2 - 3 - 2 Basic Design

1. Equipment Plan

Meteorological disasters in Pakistan usually develop from concentrated heavy rains and strong winds, brought in by Cb clusters and other mesoscale phenomena in the ITCZ. The size of these phenomena ranges from a few kilometers to 20 ~ 30 Km, with the storms lasting from 20 ~ 30 minutes to as long as 2 hours. In order to accurately observe and monitor these phenomena, which occur throughout the country, this Project calls for the installation of radars at D. I. Khan and Rahimyar Khan which, together will the 2 existing radars at Karachi and Islamabad, are to form a 4 radar observation network. D. I. Khan is located in northwest Pakistan, permitting effective radar coverage of the upper reaches of the main channel of the Indus River basin and neighboring agricultural areas. Rahimyar Khan will permit radar monitoring of the mid-section of the Indus basin, where the Indus is joined by the Sutlej and Chenab Rivers, together with the fertile plain areas on both sides of the river.

By establishing a meteorological radar network incorporating the 2 new weather radar systems and the existing radar systems at Karachi and Islamabad, it will be possible to monitor rainfall along the entire length of the Indus catchment, When a telecommunication system, using microwave links between the radar sites and telephone exchanges, and a meteorological radar network, incorporating the various radar sites, are completed, the 2 newly installed radar systems will be incorporated as an organic port of this network and, as such, will plan is vital role in monitoring heavy rain and other meteorological phenomena in Pakistan. In addition, in order to more effectively reduce damage from meteorological phenomena, the data obtained from the meteorological radar network can be rapidly communicated to Pakistani disaster relief organizations, aircraft and ships, the media, and the agriculture and fishery sectors and effectively utilized over a broad range of activities.

The Basic Plan for the Meteorological Radar Network is outlined in Figure 2-5.

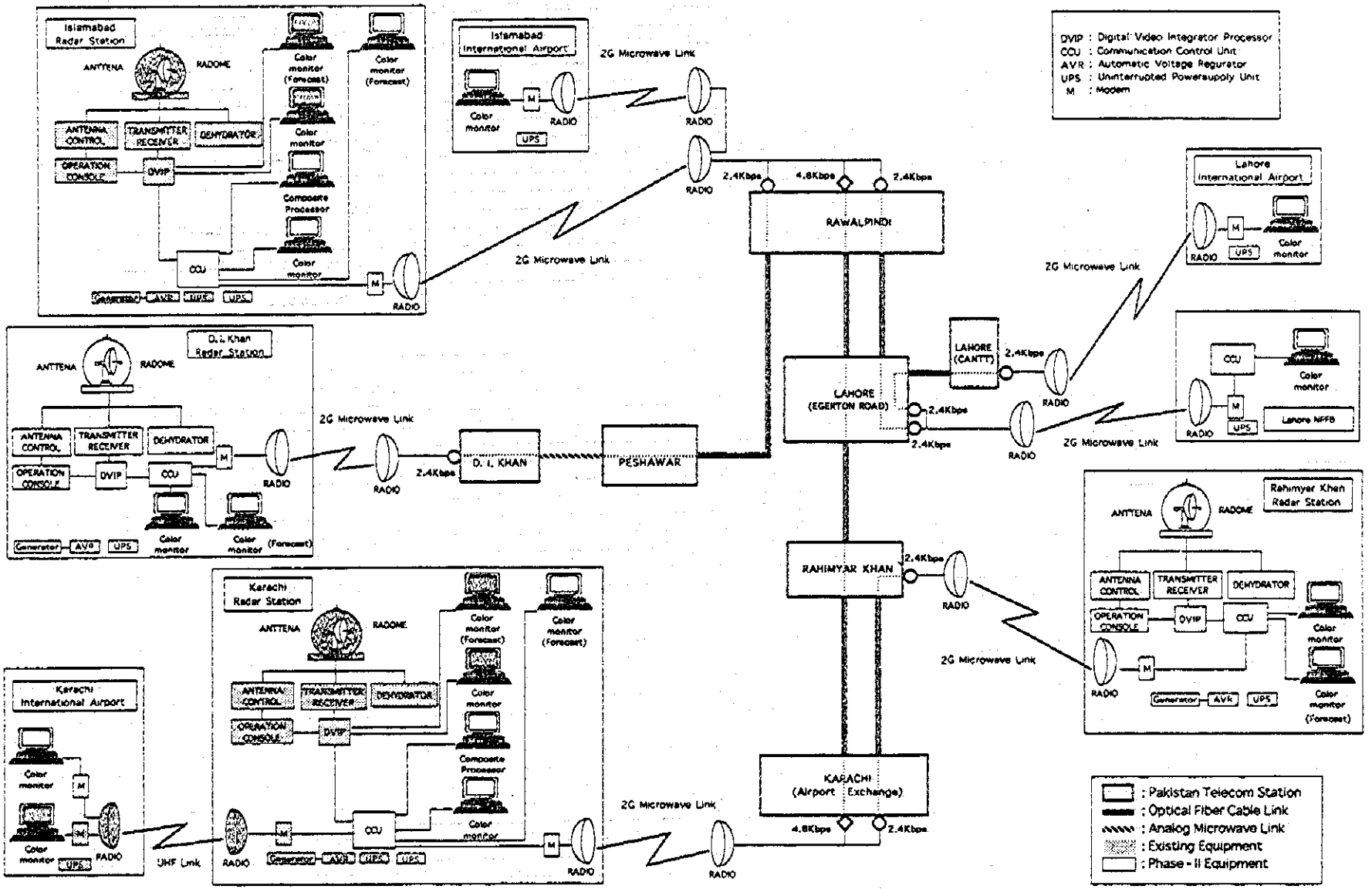


Fig. 2-5 Meteorological Radar Network

1) Weather Radar System

Weather radar systems will be installed at D. I. Khan and Rahimyar Khan.
The objective of the observations to be performed at these facilities will be the quantitative observation of precipitation phenomena, based on CB and other mesoscale phenomena. For transmitting frequencies, one of the key factors determining the basic performance of weather radar systems, the 5,300 MHz (C band) will be used, which is suitable for precipitation observations, since good reflections can be obtained from raindrops. For purposes of composition processing, it is essential that standardized observation data be provided by the various weather radar stations. To this end, the same frequency band will be required as that used by the existing radars at Karachi and Islamabad.

2) Radar Image Transmission System

In order to effectively collect and disseminate the observed radar imageries from the 4 weather radar stations, imagery composite processing systems will be performed at two locations, Karachi and Islamabad. The decentralization of the processing function between these two sites has the following distinct advantages.

a. Processing the composite at 2 sites will enhance reliability of the system.

b. It will also serve to reduce the costs of the leased lines, thereby reducing recurrent costs.

c. When radar imageries of precipitation phenomena, as observed in the respective areas, can be obtained on real time, it will be possible to monitor, on real time, heavy rain and other meteorological phenomena, thereby helping to improve the accuracy of very short-range forecasts.

In order to process imagery efficiently, the radar images observed at the D.I. Khan station will be transmitted to Islamabad, while those from Rahimyar Khan will be sent to Karachi. Karachi and Islamabad will then make a composite of the radar images received from their own radars and the outside stations, at which point 2-point composite imagery (for the 2 northern and 2 southern systems) will be exchanged, After the respective composites have been received at Karachi and Islamabad, a composite imagery of the 4 radar systems will be prepared.

In addition, display monitors are to be installed in the briefing rooms of the observatory at the Karachi, Islamabad, and Lahore International Airports as well as at the Lahore NFFB.

Table 2 - 7 shows the contents of the radar image displays at each site.

Table 2-7 Contents of Radar Image Display

	Site	Radar Image Display	Remarks
1. Karachi	Radar Site	Rahimyar Khan Southern composite image Northern composite image National composite image	Karachi radar image isdisplayed at a existing monitor.
	H.Q. Forecasting Room	Rahimyar Khan Southern composite image Northern composite image National composite image	Karachi radar image isdisplayed at a existing monitor.
	International Airport	Rahimyar Khan Southern composite image Northern composite image National composite image	Karachi radar image isdisplayed at a existing monitor.
2. Islamabad	Radar Site	Dera Ismail Khan Southern composite image Northern composite image National composite image	Islamabad rader image is displayed at a existing monitor.
	Forecasting Room	Dera Ismail Khan Southern composite image Northern composite image National composite image	Islamabad rader image is displayed at a existing monitor.
	International Airport	Islamabad Southern composite image Northern composite image National composite image	
3. Dera Ismail Khan	Radar Site	Dera Ismail Khan	
	Forecasting Room	Dera Ismail Khan	
4. Rahimyar Khan	Radar Site	Rahimyar Khan	
	Forecasting Room	Rahimyar Khan	
5. Lahore	NFFB	Islamabad Northern composite image National composite image	
	International Airport	Southern composite image Northern composite image National composite image	

3) Telecommunication System

The telecommunication system is intended to transmit radar imagery. A digital system will be used wherever possible, since this type will minimize the risk of deterioration in the quality of radar imageries. The standards of the digital radio links will conform to the recommendations of ITU-R and other International standards.

a. Transmission of radar imageries through the public telecommunications

Radar imageries will be transmitted via the existing optical fiber telecommunication network of the PTCL. However, optical fiber link is not yet available at D. I. Khan, for the present, data will be routed through Peshawar via analog microwave link.

- Links using the optical fiber network

(1) Rawalpindi telephone exchange ~ Karachi telephone exchange (Airport station)
(2) Rawalpindi telephone exchange ~ Lahore telephone exchange (Cantonment Station)
(3)Lahore telephone exchanges, Egerton road station ~ Cantonment station
(4) Karachi telephone exchange (Airport station) ~ Rahimyar Khan telephone exchange
(5) Rawalpindi telephone exchange ~ Peshawar telephone exchange

- Links using analog microwave

(1) D.I. Khan telephone exchange ~ Peshawar telephone exchange

b. New digital radio link.

Digital microwave radio equipment for radar imagery transmission is to be newly installed in 7 links in 5 areas.

(1) D. I. Khan radar site ~ D. I. Khan telephone exchange
(2) Rahimyar Khan radar site ~ Rahimyar Khan telephone exchange
(3) Karachi radar site ~ Karachi telephone exchange (Airport station)
(4) Islamabad radar site ~ Rawalpindi telephone exchange
(5) Rawalpindi telephone exchange ~ Aeronautical meteorological office at Islamabad International Airport

(6) Lahore NFFB ~ Lahore telephone exchange (Egerton road station)

(7) Lahore telephone exchange (Cantonment station) ~ Aeronautical meteorological office at Lahore International Airport

The major equipment required for each system are as follows.

Table2 - 8 Major Equipment List (1/3)

Equipment Designation	Specifications	Quantity	Purpose
(1) Weather Radar System (for D. I. Khan and Rahimyar Khan)			
Radome	Diameter: about 7m, Spherical shape , Maximum wind speed resistance: 70m/s Base ring, lighting arrester attached	1	To protect the radar antenna assembly and shelter maintenance personnel from severe weather conditions. A lightning arrester will be attached to the top of the radome for protection from lightning.
Antenna Assembly	Diameter about 4m Parabolic antenna Beam width: 1. 2° Gain: 42 dB or more	1	The parabolic antenna will rotate over an azimuth of 360° and at an angle of elevation of 0~45° in either direction. The waves transmitted from the transmitter/ receiver will be radiated in pencil-beam form into the atmosphere, receive the scattered waves returning from the precipitation particles, and return these waves back to the transmitter/receiver unit.
Antenna Control Unit	Dual-axis scan (rotation in azimuth) Horizontal scan : 360°, 4 rpm Vertical scan : 0 ~ 40°, about 15 seconds Angle precision (accuracy) :0. 3° or less	1	Based on an antenna control signal pursuant to the radar observation mode, this unit drives the horizontal and vertical antenna motors, controlling the azimuth and elevation of the antenna.
Transmitter / Receiver	Transmitting frequency:5250-5350MHz Transmitting power : 250 kW Pulse repetition frequency : 260 Hz Minimum detectable signal : 110 dBm or less Dynamic range : 70 dB or more	1	The microwave power emitted at the transmitter section is sent to the antenna as the transmitting wave, while a video signal is obtained in response to the strength of the receiver wave. After being converted to a digital value, the video signal is outputted to the signal processor (digital video integrator and processor).
Dehydrator	Normal pressure level : 195 hPa Upper level of pressure for wave guide : 295 hPa Lower level of pressure for wave gulde : 70 hPa	1	The wave guide, connecting the antenna and the transmitter receiver, is filled with drop and pressurized air so as to reduce and stabilize the wave propagation loss
Digital Video Integrator and Processor	Digital video input : 12 bits Ground clutter rejection : 40 dB or more Range correction : 4 ~ 175 Km Averaging over range / polar coordinate / address calculation on Cartesian coordinate (using range and azimuth angle on the polar) Input data: 8 bits, 400 km range	1	After converting the video signal from the receiver into a digital value, ground echo rejection, averaging of the received signal echo intensity correction for distance, and other processing is performed, yielding 8-bit video data, which is then inputted into the data transmission apparatus.

Table2 - 8 Major Equipment List (2/3)

Equipment Designation	Specifications	Quantity	Purpose
PPI Indicator (Radar control and monitoring display)	Color CRT: 20 " or over Maximum PPI display :600 x 600 km Maximum for other RHI displays : 200 x 20km Other superimposed display of map and range marks Automatic / manual observation controls	1	Based on the angular data for the antenna, after the video data are converted from a polar to a Cartesian coordinate, they are displayed freely over a certain range. In order to facilitate recognition of the echo position, the echo data are superimposed on the map and range marks. Scheduled observations for composing the data observed at each radar station are performed automatically, while other observations are done manually by the operator.
Power Distribution Board	Power input : AC 230 V, single-phrase, 50 Hz Power output : AC 200 V, single-phase, 50 Hz AC 100 V, single-phase, 50 Hz using a no-fuse break.	1	The commercial power will be outputted to the automated voltage regulator and the uninterrupted power supply unit so as to distribute a stabilized power supply from these units to the various equipment items in the radar assembly.
Automatic Voltage Regulator	Capacity : about 7.5 kVA Input : AC 230V ± 20%, single-phase, 50 Hz Output : AC 200V ± 3 %, single-phase, 50Hz	1	This item will be used to stabilize power supply voltage to insure stable operation of the radar assembly
Uninterrupted Power Supply	Capacity : about 3 kVA Input : AC 100V ± 10%, single phase, 50 Hz Output : AC 100V ± 2 %, single-phase, 50Hz Backup time: at least 10 minutes at full load	1	Short-term power backup will be provided to prevent operating errors or damage to the radar facilities as a consequence of brief interruptions in the commercial power supply.

Table2 - 8 Major Equipment List (3/3)

Equipment Designation	Specifications	Quantity	Purpose
(2) Communication Equipment (at Karachi and Islamabad)			
Data Converter	Digital sampling : 12 bits Distance intervals for digital sampling : 250 m equivalent Equal echo processing range: 4 ~ 256 km Address calculations on polar / Cartesian coordinates Output data : 8 bit, 400 km range	1	The digital video signals from the radar interface assembly are equal-echo processed for composing use, obtaining an 8-bit rain intensity level value. After conversion to a Cartesian coordinate for use in data t ransmission, the data are outputted to the data transmission equipment, in accordance with the sequence of scheduled observations
Data Monitoring Display	Color CRT, 20 " or over PPI indicator: to a maximum of 600 x 600 km; other super imposed displays of map and range marks Automatic observation capability Switchover capability to existing radar units (dual control) Built-in clock: based on GPS receiving units	1	After conversion of 8 bit video data from polar to Cartesian coordinates, based on the angular values for the existing antennas, displays are shown freely over the subject range. Scheduled observations are performed automatically to compose the data observed at each radar station. In order to realize the functions of existing data equipment, the equipment will have switchover capability between the scheduled observation mode and the application mode for the existing radar installations
Radar Interface Assembly	Digital sampling : 12 bits Distance intervals for digital sampling : 250 m equivalent Input / output : Monitoring control signals for existing radars Monitoring control signals for communication interface equipment Function : dual control switchover	1	After converting the video signals received from the existing transmitter/ receiver unit to digital values, they are outputted to the data converter. In order to be able to make automatic scheduled observations without impairing the functions of the existing radar units, the radar interface assembly will permit switchover to the observation interface signal and will also have signal
Power Distribution Board	Power input : AC 230V, single-phase, 50Hz Power output : AC 100V, single-phase, 50 Hz Using a no-fuse breaker	1	The commercial power supply is outputted to the uninterrupted power supply unit so as to distribute stabilized power from the latter unit to the various equipment items in the radar assembly.
Uninterrupted Power Supply	Capacity : about 2 kVA Input : AC 100V ± 10 %, single-phase, 50 Hz Output : AC 100V ± 2 %, single-phase, 50 Hz Backup time : at least 10 minutes at full load	1	Short-term power backup will be used to prevent operating errors or damage to the communication interface equipment as a consequence of interruptions in the commercial power supply.

Table2 - 9 Major Equipment List (1/5)

Equipment Designation	Specifications	Quantity	Purpose
(1) Weather Radar Composite Image Transmission System(at Karachi and Islamabad)			
Communication Control Unit	Serial port -- supporting Ethernet (rack-mount type) CPU performance: Pentium 160 MHz or more Hard disk -- 1G byte or more Memory -- 32 Mbyte or more Serial ports -- 6 or more Built in synchronous telecommunication board Pass Slot PCI x 2 ISA x 6	1	Composite data are received from the signal processor, with the image data distributed to various image display monitors. The image data, as processed by the composite processor, are received and sent on to the various image display monitors.
Composite Processor Unit	Serial port -supporting Ethernet (desk-top type) CPU performance : Pentium 133 MHz or more Hard disk -- 340 Mbyte or more Memory -- 16 Mbyte or more Serial ports -- 2 or more Parallel ports -- 1 or more SCSI - IF (built-in) SCSI control driver software	1	This unit will receive a number of radar images, as relayed from the communication control apparatus, and do composite processing of the received images. These image composites will then be sent on to the various image display monitors via the communication control unit.
Monitor Display	Serial port -- supporting Ethernet (desk top type) CPU performance : Pentium -- 100 MHz or more Hard disk -- 340 Mbyte or more Memory -- 16 Mbyte or more Serial ports -- 2 or more CRT display resolution : 1024 x 768 dot or more CPT size -- 17 " or larger --- with mouse and keyboard	2	This equipment will receive the observed image data or composite processed images and will superitmpose this data, along with map and range marks, for display. It will also accumulate, play back, and print the imagery received.
Color Printer	136 + columns / line printing speed at over 50 lines per minute. Print Colors : at least 7	3	For color printing of image data displayed on the image display monitors.
Modem (2400 bps)	Interface : RS 232 C Communication mode : full duplex / half duplex Transmission speed : 2400 bps Communication interface : leased line	1	To transmit radar imagery via multiplex radio to the image display monitors.
Modem (4800 bps)	Interface : RS 232 C Communication mode : full duplex / half duplex Transmission speed : 4800 bps Communication interface : leased line	1	For exchanging image data between Karachi and Islamabad.
Uninterrupted Power Supply	Capacity : 1kVA Input : AC 100 V ± 10 %, single-phase, 50 Hz Output : AC 100V ± 2 %, single-phase, 50 Hz Backup time : 5 minutes at full load	4	To protect computer equipment, fitted with a hard disk, from total blackout or short interruptions in the commercial power supply.

Table2 - 9 Major Equipment List (2/5)

Equipment Designation	Specifications	Quantity	Purpose
(2) Radar image Transmission and Display System (at D. I. Khan and Rahimyar Khan)			
Communication Control Unit	Serial port -- supporting Ethernet (desk -top type) CPU performance : Pentium 160 MHz or more Hard disk -- 500 Mbyte or more Memory -- 32 Mbyte or more Serial ports -- 3 or more Built-in synchronous telecommunication board Pass slots: PCI x 1 ISA x 3	1	Composite data are received from the signal processor, while image data are distributed to various image display monitors. In addition, the image data are transmitted to PMD's own radar stations in Karachi and Islamabad.
Monitor Display	Serial port -- supporting Ethernet CPU performance : Pentium 100 MHz or more Hard disk -- 340 Mbyte or more Memory -- 16 Mbyte or more Serial ports -- 2 or more Parallel ports-- 1 or more CRT display resolution: 1024 x 768 dots or more CRT size -- 17 or more	1	This equipment will receive the image data observed at each radar station or the composite processed imagery and will superimpose and display this data, together with the map displays and range marks. It will also accumulate, play back, and print the received imagery.
Color Printer	136 + columns / line printing speed at over 50 lines per minute. Print Colors : 7 or more	2	For color printing of image data displayed on the image display monitors.
Modem (2400 bps)	Interface : RS 232 C Communication mode : full duplex / half duplex Transmission speed : 2400 bps Communication interface : leased line	1	To transmit radar imagery via multiplex radio to the image display monitors.
Uninterrupted Power Supply	Capacity : 1kVA Input : AC 100 V ± 10 %, single-phase, 50 Hz Output : AC 100V ± 2 %, single-phase, 50 Hz Backup time : 5 minutes at full load	3	To protect computer equipment, fitted with a hard disk, from total blackout or short interruptions in the commercial power supply.

