**REVISED MASTER PLAN REPORT**

**PART (1)**

**SECTION (1): PROPOSED DEVELOPMENT AT ZALINGI:**

1. **Site appraisal:**

The Airport site at ZALINGI proposed by SCAA form the basis of the proposed development set hereafter with our following observation and comments:

* Continuous drainage problem.
* Unavailability of electricity and water supply.
* Unavailability of land for further extension.
* The high cost of access road rehabilitation.
* Passenger cost and vehicle operating cost for travelled road of 20 km to town center.

1. **Design aircraft:**

According to the term of reference the suggested designed aircraft F50, as earlier stated in the Inception Report the suggested aircraft would limit the airport code to 3C and accordingly the total thickness of pavement would be reduced, nevertheless the suggested aircraft would require fueling at ZALINGI at initial stage so as to cater for safety regulation which impose reverse fuel for alternate airport.

The capacity of F50 is limited and our survey indicates that these types of aircrafts not used excessively in regular commercial travel, also indicates that a very wide variety of aircrafts are expected to be used.

We suggested CRJ-700 as a Design Aircraft.

The CRJ-700, as a Design aircraft, create a big opportunity to use the airport by a very wide variety of aircrafts with limited restrictions.

Cost Benefits analysis indicates that the technical and operational result to adopt CRJ-700 as a design aircraft.

1. **Traffic forecast** :

Sudan National Transport Master Plan sets the frame of directions of the airports system as follows :

* Over the past 3 to 4 years, Sudan has witnessed an expansion of civil aviation services and traffic, the liberalization of the air market, domestically and internationally, has resulted in considerable growth in both categories of traffic, but especially at domestic airports. During the same period, the country has seen a large increase gross of domestic product fueled by oil revenues, the economic growth has spurred civil aviation traffic by providing more disposal income with which to travel and more commercial opportunities for businessmen throughout the country.
* The Darfur conflict has isolated this region from the rest of the country ; civil aviation the only mean by which persons and to a large extended cargo can travel between that region and the rest of the country quickly with security, Growth has been high for Khartoum International Airport: domestic traffic grew at annual rate of 14% between 2000 and 2007 and international traffic for the same period at 8%. These high rates are not anticipated to continue, except for a few location such as Port Sudan with tourism for International traffic, and domestically the airports located at Darfur might see some substantial growth with the coming of peace .
* Because of the high variability of traffic flows from year to year with a general upward trend, there appears to be no single parameter that drives traffic growth. Trends generally follow regional and local developments; the later has the greatest impact on domestic traffic.
* International traffic will continue to be centered in Khartoum with growth poles located in Nyala and Port Sudan. A number of smaller airports will have limited International operations as part of the continuation of government policy aimed at developing other International destinations in Sudan, but the Diaspora and overseas workers provide a sound base on which to build International traffic, but this market is not likely to grow rapidly in the present International environment. Once global economic recovery occurs it is likely to be the fastest growing market in a short period of time.
* Basically, the long term trend will be in the order of magnitude of 7 plus percent over the next 15 to 25 years period. However the short term (3 to 5 years ) it will be lower than this, ranging between 3 to 7 percent. The intermediate trends include economic recovery with higher oil prices, growth in air traffic will increase substantially for a period of 5 to 10 years .
* The traffic growth will increase at certain domestic locations at guide high rates due to particular events affecting the hinterland of the airports. Domestic regional hubs will develop at Nyala. Traffic at some airports will be adversely affected by the continued development of the road network, In particular, air traffic growth at Dongula and El Obied, where new roads are constructed will reduce overland travel distance and times will be considerable risk. Merowi, with its relatively new airport is also be affected by shorter roads distances to Khartoum. Kassala, likewise could be affected by the shorter overland routes, and its traffic is likely to remain relatively small over the forecast period. In the El Obied cases there will be an extensive loss of traffic once the UN departs.
* UN operation will be greatly diminished after, say, a five years period once peace is restored to the Darfur region. Thereafter, reconstruction and humanitarian aid activities presently depending upon aviation will slowly drop over a period of time.
* The indicative growth rates for international and domestic airports, in general growth of domestic traffic will be the highest between 2012 and 2021 and will drop off to between 5 and 7% after that period, and Growth In international traffic is expected to grow at a slightly higher rate than domestic traffic after 2021.

