Request for quotation (RFQ) for S.I.T.C. of Basic Airfied Ground lighting Facilities at KURNOOL AIRPORT, IN ANDHRA PRADESH.

The Bidder would be required to register on the e-procurement market place www.apeprocurement.gov.in and submit their bids online. The department will not accept any bid submitted in the paper form. Please visit www.apeprocurement.gov.in for further details

GOVERNMENT OF ANDHRA PRADESH

ANDHRA PRADESH AIRPORTS DEVELOPMENT CORPORATION LIMITED (APADCL)
(A government of Andhra Pradesh Undertaking)

BID DOCUMENT
For
e - Procurement
EPC – TURNKEY CONTRACT (OPEN CATEGORY)

REQUEST FOR QUOTATION (RFQ) FOR S.I.T.C. of BASIC AIRFIED GROUND LIGHTING FACILITIES AT KURNOOL AIRPORT IN ANDHRA PRADESH.

RFQ No: 16/APADCL/KURNOOL/2018-19/ BASIC AIRFIED GROUND LIGHTING FECILITIES AT KURNOOL Dated. 12.4.2019

ANDHRA PRADESH AIRPORTS DEVELOPMENT CORPORATION LIMITED (APADCL)
Government of ANDHRA PRADESH
1st Floor, FDC Complex, AC Guards, Hyderabad 500 028

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Andhra Pradesh Airports Development Corporation Limited
(APADCL), GOVERNMENT OF ANDHRA PRADESH
Notice Inviting e-tenders (NIT)

RFQ No: 16/APADCL/KURNOOL/2018-19/ BASIC AIRFIED GROUND LIGHTING FECILITIES AT KURNOOL Dated. 12.4.2019

Tender Type: Open

Name of work: S.I.T.C. of BASIC AIRFIED GROUND LIGHTING FACILITIES AT KURNOOL AIRPORT IN KURNOOL DISTRICT

1.	Department Name	APADCL
2.	Circle / Division Name	O/o the Managing Director, APADCL, Vijayawada
3.	Tender Number	**RFQ No: 16/APADCL/KURNOOL/2018-19/ BASIC AIRFIED GROUND LIGHTING FECILITIES AT KURNOOL Dated. 12.4.2019**
4.	Tender Subject	a) Supply, installation testing and commissioning of FAA approved Advanced Air Traffic Advisory System (AATAS) as per technical specifications of this tender at KURNOOL AIRPORT IN KURNOOL DISTRICT, AP. b) Supply, installation, testing and commissioning of i. Aerodrome simple Approach Lighting systems (420 m) & PAPI for both ends of runway; ii. runway edge lights, taxiway edge lights, apron edge lights- one circuit as per DGCA- CAR; iii. mandatory, informatory& Mandatory signages as per technical specifications and quantities as laid out in this tender. iv. Construction and development of a CCR & DG room of min 700 square feet / or a suitable size (pre-fab. structure is also permitted) shall be included with the airfield lighting. (In line with scope and deliverables wherever mentioned)
5.	Estimated Contact Value (Internal Bench Mark)	Rs.7,25,00,000
6.	Period of Contract	4 (Four) Months
7.	Form of Contract	EPC – Turnkey system.
8.	Tender Type	Open
9.	Tender Category	Electrical Works
10	EMD / Bid Security	Rs 35,00,000.00

11.	EMD / Bid Security Payable to	In the shape of unconditional & irrevocable Bank Guarantee in the standard format in favour of the Managing Director, APADCL, Vijayawada to be obtained from any Government owned Public Sector Bank or any scheduled commercial bank (or) cash deposit using net banking / RTGS/NEFT from their registered bank account to A/C No: 50200014443370 of HDFC Bank, IFSCode: HDFC0000050, Branch: Dwarika Nagar Branch of the Managing Director, APADCL, Visakhapatnam .
12.	Tender Fee	Rs.25000/-
13.	Tender Fee Payable to	DD in favour of MD., APADCL
14.(a)	Transaction Fee	Rs. 11,800.00 (Inclusive of GST @ 18.00 %)
14.(b)	Transaction Fee Payable to	M/s Upadhi Techno Services Pvt. Ltd., Gachibowli, Hyderabad.
15. (a)	E- Procurement Corpus Fund	Rs 10,000.00
15.(b)	E- Procurement Corpus Fund Payable To	MD, APTS, Vijayawada
16.	Bid document download Start Date and time	12-04-2019 at 7.00 PM
17.	Bid Document download end date and time	22-04-2019 by 1.00 PM
18.	Pre-Bid Meeting Date	NA
19.	Bid submission closing Date (online)	22-04-2019 by 2.00 PM
20.	Pre-Qualification / Technical bid opening date (Qualification and Eligibility stage)	22-04-2019 by 3:00PM
21.	Price Bid Opening Date (Financial Bid Stage)	26.04.2019 by 11.30AM
22.	Place of Price Bid Opening	O/o APADCL, Hyderabad
23.	Officer Inviting Bids / Contract Person	Managing Director & CEO APADCL Vijayawada .
24.	Address / E-mail ID	Managing Director & CEO APADCL, Hyderabad. # 10-2-1,1st Floor, FDC Complex, AC Guards, Hyderabad - 500028 E-mail id: ceoapadcl@gmail.com,
25.	Contact Details/Telephone, Fax	O/o Managing Director & CEO, APADCL, Hyderabad. PH No: 040 – 29700263
26	**Eligibility criteria:**	**1. <u>General Requirements</u>** The following **minimum** eligibility criterion has been laid out: *a)* Bidder shall be a company registered in

		India under the Indian Companies Act, in existence for the last three years. *(Copy of certificate of incorporation to be submitted)* *b)* The bidder shall have a NET WORTH of at least Rs. 3.5 Crores. *(Copy of Auditors Certificate or Chartered Accountant Certificate shall be submitted)* c) The bidding entity should not be on the sanctioned list (black listed) by any multilateral funding agency, Government, PSU or Government organization. *(An affidavit of self-declaration on Rs. 10/= stamp paper duly notarized to be submitted)* **2. <u>Technical Requirements</u>** The Bidding firms should have experience of: i. Supply, Installation, Testing and Commissioning of any Airport Equipment, from the following, at any aerodrome: -Non-Directional Beacon (NDB) **or** -Very High Frequency Omni direction Radio (VOR) **or** -Advanced Air Traffic Advisory System (AATAS) **or** - Instrument Landing System (ILS). ii) Supply, Installation, Testing and Commissioning of RUNWAY lighting system, PAPI and mandatory signage. iii) The bidder shall have at-least 1 CEO and one VP / GM on the board of the company, at the time of submitting the bid, with aviation experience of more than 10 years each. iv) Two Independent firms having not more than three common directors are also eligible to participate but no JV is permitted. v) Bidders/firms should possess at least: one work of any of the afore mentioned types for an amount of **Rs. 7,00, 00,000/- (Rs. Seven crores and more)** **or** Two work orders of any of the afore mentioned types for at least an amount of **Rs. 3,50, 00, 000/- (Rs. Three crores fifty lakhs each)** **or** Four work orders of any of the afore mentioned types for at least an amount of **Rs. 2,75,00, 000/- (Rs. Two crores seventy-five lakhs each)** -during the last five years, from any State

		Government in India or with Airports Authority of India/ private airport operator/ PPP airport. g) The bid document shall be supported with self-attested photo copies of valid Registration (Trade license), Permanent Account Number (PAN), Tax Deduction and Collection Account Number (TAN), GST registration, ISO Compliance Certificate. Bids not found meeting pre-qualification criterion will be rejected. **3. <u>Financial Requirements</u>** The bidder shall have a NET WORTH of at least Rs. 3.5 Crores. *(Copy of Auditors Certificate or Chartered Accountant Certificate shall be submitted)*
27.	Procedure For Bid Submission	a) Intending Bidders can contact office of the Managing Director, Andhra Pradesh Airport Development Corporation Ltd, for any clarification, information on any working day during working hours. b) The Bidder would be required to register on the e-procurement market place www.apeprocurement.gov.in and submit their bids online. The department will not accept any bid submitted in the paper form. Bidders are requested to submit the bids in two stages: Stage-I: Eligibility and Technical bid stage (Envelope-I). Stage-II Financial bid stage (Envelope-II) c) The first stage will cover the qualifications, eligibility details and the technical bid. The Bidder shall upload documents in support of the above. The bidder shall submit price bid online under second stage which may include proposals for financing to cover part of the scope of the work as per bid documents before the bid submission closing date d) The detailed procedure for bid submission is described in the bid documents. e) Bidders shall submit a declaration without any reservation whatsoever that the submitted eligibility and qualification details, Techno Commercial bid and financial bid are without any deviations and are strictly in conformity with the documents issued by the Employer. f) Declaration should be given by the bidder for the correctness of the credentials submitted by him.

		g) The Bidders shall sign on the documents (such as EMD, transaction fee payable at Vupadhi Techno Services Pvt. Ltd.,, Gachibowli, Hyderabad etc.) uploaded by him, owing responsibility for their correctness / authenticity. h) After bidding, the original relevant documents inclusive of B.G. shall be furnished to the Managing Director, APADCL through a Registered Post / Courier / Personally i.e., at least one day before technical Bid opening date. Failure to submit the hard copies of BG for EMD, for transaction fee, hard copies or uploaded documents within the stipulated time, the tenderer will be suspended / disqualified from participating in the tenders on e-procurement platform for a period of 12 months from the date of bid submission in accordance with G.O. Ms. No.245 dated 30.12.2005 and G.O. Ms. No. 155 dated 23.8.2006. 1. For registration and online bid submission bidders may contract HELPDESK of Vupadhi Techno Services Pvt. Ltd., Gachibowli, Hyderabad, on www.eprocurement.gov.in or https://tender.apeprocurement.gov.in 2. The employer reserves the right to relax the conditions if required for eligibility of the bidders in the public interest. The bidder(s) shall not have any right to question the decision taken by the Employer in this regard. 3. The bidders shall submit a written power of attorney authorizing the signatory of the bid to commit on behalf of the bidder.
28.	General Terms & Conditions	1. The details and certificates are to be furnished as per the pro-forma available in the tender schedules. 2 The bidder should have the key 3. The bidder is subjected to be disqualified and liable for black listing and forfeiture of EMD, if he is found to have misled or furnished false information in the forms / statements / certificates submitted in proof of qualification requirements. 4. Even while execution of the work, if found that the contractor had produced false / fake certificates of experience he will be liable for black listing and the contract will be liable for termination and liable for forfeiture of EMD and all the amounts due to him. 5. Bidders shall submit a declaration without any

		reservation whatsoever that the submitted eligibility and qualification details, technical and financial bid are without any deviations and are strictly inconformity with the documents issued by the employer. 6. Declaration should be given for the credentials submitted by the bidder. 7. The employer reserves the right to relax the conditions and required for eligibility of the bidders in the public interest. The Bidder(s) shall not have any right to question the decision taken by the employer in this regard. 8. The bidder(s) shall submit a written power of attorney authorizing the signatory of the bid to commit for the bidder.
		Special Conditions : 1) Tenders with an excess of **more than 5%** over the Internal Bench Mark value arrived by the department shall be summarily rejected. Bid validity is 90 days 2) In respect of tenders beyond 25% less than internal benchmark arrived by the department, a Bank Guarantee or Demand Draft for the difference between the tendered amount and 75% of internal benchmark value should be furnished at the time of agreement as additional security deposit. 3) Transaction Fee : As per 14 (a) and 14 (b) 4) e-procurement corpus fund: As per 15 (a) and 15 (b) 5) The e-procurement application is PK1 enabled and supports the digital certificates issued by APTS, for signing the bids at the time of submission by contractor. The contractor has to procure digital certificates issued by APTS, Vijayawada as per the procedure. Digitally signed bids are to be submitted electronically through e-procurement, without which the tender will not be considered for opening the Price Bid. 6) The bidders intend to know the procedure of bid submission on e-procurement platform; suitable training will be given by M/S Upadhi, Gacchibowli, Hyderabad. 7) Government reserves the right to cancel / alter the bid conditions at any time without assigning any reason. 8) The bidder should submit a copy of valid VAT registration certificate issued by the VAT registration authority. 9) In case of discrepancy between the price quoted online and in supporting documents uploaded, then,

		the price quoted in the template provided online only would be considered for evaluation. 10) After bidding, the original relevant documents inclusive of B.G. shall be furnished to the Managing Director, APADCL through a Registered Post / Courier / personally i.e., at least one day before technical Bid opening date. Failure to submit the hard copies of BG for EMD, for transaction fee, hard copies or uploaded documents within the stipulated time, the tenderer will be suspended / disqualified from participating in the tenders on e-procurement platform for a period of 12 months from the date of bid submission in accordance with G.O. Ms. No.245 dated 30.12.2005 and G.O. Ms. No. 155 dated 23.8.2006. **Scope of work:** a) Supply, installation testing and commissioning of FAA approved Advanced Air Traffic Advisory System (AATAS) as per technical specifications of this tender at KURNOOL AIRPORT IN KURNOOL DISTRICT, AP. b) Supply, installation, testing and commissioning of i. Aerodrome simple Approach Lighting complete systems (420 m) & PAPI lighting system for both ends of runway; ii. runway edge lights, taxiway edge lights, apron edge lights- one circuit as per DGCA- CAR; iii. Mandatory, informatory signage as per technical specifications and quantities as laid out in this tender. iv. Construction and development of a CCR & DG room of min. 700 square feet / or a suitable size (pre-fab. structure is also permitted) shall be included with the airfield lighting. v. Provision of suitable control panel in ATC tower for PAPI and RWY approach lightings. vi. Provision of one non-frangible wind-sock system with five spare standard socks, as per DGCA relevant CAR. (To be read in conjunction with deliverables at page 73) 1. The scope of work shown above is indicative and

		the bidder should submit the detailed designs and drawings duly conducting survey. 2. The time for completion of the project is 6 months. 3. Issue of bid document will not automatically construe the eligibility of the bidders for participation in the subsequent bidding process and will be determined during evaluation. 4. Department reserves the right to accept or reject any or all the bids without assigning any reasons whatsoever. 5. The dates stipulated in the NIT are firm and under no circumstances they will be relaxed unless officially extended. 6. The bidders shall submit their tenders online only. The department is not responsible for any sort of difficulties for the problems in the Internet, website in submission of tenders. 7. Other conditions can be seen in the bidding document. 8. Issue of bid document will not automatically construe the eligibility of the bidder(s) for participation in the subsequent bidding process and eligibility will be determined during evaluation. 9. Managing Director, APADCL, Hyderabad, and the right to accept or reject any or all the bids without assigning any reason what so ever. 10. The bidders shall submit their tenders online only. Any sort of difficulties for the problems in the Internet, Web site, in submission of tender, the department is not responsible. 11. Government reserves the right to cancel / alter the bid conditions at any time. 12. In the process, if the works are stalled due to legal intervention or due to natural calamities, no compensation will be paid. 13. All necessary permissions / clearance / approvals are to be processed and obtained by the firm only. As a user agency this Department will initiate the proposals in respect of above. 14. All land cost required for the disposal of muck is rest with firm only i.e., no land will be supplied by the department. The IBM indicated is inclusive of following recoverable / reimbursable amounts. 1. Payment towards Technical Personnel employed on the work. 2. Bank commission charges.

GENERAL TERMS AND CONDITIONS:

One Bid per Bidder:

Each Bidder shall submit only one Bid. A Bidder who submits or participates in more than one Bid shall cause all the proposals with the Bidder's participation to be disqualified. However, multiple individual companies (registered under the Indian Companies Act) having no more than 2 common Directors/shareholders are eligible to submit bids through individual corporations.

Cost of Bidding:

The Bidder shall bear all costs associated with the preparation and submission of his/her Bid, and APADCL shall in no case be responsible or liable for those costs.

Site Visit:

The Bidder, at the Bidder's own responsibility and risk, is encouraged to visit and examine the Site and its surroundings and obtain all information that may be necessary for preparing the Bid and entering into a contract for the said work. The costs of visiting the Site shall be borne by the Bidder.

Signing of bids:

All documents (all pages) to be submitted against the tender/bid have to be stamped (official stamp of the bidding entity) and signed in original by the authorised signatory. A power of attorney or authorization as the case be, in favor of the signatory is to be submitted with the pre-qualification documents.

Clarifications required by bidders:

Bidders may seek clarifications to their queries, if any, on email ceoapadcl@gmail.com up-to 18-04-**2019, 3 p.m. only**. In response, if necessary, APADCL may issue corrigendum or addendum to the bid document.

Clarifications on bids submitted:

APADCL reserves the right to seek clarifications or additional information on the bids submitted by the bidders at any stage of the process if so required.

Amendment of Bid Document/Conditions:

APADCL may do necessary amendment/changes/additions/deletions to the tender documents or conditions, if so required.

Evaluation and rejection of bids:

APADCL reserves the right to reject any or all bids without assigning any reasons. APADCL also reserves the right to call off the process of tendering at any stage without assigning any reason.

Pre-Qualification/ Eligibility criteria:

The following **minimum** pre-qualification/ eligibility criterion has been laid out:

a) Bidder shall be a company registered in India under the Indian Companies Act, in existence for the last three years. *(Copy of certificate of incorporation to be submitted)*
b) The bidder shall have a NET WORTH of at least Rs. 3.5 Crores.
(Copy of Auditors Certificate or Chartered Accountant Certificate shall be submitted)

c) The bidding entity should not be on the sanctioned list (black listed) by any Multilateral funding agency, Government, PSU or Government organization.
(An affidavit of self-declaration on Rs. 10/= stamp paper duly notarized to be submitted)

d) The Bidding firms should have experience of:

(i) Supply, Installation, Testing and Commissioning of any Airport Equipment, from the following, at any aerodrome:

-Non-Directional Beacon (NDB) **or**
-Very High Frequency Omni direction Radio (VOR) **or** -
Advanced Air Traffic Advisory System (AATAS) **or** –
Instrument Landing System (ILS).

(ii) Supply, Installation, Testing and Commissioning of RUNWAY lighting system, PAPI and mandatory signage.

d) The bidder shall have at-least 1 CEO and one VP / GM on the board of the company, at the time of submitting the bid, with aviation experience of more than 10 years each.

e) Bidders/firms should possess at least:
One work of any of the afore mentioned types for an amount of **Rs. 7,00, 00,000/- (Rs. Seven crores and more) or**
Two work orders of any of the afore mentioned types for at least an amount of
Rs. 3,50, 00, 000/- (Rs. Three crores fifty lakhs each) or
Four work orders of any of the afore mentioned types for at least an amount of
Rs. 2,75,00, 000/- (Rs. Two crores seventy-five lakhs each)
-During the last five years, from any State Government in India or with Airports Authority of India/ private airport operator/ PPP airport.

g) The bid document shall be supported with self-attested photo copies of valid Registration (Trade license), Permanent Account Number (PAN), Tax Deduction and Collection Account Number (TAN), GST registration, ISO Compliance Certificate.

Bids not found meeting pre-qualification criterion will be rejected.

Scope of Work:

a) Supply, installation testing and commissioning of FAA approved Advanced Air Traffic Advisory System (AATAS) as per technical specifications of this tender at KURNOOL AIRPORT IN KURNOOL DISTRICT, AP and (5) five years Extended Warranty after initial 1 year warranty of the system .

b) Supply, installation, testing and commissioning of
(with 3 year Extended warranty after initial 1 year warranty of the system)

i. **Aerodrome simple Approach Lighting systems (420 m) & PAPI for both ends of runway;**
ii. **runway edge lights, taxiway edge lights, apron edge lights- one circuit as per DGCA-CAR;**
iii. **Mandatory, informatory signage as per technical specifications and quantities as laid out in this tender.**
iv. **Construction and development of a CCR & DG room of min 700 square feet / or a suitable size (pre-fab. structure is also permitted) shall be included with the airfield lighting.**

(Complying all the above in conjunction with deliverables at page no 73 of this tender doc).

The technical information of Airport is as follows:

a. **Runway length – 2000 m (10-28)**
b. **RWY 10 Displaced threshold – 150m**
c. **Aerodrome code – 3C, Non Instrument runway**
d. **Taxiways – 02 Numbers**
e. **Apron – main apron suitable for 04 ATR 72 type of aircraft, Isolation parking stand suitable for 01 ATR 72 type of aircraft.**

Technical Evaluation:

Technical bids shall be evaluated based on conformance to specifications of systems mentioned in the bid document.

Period of completion:

The work under the assignment is to be mandatorily completed by successful bidder within a period of 180 days from the date of signing of contract.

Payment Terms:

The following payment terms shall be adopted for the works under the tender:

a) 30% advance payment (against a separate irrevocable Bank guarantee valid for 270 days.) (Except the cost of Warranty)
b) 40% on delivery of materials at site. (Except the cost of Warranty)
c) 30% on successful installation, commissioning and handover. (Except the cost of Warranty)
d) Warranty payment will be paid proportionately after completion of each 6 months period during balance warranty period after completion.

Necessary deductions from payment shall be made towards statutory taxes as per rules like Income Tax, GST etc. as per prevailing rates.

The LoA will be issued to the successful bidder. Agreement to be signed within 15 days of issuance of LoA, subject to submission of performance security bank guarantee and advance payment bank guarantee. Advance payment to be given after submission of bank guarantee.

Equipment / Work:

The bidder will also certify that the equipment/ work done conform to the bye laws, rules and stipulations of respective International/Indian authorities. The systems shall have FAA approvals, ICAO or DGCA compliances, as applicable.

Acceptance of Tender Conditions:

Submission of a Tender by a Bidder implies that he/she has read the notice tender document and all other conditions, contract documents and has made himself/herself aware of the scope and specifications of the scope of work/s to be done and of conditions and rates at which land for stores, tools and plant, etc. will be available at the specified site, local conditions, local material rates and other factors bearing on the execution of the works. No counter conditions shall be acceptable.

Currency for Quotation:

All bids will be submitted **ONLY in INDIAN RUPEES**. APADCL will not be responsible for any currency fluctuations, so bidders are advised to take necessary precautions towards this in case of imported component, if any, of the bid.

Taxes:

For evaluation purposes, all taxes, as applicable on the date of financial bid, have to be included and shown separately individually by the bidder. Any change in tax rates or levy of any additional tax by the Government (Central /State) shall be handled as per prevailing rates on the date of raising of invoice. *(necessary proof of change shall have to be submitted by successful bidder).*

Approvals:

The bidder will seek approvals at all stages from competent authority, as defined in the contract. There shall be no deemed approvals.

Canvassing and use of Corrupt Practices:

All bidders are cautioned not to adopt canvassing in any form in connection with the tender as it is strictly prohibited, and the bid submitted by the bidder who resort to canvassing will be liable to be rejected. Bidders are also advised not to resort to use of any corrupt practice such as payment of commissions to influence the bid process. Any bidder found to have used corrupt means/ practice shall be black listed in addition to any other punitive action which APADCL may take. Bidder shall also give a declaration that they have not resorted to any collusive/corrupt practice for influencing the bid process in their favor and have not paid any commissions for such activity.

Contract:

The successful bidder will be required to enter into a contract with APADCL on non-judicial stamp paper of Rs. 200/- (to be purchased from State of Andhra Pradesh, India). The contract would invariably define the terms governing the work, scope of work etc.

Indemnity:

The successful bidder shall indemnify APADCL of all copyrights/ IPR and any individual/group claims towards the equipment, software, material and work performed under the contract. Bidder will ensure that there is absolutely no infringement of any copyrights/laws of the land/international laws. Bidder shall also indemnify that the items offered and the installation process do not violate any environment parameters laid down in India.

Jurisdiction:

The Courts of Law situated in Vijayawada, Andhra Pradesh, India shall have absolute jurisdiction.

Force Majeure and Arbitration:

The contract shall be covered under a Force Majeure clause. The disputes arising, if any, shall be settled amicably by the parties to the contract and any unresolved matter shall be referred to MD APADCL for resolution. If still unresolved, the Arbitration Act 1996 (and all its latest amendments / enactments) shall be applicable to the contract.

Financial bid format:

Financial bids have to be submitted on the format placed at annexure.

