8.5 Access Road and Car Parking Area

8.5.1 Access Road

The existing access road will be extended to the west to the new terminal area as shown in Figure 8.1.1.

Alignment of the access road at the entrance to the airport will be improved. The width of the two lane access road is planned to be 7m with a 1m wide shoulder on each side.

An underpass is required at the intersection with the military taxiway.

8.5.2 Car Parking and Internal Road

A public car parking area with about 560 parking spaces is planned to meet the Phase I requirement. The dimension of one parking space is 5m x 2.5m. Taxi and bus stands will also be provided.

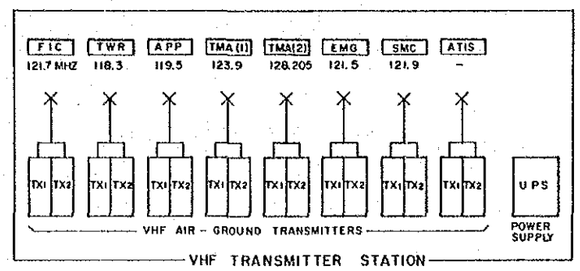
The width of the two lane internal road is designed to be 7m except for the terminal frontage road. The terminal frontage road consists of two through traffic lanes, one passing lane and one parking lane; hence the total width is 13.25m as shown in Figure 8.1.2.

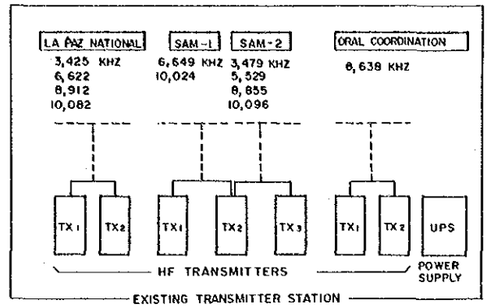
8.6 Air Navigation Systems

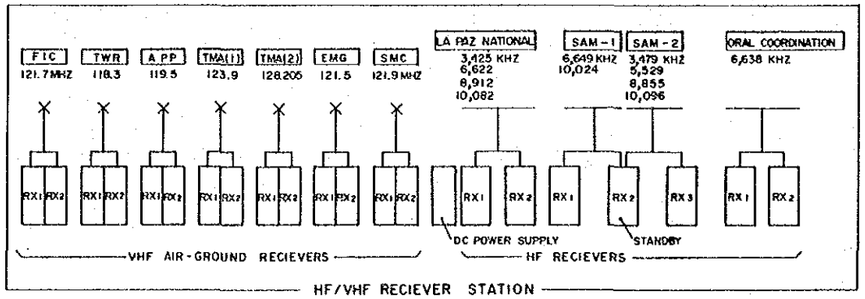
Renovation of the air navigation systems has been studied and the system plan is shown in Figure 8.6.1.

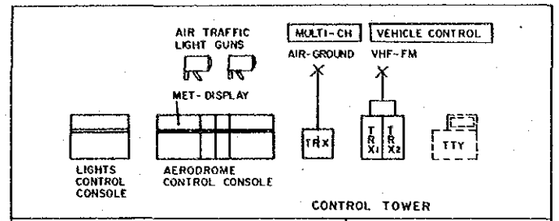
8.6.1 Radio Navigation Aids

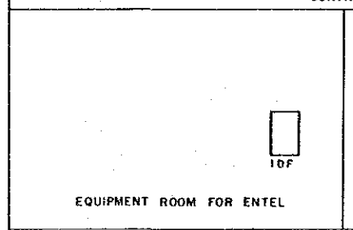
Replacement of the existing conventional type VHF omni-directional range and co-located distance measuring equipment (C-VOR/DME), and locator has been planned in Phase-I, while the non-directional beacon (NDB) is scheduled to be replaced by AASANA in 1988. The instrument landing system (ILS) will be replaced by a microwave landing system (MLS) in accordance with the ICAO ILS/MLS transition plan. Air navigational aids plan is shown in Figure 8.6.2.

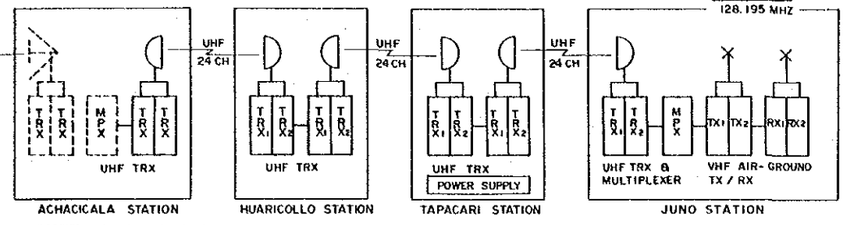


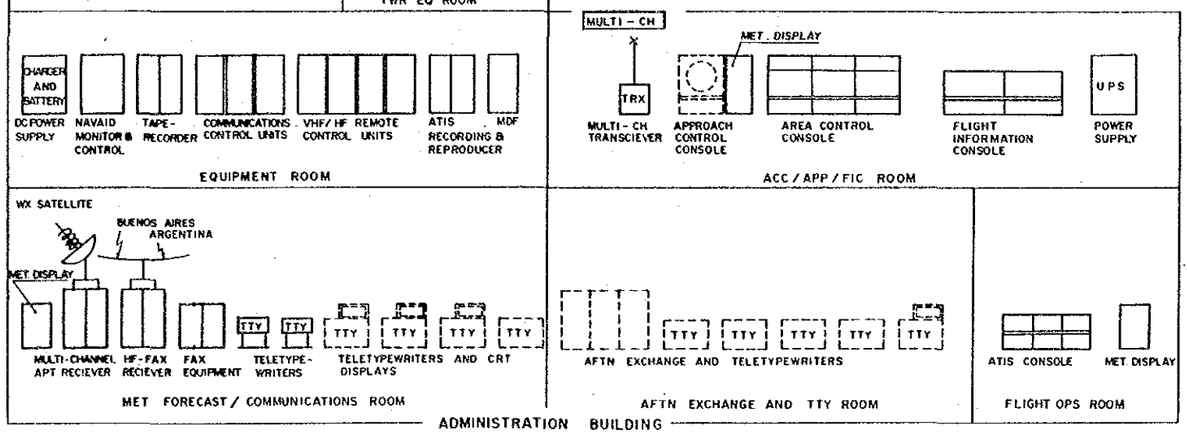


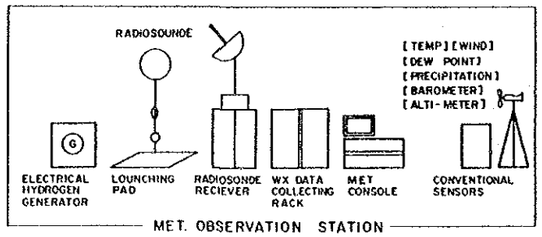


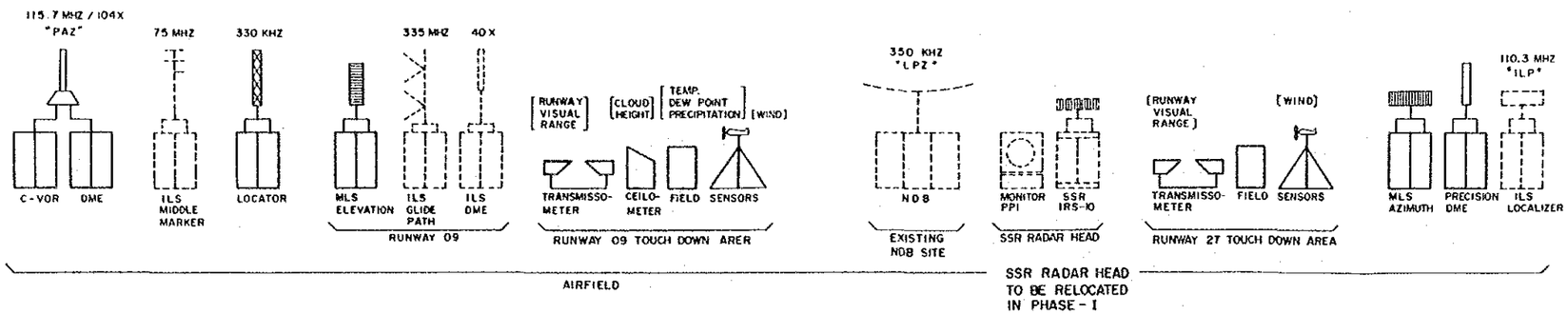


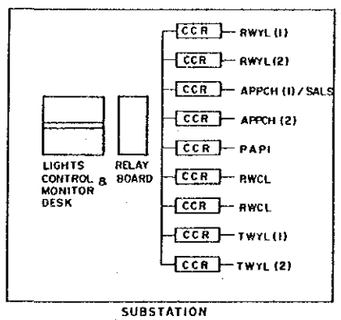






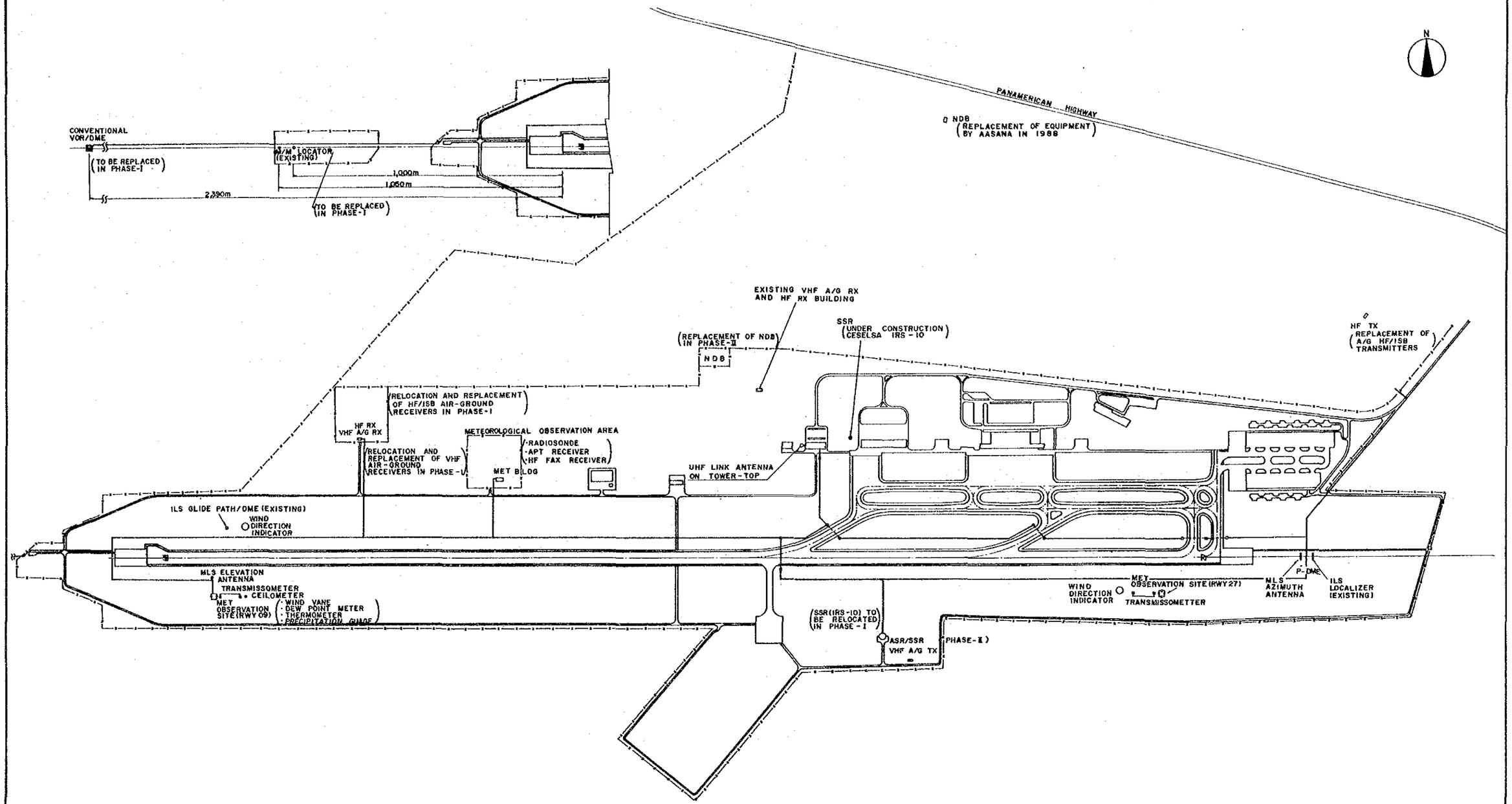






LEGEND	
	EXISTING EQUIPMENT
	PHASE-I DEVELOPMENT PROJECT

FIGURE 8.6.1 BLOCK DIAGRAM OF AIR NAVIGATION SYSTEMS



LEGEND	
———	MAIN CABLE ROUTE (DIRECTLY BURIED)
———	DUCTS AND MANHOLES

FIGURE 8.6.2 AIR NAVIGATIONAL AIDS LAYOUT PLAN

0 100 200 300 400 600
SCALE IN METERS

8.6.2 Air Traffic Control and Aeronautical Telecommunications Systems

The terminal secondary surveillance radar (SSR) presently being installed will be relocated south of the runway near the existing sewage treatment plant. The radar control console will also be relocated to an approach control room in the administration building.