Accordingly ZALINGI Airport will be affected by the following factors :

* The continuous up wards development.
* No international traffic would be expected.
* UN operations expected to be curtailed.

Due to lack of aircraft movement data to facilitate a linear regression, judgment would be the only method to predict the movement and passenger peak hour, so we assume El Deain forecast of movement is similar to ZALINGI airport due to many factors that had been taken into account.

1. **Airport code:**

The airport code would be 3C to maximize the flexibility of maneuvering area to accommodate variety of aircrafts of medium size with minor limitations. Adopting code 3C minimized the necessary modification in maneuvering area to accommodate wide body aircrafts which could be summarized in runway length and parking stands when these aircrafts plan to use the airport.

The adoption of code 3C would not imposed additional cost except lengthening the taxiway to comply with the SUCAR 14 separation as physical characteristics and if in the opinion to receive aircrafts, up to type C, provisional firefighting cat 6 would be required.

All these consideration are taken to fill the gap of uncertainty and the future development of the airport which is not recognized clearly due to absence of data concerning socio economical data that can affect the forecast.

1. **Maneuvering area consideration (Runway, Taxiway and Apron ):**

* The design aircraft would be CRJ-700 as stated in the Inception Report, the Runway length required to permit takeoff by the CRJ-700 one the longest proposed sector, Khartoum to ZALINGI is 2250m.
* The maximum takeoff weight which is recommended for Runway length 32 Tons.
* The recommended Runway length would allow for the CRJ-700 landing at maximum payload weigh both in dry and wet condition.
* The width of the Runway would be 30 m according to ICAO standards.
* The Runway would be connected by the taxiway 200m x 28m and Apron

200m x 120m to provide stands for the three CRJ-700 Aircrafts.

* The Runway would be provided by a 150m instrument cleared and graded strip, and provision has been made for a future parallel taxiway and R/W extension beyond 07.
* Hard shoulders of 5m wide are provided to the R/W, T/W and Apron.
* Beyond the threshold there would be a blast pad, 30m in width.
* According to the wind analysis 85% of landing and takeoff takes place at R/W 07 hence the logical location of the T/Ws would be on the northern part of the R/W to maximize the usability of R/W and to minimize the runway occupancy time.

1. **Capacity demands :**

As shown in the layout plan, the configuration of the airport is single Runway and the wind analysis is nearly 85% north and 15% from the south so the capacity of the runway is not less than 50th aircraft per hour for IFR and 70 aircraft per hour for VFR, so the annual service volume of the runway, regardless of metrological conditions and airspace, would be 200,000 operation, but these high capacity of no need due to the very poor demand as illustrated in the forecast.

The actual demand for terminal building space is 400 meter square and according to term of reference the suggested space is 1000 meter square accordingly the capacity of the terminal building would be 250%.

The space calculations for terminal building indicate that 965 square meter are quite appropriate; no extension shall be required during the total forecasted period.

1. **Obstacles limitation surface;**

As shown in the layout plan no obstruction is recorded within the airport vicinity and accordingly the airport complying with SUCAR 14 obstacle limitation surfaces for the instrument runway airport code 3C.

1. **Earthworks :**

The site of the proposed development of the new Airport at Zallingi is in a clay area, the soil is described in the Geotechnical Report.

It will be necessary to remove the vegetation within the strip for the new Airport. The site is sloping from north east to south west and cut and fill is necessary for up to a maximum of 1 meter in depth over the site.

At the threshold blast protection would be necessary, in the form of extension of the hard shoulders for 60 m beyond R/W pavement to form blast pads, and then protection of the ground surface.

1. **pavement development:**

the pavement in the proposed development at ZALINGI would consist of flexible runway, asphalt concrete, taxiway and hard shoulders and a rigid pavement for apron.

Flexible construction is proposed for the R/W and T/W consisting of 100m of asphaltic concrete surfacing in two courses on 250 mm of graded crushed granular base compacted of 98% of its modified AASHTO density and sub base of 200 mm. the formation level for the R/W is general will be in well graded natural gravel.