Financial bids will be evaluated for the minimum quantity as mentioned in the financial bid format. However, APADCL reserves the right to increase or decrease the quantity of work as per requirements. The bidder has to include all cost related to the said work such as travel, boarding, professional fee, professional, accidental and third-party insurance of workmen and crew. APADCL may at its discretion facilitate some of the arrangements on payment of necessary charges by bidder to the respective organization

The documents in support of Eligibility and the Technical bid, invariably the following documents shall be submitted (self-attested):

a) Proof of Incorporation in India under the companies act.
b) Auditor's Certificate / CA Certificate with supporting documents stating Net Worth.
c) An affidavit of self- declaration of not being on sanctioned list (black list) on Rs. 10/= stamp paper, duly notarized.
d) Documents in support of experience for S.I.T.C. of aerodrome/aerodrome equipment such as NDB or VOR or AATAS or ILS.
e) Documents in support of experience for S.I.T.C. of Runway lights & mandatory signage.
f) Documents in support of minimum 1 CEO & 1 VP/GM on board of the bidder, having minimum of 10 years of Aviation experience each.
g) Document in support of execution of same type of work for an amount of One work order of minimum Rs. 7,00,00,000/- (Rs. Seven crores) or
   Two work orders of minimum of Rs. 3,50,00,000/- (Rs. Three Crores fifty lakhs each) or Four Work order of minimum of Rs. 2,75,00,000/- (Rs. Two Crores seventy-five lakhs each).
h) Valid Trade Tax Registration (Trade license).
i) Permanent Account Number (PAN).
j) Tax deduction and Collection Account Number (TA N).
k) GST number.
l) ISO Compliance Certificate.
m) Complete Technical Specification document and brochure on the products offered, along with compliance to technical specifications mentioned in the bid document.
n) The bid document duly signed and stamped, numbered on all pages (with blank and crossed price bid format), submitted in hard binding.
o) CHECK LIST: Bidders are advised in their own interest to submit a check list of all documents submitted in the Technical bid Envelope indexing the various documents submitted.

Corrections, Over Writing:

Any bid containing any correction/s or over writing shall be liable to be rejected.

Award of Contract:

Notification of Award of contract will be made in writing to the successful bidder by the Authority or it's representative. The contract will normally be awarded to the qualified and responsive Bidder offering lowest evaluated bid in conformity with the requirements and the specifications and bid documents and the Authority shall be the sole judge in this regard. The Authority does not bind himself to accept the lowest or, any bid or to give any reason for it's decision. A responsive bidder is one who submits priced bid and accepts all terms, conditions and specifications of the bid documents. A bidder shall submit a responsive

bid, failing which his bid will be liable to be rejected. In case successful bidder fails to accept the award, the EMD shall be forfeited.

False Information/ Concealment of facts:

APADCL reserves the right to disqualify the bidders whose performance based on feedback obtained in ongoing project(s) is below par or unusually poor. If at any stage, any information/documents submitted by the applicant are found to be false/ information is found to be concealed, the bidder shall be liable for debarment from tendering and the bid shall be rejected in addition to any other appropriate/legal action which APADCL may initiate. The EMD of such bidders shall be forfeited.

Validity of bids:

The bid for the work shall remain valid for acceptance for a period of 90 days from the date of opening of Price Bid. If any bidder withdraws his bid before the said period, then APADCL, shall without prejudice to any other right or remedy, will be at liberty to forfeit the full earnest money absolutely. Bidders are not allowed to make any modifications in the bids such as specifications, price, terms and conditions. APADCL may seek extension of bid validity, if required, and bidder will have the liberty to accept or decline such a request.

Complete Turnkey Project:

The bidder shall only bid for complete turnkey project of all works as defined in the scope of works. Partial works bidding or consortium bidding for partial works shall not be entertained.

Ownership of Contract from APADCL side:

APADCL reserves the right to transfer the ownership of the contract to the concerned organization/department of the government, in which case the bidder shall be liable to perform all requirements under the control and guidance of that particular organization/department. APADCL may also assign a particular organization / department of the government to sign the contract under this bid with the successful bidder. APADCL reserves the right to accept in whole or any part of the bid/Tender and bidder shall be bound to perform the same at their quoted rates. No claim whatsoever will be entertained on this account.

On acceptance of the bid, the name of the accredited representative(s) of the Bidder who would be responsible for taking instructions from the CEO or his representative shall be communicated.

MD & CEO
APADCL

INDICATIVE CHECKLIST

FOR S.I.T.C./ of BASIC AIRFIELD GROUND LIGHTING FACILITIES AT KURNOOL AIRPORT IN KURNOOL DISTRICT

Instructions:

1. Please fill the following table and submit the table along with necessary annexure
2. Applicant may add more than one Annexure as the underlying enclosures for each point.

<table>
<tr><th>Sl. No.</th><th>Particulars Required</th><th colspan="5">Details</th><th>Annexures Enclosed</th></tr>
<tr><td>1.</td><td>Name of the Bidder:</td><td colspan="5"></td><td></td></tr>
<tr><td>2.</td><td>Address and Contact Details of the Bidder:</td><td colspan="5"></td><td></td></tr>
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<tr><td>4.</td><td>Details of Experience for Pre-Qualification:</td><td colspan="5"></td><td></td></tr>
<tr><td>5.</td><td>Details of PAN and TAN/ TIN (as applicable)</td><td colspan="5"></td><td></td></tr>
<tr><td rowspan="4">6.</td><td rowspan="4">Details of Works Successfully Completed:</td><td>Sl. No.</td><td>Name of Work</td><td>Work Order No./ Agreement No.</td><td>Term of Contract; and Final Completion Date</td><td>Cost of Contract as per Agreement; and Final Cost Incurred</td><td rowspan="4"></td></tr>
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Signature of Authorized Signatory of the Bidder
Name:
Designation:
Place:
Date:

Declaration on Bidder's Letter Head

I *(state here the name of signatory)* hereby declare that the documents submitted/enclosed are true and correct. In case any document, at any stage, is found fake/incorrect, my EMD may be forfeited and action as deemed fit by APADCL, Government of Andhra Pradesh, can be taken against me.

I undertake to keep my bid (Technical and Financial) valid for a period of (insert no. of days) days as required in the bid document. I also undertake that in case I withdraw my bid before the said validity my EMD deposit may be forfeited.

I further undertake that changes suggested by ICAO/DGCA in method of reporting or format during the warranty period will be incorporated by us without any extra cost.

I further declare that I/we have not resorted to any collusive/corrupt practices in connection with this bid and that we have not paid any commissions to influence the bid process to any person/s or organization in this regard.

Place:

Date:

Signature
Authorized Signatory of the Bidder
Stamp

Chapter I

Technical Specifications for Aerodrome Lighting & Mandatory Signage

General

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation. Electrical work in general shall be carried out as per CPWD Specifications amended up-to date and as per ICAO Annex 14 / DGCA CAR Sec 4 Sr. B, Pt 1 and FAA specifications. Wherever these specifications call for a higher standard of material and/ or workmanship than those required by any of the above-mentioned regulations and specification, then the specification hereunder shall take precedence over the said regulations and standards. The details of scope of work, subhead wise, are given in the subsequent paras. The quantities worked out in schedule of quantities are based on particular equipment considered at design stage. The Bidder is required to recheck the quantities based on equipment offered by him to achieve required parameters. The Bidder, before supply, shall submit the drawings and actual measurement of secondary leads as measured from site.

SPECIFICATIONS FOR INSET FIXTURES

1.1 General:

1.1.1 Scope of work includes supply of inset type, high intensity bi-directional edge light & Unidirectional THRESHOLD / END light fixtures i/c Lamps.

1.2 Applicable Specifications:

1.2.1 as per ICAO Annex-I4 and relevant DGCA CAR.

1.3 Condition of Use:

1.3.1 General:
In addition to other conditions detailed hereunder, the light fixtures shall be designed for.

(a) Blast effects from Jet engines, including wind velocities as per FAA Specifications.

(b) Impact loading of 30,000 kgs and other stretched version of high speed 6.6 Amp [A.C] Secondary rating.

1.3.2 Circuitry:

The fittings shall be suitable for use on a constant current series system.

1.3.3 Ambient Temperature:
The light fittings assembly shall be capable of continuous satisfactory
p e r f o r m a n c e under temperature conditions ranging from -05°C to + 55°C

1.3.4 Humidity:

Relative Humidity up to 100%, including conditions where condensation takes place in the form of both water and frost.

1.3.5 Vibration /Static Load.
The fixtures shall meet the detailed requirement as in ICAO standard /FAA Specifications.

1.4 Design Requirement and Constructional features.

1.4.1 The inset light fixtures shall be directional type and shall emit light beams in all approach directions. The photometric performance shall comply with Annex.14 of ICAO.

1.4.2 The fixtures would comprise of a top light assembly and a shallow base. All interfaces of the top assembly and shallow base shall be machined to the same true finish. Pry bar slots indentations or other suitable means shall be provided for prying or jacking the top assembly free of the base. The base shall be capable of installation in a drilled cavity, not exceeding 150 mm in depth, in the existing concrete/asphalt runway.

1.4.3 The external portions of the top assembly, which extends above the Pavements, shall be smoothly sloped upwards from the edges.

1.4.4 Lamp and Lamps Holder:

1.4.4.1 The lamps used in top assembly shall be of quartz halogen type, with a rated life at full brilliance. The lamp shall be capable of easy replacement in the field with the help of standard tools.

1.4.4.2 The lamp holder shall securely and accurately position the lamp in the fixture. It shall permit easy re-lamping without involving the use of special tools. Such re-lamping shall not disturb colour filters or other optical components and after re-lamping there shall be no change in the photometric.

1.4.5 Operating Temperatures:

With the unit operating at continuous full brilliancy and under maximum ambient conditions of temperature, no parts of the complete assembly will deteriorate or get damaged on account of thermal stress applied under rain or snow conditions.

1.4.6 When the unit is operating at a continued full brilliancy, it shall dissipate the heat generated within, in such a manner that no component of the hardware develops temperature which can be hazardous to the aircraft tyres.

1.4.7 Optical Components:

1.4.7.1 The prisms shall be made out of heat resistant glass, designed to with stand the heat buildup and also the thermal stresses on account of external rain or snow. The prisms shall be accessible for easy maintenance and periodical cleaning. The windows in front of the prisms should not have appreciable negative slopes, which would result in accumulation of dirt, water etc. and contribute towards deterioration in photometric performance.

1.4.7.2 All reflectors used in the optical assembly shall have high specular reflectively.

1.4.7.3 The optical system shall be such that the chromaticity and other color requirements of these filters would conform to the ICAO requirement specified in Annex-14.

1.4.8 All components, including optical top lamp and base receptacle shall be corrosion resistant and shall not be affected by continued atmospheric action. Dissimilar materials in contact with each other, which will lead to bi-metallic corrosive action, shall not be used. All parts/components not made of stainless steel shall be rendered resistance to corrosion by plating, anodizing or painting.

1.4.9 Prisms, gaskets and other parts of the units shall not be damaged by water, hammer action encounter during aircraft maneuvers over the fixtures.

1.4.10 The shallow base should have external ribs or other locking device feature so as to minimize vertical, lateral and rotational movements of the base receptacle from its installed position in the pavement.

1.4.11 The top assembly unit have a portion extending into the base receptacle so as to restrict side motion and shear action when the unit is struck.

1.4.12 Installation Jig:

Successful tenderer will have to use installation jig suitable for installing the inset light fixture in the pavement.

1.5 Water Tightness of the Unit:

1.5.1 The complete assembly shall be water proof and shall remain so under all normal operating conditions. It shall also meet the requirements as per FAA specification for water leakage test.

1.5.2 Wherever gaskets are used, they should be of 'O' ring type properly seated in their grooves. Such 'O' ring gaskets shall be moulded from the best quality silicon rubber, neoprene. Such gaskets shall be suitable of performing satisfactorily for a period of at least one year of operation, which would include at least 15 top assembly removal and replacements. Under no circumstances bituminous or other similar sealing compounds shall be used on such joints.

1.5.3 All hold down bolts, nuts and washers shall be made of the best quality stainless steel and shall be corrosion resistant.

1.5.4 Hold-down bolts shall be hexagonal head type. There should be clearance for application of socket/torque-wrenches. Such bolts heads shall not project above the surface.

1.5.5 There shall be adequate clearance under the hold down bolts to serve as a sump for foreign matters. This would enable the hold down bolts to be properly tightened to the required torque value under normal field operation conditions.

1.5.6 Prisms in the top optical head shall be such as to render the top unit completely water tight under normal operating conditions.

1.5.7 Power leads to the optical system shall be brought through the bottom box. The wire entry arrangement shall be completely waterproof under all operating conditions.

1.6 Electrical Components:

1.6.1 All electrical components used in the fixtures shall be rated for at least 500v (rms value to ground) and shall have a current carrying capacity of at least 10 Amps.

1.6.2 High conductivity, non-corrosive metal, suitably protected against corrosion shall be used for current carrying components. Aluminium will not be acceptable for this purpose.

1.7 Qualification Testing:

The light fixture assembly shall be tested in accordance with relevant and applicable FAA specification.

1.7.1 Routine Test:

Each type of inset fixture would be required to undergo the following routine tests successfully before leaving the manufacture's works.

1.7.2 Photometric Test:

The Photometric Test for inset light fixtures shall be in accordance with Aerodromes Annex-14 of International Civil Organization (Latest Edition)

1.7.3 Leakage Test:

This shall be accomplished by means of a standard head and a standard base properly fitted with pressure fittings to permit each top assembly and base receptacle to be subjected to a pressure of at least 1.5 kg/cm2.

1.7.4 Insulation Test:

The insulation resistance of the fixture assembly shall be tested with a 500V insulation meggar and the value should be not less than 100 mega ohms.

1.7.5 Visual Examination:

Light fixtures shall not have any visible sign of damage/distortion. Compliance is checked by visual examination.

1.7.6 The fixture shall be installed / fixed by selected contractor by ensuring no F.O.D or executed material is left at site which can endanger operating aircraft in the vicinity.

SPECIFICATION FOR HIGH INTENSITY ELEVATED RUNWAY EDGE LIGHT FIXTURES

2.1 GENERAL

The runway edge light fixture shall be designed to withstand blast effects from Jet Engines including wind velocity up to 560 km/hr to the extent they are likely to be encountered on the runway. The fixture shall be suitable for use on a constant current secondary lamp loop of 6.6 amps AC (Secondary rating). However, all current carrying parts of the light unit shall be suitable for the service intended and have the capacity to handle at least 10 amps. The light fixture shall be capable of withstanding continuous outdoor operation under normal weather conditions ranging from temperature of (-) 20 to + 55 deg C, the effect of blowing dust, heavy rain, snow, 100% relative humidity and wind velocities as mentioned above. The unit operating at continuous full brilliancy and under extreme conditions, no part of the light fixture will deteriorate or get damaged.

2.1.1 Applicable Specifications

The light fixture shall meet the requirement of ICAO Annex 14, Aerodrome Design Manual part IV, as described here under and generally shall confirm to IS 7785 part -I & II with latest amendments.

2.2 Design and construction

The fixture shall consist of an optical system, lamp, lamp holder, mounted in a suitable metallic housing, breakable coupling, connecting leads, mounting assembly and a base plate with pipe column as specified in BOQ.

2.3 Optical system

The optical system shall consist of a glass lens assembly consisting of an outer dome with smooth outer surface and a 360 degree inner clear prismatic lens or two numbers 180 degree inner prismatic lenses in clear or green or yellow or red colour as specified. This assembly must be easily removable and replaceable and must retain its correct alignment on replacement. The lens shall not melt, deform, crack, blister, bubble or get affected in any manner for colour characteristics under normal operation under the conditions of use as specified above. The optical system, chromaticity, transmittance & other requirement should confirm to ICAO Annex-14 and Aerodrome design manual part IV and shall be in accordance with the specifications of Appendix 2/ICAO Annex 14 (refer relevant isocandela diagram).

2.3.1 The lens shall be made of heat resistant glass and shall be capable of withstanding continued atmospheric action including the thermal stresses without deterioration in the photometric performance of the fixtures. The lens shall be suitably clamped to the housing with a gasketed joint. The lens shall be capable of replacement in the field without the use of special tools.

2.4 Lamp & Lamp holder

The lamp used shall be 6.6A, Bi-pin Halogen / LED lamp with a minimum rated life of 1000 hours burning at full brilliancy. The lamp holder shall be suitable to receive the Bi-pin Halogen / LED lamp with a good ceramic housing with a current rating of not less than 10A at 250 volts. Lamp holder shall be mounted rigidly in a metal fitting. All electrical conducting parts shall be made of corrosion resistant and high conductivity materials. Aluminium shall not be used.

2.5 Housing

All metal parts of the housing shall be fabricated from aluminium alloy of type A-5 or A-6 conforming to IS 617-1959 with up-to-date amendment. Copper bearing hardware in contact with aluminium shall be either nickel or zinc plated. A means for drainage shall be provided in the bottom of the housing to drain water. Suitable means shall be provided for holding the optical assembly securely in place on the metal housing. The housing shall support the lens assembly and a natural or synthetic rubber gasket shall be provided for sealing the lens. A continuous metal band fitted either with a trunk latch or an acceptable substitute to ensure a positive

holding of lens assembly shall be provided. The fitting shall be provided with a slip fitter to receive the central column and means shall be designed to require no special tools for reclamping or for cleaning purposes.

2.6 Mounting Assembly

2.6.1 The mounting assembly shall consist of a breakable coupling and a base plate as required. The overall height of the unit mounted in place shall not exceed 350mm above housing box level. All parts of the mounting assembly shall be made of non-ferrous metal or ferrous metal protected against corrosion.

2.6.2 The breakable coupling shall be firmly secured to the base plate. The coupling shall have a shearing groove produced by securing moulding etc which will withstand a static load of 1400 N with less than 15 mm deflection when the load is applied perpendicular to the axis of the coupling at a point 300 mm above the shearing groove. The coupling shall break clearly at the groove when a static load of 2500 N is applied at the same point. The breakable coupling shall also be provided with one or more drainage holes near the shearing groove.

2.6.3 The base plate of the fittings shall be designed to receive the breakable coupling and when assembled, the shearing groove on the coupling shall not be more than 30mm above the top of the base plate. The base plate shall have a bolt hole circle of dia. 260mm to receive 6 bolts of size M 10.

2.6.4 A heat resistant rubber/neoprene gasket for the base plate shall be supplied to obtain a water tight seal with the base plate. The gasket shall have a minimum thickness of 3 mm and shall fit the bolt hole circle of 260 mm diameter.

2.7 Leads

A connecting lead assembly shall be supplied to make connection between the lamp holder & socket of source of supply. This lead shall consist of approximate length of 300 mm of twin tough rubber sheath (TRS) flexible (either silicon rubber insulated or with polychloroprene (PCP) sheath) with neoprene sheath 2.5 sq. mm cross section stranded copper conductor copper conductor of 250- v o l t grade. The lead shall be terminated in a plug. The moulded plug shall be made of polychloroprene (PCP). A cable clamp or similar device shall be part of assembly to prevent strain at the lead connection terminals.

2.8 Gaskets

The gasket material between the metal part of the housing and glass shall be such that it is water tight and heat resistant and it shall withstand temperature of 90 deg C without damage. The gasket shall have a minimum thickness of 3mm for providing a water tight joint.

2.9 Fasteners

All fasteners shall be suitably protected against corrosion by aluminium plating.

2.10 Painting

The paint used for the finish shall be high quality enamel suitable for the drying process used. The color shall be aviation yellow. The paint used as a primer shall be suitable for the metal treatment involved. The paint finish shall be resistant to heat from the lamp and weathering.

2.11 Qualification testing

The light fixtures assembly shall be tested in accordance with the tests detailed below:

2.11.1 Type tests

The under mentioned type tests shall be carried out for initial approval of the fixtures and shall be valid for maximum five years even if the design as per the original type tests is not changed.

2.11.2 Photometric test

The optical performance of the light fixture shall be determined by photometric measurement with aviation clear lens and with the type of lamp for which the unit is designed. The readings shall be taken with a lamp stabilized for its rated lumen output. The photometric readings shall be taken for horizontal as well as vertical distribution of light and shall comply with particular light distribution requirement specified in Appendix 2 of Annex 14/ICAO manual.

2.11.3 Test for resistance to heat

2.11.3.1 The light fitting shall be operated with lamps of maximum wattage to be used in still air at 27+ or –5o C for one hour after which the fittings be immediately immersed in water at a temperature of 10o C or if immersion is not practicable, they shall be sprayed with water at a temperature of 10o C in a manner simulating rainfall.

2.11.3.2 The fitting shall be operated at full output in an ambient temperature of 50 degree C for a period of 24 hours and there shall be no deterioration or permanent deformation of insulating material or other parts.

2.11.4 Test for Temperature shock

The outer glass of the fitting shall be heated in an oven to a temperature of 100 $\pm$ 2º C for one hour. It shall then be immediately immersed in water at a temperature of 0 to 5 deg C. No cracking or other failure should occur.

2.11.5 Test for temperature rise

The test for temperature rise shall be conducted in accordance with IS 1913 (latest edition). The temperature at any point of the holder shall not exceed 200 deg C. After this test the insulation resistance shall be measured in accordance with IS 1913 (latest edition) and the values thus measured shall not be less than 0.10 mega ohm.

2.11.6 Rain proof test

This test shall be conducted in accordance with IS 1913 (latest edition).

2.11.7 Insulation resistance (dry test)

This test shall be conducted in accordance with IS 1913 (latest edition).

2.11.8 High voltage test

This test shall be conducted in accordance with IS 1913 (latest edition).

2.11.9 Test for mechanical strength

2.11.9.1 for Lead:

The plug connected to the socket shall not show any evidence of separation when subjected to static pull load of 50N.

2.11.9.2 for breakable couplings:

This test shall be performed with the couplings secured tightly in a base plate which has been bolted rigidly. Insert in the breakable couplings a 400 mm length round aluminium rod suitably turned down at one end to fit tightly in the breakable couplings. The load shall be applied at not more than 250 N per minute until the

coupling breaks. The average breaking strength after conducting tests of at least five couplings shall not exceed 2500 N.

2.12 Acceptance test

The following test shall be carried out as acceptance test.

(a) Visual inspection
(b) Rain proof test.
(c) Insulation resistance (dry test)
(d) High voltage test.
(e) Photometric test

2.13 Routine Test

(a) Insulation Resistance (dry) Test.
(b) High Voltage Test.

Note: - The tests under photometric, test for resistance to heat & test for temperature shock are applicable when the fixtures are ordered along with optical system & lamp. In case fixtures are ordered without optical system & lamp the supplier shall arrange these and conduct remaining tests.

2.14 Marking

Information to be marked: - Each light fitting shall be suitably & clearly marked with the following information: -

a) Manufacturers' name or trade mark or both
b) Model or type designation and
c) Country of manufacture.
d) Fixture serial number by red paint (post installation)

2.15 Information to be submitted by the Bidder after receipt of the order

2.15.1 Instruction Manual

An instruction manual shall be supplied with each order and shall contain at least the following information: -

(a) Diagram showing lay-out of parts and wiring.
(b) Assembly and installation instructions.
(c) Maintenance instructions.

2.15.2 The following information shall also be submitted

(a) Drawings indicating all components of the light fixtures.
(b) Full descriptions of assembly installation and maintenance operations.
(c) Photographs of the unit both fully and partly assembled.
(d) Manufacturer's type test certificates.

2.16 Samples for acceptance test

Sample should be taken from each lot of particular type of fitting for ascertaining the conformity of the lot to the requirement of specifications. The number of samples to be selected and permissible number of defects shall be as given below:-

2.16.1 Scale of Sampling

All the light fittings of the same type, manufactured using the same raw material under similar conditions of production shall be grouped together to constitute a lot.

2.16.2 The number of lighting fittings to be selected from each lot shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table given below:

SAMPLE SIZES AND ACCEPTANCE NUMBERS

LOT SIZE (1)		SAMPLE SIZE (2)	ACCEPTANCE NUMBER (3)
Up to	50	8	0
51 to	100	13	0
101	150	20	1
151	300	32	1
301	500	50	2
501 to 1000		80	3
1001 and above		125	5

2.16.3 These samples shall be selected from the lot at random.

2.16.4 Number of Tests and Criteria for Conformity

The light fittings, selected at random according to col 1 and 2 of Table above, shall be subjected to the acceptance tests as specified above. A fitting failing to satisfy any of the acceptance tests shall be termed as defective. The lot shall be considered as conforming to the requirements, if the number of defectives found in the samples is less than or equal to the corresponding acceptance number; otherwise the lot shall be rejected.

