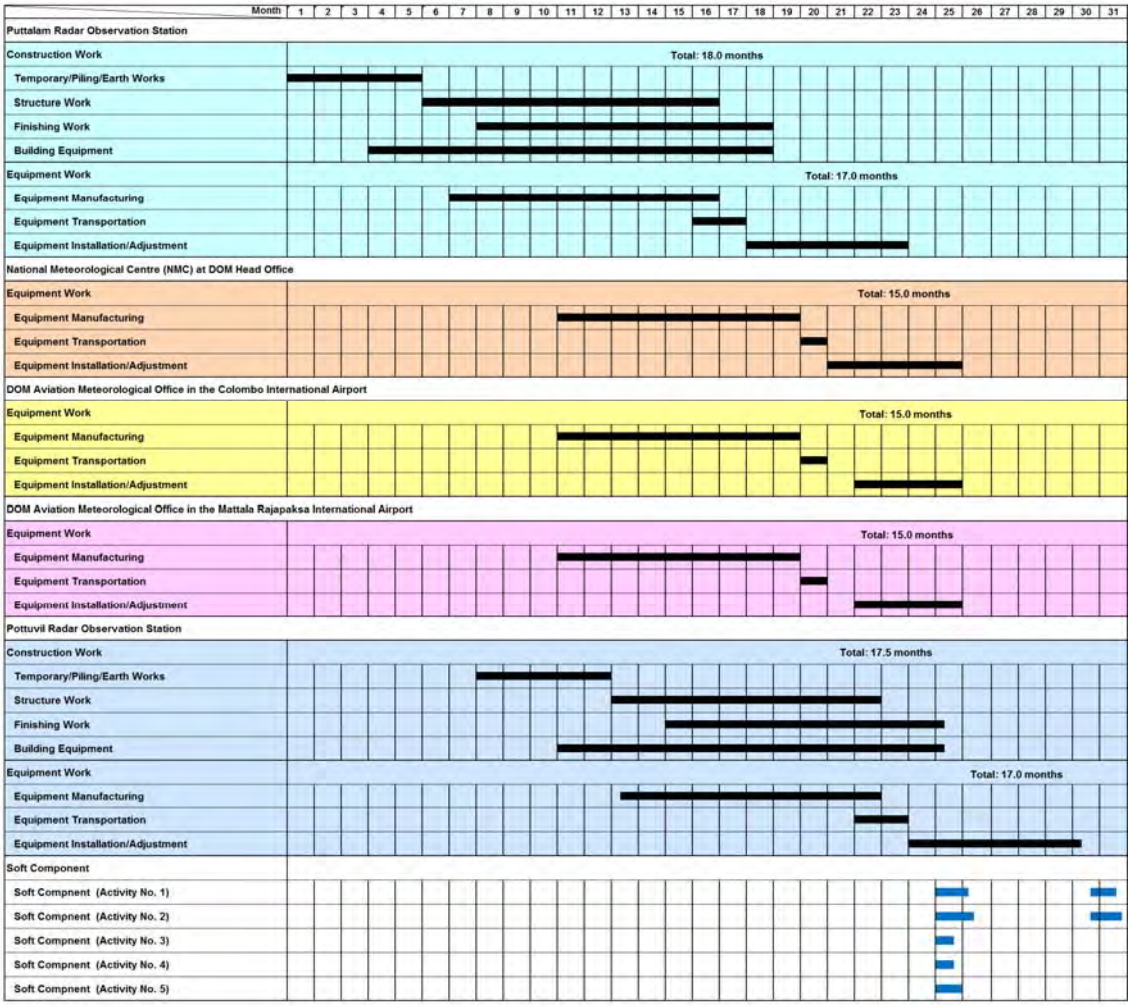
Implementation Resources are procured based on the direct support of the Japanese consultants who are in charge of equipment procurement for the Project. The rationales for which are presented below.

- Personnel with advanced technique and knowledge of weather services and meteorological radar system is necessary.
- Personnel as indicated above usually belongs to weather organizations which actually conduct weather services.
- Personnel who has similar experience to the proposed technology transfer is required.

<Implementation Schedule>

The implementation schedule of the whole Project and soft component is indicated in the following table. The soft component is planned to be implemented during the adjustment stage after the installation of the meteorological radar system and before the completion of the Project.

Table 8: Implementation Schedule



<Soft Component Product>

Soft Component Products are as follows.

Table 9: Soft Component Products in Technology Transfer

Product Name	Submission Time	No. of Pages
Procedures paper on 1) routine maintenance using measuring instruments and tools, 2) practice of replacing spare parts into the actual system and the subsequent confirmation of system operation, 3) practice of minor fault finding, remedy and recovery, and 4) major fault countermeasure for C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System.	After Technology Transfer	20
C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System manual summary		30
C-Band Pulse Compression Solid State Dual Polarization (Polarmetric) Meteorological Doppler Radar System maintenance and management record book		9
Procedures paper on 1) routine maintenance using measuring instruments and tools, 2) practice		15

of replacing spare parts into the actual system and the subsequent confirmation of system operation, 3) antenna alignment adjustment, 4) practice of minor fault finding, remedy and recovery, and 5) major fault countermeasure for Meteorological Data Satellite Communication System (VSAT).			
Meteorological Data Satellite Communication System (VSAT) manual summary			20
Meteorological Data Satellite Communication System (VSAT) maintenance and management record book			5
Radar observation sequence & schedule for Intensity Mode and Doppler Mode			15
Output Name	Content	Submission Time	No. of Pages
Soft Component Completion Report	• Scheduled Activities and Actual Achievement • Scheduled Outputs and Achievement • Factors which influence Achievement of Outputs • Recommendation • Outputs	Completion of Soft Component	50

<Obligations of the Recipient Country>

Obligations of the DOM for the implementation of Soft Component are as follows.

1) Manpower Development
   a) Continuous recruitment of human resources for the next generation.
   b) Development of more qualified technical personnel through training and other related manpower development programs.
2) Longer Life Span of the Equipment procured under the Project
   a) Regularly secure the necessary budget for the efficient operation and maintenance of the systems and the procurement of requisite spare parts and consumables for all the equipment to be supplied under the Project.
   b) Ensure protection of the equipment against theft and vandalism.

The DOM will be able to implement the above obligations through its organizational and personnel capabilities. Most especially, the “continuous recruitment of human resources for the next generation” is of vital concern. It is imperative for the DOM to become self-reliant in technical areas such as the operation and maintenance of radar systems. Hence, it is essential that it puts forth continued efforts to recruit and fill vacancies, thereby, promoting technology transfer across all staff levels from the assistant personnel to the engineer(s).

Appendix 6. References

No	Name of References	Original/Copy/ Digital File	Publisher	Data of Publication
1	Sri Lanka Journal of Meteorology	Digital File	Department of Meteorology	2015