SECTION 120 000

AIRFIELD LIGHTING WORKS

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DIVISION 120 010: PARTICULAR REQUIREMENTS LUKLA

1.0 GENERAL

1.1 This provisions of **Division 120 010** are applicable to items of Airfield Lighting System (Aeronautical Ground Lighting System).

2.0 SCOPE OF WORKS

2.1 This Specification concerns the design (where applicable), manufacture and testing at manufacturer's premises, delivery to Site, carrying out all works, installation, testing at Site, training, setting in operation and handing over in perfect operating and running condition.

2.2 Works shown on the Drawings and not mentioned or described in the Specification, and works described in the Specification and not shown on the Drawings, will nevertheless be considered as included in this scope of Works and their execution will be deemed to be included in the Contract Price.

2.3 Integration of all Hardware required for installation and commissioning of AIRFIELD LIGHTING SYSTEM as detailed in the Technical Specification shall be the full responsibility of the Contractor. The quoted price shall be inclusive of all such costs and will be deemed to be included in the Contract Price.

2.4 Interfaces, equipment and accessories not specified in the Bid Document but found to be essential for full commissioning of the system shall be deemed to be included in the scope of Works and the full responsibility of the Contractor. The quoted prices shall be inclusive of all such costs and will be deemed to be included in the Contract Price.

2.5 Any matter not provided in the Specification shall be determined through consultation between the Engineer and the Contractor.

2.6 The Specification covers the following work items:

(1) Visual Alignment Guidance System (VAGS)
(2) Abbreviated Precision Approach Path Indicators (APAPI)
(3) Cable Ducts and Handholes
(4) Control and Monitoring System
(5) 3 kVA Generator Set
(6) 3 kVA Voltage Stabilizer
(7) LV Switch Board Panel
(8) Changeover Switch
(9) Constant Current Regulator

3.0 CODES AND STANDARDS

3.1 Characteristics of the airfield lighting shall, except when clearly indicated otherwise in the Specification, conform to the following ICAO Standards and Recommendations, Aerodrome Design Manual, Airport Services Manual, IEC International Standards and other related national or international regulations.

- Annex 14 Aerodromes (Fifth Edition – July 2009)
- Aerodrome Design Manual, Part 4 Visual Aids (Fourth Edition – 2004)
- Airport Service Manual, Part 9 Airport Maintenance Practices (First Edition – 1984)

3.2 Unless specified otherwise in this Specification, design, materials, manufacture, and testing of all works shall comply with the following Standards and recommendations;

ICAO	Aerodrome Design Manual, Part 5 Electrical Systems (1st Edition – 1983)
ICAO	Airport Services Manual Part 8 – Airport Operational Services
IEC	International Electrotechnical Commission Publications
ISO	International Organization for Standardization

3.3 Materials, devices and small parts may comply with the national or international authorized Standard prevalent in the country of manufacture. However, adequate modification shall be made for the point of interface with the facilities provided in accordance with relevant Standards and regulations.

4.0 DESIGN AND MANUFACTURE

4.1 All equipment and materials to be provided under this Specification shall be installed on the Site and shall be capable of working continuously under the conditions as specified.

4.2 The Contractor shall submit the design documents(where applicable) to the Engineer for approval within one hundred and twenty (120) days from the Commencement Date. The Engineer shall be advised if any change in design is found necessary after original approval is granted. The Engineer may require re-approval if they involve changes in concept, approach, quantity, size or weight, power requirements, performance.

4.3 LV Switch Board Panel for electrical power distribution equipment shall be provided with proper ventilation grilles, and these ventilation grilles shall be designed to ensure rodents will not enter into the cubicles.

4.5 Not less than 60 days prior to the shipment of the related equipment or structures, two final draft copies of installation instructions, drawings and maintenance and operation manuals shall be submitted to the Engineer for approval.

5.0 SPARE PARTS

5.1 General

(1) The following provisions are to be referred to in connection with this Specification.

(a) The Contractor shall supply spare parts sufficient for two (2) years normal operation of equipment.

(b) The Contractor shall assure the availability of spare parts of the same type or substitutes of equal or better quality for at least ten (10) years after the issue of the Defects Liability Certificate.

(c) The spare parts shall be supplied before the issuance of Operational Acceptance Certificate.

(d) Thus, during the one (1) year period after the Defects Liability Period, should any defect occurs which would require replacement of parts other than the spare parts recommended by the manufacturer, the Contractor shall supply as soon as possible the needed spare parts at his own expense.

(e) The quantity of spare parts shall be recommended by the manufacturer for the period as stated in para 5.2 below. The recommended quantity shall be approved by the Engineer who shall have the right to reject the quantity offered.

(f) All spares supplied shall be treated and packed for long storage under the climatic conditions prevailing at the Site. Each spare shall be clearly marked or labelled on the outside of its packing with its description and purpose and, when more than one spare is packed in a single case or other container, a general description of the contents shall be shown on the outside of such case or containers and detailed list enclosed. Also, containers and other packages shall be suitably marked and numbered for purposes of identification.