2.17 Packaging

Packaging shall ensure full protection to the equipment against corrosion and deterioration or physical damage during handling and transportation by air, road, rail or sea. With the equipment a packaging list giving full details of the contents of the case including name of manufacturer, order number, brief description of contents etc shall be enclosed.

SPECIFICATION FOR UNIDIRECTIONAL ELEVATED TYPE FITTINGS

3.1 General

The light fittings shall be designed to withstand blast effects from Jet Engines including wind velocity upto 370 KM/Hr or to the extent they are likely to be encountered on the approach. The fittings shall be suitable for use on a Constant Current series system 6.6 amps AC (secondary rating). However, all current carrying parts of the light unit shall be suitable for the service intended and have the capacity to handle at least 10 amps. The light fixtures shall be capable of withstanding continuous out door operation under normal weather conditions ranging from temperature of (-) 20 to+ 55 deg C, the effect of blowing dust, heavy rain, snow and wind

velocities as applicable. Humidity ranges from 10% to 95% at 55o C ambient temperature. The unit operating at continuous full brilliancy and under extreme conditions, no part of the light fixture will deteriorate or get damaged. This type of fittings can be used for Approach, , threshold, threshold wing bar and runway end lights.

3.2 Applicable specifications

The light fixture shall confirm to ICAO annex 14/ DGCA CAR Sec 4, Sr B, Aerodrome design manual part IV, as described here under and generally shall confirm to IS 7785 Part I & V (latest edition).

3.3 Design and construction

3.3.1 The unit shall be designed to provide a light distribution not less than the minimum candela values as per Appendix 2, Annex-14 when tested with suitable lens for the particular application specified and lamp. The light distribution, colour adjustment for alignment of beam shall conform to Annex.14.

3.3.2 The light fixtures shall consist essentially of a UNIDIRECTIONAL optical system, a lamp, a lamp holder mounted on a suitable metallic housing, connecting leads, mounting assembly and a base plate for installing the unit securely in place. The light fixture shall be furnished complete and ready for installation on a vertical spigot consisting of a tube threaded externally. Slip filter with pressure screws and facility for azimuth/ elevation adjustment shall be part of fitting construction.

3.4 Optical System

3.4.1 The optical system shall consist of an outer glass assembly. The glass assembly must be easily removable and replaceable and must retain its correct alignment on replacing. The glass must not melt, deform, crack, blister, bubble or get affected in any manner under normal operation under the conditions of use specified above. The glass shall be aviation white colour and the filter shall be red in the case of end/ approach side row and green in the case of threshold/wing bar lights. chromaticity, transmittancy and other requirements shall comply to Annex 14/ICAO, design manual part IV and shall be in accordance with the specification of Appendix 2/ICAO Annex.14 (refer relevant Isocandela diagram).

3.4.2 The glass shall be made of heat resistant material and shall be capable of withstanding continued atmospheric action including the thermal stresses without deterioration in the photometric performance of the fixture. The glass shall be suitably clamped to the housing with a gasketed joint. The glass shall be capable of replacement in the field without the use of any special tools. Fastenings and gaskets shall be captive either on the body of the Luminaries or on the removable cover.

3.5 Adjustment of alignment beam

Simple means of lockable adjustment shall be provided for use in conjunction with a removable sighting device to compensate for errors upto + or – 5o in the mounting spigot and additionally to permit the elevation of the beam upto 6o above the horizontal and adjustment of the beam in azimuth of + or – 8o. It shall be possible to make these adjustments within an accuracy of + or – 0.25o. The aiming bar and calibration bar shall be as per IS 7785, part V, section 1(latest edition).

3.5.1 The lamp used shall be 6.6A, Bi-pin Halogen/ LED lamp with a minimum rated life of 1000 hours burning at full brilliancy.

3.6.0 Lamp holders

The lamp holder shall be suitable for bi-pin halogen lamp base type with a good ceramic housing with current rating of not less than 10A at 250 volts. Lamp holder shall be mounted rigidly in a metal fitting. The position

of the lamp holder with respect to the optical system shall be fixed and it shall not be possible to alter it inadvertently during installation, when renewing lamps etc. All electrical conducting parts shall be made of corrosion resistance high conductivity materials. Aluminium shall not be used.

3.7.0 Housing

All metal parts of the housing shall be fabricated from aluminium alloy of type A-5 or A-6 conforming to IS 617(latest edition). Copper bearing hardware in contact with aluminium shall be either nickel or zinc plated. A means for drainage shall be provided in the bottom of the housing to drain water.

3.8.0 Focusing

Focusing of the Luminaire shall be fixed and it shall not be possible to throw it out of adjustment inadvertently during installation, when renewing lamps or performing other maintenance operations.

3.9.0 Mounting Assembly

Breakable coupling and a base plate shall be arranged for mounting, on a vertical spigot. The luminaries and support shall fail when an impact load of not more than 5 kg. and static load not less than 230 kg. is applied horizontally at 30 cm. above the break point of structure. The base plate of the fittings shall be designed to receive the breakable coupling and when assembled, the shearing groove on the coupling shall not be more than 30mm above the top of the base plate. The base plate shall have a bolt hole circle of diameter 260mm to receive 6 bolts of size M 10. A heat resistant rubber/ neoprene gasket for the base plate shall be supplied to obtain a water tight seal with the base plate. The gasket shall have a minimum thickness of 3 mm and shall fit the bolt hole circle of 260 mm.

3.10 Leads

A connecting lead shall be supplied to make connection between the lamp holder and the source of the supply. This lead shall consist of approximate length of 300 mm of twin tough rubber sheath (TRS) flexible (either silicon rubber insulated or with polychloroprene (PCP) sheath) with neoprene sheath 2.5 sq. mm cross section stranded copper conductor of 250volt grade. The lead shall be connected to the socket terminated in a plug. The molded plug shall be made of polychloroprene (PCP).

3.11 Gaskets

The gasket material between the metal part of the housing and glass shall be such that it is water tight and heat resistant and it shall withstand temperature of 90º C without damage. The gasket shall have a minimum thickness of 3mm for providing a water tight joint.

3.12 Fasteners

All the fasteners shall be suitably protected against corrosion by nickel plating.

3.13 Painting

The paint used for the finish shall be high quality enamel suitable for the drying process used. The colour shall be aviation yellow. The paint used as a primer shall be suitable for the metal treatment involved. The paint finish shall be resistant to heat from the lamp and weathering.

3.14 Qualification testing

The light fixtures assembly shall be tested in accordance with the tests detailed below.

3.14.1 **Type tests**

The undermentioned type tests shall be carried out for initial approval of the fixtures and shall hold good for five years or whichever is less.

3.14.2 **Visual examination**

Luminaries shall not have any visible sign of damage.

3.14.3 **Photometric test**

The optical performance of the light fixture shall be determined by photometric measurement with beam spreader glass, filter and with the type of lamp for which the unit is designed. The readings shall be taken with a lamp stabilized for its rated lumen output. The photometric readings shall be taken for horizontal as well as vertical distribution of light and shall comply with particular light distribution requirement specified in Appendix 2 of Annex. 14 /ICAO for a particular type of fitting namely approach, threshold, wing bar, approach side row and end lights. Reading shall be taken at 2ointerval in both the elevation and azimuth and in sufficient details to establish the compliance of requirement of light distribution

3.14.4 **Test for resistance to heat**

The light fitting shall be operated with lamps of maximum wattage to be used in still air at 27+ or –5° C for one hour after which the fittings be immediately immersed in water at a temperature of 10° C or if immersion is not practicable, they shall be sprayed with water at a temperature of 10° C in a manner simulating rainfall. The fitting shall be operated at full output in an ambient temperature of 50 degree C for a period of 24 hours and there shall be no deterioration or permanent deformation of insulating material or other parts.

3.14.5 **Test for Temperature shock**

The outer glass of the fitting shall be heated in an oven to a temperature of 100 $\pm$ 2º C for one hour. It shall then be immediately immersed in water at a temperature of 0 to 5º C. No cracking or other failure should occur.

3.14.6 **Test for temperature rise**

The test for temperature rise shall be conducted in accordance with IS 1913 (latest edition). The temperature at any point of the holder shall not exceed 200º C. After this test the insulation resistance shall be measured in accordance with IS 1913 (latest edition) and the values thus measured shall not be less than 0.10 mega ohm.

3.14.7 **Rain proof test**

This test shall be conducted in accordance with IS 1913 (latest edition).

3.14.8 **Insulation resistance (dry test)**

This test shall be conducted in accordance with IS 1913 (latest edition).

3.14.9 **High voltage test**

This test shall be conducted in accordance with IS 1913 (latest edition).

3.14.10 **Frangibility test**

For Lead: The plug connected to the socket shall not show any evidence of separation when subjected to static pull load of 50N.

For breakable coupling: The luminaries and supports shall fail when an impact load of not more than 5 kgm and a static load of not less than 230kg is applied horizontally at 30 cm above the break point of the structure.

3.15 Wind pressure test

The luminaire shall be mounted on a rigid horizontal test spigot tube with its maximum projected area lying in a horizontal plane. A distributed load of 2.4 KN/sqmt shall be applied, preferably by means of sand bags of suitable weight for a period of 10 minutes. Test shall be repeated with the fittings turned through 180 deg about

the axis of the spigot. The luminaire shall be considered for acceptance if there is no failure or a movement at the point of attachment and no deflection exceeding 1 deg.

3.16 Acceptance test

The following test shall be carried out as acceptance test.

(a) Visual inspection
(b) Rain proof test.
(c) Insulation resistance (dry test)
(d) High voltage test.
(e) Photometric test

3.17 Routine Test

(a) Visual examination
(b) Insulation Resistance (dry) Test. (c) High Voltage Test.

3.18 Samples for acceptance test

Sample should be taken from each lot of particular type of fitting for ascertaining the conformity of the lot to the requirement of specifications. The number of samples to be selected and permissible number of defects shall be as given below:-

3.18.1 Scale of Sampling

All the lighting fittings of the same type manufactured using the same raw material under similar conditions of production shall be grouped together to constitute a lot.

3.18.2 The number of lighting fittings to be selected from each lot shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table given below:

SAMPLE SIZES AND ACCEPTANCE NUMBERS

LOT SIZE		SAMPLE SIZE	ACCEPTANCE NUMBER
(1)		(2)	(3)
Up to	50	8	0
51 to	100	13	0
101 to	150	20	1
151 to	300	32	1
301 to	500	50	2
501 to 1000		80	3
1001 and above		125	5

3.18.3 These samples shall be selected from the lot at random.

3.18.4 Number of Tests and Criteria for Conformity

The lighting fittings, selected at random according to col 1 and 2 of Table above, shall be subjected to the acceptance tests as specified above. A fitting failing to satisfy any of the acceptance tests shall be termed as defective. The lot shall be considered as conforming to the requirements, if the number of defectives found in the samples is less than or equal to the corresponding acceptance number; otherwise the lot shall be rejected.

3.19 Marking

Information to be marked: - Each light fitting shall be suitably & clearly marked with the following information: -

a) Manufacturers' name or trade mark or both
b) Model or type designation and
c) Country of manufacture.

3.20 Information to be submitted by the Bidder after receipt of the order

3.20.1 Instruction Manual

An instruction manual shall be supplied with each order and shall contain at least the following information:-

(a) Diagram showing lay-out of parts and wiring.
(b) Assembly and installation instructions.
(c) Maintenance instructions.

The following information shall also be submitted

(a) Drawings indicating all components of the light fixtures.
(b) Full descriptions of assembly installation and maintenance operations.
(c) Photographs of the unit both fully and partly assembled.
(d) Manufacturers type test certificates.

3.21 Packaging

Packaging shall ensure full protection to the equipment against corrosion and deterioration or physical damage during handling and transportation by air, road, rail or sea. With the equipment a packaging list giving full details of the contents of the case including name of manufacturer, order number, brief description of contents etc.

SPECIFICATION FOR GUIDANCE SIGN BOARD

Note: To be installed within 30 days on award of works.

4.1 Scope: Specification covers the requirement of internally illuminated guidance signs for day or night use.

4.2 Applicable Specifications:

a) ICAO Annexure 14 - Aerodrome Design & Operations
b) DGCA CAR SEC 4, Sr. B, Pt-1

Classification:

a. Mandatory Signs	}	As per ICAO Annexure 14 or relevant DGCA CAR.
b. Informative Signs	}	As per ICAO Annexure 14 or relevant DGCA CAR.

4.3 Detail Requirements:

4.3.1 **Assembly**: The assembly of signs shall be essentially consisting of a legend, which shall be housed, in a metallic housing/cabinet. The sign board assembly shall consist of cabinet mounted on frangible legs complete in all respect ready to be installed/fixed on ground or concrete block at site. Cabinet shall be made of 2 mm thick Aluminium profile reinforced by 50mm x 50mm Alloy / Aluminium structure to provide tightness and rigidity along with hardware and electrical connection etc. and painted / treated for corrosion resistance. These Sign boards including required components for operation shall be designed for continuous outdoor operations under following conditions:-

a) Temperature: An ambient temperature range from - 2°C to + 55°C.
b) Wind: Wind velocity as per Annexure 14 & Design Manual Part & 5.
c) Rain: Exposure to driving rains.

4.3.2 **Size**: Overall size (length and breadth) of each signboard shall be determined based on the message to be in-scripted / conveyed on the facia. Width and height of each letter shall be in accordance with ICAO Annexure 14 and Aerodrome Design Manual Part IV& V.

Note: For the purpose of payment of guidance signboards, measurement of board shall be done as per front face area of sign cabinet only (in sq. mtrs.), irrespective of supporting legs.

4.3.3 **Cabinet**: Cabinet shall have sign face made out of glare free superior quality, Lexan or equivalent make polycarbonate sheet, resistant to UV absorption, of suitable thickness not less than 4mm. Polycarbonate sheet shall have Nominal Tensile Strength (Break) of8900 psi, light transmission of 27-35 %. Manufacturer type / Routine test certificate for polycarbonate sheet shall be produce at the time of pre-delivery inspection of sign boards and copy of the same shall be submitted along with the delivery of sign boards. Lettering/Sign shall be in-scripted/screen painted on the inside of the sign face. Rear side of cabinet shall be made of 3mm [min] thick weatherproof Aluminum profile. On inside of rear side of the cabinet, highly reflective Aluminum reflector shall be provided, if required for optimum light distribution. Neoprene rubber gasket in all corners as well as in front and back of sign shall be provided to prevent ingress of dust and moisture. Cabinet shall also have glanded bottom entry for cable along with the provision of earth connection.

4.3.4 **Frangibility**: It shall be in accordance with FAA/ ICAO specifications to avoid damage to the aircraft, if inadvertently struck, yet must be sufficiently rigid withstand wind loads / jet blast from wide-bodied aircrafts. The mounting legs shall be frangible which will withstand wind loads due to jet blast as specified in ICAO Annex 14.

4.3.5 **Sign**: Signs shall be single sided / viewed, internally illuminated with LEDs and all other accessories including suitable current converter / inverter to be operated on 2.8 Amp. to 6.6 Amps. These shall be designed for operation from a series airfield lighting circuit fed from a constant current regulator. The illumination shall be uniform over the sign face and visible at night time from a distance of 800 ft. Lights shall be readily accessible for replacement. Signs made in multiple sections shall appear to the viewer as a single sign with a continuous border and legend. The spacing, stroke and shape of legends and symbols shall be in accordance with ICAO specification. The signs designed shall be capable of being energized at the lowest current setting and operated at any current value between 2.8 to 6.6 Amps without flickering or an appreciable decrease in sign illumination. Power input from the series light circuit shall be made through an isolating transformer of proper rating. Average output luminance shall be in accordance with ICAO Annexure 14.

4.3.6 **LEDs:** The high intensity heavy duty 3- watt LED lamps are to be used for the internal illumination of the sign boards. LED lamps shall be of long life typical 70000 Hrs. type, minimum luminous flux of more than 150 lumens per LED, colour temperature 5000 -7000 Kelvin. Adequate number of LEDs are to be used in order to achieve uniform illumination as per ICAO specification. The LED shall be provided with adequate size of heat sink for effective heat dissipation

4.3.7 **Secondary Leads**: 2 x 4 sq. mm neoprene rubber secondary cable shall be used with factory molded two pin connector of required length protected with flexible pipe for connecting the internal circuitry and the Isolating Transformer. Similarly the lead from circuitry to the lamp shall also be done through water proof arrangement. All wiring components shall be adequately rated and shall not be operated in excess of component manufacturer recommended raring.

4.3.8 **Wiring**: All wiring and electrical components shall be adequately rated and shall not be operated in excess of the component manufacturer's recommended ratings.

4.3.9 **Materials and components**: All materials used in fabrication of the signs shall be suitable for the intended purpose and adequately protected against corrosion. All assembly hardware, including screws, bolts, nuts, washers, and latches, shall be of stainless steel.

4.3.10 **Finish**: External surfaces of the signs, excluding the mounting legs and face panel, shall be preferably powder coat painted externally in white and internally matt white. The surface colour treatment of non-metallic surface shall be equal in quality to that obtained on metal surfaces.

4.3.11 **Workmanship**: The equipment shall be fabricated in accordance with the highest quality workmanship. Wiring shall be neatly run and laced. All sharp and burrs shall be removed. Painted / treated surfaces shall be free from runs, blotches and scratches.

4.4 **Test**: The firm shall submit test certificates from reputed / Govt. Approved test laboratory to the following tests:-

4.5.1 **Rain Test**: Equipment shall be tested to ensure that during rain, no water enters inside the housing and the rain shall not affect the performance of the unit.

4.5.2 **High Temperature Test**: A high temperature test shall be conducted on the sign and adapter unit. The maximum chamber temperature shall be 55°C. Failure of the unit to operate or evidence of damage shall be cause for failure.

4.5.3 **Low Temperature Test**: A low temperature test shall be conducted on the sign and adapter unit. The lowest operating temperature shall be (-) 2°C. Failure of equipment to operate or failure to reach normal sign illumination within 02 minutes after it is energized shall be cause for failure.

4.5.4 **Uniformity of Illumination Test**: The illumination level has to be achieved as per ICAO requirements.

4.5.5 **Impact Test**: Destructive impact test shall be in accordance with ICAO requirements.

4.5.6 **Insulation Test**: The insulation resistance of electrical component of assembly shall be tested for insulation value with 500V Megger.

4.6 **Grouting**: Mounting stud frame shall be grouted with 1:2:4 cement concrete 150mm all around the frame and for not less than 400mm height.

4.7 **Pedestal**: Cement concrete of ratio 1:2:4 with 150mm thick Pedestal shall be provided in and around the Guidance sign boards 1500mm from the edges of sign.

4.8 **Other:**

4.8.1 The details of signs required shall be given to the successful tenderer along with award of work. The tenderer should submit detailed drawing showing length, breadth, height, arrangement etc. of each type of sign board and calculated area of surface for approval before starting fabrication**.**

4.8.2 Overall size [length and height] of each sign board shall be determined based on the message to be in scripted on the facia. Width and Height of each letter shall be in accordance to ICAO Annex 14 and Aerodrome Design Manual Part IV.

4.8.3 Whereas technical specification differs schedule of quantity or vice versa, higher specification may be considered.

4.9 **Guide Line Data:**

The guide line – indicative data are given below. The tenderer shall furnish the details of guidance signage board offered by them as mentioned in Annexure 'A'.

DESCRIPTION		**SPECIFICATIONS**
The Electronic Current Converter unit /inverter unit to be used in the signage board shall be designed for operation from a series lighting circuit of current range.		(2.8 amp. To 6.6 Amp.)
The board shall be designed to withstand wind velocities up to		90 m/s
The current converter / inverter shall be designed to operate satisfactorily in an ambient temperature range of		(-2º to + 55ºC)
Frangibility of the mounting legs / support shall be		As per specifications in ICAO Annex 14.
Spacing, stroke and shape of legend and symbols shall be in accordance with		ICAO Specifications.
Average output luminance on the sign face shall be in accordance with		ICAO Specifications.

Thickness of Aluminium profile used for cabinet		2.0 mm (minimum).
Thickness of polycarbonate sheet		4.0 mm (minimum)
Painting of external surface		Powder coat paint.

SPECIFICATION FOR EARTHING

5 SCOPE

This chapter covers the essential requirements of earthing system components and their installation. For details not covered in these specifications, IS Code of Practice on Earthing (IS: 3043-1987) shall be referred to.

5.1 APPLICATION

5.1.1 The electrical distribution system is with earthed neutral (i.e. neutral earthed at the transformer / generator end). In addition to the neutral earthing, provision is made for earthing the metallic body of equipment and non-current carrying metallic components in the sub-station, as well as in the internal/external electrical installations.

i) Earthing system is also required for lightning protection, computer installations etc. for functional reasons.

ii) Earthing requirements are laid down in Indian Electricity Rules, 1956, as amended from time to time, and in the Regulations of the Electricity Supply Authority concerned. These shall be complied with.

5.2 MATERIALS

The material of earth electrode and earth conductor shall be as specified.

5.2.1.1 Earth Electrodes

The type of earth electrode shall be any of the following.
Plate/Pipe earth electrode as specified.

5.2.1.2 Electrode materials and dimensions

The materials and minimum sizes of earth electrodes shall be as specified.

5.2.2 Earthing Conductor

The earthing conductor (protective conductor from earth electrode up to the main earthing terminal/earth bus, as the case may be) shall be of the same material as the electrode, viz. GI or copper and in the form of wire or strip as specified. The size of earthing conductor shall be as specified.

5.2.3 Hardware Items

All hardware items used for connecting the earthing conductor with the electrode shall be of GI in the case of GI pipe and GI plate earth electrodes, and forged tinned brass in case of copper plate electrodes.

5.2.4 Protective (Earth continuity/Loop earthing) Conductor

i) The material and size of protective conductors shall be as specified.
ii) Unless otherwise specified, GI conductor should not be ordinarily used as protective conductor within any circuit beyond a Distribution Board downstream.

5.3 LOCATION FOR EARTH ELECTRODES

i) Normally an earth electrode shall not be located closer than 1.5 m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases electrodes may be located further away from the building, with the prior approval of the GENERAL MANAGER (P & A), APADCL.

ii) The location of the earth electrode will be such that the soil has a reasonable chance of **remaining moist as far as possible. Entrances, pavements and roadways, should be avoided for locating earth electrodes.**

5.4 INSTALLATION

5.4.1 Electrodes

5.4.1.1 Various types of electrodes

(i) a) Pipe electrode shall be buried in the ground vertically with its top at not less than 20 cm below the ground level. The installation shall be carried out as shown in drawing.

b) In locations where the full length of pipe electrode is not possible to be installed due to meeting a water table, hard soil or rock, the electrode may be reduced length, provided the required earth resistance result is achieved with or without additional electrodes, or any alternative method of earthing may be adopted, with the prior approval of the SGM-Infra, APADCL. Pipe electrodes may also be installed in

Horizontal formation in such exceptional cases.

ii) Plate electrode shall be buried in ground with its faces vertical, and its top not less than 3 m below the ground level. The installation shall be carried out as shown in drawing.

iii) When more than one electrode (plate/pipe) is to be installed, a separation of not less than 2 m shall be maintained between two adjacent electrodes.

5.4.1.2 Artificial treatment of soil

When artificial treatment of soil is to be resorted to, the electrode shall be surrounded by charcoal/coke and salt. In such cases, excavation for earth electrode shall be increased as per the dimensions indicated in these figures.

5.4.1.3 Watering arrangement

i) In the case of plate earth electrodes, a watering pipe of 20mm dia. medium class G.I. pipe shall be provided and attached to the electrodes and a funnel with mesh shall be provided on the top of this pipe for watering the earth.

ii) In the case of pipe electrodes, a 40 mm X 20 mm reducer shall be used for fixing the funnel with mesh.

iii) The watering funnel attachment shall be housed in a masonry enclosure of size not less than 30 cm X 30 cm X 30 cm.

iv) A cast iron/MS frame with MS cover of 6 mm thick, and having locking arrangement shall be suitably embedded in the masonry enclosure.

5.4.2 Earthing conductor (Main earthing lead)

i) In the case of plate earth electrode, the earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers.

ii) In the case of pipe earth electrode, wire type earthing conductor shall be secured as indicated in drawing using a through bolt, nuts and washers and terminating socket.

iii) The earthing conductor from the electrode up to the building shall be protected from mechanical injury by a medium class, 15 mm dia. GI pipe in the case of wire, and by a minimum of 40 mm dia, medium class GI pipe in the case of strip.