The proposed pavement construction is shown hereunder on fig(3).

1. **Drainage:**

Due to heavy rains in the area of the airport the runway cross section with transverse slope of 1.5% and graded area of maximum 2.5% slope are adopted to drain water away from the R/W.

A longitudinal drainage line just outside the 150m wide graded edge would be provided with sufficient fall to ensure drainage on both sides of R/W.

Outside the graded strip area 2.5% max transverse slope would be provided to limit surface erosion.

Concrete Box culvert would be required for the taxiway.

1. **Terminal Building :**

* The location of the proposed Terminal Building is shown on the master Plan Drawing.
* The principal elements to be incorporated into the Terminal Building and into the Control Tower, together with the criteria used to derive the basic spatial requirements from the forecast peak passenger movements (judgment) are set out in drawings.
* The proposed layout of the Terminal Building, which is shown on attached drawings, has been designed to meet the forecast numbers of CRJ-700 aircraft movement and the associated peak of passenger movements set out in drawing.
* The proposed layout comprises:

1. *Main passenger concourse*:

A common concourse has been provided to serve domestic departure passengers, domestic arrivals and visitors with consideration for haj travels and future international travels. This layout has been adopted in order to facilitate future expansion of the terminal building and to enable a concourse of more impressive properties to be provided with total area of 1300 m2 for Terminal Building.

1. *Check in the Baggage Reclaim:*

Three position are sufficient according to peak hour calculation.

1. *Departure lounge 720 m2.*
2. *Arrivals lounge 260 m2.*

* The forecast of peak passengers movements indicates that intial development is quite enough for the airport and no extensions required at the forecasted period, but due to the uncertainties of data and the expected development related to huge resources of the state spare space for the Terminal Building extension had been maintained.
* The expansion of the terminal areas would be achieved by constructing gates towards the apron.
* Mezzanine 310 m2 would be required to provide more flexibility and future installation of loading bridges if required.

1. **FCR Building:**

According to SUCAR 14 the Airport Category for firefighting is Cat 7 for aircrafts type C which is expected to use the airport at the base case. The location of FCR station would be at the middle of the runway, so it can meet the requirements of ICAO for response time and no need for substation during the forecasted period.

1. **Crush roads:**

Crush roads would be as shown in master plan.

1. **Control Tower:**

The building would be used to accommodate for airport administration, metrological office, equipment room, rest room and control room at the initial development of the airport as shown on drawing, a six-storey control tower is provided at the north sife of the airport .

The control room is of a sufficient height to provide adequate visibility of both runway thresholds.

1. **VIP:**

Would be required to state officials with dictated car parking, its located near the main terminal as illustrated in the master plan so as to reduce the cost of utilities and the operational expenses.

Since the VIP is not included in Term of Reference it can be provided in concessionaire or state participation.

1. **Water supply :**

Consumption of water is based on an average of 45 liters per head per day for passengers, visitors and airport personnel.

Tank of 250 cum would hold sufficient capabilities for the peak daily demands, plus 24 hours reserve and 150 cum for fire.

The long distance for feeding the airport by water from ZALINGI city, it is recommended to obtain this amount from water well in the vicinity of the airport.

1. **Military Base :**

the military base is proposed in the southern part of the airport.

1. **Access Road:**

The total length of the access road is about 20km from town center which is part of the highway Nyala – Cas, but it need rehabilitation.

A car parking is proposed to accommodate 75 cars during the forecasted period.

**18. Fence:**

The proposed fence would be chain link galvanized as shown in layout drawing to protect the airport from unauthorized persons and wild animals.

The layout of the fenced area would be required for the whole area allotted for the airport.

Internal fence to separate the passenger movement from maneuvering area as shown in layout would be required initially.

**19. Sewerage:**

The airport site would be provided with a sewerage system to cater for the development in the short term, with provision made for future connections with the cargo and maintenance areas when required. A septic tank facility would be provided having capacity of 60 cum which Is adequate for the forecasted population.

**20. Electrical System :**

**Power Supply:**

1. **External Power Supply (NEC feeder).**

NEC feeder source is far away from the airport is about 20km.