Table2 - 9 Major Equipment List (3/5)

Equipment Designation	Specifications	Quantity	Purpose
(3) Radar Image Transmission and Display System (at the Lahore NFFB)			
Communication Control Unit	Serial port -- supporting Ethernet (desk -top type) CPU performance : Pentium 160 MHz or more Hard disk -- 500 Mbyte or more Memory -- 32 Mbyte or more Serial ports -- 3 or more Built-in synchronous telecommunication board Pass slots: PCI x 1 ISA x 3	1	This equipment will receive radar image data and distribute this imagery to the various image display monitors.
Monitor Display	Serial port -- supporting Ethernet CPU performance : Pentium 100 MHz or more Hard disk -- 340 Mbyte or more Memory -- 16 Mbyte or more Serial ports -- 2 or more Parallel ports -- 1 or more CRT display resolution: 1024 x 768 dots or more CRT size -- 17 or more	1	This equipment will receive the image data observed at each radar station or the composite processed imagery and will superimpose and display this data, together with the map displays and range marks. It will also accumulate, play back, and print the received imagery.
Color printer	136 + columns / line printing speed at over 50 lines per minute. Print Colors : 7 or more	2	For color printing of image data displayed on the image display monitors.
Modem (2400 bps)	Interface : RS 232 C Communication mode : full duplex / half duplex Transmission speed : 2400 bps Communication interface : leased line	1	To transmit radar imagery via multiplex radio to the image display monitors.
Uninterrupted Power Supply	Capacity : 1kVA Input : AC 100 V ± 10 %, single-phase, 50 Hz Output : AC 100V ± 2 %, single-phase, 50 Hz Backup time : 5 minutes at full load	3	To protect computer equipment, fitted with a hard disk, from total blackout or short interruptions in the commercial power supply.

Table2 - 9 Major Equipment List (4/5)

Equipment Designation	Specifications	Quantity	Purpose
(4) Radar Image Display System (for the Islamabad, Karachi, and Lahore International Airports)			
Monitor Display	Serial port -- supporting Ethernet CPU performance : Pentium 100 MHz or more Hard disk -- 340 Mbyte or more Memory -- 16 Mbyte or more Serial ports -- 2 or more Parallel ports -- 1 or more CRT display resolution: 1024 x 768 dots or more	1	This equipment will receive the image data observed at each radar station or the composite processed imagery and will superimpose and display this data, together with the map displays and range marks. It will also accumulate, play back, and print the received imagery.
Color Printer	136 + columns / line printing speed at over 50 lines per minute. Print Colors : 7 or more	2	For color printing of image data displayed on the image display monitors.
Modem (2400 bps)	Interface : RS 232 C Communication mode : full duplex / half duplex Transmission speed : 2400 bps Communication interface : leased line	1	To transmit radar imagery via multiplex radio to the image display monitors.
Uninterrupted Power Supply	Capacity : 1kVA Input : AC 100 V ± 10 %, single-phase, 50 Hz Output : AC 100V ± 2 %, single-phase, 50 Hz Backup time : 5 minutes at full load	1	To protect computer equipment, fitted with a hard disk, from total blackout or short interruptions in the commercial power supply.

Table2 - 9 Major Equipment List (5/5)

Equipment Designation	Specifications	Quantity	Purpose
(5) Software for the Radar Image Composite Transmission System			
Software for the communications control unit	To achieve the following capabilities relating to the transmission control of radar image composites: 1.Data receipt from radars 2.Data distribution to display monitors 3.Connection with the composite processing unit 4.Block transmission control 5.Image data compression function 6.Error check code (as a supplementary function) 7.Synchronous telecommunication	1	This apparatus will send and receive radar imagery and relay-process these images.
Software for composite processing	To achieve the following capabilities regarding the transmission control of radar image composites: 1. Input / output of radar data 2. Identifying and recognizing radar data 3. Coordinates conversion 4. Image composite processing 5. Composite data entry 6. Mapping process	1	Radar data from the various stations are received via the communications control apparatus and then composite processed. The composite- processed data are distributed, again via the communications control apparatus, to the image display monitors installed in the forecasting rooms and at airport weather stations.
Software for image display	To achieve the following capabilities relation to the transmission control of radar image composites: 1. Receipt of radar images (including a requirement for error check and retransmitting functions) 2. Automatic updating of latest radar images 3. Preserving image data 4. Radar image playback 5. Point display of latitude and longitude 6. Color printing of images	1	To execute the various functions as prescribed in the specifications in accordance with operator skills.

Table 2 - 10 Major Equipment List (1/1)

Equipment Designation	Specifications	Quantity	Purpose
(1) Communication System			
1) Microwave Multiplex Radio Equipment			
Multiplex Radio Equipment	Frequency range : 2 GHz band Line capacity : 2 Mbps Transmitting power (output) : 1W	14	To link up the weather radar stations with neighboring PTCL exchanges for transmitting weather radar data and telephone and facsimile signals.
Antenna	Grid parabolic antenna Frequency range : 2 GHz band Standing Wave Ratio : less than 1.2	14	The antenna will used for directing modem signals from the multiplex radio equipment to the counterpart exchange, while adjusting transmission and receiving with space. The antenna diameter is estimated at 1.2 ~ 1.8 m.
Feeder	Insertion loss : 8.5 dB or less per 100 m (at 2.4 GHz) Standing Wave Ratio : less than 1.2	14	These lines will be used for transmitting high-frequency signals between the indoor multiplex radio equipment and the antenna. The diameter of the external conductor is estimated at 22.2 mm (7 / 8 ").
Coaxial Arresters	Insertion loss : 0.1 dB Standing Wave Ratio : less than 1.2	14	This arrester will excite the external antenna and distribution lines, thereby reducing the lightning surge arriving at the indoor cables.
2) Multiplex Carrier Teminal Equipment	Power input and output capacity for at least 4 transmission lines in 1st group (equivalent to 30 CH converted at 64 kb/s) Digital interface (64 kb / s) Digital interface (V. 24) 4W analog interface	13 26	This equipment will convert the data and audio signals to PCM symbols and multiplex them to 2,048 Mb / s.
3) Telephone Receivers	To be equipped with a switchover between push-button and pulse-dial operation	26	For office communication use.
4) Facsimile	G - III	13	For transmitting meteorological information
5) DC Power Supply Storage battery: Isolation transformer:	30 A 130 AH (170 AH only for the Rawalpindi station) 5 kV	13	The UPS is intended as a backup during blackouts of the commercial power supply. At normal times, it will furnish DC power to the load at the rectifier while also recharging the battery. During power blackouts, power will be supplied to the load from the stored battery. The isolation transformer will prevent movement of the induced lightning surge to the communication equipment, thereby preventing accidental interference with this equipment.

2. Basic Facility Plan

1) Site Layout Plan

In a weather radar facility, when radar observers and forecasters work at the display monitors and radar operating consoles, they typically face north, since this direction is considered optimum in terms of operating efficiency and directional sense. This direction clearly facilitates the efficient conduct of radar operations, since the screen surface on which radar images are displayed on monitors and consoles is oriented to the north, which coincides with the facing direction preferred by operators and forecasters. Accordingly, the layout plans for the two radar tower buildings will have the backs of the radar display monitors and operating consoles facing north.

- Dera Ismail Khan Site

As already noted, D. I. Khan site is located in the premises of the PMD's D. I. Khan Observatory. The site is virtually flat and sufficiently large to accommodate a radar tower building construction. And, since the land slopes gently toward the north, the site has been located in the southern portion of the observatory premises. While the existing facilities in this area are not particularly high, the trees on the property stand 14~15 m tall, making it essential that the radar tower building clear the tops of these trees. Regarding the site infrastructure, power supply and telephone line are available, however, there is no water supply facility, so that the existing facility must presently rely on well water. For this reason, after completion of the building construction, a well for the building construction work will be used as water supply facility for obtaining water for the radar tower building.

- Rahimyar Khan site

Rahimyar Khan site is located in the premises of Rahimyar Khan domestic airport, owned by the Civil Aviation Authority (CAA). Scrutinizing must, therefore, be given to insuring compatibility between a radar tower building and the existing facilities of the airport, as well as those presently under construction, with particular reference to the airport facilities, control tower, internal airport communication and radio facilities, underground lines, and airport traffic patterns. The site is virtually flat and of sufficient size to accommodate the construction of a radar tower building. A terminal building and control tower are presently being built at this airport, with completion planned during 1997.

The terminal and tower will be close to the Project site, with construction also planned for a water distribution tower and power intake facilities. Thus, when this Project under Japan's Grant Aid Assistance and the project for improvement of Rahimyar Khan airport are completed, the weather radar facility will have the grave responsibility of insuring that its operations do not in any way prejudice the safety of the airport and the surrounding area.

Upon completion of the airport improvement, all basic utilities such as telephone, power, and water will be able to be provided by the airport facility. In addition, due to convenient location of the Project site form the airport terminal building, it will be possible for the radar station to provide pilot weather briefings and information. The Project site is, therefore, extremely well placed to maximize the benefits to be derived from the Project.

2) Architectural Design

a. Floor Plan

The floor plan will be virtually symmetrical, making possible a structural design that is safe and avoids eccentricity. The floor plan for the central portion of the tower building will allow the various rooms to be arranged more flexibility, since all structures such as columns and beams will not protrude into the each room and the internal staircase, which are also to serve as evacuation routes. Construction methods and materials have been employed in common local use and the buildings will be of standard grade in Pakistan.

The following table summarizes the floor areas and planned occupancy of the various rooms incorporated in the radar tower building, along with the bases for these area calculations and a comparison with the existing buildings.

- Outline of the Room and Equipment Layout for the Radar Tower Buildings

Name of Room	Floor Area (m^2)	No. of staff	Equipment and room function
Rooftop	84.60	--	Telecom & radar antenna, radome to be installed
Radar equipment room	31.50	Daytime:4 Night:3	2 AC (15,000 Kcal), radar transmitter/receiver, AVR, UPS, signal processing equipment
Radar observation room	31.50	--	2 AC (15,000 Kcal), radar operating console & display monitor, telecommunication equipment, UPS
Analysis room	20.25	3	Analysis of radar echo sketches for areas unable to receive radar data on-line, preparation of telegraphic messages
Data room	11.25	--	For analyzed data and floppy disk & MO strage
Maintenance room	20.25	--	For storage of spare parts, measuring equipment, and maintenance tools, space for repairing work
Storage	11.25	--	For storage of oil, grease, other expendables, cleaning gear and spare parts for the building
Electrical room	9.74	--	Main power board, distribution board and cable racks
Generator room	31.82	--	Standby generator, peripheral devices, and service tank
Weather forecasting room (D.I.Khan) Weather forecasting & pilot briefing room (Rahimyar Khan)	31.82	Daytime:3 Night:2	Radar imagery display monitor, weather charts drawing desk Space for meteorological services and briefings for pilots
Pump room	14.16	--	Water-intake tank, pumps and inspection space
Tea kitchen	7.50	1~2	Water heater, kitchen facilities, cupboard
Common area	96.33		
TOTAL	**314.37**		

- Calculating Bases for Determining Room Area and Comparisons with Existing Buildings

Room Name	Room Area (m^2)	Calculation Bases for Room Area	Existing Buildings K: Karachi Is: Islamabad
Roofs	84.6	For installation of radar antenna, radom and maintenance, approximately 84 m^2 will be required.	K:83.0 Is:83.0
Radar Observation room	31.5	Space for installation of radar systems and working space (7~8m^2/person ×4 persons≒30 m^2).	K:32.0 Is:32.0
Radar equipment room	31.5	Installation space for radar systems and working space (7~8m^2/person ×4 persons≒30 m^2).	K:32.0 Is:32.0
Analysis room	20.25	Working space (6~7m^2/person ×3 persons≒20 m^2).	K:20.7 Is:20.7
Data room	11.25	Storage space for meteorological observation data for 10 years.	K:11.3 Is:11.3
Maintenance room	20. 25	Storage space for spare parts, special tools, etc. : 10 m^2 Mechanical repairing space : 10 m^2 for 2 persons	K:32.0 Is:34.1
Storage room	11.25	Storage space for spare parts for radar tower building, cleaning things, oil, etc.≒11 m^2	K:15.0 Is:15.0
Electricity room	9.74	Installation space for power distribution boards, cable racks, etc.	K:12.4 Is:12.4
Generator room	31.82	Installation space for engine generator, day tank and automatic switch board.	K:34.1 Is:34.1
Weather forecasting and briefing room	31.82	Installation space for forecasting equipment. Working space : 6~7m^2/person ×3 persons (day time)	——
Pump room	14.16	Installation and maintenance space for pumps, switches, and FRP water tank (0.5 m^3).	K:14.4 Is:14.4
Tea kitchen	7.5	Space for kitchen sink and shelf and preparation of drinks	——

b) Sectional Plan:

(1) Hight of Tower Buildings and Floors

- Dera Ismail Khan Site

Adjoining D. I. Khan site, there is a 13.5 m high overhead water tank tower, the exisiting synopic observatory building and along with very tall trees reaching a height of 14~15 m. The height of a radar tower building to be constructed, therefore, must be sufficient to clear the tops of those trees.

- Rahimyar Khan Site

At the present time, a terminal building and air control tower building are under construction at the Rahimyar Khan Airport premises, while construction is also planned for a overhead water tank tower and power distribution facility (generator shed) adjacent to the proposed site. The control tower building and overhead water tank tower are both expected to have heights of about 13 m, with an antenna and other air traffic control equipment to be installed on the roof of control tower building. The weather radar tower building, accordingly, will have to be given at least 15 m high to clear these other structures.

Based just on the above considerations, the radar towers building at both proposed sites must be at least 15 m tall. However, in consideration of the establishing a meteorological telecommunication network as well as keeping appropriate quality of the telecommunication link that must be maintained therein, an extra clearance of about 1 m will be required. On this basis, the total height of each tower building, from the ground level to the top floor slab, must be approximately 16 m.

Regarding calculation of standard height between structural slabs, taking into consideration on proper height and dimensions of each equipment of radar system, wiring and cabling space behind the ceiling, etc., the radar equipment room and observation room should be 3.5 m. This height, therefore, has been made the standard height for the upper floors of the building.

The rooms located on ground floor will be given a slab height of 4.0 m. Considering protection from high temperature and humidity for radar imagery display system to be installed at the forecasting room and heat occurrence at the generator room, high

ceilings will be desirable. Finally, considering heavy rainfall and potential flood damage, the height from the ground level to ground floor slabs has been set at 60 cm.

Based on the above, the radar tower building will be a 4 story building including the middle ground floor, with the height from ground level to roofing slabs set at G.L+16.1m.

(2) Number of Floors:

In order to accommodate the required rooms, the ground floor slab height has been set at 5.0 m, including the middle ground floor. Maintenance and storage rooms will be located on he middle ground floor.

By avoiding, to the utmost, the cost escalation associated with enlarging floor areas, construction costs can be held at an economical level. Thus, each of the radar tower building is designed as 4-story building, incorporating the middle ground floor.

(3) Ceilings

In the radar equipment and observation rooms, the equipment must be protected against dust collecting above the cable rack. In addition, so as to improve the airtightness of these rooms as well as to reduce the equipment noise, the ceilings will be finished with acoustical boards. And, since both of these rooms are to be air-conditioned, the use of ceiling boards will be also be effective in terms of raising the efficiency of both cooling and heating operations. Ceiling height has, accordingly, been set at about 2.7 m, based on the dimensions of the intended equipment.

(4) Radome and Radar Equipment Room

Foundation of radome and radar antenna will be made a part of the roof floor slabs, so that the weight of the radar antenna will be borne by the beam located at mid-portion of the roof slab.
For access to inside of the radome and the exterior rooftop, traps and roof hatches will be provided at the radar equipment room.

(5) Equipment Installation Method

In order to install all the equipment directly from outside into the radar equipment and observation rooms, a large opening is necessary for bringing the equipment form outside. However, the large opening would be undesirable from the standpoint of airtightness and dust proofing. The equipment will, therefore, be brought in via an unloading balcony at the adjacent staircase landing. For lifting the equipment, 2-tons lifting hook will set at the upper part of this balcony

c) Elevation Plan

The columns and beans will protrude to the outside, with an appealing elevation plan that enhances the structural design. In this way, since columns and beams will not protrude into the interior rooms or staircase, the equipment and furniture can be deployed freely, while staircase will be able to comfortably handle traffic in both directions.

d) Material Plan

Materials specified for both exterior and interior finishing are all available locally. They have been selected with a view to ease of maintenance.

Exterior	
Roofs	Waterproof mortar t=30mm, Asphalt waterproofing, Insulation boards t=30mm, Protection concrete and Cement tiles
Exterior walls	Burnt clay bricks Cement sand mortar base t=20mm Colored cement spray finish Skirtings : Concrete base, cement sand mortar t=20mm
Interior	
Floors	Marble tile Epoxy resin paint (dust-proof) Vinyl tile
Walls	Cement sand mortar Vinyl & Emulsion paint 100 glazed ceramic tiles
Ceilings	Plaster, Emulsion paint Acoustic mineral board (suspended ceiling system)
Windows and Doors	
Exterior	Aluminum
Interior	Wooden

In consideration of maintenance by PMD for radar tower buildings, all the necessary materials for construction of the buildings will locally procured in accordance with the following reasons.

External Finish

Roofs : Due to external temperatures are high, reaching 50° C, insulation boards t=30 mm are required.
Asphalt waterproofing is the most reliable waterproofing material which will be protected by protection concrete, mortar and cement tiles.

Exterior walls : Walls of the ground floor will use burnt clay bricks and other walls will apply cement sand mortar and colored cement splay finish on structural bricks. All materials are generally used locally, they are considered highly reliable in terms of both construction ease and accuracy .

Interior Finish

Floors : Materials have been selected on the basis of superior durability and ease of maintenance.
Marble tiles around the entrance hall and vinyl tiles in the other rooms have been selected. In rooms where dust must be avoided, a dust-proof paint finish has been specified.

Walls : Mortar (trowel-coated) has been chosen primarily for its durability. Vinyl paint will be applied to walls of 1.8 m high form floor level and emulsion paint will be used for higher wall surfaces (i.e, above 1.8 m). 100 square glazed ceramic tiles will be laid in the rest rooms (1.5 m high form floor level).

Ceilings : In order to enhance the environment in rooms, acoustic mineral boards will be used and other rooms which will not require any ceiling board will be directly applied plaster and emulsion paint finish.

Windows and Doors

Exterior : Aluminum has been chosen throughout for reasons of durability, ease of handling, and accuracy and also easy local procurement.

Interior : Wooden with synthetic oil resin paint will be employed throughout for its handling ease during construction and from a maintenance standpoint.

3) Structural Design

a) Structural Design Standards

Constructions codes in Pakistan have been determined in conformity with U.K. standards (BS), but independent structural standards have not yet been completed. Also, Pakistan is an earthquake-prone country, forming part of the Eurasian seismic belt, since British standards do not specifically address seismic considerations, it is recommended that calculations of seismic force be based particularly on U.S design standards, as contained in the UBC (United Building Code, 1982). Accordingly, with respect to seismic force, the structural design for the radar tower buildings will adopt these UBC standards, in the case of wind pressure and seismic force, exterior force will be determined on the basis of actual records. Moreover, reference has been made, as required, to the Japanese Construction Code as well as the standards of the Architectural Institute of Japan (AIJ).

b) Structural Type

Reinforced concrete has been nominated as structural type for the radar tower buildings because, locally reinforced concrete is most typical structural type in Pakistan. The floor slabs are to be reinforced concrete while exterior walls and partition walls are to be burnt clay bricks (with a thickness of 226 mm).

c) Foundations

Based on geological surveys at the proposed sites in D. I. Khan and Rahimyar Khan, direct foundations have been specified, with the foundation layer just beneath the surface deemed to be silt down to a depth of 3 m.

d) Structural design standards

a. Stress calculations :

Calculated based on an elasticity analysis

b. Section design

The reinforced concrete structural design has been based on the calculation standards for this material established by the Architects Institute of Japan (AIJ), applying the elasticity design method.

e) Design loads and external pressure

a. Dead load

Dead load calculation will include all of the structural and finishing materials. The estimated combined weight of the radome and radar antenna, which are to be mounted on the roof of the radar tower building as a special dead load, is approximately 3 tons.

b. Live loads

Since virtually all the rooms in the radar tower building will have a storage function, either as equipment room or store room, live loads, with the exception of live loads of the roof, will all be uniform. These loads, which are deemed to be identical to those for telecommunication equipment rooms in Japan, have been applied as follows.

Floor slab and small beams	:	500 kg / m^2
Other structure	:	400 kg / m^2
Foe seismic	:	300 kg / m^2

In estimating loads of the roof, an allowance has been made for the moving weight of the maintenance workers servicing the radar radome. Based on the Building Standard Law of Japan, the above values have been reduced to 180, 130, and 60 kg / m^2, respectively for these roof surfaces.

c. Wind load

The maximum wind velocity recorded over the past 27 years at the D. I. Khan PMD meteorological station is approximately 20 m/s, with that at Rahimyar Khan (based on data of the Khanpur PMD meteorological station) at 14 m/s. Accordingly, the maximum wind velocity of 20 m/s at D. I. Khan will be used as the design wind velocity for the design of the radar tower buildings, including consideration of safety factor.