The protection pipe in ground shall be buried at least 30cm deep (to be increased to 60 cm in case of road crossing and pavements). The portion within the building shall be fixed on walls.

iv) The earthing conductor shall be securely connected at the other end to the earth stud/earth bar provided on the switch board by:

a) Soldered or preferably crimped lug, bolt, nut and washer in the case of wire, and,

b) Bolt, nut and washer in case of strip conductor.

5.4.3 Earth bus and main earthing terminal

i) In all installations, main earthing terminal shall be provided at the main switchboard. This may be in the form of earth stud or single earth bar depending on the type of the switchboard.

ii) Following conductors shall be terminated on to the main earthing terminal.
   a) Earth connection from electric supply company (where provided)
   b) Earthing conductor from electrode.
   c) Protective conductors.
   d) Equi-potential bonding conductors.

5.4.4 Protective (Loop earthing/ earth continuity) conductor

i) Earth terminal of every switchboard in the distribution system shall be bonded to the earth bar/terminal of the upstream switch board by protective conductors.

ii) Two protective conductors shall be provided for a switchboard carrying a 3-phase switchgear thereon.

5.5 Earth Resistance

i) The earth resistance at each electrode shall be measured. No earth electrode shall have a greater ohmic resistance than 5 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be up to 8 ohms.

ii) Where the above stated earth resistance is not achieved, necessary improvement shall be made by additional provisions, such as additional electrode(s), different type of electrode, or artificial chemical treatment of soil etc., as may be directed by the SGM-Infra, APADCL, at additional cost as per the provisions of the contract.

5.6 Marking

i) Earth bars/terminals at all switch boards shall be marked permanently, as "E". Main earthling terminal shall **be marked "SAFETY EARTH - DO NOT DISCONNECT".**

SPECIFICATION FOR AIRFIELD LIGHTING CABLE

6.1 General

This specification covers the requirements for single core, copper conductor, PVC insulated, PVC sheathed unshielded (unscreened) type airfield lighting cable for use on 5KV system (unearthed system). Cable shall be generally conforming to IS: 1554-Part II (latest edition) and details specified below.

6.2 Conductor details

	Size :	6 and 16 sq. mm.
	Material:	High conductivity annealed copper wires
	No. of	Minimum 7 for 6 & 16 sq mm
	Dia.of strand:	The diameter of each strand shall be chosen to achieve 6 sq mm & 16 sq mm and not to exceed the maximum resistance of the conductor as per IS. The maximum resistance of the conductor at 20o C as per IS 8130 – 1984 are 1.15 ohm per km for 16 sq mm & 3.08 ohm per km for 6 sq mm.

6.3 INSULATION

i. Composition of insulation: P.V.C. Type 'B' to meet the requirement of clause 4.1 of IS 1554 Part II

ii. Thickness of insulation: Average thickness of PVC insulation shall not be less than 3.60 mm. But not less than 3.14mm at any point as per IS:1554 part II-1988, for 6 sq mm & 16 sq mm.

iii. Insulation Colour: 6 sq.mm. Yellow 16 sq.mm Yellow

6.4 Outer sheath

a) Outer sheath colour : 6 sq.mm. Black 16 sq.mm Blue

b) Composition sheath : PVC compound confirming to the requirement of Type

c) Thickness of outer sheath :

i) 1.8 mm average for 1 x 6 sq.mm

ii) 1.8 mm average for 1 x 16 sq.mm

iii) At no place it should be less than 1.24 mm for 6 & 16 sqmm single core.

PVC insulation and outer sheath shall be done in pressure extrusion by PVC extruding machine. The sheathing shall be so designed so as to afford high degree of mechanical protection and shall also be oil weather resisting and treated for anti-rodent & termite.

6.5 Operating temperature (-) 20°C to (+) 70°C .

6.6 Overall diameter of cable has to be arrived at keeping in view of the above duty conditions.

6.7 Length

Length of cable in one drum shall not exceed 1000 mt + or – 5%. Variation to the extent of + or – 5%of ordered quantity is acceptable or as specified in the agreement.

6.8 Bending Minimum radius of cable during bending 90mm approx.

6.9 Marking Manufacturer's trade name, voltage grade, year of manufacture & AAI shall be embossed on the outer sheath at regular interval. The cable shall also have sequential numbering at 1 mt interval indicating the length of the cable.

6.10 Tests

6.10.1 <u>Type Tests</u>

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Test	Requirement	Test Method
Tests on conductor	**IS 8130**	**IS**
Resistance test	**IS 8130**	**IS**
Test for thickness of	IS 1554 (part	**IS**
& sheath		
ii) Aging in air oven	**IS 5831**	**IS 10810/11**
iii) Shrinkage test	**IS 5831**	**IS 10810/12**
iv) Hot deformation test	**IS 5831**	**IS 10810/15**
v) Loss of mass in air oven	**IS 5831**	**IS 10810/10**
vi) Heat shock test	**IS 5831**	**IS 10810/14**
vii) Thermal stability test	**IS 5831**	**IS 10810/60**
viii) Water absorption	**IS 5831**	**IS 10810/33**
ix) Insulation resistance test	**IS 5831**	**IS 10810/43**
x) High voltage test	**IS 1554 (part 2)**	**IS 10810/45**
xi) Flammability test	**IS 1554 (part 2)**	**IS 10810/53**

a. Physical tests for insulation & shealth
b. Tensile strength & IS 5831, IS 10810/7 elongation at break

The above mentioned type tests shall be carried out for initial approval of the cables and shall be valid for maximum five years even if the design as per the original type tests are not changed.

6.10.2 Acceptance test

The following tests shall be carried out as acceptance tests by the inspecting officer of AAI.

i. Conductor resistance test.
ii. Test for thickness of insulation and sheath.
iii. Tensile strength and elongation at break of insulation & outer sheath
iv. Test for insulation resistance.
v. Anti-rodent/anti-termite test.

6.10.3 Procedure for anti-rodent/anti-termite test

A few chippings of the PVC compound are slowly ignited on a porcelain dish or cubicle in a muffle furnace at about 600°C. The resulting ignited ash is boiled with little ammonium acetate solution (10%). Place a drop of ageous sodium sulphide solution on a thick filter paper and allow to soak. Touch the spot with a drop of above extract. A black spot indicates the presence of lead – the anti- termite & rodent compound.

6.10.4 Routine test

The following shall be carried out as routine test:-

- Conductor resistance test
- High voltage test
- Annealing test for copper conductor

The manufacturer shall produce the routine test certificate to the inspecting officer of APADCL for all the drums offered for inspection.

6.11.0 Samples

Samples shall be taken and tested from each lot for ascertaining the conformity of the lot to the requirement of specifications.

6.11.1 The number of samples to be selected shall depend on col 1 and 2 as indicated below:

Number of Drums in the Lot	Number of Drums to be taken as sample	Permissible Number of defectives
(N)	**(n)**	**(a)**
(1)	(2)	**(3)**
Up to 50	2	**0**
51 to 100	5	**0**
101 to 300	13	**0**
301 to 500	20	**1**
501 and above	32	**2**

6.11.2 Number of Tests and Criterion for Conformity

Suitable lengths of test samples shall be taken from each of the drums selected. These test samples shall be subjected to each of the acceptance tests. A test sample is called defective if it fails in any one of the acceptance tests. If the number of defectives is less than or equal to the corresponding permissible number

given in col 3 under the table above, the lot shall be declared as conforming to the requirements of acceptance tests, otherwise not.

6.12 Packaging

The cable shall be wound on a wooden drum of suitable size and packed. The ends of the cable shall be sealed by means of non-hygroscopic sealing material.

SPECIFICATION FOR ISOLATING TRANSFORMER FOR 5KV SERIES CIRCUIT

7.1 General

This specification covers completely enclosed rubber covered isolating transformer for use of 6.6 and 20 amps series airport lighting circuits having nominal voltage rating of 5KV. The transformer shall be water tight and shall be designed for direct burial in the earth or installation in a base. The isolating transformer shall confirm to IS specifications 12290 (latest edition).

7.2 Rating

The transformer shall be of rating as specified in schedule of quantities and all rated for operation on50 Hz.

7.3 Operating conditions.

The transformer shall be constructed for continuous outdoor service at any ambient temperature from minimum of (-) 20°C to a maximum of 55°C. They shall operate properly when buried in the ground with 5KV on the primary winding. The transformer shall be designed to operate satisfactorily at rated 50 Hz. Frequency.

7.4. Transformer characteristics.

The characteristics of the transformer shall be within the limits as specified below in Table

Table 1

Primary				Secondary		Secondary	
Watt	**Amps**	**p.f**	**Eff.%**	**Full load**	**Short Ckt.**	**Load Ohms**	**Max. open ckt.**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
30	6	9	8	6.53	6.6	1.1	25
30	2	9	8	-	-	1.1	25
10	6	8	8	-	-	2.4	70
10	2	8	8	-	-	2.4	70
20	6	9	9	-	-	4.8	100
20	2	9	9	6.53	6.6	4.8	100
30	2	9	9	19.8	20	0.9	70
30	6	9	9	6.53	6.6	8.2	135
50	6	9	9	6.53	6.6	1.3	70
50	2	9	9	19.8	20.	1.3	70

Note : Voltage rating shall be primary 5000V and secondary 600V.

7.5.0 Temperature rise

The temperature rises when a transformer is operated at rated load or when short circuited or open- circuited with rated current and frequency in the primary shall not exceed 55°C as determined by the resistance method. Temperature rise shall be computed from the following formula.

Temp. rise (C) = (234.5 + X) R1 – RO
---------- RO
Where X = Temperature (C) corresponding to cold resistance
RO = Cold resistance
R1 = Hot resistance

7.6 Insulation

The transformer shall be insulated for operation on a 5000 volt primary circuit.

7.7 Core and coil

The windings shall be completely insulated from each other and the core. Sharp corners and edges of the core and coil assembly shall be eliminated so that they should not cut the housing, if transformer is dropped or handled roughly.

7.8 Housing

The housing shall completely enclose the core and coil assembly with lead sealed into the housing in such a way as to produce a completely watertight unit. All exposed parts of the transformer assembly shall be capable of withstanding outdoor exposure, immersion in water, exposure to gas line and direct burial in earth containing large concentrations of oils, acids or alkalis. The housing material shall consist of rubber, synthetic rubber or rubber like compound. Other compounds may be used for the housing. The minimum strength requirements of housing material shall not be less than the following:

i. Tensile strength = 84 Kg/cm^2
ii. Tensile strength after 96 hours oxygen bomb test = 70 Kg/cm^2
iii. Tensile strength after 168 hrs. in an oven test at 80 $\pm$ 1° C = 70 Kg/cm^2

In the housing no portion of the case shall be less than 0.64 cm thick and it shall be free of cracks, blisters, holes etc. which would be detrimental to transformer service life. Internal air pockets or voids, if any, shall be very minimum and the assembly shall sufficiently be rugged to withstand rough handling. The shape of the transformer may be either rectangular or circular. The overall dimensions of the transformer shall be such that it can fit easily inside a space defined as a cylinder of 20.3 cm. diameter by 25.4 cm. in height, inside dimensions. The case shall be designed so that transformer may be installed upright or lying on any side.

7.9 Marking

The following information shall be moulded on the surface of the transformer:
(a) Transformer rating: Primary amperes ……..Secondary amperes ……..
(b) Watts …….. Volts 5000 ……
(c) Transformer series to series/Year of manufacture ……
(d) Manufacturer's name or trade name ……

7.10 Transformer lead

The transformer shall be provided with a two conductor secondary lead and two single conductor primary leads. Lead connections may be of the solder or of the solder-less type. If solderless connections are used in jointing leads to the transformer windings, these shall be of a type designed for the application and properly applied. Care shall be exercised during moulding to ensure the

proper clearance exists between these connections after the moulding operation has been completed. All three leads shall emerge from one end of the transformer. Spacing and arrangements are optional, provided all other requirements are complied with. The leads shall be securely fastened to the transformer in such a manner that carrying by a single lead will not loosen the electrical connections or effect the water seal. The length of all transformer leads shall be measured from the connector face to the junction of the transformer case. One primary lead shall be equipped with a plug type connector; the other primary lead shall be equipped with receptacle. The cable for the primary leads shall be 19/0.75mm single core cable, annealed tinned copper conductor insulated with composite insulation of HR-VIR and PCP sheathed suitable for 5000V operating voltage. Each primary lead shall extend not less than 60 cm, plus or minus 7.5cms beyond the housing including the cable connector. The secondary lead shall be equipped with a receptacle. The cable for secondary lead shall be at least37/0.30mm twin core cable, annealed tinned and filled and sheathed with special type of PCP suitable for 600 volt operating voltage. The cable shall extend 120cms plus or minus 7.5cm, beyond the housing, including the cableconnector. An approved watertight cap or plug shall be furnished on each mating part of each plug or receptacle for protection during shipment and installation from moisture and dirt.

7.11 Testing

Each transformer shall be examined visually for good workmanship.
Ratio test shall be carried out on each transformer for current ratio at rated frequency of current on the primary and rated load on the secondary. The secondary current of each transformer shall conform to the limits specified in table-1 specified above.

Test for voids: The maximum pressure which could be exerted directly with hands shall be applied to all parts of the transformer cases. Any evidence of voids beneath the surface of the case shall be cause for rejection.

7.11.1 Insulation resistance tests

The sample transformer shall be subjected to a continuous 20 cycle tests as follows :

Mating connectors that were gauged with ‘go’ and ‘no go’ gauges shall be installed in the three connectors of the transformer. The mating connectors shall not be removed before completion of the 20 cycle testing. One cycle shall consist of the sequence of operation specified below.

The transformer shall be operated with mating connectors installed for a minimum of 6 hours in air at room temp. with rated current flowing in primary coils. The secondary of the transformer shall be open circuited. This procedure shall hereinafter referred to as the heating cycle.

Immediately following the heating cycle the transformer with leads and connectors shall be completely sub-merged in water which is grounded, at room temp., Care should be taken to ensure that all moulded connections, transformer leads and test harness are completely immersed in water during test. Immediately after immersion, insulation resistance of each coil and lead assembly shall be measured. The time period between interruption of heating cycle and start of the measurement shall not exceed three minutes.

The transformers and their connectors shall be soaked in water at room temperature for not less than12 hours and the insulation resistance measurements repeated.

The direct current insulation resistance shall be measured immediately after immersion (before 3 minutes have elapsed) and measured again after the soaking period. The insulation resistance shall be measured after the voltage shown in Table 2 has been applied for one minute between each coil and ground with the other coil grounded and its connectors submerged in water. An insulation resistance less than the values specified in table 2 shall cause rejection. Any softening or swelling of the housing or any evidence of leakage or damage shall also because of rejection. Zero and

maximum readings of the test instruments shall be periodically checked by immersing the high voltage lead in water alongside the transformer and by suspending it in air.

TABLE – 2

DC TEST MINIMUM INSULATION RESISTANCE

IN MEGOHMS					
COIL	**VOLTA**	**CO**	**ELC**	**HOT**	**ELC**
Secondary	**5000V**	**750**	**6.7**	**300**	**17.0**
Primary	**15000 V**	**200**	**7.5**	**750**	**20.00**

7.11.2 Characteristics tests

The sample shall be tested to show that their electrical characteristics are as specified in Table 1. All corrections necessary to compensate for meter power consumption shall be applied. The transformer shall be operated in air at room temperature with rated load connected to the secondary until the transformer windings have reached normal operating temperature at which time the measurement will be taken.

7.11.3 Impact Test

The transformer shall be dropped twice from a height of two meters upon a smooth concrete surface hardware floor, once so it hits on the bottom of the case and once on the side of the case, location of hitting is so decided, where the most damage is likely to occur to the windings or due to core cutting into the housing. Lead rigidity shall be tested by securing (just below the connector) each lead one at a time in a clamp fastened to a support, elevated a distance in excess of the length of leads and then releasing the transformer for a free fall from clamp elevation. The lead clamp used shall be such as not to cause damage to the lead at the point of attachment. The test shall be conducted subsequent to the electrical characteristic test specified in Table 1. Following this impact test, the transformer shall again be subjected to the electrical characteristic tests. Any failure or a change of more than 1% in the results obtained in the electrical characteristic tests or evidence of damage to the housing & attached leads shall be cause for rejection.

The manufacturer shall possess test certificate for all the tests specified above for each capacity of isolating transformer from an independent GOVT. LABAROTARY without that the item shall not be accepted. Test report shall not be later than five years

7.11.4 Acceptance tests

The following test shall be carried out at the time of acceptance.

i. **Visual examination for good workmanship.**
ii. **Ratio test: Each transformer shall be tested by the manufacturer for current ratio at rated frequency & current on the primary and rated load on the secondary. The secondary current of each transformer shall be within the limits specified in table 1.**
iii. **Insulation test: Transformer shall be subjected to one complete cycle of the test specified under insulation resistance test specified above.**
iv. **Test for voids: The maximum pressure which can be exerted directly with the hands shall be applied to all parts of the transformer housing. Any evidence of voids beneath the surface of the housing shall be cause for rejection.**

7.12 Samples for acceptance test

Sample should be taken from each lot of particular type of isolating transformer for ascertaining the conformity of the lot to the requirement of specifications. The number of samples to be selected and permissible number of defects shall be as given below: -

7.12.1 Scale of Sampling

All the isolating transformers of the same type manufactured using the same raw material under similar conditions of production shall be grouped together to constitute a lot.

7.12.2 The number of isolating transformers to be selected from each lot shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table given below:

SAMPLE SIZES AND ACCEPTANCE NUMBERS

LOT SIZE	SAMPLE SIZE	ACCEPTANCE NUMBER
(1)	(2)	(3)
U – 50	8	0
5-100	13	0
1-150	20	1
1-300	32	1
3-500	50	2
501 to 1000	80	3
1001 and above	125	5

7.12.3 These samples shall be selected from the lot at random.

7.12.4 Number of Tests and Criteria for Conformity

The isolating transformers, selected at random according to col 1 and 2 of Table above, shall be subjected to the acceptance tests as specified above. A isolating transformer failing to satisfy any of the acceptance tests shall be termed as defective. The lot shall be considered as conforming to the requirements, if the number of defectives found in the samples is less than or equal to the corresponding acceptance number; otherwise the lot shall be rejected.

7.13 Packing

Packing shall ensure full protection to the equipment against corrosion and deterioration or physical damage during handling and transportation by air, road or sea.

Each case shall be marked on the outside with the following details:

i. Name of manufacturer.
ii. Order Number
iii. Brief description of contents.

SPECIFICATION FOR PLUG AND RECEPTACLE, CABLE CONNECTORS

8. SCOPE AND CLASSIFICATION.

8.1.1 Scope. This specification contains requirements for plugs and receptacles (cable connectors) to be used for underground cable connections, for power cables, isolation transformer leads, and light fixture leads for airport systems.

8.1.2 Classification. Cable connectors are classified by this specification into two types, two classes, and six styles of plugs and two types, two classes, and six styles of receptacles.

8.1.2.1 Type. Plugs and receptacles with the following electrical characteristics are covered by the specification:

Type I	1 conductor, 25 ampere, 5000 volt
Type II	2 conductor, 20 ampere, 600 volt

8.1.2.2 Class. Plugs and receptacles with the following attachment methods are covered by this specification:

Class A	Factory molded to conductors
Class B	Field attached to conductors

8.2 Equipment requirements.

8.2.1 General. Plugs and receptacles (cable connectors) shall be fabricated in accordance with all specification requirements.

8.2.2 Environmental Requirements. The plugs and receptacles (cable connectors) shall be designed for continuous use within a temperature range of –55°C to +65°C while exposed to weather, submerged in water, or buried in the earth.

8.3 Performance Requirements.

8.3.1 Electrical Connection. The electrical rating of each connector shall not be less than 5000 V for type I connectors, or 600 V for type II connectors. The voltage drop across the contacts of a connected plug and receptacle shall not exceed 7.5 millivolts for the Type I connectors, and 6.0 millivolts for the Type II connectors.

8.3.2 Bonding Strength. The completed Class A connector assembly shall withstand a longitudinal pull of at least 30,000 psi (207 Mpa), 75 percent of an average tensile strength of 40,000 psi, (276 Mpa) for all wire sizes. Separation between the molded on connector and the cable shall not exceed 0.03 inches (0.8 mm).

8.3.3 Mechanical Connection. Each connected plug and receptacle shall withstand a static pull load of 10 pounds (44N) without showing evidence of separation. No damage shall occur to the mating components when the connected plug and receptacle are separated by a greater static pull load.

8.3.4 Seal. A watertight seal shall be provided between the mated plug and receptacle and between the rubber and metal parts of the plug and receptacle.

8.4 Fabrication and Materials.

8.4.1 General. Each plug and receptacle (cable connector), type, class, and style shall conform to the dimensions and construction requirement shown on the applicable figures in Appendix I of this specification.

8.4.2 Housing. The connector housing shall be molded from natural and/or synthetic elastomeric materials serving both as insulation and sheath to fully enclose the pins of the plug and sockets of the receptacle. The housing material shall be suitable for direct earth burial, submergence in water, and capable of withstanding limited attack from chemicals, typically present on the airfield, including but not limited to, oil, de-icing fluids and/or gasoline. Material compounds used in connector housings shall not contain more than 25 pounds (11 kg) of carbon black per 100 pounds (45kg) of elastomer. Housings for Class A connectors shall be fabricated from materials capable of bonding to cable sheaths or conductor insulation, during the manufacturing process to provide a watertight bond.

8.4.3 Pins and Sockets. The pins and sockets shall conform to all dimensions and construction requirements indicated on the applicable figures in Appendix I of this specification. Pins and sockets shall be made of materials that contain at least 98 percent copper. The contact portion of the pin and socket shall be left "stock hard" and the crimping section, when necessary, fully annealed. The hardness transition shall be limited to the locking section of the pin and socket. The pin and socket shall be electroplated with tin or other suitable material to provide good electrical contact as required under electrical connection specified above. The sockets shall be spring loaded or slotted and spring loaded to ensure good electrical contact as required under electrical connection specified above and Class A sockets shall have a means that protects the sockets slots from filling with insulating compound during molding. The pin for the Style connector shall be provided with a visual indication that verifies proper assembly position. Pins and sockets provided for Class B connectors shall have provisions for crimping to the cable conductors(s), and shall not exhibit damage after crimping.

8.5 **Connector Assemblies.**

8.5.1 Class A. Pins and sockets shall be held perpendicular to the face of the block. Suitable electrical conductors shall be mechanically and electrically connected to the pin(s) or socket(s). The connector housing shall be molded as specified under housing. Primary connectors shall be molded to an electrical conductor having a voltage rating equal to or less than the specified voltage rating of the connector. Secondary connectors shall be molded to an electrical conductor having a voltage rating equal to or less than the specified voltage rating of the connector with the preferred being equal to the connector rating. A connector shall never be molded to an electrical conductor or cable having a higher voltage rating than the specification requirements for the connector. After molding, the space between the pins of Type II plugs shall not be less than 1/8 inch (3mm) when the pins are pinched together with a force of 6 pounds (27n) applied 1/2 inch (12.7 mm) out from the face of the plug. Also, the space between the ends of the pin of the Type II plugs shall not be greater than 9/16 inch (14.3 mm) when the pins are pulled apart with a force of 6 pounds (27N) applied 1/2 inch (12.7 mm) out from the face of the plug. The force is applied to the pins only. During testing for the above-mentioned requirement, the plug is to be held only to keep it from turning.

8.5.2 Class B.

8.5.2.1 Type I Each receptacle shall be equipped with a disposable sleeve fitted into the receptacle's water seal to catch surplus silicone compound upon assembly. Each socket shall be equipped with a disposable pin fitted tightly into the pin end of the socket to prevent entry of silicon compound on assembly and to provide a visual indication of proper socket position after assembly. The pin design shall be such that proper internal dispersion of silicone compound in the assembly is assured. An adequate amount of silicone insulating compound shall be furnished with each connector to ensure filling all internal voids when the connector is assembled. Each housing shall be capped with a disposable shipping cap on the cable entrance end.