(g) All such cases, containers, cable drums or other packages are liable to be opened for such examination as the Engineer may reasonably require, and all such opening and subsequent repacking shall be at the expense of the Contractor.

5.2 Minimum Requirements

The Contractor shall supply as a minimum requirement, the spare parts listed below.

(a)	VGAS System	
	- Printed-circuit boards	1 no.
(b)	APAPI System	
	- Lamps	12 nos.
	- filters	1 no.
(d)	CCR	
	- Printed-circuit boards	1 no.

6.0 TOOLS AND APPLIANCES

6.1 General

(1) The following provisions are to be referred to in connection with this Specification.

(a) Tools and appliances necessary for normal maintenance shall be supplied by the Contractor.

(b) Each tool or appliance shall be clearly marked with its size and/or purpose where necessary.

(c) The tools and appliances with appropriate boxes shall be handed over to the Engineer prior to the issuance of the Operational Acceptance Certificate.

(d) The tools and appliances supplied for maintenance shall not be used for erection purposes.

(e) The Contractor shall supply effective and efficient tools and appliances to meet the recommendations for maintenance as set out in ICAO Airport Service Manual Part.9 (Airport Maintenance Practices).

(f) The scope of tools and devices for assembly and maintenance shall include all customary tools and all devices and tools which are specially made and/or required for complete assembling, dismantling, adjustment and maintenance of all equipment.

7.0 MEASURING EQUIPMENT

7.1 Measuring equipment necessary for normal maintenance shall be supplied but not limited to those specified in the relevant sections hereunder.

7.2 Measuring equipment with all necessary accessories for measuring shall be provided with adequate supply of spares and also including operation manuals.

7.3 Measuring equipment shall have sufficient measuring range and accuracy required by the respective system for which it is intended.

7.4 Measuring equipment except for the stationary type shall be easy to transport. If the weight of the measuring equipment is such that it cannot conveniently be carried, suitable hand carts with steerable rubber-tired wheels shall be supplied.

7.5 All measuring equipment to be used on AC shall be suitable for 50Hz, 230V, single-phase two-wire circuits and be capable of satisfactory operation within voltage variation of ±10%.

7.6 All measuring equipment necessary for installation and testing shall be arranged by the Contractor in addition to the measuring equipment for normal maintenance.

7.7 The Contractor shall supply effective and efficient measuring equipment to meet the recommendations for maintenance as set out in ICAO Airport Services Manual Part 9 – Airport Maintenance Practices, Preventive Maintenance of Illuminated Visual Aids.

8.0 EQUIPMENT REQUIREMENTS

8.1 Screw Thread

All bolts, nuts and screws shall conform to the metric thread of ISO (International Organization for Standardization)

8.2 Cleaning and Painting

(1) All bright metal parts shall be covered before shipment with an approved protective compound and protected adequately during shipment to the Site. After erection these parts shall be cleaned with a correct solvent and polished bright where required.

(2) All metalwork which is normally painted after manufacture, except where finish

painted, galvanized or polished in the factory, shall be well brushed down and given one coat of red lead paint before shipment.

(3) All parts which will ultimately be buried in concrete shall be cleaned and protected before leaving the factory by approved method. Before being built in they shall be thoroughly descaled and cleaned of all rust and adherent matter by the used of strong wire brush.

(4) Exterior surface of metal-enclosed switchgear and control-gear (metal-enclosed type, cubicle-type), cabinets, switch box, transformer box, etc. shall be given one prime coat, one undercoat before assembling and two finish coats at factory, as follows.

(a) Before prime coat, oil or grease shall be removed with benzine or other solvent and scale, rust and other foreign substance on the surface shall be thoroughly cleaned by sandblasting or bonderizing.

(b) For prime coat an anti-corrosive paint shall be used. The dry film thickness of coating shall be not less than 0.02mm and the coating weight shall be not less than 0.14kg/m².

(c) The coating weight of oil putty shall be decided in accordance with the surface condition of the prime coat. The coating weight of filling shall be not less than 0.15kg/m² for each coat.

(d) The dry sanding with paper shall be applied after putty. The dry film thickness of under coat shall be not less than 0.02mm and the coating weight shall be not less than 0.14kg/m².

(e) The coating weight of finish coat shall be not less than 0.12kg/m² for each coat and the dry film thickness of finish coat shall be not less than 0.035mm.

(5) Interior surface of metal-enclosed switchgear and control-gear (metal-enclosed type, cubicle-type) cabinet, switch box, transformer box, etc. shall be given one prime coat before assembling and two finish coats at factory, as follows:

(a) Before prime coat, oil or grease shall be removed with benzene or other solvent and scale, rust and other foreign substance on the surface shall be thoroughly cleaned by sandblasting or bonderizing.

(b) For prime coat an anti-corrosive paint shall be used.