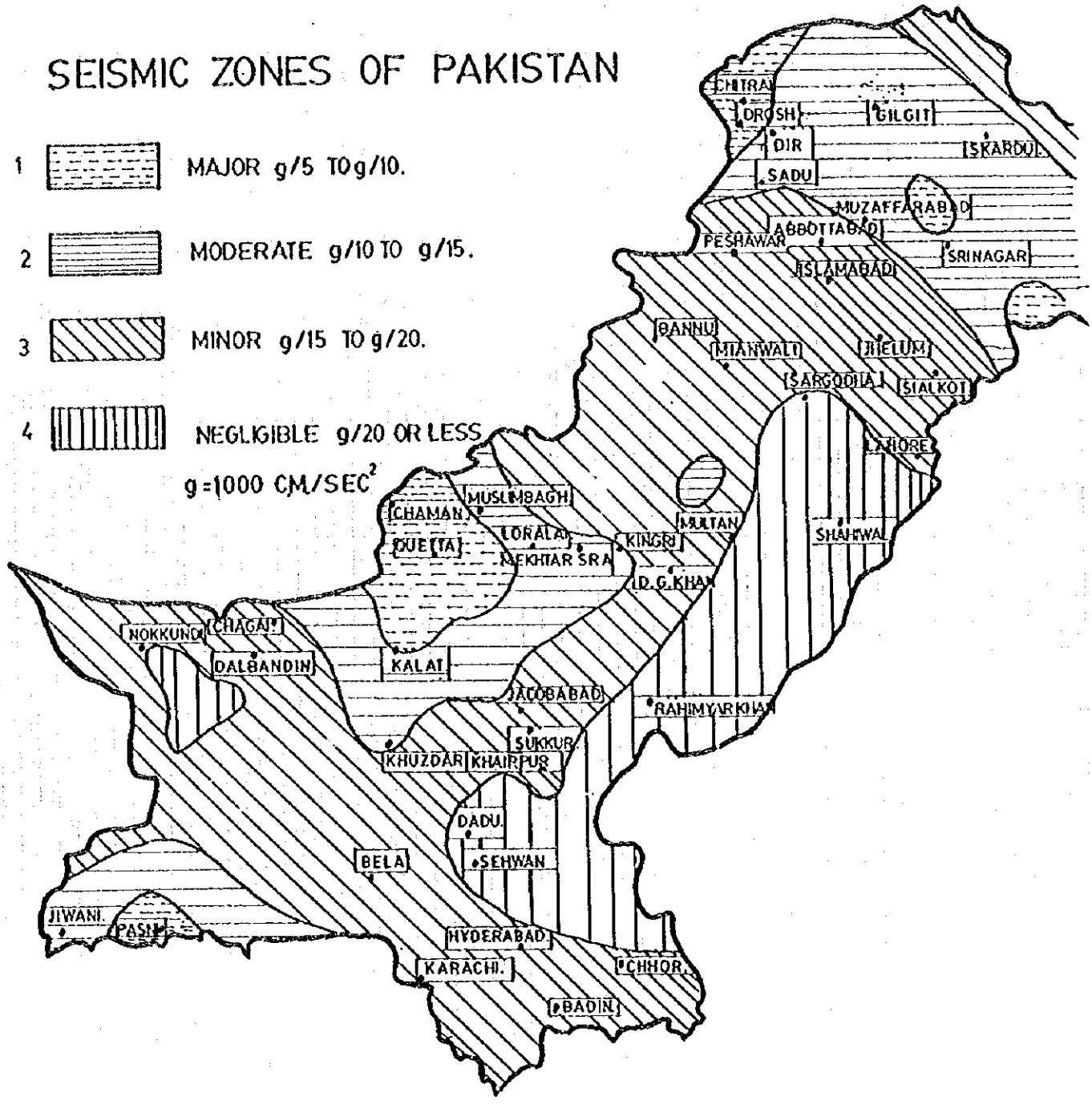
d. Seismic force

Seismic force calculations have been based on American UBC design standards. A chart of the seismic zones of Pakistan is attached hereinafter as Figure 2-6. D. I. Khan belongs to the

"Minor Zone", with a seismic acceleration factor of g / 15 ~ g / 20, while Rahimyar Khan is located in "Negligible Zone", with an acceleration value of g / 20, or g = 1,000 cm / sec^2.

Therefore, D. I. Khan and Rahimyar Khan, both areas have applied the same regional factors, using a Zonal Factor of Z = 1 as the seismic force calculation standard and a standard shear modulus of Co = 0.05.

Fig. 2-6



e. Soil bearing capacity

The site geology at both D.I. Khan and Rahimyar Khan is clayish silt, with low sand content. Since the results of the boring tests in the proposed sites, rafter foundation is not sufficient for the radar tower buildings, however, in case of applying spread footing foundation for the buildings, the soil bearing capacity at D. I. Khan and at Rahimyar Khan can be expected 20 tons/m^2. This soil bearing capacity together with appropriate consideration of safety factor has been employed as the soil bearing capacities for the basic design and the building foundation has been set at 3 m depth from the ground level.

Due to the results of the boring tests at Rahimyar Khan, there is a very weak soil layer between depth of 3 ~ 5 m form the ground level. Therefore, a change of this unsuitable soil layer which is a thickness of 2 m with transported stiff soil will be required, before commencement of construction of the building foundation.

f. Structural materials and strength

• Concrete

Ordinary concrete will be used, with a design strength of c = 210 kg /cm^2 (with a 28-day compression strength).

• Reinforced concrete

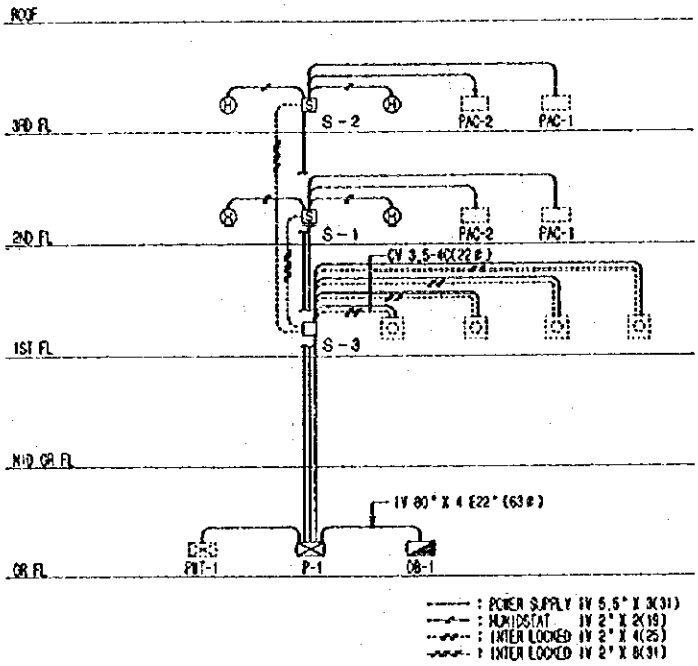
Reinforcing bars	Standard	Yield strength (MPa)
Deformed bars	Grade 235	235 MPa
	Grade 275	275 MPa

4) Electrical Facilities Design

a) Power intake facility

Power intake up to the project site including wiring and power connection to a low-voltage switch board are major scop of works to be taken by the government of Pakistan on his responsibility. In connection with the 400V and 50Hz low-voltage facilities, a hand-hole will be installed at the site, with an FEP 150 mm underground pipe to be laid from this hand-hole to the low-voltage switchboard on the ground floor of the radar tower building.

The required power will be 2 circuit, 3-phase, 4-line, 50 Hz.



POWER WIRING DIAGRAM

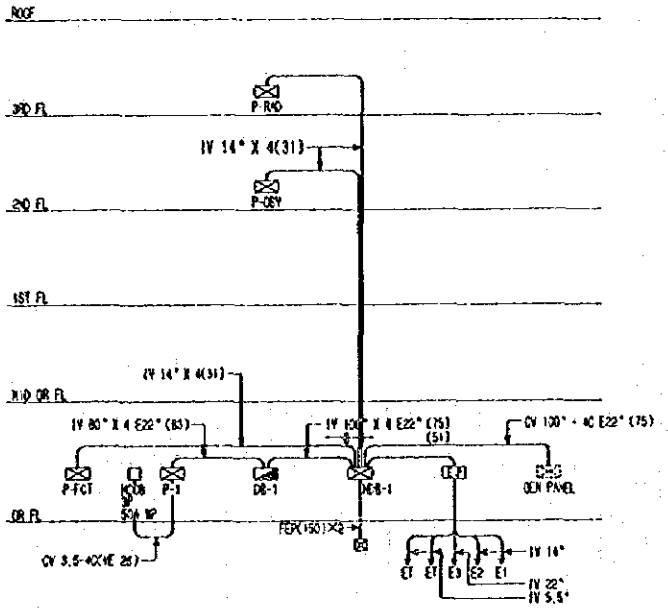
b) Generating facility

To insure uninterrupted operation of the weather radar systems, an engine generator will be installed at each site, as follows, as a back-up power source during the commercial power supply failure.

Capacity : 60 KVA
Voltage : 3 PH 4 W, 400 V and 50 Hz

c) Trunk line and power facility

Both the exterior and underground pipes will be of polyethylene pipes against saline rot. Inside the buildings, steel piping will be employed. Air conditioning units will be individually controlled, while ceiling and ventilating fans will be manually operated.



POEWR FEEDER DIAGRAM

d) Lighting and wall sockets

Wining work will conform to the Pakistan technical standards for electrical facilities as well as British Standard and using voltage will be single-phase 230V, with all the equipment to be grounded. Steel pipes will be specified, as generally used in Pakistan. Lighting fixtures will be mainly fluorescent, for their low power consumption, though incandescent fixtures will also be used to some extent, depending on the particular application. Obstruction lighting system for aviation will be placed on the roof of radar tower building.

The illuminance standard in the various rooms will be approximately as shown below.

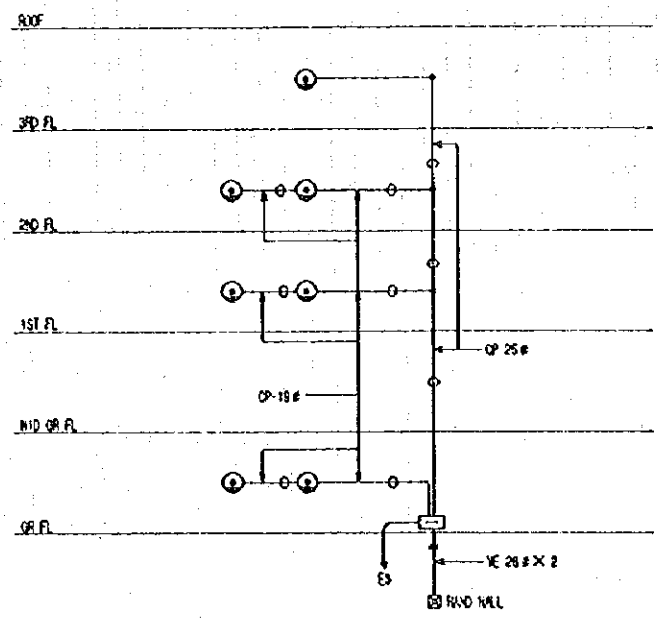
Radar equipment room:		400 lx
Observation room	:	400 lx
Data room	:	350 lx
Analysis room	:	350 lx
Forecasting room	:	400 lx

Generator room	:	250 lx
Pump room	:	300 lx
Electricity room	:	250 lx
Maintenance room	:	350 lx
Other rooms	:	200 lx

General-purpose sockets will be equipped with switches, with a 2-pronged socket to be placed at 8 m ~ 10 m intervals and also a separate socket will be provided for the wall ventilating fan.

e) Hollow pipes instllation for telephone lines:

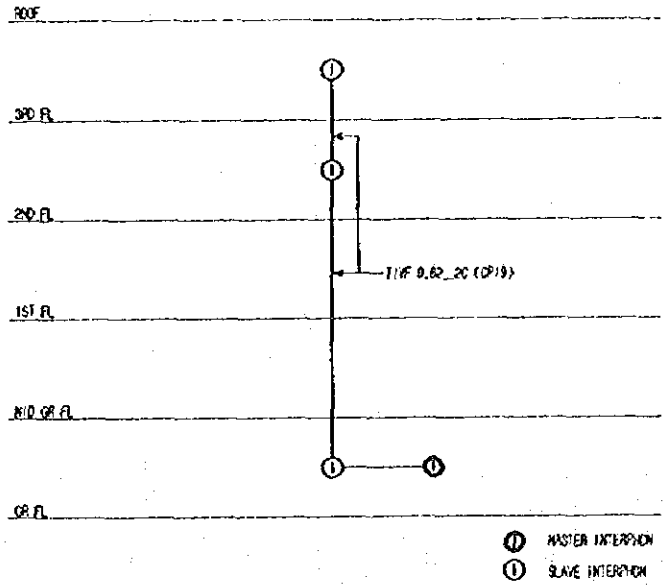
Hollow vinyl piping, with a diameter of at least 28 mm$^{\phi}$, will be installed from the hand-hole to be provided in the project site to the terminal board installed at the building. Hollow steel pipes will be laid between the terminal board and the various telephone outlets, with lead wires to be installed in the pipes. The wirings and related works will be performed by PTCL, with costs to be borne by the government of Pakistan.



TELEPHON DIAGRAM

f) Interphone equipment

Interphone equipment will be installed at the ground floor, outside entrance and in the various meteorological operating rooms (radar equipment, observation and forecasting rooms) as a security measure to permit night personnel to screen visitors.

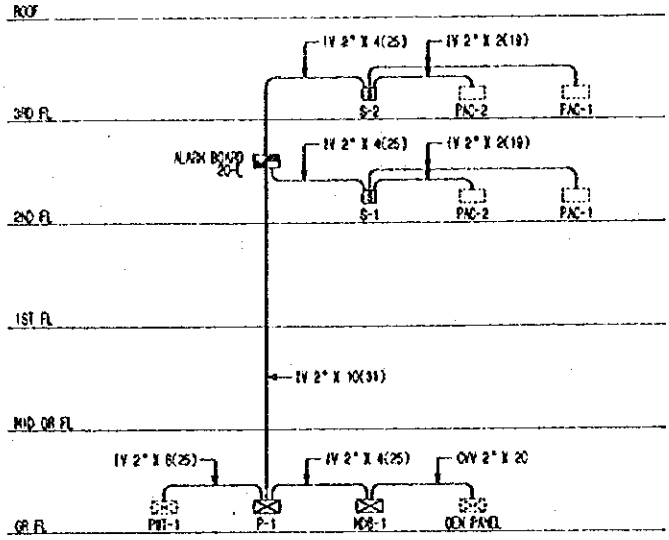


INTERPHON DIAGRAM

g) Alarm facilities

Alarms will be equiped with 20 terminals, the following warnings of the building equipment will be indicated.

No. 1 System failure and overheating of air-conditioning units.
No. 2 System failure and overheating of an engine generator facilities.
No.3 System failure and overheating of the low voltage switch boards.
No.4 Tank water levels at full, low and empty.



ALARM SYSTEM DIAGRAM

h) Grounding facilities

Grounding facility terminals for the equipment will be installed on the 2nd and 3rd floors. A PVC grounding wire of at least 5.5 sq. will be connected to the terminal board located on the ground floor.

The equipment in the electricity room will be grounded via the terminal board, while the telephone equipment will be grounded by erecting a grounding pole and running a wire from there to the terminal board.

i) Lightning rod facilities

A connection box will be placed on the roof. Inside the building, copper wire 2.6mm$^{\phi}$ × 17 will be laid in a vinyl pipe VE 28mm$^{\phi}$ and grounded via the test terminal board. The connection from the lighting rod on top of the radom to the grounding box on the roof will be portion of the equipment installation work.

5) Water Supply, Drainage and Sanitary Fixture Design

a) Water supply system

Water intake into the site will be via a water meter. The Pakistan government will be responsible for the intake works up to the 3/4" gate valve inside the project site. The water will be raised via a 3/4" water pipe to a FRP water tank located at pump room. The water will then be distributed by the pressure feed system.

b) Drainage system

Drainage will be divided into 2 systems as sewage and miscellaneous drainage. Rainwater drainage work will be included in the portion of building construction work. Sewage will be treated in a septic tank and then permeated in a permeation tank. Miscellaneous drainage will be fed directly into a permeation tank.

c) Sanitary fixtures

Toilet seats, washbasins, and other types of sanitary fixtures will be installed where required.

d) Fire-fighting equipment will be installed as required

6) Air-conditioning and Ventilation Facility Design

Large size of air-conditioners will be installed in the radar equipment and radar observation rooms. Air-conditioning system will also be provided in the forecasting rooms in which a radar display monitor will be installed.

a) Environmental conditions

- Exterior condition

  Hot season 50 °C D.B MAX

- Interior condition

  Hot season 25 °C D.B 50% R.H.

b) Air-conditioning equipment

The air conditioning equipment to be installed in the radar tower building will be package systems. They can be separately controlled due to the interest of energy conservation and from the standpoint of their intended use. The outside units for the air-conditioning systems will be installed on the roof of the building.

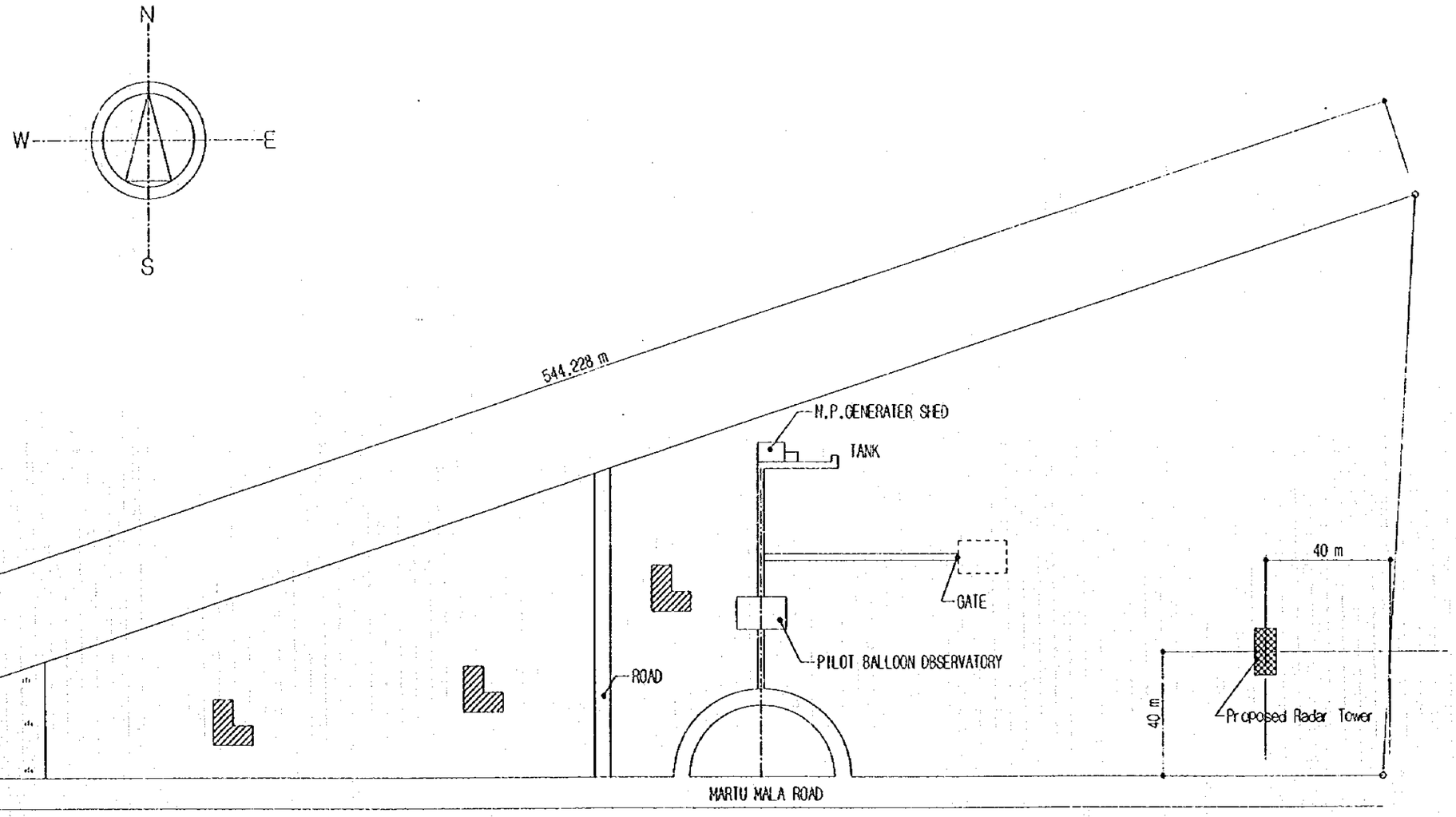
c) Ventilating equipment

Ceiling fans providing forced ventilation will be installed in tea-kitchen, lavatory and other rooms emitting offensive odors. Ventilation systems will also be installed in other rooms where it is deemed necessary to maintain an appropriate environment.

d) Basic Design Drawing

The basic design drawings are as follows.