8.5.2.2 Type II. Connector assemblies shall be composed of two parts, an insert assembly and housing. Pins or sockets shall be held perpendicular to the face of each end of the molded insert assembly and fastened. After proper assembly, the space between the pins of the plug shall not be less than 1/8-inch (3 mm) when the pins are pinched together with a force of 6 pounds (27 N) applied1/2 inch (12.7 mm) out from the face of the plug. Also, the space between the ends of the pin shall not be greater than 9/16 inch (14.3 mm) when the pins are pulled

apart with a force of 6 pounds applied 1/2 inch (12.7 mm) out from the face of the plug. Inserts and housing shall be molded as specified in paragraph 'housing', and shall comply with the dimensions and styles shown on the applicable figures in Appendix I of this specification. When assembled the plug and receptacle assemblies shall provide a watertight seal to prevent moisture from entering the housing.

8.6 Marking. Each plug and receptacle shall be marked with manufacturer's identification and bold style number.

8.7 Caps. Caps shall be supplied with Class A connectors to protect plugs and receptacles prior to final connection. Caps shall be made of a plastic material compatible with the housing materials specified in paragraph 'housing'. When a series short circuiting plug type cap with internal jumpers is required for Type II receptacles, jumpers shall be connected to the proper pins. The mating dimensions shall be the same as the corresponding plug. The short-circuiting cap shall be permanently marked with an "S".

8.8 Instructions. Installation instructions shall be furnished by the manufacturer with each Class B connector.

8.9 Equipment qualification requirements.

8.9.1 Type Test.

The under mentioned type tests shall be carried out for initial approval of the item and shall be valid for maximum five years even if the design as per the original type tests is not changed. The plug and connector assembly shall be tested in accordance with the tests detailed below:

8.9.1.1 General Assembled connectors, with conductors attached, shall be subjected to electrical and physical tests. Class B connectors shall be assembled in accordance with manufacturer's instructions to lengths of wire or cable, as appropriate, of at least 24 inches (0.6 m) for all tests. Six pairs of mated connectors shall be selected at random from a production run for each type of connector to be tested for approval. Each tested connector shall pass all qualification tests. Failure of any one of the connectors in any one of the qualification tests shall indicate failure of this product to comply with this specification unless otherwise noted in a particular test.

8.9.1.2 Dielectric Tests

Plugs and Receptacles. Six tests insert plugs made of nylon or equal material of suitable dielectric strength shall be provided for the test. These test plugs shall meet the mating dimensions of the corresponding standard plug intended for use with the receptacle being tested. Each plug shall be checked with "go" and "no go" ring gauges to ensure compliance with specified dimensions. Each connector receptacle under test shall be mated with one of the test plugs and allowed to soak for 24 hours in a tap water
bath at room temperature, 20-25° C. At the end of the soaking period, with the receptacle still immersed, apply a test voltage of 4.7 KV DC for 5 minutes to Type II connectors and 15 KV DC to Type I connectors. One minute after the test voltage has been applied the minimum insulation resistance between the conductors and water, and between conductors measured with a 500-volt source shall be 25,000 megohms. The receptacles having passed this test are now used for testing the corresponding plugs in a like test.

Connector Assembly. After the conclusion of the test as above, each plug and receptacle being tested shall be mated and immersed in a tap water bath at room temperature, 20-25°C. Immerse not more than 2 feet (0.6 m) of cable, 1 foot (0.3 m) of the plug and 1 foot (0.3 m) of the receptacle. While immersed, each connector assembly shall be manually flexed for 2 minutes and then left immersed for a minimum of 24 hours with its cable leads flexed and maintained 180° from its longitudinal axis. Measure insulation resistance between conductors of each connected assembly after the 24hour soaking period. The resistance measurements shall be taken 1 minute after a test voltage of 4.7 kV dc has been applied for 5 minutes to Type II connectors and 15 kV dc to Type I connectors. The minimum resistance between conductors shall be 25,000 megohms. Heat the tap water to 65°C without removing the assemblies and maintain this temperature for at least 1 hour. Again, measure the resistance between the conductor(s) and water, and between conductors with a 500-volt source. The minimum acceptable resistance after the heated soaking period shall be10,000 megohms.

8.9.1.3 **Bond Test :** The molded bond between cable and Class A connector shall be subjected to a static longitudinal pull load of the magnitude specified in this specification under 'bonding strength'. When testing class A, Type II, connectors of any style the two conductors shall be pulled as a single cable, not as individual conductors. The connector shall be held in a manner that does not impart a crimping or clamping action to the connector that would affect the pull test. The connector molding cavity, or a similarly shaped fixture, is acceptable for holding the connector. Separation between the molded on connector and the cable jacket or conductor insulation exceeding 0.03 inches shall be cause for rejection.

8.9.1.4 **Mechanical Connection Test:** Each plug and receptacle intended to be mated shall be connected together and subjected to the static pull load specified in this specification under mechanical connection. Any evidence of separation of the connection shall be cause for rejection. Increasing load shall be applied to the connector assembly until separation occurs. No damage shall occur to the mating components when the connected plug and receptacle are separated by the greater static pull load. Any evidence of damage to plugs, receptacles, conductors, and/or the connector bond shall be cause for rejection.

8.9.1.5 **Electrical Connection Test :** Voltage drop measurements shall be made across mated connectors while conducting rated current. Voltage drops in excess of those specified in this specification shall be cause for rejection. This test may be performed using unmolded contacts conducting rated current. This would permit the measurement to be made without damaging the molded connectors. This test shall be performed on the equivalent of six connectors (six contact pairs for Type I connectors and twelve contact pairs for Type II connectors).

8.9.1.6 **Metal Bond Test** : Class A assemblies shall have their connector plug and receptacle placed in water, with 20 psi air pressure applied from the free end of the cable, for a period of 10 minutes. No air bubbles shall be observed in the water.

8.9.2 Acceptance Tests

The following tests shall be carried out as acceptance test:

i. Dielectric test
ii. connector assembly test
iii. mechanical connection test
iv. Electric connection test

8.9.2.1 Samples for acceptance test

Sample should be taken from each lot of particular type of plug and receptacle for scertaining the conformity of the lot to the requirement of specifications. The number of samples to be selected and permissible number of defects shall be as given below:-

8.9.2.2 Scale of Sampling

All the plug and receptacle of the same type manufactured using the same raw material under similar conditions of production shall be grouped together to constitute a lot.

8.9.2.3 The number of plug and receptacle to be selected from each lot shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table given below:

SAMPLE SIZES AND ACCEPTANCE NUMBERS

LOT SIZE		SAMPLE SIZE	ACCEPTANCE NUMBER
(1)		**(2)**	**(3)**
Up to	**50**	**8**	**0**
51 to	**100**	**13**	**0**
101 to	**150**	**20**	**1**

151 to	**300**	**32**	**1**
301 to	**500**	**50**	**2**
501 to 1000		**80**	**3**
1001 and above		**125**	**5**

8.9.2.4 These samples shall be selected from the lot at random.

8.9.2.5 Number of Tests and Criteria for Conformity

The plug and receptacle, selected at random according to col 1 and 2 of Table above, shall be subjected to the acceptance tests as specified above. A plug and receptacle failing to satisfy any of the acceptance tests shall be termed as defective. The lot shall be considered as conforming to the requirements, if the number of defectives found in the samples is less than or equal to the corresponding acceptance number; otherwise the lot shall be rejected.

8.10 Packaging

Packaging shall ensure full protection to the equipment against corrosion and deterioration or physical damage during handling and transportation by air, road, rail or sea. With the equipment a packaging list giving full details of the contents of the case including name of manufacturer, order number, brief description of contents etc. shall be enclosed.

CURRENT SPECIFICATION FOR CONSTANT CURRENT REGULATORS

9 SCOPE AND CLASSIFICATION

9.1 Scope

The specification sets forth the requirements for Constant Current Regulators (CCRs) for use in airport series lighting circuits. The CCRs shall be of electronic type with thyristor control, capable to generate generic reports.

9.1.1 Applicable Specifications

The CCR shall confirm to the specification described herein.

9.1.2 Classification

Two types, two classes, two styles and eight sizes of Constant Current Regulators are covered by this specification. The various combinations are shown in table 1:

TABLE 1 REGULATOR CLASSIFICATION

Rating	Type		Class		Style	
	Output Current		Input		No. of brightness	
	I	I			I	II
KW	6.6A	20.0A	240V	415V	3 Step	5 Step
4.0	X	-	X	-	-	X
7.5	X	-	X	-	-	X
10.0	X	-	-	X	-	X
15.00	X	-	-	X	-	X
20.00	X	-	-	X	-	X
30.00	-	X	-	X	-	X
50.00	-	X	-	X	-	X
70.00	-	X	-	X	-	X

9.2 Requirement

9.2.1 General :-The Constant Current Regulators described herein are intended to be power sources for series lighting circuits on airports.

9.2.2 Environmental Requirements

The CCRs shall be designed for continuous indoor operation under the following conditions:

i. Temperature range of –15º C to +55º C at sea level.
ii. Relative humidity range of 10% to 100%.
iii. Altitude range of 0 to 10000 feet above MSL.
iv. Salt spray – Exposure to salt laden atmosphere.

9.2.3 Regulation -Resistive load requirements

The regulator shall maintain the output current within the limits of table II (a) & II (b) at any load between no (short circuit) load and full load. The current setting device shall have provision to vary its setting. The change in setting shall be continuous (no break)and smooth.

TABLE II(a): OUTPUT CURRENT (6.6 AMPS)

Brightness Step	Nominal RMS output current (amp)	Current
	STYLE II	
1.	2.80	2.72 – 2.88
2.	3.40	3.30 – 3.50
3.	4.10	3.98 – 4.22
4.	5.20	5.04 – 5.36
5.	6.60	6.40 – 6.70

TABLE II(a): OUTPUT CURRENT (6.6 AMPS)

Brightness Step	Nominal RMS output current (amp)	Output Current Limit (amp)
	STYLE II	
1.	8.50	8.24 – 8.76
2.	10.30	9.99 – 10.61
3.	12.40	12.03 -
4.	15.80	15.33 -
5.	20.00	19.40 -

9.2.4 Regulation Reactive load requirements

When the regulator is loaded with isolating transformers and suitable lamps and the secondaries of 30% of the transformers are open circuited, the output current shall remain within limits given in table II (a) & (b) as applicable, for all brightness steps. The load before opening the isolating transformer secondary's shall be any value from half load to full load.

9.2.5 Efficiency

The efficiency of the regulator operated with rated input voltage into a full load having unity power factor shall not be less than the value given in table III.

TABLE – III : REGULATOR INPUT EFFICIENCY

Capacity of CCR (KW)	Minimum overall efficiency (in %)
4.0	90
7.5	90
10.0	90
15.0	90
20.0	90
30.0	92
50.0	93
70.0	94

9.2.6 Power Factor:

The power factor for regulators of capacity 10 KW and below shall be not less than 90% and for regulators of capacity more than 10 KW it shall not be less than 95%. The power factor shall be measured with the regulator operating on the maximum intensity setting, at rated input voltage and into a rated resistive load.

9.2.7 Temperature Rise

Determine the winding temperature by resistance method for both primary and secondary coils, obtain the temperature rise after operating the regulator continuously for a period of 4 to 6 hours at full load and at unity power factor. The maximum temperature rise of the regulator under these conditions shall not exceed 65°C.

9.2.8 Control System

The control system shall stabilize at any intensity setting within 5 seconds and shall hold the output current stable within $\pm$ 0.1 amp. at any output setting. The control system shall be designed for both local and remote-control Circuit lengths up to 3000 Mts. using 2.5 sq mm copper control cable as required. Remote control shall not affect the regulator performance

Characteristics. Voltage for the control system shall not exceed 120 Volts and shall be of self generated and integrated.

9.3 Detailed Requirements

9.3.1 Input voltage

Input voltage shall be single phase / two phase 50 Hz A/C supply as follows:

a) For regulators 7.5 KW and below – 240V $\pm$ 10%

b) For regulators 10.0 KW and above – 415 $\pm$ 10%

The input voltage range as mentioned above has to be considered in designing the electronic components of control circuit and transformer etc. The regulator shall be designed to withstand momentary over voltage up to 120% of nominal input voltage without being shut off or damaged by such over voltage. The duration of such over voltage excursions shall be no longer than 50 milliseconds and shall occur no more than once per minute.

9.3.2 Rating

Design the regulator to supply the applicable range of current to a load of incandescent/halogen filament lamps, with each lamp connected to an individual isolating transformer. Determine the regulator load by multiplying the output voltage and current obtained at brightness step 5. The calculated KW is not less than the KW rating of the regulator.

9.3.3 Circuit Isolation

The power input circuit shall be electrically isolated from the output circuit. The peak output voltage of an open-circuited regulator shall not exceed two times the rated wattage divided by the rated current or 4250 Volts peak, whichever is greater. These measurements shall be made with an oscilloscope or high voltage peak reading meter.

9.3.4 Primary Switch

The regulator shall have an integral remotely controlled primary switching device operated by control voltage. It shall operate via remote control & shall not interrupt power to remote control.

9.3.5 Control and External Power

The CCR shall be used with control supply of 24/48 volts. This control supply shall be generated in CCR Panel and shall be available for Remote /Brightness Controls as well as primary switch (ON –OFF) of CCR.

9.3.6 Open-circuit Protection

The regulator shall include an open-circuit protective device to open the primary switch within 2 seconds after an open-circuit occurs in the secondary. The device shall reset within 2 seconds after the control switch is turned off and re-energized.

9.3.7 Over-current protection

Constant current Regulators of all capacities shall include an over-current protective device that opens the primary switch when the output current exceeds the normal set output current by 5%. The device shall operate within 5 seconds after an over-current of 5% and within 1 second after an over-current of 25%. The device shall reset within 2 seconds after the control switch is turned off and re-energized. The over current protection shall not be activated by a momentary (0.25 second) over-current caused by switching off load circuits or by other transients. The over current protection device shall house provision to vary its settings. The change in setting shall be of continuous (no break) and smooth.

9.3.8 Input Power Loss In the event of loss of input power long enough to affect the regulator output current, the regulator shall resume operation on the selected brightness setting within 5 seconds after the restoration of input power.

9.3.9 Remote / Local Control Switch

A multi-position selector switch to select Remote, OFF, Local and brightness control shall be located for ready access by an operator without opening doors or removing covers. Mark the position of the by selector switch as below:

Remote, Off and Local: Provide connections for these positions as follows:

Remote: Remote control circuit connected and local control circuit open. (the remote-control station is not furnished as part of this assembly).

OFF: Remote and local control circuits open.

Local: Local control circuit connected and remote control circuit open.

Provide brightness selector switch (5steps or 3 steps as applicable) to control the regulator locally. CCR shall have provision to control the brightness from remote. Remote control brightness selector switch unit is not a part of the CCR.

Back indication: Back indication is required to know whether the CCR is ON and the series circuit is energized or not. The indication shall be provided on the CCR. Provision shall also be made in the CCR for back indication arrangement on remote control panel.

9.3.10 Out-put Ammeter

A flush mounted, true R.M.S. indicating digital ammeter to indicate output current shall be provided on the front of the regulator so that it may be easily read. The meter accuracy shall be at least ±1%.

9.3.11 Terminal Block and Wiring

A pressure type terminal block having suitable voltage rating shall be installed in the control cabinet. Label the termination as shown below. The terminal block shall accommodate 3.25 sq. mm. to 0.52 sq. mm (No. 12 to 20 SWG) wire with an insulation rating upto 600 volts. At least five spare terminal block position shall be provided in addition to those listed below. Terminal XCP and N need be supplied only if external control voltage is used.

Terminal Function	Label
a. Power supply for remote control Panel	CCI
b. Return from remote ON/OFF switch	CC
c. Returns from remote intensity switch (6) terminals to be provided	OFF-B1-B2-B3-B4-B5
d. Input for external control Power (Optional)	XCP
e. Neutral for external control panel (Optional)	N

9.3.12 Regulator Enclosure

The regulator and the transformer shall be housed in a sheet steel enclosure of 2 mm. thick all around and the construction shall meet IP 42 class of protection. The enclosure shall be equipped with a hinged / removable cover that is held securely in place by cap screws. Foot or channels shall be attached to the bottom of the enclosure so that there will be a gap of not less than 2" (5 cm.) is available between the enclosure and the floor. Detachable cable gland plates for incoming and outgoing cables shall be provided. Four enclosed terminals (for input and output) suitable for voltages involved shall be located on the front side of the enclosure with each pair labelled 'input' or 'output' as applicable. Lifting hooks shall be installed on the enclosure. Overall physical size of the complete regulator assembly shall be such that it will pass through an opening of 39" wide by 78" height (1 Mt.x2 Mts.). Two ground terminals shall be installed on the outside of the regulator enclosure. A suitable steel control cabinet or compartment for housing the relays, control cards, the control terminal block, the remote/local control switch and other low voltage compartments shall be either permanently attached to or an integral part of the enclosure. All low voltage control components shall be accessible by opening the cabinet. The cabinet shall close tightly in order to minimize entry of insects and airborne foreign material.

9.3.13 Capacitors:

Capacitors shall be provided for power factor correction to meet the requirement specified above under 'power factor'.

9.3.14 Output current surge limitation:

The regulator shall be designed so that any output surges caused by switching the regulator ON and OFF, changing brightness steps, or shorting the load will not damage series incandescent/Halogen lamps. If time delay is utilized, not more than 2 seconds shall elapse from when the regulator is turned on to when the current is delivered to the load terminals.
Pulsation or hunting of output current shall be limited to 5 seconds or less under all conditions of switching.

9.3.15 Wiring Diagram:

A legible wiring diagram shall be permanently mounted in an unobstructed place in the control cabinet.

9.3.16 Painting and Finishing:

Inside and outside of the enclosure one primer coat and two or more finish coats of oil proof and weatherproof paint are to be applied. The outside of the enclosure shall be finally painted after assembly and testing are completed.

9.3.17 Name Plate:

A name plate with the following minimum information shall be securely attached to the front of the regulator enclosure :

a) Constant Current Regulator,

phase
b) Input : V at Hz amps.
c) Control : V at Hz.
d) Identification : Serial No. .
e) Output : KW at amps.
f) Output : amps.(At each step)

If the name plate is attached to a readily removable surface such as a cover, the serial number shall be duplicated in a permanent conspicuous place else where on the Regulator.

9.3.18 Instruction Book:

Three copies of instruction books with the following minimum information shall be furnished with each regulator.

i. Complete schematic and wiring diagrams showing all components cross indexed to the parts list.
ii. Complete parts list with applicable rating and characteristics of each part and with the component
    a. manufacturer's part number.
iii. Installation instruction manual.
iv. Maintenance instruction manual with wave forms at various stages.
v. Trouble shooting charts.
vi. Theory of operation.

9.3.19 Special provisions
The output transformer shall have tapping as below:-

i. 20 kw CCR shall have an tapping for 15 kw
ii. 30 kw CCR shall have an tapping for 20 kw
iii. 50 kw CCR shall have an tapping for 30 kw
iv. 70 kw CCR shall have an tapping for 50 kw

All capacities of CCRs shall be provided with earth fault protection device with calibrated earth leakage meter on the front panel.

9.3.20 Lightning arrestors

Lightning arresters of the size necessary to protect the regulator shall be installed across the regulator output terminals. The ground side of the arrestors shall be connected to the grounding lug of the enclosure. The lightning arrestors shall be able to handle the pulse specified below under 'transient suppression' as a minimum.

9.3.21 A plate with below mentioned warning shall be affixed to the front of the regulator control cabinet door.

WARNING

REMOVE MAIN INPUT AND CONTROL POWER BEFORE OPENING COMPARTMENT

9.3.22 Indications: -

To indicate failure of SCR fuse, over current trip, earth fault trip, open circuit trip, CCR ON/OFF and remote/local indication lamps shall be provided on the front of CCR panel. Audible alarm shall also be provided for fault conditions.

9.4 Quality assurance provision

9.4.1 Type test

The manufacturer shall possess satisfactory test certificate for all the tests described here in for each capacity of CCR. The test certificate from Government laboratory is acceptable. The test report shall not be older than 5 years even if the design as per the original type tests is not changed.

9.4.2 Testing

9.4.2.1 Regulation test

The following tests shall be performed to demonstrate compliance with the requirement specified under 'regulation' and table II. Where isolating transformers and lamps are not specifically available, a resistive load may be used. For reactive load test suitable inductive load should be used.

9.4.2.2 Input Voltage Tests

Load the regulator to full load and energize it with nominal input voltage, 110 percent of nominal voltage, and 90 percent of nominal voltage and verify that the output current falls within the limits of table II. Repeat this test at half load and short circuit. These tests shall be repeated at all brightness settings.

9.4.2.3 Inductive load test

An equivalent of full load and half load shall be placed on the regulator, but with 30 percent of the isolating transformers open-circuited. The input voltages shall be nominal, 110 percent of nominal, and 90 percent of nominal voltage. The output current shall be checked at all brightness settings and shall be within the limits of Table II.

9.4.2.4 Remote Control Test

Check the output current at all brightness steps using the following remote control circuits (a resistance load may be used in lieu of the full length specified) and rated output load:

a) Connect the remote switch by simulated 30 mtr length of 2.5 sq mm copper control cable having a resistance equal to 0.16 ohm per wire, operate the regulator remotely on all brightness steps to determine compliance with 2.3.5.

b) Connect the remote switch by simulated 3000 m lengths multicore cable having resistance equal to 87 ohm per 3000 mt of wire and a capacitance of 0.16 microfarad. Operate the regulator remotely on all brightness steps to determine compliance specified above under 'control system'.

9.4.2.5 Temperature rise

Determine the regulator temperature rise in accordance with relevant IS specifications.

9.4.2.6 Efficiency

With nominal input voltage and a full load of out put of unity power factor, determine that the efficiency of maximum brightness is not less than specified in table III.

9.4.2.7 Power Factor

With nominal input voltage and full load of out put of unity power factor, determine that the input power factor at maximum brightness is not less than that specified above under 'power factor'.

9.4.2.8 High Temperature

Place the regulator in a test chamber and maintain the ambient temperature at 55ºC+ 2ºC. After the temperature of the regulator components has stabilized, operate the regulator for 4 hours at full rated input voltage and output current. Perform the tests specified above under 'input voltage tests' to demonstrate compliance.

9.4.2.9 Humidity

Regulator shall be tested for resistance to humidity at the maximum temperature of +55º C. Perform the tests specified above under 'input voltage tests' to demonstrate compliance.

9.4.2.10 Dielectric tests

Test the circuits of all regulator sizes to determine the equipment's ability to withstand the following rms 50Hz test voltage for 1 minute without failure:

i. 240V/440V input circuit to ground – 2,000 V.
ii. 2,400 volts input circuit to ground – 19,000 V.
iii. 240 V control circuits to ground – 2,000 V.
iv. 120 V control circuits to ground – 1,000 V.
v. 24/48 V control circuits to ground – 500 V.
vi. Output circuit to ground – 5 times the full load RMS voltage. Lightning arrestors shall be disconnected during the test.

9.4.2.11 Protective device tests

Test all protective devices for proper operation as specified above under open circuit protection, over current protection and earth fault protection. Also test to determine the open- circuit voltage as specified above under 'circuit isolation'. Disconnect the open-circuit protection for this test.

9.4.2.12 Transient Suppression

To determine the effectiveness of the lightning arrestors, they shall suppress a test pulse on the out-put lines consisting of a 10 by 20 microsecond current surge of 15,000 amperes with the subsequent power-follow current and a voltage surge of 10 KV per microsecond minimum without damage to the regulator.

9.4.2.13 Output Current Surge Check the regulator to determine compliance as specified above under 'output current surge limitation'.

9.4.3 ACCEPTANCE TEST

The following shall constitute Acceptance test:

Regulation
Remote
Efficiency
Dielectric
Protective

9.4.4 ROUTINE TEST

The following tests shall be carried out as routine tests in the factory by the manufacturer and furnish the test results**.**

i. Regulation test
ii. Input Voltage test
iii. Inductive load test
iv. Remote control test
v. Temperature rise test
vi. Efficiency test
vii. Power factor test viii. Dielectric test
ix. Protective device test

9.5 Packaging

Packaging shall ensure full protection to the equipment against corrosion and deterioration or physical damage during handling and transportation by air, road, rail or sea. With the equipment a packaging list giving full details of the contents of the case including name of manufacturer, order number, brief description of contents etc shall be enclosed.