1. **Local Power Supply (Airport) :**

* Accordingly the local power generation should be used.
* The max electrical power demand is estimated at 230KVA/415 V/50HZ.
* A number of two continuous diesels Generators sets of 300KVA each should be provided, works as alternative mode.
* A monthly fuel tank should be provided as the fuel supply to the airport is an uncertainty of the daily and weekly basis.
* An adequate power house has to be implemented.
* Automatic switchover means should be installed.
* One more Diesel generator set of 100KVA should be provided for low consumption then big engines malfunction risk possibly avoidance, is suitable switchover device prepared manual.

1. **Primary and secondary power supply:**

* Primary and secondary power supplies are available as one generator unit is capable to operate the maximum demand and other two works as alternative and secondary genesets.
* Future NEC source if provided would be the primary source. The other genesets will be the secondary power supply.
* The switchover time should be complying with the non-precision approach category.

**Aerodrome Facility Supply :**

1. **VOR DME:**

* Supplied from the main Airport substation.
* Set up (0.415/11 KV) and set down (11/0.415 KV) transformers each of 50 KVA/3 PH/50 KZ.
* An overhead line installation method is performed to reduce the cost.

However the ground cable method may be used.

**ii. Metrological :**

* Supplied from the main airport substation.
* An overhead line installation method is performed to reduce the cost.

However the ground cable method may be used.

**iii. Tower:**

* Supplied from the main airport substation.
* An overhead line installation method is performed to reduce the cost.

However the ground cable method may be used.

1. **REF:**

* Supplied from the main airport substation.
* An overhead line installation method is performed to reduce the cost.

However the ground cable method may be used.

**v. Terminals:**

* Supplied from the main airport substation.
* An overhead line installation method is performed to reduce the cost.

However the ground cable method may be used.

**vi. Out Door Lights:**

* Supplied from the main airport substation.
* An overhead line installation method is performed to reduce the cost.

However the ground cable method may be used.

**21.0** **Cargo:**

The cargo travel level is very low during the forecasted period, so no justification for cargo building during the short term development, when cargo traffic levels justify the cargo handling activities would be accommodated to area allotted on the master plan.

We recommend developing the cargo facilities in concessionaire base.

**22.0 Fuel Supply :**

An assessment of the turbojet fuel demand in relation to the aircraft within the study had been done. The predicted number of movements on the sectors operated from ZALINGI during the forecasted period is 124 movements annually.

The predicted fuel consumed per week is 50.000kg.

As the range of aircrafts sizes at ZALINGI would be large, hydrant fueling is not proposed, browsers should be provided by the concessionaire to meet the above fuel loads.

In addition storage of aviation gasoline and lubricants would necessary, a fuel farm area shown on the master plan.

**23.0 Ground handling :**

Unobstructed space adjacent the apron had been secure for ground handling, the provision of these equipment is the responsibility of the airlines.

Proper fencing and platform would be required.

**24.0 Other Facilities :**

Shops, mosque, gates, stores, rest room for security staff and land gardens of highly importance and affect directly the airport operation but these activities are not mentioned in the Term Of Reference.

We recommend providing these buildings in the initial development of the airport never the less the low budget of these buildings.

Other buildings maintenance hangers, workshops, car fuel station, airlines offices, car rent kiosks, other authorities offices and clink spare space for the provision of these activities had been taken into account, but these activities of minor importance for the initial development of the airport and the total forecasted period, although these activities could be developed in concessionaire and state participation bases.

**25.0 Staff houses:**

Staff houses would not be required due to the special situation of the state and security issues.

**MASTER PLAN REPORT**

**Part (2)**

**AIR NAVIGATION SYSTEM AND FACILITATIONS**

**PROPOSED DEVELOPMENT AT ZALINGI AIRPORT**

**INTRODUCTION**:

ZALINGI AIRPORT air navigation systems and facilitations are planned accordance with the air navigation regulations, standards and innovations in the field to achieve the airport project objective.

**SITE LOCATION:**

ZALINGI AIRPORT site proposed by SCAA form air navigation point of view, ill introduce several limitations to the airspace and air traffic management issues as would be later.