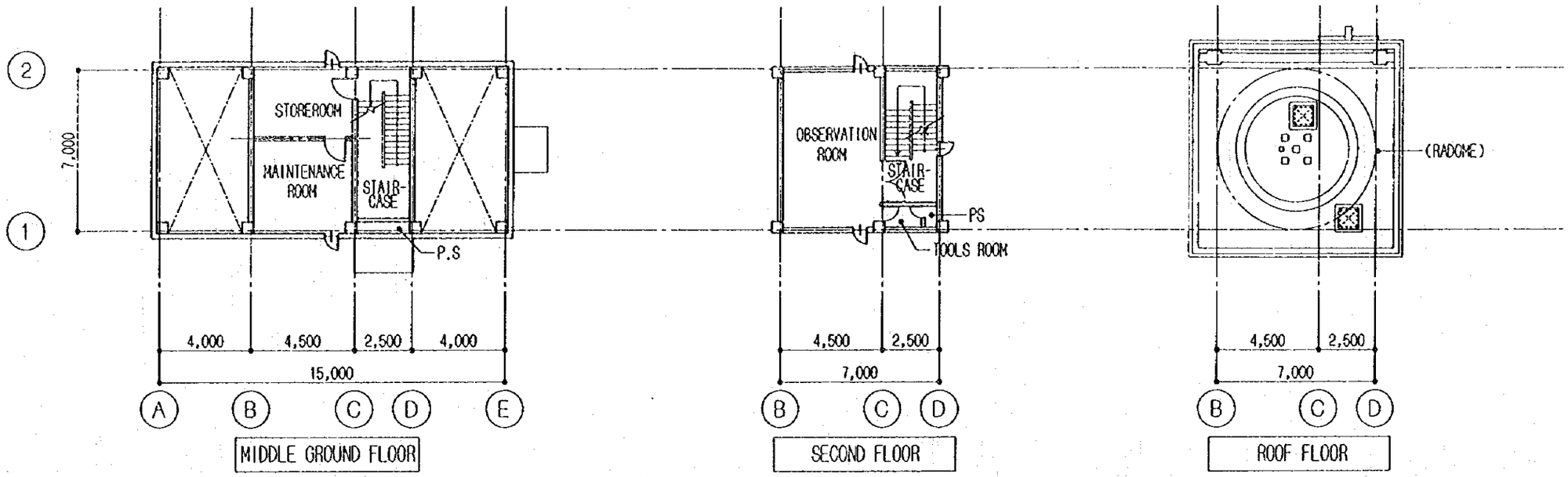
D.I.Khan	
SITE LAYOUT PLAN	A-01
FLOOR PLAN	A-02
ELEVATION AND SECTION	A-03
EQUIPMENT LAYOUT PLAN	A-04
Rahimyar Khan	
SITE LAYOUT PLAN	A-05
FLOOR PLAN	A-06
ELEVATION AND SECTION	A-07
EQUIPMENT LAYOUT PLAN	A-08
Karachi (Existing)	
EQUIPMENT LAYOUT PLAN	A-09
Islamabad (Existing)	
EQUIPMENT LAYOUT PLAN	A-10

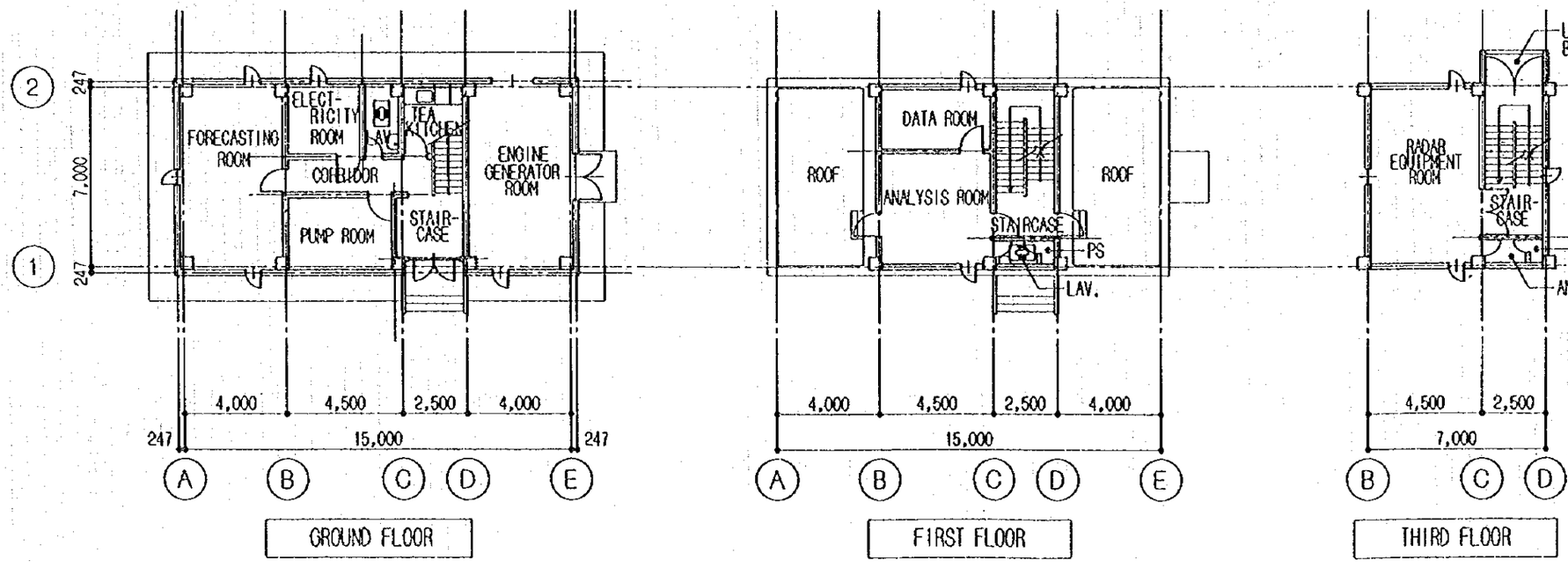


SITE LAYOUT PLAN

Japan Weather Association
International Affairs Dept. : Sunshine 60 Bldg., 55F, 3-1-1, Higashi Ikebukuro, Toshima-ku, Tokyo, 170 Japan
Tel. +81-3-5958-8161 Fax.+81-3-5958-8162 E-mail kokusai@jwa.go.jp

PROJECT:	DRAWING TITLE:	SCALE:	DRAWING No.
D.I.KHAN RADAR TOWER	SITE LAYOUT PLAN	1:1500	A-01





FLOOR		
G	15.454 X 7.454	115.194
MG	7.000 X 7.454	52.178
1	7.000 X 7.000	49.000
2	7.000 X 7.000	49.000
3	7.000 X 7.000	49.000
	TOTAL	314.372

JWA
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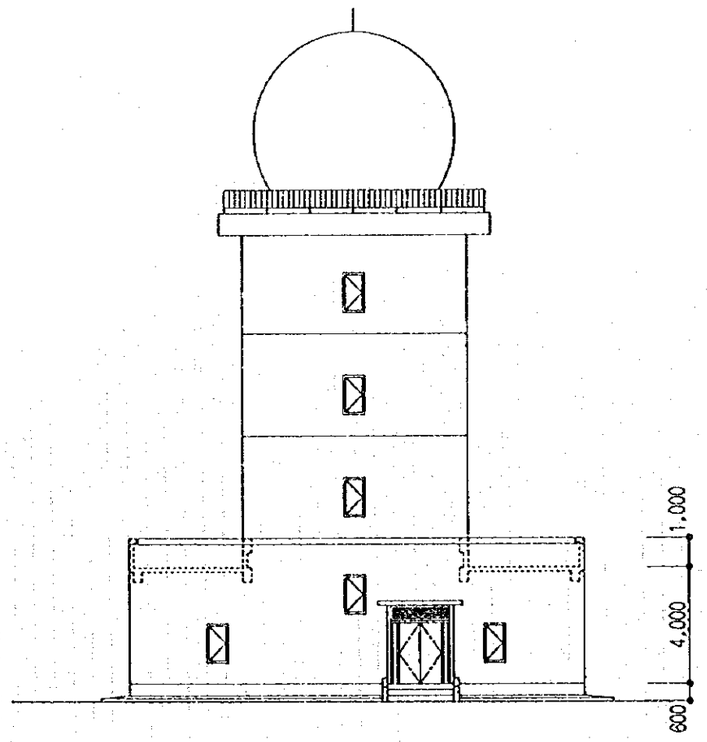
PROJECT: D.I.KHAN RADAR TOWER

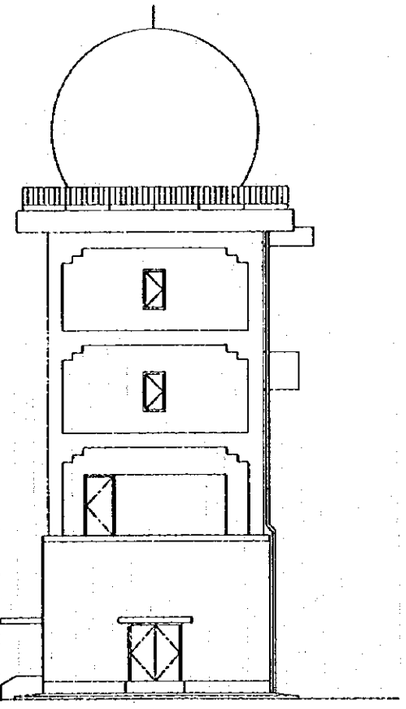
DRAWING TITLE: FLOOR PLAN

SCALE: 1:200

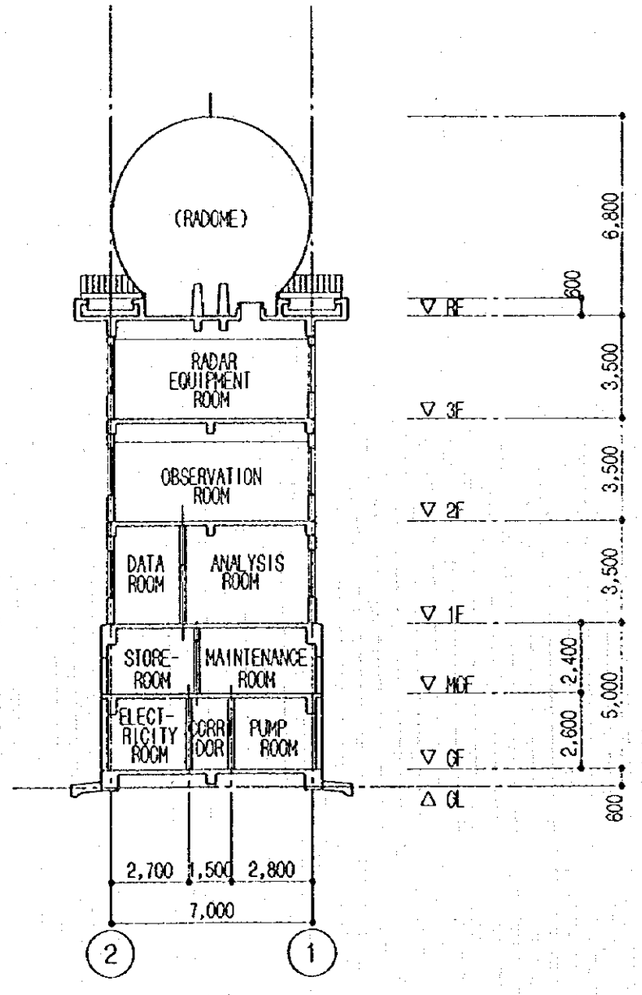
DRAWING No. A-02



WEST ELEVATION



SOUTH ELEVATION



SECTION

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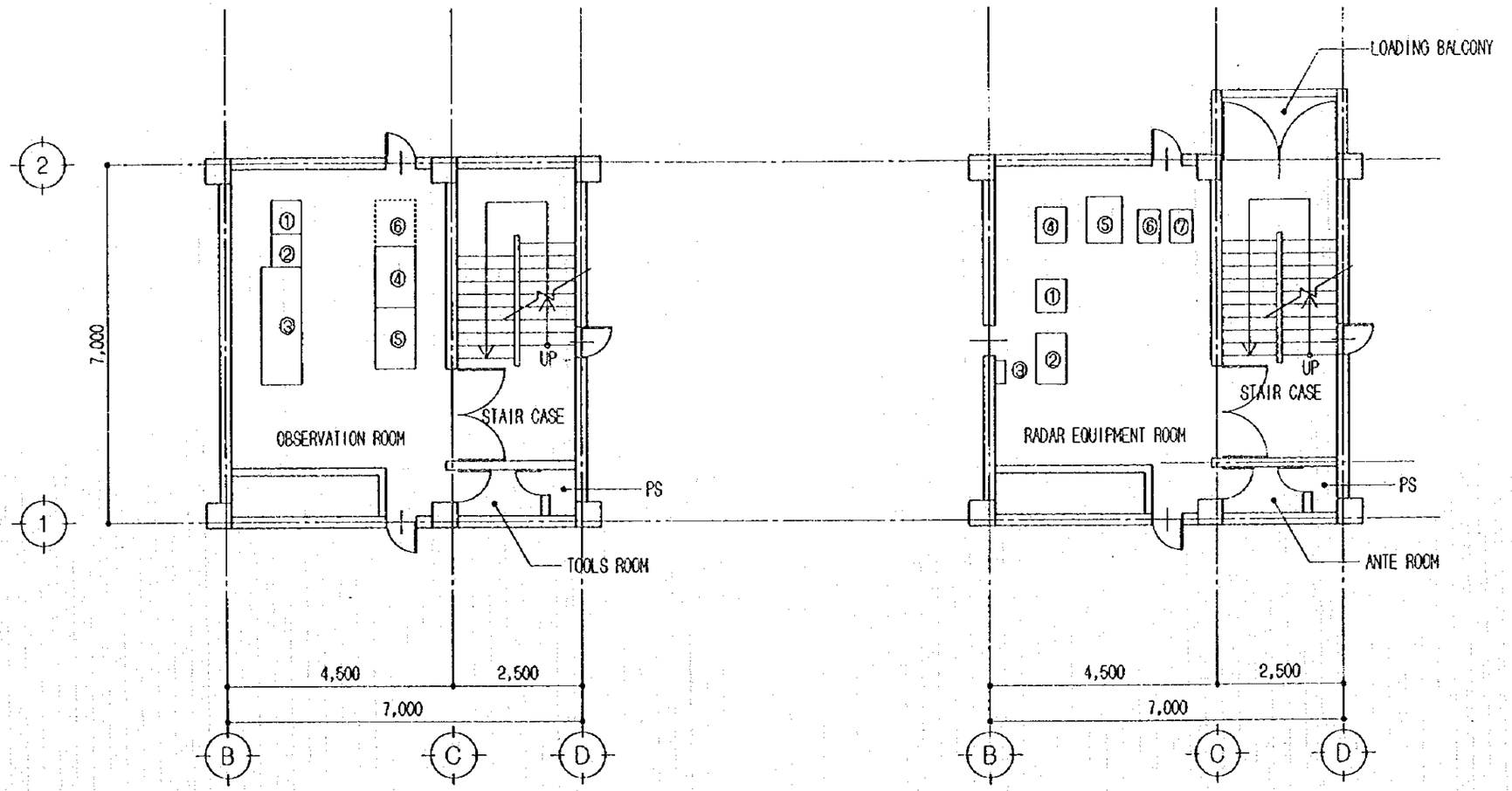
PROJECT:	DRAWING TITLE:	SCALE:	DRAWING No.
D.I. KHAN RADAR TOWER	ELEVATION AND SECTION	1:200	A-03



SECOND FLOOR

THIRD FLOOR

① PPI/RHI indicator
② Digital Video Integrator and Processor
③ PPI/RHI indicator
④ Communication Control Unit
⑤ Monitor Display
⑥ Multiplex Radio Equipment

① Antenna Control Unit
② Transmitter/Receiver
③ Dehydrator
④ Power Distribution Board
⑤ Automatic Voltage Regulator
⑥ Uninterrupted Power Supply (1)
⑦ Uninterrupted Power Supply (2)

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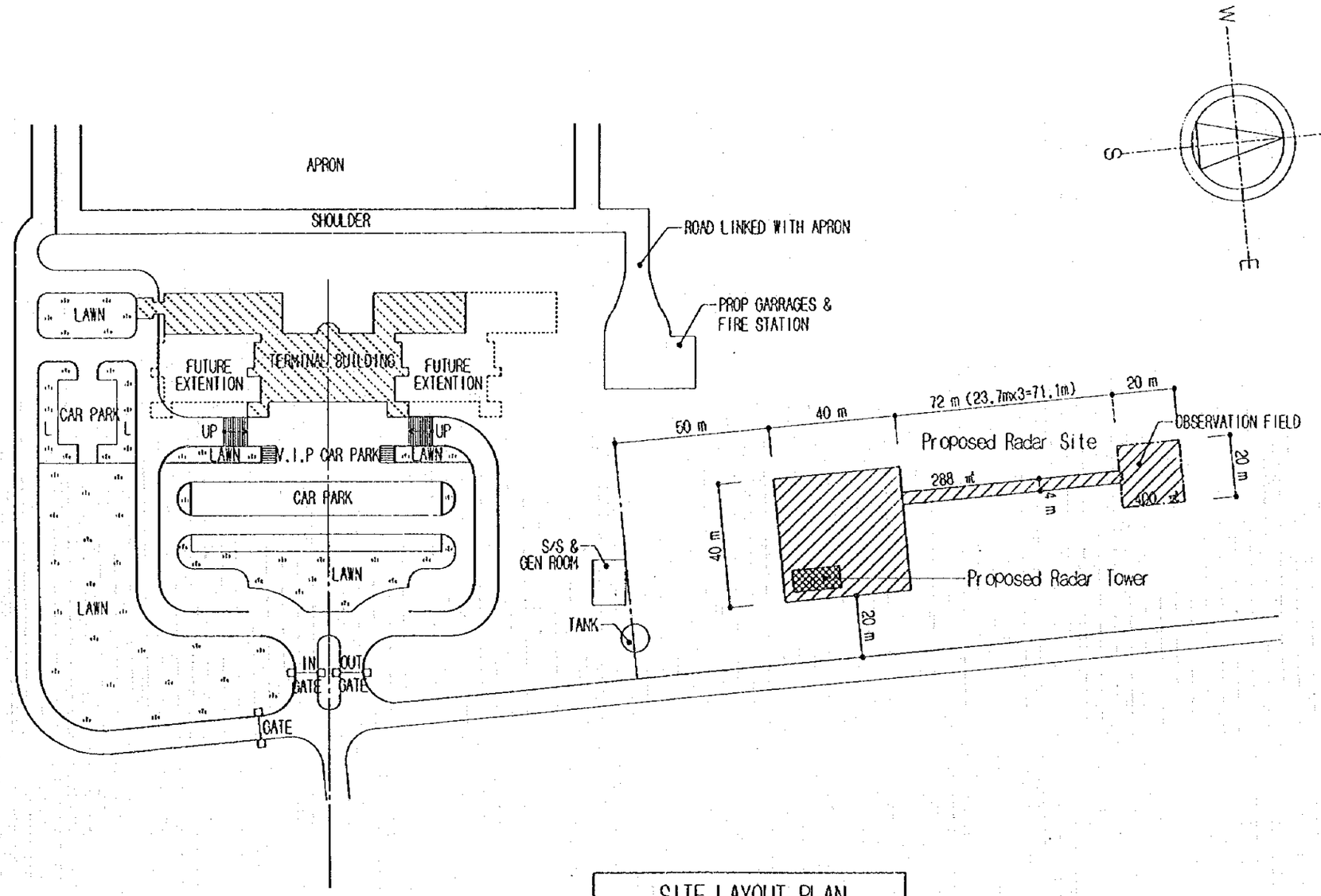
PROJECT:	DRAWING TITLE:	SCALE:	DRAWING No.
D.I.KHAN RADAR TOWER	EQUIPMENT LAYOUT PLAN	1:100	A-04