SPECIFICATION FOR CI TRANSFORMER HOUSING BOX

10.

MATERIAL	**: CI MOULD of foundry grade pig iron conforming to IS224**
THICKNESS	**: 15 mm thick on top surface and 10 mm thick all round.** Top surface should be smoothly machined to receive base plate.
HEIGHT	**: 450 mm OUTSIDE DIAMETER : 330 mm OPENING ON TOP 220 mm diameter HOLES FOR FIXING LIGHT**
BASE PLATE	**: 6 Nos. M-10 taped holes at hole centre of 250mm**
HOLES REQUIRED	**:** 1 or 2 Nos. of hole to receive 50 mm diameter 'B' class GI pipe as specified in BOQ & drawing.

Drain hole to receive 15 mm diameter 'B' class GI pipe at bottom.

Note: All other requirements as per the Drawing enclosed. The tenderer shall prepare the drawing for transformer housing boxes and shall get it approved from Sr. G.M. (Infra.), APADCL before manufacturing.

INSTALLATION TESTING AND COMMISSIONING OF HIRL, MIRL AND APPROACH LIGHTING FITTINGS

11.1.0 Runway Edge Light

11.1.1 Configuration

The runway edge lighting system is a configuration of light which define the lateral and longitudinal limits of the usable landing area. Two straight lines of light which are parallel to and equidistant from the runway center line define the lateral limits. The longitudinal limit of usable landing area are defined at each end of the area by straight lines of lights called threshold/runway end lights which are installed perpendicular to the lines of runway edge lights.

11.1.2 Location and Spacing

Runway edge lights are located on a line not more than 3 mts from the edge of the full strength pavement which is designated for runway use. The longitudinal spacing of the lights should not exceed 60 mts and be located such that a line between light units on opposite sides of the runway is perpendicular to the runway center line. The lights should be spaced as uniformly as possible with the threshold/runway end lights used as the starting reference points.

11.2.0 Threshold and Runway End Lights

The combination of threshold and runway end lights are located on a line perpendicular to the extended runway centre line not less than 0.6 mts not more than 3 mts outward from the designated threshold of the runway.

11.3.0 Displaced Threshold

When the threshold is displaced from the extremity of the runway, the threshold inset lights are located outward from the runway. The innermost light of each group is located in line with the line of runway edge lights and the remaining lights are located outwards, away from the runway, on a line perpendicular to the runway centre line, as DGCA CAR Sec4, Sr B, Part 1.

11.4.0 Taxiway Edge Lights Configuration

The taxiway edge light fixtures are located not more than 2.5 mts from the edge of the full strength pavement on each side of the taxiway and spaced longitudinally not more than 60 mts apart to define the lateral limits of the taxiing paths. On a straight section the lights on opposite sides of the taxiway are located on a line perpendicular to the taxiway centre line. The longitudinal spacing of the lights is influenced by the physical lay-out of the taxiways. The closure spacing of the lights should be provided on short taxiway sections, curves and entrances to taxiways from runways or aprons. Drawings indicating the spacing of the taxiway lights for the following are enclosed:-

Straight taxiway sections more than 200 feet, Straight taxiway sections less than 200 feet Spacing of lights on curved taxiway edges.

11.5.0 Approval of Drawings

A drawing indicating the locations of lights for the system shall be approved by the Sr GM (Infra.), APADCL before execution.

11.6.0 Installation

11.6.1 Transformer Housing Box

The transformer housing box shall be installed as shown in the figure. Level the transformer housing box so that the top of the housing box is approximately 25 mm above the finished grade. The top of the concrete is sloped away from the top portion of the transformer housing box so that the sloped outer edges of the concrete are at surface grade.

When the Transformer Housing Box is to be installed, a circular pit is made at the location where the fitting is to be installed. The pit shall be of diameter 300 mm more than the diameter of the CI box and of depth 75 mm more than the height of CI box. The pit shall be rammed so as to get a well consolidated sub base. Cement concrete of 1:3:6 mix (1 cement,3 sand, 6 coarse aggregate of 20 mm nominal size) shall be poured and consolidated to a depth of 100 mm.

The box is placed centrally over the prepared concrete base keeping in view the final orientation of the fitting. Cable entry pipe and the earth wire shall be terminated on the box. Cement concrete of 1:2:4 (1 cement, 2 sand, 4 coarse aggregate of 20 mm nominal size) shall be filled around CI box and consolidated. The top of the concrete is slopped away from the flange portion of the CI box smoothly. The concrete is cured by retention of water suitably on the finished concrete. The chase cut for the pipe shall be made good to restore the surface to the original finish, as specified in the BOQ. It may be noted that the top of the fitting when installed over the box shall not project more than 350 mm above the shoulder level.

11.6.2 Installation of Base Mounted Fittings on CI Box (HIRL & MIRL)

The base mounted fitting shall be installed over the box. The base of the elevated fitting may be used as cover over the same. This shall be fixed with gasket over the box with bolts tightened to the required torque. The isolating transformer is to be accommodated inside the box and the same shall be installed before the cover is fixed. The hardware portion of the fitting with the breakable coupling shall also be fixed on the base.

The light fixtures are supplied un-assembled and consists essentially of an optical system, lamp, a lamp holder mounted in a suitable metallic housing, connecting leads, mounting assembly and a base plate for installing the unit securely in place. The installation agency will assemble, connect to mounting, level and adjust the light fixture in accordance with the manufacturer's/ Sr.GM (Infra), APADCL instructions. Each fitting shall be numbered by stencil numbers with black paints on the runway side of the base plate. The minimum height of the numbers is 5 cm.

Prior to mounting the light fixtures on the base, the connector kit shall be installed on the primary power cables ends and appropriate isolating transformer is installed. Wrap the connector joint in the primary circuit with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one half lapped, extending at least 40 mm on each side of the joint. Plug the light disconnecting plug into the transformers secondary receptacle. Do not tape this connection.

11.6.3 Installation of Elevated Simple Approach Lighting Fitting

The elevated approach light fittings are required to be installed in the over-run of the runway, displaced threshold / portion of runway and also beyond. The fittings in the over-run area are installed over boxes in the same manner as described above.

In certain cases, barrettes of three fittings with a close spacing may be required to be installed. In such a situation, the isolating transformers for the fittings may be installed inside the respective boxes.

The fittings outside the over-run may be required to be installed on pipe supports or towers, depending on the height. The height at which the fittings should be located above the ground level depends on the gradient of the terrain and other parameters. This has been detailed in Attachment 'A'/Annex.14 of ICAO.

Where the approach light fitting is required to be installed at a considerable height above ground level calling for provision of tower structure, the frangibility criteria, as indicated in Appendix A, shall be satisfied so that, if this is hit by an under shooting aircraft, this may collapse without causing damage to the aircraft. Means shall be provided for maintenance of the fitting and lamp replacement, and for leading the cable to the fitting.

11.6.4 Installation of Inset Type Fittings

Inset fittings are intended to give output in precise envelopes. The installation tolerances permissible are, therefore, very small. The light beam shall be aligned parallel to the centre line of the runway with + or - ½ degree. The fitting must be level and its edge must be between + 0, - 2 mm from the top of the pavement. The installation has to be, therefore, carried out with precision. Tools jigs and other installation procedure prescribed by the manufacturer shall be strictly adopted. Provisions contained hereunder shall be taken to supplement the same.

Inset fittings may be required to be installed either in an existing pavement (rigid or flexible) or in a totally new pavement (rigid or flexible). Installation instructions of the manufacturers of inset fittings shall be followed. The following are the general guidelines.

11.6.4.1 Installation in Existing Pavement (Rigid or Flexible)

The fitting with a shallow base is used. The base is installed in the pavement and the top assembly is installed over the same.

After precisely marking the location for installation of the fitting, a hole is drilled in the pavement to the required diameter and depth using a core drilling machine. Normally a clearance of about 6 mm should be available around the base and also between the base and the pavement for the sealant materials. It is advantageous to use two narrow cutters instead of a single wide cutter for drilling in flexible pavements to avoid gumming up of melting asphalt while drilling.

The wire ways for taking the secondary leads in flexible pavements should also be cut, preferably using a double blade cutter.

Where wet sawing is adopted, the wire ways shall be flushed with high velocity stream of water immediately after sawing. The wire ways shall be fully dried up. The depth of saw kerf (wire way) should be 25 mm, and the width 9 mm minimum to install 2 wires, one above the other. These dimensions may be increased to accommodate additional wires, where necessary. Where the wire way is to cross existing joint seal in rigid pavements, the wire way may be made deeper near such joints so that the secondary leads are at not less than 12 mm below the joint seal compound. Alternatively, GI pipe of suitable diameter can be laid in the wire way for drawing secondary leads. The light fittings shall not be handled by the leads.

The external surface of the fitting base as well as the drilled hole/wire way in the pavement shall be absolutely clean and dry. Sand blasting of the base immediately prior to installation is recommended.

The type of sealant material is usually paste type below the base and liquid type for the sides. Due care shall be taken while placing the sealants so as to ensure that there are no entrapped air pockets. The installation jigs may be removed, only after the sealant has set. Manufacturer's instructions in respect of time for setting shall be adopted.

The secondary leads shall be placed in the wire ways at least 12 mm below the pavement surface, and held in position by suitable clips/wedges. Wood shall not be accepted as a wedge material. No

intermediate joints are permitted in the run of the secondary leads. Even the splicing for connection to the fittings should be staggered.

Where recommended by the manufacturer, clear sand to the recommended fineness may be added to the liquid sealant in wire ways, till a slight amount of sand shows on the surface.

The sealant material shall not be poured in excess so as to extend above the pavement surface.

In the case of flexible pavement, it is preferable to provide junction boxes near the fittings, considering the likely future overlays. Similar provision of junction boxes may be advantageous where more than one fitting, such as in touch down zone, are to be installed.

The top assembly of the fitting is fitted over the base with a gasket and bolts are tightened to recommended extent using a torque spanner.

11.6.4.2 Installation in New Pavements

The method outlined above could be adopted in new pavements also. The alternative procedure is described below.

The top assembly of the light fittings in new pavement constructions is installed over a deep base. The base may be in one piece or two depending on whether the pavement is laid in one layer or two. The installation procedure involves installation of the base in cement concrete anchor suitably, prior to the laying of pavement concrete (bituminous/cement). In new pavement constructions, the locations for installation of these bases have, therefore, to be carefully determined as they may have to be set 'in space' due to lack of references very precisely. Suitably designed rigid jigs shall be procured from the manufacturer and used in correctly positioning the base so that the fitting, when installed after completion of the construction of the pavement, may not project above the finished pavement beyond permissible level, nor remain too much below the pavement surface. The jig shall establish the elevation and azimuth of the base.

The excavation in soil or sub-base and soil, as the case may be, shall be done at the precise location. The base and a reinforcement steel cage shall be held in place with the jig, and these shall not be disturbed while placing the cement concrete for anchor. The jig shall be retained in position till the cement concrete has set.

The connection between the cable entry pipe and the base shall be done before placing the anchor concrete. Liquid tight flexible pipe is recommended for the purpose as this will allow adjustments in the light base alignment before concrete anchor is placed.

The fitting base shall be suitably protected using steel cover plate, when the pavement is laid.

The surface of the pavement around the light base shall be leveled with the surrounding pavement, without any dished or mound areas.

In every case, care shall be taken to check the level of the top flange of the light base with reference to finished pavement so that there is no undue projection of the fitting, when installed over the same. Where necessary, suitable spacer/adoptor rings shall be used to raise the fixture to proper elevation.

In the case of flexible pavements, the fittings base shall be of two sections. The bottom section is first installed in concrete anchor such that the top of the same does not protrude above the sub-base. The upper section of the light base is installed when the top asphaltic surface is laid.

Where the pavement (rigid or flexible) is laid in stages, the light base should also be sectionalized accordingly and individual sections be installed before every 'pass' of the paving machine. The two sections of the base are jointed using a suitable sealant material. The sections are suitably protected using steel cover plate during paving operations.

Water tight gasket supplied by the fitting manufacturer shall be provided between the base and top assembly of the fitting. Holding bolts shall be tightened to the recommended extent using torque spanner.

11.7.0 Air field Cable (5 KV grade) Laying

As the airport lighting series cables are high voltage cables should be handled with care as necessary for HV cables. The method of laying shall be same as outlined in the relevant Indian Standards. A lower depth up to 0.9 meter below ground level within operational areas is acceptable since approach to the areas is restricted. Due consideration should be given for the likely provision of shoulders or widening of shoulder on a future date. To facilitate this, 50 mm diameter GI pipe ('B' class) for a length of 9 mts shall be provided from transformer housing box to away from the shoulder as provided in the BOQ. This will avoid dismantling of the cable system at a later stage.

For the ru*n*way end/threshold lights the transformer housing boxes shall be interconnected with 50 mm diameter GI pipe ('B' class) to avoid cable laying in the paved area. In case of main & standby circuits the transformer housing boxes are to be independently interconnected with GI pipe.

The cables are jointed at site for terminating to the connector kits. Crimping joints are recommended. Special care shall be taken to ensure that there is no possibility of water entry through the space between cable and the connector.

Loop length of 3 mt shall be left opposite to each fitting in soil and 1 mt loop shall be left in each transformer housing box.

Where number of cables is more and all the cables are to follow the same route, the provision of RCC pipes with manholes at every 100 Mt. throughout may be examined as an alternative. This method will not be applicable for fitting to fitting loop cable of runway edge/approach lights. The number of RCC pipes should not be less than six and diameter of the pipes should not be less than 150 mm jointed together with RCC collars. The manhole shall be provided with CI cover on the top.

The pipes should be laid in such a way that they are at least 1Mt. below the ground level.

Communication cables, LT cables and HT cables shall be drawn in independent pipes.

GI wire of airfield lighting cables shall also be drawn in a separate pipe.

11.7.1 Laying direct in ground

11.7.1.1 General

This method shall be adopted where the cable route is through open ground, along runway/roads/lanes, etc., and where no frequent excavations are likely to be encountered and where re-excavation is easily possible without affecting other services. Only with approval of Site enghineer.

11.7.1.2Trenching

Width of trench

The width of the trench shall first be determined on the basis indicated herein. The minimum width of the trench for laying a single cable shall be 35 cm. Where more than one cable is to be laid in the same trench in horizontal formation, the width of the trench shall be increased such that the inter- axial spacing between the cables, except where otherwise specified, shall be at least 20 cm. There shall be a clearance of at least 15 cm between axis of the end cables and the sides of the trench. It will be advantageous to lay main and standby cables in separate trench.

Depth of trench

The depth of the trench shall be determined on the basis indicated herein. Where the cables are laid in a single tier formation, the total depth of trench shall be 80 cm and 75 cm for cables of Air Field Lighting type in the operational area and LT cable respectively. The depth of the trench shall not be less than 1.2 mts for Air Field Lighting cables to be laid in other than operational areas.

Excavation of trenches

The trenches shall be excavated in reasonably straight lines. Wherever there is a change in the direction, a suitable curvature shall be adopted. Where gradients and changes in depth are unavoidable, these shall be gradual. The bottom of the trench shall be level and free from stones, brick bats etc. The excavation should be done by suitable means – manual or mechanical. The excavated soil shall be stacked firmly by the side of the trench such that may not fall back into the trench.

11.7.2 Laying of cable in trench

The trench shall then be provided with a layer of clean, dry sand cushion of not less than 8 cm in depth before laying the cables therein. After the cable is laid a covering of dry sand of not less than 17 cm of sand shall be provided. Care shall be taken to lay the GI earth wire before the protective cover is laid. Unless otherwise specified, the cables shall be protected by second class brick of nominal size 22cmx11.4cmx7cm or locally available size, placed on top of the sand (or, soil as the case may be). The bricks shall be placed breadth-wise for the full length of the cable. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at least 5cm over the sides of the end cables. The trenches shall be then back-filled with excavated earth, free from stones or other sharp edged debris and shall be rammed and watered, if necessary in successive layers not exceeding 30 cm depth.

11.8.0 Testing before laying

At the time of issue of cables for laying, the cable shall be tested for continuity and insulation resistance.

11.8.1 Testing before covering

The cables shall be tested for continuity of cores and insulation resistance and the cable length shall be measured, before closing the trench. The cable end shall be sealed /covered.

11.8.2 Laying in pipes/closed ducts

In locations such as road crossing, entry in to buildings, paved areas etc, cables shall be laid in pipes or closed ducts. Metallic pipe or RCC shall be used as protection pipe for cables.
The size of the pipe shall not be less than 10 cm in diameter for a single cable and not less than 15 cm for more than one cable.

11.8.3 Road crossing

The top surface of pipes shall be at a minimum depth of 1m from the pavement level when laid under roads, pavements etc. with man holes at both ends of the pipes. The number of pipes to be laid should include sufficient number of spare pipes for future use.

11.8.4 Laying in open ducts

Open ducts with suitable removable covers (RCC slabs or chequered plates) are generally provided in sub-stations, switch rooms, plant rooms, workshops etc., for taking the cables. The cable ducts should be of suitable dimensions for the number of cables involved. Laying of cables with different voltage ratings in the same duct shall be avoided. Where it is inescapable to take HV & MV cables in same trench, they shall be laid with a barrier between them or alternatively, one of the two (HV/MV) cables may be taken through pipe(s).Splices or joints of any type shall not be permitted inside the ducts. The cables shall be laid directly in the duct such that unnecessary crossing of cables is avoided. Cables shall be fixed with clamps on the walls of the duct or taken in hooks/brackets/troughs in ducts. The size and material of saddles/clamps shall be as given under laying on surface.

11.8.5 Laying on surface

This method may be adopted in places like switch rooms, CCR room, rising (distribution) mains in buildings etc. This may also be necessitated in the works of additions and/or alterations to the existing installation, where other methods of laying may not be feasible. Cables may be laid in surface by any of the following methods as specified:-

a. Directly clamped by saddles or clamps.
b. Supported on cradles.
c. Laid on troughs/trays duly clamped.

The saddles and clamps used for fixing the cables on surface shall be 1 mm thick with fixing interval of 45 cm for cable size upto 25 sq mm and 3mm thick 25mm wide with fixing interval of 60 cm for cable size upto 120 sq mm. Additional clamping shall be provided at 30 cm from the center of bend on both sides. Saddles shall be secured with screws to suitable approved plugs. Clamps shall be secured with nuts on to the bolts, grouted in the supporting structure in an approved manner. In the case of single core cables, the clamps shall be of non-magnetic material. A suitable non-corrosive packing shall be used for clamping unarmoured cables to prevent damage to the cable sheath. Cables shall be fixed neatly without undue sag or kinks. All MS components used in fixing the cables shall be either galavanised or given a coat or red oxide primer and finished with 2 coats of approved paint.

11.8.6 Laying on cable tray

This method may be adopted in places like indoor substations, CCR rooms, generator rooms etc., or where long horizontal runs of cables are required within the building and where it is not convenient to carry the cable in open ducts. The cable trays may be either of perforated sheet type or of ladder type. The width of cable tray shall be chosen, so as to accommodate all the cables in one tier plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100 mm. The overall width of one cable tray shall be limited to 800 mm. All cable trays should be galvanised type. The cable tray shall be bonded to the earth terminal of the switch boards at both ends. The cable tray suspender should be 10 mm dia galvanized rod or 25mmx5mm GI flat as per BOQ.

11.8.7 Bare Earth Wire Installation and Grounding for Lightning Protection

No. 8 SWG minimum size GI wire shall be installed for lightning protection of the airfield underground cables. The bare wire shall be installed in the same trench for the entire length of the insulated cables it is designed to protect, and shall be placed at a distance of approximately 150 mm from / above the insulated cable. The wire shall be securely attached to each transformer

housing box. Earth pits for this purpose shall be provided at every 300 mt. The earth wire shall terminate at the respective CCR. CCRs shall be securely connected to the equipment grounding system.

11.8.8 Testing & Commissioning

Before commissioning the circuit, inspection shall be carried out. The details are as follows:

a. Inspect each light fixture to determine that is installed correctly at the proper height in line with the other fixtures and properly oriented.
b. Check light fixtures to determine that the lenses are properly oriented with reference
c. To runway longitudinal sides and the threshold. Inspect and test insulation Resistance of underground cables.
d. Check input voltage at the power and the control circuit to determine that the voltage is within limits required for proper equipment operation.
e. Select the proper voltage tap on equipment where taps are provided.
f. Check fuses and circuit breakers to determine if they are of proper rating.
g. Check the current or voltage at the lamps to determine if the regulator current or supplied voltage is within specified tolerance.

Once the above inspection is completed the following tests are to be carried out at the time of commissioning: -

a. Test the installation by operating the system continuously for at least one & a half hours. In addition, operate each control not less than 10 times.
b. Test the insulation resistance of the cable with 1000 volt meggar. Minimum acceptable
c. resistance to ground is 50 mega ohms.
d. Testing of multiple circuits when carried out remove all the lamps.
e. Check the earth resistance to ground.
f. Subject the regulators and other applicable equipment to performance test as specified in the contract for the initial installation.

DELIVERABLES:

Complete Turn-Key supply, installation, testing and commissioning shall include:

a. civil works for related installations meeting DGCA relevant C.A.Rs,
b. required accessories such as isolating transformers, housing boxes, GI Pipes, Airfield Cables, Constant Current Regulators and construction and development of their housing room,
c. suitable AGL console in ATC tower,
d. Base plates and all others as may be needed to ensure the following lights are functioning without any trouble.
e. High Intensity Elevated Type RUNWAY EDGE Lights – 80 bi-directional Lights, 15 spare bulbs.
f. High Intensity Elevated Type Runway End / THR lights – 07 bi-directional lights, 07 unidirectional lights, 20 spare bulbs
g. High Intensity Elevated Threshold Lights – 12 Unidirectional lights, 06 spare bulbs
h. Elevated Type Taxiway Edge Lights – 30 omnidirectional lights, 10 spare bulbs
i. PAPI Light Set – 2 sets along with calibration unit. 06 spare bulbs.

j. **Aerodrome Rotating Beacon – 1 Beacon complete set with four spare bulbs.**
k. **Mandatory Signage – total 05 Nos (RWY holding {04}, Intermediate departure {01}), 04 spare bulbs**
l. **Information Signages – total 05 Nos (RWY vacation {04}, 04 spare bulbs**
m. **Simple approach light system-420 m – two sets (including 04 inset light sets), 20 spare bulbs & 02 inset lamps.**

Chapter II

TECHNICAL SPECIFICATIONS FOR ADVANCED AIR TRAFFIC ADVISORY SYSTEM

The following should be broadly considered while implementing the project as an integrated system and as a turn key solution, with complete installation and commissioning.

Required safety services and sensors for aviation:

Air traffic and advisory services to pilots over helipad/airport VHF

1) Advisory to pilots of nearby air traffic
2) Two-way radio check for pilots for takeoff
3) Monitor and remotely report 121.5 aircraft emergency beacons
4) Runway advisory for current conditions
5) Calm wind runway advisory
6) Crosswind advisory warning
7) Wind shear advisory warning
8) Density altitude warning

Weather features

1) Wind direction
2) Wind speed
3) Temperature
4) Humidity / Dew point
5) Pressure
6) Precipitation (Rain)
7) Weather (Fog/Mist/Haze)
8) Sky condition

IN-DEPENDENT, OFF-GRID, AUTOMATIC ADVISORY AND INFORMATION SYSTEM. AC power may not be reliable or available anywhere near installation sites. The system must be self-contained and 100% totally off-grid, powered only by 12 volt batteries charged through Solar panels. The system must not require any AC power for any part.

Civil works required for the installation shall be 6 meter frangible mast (if installed in RWY strip), and all related sensors and equipment.

Electrical grounding must operate reliably from a simple grounding rod.

1. AIR NAVIGATION SERVICES

- Bidder should provide weather proof Power distribution along with safety devices at equipment site.
- Bidder should also provide weather proof signal junction boxes for termination and distribution.
- Separate discrete VHF frequency may not be possible. If available at all, authorization may delay installation by considerable period. System must have

proven track record of sharing airport VHF traffic frequency already used by pilots for air traffic operations.