(c) The dry film thickness of coating shall be not less than 0.02mm and the coating weight shall be not less than 0.14kg/m².

(d) The coating weight of finish coat shall be not less than 0.12kg/m² for each coat and the dry film thickness of finish coat shall be not less than 0.025mm.

8.3 Rating Plates and Labels

(1) Each main and auxiliary item of equipment shall have permanently attached to it in a conspicuous position a nameplate and/or a rating plate of incorrodible material upon which shall be engraved identifying name, date of manufacture, type or serial number together with details of the conditions under which the item in question has been designed to operate, and such diagram plates as may be required by the Engineer.

(2) All equipment and cubicle doors shall be labelled in an approved manner to indicate the service provided.

(3) Labels or appropriate identification marks shall also be provided to identify all items of equipment or parts, and where applicable current ratings of fuses and setting of relays, etc.

(4) Warning labels with red lettering shall also be provided on covers over equipment carrying high tension voltage, as directed by the Engineer.

(5) The inscription of all nameplates, labels shall be in English and identification marks shall be in English and clearly designate the service or rating of the particular equipment. Such nameplates or labels shall be of non-hydroscopic material with engraved lettering or a contrasting colour or, alternatively, in the case of indoor switchgear, etc., of transparent plastic material with suitably coloured lettering engraved on the back.

(6) All labels shall be attached to equipment by means of adhesive material or of machine screws and nuts, machine screws in drilled and tapped holes. Wherever practicable, identifying signs shall be provided by means of engraving or printing directly on the body of equipment.

8.4 3 kVA Generator Set

(1) The generator shall be air cooled engine and Petrol- Start, Kerosene Run Type with:

Output Voltage:	230 V, 50 Hz
Rated power:	3 kVA

8.5 3 kVA Voltage Stabilizer

(1) The Voltage Stabilizer shall have the following features:

Output Voltage:	230 V, 1-phase
Input Voltage Range:	160 – 250 V
Power Rating:	3 kVA
Regulation:	± 1%

8.6 LV Switch Board Panel

(1) The LV Switch Board Panel shall be constructed with 1.5 mm thick sheet metal and it shall be fitted and wired with the following:

Incoming – 1 x 30 A SPN MCB
Outgoing- 3 x 10 A SPN MCB
Earth Link
Neutral Link
Indicator Lamp for Incoming Supply

8.7 Changeover Switch

(1) The Changeover Switch shall have the following features:

Current Rating:	30 A
Voltage Rating:	600 V AC

No. of Pole: 2 pole
Operation: Manual

8.8 Electrical Power Equipment

(1) The electrical panels shall be of self-contained cubicle type, floor standing, with a full front face door, and/or rear access, with cable entry from the bottom.

(2) Adequate ventilation shall be provided to enable the equipment to operate continuously under the local ambient temperature designated hereinabove, and the same time care should be taken into account of rodents.

(3) Precautions shall be taken to prevent overheating through hysteresis and eddy current loss.

(4) All electrical equipment shall be provided with a suitable grounding terminal.

(5) All control panel wiring and secondary control wiring in circuit breakers, control gear and the like shall be made in a neat and systematic manner, with cables supported clear of the panels and other surfaces at all points to obtain free circulation of air.

(a) Wiring shall be colour-coded as follows:
Green : Grounding
Yellow : All wiring other than grounding circuit

(b) All small wiring ends shall be marked to discriminate the circuits, voltage, current, fault circuit, etc.

(6) The miniature circuit breakers (MCB) shall be manually operated, trip free mechanism with electromagnetic or thermal-magnetic type tripping element.

8.9 Grounding Systems

(1) Generally

(a) The lighting protection for underground cables is specified in para. 13.11 herein after.

(b) The light fittings, secondary cables and secondary wires of isolating transformers shall be grounded for lightning protection.

(c) The grounding system shall be provided properly for safeguard to the person, equipment, light unit, and fitting, etc.

(d) The grounding of equipment shall be made mechanically and electrically to ensure the continuous system, and shall be conductive.

(e) The common grounding counterpoise wires of the grounding system and lightning system shall be used for light fitting and light units.

(2) Common Grounding Wires

The lightning protection wires shall be installed above underground cables and power cables for linked circuits.

(3) Grounding Wires

(a) The grounding wires to be used in this work shall be manufactured and tested in accordance with the appropriate standards authorized in the country of manufacture or equivalent thereto.

(4) Light Units

The grounding of the VAGS and APAPI shall be made by connecting 8 mm² 600 volts PVC insulated wire with the grounding terminal of each light unit to the main common grounding wires.

(5) Equipment

(a) Common grounding wire shall be installed in the cable pit. The wire shall be connected to copper grounding rods and shall also be connected with the grounding terminal of equipment.

(b) The copper grounding rods shall be installed underground to a depth of not less than 1.0m. Grounding resistance of the system as a whole shall not exceed 5 ohms.