SITE LAYOUT PLAN

Japan Weather Association
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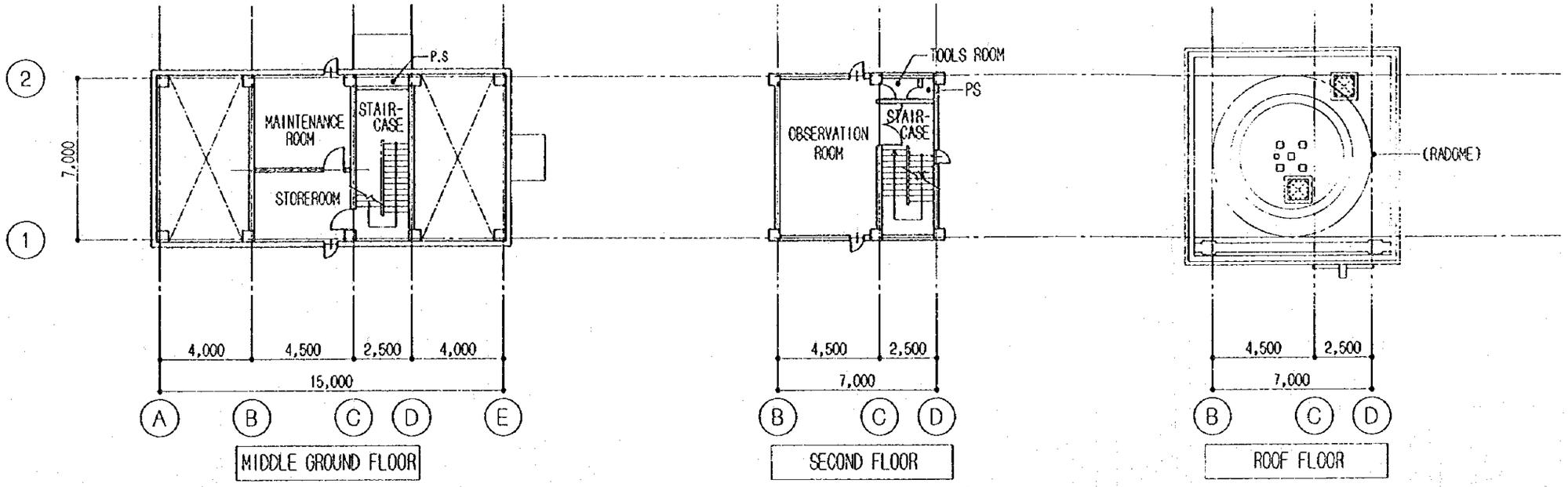
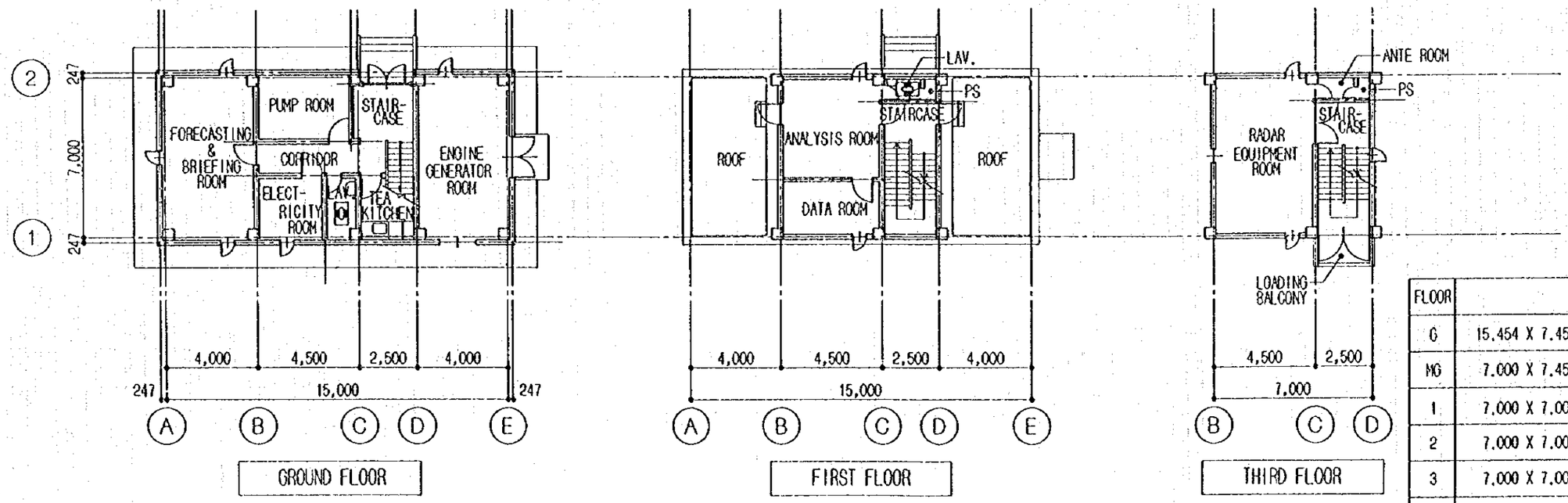
PROJECT:	DRAWING TITLE:	SCALE:	DRAWING No.
RAHIMYAR KHAN RADAR TOWER	SITE LAYOUT PLAN	1:1500	A-05





FLOOR		
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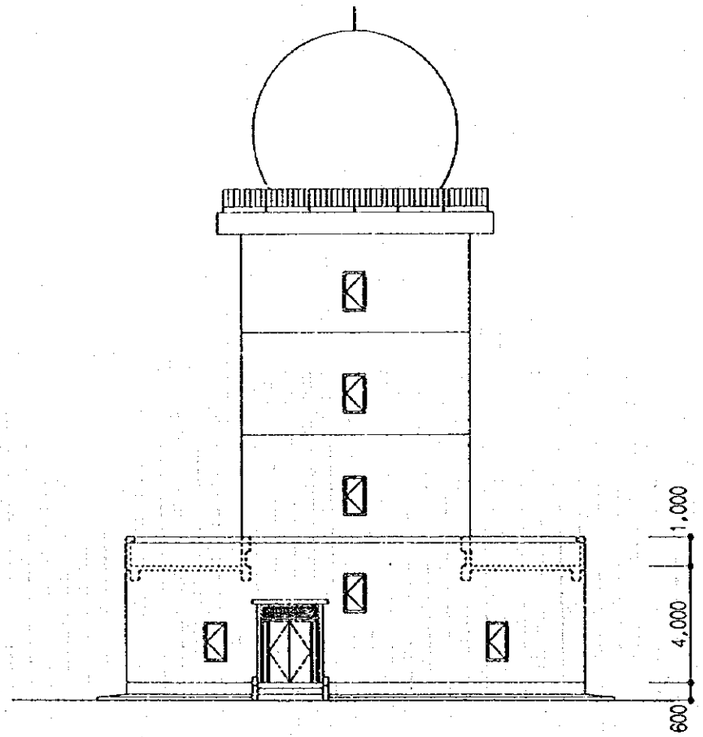
PROJECT: RAHIMYAR KHAN RADAR TOWER

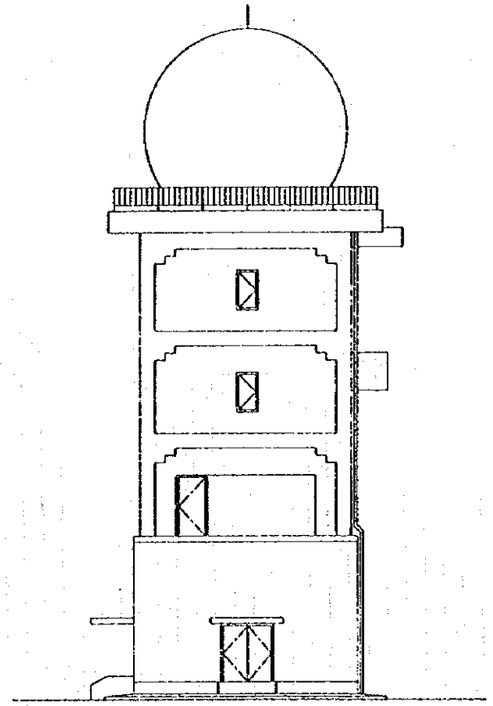
DRAWING TITLE: FLOOR PLAN

SCALE: 1:200

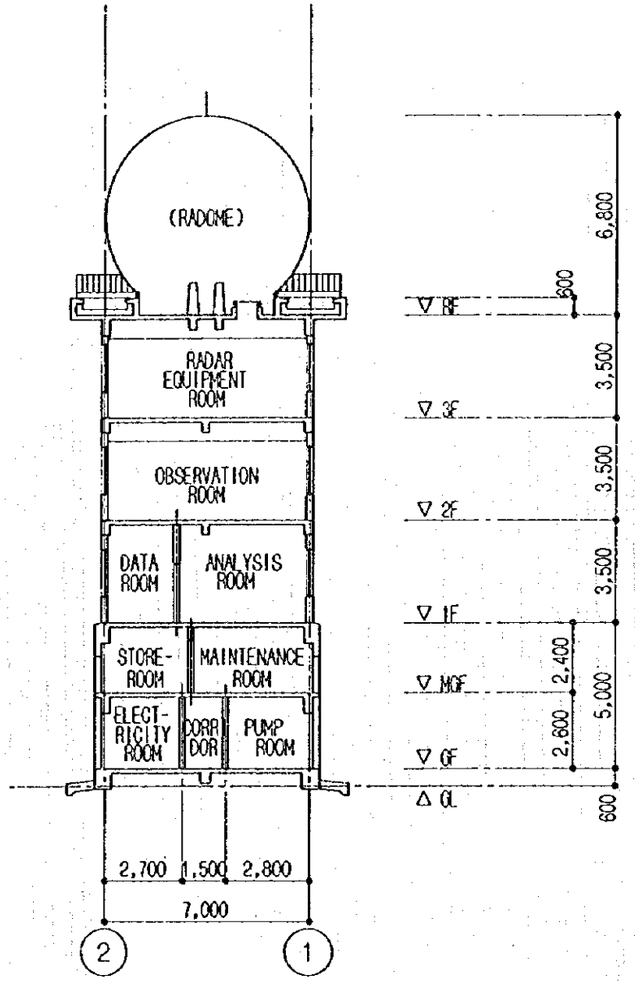
DRAWING No. A-06



EAST ELEVATION



SOUTH ELEVATION



SECTION

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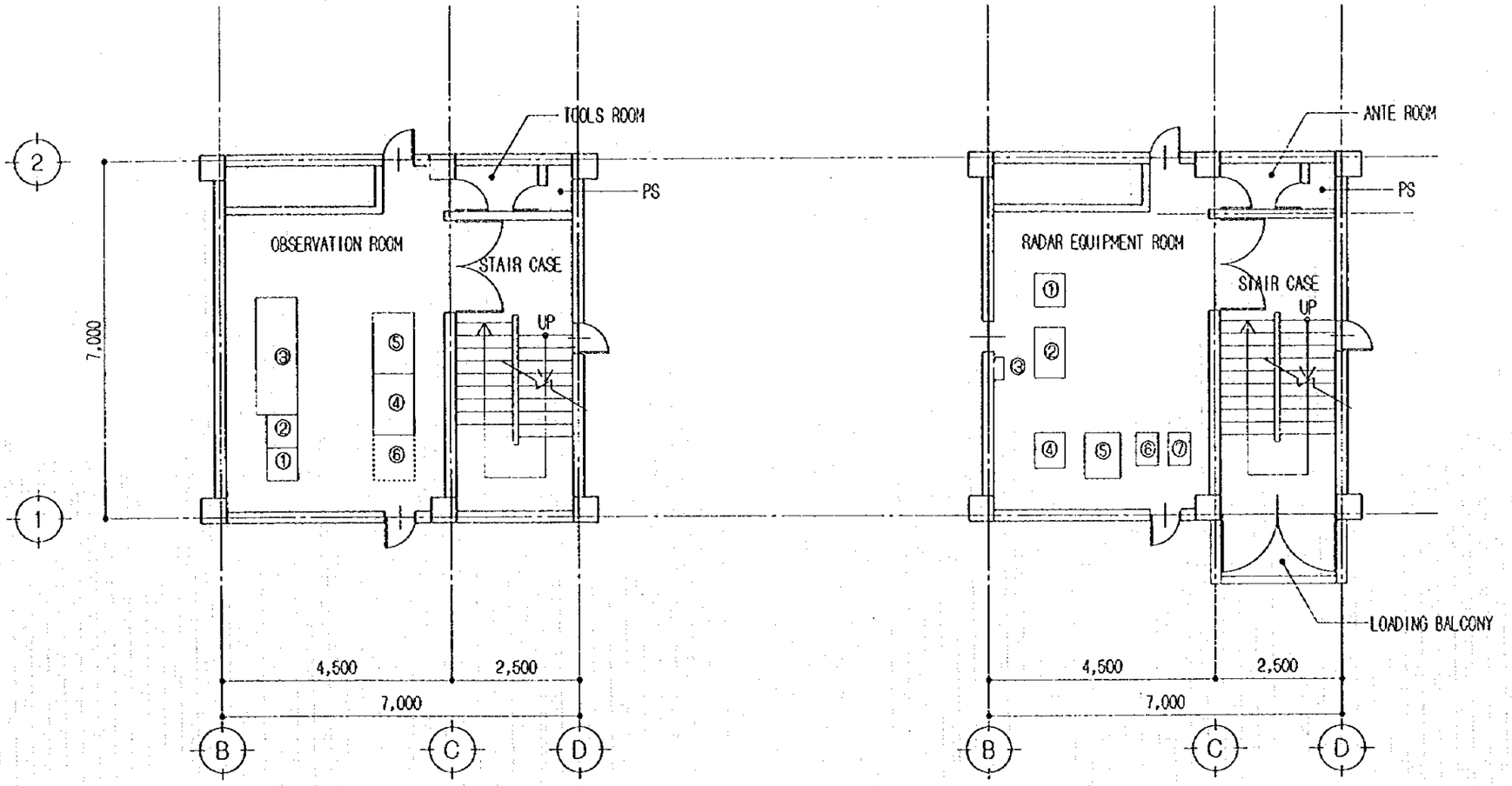
PROJECT:	DRAWING TITLE:	SCALE:	DRAWING No.
RAHIMYAR KHAN RADAR TOWER	ELEVATION AND SECTION	1:200	A-07



SECOND FLOOR

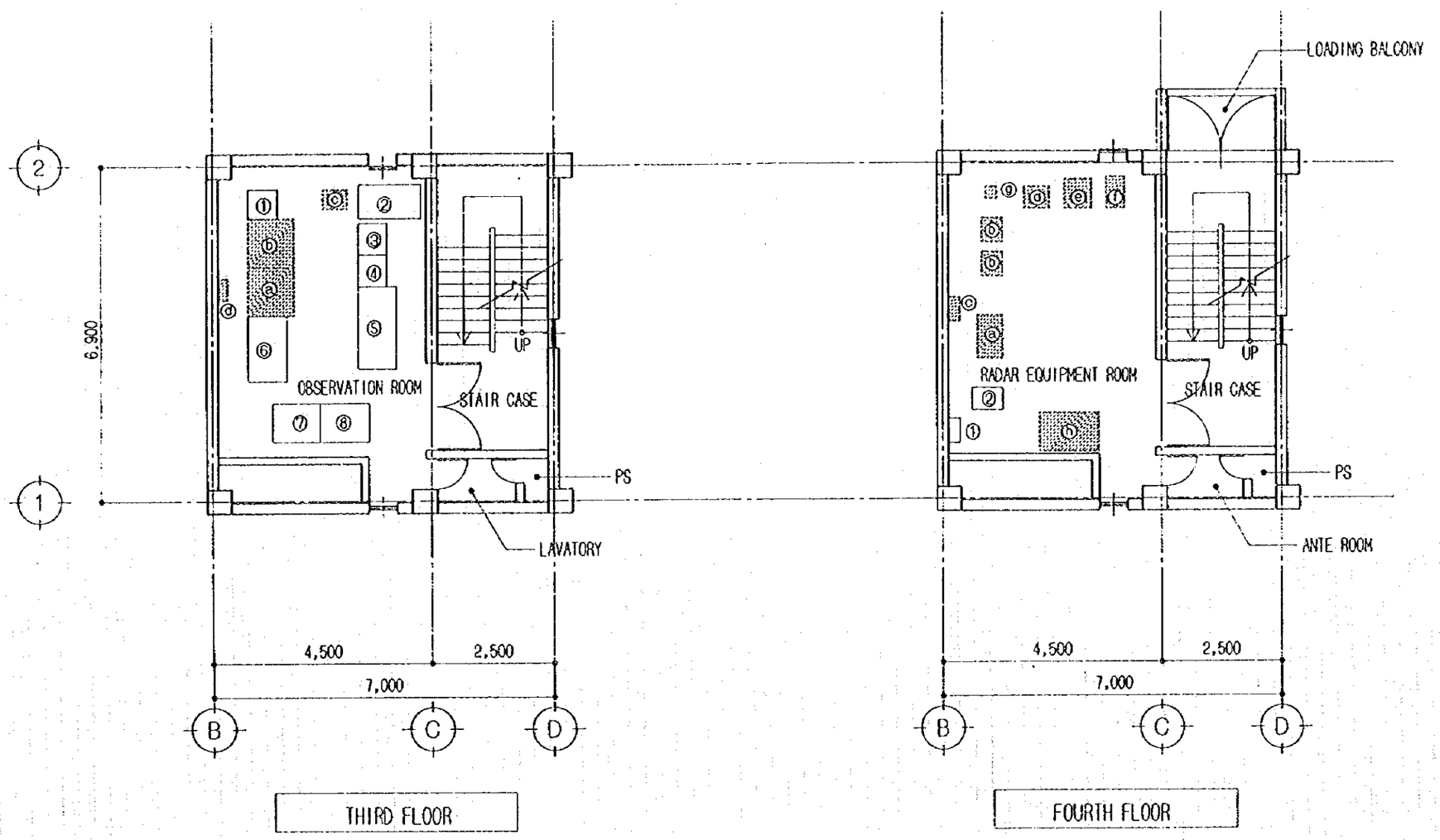
THIRD FLOOR

① PPI/RHI indicator
② Digital Video Integrator and Processor
③ PPI/RHI indicator
④ Communication Control Unit
⑤ Monitor Display
⑥ Multiplex Radio Equipment

① Antenna Control Unit
② Transmitter/Receiver
③ Dehydrator
④ Power Distribution Board
⑤ Automatic Voltage Regulator
⑥ Uninterrupted Power Supply (1)
⑦ Uninterrupted Power Supply (2)

JWA Japan Weather Association
International Affairs Dept. : Sunshine 60 Bldg., 55F, 3-1-1, Higashi Ikebukuro, Toshima-ku, Tokyo, 170 Japan
Tel. +81-3-5958-8161 Fax.+81-3-5958-8162 E-mail kokusai@jwa.go.jp

PROJECT:	DRAWING TITLE:	SCALE:	DRAWING No.
RAHIMYAR KHAN RADAR TOWER	EQUIPMENT LAYOUT PLAN	1:100	A-08



Existing Equipment

- ⓐ Monitor Display
- ⓑ PPI/RHI Indicator
- ⓒ Digital Video Integrator and Processor
- ⓓ Time Display

- ① Rader Interface Assembly
- ② Multiplex Radio Equipment
- ③ Data Monitoring Display
- ④ Data Converter
- ⑤ Data Monitoring Display
- ⑥ Communication Control
- ⑦ Monitor Disolay
- ⑧ Composit Processor Unit

Existing Equipment

- ⓐ Transmitter/Receiver
- ⓑ Antenna Control Unit
- ⓒ Dehydrator
- ⓓ Autmatic Voltage Regulator
- ⓔ Power Distribution Board
- ⓕ Uninterrupted Power Supply
- ⓖ UHF Multiplex Radio Relay
- ⓗ Data Processor

- ① Power Distribution Board
- ② Uninterrupted Power Supply

Japan Weather Association
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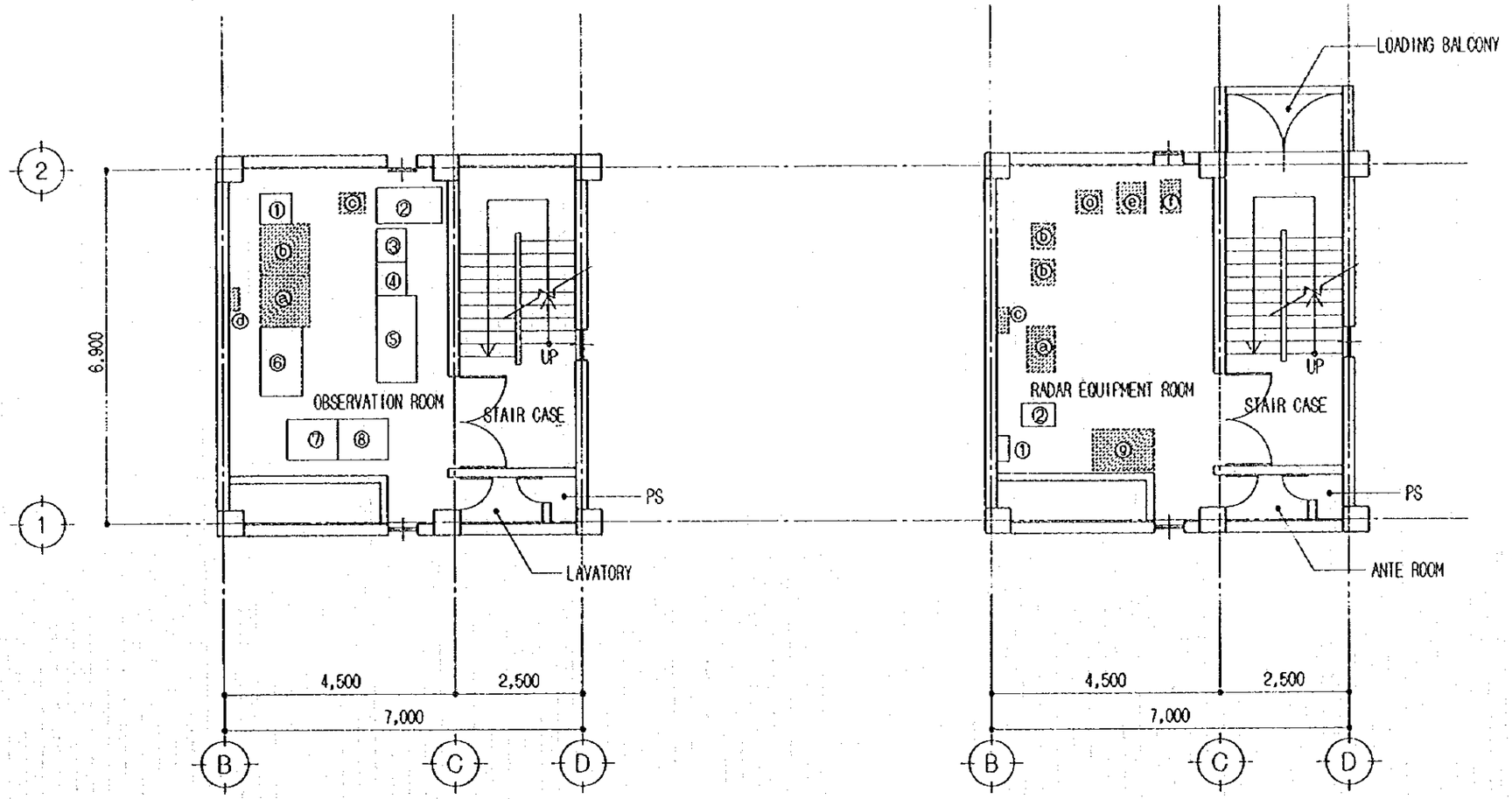
PROJECT:	DRAWING TITLE:	SCALE:	DRAWING No.
KARACHI RADAR TOWER	EQUIPMENT LAYOUT PLAN	1:100	A-09



Existing Equipment

- ⓐ Monitor Display
- ⓑ PPI/RHI Indicator
- ⓒ Digital Video Integrator and Processor
- ⓓ Time Display

- ① Rader Interface Assembly
- ② Multiplex Radio Equipment
- ③ Data Monitoring Display
- ④ Data Converter
- ⑤ Data Monitoring Display
- ⑥ Communication Control Unit
- ⑦ Monitor Disolay
- ⑧ Composite Processor Unit

Existing Equipment

- ⓐ Transmitter/Receiver
- ⓑ Antenna Control Unit
- ⓒ Dehydrator
- ⓓ Autmatic Voltage Regulator
- ⓔ Power Distribution Board
- ⓕ Uninterrupted Power Supply
- ⓖ Data Processor

- ① Power Distribution Board
- ② Uninterrupted Power Supply

Japan Weather Association
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PROJECT:	DRAWING TITLE:	SCALE:	DRAWING No.
ISLAMABAD RADAR TOWER	EQUIPMENT LAYOUT PLAN	1:100	A-10

Chapter 3
Implementation Plan

Chapter 3 Implementation Plan

3 - 1 Implementation Plan

3 - 1 - 1 Implementation Concept

The coordination among related implementation of the Project shall be required, because the Project concerns systematically many engineering fields such as meteorology, architecture, civil work, etc. In this Project, there is a meteorological equipment portion which refers to manufacturing, shipment, local installation, adjustment and commissioning.