All the VHF air-ground radios, viz., La Paz Information, La Paz Control, La Paz Approach, La Paz Tower, Surface Movement Control, and Emergency, will be replaced by completely dual equipment. The transmitter and receiver antenna sites will be relocated to the airside of the terminal in order to obtain complete coverage for VHF radios between aircraft. The HF air-ground radios for SAM-1, SAM-2, and National use will be replaced with new equipment, while other more reliable means of communication such as AASANA UHF link, ENTEL microwave link, etc., will be substituted for the HF ground-ground radios.

The existing VHF links for aeronautical use connecting El Alto airport and the Juno relay station will be replaced by UHF links in order to resolve the radio interference to VHF links and to ensure high reliability for fixed communication.

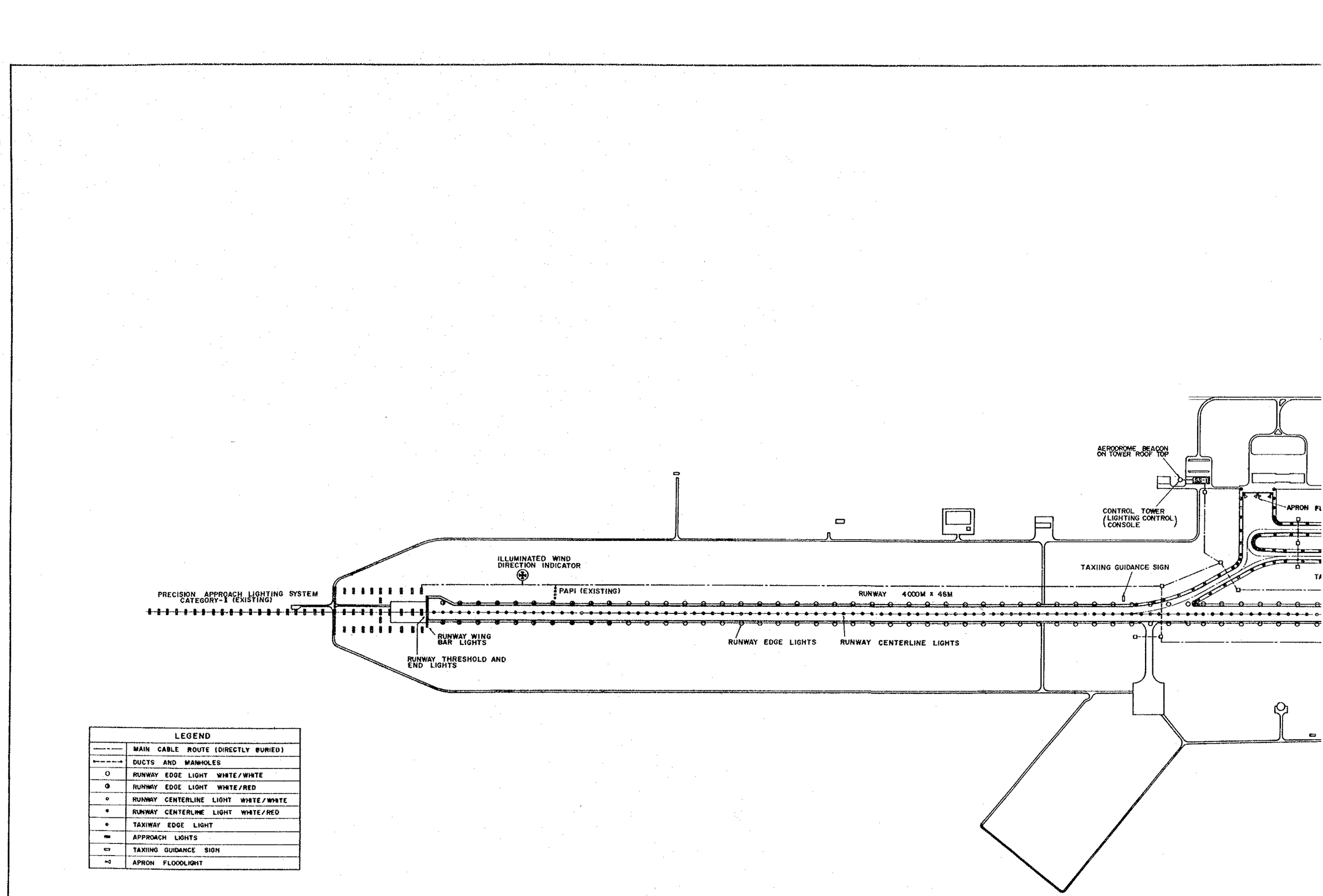
8.6.3 Aeronautical Ground Lights

Replacement of all the existing aeronautical ground lights except for the precision approach category-II lighting system and precision approach path indicator (PAPI) has been planned. The replacement of lights will include constant current regulators (CCR), lighting fixtures and bulbs, sealed transformers, re-wiring of high/low tension cables, control consoles, etc.

Runway centerline lights will be installed new for precision approach category-I operations.

A logic system will be introduced for intensity control of aeronautical ground lights.

Aeronautical ground lights plan is shown in Figure 8.6.3.



LEGEND	
———	MAIN CABLE ROUTE (DIRECTLY BURIED)
——→——→	DUCTS AND MANHOLES
○	RUNWAY EDGE LIGHT WHITE/WHITE
◑	RUNWAY EDGE LIGHT WHITE/RED
◦	RUNWAY CENTERLINE LIGHT WHITE/WHITE
•	RUNWAY CENTERLINE LIGHT WHITE/RED
◆	TAXIWAY EDGE LIGHT
▬	APPROACH LIGHTS
▭	TAXIING GUIDANCE SIGN
⊲	APRON FLOODLIGHT

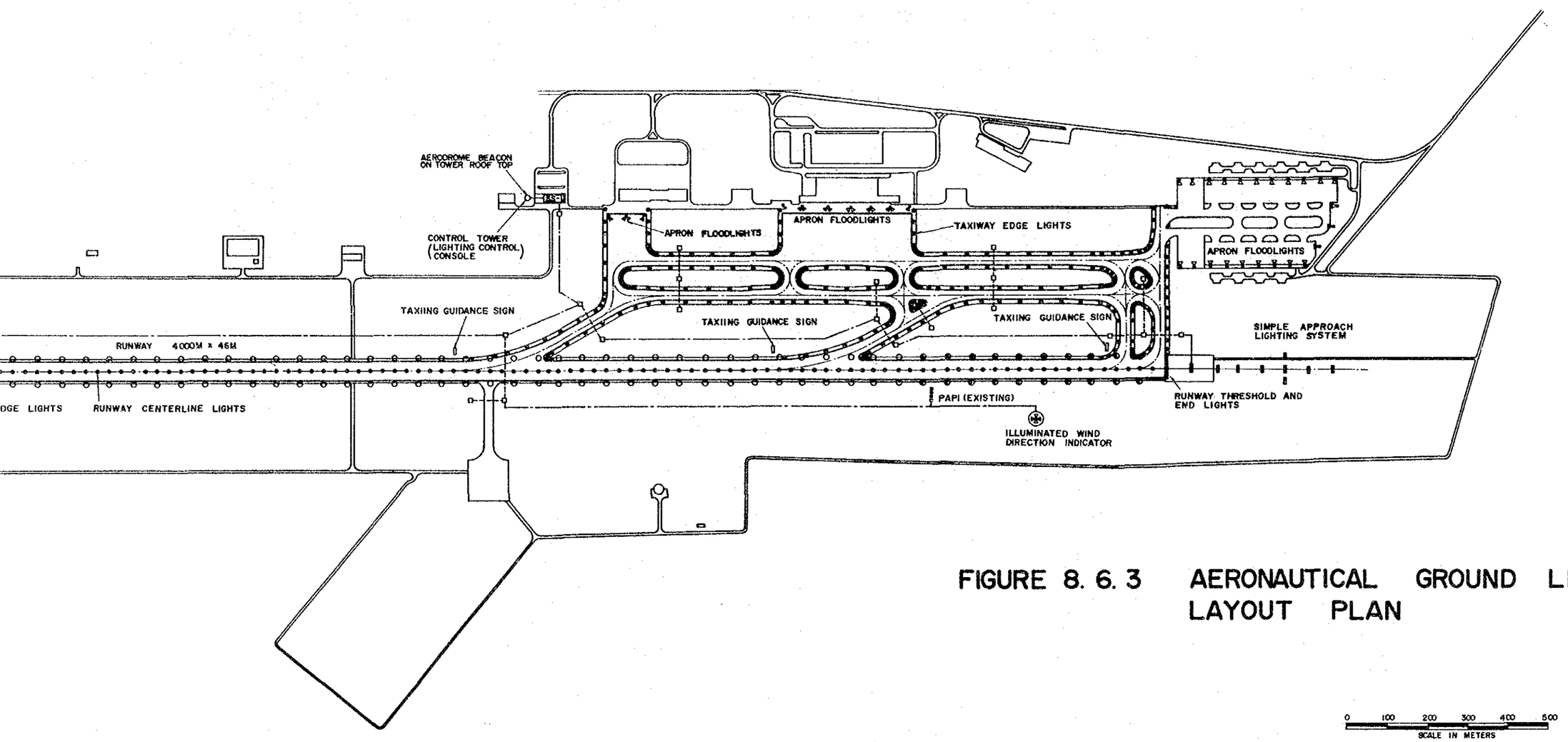


FIGURE 8. 6. 3 AERONAUTICAL GROUND LIGHTS LAYOUT PLAN

8.6.4 Meteorological System

Meteorological forecast and telecommunications offices will be accommodated in the administration building while a meteorological observation station will be located separately near the runway, and between the sewage treatment plant and receiver station.

All meteorological systems and equipment will require drastic renovation. Airport surface sensors will be located near runway 09 and 27 touch-down areas and observed data will automatically be collected and compiled at the meteorological observation station.

The airport surface data such as wind speed and direction, temperature, QNH etc., will be distributed and displayed at the aerodrome control tower, approach control room, etc.

In order to obtain and forecast weather charts, an automatic picture transmitter (weather satellite) receiver, HF radio facsimile equipment will be replaced and installed at the meteorological forecast/communications offices in the administration building, while radiosonde facilities complete with hydrogen generator will be installed at the meteorological observation station and upper air data will be sent to meteorological forecast/communications offices.

8.7 General Services

8.7.1 Rescue and Fire-Fighting Services

The airport category for rescue and fire fighting services in the Phase I development is category 7. One rapid intervention vehicle, two major vehicles, one ambulance and one command car will be accommodated in the fire fighting station.

8.7.2 Aviation Fuel Supply

A fuel yard and fuel hydrant system will be constructed by YPFB. These facilities are excluded from the construction items of the Phase I development, but the areas required are reserved as shown in Figure 8.1.1.

8.8 Airport Utilities

8.8.1 Power Supply System

The power supply system will consist of 14 substations and 6.6 KV and 380/220V distribution lines connecting each of the substations and other facilities as shown in the diagram in Figure 8.8.1.

Electrical power is planned to be supplied by two lines from Alto La Paz substation and Tarapaca substation of COBEE as shown in Figure 8.8.2 in order to provide high reliability.

The power supply system planned for the airport is shown in Figure 8.8.3. One 1000 KVA emergency generator will be installed in switching and generator station in order to supply emergency power to essential consumers in the airport in case of commercial power interruption. The emergency generator starting time is less than 15 seconds in accordance with the ICAO requirements for precision approach category I.