9.0 CIVIL WORKS

9.1 General

(1) This work shall be applied for the installation of mounting light bases, handholes, foundations,and outdoor cable trench.

(2) Foundations for equipment shall be sufficient size and thickness as recommended by the equipment manufacturer.

9.2 Excavation and Backfill Work

(1) The depth and width of excavation shall be minimum for the installation of above facilities. The bottom plane of excavation shall be flat.

(2) Excavated material may be used for backfill provided it is free of stones and other objects that can cause cable damage. Backfilling shall be put in horizontal layers not to exceed every 250 mm in depth, and shall be compacted to the satisfaction of the Engineer.

9.3 Concrete Works

(1) Reinforcement Work
Reinforcement steel bar for the Concrete Chamber for Isolating Transformer/Concrete Chamber for Lightning Arrester shall be fabricated and installed in accordance with the size and shape indicated in the drawing. Reinforcement steel bar for other blocks and foundations which are not shown in the drawing shall be fabricated as per recommendation of Manufacturer of the equipment.

(2) Material

Only approved materials, conforming to the requirements of these specification shall be used in the work.

(3) Forms and Finishing

Form shall be made of wood or steel. Obtain Engineer's approval of form before placing concrete. The surface of the top of concrete blocks and cover of chambers shall be made smooth.

All holes left by insertion of PVC pipes or earthing wire in the Concrete Chamber for Isolating Transformer/Concrete Chamber for Lightning Arrester shall be filled with cement mortar.

(4) Dimensions

Dimensions of Concrete Chamber for Isolating Transformer may change subject to prevailing site conditions.

(5) Sample

A Sample Concrete Block for Light fittings, Concrete Chamber for Isolating Transformer including covers, handholes shall be made and approval shall be obtained from the Engineer before proceeding with further construction.

10.0 TESTS AND INSPECTION

10.1 General

(1) The following provisions are to be referred to in connection with this Specification.

10.2 Scope of Testing

(1) The Contractor shall perform all the test activities specified in this Sub-Section.

(2) The Contractor shall prepare and submit, at least twenty eight (28) days) prior to any test carried out by the Contractor, two sets of detailed test procedures and schedules to the Engineer for consideration and approval. Test procedures shall be comprehensive and shall demonstrate equipment hardware compliance with all the requirements of this Specification.

(3) The entire work to be executed by the Contractor is subject to inspection and test by the Engineer during manufacturing, installation and on completion at the Site, but the approval of the Engineer or the passing of any such inspection or test shall not, however, prejudice the right to reject the items of equipment if they do not comply with the Specification when installed.

(4) Test items are shown as follows:

(a) Tests at factory by the Contractor himself
(b) Witness test at factory
(c) Tests at the Site during construction
(d) Commissioning tests
(e) Flight tests

(5) The Contractor should carry out the tests according to the following Tables 1 to 2

Table 1 Test Item for Airfield Light Fittings

Detail \ Test Item	1	2	3	4	Standard
Composition Test (Quality)	●	●			Approved Shop Drawings
Appearance & Structure Test	●	●			- Ditto -
Dimensional Test	●	●			- Ditto -
Photometric Test	●	●			- Ditto -
Continuous Operation Test (Temperature Rise Test)	●	●			Relevant Specification
Waterproof Test	●	●			Relevant Standard
Insulation Resistance Test	●	●	●	●	Relevant Specification
Dielectric Test	●	●			- Ditto -
Alignment Test			●	●	Document for Test and Inspection
Operation Test			●	●	- Ditto -

Test Item 1 Test at factory by the Contractor himself.
2 Witness test at factory.
3 Test at the Site during construction.
4 Commissioning test.

Sample size for test shall be decided with agreement between the Employer and the Contractor before factory test.

Table 2 Test Item for Constant Current Regulator

Detail \ Test Item		1	2	3	4	Standard
Composition Test (Quality)		●	●			Approved Shop Drawings
Appearance & Structure Test		●	●	●		- Ditto -
Dimensional Test		●	●			- Ditto -
Photometric Test		●	●			- Ditto -
Operation Test	1) Transitional Response Test	●	●			- Ditto -
	2) Soft-starting Test	●	●			- Ditto -
	3) Brilliancy Tap Changing-over Test	●	●	●	●	- Ditto -
	4) Protective Device Test	●	●	●	●	- Ditto -
	5) Overall Operational Test	●	●	●	●	- Ditto -
Insulation Resistance Test		●	●	●	●	Relevant Specification
Dielectric Test		●	●			Relevant Specification
Temperature Test		●	●			Relevant Specification

Test Item 1 Test at factory by the Contractor himself.

2 Witness test at factory.
3 Test at the Site during construction.
4 Commissioning test.

Sample size for test shall be decided with agreement between the Engineer and the Contractor before factory test.

10.3 Documents for Tests and Inspection

(1) Before execution of test and inspection, the Contractor shall prepare and submit the following documents to the Engineer for his approval:

(a) Complete description in writing about procedure of tests at the factory.
(b) Complete description in writing about procedure of tests at the Site.
(c) Complete description in writing about procedure of commissioning tests at the Site.