**AIR TRAFFIC: MOVEMENT:**

As described earlier in part we adopt the forecast of El-Daein airport, due to absents of actual airport movements.

**NAVIGATION AIDS – NAVAIDS:**

1. **HFDL**

* HFDL ground stations provide communications to and from aircraft at various distance from the stations. Theses distances varies as from very short to as long as 5000km, but normally in the range of 2500km.
* HFDL might be used as an alternate communication medium to VDL 400km coverage range.
* The specification shall cover the minimum requirements for design, performance, construction, inception and testing of the HFDL.
* The system shall be required to provide coverage to the facility personnel communications within the coverage zones and to establish communications between the aircraft pilot and the ground crew, and also to cater for communication with other airports.

1. **DIGITAL VHF SYSTEM**

* The specification shall cover the minimum requirements for design, construction, inception and testing of the digital VHF system to be installed at Sudan Airports.
* The digital VHF/ radio system shall be able to establish two-way communications between the aircraft pilot and the ground station of the Airport.
* The very high frequency (VHF) radio equipments shall be designed to give the following:
* Offers concept for ground to air communication with aircrafts.
* Giving Omni-Directional coverage with range out not less than 200NM.

**iii. VERY HIGH FREQUENCY OMNI-DIRECTIONAL RANGE-VOR**

* Dual systems of power 100 watts is requiring giving bearings to end from the airport make it easier for the ATC for separation for both terminal and –En route facility.
* The azimuth indications of the aircrafts position relative to the ground beacon.
* The bearing which indicated whether the aircraft is flying to the left or right of the reselected course.
* The range out of the system shall not be less than 150 nautical mile (NM).
* The ‘From/to’ indication which shows whether the aircraft is flying toward the VOR or away from it .
* The redundancy configuration of switching over the system from the main to the standby mode shall be automatic.
* The location selected at 1050 meters at center line at 36 locations the selection was done due to the wind direction attached. The location on the center line will help into center line location also in the position of the inner marker which is known for the pilots. This will help must into the FIR led down procedure.

**iv. DISTANCE MEASURING EQUIPMENT – DME:**

* A dual system supposed to be installed with the VOR of 1000 watts which serve the zero location on the led down procedure also for reporting points around the FIR.
* DME is a ground bacon to provide the airborne interrogators with the distance information necessary during flight, the equipment shall be used for flight procedure, but may also be employed by the aircraft when preparing for landing (initial approach).
* It shall generate and radiate pulse pairs making up the identity code, expressed in international Morse Code, at a 1350Hz.
* It shall receive and decode the interrogation pulse pairs and radiate the reply pulse pairs after a reply delay for the distance measurement.
* Beacon operation shall be fully automatic. Operating mode selection and all parameters presetting are performed by the operator via a PC.

**v. VSAT SYSTEM**

VSAT specifications shall cover the minimum requirements for design, installation , commissioning and testing a new MF-TDMA VSAT fully meshed network supporting a wide variety of end-user business communication applications used for linking surveillances system data, air to ground communications (VHF) and other voice and data services from remote stations throughout the Sudan to a hub station at Khartoum ATC center, and also enable voice and data communications among these remote stations.

**Vi. AWOS & MET.DISPLAY**

* The specifications shall cover for the design, manufacture and configuration of the Automated Weather and Observation system.
* (AWOS) for the new Tower.
* The AWOS will continuously measure the key weather parameters using a suite of sensors chosen from All Weather Inc. as follows:
* Wind speed and Gust
* Wind Direction and Variable Wind Direction
* Temperature
* Dew Point Temperature / Humidity
* Barometric Pressure

**vii. CONSOLES**

Supply and install an Air Traffic Control (ATC) Consoles for ZALINGI airport.

**viii. RECORDED AND PLAYBACKSYSTEM**

* The equipment required for Recorder & Playback Station System is adapted for ATC applications and shall not be a derivative of other generalized record and replay applications.
* This system provide 100% redundancy for all channels of recorded data irrespective of the source of that data, with the capacity to store 30 days of all channels of data as a minimum.

**ix. AC & DC POWER SUPPLY SYSTEM**

Uninterruptible power supplies (AC & DC) will be installed to ensure that the ATC equipment remain operational when the airport mains power supplies fail.