For smooth implementing of the Project and avoiding delays and misunderstanding, close liaison should be necessary with the responsible organization in Pakistan, JICA Pakistan office, and concerned government authorities and public agencies.

1. Executing agency of the Project
The government agency of Pakistan responsible for the execution of this Project is PMD, which is supervised by Aviation Division. These two organizations are the executing agencies in Pakistan for Consultant Agreement and Contract.

2. Implementation Plan
As for the implementation plan, it is necessary to discuss in detail and confirm the following points between PMD and the Consultant during the implementation period of the detailed design.

1) The arrangement of the Project site to be shouldered by Pakistan side, securing of the temporary electrical power and telephones, and the water supply for construction work, and official procedures, etc., shall have been completed prior to the commencement of the Project.

2) The construction period is supposed to be approximately 9 months, since part of the building construction works period may fall within the rainy and flooding season, the implementation schedule must be meticulously planned.

3) Adequate attention and careful consideration shall be paid to avoid disruption of the

airport operations, since the Rahimyar Khan site is located in the domestic airport premises. It should be specially noted in this connection that a new terminal building is presently under construction at this airport, while the Project site is very close to the control tower.

4) While procurement of the equipment and materials for this Project will be covered by a grant-aid from Japan, careful liaison and coordination must nevertheless be maintained with concerned government agencies in Pakistan will regard to the Project items on the Prohibited Import List. Also, since import licenses are issued by the Central Board of Revenue (CBR), import procedures and duty exemption procedures must be promptly completed in cooperation with the implementing organization, PMD.

5) With regard to the installation works for the meteorological telecommunication system, the equipment to be supplied under the Project will be installed at the existing facilities of PTCL, various airports and the existing radar sites. Therefore, elaborate precautions will have to be taken to ensure the safety of these existing facilities.

6) The equipment and materials shall be procured as far as possible in Pakistan. However, in case of procurement from Japan or third countries is necessary, the Pakistan side will be required to defray all customs clearance and related charges.

7) At the time of the detailed design, the confirmation of the budget to be allocated will be required for the procurement of furniture, fixtures, etc., and also external work and removal and setting of existing equipment, and furniture and fixtures to be shouldered by Pakistan side.

3 - 1 - 2 Implementation Conditions

1. Construction Conditions

1) Local Contractors

In the local contractors in Pakistan, there is a number of large firms that have many experiences on large-scale development and plant projects as well. Generally, the technical levels of the major construction firms in Pakistan are relatively high in comparison with other developing countries. Thus, no particular problems are expected even in connection with the construction work on the weather radar towers at the Project sites and also the equipment installation works with respect the technical levels of private local contractors, who will be undertaking this work in close association with Japanese engineers.

2) Labor Condition

Laborers are classified by their skills such as carpenters, masons, steel fitters, etc. and are organized into labor unions, however, there is no standard license or qualification to identify the skill of laborers. Common laborers are not classified into special fields and are employed when necessary. The skills of skilled laborers are much varied and truly skilled laborers are quite few. Today, the average performance of various skilled laborer in Japan is 1.7 times that of Pakistan.

3) Quality and process control

Concrete aggregate, cement, lumber, and other primary products as well as construction materials and equipment are either produced or assembled on a knock-down basis within Pakistan. Thus, almost all budding materials can be sourced locally. Moreover, specialty machinery and equipment can be imported from such countries as Singapore or Thailand, so that a reasonable level of quality can be expected in this field.

2. Special Project Considerations

The construction work of the Project involves the 4-story building above ground, and employs no special construction methods. In addition, the materials are to be procured in Pakistan as

far as possible. Accordingly, the construction work can be adequately carried out by local construction firms. The materials to be procured from Japan or the other countries would not pose any substantial problems, providing these materials are appropriate for the construction standards in Pakistan.

Weather radar systems, composite processing systems for radar imagery, meteorological telecommunication systems for the meteorological observation are to be installed at the buildings. Thus, it would be no exaggeration to say that the electrical/electronic equipment for these systems will constitute the vital core of the weather radar tower buildings. In accordance with the construction schedule, the electrical engineer shall be dispatched at the time of the installation, adjustment and wiring construction of the electrical power equipment of the systems related, power failure back-up system and the air-conditioning and also plumbing engineers shall be dispatched for adjustment and confirmation of the computer-related rooms' air-conditioning performance at the time of the installation of air-conditioning equipment and plumbing. During the construction period, procurement of the materials and securing of the skilled laborers shall be performed on in accordance with the construction schedule.

As to the procurement and installation of the equipment and materials, an engineer shall be required to be dispatched for the training of handling at sites, and maintenance of the equipment, and explanation of handling, in view of specific works and precision of installation works. Maintenance after the installation shall be discussed in full detail.

The dispatch of the engineers to be required during each implementation period is as follows.

<Building construction>

・Electrical engineer :	1 person
・Air-conditioning and plumbing engineer :	1 person

<Equipment installation and adjustment>

• Weather radar system engineer :	2 persons
• Radar imagery composition & display engineer :	1 person
• Antenna engineer :	3 persons
• Radio engineer :	2 persons
• Transmission engineer :	2 persons

3 - 1 - 3 Scope of Works

(1) Construction of Weather Radar Tower Building

• Portions to be undertaken by the Japan side :

1) Architectural and civil works on for radar tower buildings
2) Electrical works for radar tower buildings
3) Air-conditioning works for radar tower buildings
4) Plumbing works for radar tower buildings

• Portions to be undertaken by the Pakistan side :

1) Securing the Project sites (D. I. Khan and Rahimyar Khan)
2) External & planting work
3) Fencing work
4) Access roads work
5) Power supply intake work (including meters)
6) Water intake work
7) Telephone line intake work
8) Purchase of furniture
9) Movement and relocation of the existing objections on the Project sites

(2) Installation Work for the Equipment:

• Portions to be undertaken by Japan

1) Equipment procurement for establishing the meteorological radar observation network.
2) Transport of the equipment to the various project sites.
3) Installation work for the equipment.
4) Adjustment work for the equipment.
5) Commissioning for the total system as the meteorological radar observation network.

• Portion's to be undertaken by Pakistan :

1) Removal and relocation of the existing facilities for installation work of the equipment to be supplid under the Project, if any.

3 - 1 - 4 Consultant Supervision

Construction Supervision Plan

Based on the guidelines established by the Government of Japan for grant-aid assistance and the specifications of the basic design, the Consultant will be responsible for expeditious project implementation, forming project teams for detailed design and construction supervision.

The Consultant is to dispatch one resident engineer to Pakistan for the construction of the radar tower buildings. This supervision will provide guidance for personnel involved in the project, while maintaining close liaison with the PMD, CAA, the Embassy of Japan in Pakistan, the JICA Pakistan office, as well as the Japanese side. With the progress of the construction work, Japanese engineer in charge of structures and facilities will be dispatched, as required, to conduct inspections and provide construction guidance on site.

With respect to installation and adjustment work of the equipment, the engineers from the Consultant will be dispatched to the site timely for inspection and liaison and construction guidance in each system. Their supervisory services will be particularly critical in connection with the weather radar and radar composite imagery systems, where there will be a continuing requirement for performance checks in Japan and adjustments, inspections, certification of equipment, and checks on data reception and transmission conditions on existing lines in Pakistan.

It may, therefore, be expected that the services of these engineers will be required over a certain period. In addition, certification will be made of the performance of the each system .

1. Principal Guidelines for Supervisory Plan

1) To maintain close liaison with responsible organizations and opersonnel in both countries, and complete the Project on time in accordance with the implementation schedule.

2) In order to carry out the construction and equipment installation work in accordance with the design plans, guidance and advice will be given to contractor personnel without delay.

3) Local construction methods will be adopted, to the maximum possible extent, on the basis of locally available materials.

4) Instruction in construction methods will be provided so as to maximize project impact.

5) Upon project completion, the contractors will be obliged to submit the maintenance manuals and provide appropriate guidance to the PMD to ensure smooth operations.

2. Construction Supervision Work

1) Construction supervision

The Consultant, as proxy for the Pakistan government, will determine the format of the Construction Contract, prepare an initial draft of the Contract, select the Contractor, and recommend this selection to the Pakistan government, and serve as witness for the Contract.

2) Inspection and confirmation of the construction drawings, materials, and equipment

The Consultant will check and confirm the construction drawings, manufacturing drawings, system diagrams, and material samples submitted by the Contractor as well as performance of the equipment.

3) Construction guidance

Based on a review of the construction plan and schedule, the Consultant will provide instructions to the Contractor and submit progress reports on the construction work to the PMD, CAA, Embassy of Japan in Pakistan, JICA's Pakistan office, etc.

4) Approval procedure for payment

The Consultant will cooperate in certification for payment, such as meticulous examination of notice of approval and invoices in connection with construction cost to be disbursed during the construction period and upon completion of the work.

5) Attendance for inspection

As required during the construction period, the Consultant will perform inspections at each stage of the work and, based on confirmation of completion and fulfillment of the contract

conditions. The Consultant will be present at the final turnover of the facilities and equipment, at which point its tasks will be completed, with the approval of the Client. Reports will also be made to concerned personnel in the Government of Japan on all required items, such as progress reports during the construction period, payment procedures, and final turnover.

3. Dispatch of Resident Engineer

A meteorological planning engineer will be dispatched to Pakistan as the general project supervisor.

<Building Construction>

Accurate quality control and supervision of construction progress will be required through the construction period. With regard to quality control, it should be observed that, whether the construction materials are sourced within Pakistan or brought in from Japan or third countries, quality and construction methods may differ even for the same material, so that, in most cases, swift assessments must be made, owing to the severe time restraints of the Project. In case of the absence, precious time would be required to reach decisions.

With respect to the construction schedule, the delays of the construction can be expected in the lumbering and foundation work in rainy and flood season. Furthermore, as radar tower buildings are to be constructed at both the D. I. Khan and Rahimyar Khan sites, the supervisory service is likely to be quite complex. Based on the above considerations, in case of spot supervision, serious problems could be expected in both quality and progress control. Therefore, it is deemed that a resident engineer be dispatched for the project. Accordingly, architectual engineer-B will be sent to Pakistan for 9 months under construction period.

During the construction period, the engineer will provide supporting services on construction drawings, methods as well as inspections of the equipment in Japan. In addition, these engineers will be dispatched to Pakistan, as required, for supervision on installation and adjustment stages.

a) Architectural engineer - A
b) Architectural engineer - B
c) Structural engineer
d) Electrical engineer
e) Air-conditioning & plumbing engineer

f) Quantity surveyor

The various equipment differs on function and performance. Thus, in order to combine each equipment organically into a single meteorological system, and integrate these separate systems into one total system, based on the specifications, it is vital that such overall integration be made the cornerstone of the construction schedule. To support the resident engineer, each engineer in meteorological communication, radio and transmission will be dispatched to supervise the meteorological communication system, along with radar engineers to oversee the weather radar system, and a meteorological planning engineer to provide general supervision for the system. Moreover, these supervisory services will be performed from the standpoint of the user, the PMD. Supervision will be carried out in close coordination with a radar image analyst and a data processing engineer, based on the meteorological communication and data processing capabilities required in a meteorological radar network as well as the radar observation.

In connection with the supervision of equipment installations, selected engineers will be dispatched timely to carefully supervise installations in their respective areas of expertise. During the construction period, these engineerws will also perform checks on manufacturing drawings and installation methods along with equipment inspections in Japan and will be dispatched, as needed, to Pakistan for installation and adjustment works.

a) Meteorological planning engineer
b) Meteorological telecommunication engineer
c) Telecommunication radio engineer - A
d) Telecommunication radio engineer - B
e) Radar engineer
f) Data processing engineer

3 - 1 - 5 Procurement Plan

The procurement plan for materials and equipment is oriented to local maintenance level and structure for the weather radar network systems and equipment, and radar tower buildings and building equipment. The Plan is deemed to be appropriate, in that recurrent costs have been estimated on the basis of PMD's probable financial capabilities after completion of the Project. The procurement plan has been designed, with full awareness of the current situation at PMD, on the basis of the estimated useful life of each item, a regular maintenance cycle for the systems and equipment, a proper supply of spare parts for maintenance use, and procurement methods. Consideration has also been given to the preparation of operating and maintenance manuals, related guidance, as well as training programs for PMD.

• Prohibited Import Items

Virtually all types of construction materials, including imports, are available in the Pakistan, the procurement plan for materials for construction of the buildings and the equipment must be carefully prepared. Policy of procurement plan for the Project will be to utilize locally produced items wherever possible and, in survey of materials and equipment, particular importance was placed on the Prohibited Import List, the specific materials that can be locally sourced, along with a quality evaluation of the latter items.

The Prohibited Import List includes, under the building materials category, such items as reinforcing bars, steel frames (depending on size), plywood, aluminum openings, tile, wood products, aggregate, blocks, glass, and paint. The List also embraces virtually all types of materials used in the construction works, such as sanitary fixtures, lighting fixtures, panels, air-conditioners, pumps, etc.

PMD is very conversant with procedures relating to the import of materials and equipment, and so a vital element in expediting this Project will be prior consideration of anticipated problems and the measures to be taken to deal with them. The cooperation of the PMD is essential to the procurement of items on the Prohibited Import List, and such import requirements will be clearly identified to PMD at an early stage of the Project.
In order to ensure smooth Project implementation, careful consideration must be given to these conditions as well as local supply capabilities in selecting the products to be used.

The Ministry of Commerce (MOC) is the contact point for procedures relating to the import

of materials and equipment. A rigorous check will be made by this organization for each desired import item against the voluminous Prohibited Import List and, in the case of a prohibited item, an import application is sent to the Ministry of Industry (MOI) and the Ministry of Finance (MOF). Only after their examination and approval can a Non-Objection Certificate (NOC) finally be issued. The NOC is then forwarded to the Central Board of Revenue (CBR), where an import tax of about 4% of CIF value is collected from the implementing organization, at which point the import and customs exemption procedurse are completed. This formal process is followed without fail, even in the case of a grant-aid project. In order, therefore, to implement the Project without any delay, the Client (PMD), Consultant and Contractor must conduct a detailed examination and cooperate fully in adhering to the required procedures in executing the procurement plan.

1. Equipment

The most considerable factors in supplying equipment is maintenance method of the equipment and availability of the necessary parts and consumables in Pakistan. The equipment procurement must take account of ongoing maintenance requirements after completion of the Project. Careful consideration should be given to making maximum use of the local agent when problems occurred with a particular item of the equipment.

The weather radar systems and weather radar image composition systems and other equipment, many of which will be difficult to procure locally. Thus, in connection with maintaining quality levels of the weather radar network, it will be absolutely essential to procure such components from Japan and/or third countries. At these days, equipment prices are almost identical in Japan and third countries. However, in case of procurement of the equipment from third countries, extra expense of sending engineers to third countries for equipment inspections (e.g., interim and final inspections, performance tests, shipping inspections, etc.) will be required. Therefore, the final unit price of procuring from Japan will provably be cheaper. In addition, for quality control of the radar systems, procurement of the equipment from Japan will be easier than third countries.
It is sure that procurement from Japan would surely be advantageous to PMD in consideration of unification of the systems and spare parts, operating procedures, maintenance techniques and also familiarity of the equipment because the existing radar systems at Karachi and Islamabad established in the previous project under Japan's Grant Aid Assistance are Japanese products.

Nevertheless, with respect to the meteorological telecommunication system and related

equipment, it should be noted that this equipment is being assembled, produced and sold in Pakistan by a subsidiary of Pakistan Telecommunication Corporation Ltd (a semi-governmental corporation) on a knock-down basis, based on technical cooperation from Germany's manufactures (German engineers are available as technical advisors). Considering also the fact that, after completion of the Project, there will be no difficulty in obtaining local maintenance services or spare parts, there would be considerable merit in procuring the meteorological telecommunication system locally. Moreover, in terms of price comparisons with sourcing in Japan or third countries, local unit prices would be slightly lower. In addition, in view of the fact that Pakistan telecommunication itself uses many items of domestically produced telecommunication equipment, there would be no problems will local equipment even from the standpoint of reliability.

The most considerable points in connection with supply of the equipment are regarding operation and maintenance methods and also procurement of necessary spare parts after completion of the Project. This will surely be a vital factor is determining the success of the Project.

As might be expected, our major concern from a maintenance standpoint relates to the weather radar and weather radar composite imagery systems, with the latter system being essentially a computer systems. As activities of the private sector related to computer system, there are several agents of the computer equipment in Pakistan and the maintenance of the computer system belonging to the Government of Pakistan is provided by them. They have sufficient engineering skills, experiences and capabilities for maintenance and management on computer equipment. The activities of the private sector will be useful for the computer system of the weather radar and weather radar composite imagery systems introduced under the Project.

Based on the above considerations, the procurement plan for the Project equipment should be designed with a view to achieving the maximum possible degree of standardization as well as ease of obtaining spare parts; and selecting equipment with which PMD is already familiar and which can be maintained locally.

2. Construction Materials

Almost all of the required construction materials such as concrete aggregate, cement, lumber, and fittings are obtainable in Pakistan. On the other hand, building equipment is, at present, largely imported. In addition, the market being small, the procurement of the materials is subject to be affected by the other construction projects. The construction materials should basically be procured locally. Only the materials difficult to obtain in Pakistan and those specially required to achieve the quality and level of the facility of the Project shall be procured from Japan and/or the other countries.

1) Cement

Supply is relatively stable, with quality standards generally quite high. However, since the local product is inferior to Japanese cement, careful equality checks will be required during construction.

2) Concrete aggregate

Concrete aggregate uses mainly crushed stone. Local supplies are stable and able to meet current demand in terms of both quantity and quality.

3) Concrete products

Concrete blocks and other secondary concrete products are also made locally. However in the absence of ready-mixed concrete (fresh concrete), all supplies must be mixed at a site, requiring careful quality and intensity checks. Cement should be test-mixed at the site, after which an optimum mixture can be determined.

4) Reinforced bars

Reinforced bars, as required for the production of reinforced concrete, can be locally sourced, and a reliable intensity value can be confirmed from the mill sheet obtained of the reinforcing bars.

5) Timber and Plywood

Plywood for both interior at exterior use, as well as for use in concrete forms can be procured locally.

6) Aluminum products

Various types of aluminum windows and doors produced in Pakistan, they are widely used in the country and generally pose no problems. For this Project, therefore, local aluminum windows and doors will be used.

7) Paint

The paints both for indoor and exterior are available in a wide variety of colors and in terms of quantity, color, and base (oil, emulsion, epoxy).

The major building materials except those mentioned above may be regarded as being imported. Especially, the installation (electricity, water supply and drain, air conditioning, ventilation) related materials and equipment are to be imported, with the exception of thin vinyl chloride pipes of diameter less than 150 mm, and a portion of the electric wire covered with vinyl.

As noted above, construction materials are generally available in Pakistan, with quality presenting no particular problem. However, in connection with the radar tower buildings construction period, since certain materials for special power-supply equipment, as needed to install the weather radar systems, cannot be locally sourced, such items will have to be brought in from Japan or third countries.

3. Transport Routing for Materials

The principal port in Pakistan is Karachi. Thus, materials shipped by sea to Pakistan from Japan or third countries will be unloaded at Karachi and trucked overland to the Project sites. The highways to these sites are almost entirely asphalt-paved, so transport presents no particular problems.

1) Air service

Pakistan International Airline (PIA) operates 4 round-trip flights per week between Tokyo and Islamabad and Karachi International Airports. This airline also have many domestic flights schedule a day between Islamabad and Karachi.