(2) Certified readings and data of all tests to be carried out by the Contractor shall be submitted to the Engineer from time upon completion of each test and the Contractor shall prepare additional four (4) copies of complete set of these test data bound in book form for submission at the time of the commissioning test.

10.4 Factory Tests

(1) Factory tests shall be made by the Contractor on specific items of equipment to demonstrate that the equipment complies with applicable specifications and, additionally, any test called for by the Engineer to ensure that the equipment to be supplied meets the requirements of the Specification. The methods of testing of equipment not covered by any specification or applicable Standards shall be agreed with the Engineer.

(2) The Engineer/Employer shall be given the option of witnessing all tests. When the equipment is ready for inspection or test, the Contractor shall give notice to the Engineer together with the data of tests done by himself.

(3) The results of factory tests shall be recorded for submission to the Engineer, copy furnished to the Employer, prior to the shipment of the equipment item.

(4) The test report shall contain the information specified below:

(a) Indicate the performance of each equipment under the test and whether it meets the system limits.
(b) A record of any engineering changes necessary to correct design deficiencies.

(5) The suitability of diagnostics and technical manuals provided by the Contractor and their capability of off-line failure isolation and its repair shall be proved by the Contractor.

(6) The Contractor shall include all the costs required for such factory test mentioned below:

(a) Number of person to be dispatched from the Employer: One (1) persons (maximum).

(b) Round trip air ticket between Kathmandu and manufactures/supplier’s

country.

(c) Accommodation.

(d) Local transportation and daily subsistence allowance sufficient to cover daily basic requirements..

(e) Time period: Total 7 days including travel.

10.5 Tests at Site during Construction

During the course of installation, the Engineer shall have full right for making tests and inspection for the work, as he may deem necessary always with the participation of the Employer's personnel in all tests at Site if so requested by the CAAN for the purpose of on-the-job training. In this case, the Contractor may have part of the tests conducted by such personnel but shall assume final responsibilities for test results.

10.6 Commissioning Tests

(1) Commissioning tests of the system shall be carried out after it has been installed and tested. No commissioning test shall be commenced without prior approval of the Engineer to the schedule and procedure which are to be followed. At least ten (10) working days' notice of the Contractor's readiness to start each site test shall be given to the Engineer.

(2) The Contractor shall conduct the commissioning tests which, however, shall be carried out under the direction of the Engineer.

10.7 Reliability Tests

(1) When the Contractor considers that the installations are ready for commercial service, the Engineer shall be notified accordingly after the commissioning tests. When the Engineer agrees that the Works are ready for commercial service, each system will be required to operate under the working conditions, either continuously or intermittently as may be convenient, without failure or interruption of any kind for a period of not less than fifteen (15) days.

(2) The system shall be operated by the Employer's staff during the reliability test period, but the Contractor will be allowed to make any minor adjustment which may be necessary, provided that such adjustments do not in any way interfere with, or prevent commercial use by the Employer.

10.8 Flight Checks

(1) Actual location of APAPI units and setting angle shall be decided after detail survey of site and determination of operational requirement of setting angle in consultation with pilots. The commissioning of APAPI system will be done only after checking the system by the regular flights in Lukla Airport.

(2) The Contractor may use for this at the Site the measuring equipment supplied by him under the Contract with permission of the Engineer, provided that such equipment be restored to its original condition at the time of commissioning tests.

10.9 Retest

Should the systems or any portion thereof fail under test to give the performance required, then any further test(s) which may be considered necessary by the Engineer shall be carried out in a similar manner, but the whole cost of the repeated test(s) shall be borne by the Contractor.

10.10 Rejection

If any item fails to comply with the requirements specified in the Specification in any respect whatsoever at any stage of manufacture, test, erection or on final completion, the Engineer may reject the item or defective component thereof, whichever is considered necessary, and after adjustment or modification as directed by the Engineer, the Contractor shall submit the item for further inspection and/or test. In the event of the defect of any item being of such a nature that the requirements in the Specification cannot be fulfilled by adjustment or modification, such item is to be replaced by the Contractor at his own expense, to the entire satisfaction of the Engineer.

11.0 TRAINING OF PERSONNEL

11.1 General

(1) The following provisions are to be referred to in connection in this section.

11.2 Phases of Training

(1) The Contractor shall conduct training for technical personnel who will operate and maintain the system equipment supplied under this Contract.

(2) Training for equipment operation and the maintenance of the equipment and systems shall be provided as specified herein in phases as follows:

(a) Factory training.
(b) Local training.

(3) All training shall be conducted in English language and be suitable for trainees with the appropriate level of education. A detailed programme for all training shall be submitted to the Engineer not later than fifty-six (56) days before any training is started.

(4) The Contractor shall update, if deemed necessary by the Engineer, the detailed programme under the Contract not later than twenty-eight (28) calendar days before the date when the Contractor intends to start the programme.