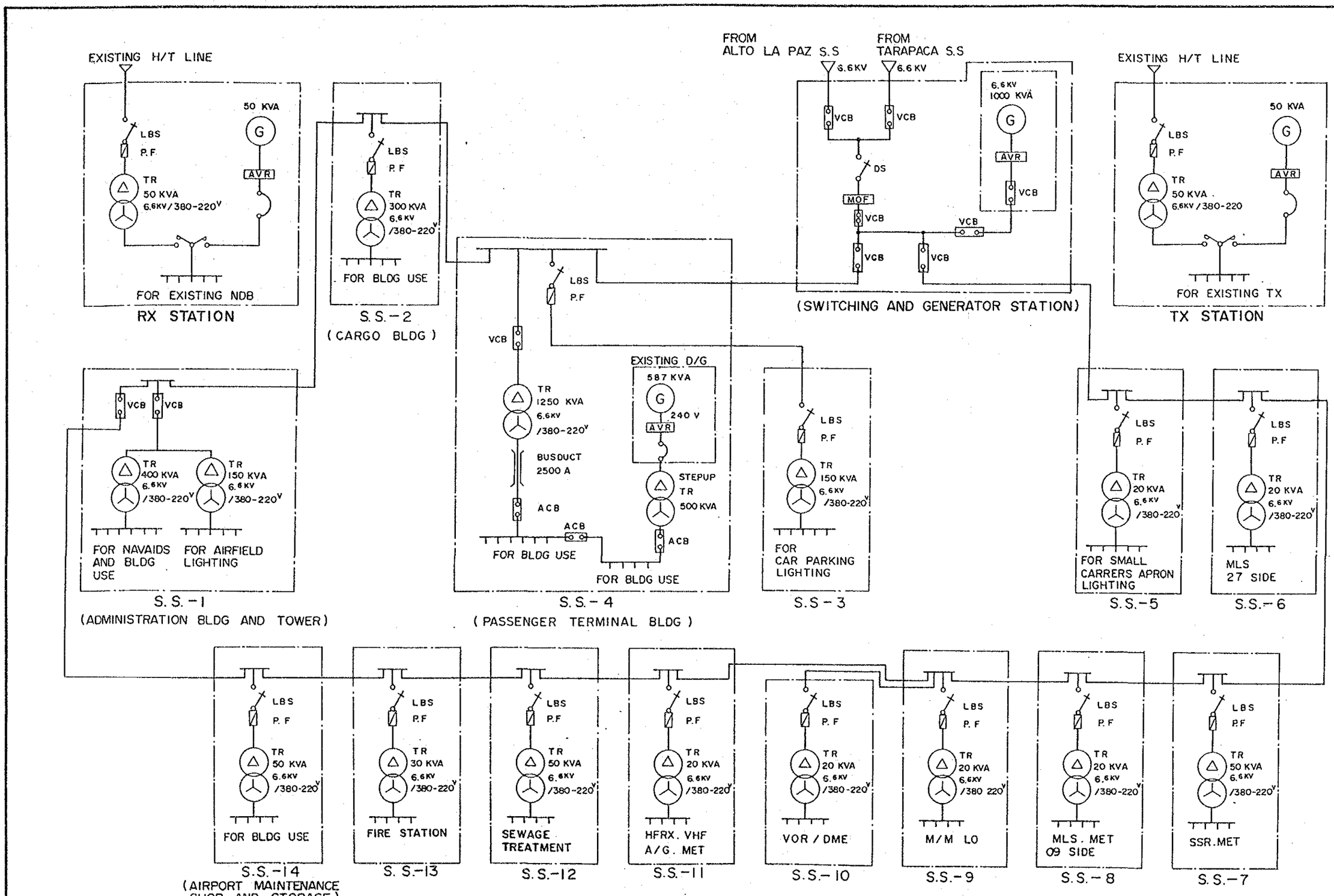


FIGURE 8.8.1 POWER SUPPLY SYSTEM CIRCUIT DIAGRAM

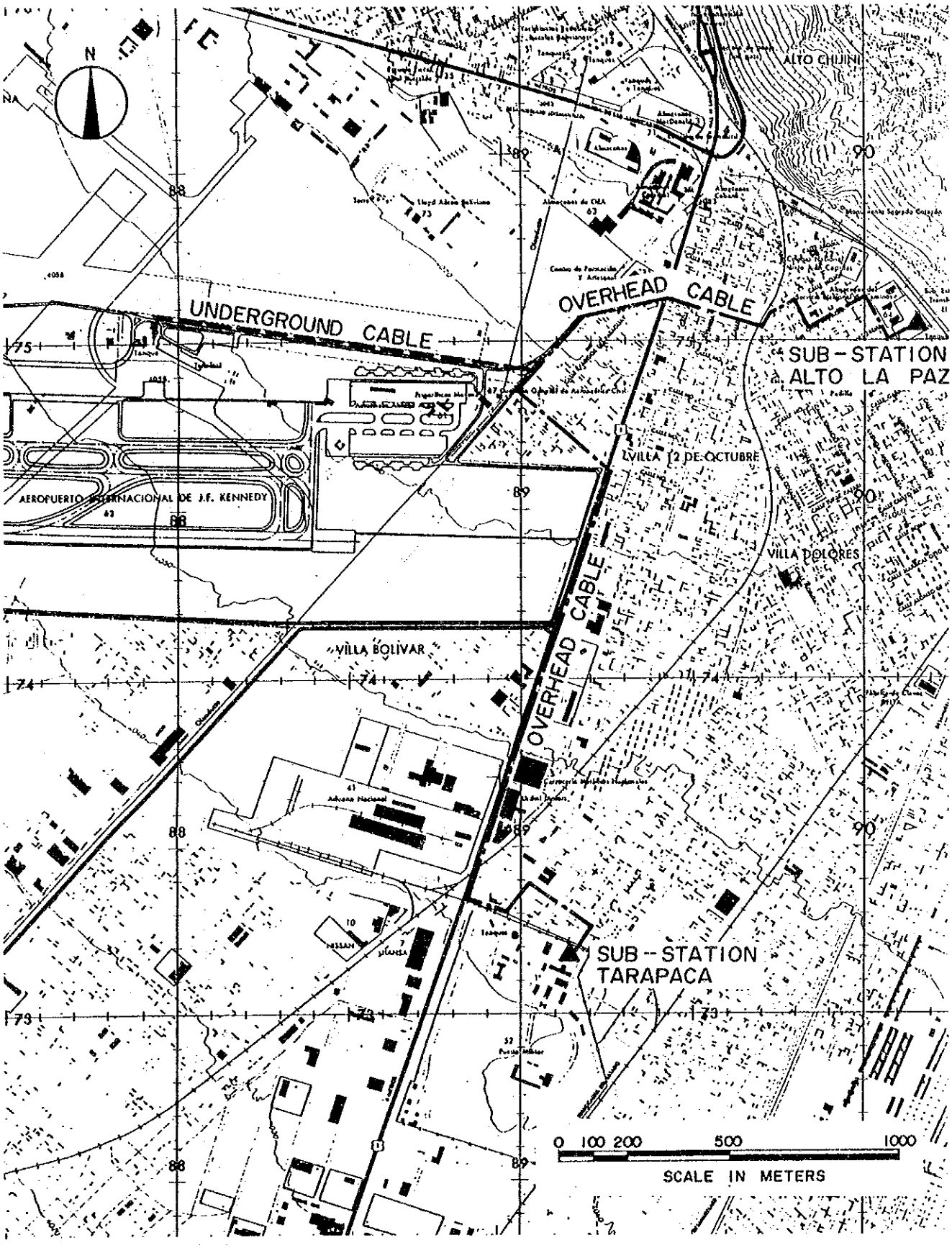
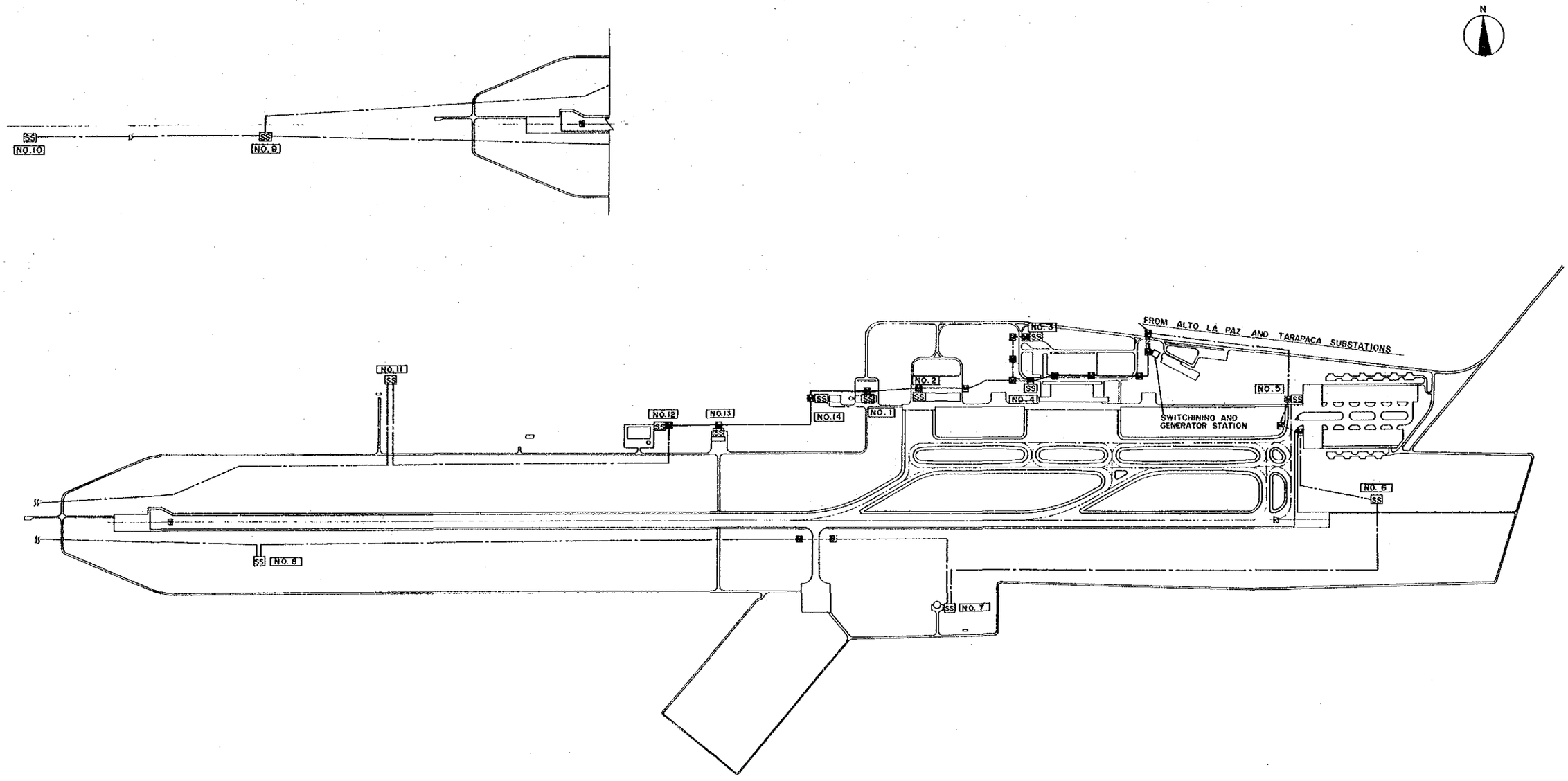


Figure 8.8.2 Power Distribution to the Airport



LEGEND	
———	6.6 KV XLPEMAZV 3C - 150°
—·—·—	6.6 KV XLPEMAZV 3C - 35°
SS NO. 1	SUBSTATION NUMBER
▭ - - - ▭	DUCTS AND MANHOLES

FIGURE 8.8.3 POWER SUPPLY SYSTEM PLAN

0 100 200 300 400 500
SCALE IN METERS

8.8.2 Water Supply System

Water will be supplied from the existing water transmission main of SAMAPA. A new distribution main for the airport will be connected to this water main at the entrance to the airport. The capacity of this connecting main will be designed to accommodate the demand for the Phase II development.

An elevated tank system will be adopted for the water distribution system taking into account the steady state nature of that type of water supply compared with the direct supply system. The concept for the water supply system is shown in Figure 8.8.4.