**5. AIRPORT EQUIPMENTS**

**I. PRIVATE AUTOMATIC BRANCH EXCHANGE – (PABX)**

* Private automatic branch exchange system is required at ZALINGI AIRPORT project.
* Fully digital TCP/IP PABX.
* It shall be equipped with new PABX equipment for the office voice communications, inter-office communication as well as other parties outside via Public Switched Telephone Network (PSTN).

**ii. CCTV SYSTEM**

* Closed circuit television (CCTV) system for ZALINGI AIRPORT project.
* The specification shall include the design , supply, test and commissioning of the complete CCTV system including indoor and outdoor cameras, videos servers, digital video management, Recording/playback server remote controllers, back-

up facilities viewing and control equipment and network equipment for the successful implementation of the CCTV in accordance with this specification.

* This shall include all hardware, software and associated accessories.

**iii. FIRE ALARM AND DETECTION SYSTEM-FADS**

* The specification defines the minimum functional requirements for the supply of an airport building Fire Alarm And Detection System (FADS) for use within project.
* The specification defines the minimum basic requirements of Fire Alarm System including detectors to be employed for the airport building.
* The FADS shall be a real-time monitoring system monitoring any break out of fire in these buildings and activate the personnel warning system.

**iv. PUBLIC ADDRESS SYSTEM**

* Public Address System are required to be installed at ZALINGI AIRPORT terminals
* It shall be a fully digital modern system and of the latest technology.

**v. IT AND ACCESS CONTROL**

* A very high quality services are expected by the ZALINGI AIRPORT project.
* IT infrastructure should be laid over the airport to provide value added services.

**vi. UNINTERRUPTED POWER SUPPLY**

The specification covers the functional requirements for the design manufacture, installation, test and commissioning of the UPS system for the operation of the System.

**6. AIR TRAFFIC MANAGEMENT**

**A. INTRODUCTION**

a. Airspace management proposals shall handle the sitting of NAVAID, visual aids and communications systems for the appropriate Standard instrument Departure Routes (SIDs) and Standard Terminal Arrival routes (STARs) procedure planning and Implementation consideration.

**B. AIRPORT LOCATION**

**a. Zalingi Airport site criteria :**

1. **The new airport is located at :**

* Direct distance (air) of 16km north west of Zalingi town while road (land distances is 20 km).
* Distance of 38 NM FROM DERIBA CALDERA which is at the highest point of jebel Marra at an elevation of 3.042m (9.980ft).

2. the location is at a distance of 62NM form Elgineina airport VOR/DME. The highest point along this route is at an elevation of 104 0M at 21 NM from suggested airports.

3. the location is at a distance of 107NM form Elfasher airport VOR/DME. The highest point along this route is at an elevation of 1150 M at 46NM from suggested airport site.

4. the location is at a distance of 38NM from Nyala airport VOR/DME. The highest point along this route is at an elevation of 1330 M at 20NM from suggested airport.

**C. AIRPORT RUNWAY CRITERIA**

**a. Runway Orientation:**

the suggested runway orientation is 07/25.

**b. Runway Approach:**

1. The town is located below the expected initial approach fix for RWY 07 and RWY 25 missed approach area.

2. For initial approach fix for RWY07 and RWY 25 missed approach area, the highest obstacle in that area is at an elevation of 1160 M – NE at 20NM from suggested airport site.

3. The required altitude over obstacles at the initial approach area I 100 feet above the highest obstacle in that area. Generally for present time this may be managed, but for future the town may extend toward the airport direction and high building and antennas may penetrate the protection area of the instrument approaches.

**c. RWY Elevation (Approximately):**

i. RWY 25 is 952m (3123ft)

ii. RWY 07 is 936m (3071ft)

**D. ROUTES INFRASTRUCTURE IN THE VICINITY**

a. The only lower Route coming in the vicinity of the Airport is G660 which is linking Elgineina and Elfasher airport.

b. This route is regional route linking west Africa with Saudi Arabia and Gulf States at a distance of 20NM from the suggested location of the airport.

c. Route UT267 which upper route is at distance of 16NM.

d. Standard instrument Departure Routes (SIDs)

1. The area is mountainous area obstacles surrounding the airport.

2. SIDs is required to be designed.

3. Protection from obstacle must be considered from the departure from the runway .

e. Standard Terminal Arrival routes (STARs)

STARs are required to be designed for arriving aircraft. The surrounding is odd the airport is mountainous taking into consideration the hills.