(5) The Employer shall nominate candidates for the trainees whose qualification shall be subject to examination by the Contractor. The Contractor shall reserve the right to reject any or all the candidates deemed disqualified and to request the Employer to nominate other candidates.

(6) The Employer shall have the trainees qualified by the Contractor be ready and available for the training in accordance with the said programme.

11.3 Factory Training

(1) Factory training of the Employer’s trainees shall be conducted in the manufacturer’s

country before shipment.

(2) The Contractor shall include all the costs required for such training mentioned below:

(a) Maximum number or persons to be dispatched from the Employer one (1) persons in the field of Airfield Lighting.
(b) Round trip air ticket between Kathmandu and manufacturer's country.
(c) Accommodation
(d) Local transportation and daily subsistence allowance sufficient to cover daily basic requirements.
(e) Time Period: Total 14 days including travel.
(f) Training subjects shall include the following:
VAGS, APAPI, CCR, Remote control and Monitoring System.

11.4 Local Training(at Site)

(1) Training facilities shall be provided by the Contractor.

(2) Maximum number of trainees to attend the course for theoretical and practical training shall be four (4) persons .

(3) The duration of the course both for theoretical and practical shall be at least the duration mentioned below :

Course	Course Duration
Lighting & Cables, CCR, Control and Monitoring	2 days

(4) The Contractor shall include the cost of instruction for the above mentioned courses and training manuals and material to be used in the courses, in his unit rates or lump sum prices, unless identified separately in the Bills of Quantities.

(5) Travel cost and daily allowance for trainee will be borne by CAAN.

12.0 OPERATION AND MAINTENANCE MANUALS

12.1 General

(1) The following provisions are to be referred to in connection with this Specification.

12.2 Draft Manuals

The draft manuals to be submitted shall include, as a minimum, the following:

(a) Introductory material stating the model or type designation, the equipment purpose, and any appropriate general descriptive information.

(b) Preparation for use – any special unpacking and assembling requirements shall be explained. Essential installation instructions, such as foundation requirements, plumbing or electrical connections, power requirements and initial lubrication, servicing and inspection instructions shall also be explained.

(c) Operating Instructions – as applicable to the equipment, operating instructions shall include but not be limited to : preliminary adjustment and control settings, starting and stopping the equipment, operation, etc.

(d) Cleaning and lubricating.

(e) Trouble-shooting.

(f) Preventive maintenance.

(g) Test equipment.

(h) Parts list, (including component and parts layout)

(i) Maintenance record log forms and check lists for daily, weekly, monthly, semi-annually and annually.

(j) Service life (year or hours) of equipment and main parts and devices.

13.0 CABLE WORKS

13.1 General

(1) Airfield lighting power and control cables shall be installed in ducts, conduits, and pits and on cable racks. Counterpoise wire and underground cable marker sheet shall be installed in the trench of cable ducts.

(2) The cable conductor size in the Specification and on the Drawings are given in mm or mm^2.

(3) Cable length per cable drum shall be less than 1000 meter, and total weight of cable and drum shall be less than 5 tons, for easy transportation. The Contractor shall submit AFL power cable length list to the Engineer for approval before manufacturing.

(4) Where cable end projects from a drum they shall be adequately protected to prevent damage during handling and transportation, and a thick PVC wrapper (cap) shall be placed over the cable to prevent the ingress of dirt, dust and grit, etc.

(5) Each drum shall bear a distinguishing number which is branded with hot iron or neatly chiselled on the outside of one flange. A painted marking shall not be accepted.

(6) Particulars of the cable, i.e. type of cable, rated voltage, length, conductor size, number of cores, gross and net weights, as well as position of cable end, manufacturer's name and year and month of manufacture shall be clearly shown on the drum. The direction of rolling shall be indicated by an arrow.

13.2 Underground Series Circuit Cable (Primary Cable)

(1) Airfield lighting primary cable shall be manufactured as per this specification.

(2) High voltage series circuit cables (primary cable) to be used in the Works shall comply with ICAO Aerodrome Design Manual, Part 5 and the specification of

primary cable shall be as follows:

Type of Cable:	Cable with screen
Type of Screen:	Copper Tape
Type of Outer Sheath:	XLPE(Cross linked polyethylene)
Conductor:	Stranded copper
Inner Core Cross section:	6 mm²
Rated voltage:	5KV
Semi-Conductor:	Extruded
Insulation Resistance:	as per ICEA standards

13.3 Extension Cables (Secondary Cables)

(1) The cable for airfield lighting secondary circuit shall comply with ICAO Aerodrome Design Manual Part 5. The specification of AFL Secondary Cable shall be:

Type of cable:	Two core cable
Type of outer sheath :	Black Elastomer
Conductor:	Stranded copper
Cross Section:	$3.5mm^2$
Inner sheath:	Blue and Brown Elastomer
Rated Voltage:	600 Volt

(2) The secondary cables shall be provided either with a factory moulded receptacle or factory moulded plug, depending upon their location.