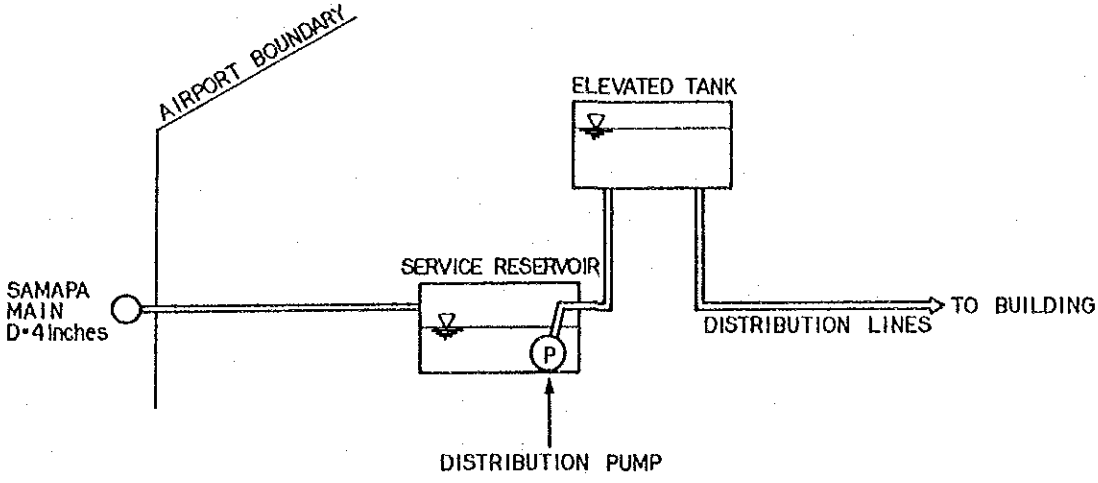


Figure 8.8.4 Concept of Water Supply System

8.8.3 Sewerage System

There are various systems to be considered for the sewage treatment, such as extended aeration, rotating biochemical contactor, oxidation ditch, oxidation pond, etc. Each has its advantages and disadvantages based on the external conditions of the system to be adopted.

For this study, an extended aeration method is recommended related to the stable quality of the effluent, lower construction and operating cost and compatibility with the climate of the site which is relatively cold during the winter.

The concept of the extended aeration method is shown in Figure 8.8.5.

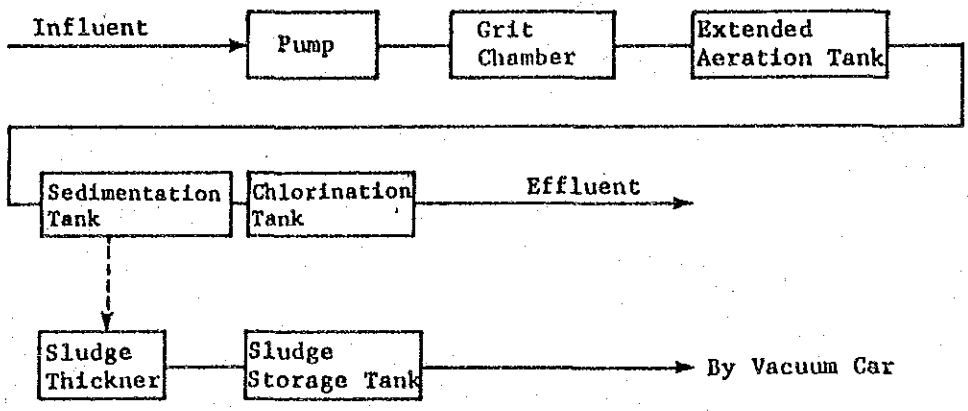


Figure 8.8.5 Concept of Sewerage System

The wastewater disposed from each building and facility will be collected through sewer pipes and transmitted to the sewage treatment plant, and the effluent water will be discharged into the Seco River.

8.8.4 Solid Waste Disposal System

The installation of a special incinerator which can handle both rubbish and garbage waste is recommended. The solid waste collected by trucks will be burned in an incinerator which will be located near the sewage treatment plant.

CHAPTER 9 AIRSPACE USE

CHAPTER 9 AIRSPACE USE

9.1 General

This chapter discusses airspace use for El Alto airport. There are no unusual problems related to aircraft operations anticipated in and around El Alto airport even in the future after completion of the modernization works.

9.2 Aircraft Operations Procedures

The existing aircraft operations procedures such as instrument approach procedures and standard instrument departures for El Alto airport are basically considered to be unchanged.

9.3 Obstacle Limitation Surfaces

Figure 9.3.1 shows the obstacle limitation surfaces for El Alto airport. The obstacle limitation surfaces were studied based on the ICAO requirements for precision approach Category-I (Aerodrome reference code: 4E).

No obstruction protrudes upon the approach and transitional surfaces for El Alto airport.

TV antenna masts, hills and houses protrude upon the inner horizontal and conical surfaces on the northern side of El Alto airport as shown in Figure 9.3.1. Safe operations for a circling approach to Runway 27 will be ensured, however, by setting the maneuvering area on the southern side of the airport so as to avoid these obstacles.

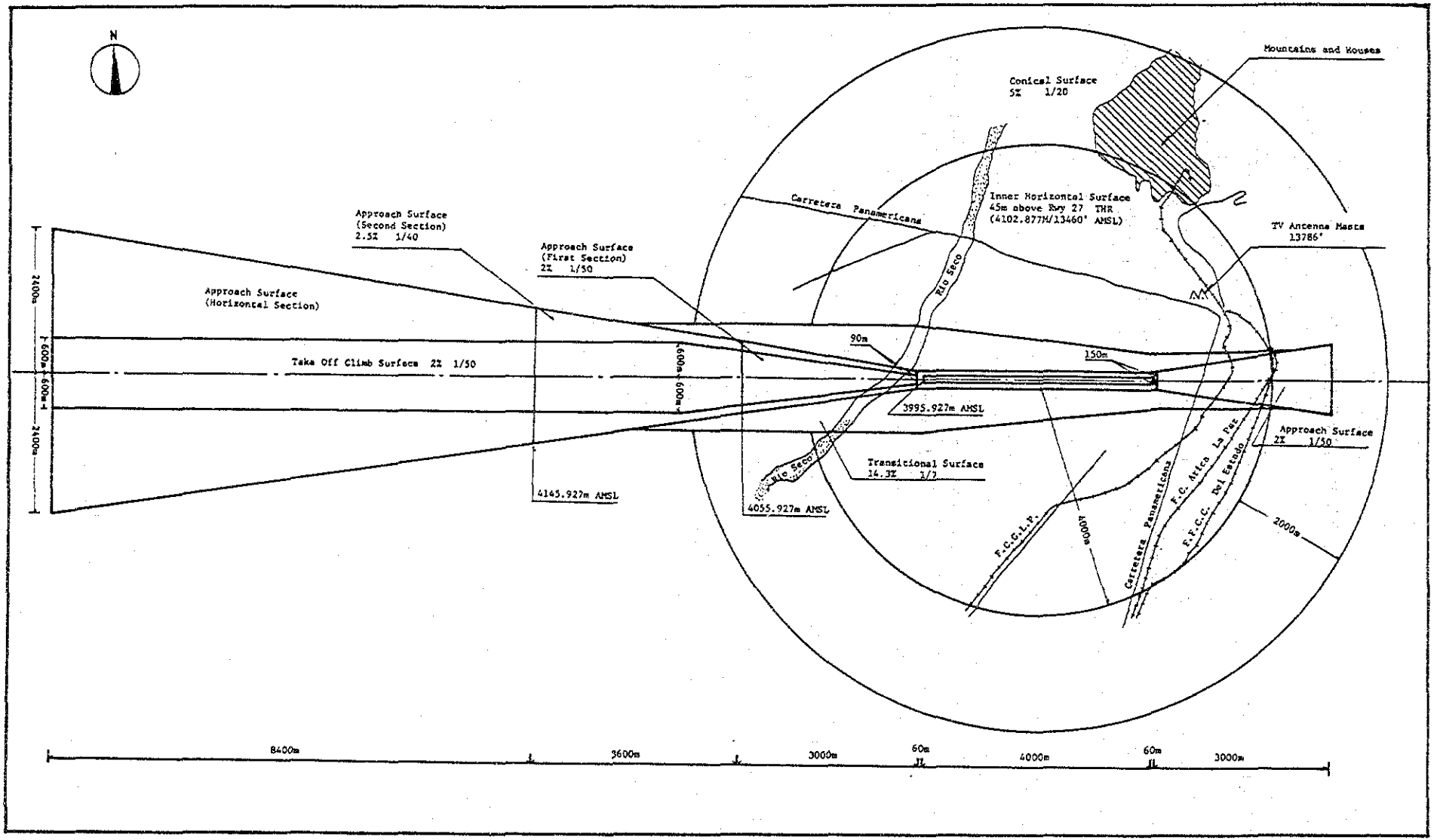


Figure 9.3.1 Obstacle Limitation Surfaces
for El Alto Airport (Phase-I)

CHAPTER 10 SUPPLEMENTARY CONSIDERATIONS

CHAPTER 10 SUPPLEMENTARY CONSIDERATIONS

10.1 General

This chapter presents the results of the study on aircraft noise influence and land use of the area surrounding the airport.

10.2 Aircraft Noise

Development of aircraft noise contours measured in Weighted Equivalent Continuous Perceived Noise Level (WECPNL) is shown in Figures 10.2.1 and 10.2.2. (For details of WECPNL, refer to Attachment F to Annex 16 *Environmental Protection*, Vol. 1 *Aircraft Noise*, ICAO)

At the present time, a densely populated area located to the east and south-east of the airport is covered by the noise level of WECPNL 70. The northern part of a residential area provided by CONAVI (Concejo Nacional de Vivienda, National Housing Bureau of the Ministry of Urbanization and Housing) is also within the noise level of WECPNL 70.

In the year 2005, the noise contour of WECPNL 70 will extend to approximately 7.5km west of the runway 09 threshold and approximately 2.5km east of the runway 27 threshold. The total area covered by WECPNL more than 70 will increase 1.6 times the present level.