- Power and signal cable wiring at the site is to be arranged and made by the vendor.
- UPS with a minimum 1 week continuous operation under full load at each site of the Airport, to operate from solar charged batteries under extended periods of overcast, with weatherproof enclosure.
- Supply of advanced automated airport system as described in 1a and 1b above.
- Two way VHF transmitter / receiver should work on 12V battery.
- The system should automatically generate air traffic and weather information in standard METAR / ICAO sequence and in plain language.
- Weather data should be sent as requested by Tender, or to authority (APADCL) website, as advised.
- Speech synthesizer unit is required at site for converting messages to speech output for broadcasting to pilots. Voice converter is to be provided for sending the speech data to VHF transmitter.
- Supply of necessary calibration equipment
- Supply of VHF transmitter and Antenna for transmitting voice data up to a range of 50 KM.
- Supply of portable VHF tester for each site for checking data transmission with Aircraft pilot. VHF tester required for testing and maintenance.
- The system should have provision for remote web based technology for monitoring data and status of each Airport system.
- The system should have Remote monitoring facility to monitor all sensors, contamination level of Visibility sensor, calibration level of Visibility sensor, battery and VHF transceiver transmitter and receiver performance and power etc**.**

2. SYSTEM OVERVIEW

There will be VHF transmission of messages to pilots.
Field sensors are to be located at sites representing the prevailing meteorological runway conditions at the Airport.

3. SYSTEM SPECIFICATIONS

3.1 General Specifications

The system shall monitor aerodrome VHF communications and dynamically share the exiting VHF airport frequency real-time, only providing operationally relevant real-time weather data from various sensors for support of Aircraft operations directly to pilots over VHF.

In addition, the system and its support network should provide data remotely to pilots for flight planning purpose.

3.1.1 The system shall be based on the latest technology and modular structure to facilitate changes, expansion and integration to support airport expansion/alteration.

3.1.2 System design shall be based on open architecture for facilitating changes, expansion, and integration.

3.2 Safety of Flight Operations and System Reliability

The system should have maximum reliability from aviation operational point of view.
The system should include the following features:

- High sensitivity VHF receiver, required to share VHF channel
- Adaptive software able to share VHF channel
- High quality sensors in resolution and accuracy to be used.
- All Sensors should be reliable and corrosion resistant.
- Automatic generation of air traffic and weather reports
- Automatic generation of Error logs to track problems in the system.
- System should withstand harsh conditions and should have protective devices in-built sensors.

4. HARDWARE REQUIREMENTS

4.1 FIELD EQUIPMENT:

- Features and sensors specified in sections 1a and 1b:
- Collapsible frangible 6m wind mast with all installation accessories.
- Speech synthesizer for producing Audio messages to pilots
- VHF Transmitter (Operating at 118-150MHZ) with Omni directional antenna and required connectors, cables and accessories.
- Wireless VHF transmitter and receiver for communication directly with pilots, with method of monitoring status, signal strength, and radio
- UPS along with weather proof enclosure for minimum 1 week operation to maintain operation by solar under extended low light
-

4.2 INDOOR EQUIPMENT:

- No indoor equipment. No AC power or structures are available for any indoor equipment.

4.3 COMPONENTS OF THE SYSTEM

- 4.3.1ADVISORY & WEATHER SYSTEM:
- Wind mast, VHF transceiver, sensors and data logger. Wind mast is a 6m length collapsible and frangible with ICAO markings.
- Lightning protection and obstruction lights installed on the mast.
- Sensors capable of working under severe meteorological conditions such as heavy rainfall, lightning.
- Sensors shall have the ability to be removed or installed without affecting overall performance and calibration of the system.
- The sub- components are as follows:

4.3.2 SENSORS:

- Each weather sensor should be capable of monitoring parameters without manual intervention. Performance should be optimum for the entire range.

Latest Factory calibration certificate with traceability is to be provided from OEM for all the sensors.

4.3.3 VHF TRANSMITTER & RECEIVER

- **VHF radio transceiver should detect distant VHF communication by pilots and transmit clearly back to pilots.**
- **Receiver should be able to also periodically scan other frequencies such as aircraft emergency beacon detection.**
- **Power2 watts nominal**
- **Equal RF field strength 10 watts**
- **Sensitivity -100dbm or better**
- **Frequency 108-150* MHz AM**
- **Temperature Range -40 ° to 160 °F (-40 ° to 60 ° C)**
- **Extended VHF beyond 139 MHz, to accommodate military helicopter uses, if needed.**

4.3.4 WIND (DIRECTION & SPEED):

The sensor shall be of state-of-the-art design, high performance, rugged and corrosion resistant for trouble-free operation.
The range and accuracy specifications of this unit should be verified and information should be available upon request.

Direction:

- Range 0° to 360°
- Accuracy 1°
- Resolution 1° (0° to 355°)
- Operating temperature -40 ° to 160 °F (-40 ° to 60 ° C)
- Operating Humidity 0-100%

Speed :

- Range 2 to 150 mph, 2 to 130 knots
- Accuracy ±2 mph (2 kts, 3 km/h, 1 m/s)
- Resolution 1 mph (1 knot, 0.1 m/s, 1 km/hr)
- Operating temperature -40 ° to 160 °F (-40 ° to 60 ° C)
- Operating Humidity 0-100%

4.3.5 AIR TEMPERATURE:

- Range -50° to 140°F (-40° to 60°C)
- Accuracy ±1°F (±0.5°C) (typical)
- Resolution 1.0° or 0.1°F or 1.0° or 0.1°C Celsius
- Operating temperature -50° to 140°F (-45° to 60°C)
- Operating Humidity 0% to 100%

4.3.6 RELATIVE HUMIDITY

- Range -0-100° to 140°F (-40° to 60°C)
- Accuracy +/2%
- Resolution RH 1%
- Operating temperature -40 to 60° C
- The sensors shall be housed in a suitable radiation shield to ward off radiation effect.
- The sensors should be easily replaceable without loss of accuracy or need for calibration.

- Dew point should be provided, calculated based on standard hygrometric tables using air temperature and humidity.

4.3.7 ATMOSPHERIC PRESSURE:

- Two pressure sensors to be employed to cross check against each other, Pressure sensors shall be using solid state digital pressure transducer type sensor. The sensor shall have excellent hysteresis and repeatability and outstanding temperature & long term stability.

QFE (Station Level Pressure):

- Accuracy : ± 0.5 hPa or better
- Resolution: 1 hPa or better
- Range:650 hPa to 1050 hPa
- Operating temp: -20 to +60ºC

QNH is Computed using standard ICAO atmospheric table:

- Accuracy : ± 0.5 hPa or better
- Resolution: 1 hPa or better
- Range: 650 hPa to 1050 hPa
- Operating temp: -20 to +60ºC

4.3.8 VISIBILITY SENSOR MODULE

The Visibility sensor should be based on the leading design concepts and field proven.

This sensor should be capable of working in tropical and sub tropical climates.

Visibility: Visibility measurements should conform to standard requirements Factory

calibration certificate is to be provided from OEM.

Fully automatic operation, with excellent accuracy and stability.

Provision for calibration and compensation with suitable optical filters.

Visibility sensor should be suitable to work in tropical environment where excessive dust, smoke and other suspended aerosols present in the air. Sensor should have been installed in tropical region anywhere in the world.

Meteorological Optical Range (MOR)

- Range : 10 to 10,000 m or better
- Accuracy : ±2% for MOR up to 10,000 m

4.3.9 PRECIPITATION:

- Sensor should able to measure precipitation intensity and precipitation accumulation.
- Precipitation detection: Should be able to detect Precipitation in 10 minutes.
- Precipitation Intensity: 0.00 to 400mm/Hr.
- Precipitation accumulation: Unlimited.

4.3.10 WEATHER

Detection: Different types of precipitation like fog, mist, haze or clear; which may be calculated from other variables.
Reports: Fog, mist, haze, clear.

4.3.11 CLOUD HEIGHT/SKY CONDITION SENSOR :

The cloud height sensor should reliably distinguish the sky condition operationally important to aviation users.
Traditional Laser ceilometers are not required as they consume more power than available, and difficult to operate on Battery power.

Following are the general specifications of the sensor:

- Measurement of cloud height and sky condition may be based on laws of thermodynamics of atmosphere.
- The sensor should have a wide view of about 45 degrees above the horizon.
- Estimated height of the lowest layer affecting flight operations should be measured & displayed.
- The sensor should consume very less power so as to operate on battery / solar panel.
- It shall comprise built-in tests to determine fault in sub-system without the need for on-site trouble shooting.
- Subsystem shall be replaceable without the need for on-site calibration.

4.4 DATA LOGGER

4.4.1 General

Data Logger should process the raw data of sensors and should average the measurements as below:

- **Temperature** **:** 1 minute Average
- **Pressure** **:** 1 minute Average
- **Wind Speed** **:** Real-time over VHF, 2 minute average sent remote
- **Wind Direction** **:** Real-time over VHF, 2 minute average sent remote
- Gust, crosswind and wind shear are to be detected and Warning is to be generated real-time directly to pilots over VHF
- **Relative Humidity** : 1 minute Average
- **Precipitation** **:** Total per hour to be available
- **Visibility** **:** 10 minute averaging

4.4.2 Data Logger should employ following quality control procedures on raw data of each sensor.

Plausible value check (The gross error check on measured value): Each sample should be examined to check if its value lies within the measurement range of a particular station. If the value fails the check it is rejected and not used in the further computation of the relevant parameter.

Check on Plausible rate of change (The time consistency check on measured values).

This check is to verify the rate of change (unrealistic jumps in the values).

After each signal measurement, the current sample shall be compared to the proceeding one. If the difference of these two samples is more than specified limit then the current sample is

identified as suspect and not used for the computation of average. However it is still used for checking temporal consistency of sample.

Internal consistency check: This check is based on the relation between the parameters of the same system.

4.4.3 Data Logger Specifications:

4.4.3.1 Input Channels:

- Minimum 12 digital channels configurable to accept RS 232.
- Surge protection against lighting.
- Scan all channels at least once per second.
- Supply data to algorithms to generate METAR and reports.

4.4.3.2 Data retrieval

Suitable means to electronically collect and transfer the data from Airport.

4.4.3.3 Real time Clock

In-built RTC with drift less than ±1 minute/month – Provision to set the clock on daily basis automatic & manual and fully time synchronization with the server.

4.4.3.4 Operating power supply 12V DC and with automatic charging.

4.4.3.5 Power consumption

Less than 2A when operating, less than 50 watts maximum, to operate 100% from solar power.
Provision to save power during standby condition.

4.4.3.6 Operating Conditions

- Temp: -20to+55ºC
- Humidity: 5 to 100%RH
- Adequate protection against corrosion in saline atmosphere.

4.4.3.7 General Features:

- Micro-controller based modular design using state-of-the-art technology.
- Compact and light weight.
- Leak-proof internal rechargeable battery backup for data and set up retention in memory and for RTC.
- Provision to check calibration of data logger.
- Data quality checking as per afore mentioned clauses.

4.4.4 SOFTWARE / HARDWARE:

4.4.4.1 General Features:

Software should be adaptive to sharing existing VHF with many pilots. This intelligence aspect above and beyond basic weather sensing and reporting.

The open system architecture should be provided for suitable integration of various sensors and instruments installed at Runway site.

The Data Logger should have the following capabilities:

1) It should provide capabilities for background processes, which starts automatically when operating system is started.

2) Meteorological calculation & validation of incoming measurement data & should be able to derive additional variables (such as QNH, Dew Point etc) to be used by other services & end user application.

3) Validation, Data quality checks should be possible for the sensor data and diagnostic services for input / output system.

4) Auto Message generation of meteorological rep**orts e.g. METAR, etc.**

4.4.4.2 The Application/System Software in data Logger:

A. The Application/System Software in Data Logger Software license should be for lifetime of equipment. There should not be any hardware key or switch to enable / disable the software.

B. The software package should be designed to automatically collect, Process, Quality check, display, archive, format and report the environmental parameters necessary to support aviation operations.

C. The package should be user friendly and calculate the meteorological parameter like dew point from humidity and temperature.

D. Event monitor application shall be able to view the events generated by the processing unit and to acknowledge the alarm conditions. Data faults Includes

- Communication faults
- Sensor faults
- Missing data
- Value too high or too low
- Value higher or lower than airport operating maxima
- Value jumping too rapidly
- Value "frozen" within a small range of value

4.4.4.3 Data Manipulation and Storage:

The provision for performing number of statistical, arithmetic and logical calculation for the stored data should be available, such as

- Min/ Max calculations
- Averaging
- Unit conversion
- Scaling and offset
- Precision pressure elevation
- Cross wind/Track wind and wind rose.
- Marked discontinuity
- QFE to QNH
- Daily extreme values

Information to be available, and be derived from raw data used for message generation & display purpose.

Measured and calculated data as well as transmitted reports are required to be archived for a period one year. There should be web based data retrieval facility. A data back up facility also should be the part of the Data Logger system.

4.4.5 The bidder should give an undertaking that changes suggested by ICAO/WMO in method of reporting or format during the warranty period will be incorporated without any extra cost.

4.4.6 REMOTE COMMUNICATION

Data Logger should have facility to automatically send latest METAR messages as directed by PURCHASER, or APADCL / authorised website, as advised.

Arrangement should be made with the service provider for a period of 1 year.

4.4.7 Web Based remote monitoring system

A webbased monitoring system to monitor the health of various components of the AATAS. This system should also be able to monitor live data and derived products from AATAS, including weather sensors, batteries condition, and VHF transmitter and receiver operation.

4.4.8 Speech Synthesizer Unit

Speech synthesizer is a part of AATAS which receives METAR information from Data Logger and converts to speech output for broadcasting to Pilot via VHF Transmitter**.**

4.4.9 VHF transmitter and Receiver

- VHF Transmitter is a part of AATAS which receives speech output from data logger and modulates over carrier in VHF (118-150MHZ) and broadcasts via suitable omni directional antenna for a range of up to 50KM for flying heights of AIRCRAFT.
- Type and level of modulation, Transmitting Power, is chosen as suitable for reception of audio on cockpit of AIRCRAFT.
- VHF transmitter should have method for monitoring showing status of transmission, Transmitting Power, antenna performance, etc.
- VHF Transmitter should have one extra input channel with microphone for talking to pilot.
- Supplier should also provide a portable VHF tester / receiver for checking status of broadcasting from AATAS.

5. TRAINING to Appointed Authority Staff

The manufacturer/supplier should provide in-depth training to at least THREE persons, as designated by Purchaser / APADCL officers, as advised, in installation, operation and maintenance of the system, at mutually acceptable place.

6. COMPREHENSIVE WARRANTY

Warranty Maintenance: The supplier should provide a comprehensive warranty for one year from the date of satisfactory commissioning of the total AATAS system without any additional cost to the purchaser.

Any problem encountered in the system including field units like sensors, Data loggers, communication systems, UPS systems during this period shall be repaired / replaced by the firm free of cost.

6.1 EXTENDED WARRANTY

The bidder should also provide extended comprehensive warranty for FIVE years after the expiry of regular warranty.

The bidder should quote the price for extended warranty in list of deliverables.

Extended warranty charges should not be quoted as a percentage of project cost etc. but should be quoted as a lump sum amount for FIVE years.

Maintenance terms and condition will be similar to as those mentioned under warranty conditions.

Cost of freight delivery services for importing and exporting of defective parts/cards/sensors for repairs/replacement shall be borne by the supplier under extended warranty. The bidder shall give a separate undertaking for acceptance of the above terms.

The Extended warranty charges will be paid on yearly basis, only at end of a year after the satisfactory maintenance of the system by the supplier.

System will work in operational mode 24 x 7 x 365 days basis.

During the periods of warranty and extended warranty, the vendor should monitor system AATAS health on real time basis through Web based monitoring.

If any fault is observed with the system that cannot be corrected remotely, vendor should depute engineer, or local personnel to site, as soon as practically possible but within max 05 days, along with suitable spares tools and accessories for rectification of fault.

7. TESTING, INSTALLATION AND MAINTENANCE TOOL KIT

The supplier shall provide ONE set of maintenance tool kit required for installation and dismounting of EACH equipment.

8. DOCUMENTATION

The manufacturer should provide necessary operational, servicing and maintenance manuals.

9. COMPLIANCE/NON-COMPLIANCE STATEMENT

The tenderer shall submit a detailed item-wise compliance/non-compliance statement referring para-wise to the requirements given in this document, for quick evaluation of tender and for any future reference. The technical specifications and other requirements contained in this document are essentially required by the indenter. However, reasons for non-compliance, if any, for certain limited paras or even sub-paras of document may also be given by the tenderer. Silence on any part of the technical specifications will be treated as non-compliance. All non-compliance of specifications, even of small nature, should be clearly brought out.

10. RELIABILITY

The system design should have high reliability for overall performance and its automatic recovery in case of system failures and should have following features:

- Robust communication protocols – error detection & self-correction.
- Built – in test equipment & diagnostics.
- Extensive use of on-board transient protection
- Design for environmental extremes.

11. SPARES AND CONSUMABLES (Optional)

The manufacturer should submit a list of critical spares including sensors and components for operating these systems for a period of five years after the expiry of warranty period. However, this item will not be considered for price comparison. Prices should be quoted separately for this optional item.

12. TESTING AND ACCEPTANCE

Factory acceptance test (FAT) and site acceptance test (SAT) reports are to be provided.
The firm will submit FAT and SAT report as directed by Tenderer, or to the appropriate government department AS ADVISED.

13. INSTALLATION, SYSTEM INTEGRATION AND COMMISSIONING

Supplier/manufacturer should undertake the complete installation, and integration work on turnkey basis.

14. SPECIAL CONDITIONS TO TENDERERS

The bidder must be responsible for full compliance of the supply order as per RFP document like maintenance, servicing and supply of spares etc. All hardware must be quoted by bidder only, or by their partner/agent.

The bidder should provide a regular comprehensive warranty (for one year from the date of satisfactory commissioning of the AIRPORT systems) without any additional cost to the purchaser.

The bidder should also provide extended comprehensive warranty for FIVE years after the expiry of regular warranty. The bidder should quote the price for extended warranty in list of deliverables.

For the reason of Aviation safety, the system should be proven. The bidder should provide a list of clienteles where these systems are working at operational level for minimum THREE AERODROMES or HELIPORTS.

The manufacturer should provide certification reports for the Systems / sensors, if any, along with the technical bid.

DELIVERABLES:

Complete Turn-key supply, installation, testing and commissioning of FAA approved Advanced Air Traffic Advisory system at KURNOOL AIRPORT IN KURNOOL DISTRICT.

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FINANCIAL BID FORMAT

<to be submitted on bidders letter head with a covering letter>

Sl. No.	Work Component	Quantity	Rate per each in figures in	Rate per each in words
	For S.I.T.C./of Basic Airfield Ground Lighting Facilities at Kurnool Airport in Kurnool Dist.			
1.	Turn – Key S.I.T.C. of Airfield Lighting system along with Mandatory & Information signage. (Detailed break-up itemized sheet is required to be attached to justify cost)	1		
2.	Three year extended warranty with zero maintenance cost on airfield light system and mandatory, Informatory signage.	1		
3.	Turn-key S.I.T.C. of FAA approved Advanced Air Traffic Advisory System.	1		
4.	Five years extended warranty with zero maintenance cost on FAA approved AATAS system.	1		
	Grand Total all inclusive	**4**		

Spare part price list is required to be submitted for extended period beyond mandatory warranty period.

APADCL reserves the right to increase or decrease the quantity or delete any of the component. Total cost shall be compared on basis of equipment cost as quoted above.

Signature of bidder_ _____
Name _____
Date _____
Stamp of bidder:

***Note: The above items 1 & 2 included all the scope, deliverables and BOQ considered in conjunction with each other a payment will be done in proportionate the weightage of the individual item as per BOQ. The item sl.no.1 will be included as per the items of BOQ except AATAS. The BOQ is attached as "Annex-1".

SERVICE PROVIDER / MANUFACTURER'S AUTHORIZATION

< On Letter head and in Original >

Date:
Tender No.:
To:

WHEREAS_ _____ who are official manufacturers of _____ having factories at _____ do hereby authorize _____ to submit a Bid _____

in relation to the Invitation for Bids indicated above, the purpose of which is to

provide the following Goods, manufactured by us _____ and to subsequently negotiate and sign the Contract.

We hereby extend our full guarantee and warranty in accordance with the Conditions of Bid document/Contract, with respect to the Goods offered by the above firm in reply to this Invitation for Bids.

Name:
In the capacity of:
Signed:
Duly authorized to sign the Authorization for and on behalf of:
Date:
Stamp:

Format for Performance Security Bank Guarantee

BANK GUARANTEE / PERFORMANCE SECURITY
[To be executed on the stamp paper of appropriate value]

ANDHRA PRADESH AIRPORTS DEVELOPMENT CORPORATION LIMITED,
#10-2-1, 1st Floor, FDC
Complex, AC Guards
Hyderabad,
India -500028

WHEREAS:

A. **[_] ("Contractor") and the ANDHRA PRADESH AIRPORTS DEVELOPMENT CORPORATION LIMITED ("Authority") have entered into a Contract Agreement dated [_] ("Agreement"), whereby the Authority has authorised the Contractor to undertake the Supply, Installation, Testing & Commissioning of NIGHT LANDING FACILITIES and ADVANCED AIR TRAFFIC ADVISORY SYSTEM (AATAS) at Kurnool Airport in Kurnool District, in the State of Andhra Pradesh on DBFOT basis, subject to and in accordance with the provisions thereof.**

B. **The Agreement requires the Contractor to furnish a Performance Security to the Authority in a sum of Rs. [_] (Rupees [_] Crore) ("Guarantee Amount") as security for due and faithful performance of its obligations, under and in accordance with the Agreement, for a period of 21(twenty one) months from the issuance of L.O.A.**

C. **We, [_] through our Branch at [_] ("Bank") have agreed to furnish this Bank Guarantee by way of Performance Security in terms of the Performance Security.**

NOW, THEREFORE, the Bank hereby, unconditionally and irrevocably, guarantees and affirms as follows:

1. The Bank hereby unconditionally and irrevocably guarantees and undertakes to pay to the Authority, upon occurrence of any failure or default in the due and faithful performance of all or any of the Contractor's obligations or otherwise, under and in accordance with the provisions of the Agreement, on its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums upto an aggregate sum of the Guarantee Amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.

2. A letter from the Authority, under the hand of an Officer not below the rank of Chief Executive Officer that there is an amount due and outstanding from the Contractor, or the Contractor has committed default in the due and faithful performance of all or any of its obligations under and in accordance with the

Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations under the Agreement and its decision in this regard shall be final and binding on the Bank, notwithstanding any differences between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other authority or body, or by the discharge of the Contractor for any reason whatsoever.

3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/ or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.

4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.

5. The Authority has the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Agreement or to extend the time or period for the compliance with, fulfilment and/or performance of all or any of the obligations of the Contractor contained in the Agreement or to postpone for any time, and from time to time, any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions contained in the Agreement and/or the securities available to the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid, or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would, but for this provision, have the effect of releasing the Bank from its liabilities and obligations under this Guarantee, and the Bank hereby waives all of its rights under any such law.

6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Agreement or for the fulfilment, compliance and/or performance of all or any of the obligations of the Contractor under the Agreement.

7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee Amount and this Guarantee will remain in force for a period of 21 (twenty one) months from the issuance of L.O.A. of the Project and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee, no later than 3 (three) months from the date of expiry of this Guarantee, all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.

8. The Performance Security shall cease to be in force and effect after the expiry of a period of 21 months (twenty-one months) from the issuance of LOA. Upon request made by the Contractor for release of the Performance Security along with the particulars required hereunder, duly certified by a statutory auditor of the Contractor, the Authority shall release the Performance Security forthwith after the period of 3 (three) months from the date of expiry of this Guarantee.

9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalf of the Bank.

10. Any notice by way of request, demand or otherwise hereunder may be sent by post, addressed to the Bank at its above referred Branch, which shall be deemed to have been duly authorised to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course through post and in proving such notice, when given by post, shall be sufficient to prove that the Envelope containing the notice was posted and a certificate signed by an officer of the Authority that the Envelope was so posted shall be conclusive.

Signed and sealed this …… day of ……., 2019… at ……

SIGNED, SEALED AND DELIVERED

For and on behalf

of the BANK by:

(Signature)

(Name)

(Designation)

(Code Number)

(Address

<u>NOTES</u>:

(a) The bank guarantee should contain the name, designation, telephone number, email ID and code number of the officer(s) signing the guarantee.