13.4 Plugs and Receptacles

(1) Specification of Plugs and receptacles for the Primary Cable shall be as follows:

The Primary Cable Connector Kit shall comply with FAA Specification for L – 823, Class B, AC No. 150/5345-26D Plug and Receptacle Cable Connectors. The connector kit is to be used with primary cable with screen shall be suitable for termination on primary cable as specified above. The connection shall be made by using pins and sockets made of tinned copper to be crimped on the 6 mm² conductor. The kits shall also contain a special device allowing the continuity of the cable screen. The external housing shall be filled with Silicone Grease for water repellent and insulation. The specification of Primary Connector Kit shall be as follows:

Rated Current:	25 Amps
Rated Voltage:	5 kV
External Housing:	Thermoplastic Elastomer
Plug:	FAA Class B, Type I, Style 3
Receptacle:	FAA Class B, Type I, Style 10

(2) Specification of Plugs and receptacles for the Secondary Cable shall be as follows:

The Secondary Cable Connector kit shall comply with FAA: L-823 Class B, AC 150/5345-26D Plug and Receptacle Cable Connectors and shall be suitable for termination on secondary cable as specified above. The

specification of AFL Secondary Connector Kit shall be:

Current Rating:	20 Amp
Voltage Rating:	600 Volts
Housing :	External housing in thermoplastic elastomer
Plug:	FAA Class B, Type II, Style 5
Receptacle:	FAA Class B, Type II, Style 12

(3) The plug and receptacle shall be watertight and will withstand continuous use under the designed ambient temperature range. The connector plug and receptacle shall resist a pulling force equal to a static weight of 5 kg without becoming disconnected. All plugs and receptacles shall be identical and of uniform manufacture.

13.5 Isolating Transformer

(1) The types and characteristics of the isolating transformer to be supplied shall be as as specified below:

The Isolating Transformer shall comply with ICAO recommendations of Aerodrome Design Manual, Part 5 with FAA L-831 AC 150/5345-47B. It shall have two copper windings (primary and secondary) wound separately on a magnetic core circuit. One side of the secondary winding shall be connected to an external earthing terminal for its connection to the earth. It shall be completely moulded in thermoplastic elastomer, with excellent electrical and mechanical properties, and resistance to oils, kerosene, other aircraft fuel, acids and alkalis. A water resistant protective cap shall be supplied that protects the isolating transformer lead connectors mating parts from both moisture and dirt during shipping and handling.
The specification of Isolating Transformer shall be:

Nominal Rating in Watts:	100 W
Primary Current Rating:	6.6 Amps
Secondary Current Rating:	6.53-6.67 Amps
Maximum Primary voltage:	5KV
Frequency:	50 Hz
The Primary Leads:	FAA Class A, Type I, Style 2 **Plug,** 60 cm long (**Note**: This Plug is to be connected with primary cable having FAA Class B, Type I, Style 10 Receptacle with Earth Continuity Device) FAA Class A, Type I, Style 9 **Receptacle**, 60 cm long (**Note**:-This Receptacle is to be connected with primary cable having FAA Class B, Type I, Style 3 Plug with Earth Continuity Device)
The Secondary Lead:	FAA Class A, Type II, Style 8 Receptacle,

120 cm long
(Note:-This Receptacle is to be connected with FAA Class A, Type II, Style 1 Plug or FAA Class B, Type II, Style 5 Plug)

(2) All isolating transformers shall be suitable for use on series circuits with a current of 6.6 amperes.

(3) All isolating transformers shall be completely waterproof, shall withstand continuous use under the designated ambient temperatures and shall be suitable for burying in the ground or setting in transformer boxes, as required. Each transformer shall be completely sealed.

(4) Two primary lead cables and one secondary lead cable shall be attached to the isolating transformer.

(5) Isolating transformers shall show rating information. The Contractor shall examine necessary length of the secondary lead cable in consideration of the overall height of light.

13.6 Power and Control Cables

(1) All power cables of parallel circuit, as well as all control cables to be used in the Works shall be manufactured and tested in accordance with the following Standards:

IEC - International Electrotechnical Commission
ICEA - Insulated Cable Engineers Association, U.S.A.

(2) All power cables, except where otherwise specified, shall be cross-linked polyethylene insulated and polyvinyl-chloride sheathed cables (CV cable).

(3) All control cables, except where otherwise specified, shall be polyvinyl-chloride insulated, polyvinyl-chloride sheathed control cables.

13.7 Bare Copper Wire (Counterpoise wire)

(1) Bare copper wires for counterpoise installations shall be stranded or PVC insulated wire with a minimum size of 14 mm^2.

(2) The grounding wires to be used in this work shall be manufactured and tested in accordance with the appropriate Standards authorized in the country of manufacture, or equivalent.