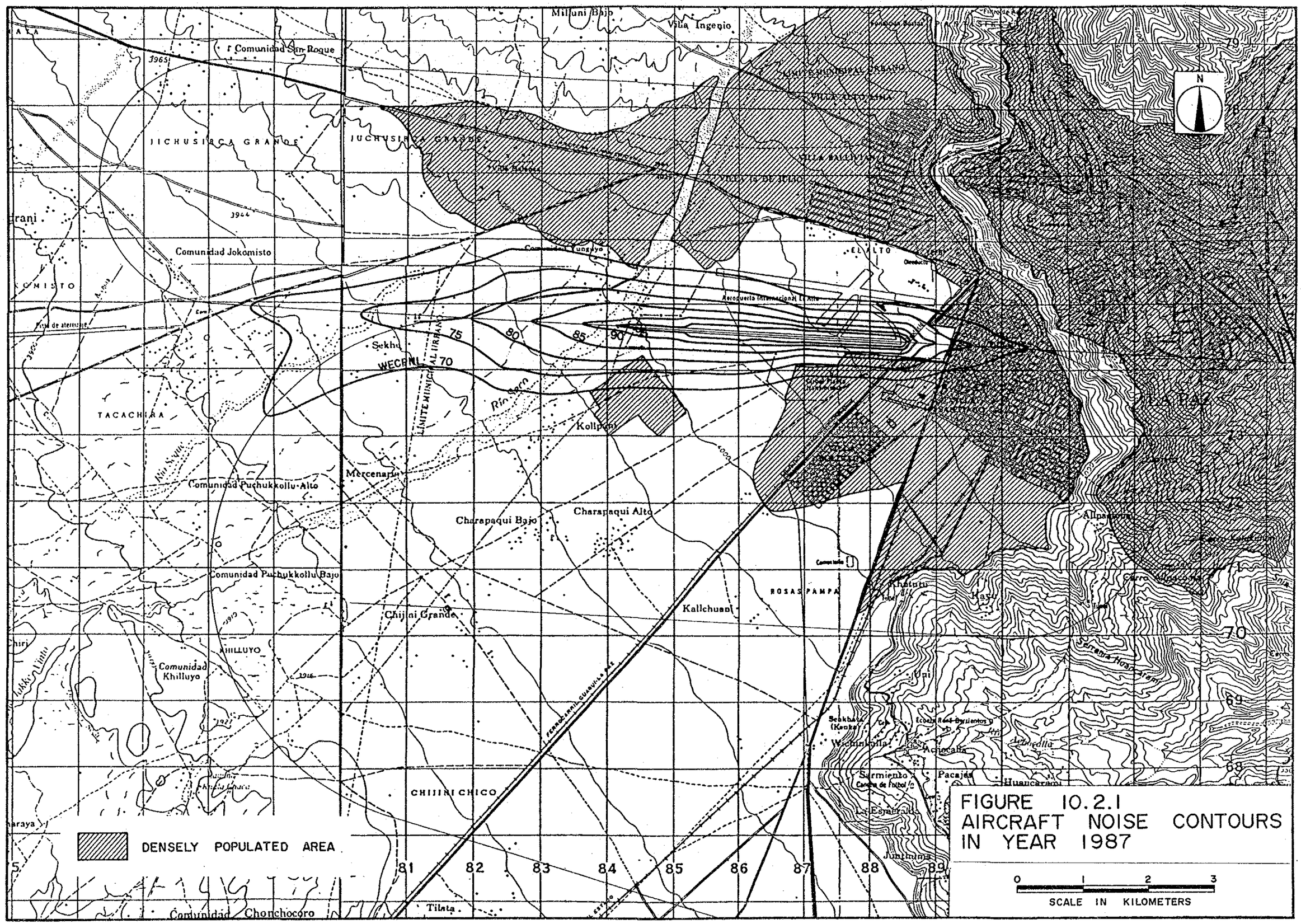
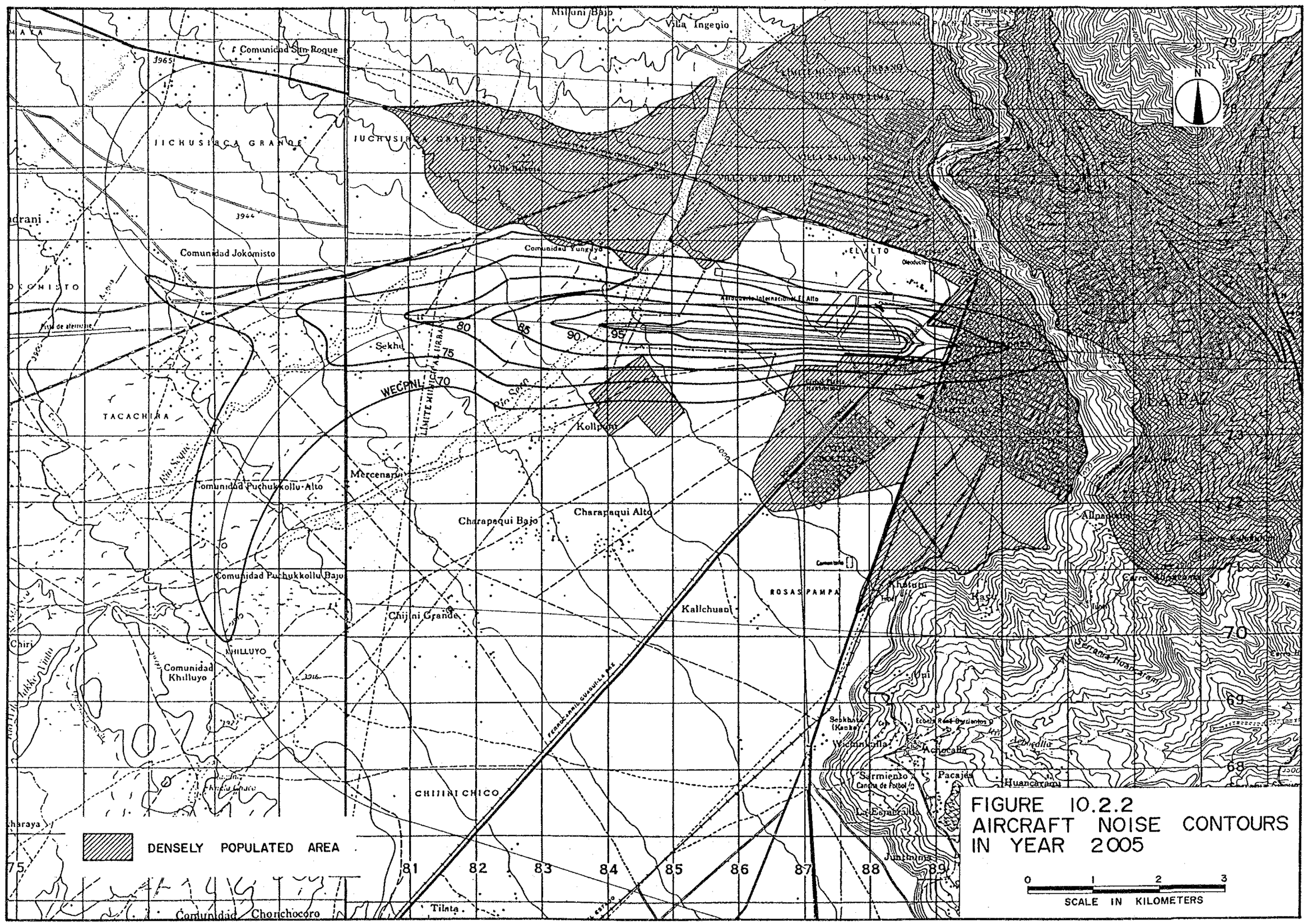


FIGURE 10.2.1
AIRCRAFT NOISE CONTOURS
IN YEAR 1987


Miluni Bajo
Villa Ingenio
Comunidad San Roque
JICHUSIRCA GRANDE
Villa Bolivia
Comunidad Jokomisto
Comunidad Yungoyo
EL ALTO
Aeropuerto Internacional El Alto
Sekhu
WECPNI
Río Seco
Kollpani
TACACHIRA
Mercenario
Comunidad Puchukkollu Alto
Charapaqui Bajo
Charapaqui Alto
Comunidad Puchukkollu Bajo
Chijini Grande
Kallchuani
ROSAS PAMPA
Khatutti
Kasu
Chiri
Comunidad Khilluyo
Upi
Sarmiento
Pacajes
Huancarani
CHIJINI CHICO
La Esperanza
Jiskimira
Tilata
Comunidad Chonchocoro
LA PAZ
Allpacoma
Cerro Achocalla
Achocalla
Pasankeri
DENSELY POPULATED AREA
FIGURE 10.2.2
AIRCRAFT NOISE CONTOURS
IN YEAR 2005
SCALE IN KILOMETERS

10.3 Land Use Planning of the Area Surrounding the Airport

In the vicinity of the airport, development of residential area is presently underway. However, it has been confirmed as shown in Figures 10.2.1 and 2 that the increase of air traffic will expand the area influenced by aircraft noise.

A comprehensive land use plan which incorporates the future population growth in this area and increase of aircraft noise is, therefore, necessary to be established based on an evaluation of existing conditions.

For this purpose, a criteria for land use controls for aircraft noise is proposed based on experience in Japan.

- Proposed Criteria -

WECPNL $\geq$ 70 : Not suitable for public facilities such as schools, hospitals, churches etc.
$\geq$ 75 : No new residences are recommended
$\geq$ 90 : Not suitable for residence

It is noted, however, that the method of estimating noise contours includes an approximation of the calculation as mentioned in Section 10.1 of the Supporting Information Report. Further study may, therefore, be required for the detailed land use planning.

CHAPTER 11 IMMEDIATE IMPROVEMENT

CHAPTER 11 IMMEDIATE IMPROVEMENT

11.1 General

In this chapter, the preliminary design, work schedule and necessary costs for the immediate improvement are described for MDA/AASANA's reference in order to solve the unusual problem of the existing airport facilities.

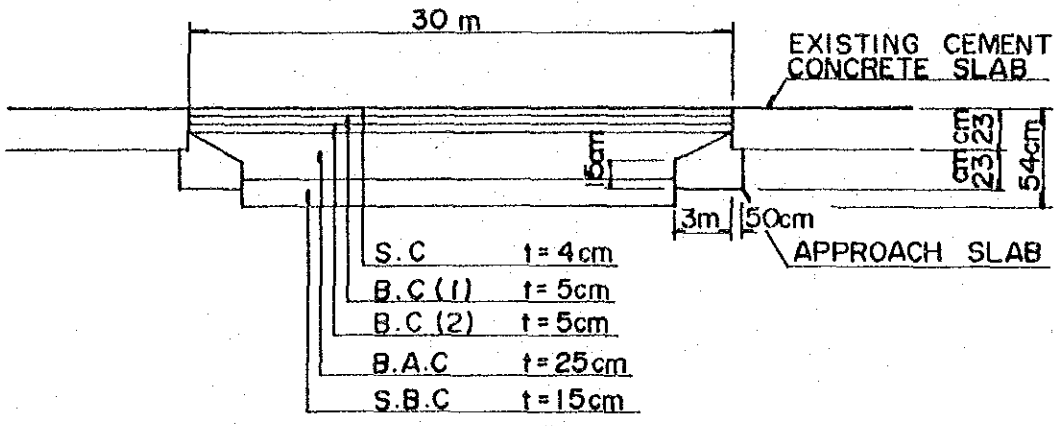
The following three construction items are included in the immediate improvement requirements as mentioned in Chapter 7:

- Improvement of the runway pavement
- Construction of runway shoulders and blast pads
- Renovation of the existing passenger terminal building

11.2 Preliminary Design for Immediate Improvement

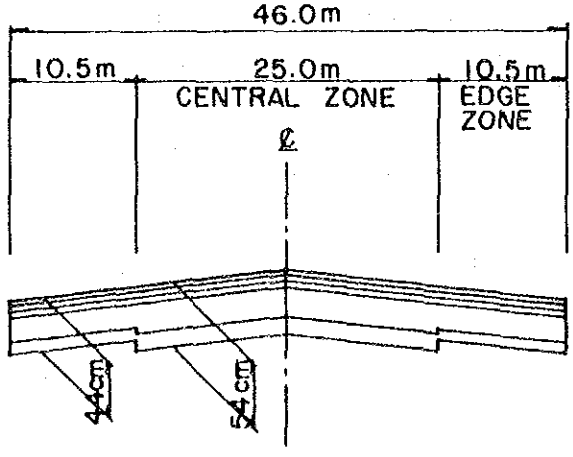
11.2.1 Improvement of Runway Pavement

The existing cement concrete pavement which occupies an area 30m long and 46m wide located at 1,740m from runway 09R threshold, is seriously damaged, and will, therefore, need to be replaced with a new pavement with adequate strength necessary to accommodate the largest aircraft operated at the present; i.e. B-747 as shown in Figure 11.2.1.



Legend, S.C : Surface course (Asphalt concrete)
B.C : Binder course (Asphalt concrete)
B.A.C : Base course (Graded aggregate)
S.B.C : Sub-base course (Crusher-run)

Profile along Runway Centerline



Cross Section

Figure 11.2.1 Improvement Plan for Runway Pavement

11.2.2 Construction of Runway Shoulders and Blast Pads

The 7m wide runway shoulders for the existing main runway 09R/27L and 60m wide and 120m long blast pads will be constructed as shown in Figure 11.2.2.

11.2.3 Renovation of the Existing Passenger Terminal Building

At the present time MDA/AASANA has a renovation plan to expand the existing passenger terminal building to a total floor area of approximately 6,000 sq.m and install boarding bridges to be donated by the United States of America. If this plan is not implemented, however, at least another renovation plan shown in Figure 11.2.3 should be implemented in order to eliminate the serious congestion in the existing passenger terminal building.