2) Shipping service

There are 3 ~ 4 scheduled shippings per week to Karachi from Japanese ports (primarily Kobe, Nagoya, and Yokohama). Direct service takes about one month from a Japanese port.

3)Domestic transport

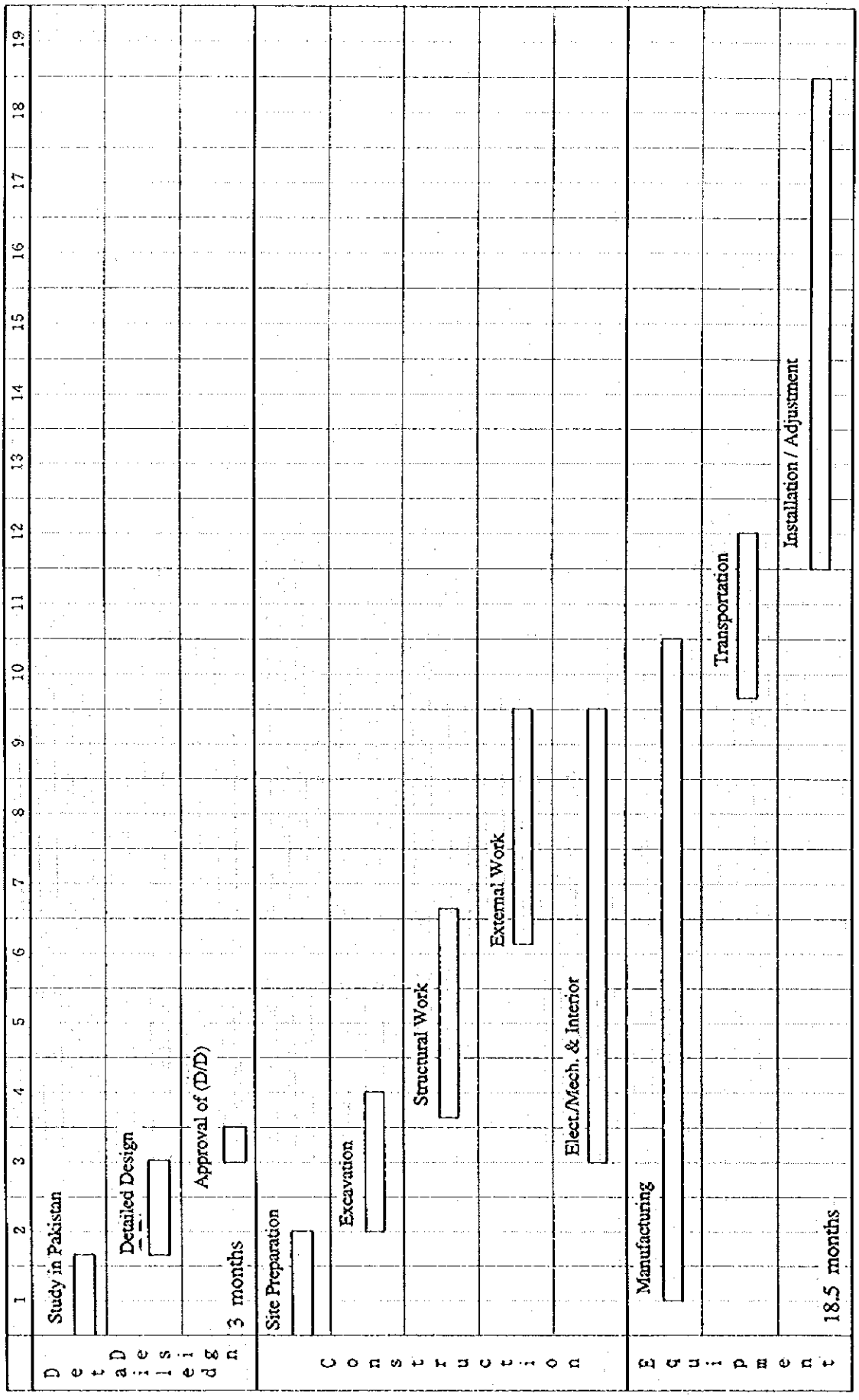
The main forms of domestic transport are road and air. Land transport is cheaper than air for long-haul and large-volume shipments and so more advantageous. Large vessels now call frequently at Karachi, whose port facilities are well developd, with one pier equipped to handle container cargo exclusively.

4. mplementation Schedule

The Project involves the construction of weather radar tower buildings at 2 locations together with the manufacturing, installation, adjustment and commissioning of equipment for weather radar, weather radar composite imagery and meteorological telecommunication systems. The entire implementation program is expected to require some 17.5 months in all.

The building construction work will consume about 9 months from the on-site preliminary work through completion, while some 9 months will be needed to manufacture the equipment. The equipment introduced under this Project will be of a specialized and used exclusively for meteorological purposes, the production cycle will necessarily be longer than for conventional equipment.

3-1-6 Implementation Schedule



3 - 1 - 7 Obligation of recipient country

Undertakings required of the Government of Pakistan

In the implementation of the Project under Japan's Grant Aid Assistance, the government of Pakistan is required to undertake such necessary measures as the following:

(1) General requirements

1) To take all necessary institution and juridical procedures in Pakistan.
2) To open an account in the name of the Government of Pakistan in an authorized foreign exchange bank in Japan and to bear commissions to the Japanese foreign exchange bank for the banking services based upon Banking Arrangement.
3) To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the project at the port of disembarkation.
4) To accord Japanese nationals whose services may be required in connection with the supply of products and the services under the verified contracts such facilities as may be necessary for their entry into Pakistan and stay therein for the performance of their work.

(2) Requirements for the Equipment

1) To remove and relocate the existing facilities for installation work of the equipment, if required for the implementation of the Project, at the expense of Pakistan.
2) To bear all the expenses other than those to be borne by the Grant Aid, necessary for the transportation and the installation of the equipment.
3) To provide appropriate frequencies for radar systems and microwave links to be established.
4) To secure effective spaces at the existing facilities for installation of the equipment to be supplied.
5) To secure the necessary interfaces on the existing telecommunication links for the Project.
6) To maintain and use properly and effectively that the equipment purchased under the Grant Aid.

(3) Requirements for Construction of Radar Tower Building

1) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.
2) To provide facilities for distribution of electricity, water supply, telephone, drainage, sewage and other incidental facilities to the Project sites.
3) To undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the sites.
4) To construct the access road to the sites prior to commencement of the construction.
5) To provide temporary facilities for distribution of electricity, water supply, telephone, and other incidental facilities for construction of the buildings.
6) To secure effective spaces at the Project sites for temporary facilities such as a contractor's office, workshop, building materials storage, etc. for construction of the buildings
7) To bear all the expenses other than those to be borne by the Grant Aid, necessary for the transportation and construction of the buildings.
8) To maintain and use properly and effectively that the buildings constructed under the Grant Aid.

3 - 2 Project Cost Estimation

Cost estimation for major undertaking to be borne by Pakistan side (Capital Budget)

At the time of implementation of the Project under Japan's Grant Aid Assistance, the estimated cost for the major undertaking of the Government of Pakistan will be necessary as described in the following table.

Item	
External & planting work cost	Rs120,000.-
Power supply intake cost	Rs500,000.-
Telephone line intake cost	Rs16,000.-
Furniture cost	Rs20,000.-
Land cost (Rahimyar Khan site)	Rs150,000.-
Total	Rs806,000.-

3 - 3 Operating and Maintenance Costs

1. Staff Requirements for Implementation of the Project

For implementation of the Project, the following additional staff assignments are being planned at the Lahore NFFB and the new radar sites at D. I. Khan and Rahimyar Khan to appropriately and effectively operate and maintain the radar network systems. The request of these assignments have been included in PC-1 Form and submitted to the government of Pakistan by PMD for obtaining an approval on allocation of additional budget for the following staffing.
The present Lahore NFFB has been positioned as the Lahore Remote Sensing Centre, which is to be the center of the Pakistan meteorological radar network. It is also planned to additionally assign forecasters at the D. I. Khan and Rahimyar Khan radar sites.

After completion of the Project, the following additional staff assignments have been planned.

- National Centre for Remote Sensing Meteorology at Lahore -

(Lahore National Flood Forecasting Bureau)

	No. of Post
1. Chief Meteorologist	1
* 2. Director	2
3. Senior Meteorologist	2
4. Senior Electronic Engineer	1
5. Asstt. Meteorologist	1
6. Stenographer	1
7. Professional Assistant	1
8. Chief Mechanic / Radio Mechanic	1
9. Naib Qasid	3
10. Sweeper	1

Total : 12

* Post of Directors (Director National Flood Forecasting Bureau & Director Regional Meteorological Centre) are already available at Lahore. These posts will be placed under Chief Meteorologist for better coordination in Weather Forecasting and Flood Forecasting throughout the Country as a result of enhanced facilities for weather & flood forecasting after the establishment of National Center for remote sensing meteorology at Lahore.

- D. I. Khan Radar Site -

	No. of Post
1. Senior Meteorologist	1
2. Meteorologist	1
3. Electronic Engineer	1
4. Assistant Electronic Engineer	2
5. Professional Assistant	2
6. Sub. Engineer / Electronic Assistant	4
7. Driver	1
8. Chowkidar	2
9. Naib Qasid	2
10. Sweeper	1

Total : 17

- Rahimyar Khan Radar Site -

	No. of Post
1. Senior Meteorologist	1
2. Meteorologist	1
3. Electronic Engineer	1
4. Assistant Electronic Engineer	2
5. Professional Assistant	2
6. Sub. Engineer / Electronic Assistant	4
7. Driver	1
8. Chowkidar	2
9. Naib Qasid	2
10. Sweeper	1

Total : 17

In accordance with the above additional staff assignments, PMD has the following plan to reorganize PMD organization structure at the time of completion of the Project.

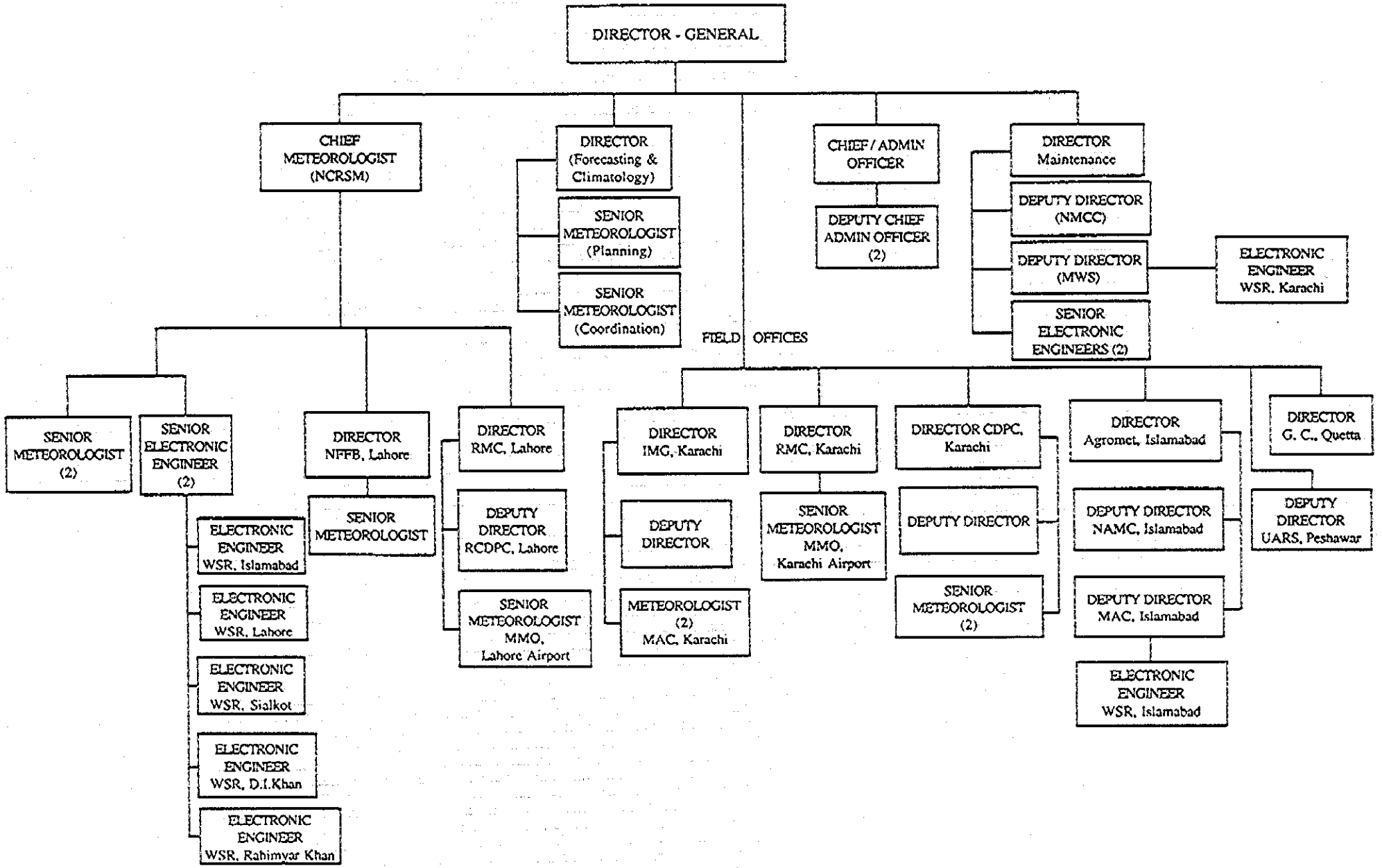


Fig. 3-1 Scheduled Organization Chart of Pakistan Meteorological Department

2. Operation and Maintenance Plan of Facilities

The existing Islamabad and Karachi radar tower buildings constructed under the previous project have been operated and maintained well by PMD.
After completion of the Project, PMD will additional play a role in operating and maintaining the weather radar tower buildings, in conjunction with other government agencies. In particular, Rahimyar Khan radar tower building will be constructed within the Rahimyar Khan airport premises owned by the Civil Aviation Authority (CAA), therefore their cooperation will be indispensable for effective operation and maintenance of the building.

<Maintenance Cost for Facilities>

After completion of the Project, PMD will take care of additional expenditure for operation of the radar tower buildings at D. I. Khan and Rahimyar Khan at his expense. The necessary expenditure for electricity, water, telephone, etc. are calculated on base of the present rate as follows.

1) Water charge : Rs2,600 / year
Per month : 5 staff × 100 ℓ / day × 1.2 × 30 days = 18,000 ℓ / month
4.5 ℓ = 1GAL
18,000 ℓ ÷ 4.5 ℓ = 4,000 GAL
Rs26/1,000 GAL
(4,000 GAL ÷ 1,000 GAL) × 12 months × Rs26 = Rs1,248 × 1,04 = Rs1,297.-
Rs1,297 × 2 sites ≒ Rp 2,596 ≒ Rs2,600 / year

2) Electricity charge : Rs250,000 / year
Electricity charges at the Karachi and Islamabad existing radar sites are approximately Rs125,000/year per site. Based on the expenditure of the existing radar sites, two new radar sites can be expected as the most likely the same power consumption of the existing radar sites as follows..
Rs125,000 / year × 2 sites = Rs250,000 / year

3) Telephone charge : Rs24,500 / year
Telephone calls : 15 calls / day at each site (supposition)
Telephone : 15 calls / day × 1.25 × 30 days × 12 months = Rs6,750 / year

Facsimile : Rs6,750 / year × 0.8 = Rs5,400 / year
Rs6,750 + Rs5,400 + 42 (Line charge) × 2 lines (Tel & Fax) = Rs12,234 ≒ Rs12,250 / year
Rs12,250 / year × 2 sites = Rs24,500 / year

4) Rental charge of the existing telecommunication links : Rs500,000/ year
Rental charge of the existing telecommunication links is expected to run at the above level. Regarding this charge is clearly stated on the PC -1 Form and accordingly, it is expected that an increased budgetary appropriation will be obtained for this purpose after completion of the Project.

5) Diesel fuel for pickup trucks : Rs26,000 / year
Diesel price per ℓ : Rs7.21
Assuming a running distance of 30 Km / day, and
diesel consumption at 7 km / ℓ ,
30 Km ÷ 7 Km / ℓ = 4.28 ℓ / day ≒ 5 ℓ / day × Rp 7.21 × 30 days ×
12 months = Rp 12,978 / year
Rp 12,978 × 2 vehicles = Rp 25,956 ≒ Rp 26,000 / year

3. Operation and Maintenance Plan of Equipment

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

- Power supply environment on unstable commercial power supply at each Project sites
- Personnel matter, based on inexperienced operators
- Operation and maintenance structure of PMD
- System failure incidence (relative to experience in Japan)
- Frequency of scheduled parts & consumables replacement and overhauls

Many electronic parts are used in the electronic equipment in these today. When they have developed a failure internally, only replacement of a part is useful to solve this failure. Therefore, the following methods will have to be applied to minimize the occurrence of failures and maintenance cost to be borne by PMD.

- The power supply to rooms to be installed radar systems should be provided through

uninterrupted power supply (UPS) and auto voltage regulator (AVR).

- At the time of installation work of the equipment, effective operation and maintenance method and technique should be provided through on-the-job training to be implemented by a contractor.

- Consideration for selection and procurement of the equipment will be necessary for utilization of local activities in the occurrence of a failure.

- Unification of spare parts and consumables for the existing equipment and the equipment to be supplied under the Project.

- For procurement of the equipment, operation and maintenance procedures should be resembled as closely as possible to the existing equipment.

In order for each responsible person to be able to appropriately and effectively perform his duty to avoid any failure, provision of operation and maintenance manuals are indispensable. In addition, on-the-job training through actual use of the equipment should be conducted to as many staff as possible in accordance with these manuals.

After expiration of the warranty period for 1 year form completion of the Project, PMD will maintain all the equipment himself, thus PMD should recognize necessity of some special expenditures at a time of problem occurred. However, for minimization of expenditures to be taken by PMD for operation and maintenance of the equipment, as much as possible, standardization and unification of spare parts & consumables and selection of the most familiarized equipment of PMD are very useful. Such a policy will be able to contribute positively to reducing financial burden of future procurement of spare parts and consumables as well as overall maintenance expenditures.

<Maintenance Cost for the Equipment>

Future maintenance costs for the equipment have been calculated on the basis of the following conditions.

The systems to be introduced under the Project will be installed at the rooms fully equipped with power backup systems, such as uninterrupted power supply, automatic voltage regulator,

and air-conditioning systems. Therefore, as the same as in Japan, the whole equipment will be installed in a suitable and effective environmental condition. In case of normal operation of the equipment under the above said conditions, the annual maintenance cost for the equipment can be estimated on the basis of Japanese experience.

1) Realistically expecting maintenance cost for the equipment

After completion of the Project, for the first year, all the equipment are still under warranty by the contractor, no problems should be encountered. Spare parts for 2 years normal operation) to be supplied should be adequate for the third and fourth year, and it is probably not expecting any major equipment failure because the whole system is still new. During these early years, therefore, maintenance expenses should be modest.
From the fifth year, practical maintenance cost will be required and the following expense may be anticipated.

Major expense items
For operating a radar system, the following essential parts, in particular, will have to be procured by PMD on a continuing basis.

- Magnetron (pulse radar transmission tubes)
  Life time : approximately 8,000 hours
- Transmitting/receiving remitter (switching equipment between radar beam transmission & receiving)
  Life time : approximately 10,000 hours
- Batteries for uninterrupted power supply equipment
  Service life : approximately 5~6 years

In Japan, a radar system is normally operated for 3,000 hours per year for meteorological observation. Figuring a usage pattern in Pakistan of about 50~70 % of Japanese levels, the systems can be expected to operate about 1,500~2,000 hours per year.
On this basis, for appropriate operation of a radar system to be installed in Pakistan, replacement of a magnetron would be required approximately every 4~5 years (8,000 hours ÷ 1,500~2,000 hours/year = 4~5 years) and also transmission/receiving remitter would be required approximately every 5 years (10,000 hours ÷ 2,000 hours/year = 5 years).

Two sets each of magnetrons and transmitting/receiving remitters are attached as actual and

standby to each weather radar system. Thus, the initial two sets of each magnetrons and transmitter /receiver remitters will last for approximately 8~10 years. However, a magnetron is a pulse radar transmission tube, certain parts will wear out before the end of the magnetron's life time, so PMD must obtain an annual maintenance appropriation at an early stage to be absolutely sure of its ability to procure these essential parts for a radar system, as required.

The PMD's maintenance capabilities have been amply confirmed on the basis of the more than 5 years' experience it has had with the existing radar systems at Islamabad and Karachi. These radar systems are still working well through appropriate maintenance of PMD, in addition, technical skill levels of radar engineers and technicians in PMD are quite enough for maintenance of a radar system.

Minimization of an annual operation and maintenance cost of PMD has been considered in the basic design study, nevertheless the operation and maintenance cost for two radar tower buildings to be constructed and the equipment to be installed under the Project will additionally be required.

In order to minimize the operation and maintenance cost, it is necessary that PMD must have the spacial consideration on minimization of consumption and must achieve economizing. It is the best method for minimization of expenditure of PMD.

・Additional Operation and Maintenance Cost due to the Project

In consequence of the above conditions, the annual operation and maintenance cost for the Project as described in the below table will be needed additionally.