(b) The address, telephone number and other details of the Head Office of the Bank as well as of issuing Branch should be mentioned on the covering letter of issuing Branch.

BANK GUARANTEE towards Advance Payment
[To be executed on the stamp paper of appropriate value]

ANDHRA PRADESH AIRPORTS DEVELOPMENT CORPORATION LIMITED,
#10-2-1, 1st Floor, FDC
Complex, AC Guards
Hyderabad,
India -500028

WHEREAS:

A. **[_] ("Contractor") and the ANDHRA PRADESH AIRPORTS DEVELOPMENT CORPORATION LIMITED ("Authority") have entered into a Contract Agreement dated [_] ("Agreement"), whereby the Authority has authorised the Contractor to undertake the Supply, Installation, Testing & Commissioning of NIGHT LANDING FACILITIES and ADVANCED AIR TRAFFIC ADVISORY SYSTEM (AATAS) at Kurnool Airport in Kurnool District, in the State of Andhra Pradesh on DBFOT basis, subject to and in accordance with the provisions thereof.**

B. **The Agreement requires the Contractor to furnish a Security to the Authority in a sum of Rs. [_] (Rupees [_]) ("Guarantee Amount") as Security towards the Advance Payment, under and in accordance with the Agreement, for a period of 18 months from the Signing of the Agreement.**

C. **We, [_] through our Branch at [_] ("Bank") have agreed to furnish this Bank Guarantee by way of Security for Advance as per the terms of the Agreement.**

NOW, THEREFORE, the Bank hereby, unconditionally and irrevocably, guarantees and affirms as follows:

1. The Bank hereby unconditionally and irrevocably guarantees and undertakes to pay to the Authority, upon occurrence of any failure or default in the due and faithful performance of all or any of the Contractor's obligations or otherwise, under and in accordance with the provisions of the Agreement, on its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums upto an aggregate sum of the Guarantee Amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.

2. A letter from the Authority, under the hand of an Officer not below the rank of Chief Executive Officer that there is an amount due and outstanding from the Contractor, or the Contractor has committed default in the due and faithful performance of all or any of its obligations under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful

performance of its obligations under the Agreement and its decision in this regard shall be final and binding on the Bank, notwithstanding any differences between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other authority or body, or by the discharge of the Contractor for any reason whatsoever.

3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/ or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.

4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.

5. The Authority has the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Agreement or to extend the time or period for the compliance with, fulfilment and/or performance of all or any of the obligations of the Contractor contained in the Agreement or to postpone for any time, and from time to time, any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions contained in the Agreement and/or the securities available to the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid, or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would, but for this provision, have the effect of releasing the Bank from its liabilities and obligations under this Guarantee, and the Bank hereby waives all of its rights under any such law.

6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Agreement or for the fulfilment, compliance and/or performance of all or any of the obligations of the Contractor under the Agreement.

7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee Amount and this Guarantee will remain in force for a period of 18 (Eighteen) months from the

   S i g n i n g of the A g r e e m e n t f o r t h e Project and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee, no later than 3 (three) months from the date of expiry of this Guarantee, all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.

8. The Security for Advance shall cease to be in force and effect after the expiry of a period of 18 months (eighteen months) from the signing of the Agreement. Upon request made by the Contractor for release of the Security for Advance along with the particulars required hereunder, duly certified by a auditor of the Contractor, the Authority shall release the Security for Advance forthwith after the period of 3 (three) months from the date of expiry of this Guarantee.

9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalf of the Bank.

10. Any notice by way of request, demand or otherwise hereunder may be sent by post, addressed to the Bank at its above referred Branch, which shall be deemed to have been duly authorised to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course through post and in proving such notice, when given by post, shall be sufficient to prove that the Envelope containing the notice was posted and a certificate signed by an officer of the Authority that the Envelope was so posted shall be conclusive.

Signed and sealed this …… day of ……., 2019… at ……

SIGNED, SEALED AND DELIVERED

For and on behalf

of the BANK by:

(Signature)

(Name)

(Designation)

(Code Number)

(Address)

<u>NOTES</u>:

(a) The bank guarantee should contain the name, designation, telephone number, email ID and code number of the officer(s) signing the guarantee.

(b) The address, telephone number and other details of the Head Office of the Bank as well as of issuing Branch should be mentioned on the covering letter of issuing Branch.

S. No.	Item No. (DSR/Non-DSR)	BOQ Item Description	UOM	Quantity	Rate	Amount
		Sub-Head 1 : Electrical Work (DSR based on 2016)				
1	DSR - 2016 8.1	Laying of one number PVC insulated and PVC sheathed / XLPE power cable of 11kV grade of following size direct in ground including excavation, sand cushioning, protective covering and refilling the trench etc. as required.				
1 (a)	DSR - 2016 8.1.1	Upto 120 sq. mm	Mtr.	500	273.00	1,36,500.00
2	DSR - 2016 8.2	Laying of one number additional PVC insulated and PVC sheathed / XLPE power cable of 11 kV grade of following size direct in ground in the same trench in one tier horizontal formation including excavation, sand cushioning, protective covering and refilling the trench etc. as required.				-
2 (a)	DSR - 2016 8.2.1	Upto 120 sq. mm	Mtr.	300	186.00	55,800.00
3	DSR - 2016 8.3	Laying of one number PVC insulated and PVC sheathed / XLPE power cable of 11 kV grade of following size in the existing RCC / HUME / METAL pipe as required.				
3 (a)	DSR - 2016 8.3.1	Upto 120 sq. mm	Mtr.	3200	37.00	1,18,400.00
4	DSR - 2016 7.1	Laying of one number PVC insulated and PVC sheathed / XLPE power cable of 1.1kV grade of following size direct in ground including excavation, sand cushioning, protective covering and refilling the trench etc. as required.				
4 (a)	DSR - 2016 7.1.1	Upto 35 sq. mm	Mtr.	3750	206.00	7,72,500.00
5	DSR - 2016 5.2	Earthing with G.I. earth pipe 4.5 meter long, 40 mm dia including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe etc. with charcoal /coke and salt as required.	Nos.	45	3,672.00	1,64,505.60
6	DSR - 2016 5.4	Earthing with G.I. earth plate 600 mm X 600 mm X 6 mm thick including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 meter long etc. with charcoal/ coke and salt as required.	Nos.	21	4,327.00	90,001.60
7	DSR - 2016 5.9	Supplying and laying 25 mm X 5 mm G.I strip at 0.50 meter below ground as strip earth electrode, including connection/terminating with G.I. nut, bolt, spring, washer etc. as required. (Jointing shall be done by overlapping and with 2 sets of G.I. nut bolt & spring washer spaced at 50 mm)	Mtr.	80	85.00	6,800.00
8	DSR - 2016 5.11	Providing and fixing 25 mm X 5 mm G.I. strip in 40 mm dia G.I. pipe from earth electrode including connection with G.I. nut, bolt, spring, washer excavation and re-filling etc. as required.	Mtr.	400	351.00	1,40,400.00

S. No.	Item No. (DSR/Non-DSR)	BOQ Item Description	UOM	Quantity	Rate	Amount
9	DSR - 2016 5.15	Providing and fixing 25 mm X 5 mm G.I. strip on surface or in recess for connections etc. as required.	Mtr.	40	129.00	5,160.00
10	DSR - 2016 5.16	Providing and fixing 8 SWG dia G.I. wire on surface or in recess for loop earthing as required.	Mtr.	32000	37.00	11,84,000.00
11	DSR - 2016 14.16	Supplying and laying of following size DWC HDPE pipe ISI marked along with all accessories like socket, bend, couplers etc. conforming to IS 14930, Part II complete with fitting and cutting, jointing etc..direct in ground (75 cm below ground level) including excavation and refilling the trench but excluding sand cushioning and protective covering etc., complete as required.				
11 (a)	DSR - 2016 14.16.3	120 mm dia (OD-120 mm & ID-103 mm nominal)	Mtr.	160	229.00	36,640.00
12	DSR - 2016 14.13	Providing, laying and fixing following dia G.I. pipe (medium class) in ground complete with G.I. fittings including trenching (75 cm deep) and re-filling etc. as required.				
12 (a)	DSR - 2016 14.13.1	50 mm dia.	Mtr.	2006	388.00	7,78,483.20
						34,89,190.40
		Sub-Head 2 : Supply of AGL materials				
13	NS/E/1	Supply of elevated type high intensity Runway edge light fixture suitable for 200W halogen lamp on 6.6A AC constant current series system complete with lense / filter, halogen lamp, reflector assembly, lamp holder, connecting lead, breakable coupling, base plate and all other accessories etc. as required and as specified.				
a)	NS/E/1 (a)	With clear filter	Each	80	16,000.00	12,80,000.00
b)	NS/E/1 (b)	With amber filter	Each	80	18,000.00	14,40,000.00
14	NS/E/2	Supply of inset type bidirectional high intensity Runway Threshold / End light fittings complete with lens holder, lens, clamping mechanism, prefocus lamp holder, 3x105 W halogen lamp, gaskets with suitable shallow base other accessories complete in all respect and in compliance with ICAO, Annex-14.	Each	12	68,200.00	8,18,400.00
15	NS/E/3	Supply of elevated type medium intensity omni directional taxiway/apron/turning pad light fixtures suitable for 45 W halogen lamp on 6.6 A AC constant current series system complete with blue lense, halogen lamp, lamp holder, connecting lead, breakable coupling, base plate and all other accessories etc. as required and as specified.	Each	30	6,000.00	1,80,000.00

S. No.	Item No. (DSR/Non-DSR)	BOQ Item Description	UOM	Quantity	Rate	Amount
16	NS/E/4	Supply of complete PAPI units ready for installation suitable for 200W halogen lamp alongwith leg assembly, 1.5 mtr. secondary lead, base plates, lamp including checking stick with base plates etc. as required.	Each	8	1,90,000.00	15,20,000.00
17	NS/E/5	Supply of clinometer required for calibration of PAPI units.	Each	1	1,20,000.00	1,20,000.00
18	NS/E/6	Supply of elevated type uni-directional high intensity Approach light fixture suitable for 200W halogen lamp on 6.6A AC constant current series system complete with lens / filter, halogen lamp, reflector assembly, lamp holder, connecting lead, breakable coupling, base plate and frangible mast and all other accessories etc. as required.	Nos.	40	18,000.00	7,20,000.00
19	NS/E/7	Supply of inset type 200W Runway Edge light fitting complete with bottom box and all accessories including halogen lamp, lens/ red filter, reflector etc. as required and as specified.	Each	6	80,000.00	4,80,000.00
20	NS/E/8	Supply of Guidance Sign Board of various sizes as per ICAO Annex.14 Vol.I (legends as approved by Engineer-in-Charge) made out of anodized 2mm thick Aluminium frame with suitable angle support with 1.5MM thick Al. backcover of 4MM thick polycarbonate sheet with glare free face, the letter & symbol should be made of self adhesive film of 3M applied on the inside face with required colouring, suitable arrangement shall be made for water tightness & locking arrangement, signboard shall be uniformly internally illuminated with required numbers of fluorescent tube lights to achieve illumination level operated on input source 2.5A to 6.6A constant current without flickering including supporting frangible legs & frame etc. complete as required and as specified.	Sq.mtr.	15	80,000.00	12,00,000.00
21	NS/E/9	Supply of 5000V, 50 Hz individual lamps series type isolating transformers encapsulated in polyester resin, finally moulded with neoprene rubber as specified in particular specifications of following ratings:				
a)	NS/E/9 (a)	300W, 6.6A / 6.6A	Each	12	12,265.00	1,47,180.00
b)	NS/E/9 (b)	200W, 6.6A / 6.6A	Each	90	5,600.00	5,04,000.00
c)	NS/E/9 (c)	100W, 6.6A / 6.6A	Each	4	5,000.00	20,000.00
d)	NS/E/9 (d)	45W, 6.6A / 6.6A	Each	40	4,500.00	1,80,000.00
22	NS/E/10	Supply of copper conductor PVC insulated, PVC sheath single core unarmoured anti termite and anti rodent treated UG cable for unearthed system of 5 KV grade conforming to IS 1554 Pt II as amended upto date and as specified in particular specifications of following sizes :				
a)	NS/E/10 (a)	1x 6 Sq.mm	Mtr.	48000	193.00	92,64,000.00
23	NS/E/11	Supply of control cables 10 core x 1.5 sq.mm solid annealed plain copper conductor PVC insulated, extended PVC inner sheathed, single layer of galvanised flat steel strip armoured and over all PVC sheathed with anti termite and rodent treated 1.1KV grade confirming IS 1554 Part-I amended upto date as required.	Mtr.	100	400.00	40,000.00

S. No.	Item No. (DSR/Non-DSR)	BOQ Item Description	UOM	Quantity	Rate	Amount
24	NS/E/12	Supply of control cables 6 core x 1.5 sq.mm solid annealed plain copper conductor PVC insulated, extended PVC inner sheathed, single layer of galvanised flat steel strip armoured and over all PVC sheathed with anti termite and rodent treated 1.1KV grade confirming IS 1554 Part-I amended upto date as required.	Mtr.	400	2,000.00	8,00,000.00
25	NS/E/13	Design, supply, installation, testing and commissioning of indoor type microprocessor based Constant Current Regulator suitable for remote as well as local control operations with 5 position brightness control for operation on input voltage 230 / 415 V, 50 Hz. AC supply as specified:				
a)	NS/E/13 (a)	30 KW, 6.6A output current	Each	4	5,50,000.00	22,00,000.00
b)	NS/E/13 (b)	7.5 KW, 6.6A output current	Each	2	4,30,000.00	8,60,000.00
c)	NS/E/13 (c)	7.5 KW, 6.6A output current with selector switch	Each	1	4,60,000.00	4,60,000.00
d)	NS/E/13 (d)	4 KW, 6.6A output current	Each	2	3,30,000.00	6,60,000.00
26	NS/E/14	Supply of non-frangible hinged Illuminated Wind Cone assembly complete as per ICAO standard and specification with LED red colour PVC dome obstruction marker light Aluminum casting, junction box with 4 nos. of lamps and shades duly fixed in windsock, duly fixed on bearings, including wind sock etc., installed on 75mm dia pipe as main pole, support and hinged base with bolts etc., complete as required.	Set	1	2,50,000.00	2,50,000.00
27	NS/E/15	Supply, Installation, testing and commissioning of Aerodrome Rotating Beacon 4x1000 W Type FAA L 802 A ACC. To ICAO Annex 14 Vol 1 PAR 5.3.3 complete with control panel all accessories.	Set	1	7,15,000.00	7,15,000.00
28	NS/E/16	Supply of ESNA connector kit set suitable for 6 sq.mm 5kV grade AFL copper conductor cable as required.	Set	539	400.00	2,15,600.00
29	NS/E/17	Supply of 2 core x 4 sq.mm. Secondary lead made out of multi stranded annealed copper conductor PCP sheathed unshielded anti-termite and anti-roddent treated 600 / 660 V grade cable as specified and as required.	Mtr.	500	300.00	1,50,000.00
30	NS/E/18	Supply of C.I. Housing Box along with top lead, round type, metal container of size 330 mm dia and 450 mm height made of 10 mm thick cast iron moulding all around, except the top surface which is 15 mm thick suitable to receive a light fitting base plate on top, having clear holes (for AFL cable entry) center 3" above bottom surface suitable to receive 1 no 50 mm dia GI Pipe & check nut as required. The box should have two Erath Bolts of M-10 x 30 mm welded inside near the cable entry hole on one side and having a drain hole at the bottom suitable tapped to receive 15 mm dia GI Pipee and having clear opening of 220 mm at the top surface and 6 nos M 10 tapped hole at the ceter 260 mm dia to receiv fitting base plate and bolts as required	Nos.	539	4,800.00	25,87,200.00

S. No.	Item No. (DSR/Non-DSR)	BOQ Item Description			UOM	Quantity	Rate	Amount
31	NS/E/19	Supply of following 1.1kV grade aluminium conductor extruded XLPE insulated PVC innersheath, GI wire/tape armoured specified and outer PVC sheathed cable of following specifications and sizes as per IS 7098 (Part -1) as required.						
(a)	NS/E/19 (a)	4 x 25 sqmm		Mtr.	100		160.00	16,000.00
(b)	NS/E/19 (b)	3.5 x 35 sqmm		Mtr.	100		183.00	18,300.00
32	NS/E/20	Design, supply, installation, testing & commissioning of LV Panel for operation on 415V, 50Hz, AC supply made out of 14 SWG CRCA sheet steel indoor type cubical fully compartmentalised, extensible on both sides, totally enclosed dust tight, vermin proof, standing on floor, complete with painting, internal wiring / connections bus bar of following capacity for all 3 phase with a separate bus bar for neutral connection & comprising of the following switchgear & accessories etc. as required. (A) TPN Al. bus bar 500 A (B) Incoming (a) MCCB 400 A, 4P with rotary machanism, 36 kA - 2 Nos. with eletromechanical interlocking. (b) Digital Voltmete - 01 No. (c) Digital Ammeter - 01 No. (d) Indicating lamp for R,Y,B and ON -2 Set Bus Coupler :- 1 no. 400A, 415V,4P MCCB with protection release alongwith indicating lamp. (C) Outgoings: (a) MCCB 80 A, 3P with rotary machanism, 36 kA - 4 No. (b) MCCB 20 A, 3P with rotary machanism, 30 kA - 3 No. (c) MCCB 16 A, 3P with rotary machanism, 16 kA - 3 No. (d) MCB 40A, SPN, C-Series, 10 kA - 3 No. (e) CT - For metering (f) Indication Lamps for R,Y,B and ON -13 nos. Note:- All the MCCB/MCB to be of thermal magnetic release having O/C, S/C & E/F protection.		Nos.	1		7,00,000.00	7,00,000.00
33	NS/E/21	Supply, installation, testing & commissioning of microprocessor based UPS system of 100 kVA rating at 0.8 pf true online UPS using PWM IGBT technology. 3-phase input 420V and input frequency 50 Hz, 3-phase out put fixed setting at 380, 415 and 430V.		No.	1		25,00,000.00	25,00,000.00
		~~Total of (Sub-Head 2 : Supply of AGL materials)~~						~~3,00,45,680.00~~
		Sub-Head 3 : Installation,Testing, Commissioning of AGL material						
34	NS/E/22	Installation, Testing and Commissioning of following elevated type Runway fittings including installation of Isolating transformer, making connection with secondary lead etc. as reqd.						

S. No.	Item No. (DSR/Non-DSR)	BOQ Item Description	UOM	Quantity	Rate	Amount
a)	NS/E/22 (a)	Runway edge lights/ Apron lights / Taxiway lights / Turning pad lights	Each	115	100.00	11,500.00
35	NS/E/23	Installation, Testing and Commissioning of following elevated type Runway fittings including installation of Frangible mast, Isolating transformer, making connection with secondary lead etc. as reqd.				
a)	NS/E/23 (a)	Approach lights (Simple Approach Lights / CAT -I)	Each	30	100.00	3,000.00
36	NS/E/24	Installation, Testing and Commissioning of following inset type Runway fittings including installation of Isolating transformer, making connection with secondary lead etc. as reqd.				
a)	NS/E/24 (a)	Runway edge lights / Runway end lights / Threshold lights	Each	12	5,000.00	60,000.00
37	NS/E/25	Installation of complete PAPI unit along with base plate including grouting of checking stick base plate with foundation bolts with 1:2:4 cement concrete, ground calibration, alignment with other PAPI units etc. as required.	Job	8	20,000.00	1,60,000.00
38	NS/E/26	Installation of CI Housing Box with a base concrete of 1:3:6 of size 630x630x100mm thick all around concrete of 1:2:4 150 mm thick, the top sloped with 1:2:4 cement concrete	Nos.	300	1,500.00	4,50,000.00
39	NS/E/27	Crimping/ fixing of Male/ Female ESNA type connectors on the existing 1x6 sq.mm. cables with rubber tape, PVC tape etc. complete in all respect as required.	Each	300	200.00	60,000.00
40	NS/E/28	Design, Supply, Installation of junction box made out of 14SWG M.S sheet containing control cable terminals of 10A suitable for 100 cores of 2.5 sqmm copper wire terminations and making connections of remote control cables etc. as reqd.	Job	1	18,000.00	18,000.00
41	NS/E/29	Design, Supply, Installation, Testing and Commissioning of remote control desk including switches made out of 14SWG M.S sheet suitable for 10 Nos. of ground lighting circuits including brilliancy control switches, on/off switches and indication lamps as per direction of Engineer- in - charge.	Job	1	4,00,000.00	4,00,000.00
42	NS/E/30	Installation, testing and commissioning of wind direction indicator i/c provision of its control panel for operation in local as well as remote control mode etc. as reqd.	Job	1	15,000.00	15,000.00
43	NS/E/31	Installation, testing and commissioning of Aerodrome Beacon light on the top of ATC building including its control panel for operation in local as well as remote control mode etc. as required.	Job	1	5,000.00	5,000.00
44	NS/E/32	Cutting kerf of suitable size including chipping, hammering, cleaning, drying etc., refilling the kerf with sealant material etc. as reqd. & laying following numbers of secondary leads:-				
a)	NS/E/32 (a)	01 No. Secondary lead of size 2x4 sq.mm.	Mtr.	300	1,000.00	3,00,000.00
45	NS/E/33	Numbering of Fittings.	Nos.	300	50.00	15,000.00

S. No.	Item No. (DSR/Non-DSR)	BOQ Item Description	UOM	Quantity	Rate	Amount
46	NS/E/34	Installation of guidance signboards of various sizes including installation of isolating transformer and providing secondary leads etc. including supply of all materials (except isolating transformer), including pedestal upto 1m all around the signage with 1:2:4 (cement, concrete, coarse) of thickness 100 mm with neat cement finish plaster, testing and commissioning etc. as required.	Sq.mtr.	15	5,000.00	75,000.00
47	NS/E/35	Supply, Installation, Testing and Commissioning of Airfield Lighting control Monitoring system with suitable UPS (for not less than 30 Min. support) , touch screen, LCD TV Monitor, CPU along with software, display of GLF at an Airport, suitable for interfacing with CCR, complete with all accessories viz 5 step touch control of brillancy selector, auxillary supply control termination with Supply, Installation, Testing and Commissioning of cable	Job	1	17,00,000.00	17,00,000.00
		etc. complete as required.				
		Total of (Sub-Head 3 - Installation,Testing, Commissioning of AGL				32,72,500.00
		material)				
51		Sub-Head 4 Supply Installation Commissioning and Training (SICT) of Frangible Windsock mast Unlid/Non Illuminated, ICAO and FAA L807 approved to	Unit	3	8,60,000.00	25,80,000.00
		the following specification:-				
51(a)		6M (to center stock) ICAO and FAA approved wind stock unit, complete with frangible GRP mast. 5.5m tall, 180mm dia coloured red and white(wrapped not painted to prevent weather damages), hinged at base plate and all treated againest				
		weather.				
51(b)		Stainless Steel Grade 316 extended swivel frame, complete with sealed bearings for				
		weather resistance.				
51(c)		100% weather proof polyster windstock with sizes 3.6m x 0.9m x 0.45m				
51(d)		Winch collar bolted around the Fangible Mast. Winch Tower with additional				
		Graound Rods, strap and winch Brakes.				
53		Supply installation Commissioning and Training (SICT) of Airport Rotating Beacon	Unit	1	14,60,000.00	14,60,000.00
		L802A to the following specifictions:				
		1.Patented belt drive system eliminates the lubrication maintanance required by				
		conventional gear-drive beacons				
		2. Patented liquid filled lamp connector, eliminating the slip rings and brushes				
		found on conventional beacons				
		3. Two 36000 lumens 400W metal halid lamps				
		4. 15000 hours typical lamp life				
		5. One clear lens, one green lens (Civilian Airports use)				
		6. Thermally protected motor eliminated burnouts				
		7. Lamp preset 5◦ above horizontal, adjustable.				
		8. 12RPM rotation, 24flashes/minuite(civilian)				
		9. Al new stainless steel fastners, plated steel parts				

S. No.	Item No. (DSR/Non-DSR)	BOQ Item Description	UOM	Quantity	Rate	Amount
		10. All new Teflon-coated wire weatherproof aluminium housing, powder coated international orange				
		Total of SH 4			9,920.00	40,40,000.00
		Total Amount of All Sub-Heads			Rs.	40847370.40

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