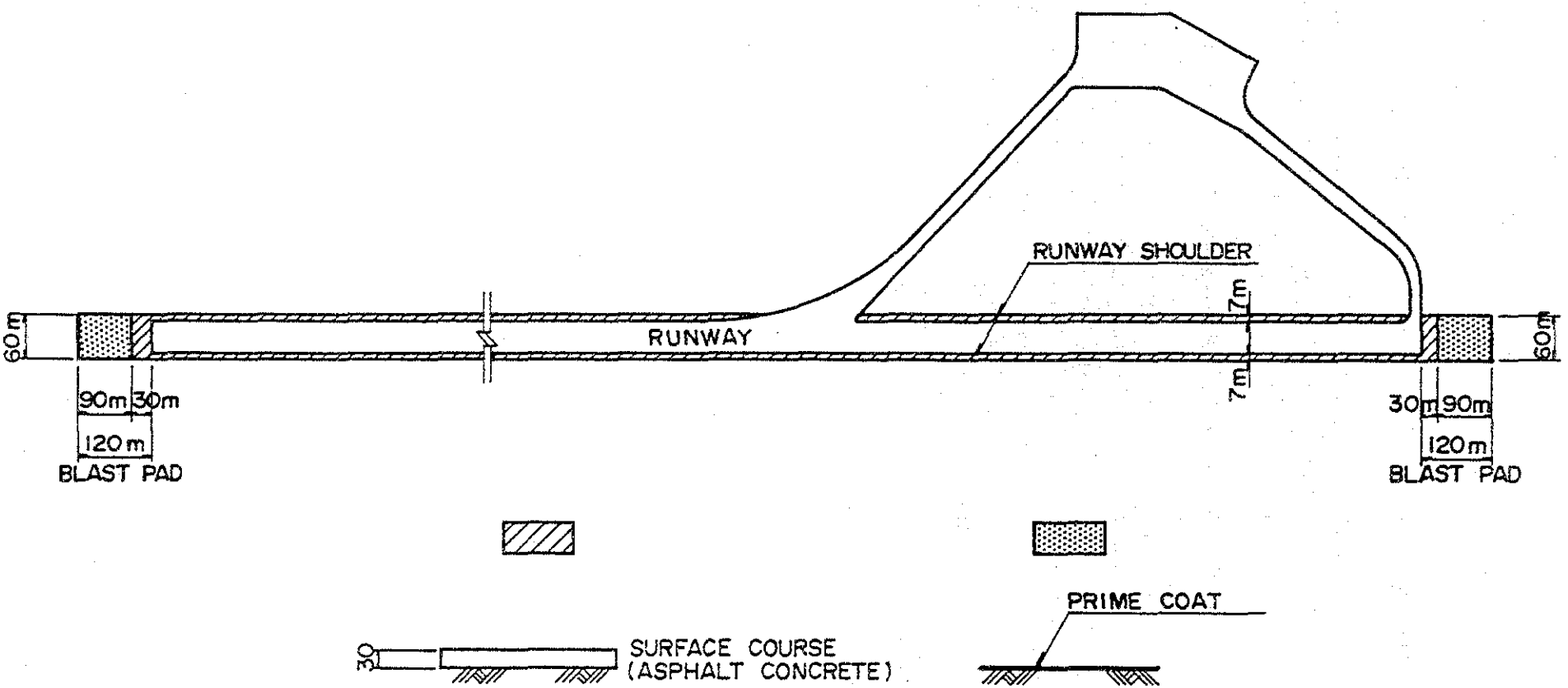


Figure 11.2.2 Plan of Runway Shoulders and Blast Pads

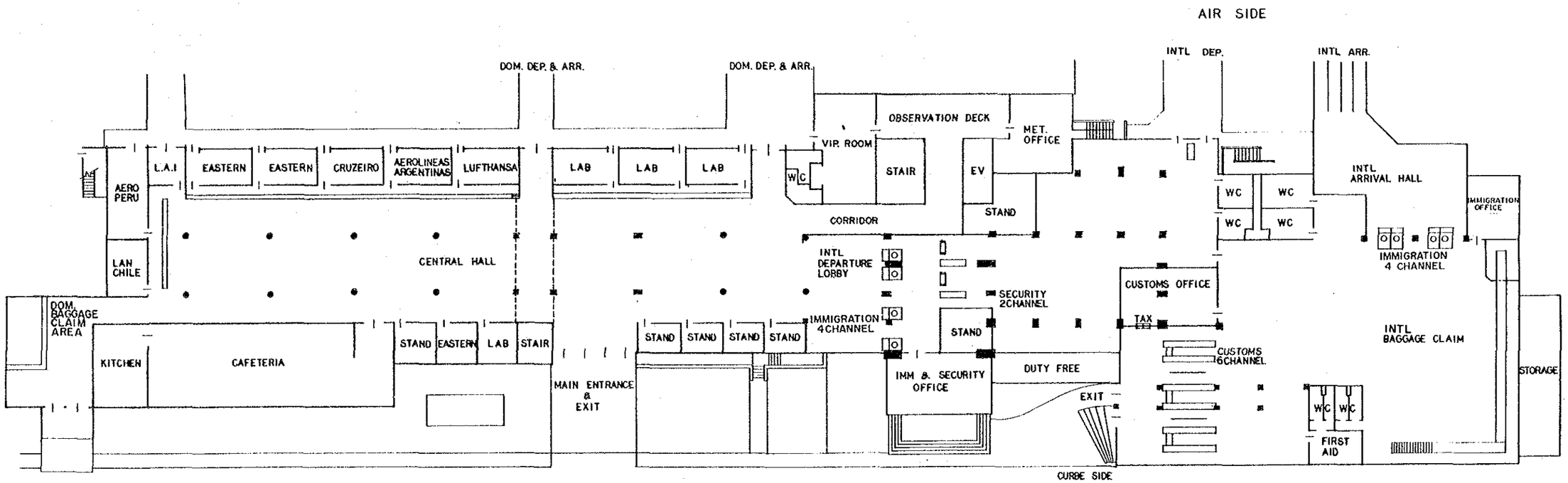


FIGURE 11.2.3 RENOVATION PLAN OF EXISTING PASSENGER TERMINAL BUILDING

SCALE 0 5 10 15

11.3 Work Schedule and Cost for Immediate Improvement

With regard to the work schedule for the immediate improvement, all construction items should be carried out as soon as possible. The period required for each of the construction items is estimated on a preliminary basis as shown below.

Item	Required Period
Improvement of runway pavement	3 months
Construction of runway shoulders and blast pads	2 months
Renovation of the existing passenger terminal building	1 month

The cost required for the immediate improvement is estimated on a preliminary basis to be 679,000 US dollars as shown in Table 11.3.1.

Table 11.3.1 Estimated Construction Cost for Immediate Improvement

Exchange Rate: US$1.00 = Bs1.95 = ¥150
(As of March, 1987)
Cost estimate based on 1987 prices

Unit: US$1,000

Item	Cost
Improvement of runway pavement	83
Construction of runway shoulders and blast pads	526
Renovation of the existing passenger terminal building	70
Total	679

CHAPTER 12 PROJECT IMPLEMENTATION SCHEDULE AND COST ESTIMATES

CHAPTER 12 PROJECT IMPLEMENTATION SCHEDULE AND COST ESTIMATES

12.1 General

This chapter explains the project implementation schedule and cost estimates based on the preliminary design for the Phase I development as described in Chapter 8.

The project cost necessary for the Phase I development is estimated to be 138 million US dollars at 1987 base price.

12.2 Project Implementation Schedule

The construction schedule for the project is indicated in Table 12.2.1.

12.3 Project Cost Estimates

The project cost required for the Phase I development is estimated to be 138 million US dollars based on 1987 prices as shown in Table 12.3.1. This cost has been estimated primarily for the economic analysis which will be evaluated considering the national economy.

This cost includes soil investigation and topographical survey, construction supervision, engineering services and physical contingencies.

The exchange rate used has been established at US$1.00 = Bs1.95 = ¥150. The contingency is estimated at about 10% of the sum of the total cost of construction works, soil investigation and topographical survey, engineering services cost and construction supervision.

Note: The cost shown in Table 12.3.1 which is based on the preliminary design is different from the cost of TC-3 shown in Table 6.2.1 which was estimated for the evaluation comparison before the preliminary design.

Table 12.2.1 Construction Schedule

ITEMS \ YEAR	1987	88	89	90	91	92	93	94	95	96	97
Service Period								PHASE I			
● Feasibility Study	———										
■ Financial Arrangement and Selection of Consultant		———									
● Detailed Engineering Services			———								
■ Financial Arrangement and Tendering for Contractors				———							
● Assistance in Tendering and Construction Supervisory Services				———	———	———	———				
▲ Construction Works					———	———	———				
1. Access Road					———	———					
2. Runway Pavement Overlay					———	———					
3. Taxiways					———	———	———				
4. Aprons					———	———	———				
5. Roads, Car Parking, and Other Miscellaneous Civil Works					———	———	———				
6. Passenger Terminal Building					———	———	———				
7. Cargo Terminal Building						———	———				
8. Administration and Other Buildings					———	———					
9. Air Navigation Systems						———	———				
10. Airport Utilities						———	———				
■ Test Operations and Flight Checks, etc.							———				

Note, ■ : Employer's Activity
● : Consultant's Activity
▲ : Contractor's Activity

Table 12.3.1 Estimated Project Cost for Phase I Development

Exchange Rate: US$ 1.00 = Bs1.95 = ¥150 (As of March 1987)
Cost estimate based on 1987 price

Unit: US$1,000

Item		Bolivian Portion	Foreign Portion	Total
Civil Works	Runway Overlay and Turning Pad	690	7,140	7,830
	Taxiways	1,550	6,260	7,810
	Passenger Terminal Apron	2,220	3,880	6,100
	Road and Car Parking Area	360	1,220	1,580
	Security Fence and Perimeter/Maintenance Road	120	310	430
	Cargo Terminal Apron	790	1,290	2,080
	General Aviation Apron, Cargo Apron for Small Carriers and Isolated Apron	380	1,940	2,320
	Sub Total	6,110	22,040	28,150
Architectural Works	Passenger Terminal Building including Flight Information System and Airport Security System	8,470	20,660	29,130
	Fire Station	200	460	660
	Administration Building and Control Tower	1,870	4,370	6,240
	Meteorological Observation Building	130	290	420
	Cargo Terminal Building	1,650	4,040	5,690
	Airport Maintenance Shop and Storage	340	790	1,130
	Sub Total	12,660	30,610	43,270
Air Navigation Systems	Aeronautical Ground Lights for Runway	170	3,320	3,490
	Relocation of Secondary Surveillance Radar	20	60	80
	Aeronautical Ground Lights for Taxiway and Apron	100	1,440	1,540
	Radio Navigational Aids	90	6,340	6,430
	Air Traffic Control and Aeronautical Telecommunications System	210	7,690	7,900
	Meteorological System	10	3,060	3,070
	Sub Total	600	21,910	22,510
Airport Utilities	Power Supply System	110	2,650	2,760
	Water Supply System	140	550	690
	Telecommunications	0	100	100
	Sewage Treatment System	490	1,950	2,440
	Incinerator	20	180	200
	Sub Total	760	5,430	6,190
Rescue and Fire Fighting Vehicles		0	1,890	1,890
Other Facilities	Boarding Bridges	0	3,300	3,300
	Lighting for Car Parking Area and Access Road	30	660	690
	Sub Total	30	3,960	3,990
Total of Construction Cost		20,160	85,840	106,000
Soil Investigation and Topographical Survey		400	0	400
Engineering Services		1,000	6,000	7,000
Construction Supervision		2,000	10,000	12,000
Sub Total		23,560	101,840	125,400
Contingency (approximately 10%)		2,440	10,160	12,600
Total of Project Cost		26,000	112,000	138,000

PART VI PROJECT APPRAISAL

CHAPTER 13 ECONOMIC AND FINANCIAL ANALYSES

CHAPTER 13 ECONOMIC AND FINANCIAL ANALYSES

13.1 General

The objectives of economic and financial analyses described in this chapter are to evaluate the economic and financial viability of the proposed Phase I development project for the El Alto airport modernization aimed at the year 1997.

Based on an economic analysis, a project will be appraised from the viewpoint of the estimated contribution of the project to the national and regional economy in which the project is carried out. A financial analysis will evaluate the financial outcome of a project from the viewpoint of an enterprise or entity that implements the project.

13.2 Economic Analysis

13.2.1 Project Life

Considering the economic life of the major facilities to be constructed and procured under the Phase I development, project life is established to be 25 years after the completion of the construction work.

13.2.2 Definition of "With Project" and "Without Project"

In spite of the immediate improvement being implemented by AASANA, the existing aircraft parking apron and passenger terminal building of El Alto airport were evaluated to have reached their capacity in Chapter 4. Unless the airport is developed, the increasing demand of air passengers can not be accommodated and will overflow. In this study, this is specified as the "Without Project" case.

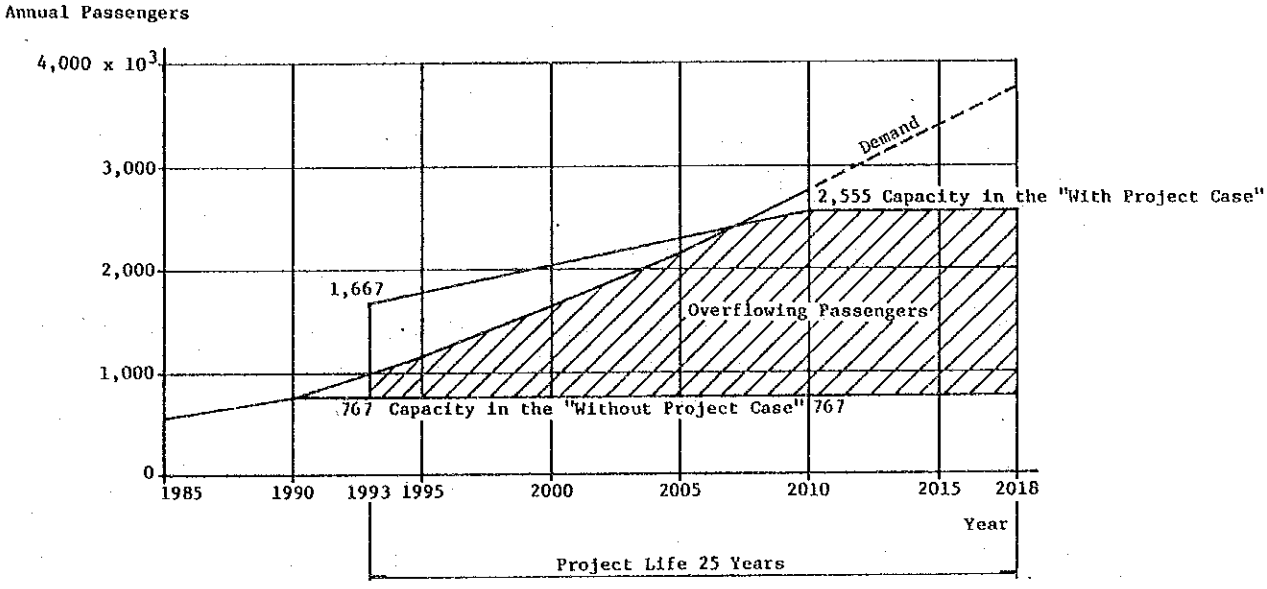
The implementation of the Phase I development project will expand the capacity of El Alto airport. The improved facilities of El Alto airport will accommodate 16,500 times of annual aircraft movement in 1994. Afterwards the increasing demand of air passengers will be accommodated with increasing aircraft movements and by the introduction of larger aircraft. This is defined as the "With Project" case in this study.