	1st year	2nd year	3rd year	from 4th year
Repairing cost	Rs0.	Rs30,000.	Rs50,000.	Rs80,000.
Consumables	Rs0.	Rs0.	Rs50,000.	Rs50,000.
Water charge	RS2,600.	Rs2,600.	Rs2,600.	Rs2,600.
Electricity charge	Rs250,000.	Rs250,000.	Rs250,000.	Rs250,000.
Telephone charge	Rs24,500.	Rs24,500.	Rs24,500.	Rs24,500.
Rental charge of the existing communication lines	Rs500,000.	Rs500,000.	Rs500,000.	Rs500,000.
Diesel fuel	Rs26,000.	Rs26,000.	Rs26,000.	Rs26,000.
Total	Rs803,100.	Rs833,100.	Rs903,100.	Rs933,100.
Additional Staffing	Rs1,906,000.	Rs1,906,000.	Rs1,906,000.	Rs1,906,000.

Chapter 4
Project Evaluation and Recommendation

Chapter 4 Project Evaluation and Recommendation

4 - 1 Project Effect

1. Benefits

Weather radar is a meteorological equipment to detect the distribution of precipitation intensity using microwave. Information to be given and its possible application are as follows:

1) Weather radar system can observe the distribution of precipitation intensity instantaneously, spatially and continuously over a broad area (qualitatively within a radius of 300 km ~ 400 km). Whenever precipitation phenomena appear in this area, the distribution of precipitation intensity can be monitored continuously.

2) The precipitation intensity and other characteristics of the precipitation can be obtained from echo intensity. The movement and modification of rainfall area also can be estimated by continuous monitoring of radar echo.

3) By integration of echo intensity data, the fine-meshed distribution of precipitation can be derived.

In this way, weather radar system is very effective equipment for observing precipitation phenomena because it enables to detect precipitation and closely associated meteorological phenomena in minute quantities, both spatially and temporally. Weather radar, therefore, is utilized throughout the world in areas that are frequently attacked by meteorological disaster caused by heavy rain, cyclones or typhoons.

In addition, through the establishment of meteorological radar networks, the coverage of the radars can be significantly expanded, and it will be possible to monitor, on a nationwide scale, both the ITCZ and depressions, along with thunderstorm cloud and local severe rain arising from such atmospheric disturbances that could not be adequately captured by single weather radar.

Following the implementation of the Protect, PMD radar network will be properly established, leading to upgrading of not only observation activity but also forecasting operations. As a

result, the accuracy of forecast will be much improved and significant improvement can be expected in the content of meteorological information. This major upgrading in PMD's meteorological operations will produce the following benefits for users of meteorological information viz., the general public, disaster prevention agencies, and aviation authorities:

1) Expansion of coverage areas for disaster prevention

Owing to the newly established weather radar network based on four locations comprising the two new radars at D. I. Khan and Rahimyar Khan along with the existing stations at Karachi and Islamabad, it will became possible to monitor the entire length of the Indus River basin, which is particularly vulnerable to frequent flooding.

Up to now, on the basis of the existing weather radars, it has been possible to execute weather surveillance over the heavily populated areas of the country, primarily Karachi, the economic hub, and Islamabad, the nation's capital district. However, the Project will expand the coverage area for the new 4-stations weather radar network to about 80% of Pakistan's total area, with only parts of Sind and Baluchistan Provinces beyond monitoring range. Population density in Baluchistan is estimated to be only about 10% of the national average (154 persons per km^2 as of 1993).
Thus, the new network will be capable of monitoring over 90% of the total Pakistani population (122,800,000 in 1993). In other words, meteorological phenomena can be accurately monitored over an area inhabited by some 110 million people, thereby contributing significantly to disaster prevention throughout this vast area.

2) Countermeasures against flooding

Accumulated precipitation can be obtained by integrating the intensity of the echoes observed by the weather radars. By placing the entire Indus River basin under surveillance by the newly established meteorological radar network, it will also become feasible to calculate the areal rainfall amount of catchmont area not only along the Indus basin itself but in each of its tributary basins as well.

PMD has established National Flood Forecasting Bureau (NFFB) at Lahore in an effort to prevent or mitigate flood damage. During the monsoon season (from June to October), run-off forecasts are issued on a daily basis for each of the 5 major river basins (the Indus, Sutlej, Ravi, Chenab, and Jhelum).
NFFB presently obtains rainfall data only from old-typed radar in Sialkot. Since this equipment

has not been digitalized, data must be reported by telephone. Basin precipitation is calculated from this information.
Under the Project, however, remote display equipment will be installed at NFFB for displaying composite radar emage and other kinds of images. Within 3~17 minutes after observation by a particular radar station, all of the imagery will be made available to the system. On this basis, NFFB will be able to calculate areal precipitation in catchment area for each of five major river basins. And, by accumulating historical radar imageries, the data can be used in research and development projects aiming at improving forecast accuracy.

In addition, obtaining radar imagery from nation-wide network in short time, NFFB will be able to compile more precise heavy rain forecasts for these river basins.
Based on these improvements in the NFFB's monitoring and forecasting operations, it will be possible to create a flood forecasting system for Pakistan's major rivers, thereby, not only facilitating the estimation of flow volume entering each basin and the establishment of controls of preparatory discharges from dams, but also expediting evacuation of area residents, based on forecasts of peak flood periods and river water levels, can be expected to contribute directly to the mitigation of flood damage.

3) *Improving safety operation of aviation*

Operations of observatories at airport are intended to observe and forecast, on a more timely basis, turbulence, icing, strong precipitation, thunderstorm, typhoons, and other meteorological phenomena.
Weather radar is particularly effective in observing such meteorological phenomena as local severe rain and thunderstorm, which are relatively small in scale, ranging from 2 to 10 km, with a short lifetime of a few hours. By monitoring the movement of convective echoes and thunderstorm echoes, which are related to turbulence and icing, weather radar contributes in a major way to air transport safety.

At present, PMD maintains a radar image monitor display at its observatory at Karachi International Airport, where it receives Karachi radar imagery on real time. However, radar imagery is not yet being transmitted to other principal international airports. At Islamabad International Airport, when there is a request for radar data from the control tower or other airport personnel during periods of hazardous weather against safety operation of aircraft, radar observer currently must prepare their own sketches, reporting their information by telephone. At the observatory at Lahore International Airport, radar information is presently received every 3 hours by WMO international code. Since these methods result in a receiving

lag of 1 to over 3 hours after observation, they cannot fully cope with the need to capture occasional and ever-changing meteorological phenomena.

Under the Project, remote monitor displays are to be installed in the briefing rooms at the Karachi, Islamabad, and Lahore International Airports. In addition to the single radar imagery, these units will also display composite radar imagery, with transmission of these radar images to be effected within 3~20 minutes after observation. These transmissions will make it possible to capture meteorological phenomena accurately posing a possible hazard to aircraft operations, thereby expediting the quick delivery of meteorological information to aircrafts in flight as well as aircrafts at taking-off and landing stages.
The 3 international airports combined account of, number of flights, passenger traffic, and cargo traffic are 62%, 83% and 97% respectively, of country total. Thus, considering the socio-economic importance of these airports, major benefits can be anticipated from the monitoring equipment to be installed therein.

2. Verification of Appropriateness

In consequence of the Implementation of the Project, the PMD's meteorological observation and forecasting operations will be modernized. This will make it possible to continuously monitor the movements and transformations of atmospheric disturbances, such as Cb clusters in the ITCZ, that lead to meteorological damage, and so can be expected to improve forecasting accuracy. PMD will thereby be in a position to provide accurately timed forecasts and warnings to the general public, disaster relief organizations, aviation sectors.

Meteorological information are exchanged on-line with neighboring countries through the Global Telecommunication System (GTS) of WMO. Thus, the benefits generated by this Project will extend also to India, Afghanistan, and Iran and also through these countries other countries, even Japan, will be able to receive meteorological data of Pakistan. PMD has prepared a development plan for organizational restructuring and personnel deployment in connection with ongoing operation and maintenance of the meteorological radar network to be established under the Project. Judging by operating performance to date at the existing weather radars at Karachi and Islamabad, engineers have been satisfactorily nurtured, while an appropriate training system is also being planned. PMD is, accordingly, deemed fully capable of operation and maintenance of the new system. It has, therefore, been determined that the operation and maintenance plans for this Project are quite realistic.
Based on the above consequences, it has been concluded that it would be appropriate to implement the Project under Japan's Grant Aid Assistance.

4 - 2 Recommendation

The Project is expected to produce the considerable benefits as mentioned above. The Project would substantially contribute to the development of the basic human needs in the people of Pakistan, the appropriateness of carrying out this Project under a grant-aid has been amply confirmed. Therefore, the implementation of the Project is inferred to be truly significant.

In addition, by improving and expediting the following items, the smoothness and effectiveness of the Project could be increased further.

- In order to operate the 4 weather radar systems on an integrated basis, radar information must be standardized and their observations be conducted smoothly. It would be desirable, in this connection, that PMD establish an operational center within the organization to coordinate radar observations and establish a proper command system for the radar network operation.

- Since weather radar systems, radar imagery composite unit as well as telecommunication equipment to transmit the imagery will be installed under the Project, it is essential that competent maintenance engineers be secured for ongoing operations. To this end, an efficient and effective training plan should be established to ensure continuing development of a qualified technical personnel.

- This Project has 14 sites to be installed the equipment of the weather radar network. So as to permit integrated operation of this system in widely dispersed areas, it is vital that checks, maintenance, and adjustments of the equipment be carried out on a regular basis. It is, therefore, important, to establish a proper maintenance system in PMD.

- Radar imagery will be displayed at all 8 stations of PMD, including its head office, for use in meteorological forecasting operations. In order to diffuse and improve the standards of forecasting techniques based on the use of radar data, it is desirable that forecasters be trained and that technical skills be constantly refined for very short range forecasts.

- Through observation of precipitation distribution on a continuous basis, using weather radar system, it will be possible to estimate surface rainfall. And, by correcting these

radar-based estimates by actual surface measurements, highly accurate rainfall can be obtained which will further enhance forecasting accuracy. For this purpose, the present deployment of rain gauges at 80 sites will not be adequate and it is considered to be expanding the number of surface rain gauges, mainly within the Indus River basin.

Appendices

Appendix 1. Member List of the Survey Team

(1) Basic Design Survey Team

Mr. Hiroshi UMEZAKI	Leader Director of Second Training Division, Tokyo International Center, JICA
Mr. Masafumi NAGAISHI	Project Coordinator Second Project Study Division, Grant Aid Project Study Department, JICA
Mr. Masayasu MINEI	Technical Advisor Chief of Radar Section Observational technology Division, Observations Department, Japan Meteorological Agency
Mr. Takashi SAITO	Chief Consultant Meteorological Observation, Forecast System planner Japan Weather Association
Mr. Shigemi NISHI	Meteorological Telecommunication System Planner, Japan Weather Association
Mr. Takatomo KATAGIRI	Meteorological Radar System Planner, Japan Weather Association
Mr. Hiroshi TOYAMA	Radar Image Analysis Planner, Japan Weather Association
Mr. Yoshihisa UCHIDA	Facility & Cost Planner, Japan Weather Association

(2) Explanation of draft Report

Mr. Yasuhiro OHMINE	Leader Deputy Director of Second Training Division, Tokyo International Center, JICA
Mr. Takashi SAITO	Chief Consultant Meteorological Observation, Forecast System Planner Japan Weather Association
Mr. Shigemi NISHI	Meteorological Telecommunication System Planner, Japan Weather Association
Mr. Yoshihisa UCHIDA	Facility & Cost Planner, Japan Weather Association

Appendix 2. Survey Schedule

(1) Basic Design Study

Aug.10 - Sept. 13,1996

	1996		Study Schedule							
			Governmental Member			Consultant Member				
			Mr. Hiroshi UMEZAKI	Mr. Masafumi NAGAISHI	Mr. Masayasu MINEI	Mr. Takashi SAITO	Mr. Yoshihisa UCHIDA	Mr. Shigemi NISHI	Mr. Takatomo KATAGIRI	Mr. Hiroshi TOOYAMA
			Leader	Project Coordinator	Technical Advisor	Chief Consultant/ Meteorological Observation, Forecast System Planner	Facility and Cost Planner	Meteorological Telecommunication System Planner	Meteorological Radar System Planner	Radar Image Analysis System Planner
1	10. Aug.	Sat	Tokyo → Bangkok (NH915)							
2	11. Aug.	Sun	Bangkok → Islamabad (PK797)			Courtesy call on Embassy of Japan, JICA Office, PMD				
3	12. Aug.	Mon	(Moving to Karachi)			Courtesy call on PMD, and Meeting with them				
4	13. Aug.	Tue				Meeting with PMD				
5	14. Aug.	Wed	(Moving to Rahimiyar Khan)			Site survey				
6	15. Aug.	Thu	(Moving to Karachi)			Site survey				
7	16. Aug.	Fri	(Moving to Islamabad)			Inner meeting				
8	17. Aug.	Sat	(Moving to D. I. Khan)			Site survey				
9	18. Aug.	Sun	(Moving to Islamabad)			Data Collection for preparation of a report				
10	19. Aug.	Mon				Meeting with PMD				
11	20. Aug.	Tue				Meeting with PMD			Tokyo → Bangkok→ Karachi (TG641&TG507)	
12	21. Aug.	Wed	Signing of the Minutes of Discussion						Courtesy call on PMD	
13	22. Aug.	Thu	Reporting to Embassy of Japan, JICA office, EAD						Data Collection for preparation of cost estimate	
14	23. Aug.	Fri	Islamabad→ Bangkok→ Tokyo (PK792&TG640)			Inner meeting			Inner meeting	
15	24. Aug.	Sat				Data Collection for preparation of a report			Data Collection for preparation of cost estimate	
16	25. Aug.	Sun				Meeting with PMD			Data Collection for preparation of a report and a cost estimate	
17	26. Aug.	Mon				Site Survey	(Moving to Karachi)	Site Survey	Data Collection for preparation of a report and a cost estimate	
18	27. Aug.	Tue				Site Survey	Meeting with CAA	Site Survey	Data Collection for preparation of a report and a cost estimate	
19	28. Aug.	Wed				(Moving to Karachi)	Meeting with PMD	(Moving to Karachi)	Meeting with PMD	
20	29. Aug.	Thu				Meeting with PMD				
21	30. Aug.	Fri				Inner meeting				
22	31. Aug.	Sat				Data Collection for preparation of a report and coat estimate				
23	1. Sep.	Sun				Meeting with PMD			Site survey	Meeting with PMD
24	2. Sep.	Mon				Meeting with PMD		Data Collection for preparation of a report and coat estimate		Meeting with PMD

				Mr. Takashi SAITO	Mr. Yoshihisa UCHIDA	Mr. Shigemi NISHI	Mr. Takatomo KATAGIRI	Mr. Hiroshi TOOYAMA
25	3. Sep.	Tue		(Moving to Islamabad)	Meeting with PMD		Site survey	
26	4. Sep.	Wed		(Daily trip to Lahore)	Site survey		Data Collection for preparation of a report	
27	5. Sep.	Thu		Site survey			(Moving to Islamabad)	
28	6. Sep.	Fri		Inner meeting				
29	7. Sep.	Sat		Data Collection for preparation of a report and a cost estimate				
30	8. Sep.	Sun		Meeting and preparation of a basic design with PMD				
31	9. Sep.	Mon		Meeting and preparation of a basic design with PMD				
32	10. Sep.	Tue		Reporting to JICA office				
33	11. Sep.	Wed		(Moving to Karachi)		Karachi →	Singapore	
34	12. Sep.	Thu		Singapore →				
35	13. Sep.	Fri		→ Tokyo (SQ012)				

(2) Explanation of Draft Report

Oct.27-Nov.6.1996

			Schedule			
			Governmental Member	Consultant Member		
			Y. OHMINE	T. SAITO	Y. UCHIDA	S. NISHI
1	27-Oct.	Sun	Tokyo ⇒ Singapore (SQ997)			
2	28-Oct.	Mon	Singapore ⇒Karachi (SQ418)⇒Islamabad (PK370)			
3	29-Oct.	Tue	Meeting with Embassy of Japan , JICA Office, PMD and Economic Affairs Division (EAD)			
4	30-Oct.	Wed	Meeting with Aviation Division, Explanation of Drafty Report to PMD			
5	31-Oct.	Thu	Explanation of Drafty Report to PMD			
6	1-Nov.	Fir	Inner Meeting			
7	2-Nov.	Sat	Inner Meeting			
8	3-Nov.	Sun	Discussion on the Minutes of Discussions, Meeting with Planning Commission			
9	4-Nov.	Mon	Signing of the Minutes of Discussions, Reporting to Embassy of Japan, JICA Office and EAD			
10	5-Nov.	Tue	Islamabad ⇒Lahore (PK389)			
11	6-Nov.	Wed	⇒ Bangkok (TG506) ⇒ Tokyo(TG640)			

Appendix 3. List of Party Concerned in the Recipient Country

Pakistan Meteorological Department (PMD)

- Karachi-

Dr. Qamar-uz-Zaman Chaudhry	: Director General
Mr. Akhtar Qaiym Siddiqi	: Director, IMG
Mr. Zia-Ud-Din Khan	: Deputy Director
Mr. Askari Hasnain	: Deputy Director, MWS
Mr. Dilshad A. Khan	: Assistant Meteorologist
Mr. Shaikh Mnhammad Aslam	: Assistant Meteorologist
Mr. Aslam Fatmi	: Assistant Manager
Mr. Hazrat Mir Gui Bazar	: Meteorologist
Mr. Abdur Rehman Tariq	: Senior Store Keeper
Mr. A. Razzaq Abbasi	: Sub Engineer
Mr. Khalid Bashir	: Sub Engineer

- Karachi Airport-

Mr. Naeem Shah	: Deputy Director

- Islamabad -

Mr. Anjum Bari Farooqi	: Director
Mr. Ghulam Rasul	: Deputy Director
Mr. Umar Hayat Ghalib	: Meteorologist
Mr. Ghulam Qadir Malik	: Meteorologist
Mr. Azmat Hayat Khan	: Meteorologist

- Lahore -

Mr. Muhammd Munir Sheikh	: Director, NFFB
Mr. Ghulam Sarwar Khan	: Deputy Director

- Multan Airport -

Mr. M. Javaid Iqbal	: Meteorologist

- Peshawar -

Mr. Rafig	: Deputy Director

- D.I.Khan-

Mr. Ajab Khan	: Assiatant Meteorologist

Aviation Division

- Rawalpindi -

Mr. M. Iqdal Farid	: Secretary
Mr.Sheikh Mohammad Saleem	: Joint Secretary

Economic Affairs Division (EAD)

- Islamabad -

Mr. Shahid Humayun	: Deputy Secretaary

Planning Committee

- Islamabad -

Dr. M. Ashraf Moten	: Chief

Pakistan Telecommunication Authority (PTA)

- Islamabad -

Mr. Mohammad Khalid Noor	: Deputy Director

National Telecommunication Corporation (NTC)

- Islamabad -

Mr. Muhammad Zafar Iqbal	: Chief Engineer, Long Distance

- Peshawar -

Mr. Abdul Rashid	: Director

Pakistan Telecommunication Corporation Ltd. (PTCL)

- Karachi -

Mr. Noor Mohammad	: Divisional Engineer, Maintenance
Mr. Naeem Farooqi	: Divisional Engineer
Mr. ZafarMasood	: Divisional Engineer

- Islamabad -

Mr. Abdus Sattar Baloch	: Acting General Manager, : Director of Optical Fiber System
Mr. Muhammad Ashraf Tahir	: Assistant Divisional Engineer, : Optical Fiber System Region
Mr. Behram Shahrokh	: Divisional Engineer, Optical Fiber System
Mr. M. Aslam Baluch	: Divisional Engineer, Public Data Network
Mr. Hassan Raza	: Divisional Engineer
Mr. Zair Ullah	: Deupty Chief Engineer, Long Distance

- D.I.Khan -

Mr. Amix Nawar Khan	: Divisional Engineer, Phones
Mr. Muhammad Isa Khan	: Divisional Engineer, Long Distance

- Rawalpindi -

Mr. Hassan Raza	: Divisional Engineer

- Peshawar -

Mr. Mumtaz Mohammad	: Divisional Engineer,
	: Public Data Network

Carrier Telephone Industries(Pvt)Ltd. (CTI)

- Islamabad-

Mr. Sultan Hassan	: Manager, Sales & Marketing
Mr. Mohammad Abid Farooq	: Executive, Sales & Marketing

Civil Aviation Authority (CAA)

- Karachi -

Mr. Mohammad Zafar Sahi	: General Manager, Air Traffic Services
Mr. Aslam Qureshi	: General Manager, Civil Designing
Mr. Aftab Ahmed Khan	: Director, Air Traffic Service
Mr. Tahir Omar	: Corporate Manager,
	: Management Information System
Mr. Muhammad Yousuf Shaikh	: Corporate Maneger, Planning Works
Mr. Razi Ata Karim	: Assistant Manager, Technical Planning
Mr. M. MH. Rana	: Group Captain
Mr. Shah Monis Ahmad	: Corporate Manager, Architecture

- Islamabad Airport -

Mr. Tufail Muhammad	: Airport Manager
Mr. M. Yaqub Satti	: Deputy Airport Manager

- Rahimyar Khan Airport -

Mr. Muhammad Iqbal Ch.	: Airport Manager, Rahimyar Khan

PDS Ltd. (SUPERNET)

- Islamabad -

Mr. Salman Ansari	: Chief Engineering Officer
Mr. Iran Malik	: Manager, Engineering (VSAT)
Miss Wajiha Malik	: Assistant Engineer, Planning & Development