**E. PROHIBITED AREAS**

a. There is no prohibited area or restricted area, for any reason id military needed to establish such areas. The new criteria of flexible airspace shall be applied.

b. Terminal Control Area not required.

c. A control zone may be established if it is decided air traffic control service will be provided after careful study of traffic volume .

**F. AIRSPACE CAPACITY**

Airspace capacity necessary to meet the busy aircraft movement condition;

1. Since there is no airspace restrictions and all the airspaces around the airport are available for use we can say this airport can have good capacity.
2. This will give more adequate airspace for the future and both RWYs can be used.

**G. NAVIGATION AIDS**

a. NAVAID are required for ; for the design of SID sans STARs , the establishment of holding areas and the design of non-precision instrument approach procedures.

b. Modern air navigation systems are required to design RNAV for both RWYs as it is highly recommended.

c. ADS-B – WAM is highly recommended to be installed in the airport to provide adequate ATM and solve convention navigational aids problems such Airspace management limitations, power supply, security, maintenance, commissioning calibrations, etc.

d. The correct decision requires accurate study of the visibility during the different seasons.

e. Basic GNSS instrument approach procedures ad BARONAV procedures are recommended.

f. The ILS is usually used according to the environmental conditions, Runway 07 and 25 elevation difference of 16 M will introduce complication with respect to safety and system operation.

**i. CIVIL MILITARY INTEGRATION / COORDINATION**

a. this can be achieved through the good coordination of Khartoum ACC with military.

b. local civil / military coordination procedures also shall be established.

**J. MAGNETIC VARIATION**

Magnetic Variation is 2.2 for Year 2013.

**k. CONCLUSIONS:**

a. So as to avoid any unforeseen factors for airport design we recommend designing complete instrument approach procedure and SIDs and STARs ensuring that the aircraft using the airport if fully protected from the mountain and obstacles.

b. For navigational aids it is not recommended to use VOR/DME as sole navigation aid because the suggested location lay almost along a valley.

c. for surveillance equipment it is require also to make detailed study so as to determine the coverage of all these equipments so as to avoid skipped areas.

d. ADS-B-WAM is highly recommended to be installed in ZALINGI airport to provide adequate ATM and to solve convention aids problems such Air Space Management limitations, power supply, security, maintenance =, commissioning, calibration, etc

e. The sitting of precision approach aids (ILS) and their safe guarding during operations will have considerable limitations due to the runway slopes as a result of runway 07 and 25 elevation difference of 16 M.

**F. SUMMARY AND RECOMMENDATIONS :**

The suggested development in short term considering the existing site accordingly the operational plan is :

**Location**

Latitude = 12° 57’ 26.21”

Longitude = 23° 37’ 26.54”

Distance and direction form town = 20km

Evaluation = 933m

Reference temperature = 35° C

**Runway:**

Designation = 07/25

Length = 2250 m

Stop way = 60 m

RESA = 240 M

Shoulders = 5 m

Width = 30m

**T/W Perpendicular**

Length = 200 m

Width = 28 m

**Apron**

Dimensions = 120 m x 200 m

Number of Stands = 3 Aircrafts CRJ-700

**Fire Crash & Rescues**

Category = Cat 6

Terminal = 1000 m2

Tower = 55 m2

**Electricity Supply**

Primary/stand generation 2 generators 2000 KVA + 1 generator 100KVA.

**Telecommunications :**

* Digital VHF System
* Digital HF System
* AMHS
* V.SAT
* REORDER

**Navigation Aids:**

* VOR/DME
* GNSS

**Airport Equipment :**

* PABX
* Airport Beacon
* Wind Cone
* CCTV
* Fire Alarm
* Public Address
* X-ray
* UPS
* Firefighting System
* BHS
* MET
* Firefighting vehicles