Table 13.2.1 summarizes the capacity of El Alto airport both in the "With Project" and "Without Project" cases.

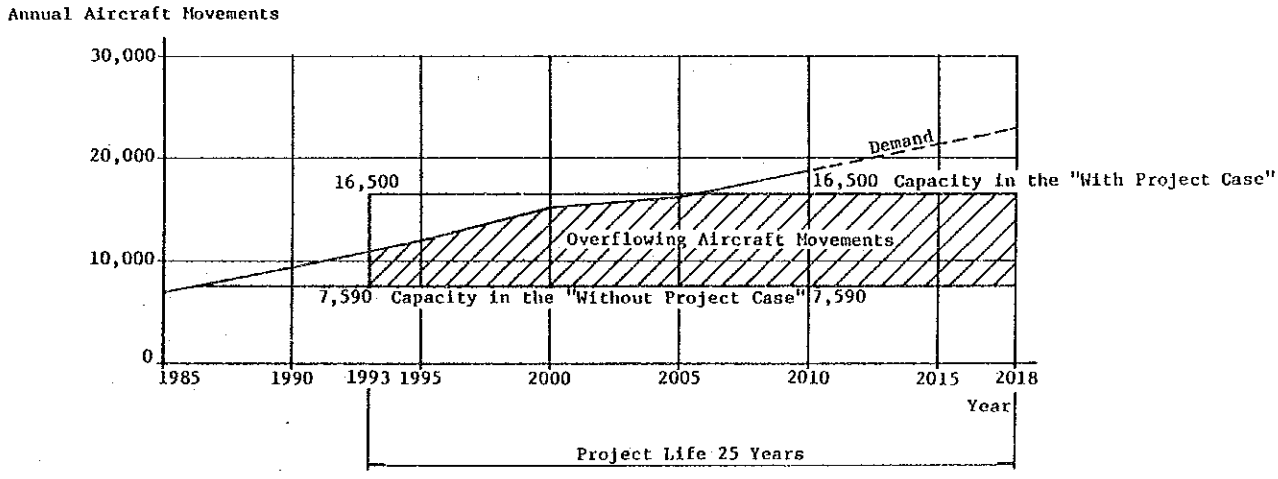
Table 13.2.1 Airport Capacity of "With Project" and "Without Project"

Year	1994	2010
Annual Passengers		
With Project	1,667,000	2,555,000
Without Project	767,000	767,000
Annual Aircraft Movements		
With Project	16,500	16,500
Without Project	7,590	7,590

The project benefits described in Section 13.2.4 are quantified based on the overflowing demand in the case of "Without Project" as shown in Figure 13.2.1.



Annual Passengers



Annual Aircraft Movement

Figure 13.2.1 Overflowing Demand

13.2.3 Project Costs

In this study, the following costs are quantified and evaluated:

- Construction Cost
- Operation and Maintenance Costs

13.2.4 Project Benefits

An airport modernization project will provide various benefits to the natioinal and regional economy. In this study, the following benefits are quantified and evaluated;

- Benefit due to accommodation of overflowing domestic passengers

- Benefit due to accommodation of overflowing international passengers

- Benefit due to accommodation of overflowing foreign tourists

- Benefit due to accommodation of overflowing foreign airline aircraft

- Benefit due to reduction of passenger processing time at the airport

Note: As for the calculation of project costs and benefits, refer to Sections 13.1.2 and 3 in Supporting Information Report.

13.2.5 Evaluation of the Project

The results of the economic analysis for the Phase I development shows that the project is feasible because the EIRR (Economic Internal Rate of Return) of 18.2% is higher than 10 to 12 percent opportunity cost of capital which the World Bank generally adopts as a criterion for selecting economically viable projects. EIRR, B/C ratio (Benefit Cost Ratio) and NPV (Net Present Value) of the project are summarized in Table 13.2.1. Cashflow is as shown in Table 13.2.2.

Table 13.2.1 Economic Assessment

EIRR (%)	B/C Ratio*	NPV* (Million US dollars, 1987)
18.2	1.7	78

Note: * at discount rate of 12%

Table 13.2.2 Cashflow

(Unit: Thousand US$)

Year	Costs					Benefits							Net Cashflow
	Construction		O & M		Total	Domestic Pax	Int'l Pax	Foreign Tourists	Landing Fee	Jet Fuel	Time Benefit	Total	
	Foreign	Bolivian	Foreign	Bolivian									
1989	3,420	921			4,341							0	-4,341
1990	6,120	1,037			7,157							0	-7,157
1991	16,070	4,412			20,482							0	-20,482
1992	45,840	8,435			54,275							0	-54,275
1993	40,550	8,231			48,781							0	-48,781
1994			2,218	409	2,627	7,346	161	1,280	1,297	1,161	626	11,871	9,244
1995			2,218	424	2,642	9,159	516	2,080	1,297	1,161	651	14,864	12,222
1996			2,218	434	2,652	11,163	1,621	3,072	1,474	1,331	674	19,335	16,683
1997			2,218	443	2,661	13,167	2,725	4,064	1,650	1,500	698	23,804	21,143
1998			2,218	443	2,661	15,170	3,830	5,056	1,827	1,670	722	28,275	25,614
1999			2,218	443	2,661	17,174	4,934	6,048	2,003	1,839	748	32,746	30,085
2000			2,218	443	2,661	19,178	6,039	7,040	2,180	2,009	773	37,219	34,558
2001			2,218	443	2,661	21,540	7,327	8,160	2,373	2,185	801	42,386	39,725
2002			2,218	443	2,661	23,903	8,615	9,280	2,572	2,363	829	47,562	44,901
2003	33,990	1,577	2,218	443	38,228	26,265	9,903	10,400	2,763	2,539	858	52,728	14,500
2004			2,218	443	2,661	28,628	11,191	11,520	2,925	2,708	888	57,860	55,199
2005			2,218	443	2,661	30,990	12,479	12,640	3,085	2,877	919	62,990	60,329
2006			2,218	443	2,661	33,697	14,005	13,984	3,264	3,040	952	68,942	66,281
2007			2,218	443	2,661	36,403	15,532	15,328	3,331	3,089	984	74,667	72,006
2008			2,218	443	2,661	39,110	17,058	16,672	3,354	3,097	1,019	80,310	77,649
2009			2,218	443	2,661	39,110	18,585	18,016	3,354	3,097	1,054	83,216	80,555
2010			2,218	443	2,661	39,110	20,111	19,360	3,354	3,097	1,092	86,124	83,463
2011			2,218	443	2,661	39,110	21,393	19,787	3,354	3,097	1,130	87,871	85,210
2012			2,218	443	2,661	39,110	22,674	20,213	3,354	3,097	1,170	89,618	86,957
2013	33,990	1,577	2,218	443	38,228	39,110	23,956	20,640	3,354	3,097	1,210	91,367	53,139
2014			2,218	443	2,661	39,110	23,956	20,640	3,354	3,097	1,253	91,410	88,749
2015			2,218	443	2,661	39,110	23,956	20,640	3,354	3,097	1,296	91,453	88,792
2016			2,218	443	2,661	39,110	23,956	20,640	3,354	3,097	1,341	91,498	88,837
2017			2,218	443	2,661	39,110	23,956	20,640	3,354	3,097	1,388	91,545	88,884
2018	-50,848		2,218	443	-48,187	39,110	23,956	20,640	3,354	3,097	1,437	91,594	139,781

EIRR = 18.2%
NPV = 77,795 (12.0%)

A sensitivity analysis is also made to provide a basis for probabilistic judgement on the feasibility of the project. The EIRRs of several cases are calculated based on the various projections and summarized in Table 13.2.3 as well as Fig. 13.2.1.

Table 13.2.3 Summary of Sensitivity Analysis

	Projections	EIRR (%)
Base Case		18.2
Case 1	Construction Cost up by 20%	16.0
Case 2	Low Forecast Traffic Demand	13.5
Case 3	Low Forecast Traffic Demand Construction Cost up by 20%	11.7

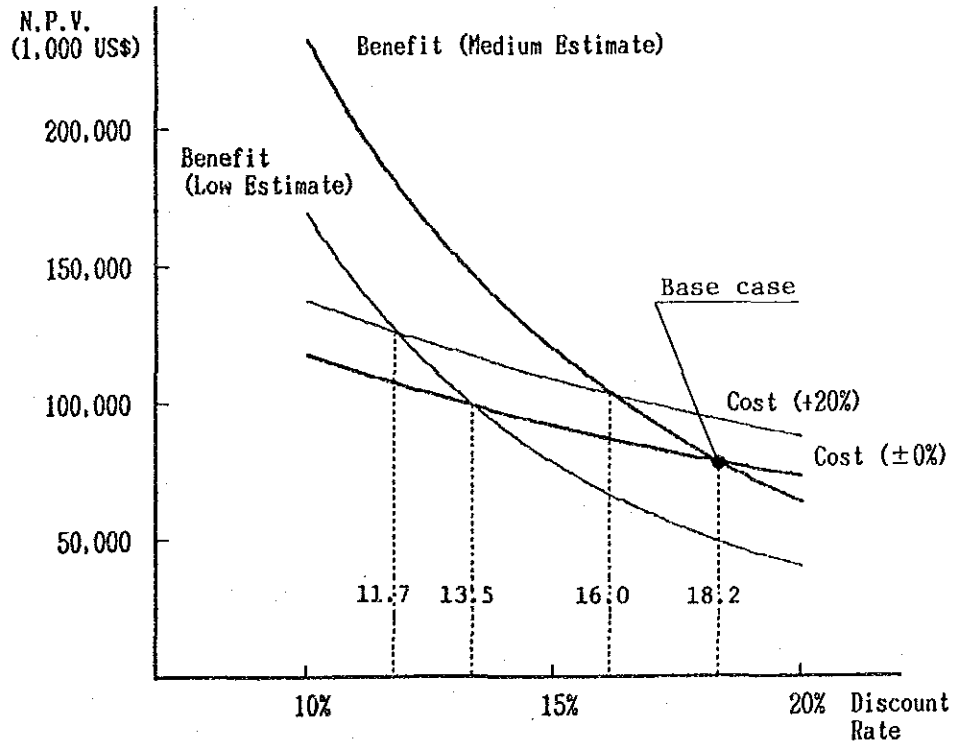


Figure 13.2.1 Summary of Sensitivity Analysis

The result of the sensitivity analysis indicates that even in the worst projection for Case 3, the EIRR satisfies the opportunity cost of capital, and proves that the project yields a high economic return on investment even if there is a substantial increase in the construction cost or reduction of traffic demand.

Along with the direct and tangible benefits, this project is expected to bring about various indirect and/or intangible benefits, for example, promotion of regional development, increase of employment opportunities, expansion of trade and business activities, improvement of air safety, etc.

Consequently, the economic and sensitivity analysis indicate that the project is definitely feasible from the viewpoint not only of the Bolivian national economy but also the society.

13.3 Financial Analysis

13.3.1 Evaluation of the Project by FIRR

(1) Expenditures

The project expenditures consist of the following items:

- Investment costs for civil and architectural facilities and equipment including engineering services
- Operation and maintenance costs comprising personnel, materials and supplies, and equipment

(2) Revenues

Operating revenues for the modernized El Alto airport will consist of the following items:

- Air passenger service charges
- Aircraft landing charges, navigation services and night/holiday surcharge
- Rent on concessions in the terminal building

Note: As for the calculation of expenditures and revenues, refer to Section 13.2.2 in Supporting Information Report.

(3) Results of Analysis

The FIRR (Financial Internal Rate of Return) has been calculated by comparing the expected revenues and expenditures as presented in Table 13.3.1. The calculated FIRR is as low as 4.0 percent. The project, therefore, will not be financially feasible unless a loan with low interest is available.

If it is possible to increase the charges mentioned above, however, by 20 percent at the time of completion of the project and then increase them by 20 percent every ten years, the FIRR increases to 7.5 percent which is considered more or less financially feasible. If it is possible to increase the charges by 20 percent every five years, the FIRR increases to 9.9 percent which is said financially favorable taking into account the recent interest requirements for loans in the world.

Table 13.3.1 Cashflow for FIRR Calculation

Year	Expenditures				Revenues				Net Cashflow
	Investment	O & M		Total	Airport Tax	Landing Charge	Concession	Total	
		Personnel	Materials						
1989	4,460			4,460				0	-4,460
1990	7,290			7,290				0	-7,290
1991	21,050			21,050				0	-21,050
1992	55,360			55,360				0	-55,360
1993	49,840			49,840				0	-49,840
1994		1,322	2,764	4,086	1,284	7,600	1,200	10,084	5,998
1995		1,337	2,764	4,101	1,367	7,740	1,200	10,307	6,206
1996		1,349	2,764	4,113	1,469	8,152	1,200	10,821	6,708
1997		1,359	2,764	4,123	1,571	8,565	1,200	11,336	7,213
1998		1,359	2,764	4,123	1,672	8,977	1,200	11,849	7,726
1999		1,359	2,764	4,123	1,774	9,390	1,200	12,364	8,241
2000		1,359	2,764	4,123	1,876	9,802	1,200	12,878	8,755
2001		1,359	2,764	4,123	1,991	10,363	1,200	13,554	9,431
2002		1,359	2,764	4,123	2,106	10,924	1,200	14,230	10,107
2003	35,770	1,359	2,764	39,893	2,221	11,484	1,200	14,905	-24,988
2004		1,359	2,764	4,123	2,336	12,045	1,200	15,581	11,458
2005		1,359	2,764	4,123	2,451	12,606	1,200	16,257	12,134
2006		1,359	2,764	4,123	2,587	12,871	1,200	16,658	12,535
2007		1,359	2,764	4,123	2,723	13,136	1,200	17,059	12,936
2008		1,359	2,764	4,123	2,859	13,400	1,200	17,459	13,336
2009		1,359	2,764	4,123	2,958	13,665	1,200	17,823	13,700
2010		1,359	2,764	4,123	3,056	13,930	1,200	18,186	14,063
2011		1,359	2,764	4,123	3,086	13,930	1,200	18,216	14,093
2012		1,359	2,764	4,123	3,117	13,930	1,200	18,247	14,124
2013	35,770	1,359	2,764	39,893	3,147	13,930	1,200	18,277	-21,616
2014		1,359	2,764	4,123	3,147	13,930	1,200	18,277	14,154
2015		1,359	2,764	4,123	3,147	13,930	1,200	18,277	14,154
2016		1,359	2,764	4,123	3,147	13,930	1,200	18,277	14,154
2017		1,359	2,764	4,123	3,147	13,930	1,200	18,277	14,154
2018	-51,943	1,359	2,764	-47,820	3,147	13,930	1,200	18,277	66,097

FIRR = 4.03%

A sensitivity analysis has also been carried out based on variations of traffic demand forecast and construction cost in order to verify what conditions shall be met when the project gets more than 4.5 % of FIRR on the assumption that a soft loan is available for the foreign portion of the investment. The results are summarized in Table 13.3.2 and Fig. 13.3.1.

Table 13.3.2 Summary of FIRR

Case	Traffic Forecast	Investment Cost	Landing Fee	Other Charges	FIRR
Base	Medium	±0 %	±0 %	±0 %	4.0 %
1		±0 %	-40 %	±0 %	0.4 %
2		±0 %	+10%/10year	+10%/10year	4.8 %
3		+10 %	±0 %	±0 %	3.2 %
4		+10 %	+20%/10year	+20%/10year	4.7 %
5		+20 %	+10%/5year	+10%/5year	4.4 %
6	Low	±0 %	±0 %	±0 %	2.5 %
7		±0 %	+10%/5year	+10%/5year	4.6 %
8		+10 %	+20%/5year	+20%/5year	5.7 %
9		+20 %	+20%/5year	+20%/5year	4.9 %
10	High	±0 %	±0 %	±0 %	5.3 %
11		+10 %	+10%/10year	+10%/10year	5.1 %
12		+20 %	+20%/10year	+20%/10year	5.0 %

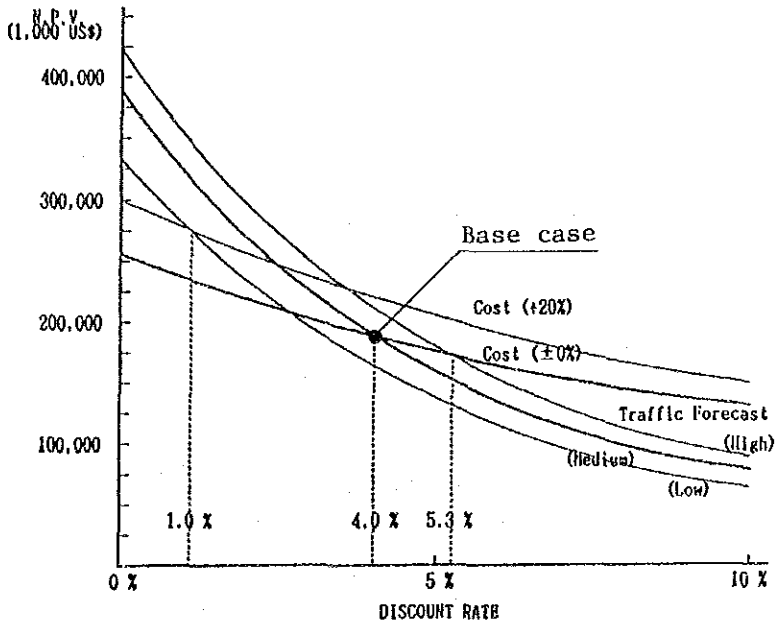


Fig. 13.3.1 Summary of FIRR

13.3.2 Evaluation of the Project by Income and Funds Statements

(1) Income Statement

Income statement comprises the following items:

- Revenues
- Expenditures
- Interest
- Depreciation

(2) Funds Statement

The funds statement consists of the following items:

- Capital and subsidy
- Long-term debt
- Bank loan
- Repayment of long-term debt
- Repayment of bank loan

(3) Results of Analysis

According to the analysis of the income and funds statement prepared for the project, the cashflow will recovers to be in the black in the 13th year of operation under the following conditions for raising funds:

Plan for Fund Raising	Kind of Funds	Interest Rate
50 % of Bolivian Portion of Investment Cost	Capital or Subsidy	
50 % of Bolivian Portion of Investment Cost	Long-term Loan from Commercial Banks	8.75 %/year
Foreign Portion of Investment Cost	International Lending Agencies or Bilateral Aid Organizations	3.5 %/year
Working Capital	Bank Loan for Short-term Debt	6.5 %/year

The project, therefore, can afford to cover the operation and maintenance cost as well as interest payable for long- and short-term loan though it can only afford to repay around half of the principal of long-term debt during the project life. The project can be said relatively feasible from the financial viewpoint when compared with other similar projects.

In the case of investment to public works, it is generally said that a project will be financially viable that its cashflow becomes in the black within approximately 20 to 25 years of operation.

A sensitivity analysis has been made to clear what conditions shall be satifsied when the cashflow recovers to be in the black within 20 years of operation. The results are presented in Table 13.3.3.

Table 13.3.3 Summary of Income & Funds Statements (1)

Case	Traffic Forecast	Interest Rate (%)			Investment	Capital/Subsidy		Charges, etc	Cash Flow[2]	Net Operating Income[2]
		Long-term (1)	Long-term (2)	Bank Loan	Increase (%)	1000 US$	% [1]	Increase (%)	(Year)	(Year)
Base	Medium	3.5	8.75	6.5	±0	0	0	±0	Over 25	Over 25
1					±0	6,500	25	±0	19	22
2					±0	13,000	50	±0	13	18
3					±0	0	0	+10/10year	19	20
4					+10	15,600	60	±0	21	26
5					+10	0	0	+20/10year	23	22
6					+20	26,000	100	±0	16	Over 25
7					+20	0	0	+20/ 5year	17	17
8		2.6	8.75	5.0	±0	0	0	±0	17	18
9	Low	3.5	8.75	6.5	±0	26,000	100	±0	22	27
10					±0	0	0	+20/ 5year	17	18
11					+10	26,000	100	+20/10year	18	23
12					+10	0	0	+20/ 5year	21	21
13					+20	26,000	100	+10/ 5year	21	25
14					+20	0	0	+20/ 5year	24	24

Table 13.3.3 Summary of Income & Funds Statements (2)

Case	Traffic Forecast	Interest Rate (%)			Investment	Capital/Subsidy		Charges, etc	Cash Flow[2]	Net Operating Income[3]
		Long-term (1)	Long-term (2)	Bank Loan	Increase (%)	1000 US$	% [1]	Increase (%)	(Year)	(Year)
15	High	3.5	8.75	6.5	±0	0	0	±0	5	12
16					+10	0	0	±0	17	19
17					+20	10,400	40	±0	14	23
18					+20	0	0	+20/10year	17	19

Note: 1) Share of capital or subsidy in the Bolivian portion of the investment cost.
2) The number of years after operation commencement when cash flow becomes in the black.
3) The number of years after operation commencement when cumulative net operating income becomes in the black.

13.3.3 Pricing Policy

In order to assess the possibility of increasing the airport charges, the aircraft landing charge which constitute a large part of the total revenue was analyzed.

The aircraft landing charge for B747 aircraft is compared with that of several other airports around the world. The present charge of about 3,705 US dollars is higher than the average range as shown in Table 13.3.4.

Table 13.3.4 Aircraft Landing charges for B-747

Unit : US$

Airport/City	Landing Charge
Narita/Tokyo	5,180
El Alto/La Paz	3,705
Frankfurt/Frankfurt	3,360
CH. De Gaulle/Paris	2,510
Amsterdam/Amsterdam	2,330
Hong Kong/Hong Kong	1,100
J.F. Kennedy/New York	820
Benito, Juarez/Mexico City	460
Heathrow/London	160

Note: As of December 1986,
exchange rate US$1.0 = ¥163

Assuming that the landing charge is increased to 120% of the present level, that is 4,446 US dollars, the charge will still not become the highest in the world. This charge will, however, be rather high in the world. Considering this comparative data, the various airport charges must be projected in the future.

PART VII CONCLUSION

CONCLUSION

Based on an overall comparative evaluation of the long-term airport master plans, Alternative-TC3 has been selected as the most suitable master plan for El Alto airport. Taking this airport master plan Alternative-TC3 into consideration, the allocation of construction work items for the immediate improvement works, the Phase-I development and Phase-II development have been discussed and determined.

The technical and economical feasibility study of the Phase-I Development Project (the Project) concluded that:

- The urgent necessity for the implementation of the project is confirmed based on technical factors stated in the engineering study.

- The project cost is estimated to be US$138 million based on 1987 prices and the economic internal rate of return is evaluated to be 18.2%.

- The project is considered economically feasible from the viewpoint of the optimum allocation of resources in the national economy.

It is, therefore, recommended to implement the project as soon as possible.

The implementation of the project will have impacts on:

- Contribution to the national economy through the unrestricted and efficient air transport services,

- Contribution to the increase of trade and business opportunities,

- Contribution to the increase of employment opportunities,

- Stimulation of international tourism development, and

- Contribution to air transport safety.

It is advisable to organize a suitable committee and begin the following preparatory and required coordination work:

- The project should be presented and discussed with the related government organizations in Bolivia in order to make up a consensus for project implementation. It should be listed with the National Development Projects and given priority suitable.

- The preparations including request for financial assistance, topographic survey and soil investigations, etc., should be initiated at the earliest possible date so that engineering services including basic design, detailed design, preparation of tender documents, assistance in evaluation of the tenders, etc., can be carried out and completed by the middle of 1991.

- The construction work should begin in the middle of 1991 so that the completed airport can become operational by the end of 1993.

- In order to harmonize the airport with the area surrounding the airport, height restriction should be enforced in order to ensure the required obstacle limitation surfaces. A land use plan in the airport vicinity in areas where aircraft noise influences will exceed the allowance should be implemented.

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