13.8 Series Circuit Cable Joint

(1) All joints of the series circuit cables including their extensions, as well as joints with lead cables of the isolating transformer shall be made by means of the plug and the receptacle.

(2) Prior to joining, the plug and the receptacle shall be thoroughly cleaned to be free from greases, dust, etc.

(3) Unless otherwise specified, all plug joints shall be protected by 4 layers of self-

bonding tape, topped by 3 layers of PVC tape, with the exception of all connections with the secondary lead cable of the isolating transformer, whose receptacle shall be joined to the plug of the light fittings by means of a cable clamp.

13.9 Power and Control Cable Joint

(1) Joints and terminations of the power cable and control cables shall be executed in a manner to be approved by the Engineer. For the sake of easy access for maintenance, in principle all joints shall be made in the handholes.

(2) Full details of jointing materials shall be submitted to the Engineer for written approval, before shipment.

13.10 Installation

(1) Power cable installation shall be executed in accordance with ICAO Aerodrome Design Manual Part 5 – Electrical Systems, - 4.5 installation of underground cables.

(2) The approximate routes of the cables are shown on the Drawings. Actual laying positions of the cable ducts and of cable supports shall be determined with due regard to any obstacles that might exist as well as to accessibility of all such routes, subject to the approval of the Engineer prior to the installation.

(3) PVC pipe ducts shall be used for cable laying work.

(4) The series circuit cables and power cables and control cables shall be allocated separate duct pipes.

(5) When the supply and return circuits of a series circuit are routed together, the cables for both directions shall be laid in the same duct pipe.

(6) All cables shall be buried at least 600 mm below finished graded except for transformer secondary cable.

(7) Each underground cable shall bear cable identification circuit markers for a non-corrodible materials, as directed by the Engineer. Cable installation shall be in accordance with the specification of FAA AC No. 150/5370-10 (Standard for specifying construction of airport) Division VI (Lighting installation, Item L-108 Installation of Underground cable for airports)

13.11 Grounding Systems

(1) A stranded bare copper wire 14 mm^2 minimum size, shall be installed for lightning protection of the underground cables in trenches.

(2) The copper wire shall be installed in the same trench for the entire length of the insulated cables; it shall be placed at a depth of approximately 300 mm above the insulated cables. Where the cables are installed in parallel and their width exceeds 300 mm, the bare copper wire shall be installed each 300 mm width.

(3) The grounding rods shall be installed not more than 200 m apart around the entire cable length. The grounding rods shall be made of copper clad steel, coupled type, 2.0 m in length 15 mm in diameter. The grounding resistance as a whole shall be less than 10 ohms. The grounding resistance of each electrode shall be not more than 20 ohms.

13.12 Secondary Cable Installation

(1) The extension wire to be used between the isolating transformer and light fittings shall be installed inside PVC pipe on the lowest base of the piping pit.

(2) After the piping has been installed on dry condition, the backup materials shall be provided on the pipes. Backup materials such as cement mortar shall be provided full around these pipes in the pits. The backup materials shall be approved by the Engineer, before installations.

14.0 MEASUREMENT AND RATES

14.1 Measurement

Work under this Sub-Section shall be measured according to the item classification and units contained in the Schedule.

14.2 Rates

(1) The rates and lump sums shall be full compensation for all plant, materials, labour, equipment, transport, temporary works, establishment charges, overheads, profits and taxes required to complete the work contained in this Section of the Specification and/or shown on the Drawings.

(2) The rates for cabling shall further include for:

(a) trenches excavated by hand or machine, and in all types of ground including backfilling, disposal of surplus material, supports, protection and maintenance of sides, dewatering, etc.

(b) PVC conduit (where not measured separately)

(c) terminations, including gland assemblies, lugs, ferrules, seals, earth tags, shrouds, markers and connections

(d) cable supports and protection, including raceways, rigid or flexible conduits, cable trays, trunking, ladders (unless separate pay items have been specifically included in the Bills of Quantities) and for all fittings, supports, brackets thereto

(e) maintaining earth continuity

(f) cable sleeves for casting into the structure and caulking between cables and plugging sleeves with fire resistant material

(g) all necessary marker post, marker tape, plates and tiles

(h) fixing to and embedding in any surface the foregoing items including providing all clips and fixings, cutting out holes, notices and chases, finishing over and all making good

(3) The rates for underground ducts (where measured separately) shall include for:

(a) trenches excavated by hand or machine, and in all types of ground including backfilling, disposal of surplus material, supports, protection and maintenance of sides, dewatering, etc.

(b) bedding

(c) concrete encasement

(d) all short lengths and joints in the running lengths, including the provision of all loose collars, coupling and similar items where required and all jointing and sealing materials including gaskets, bolts and nuts

(e) jointing assemblies

(f) providing all necessary fittings including joints, marker-plates or posts, plugs, draw-cords and the like

(4) The rates for electrical handholes shall include for:

(a) excavating by hand or machine, and in all types of ground, including all backfilling, disposal of surplus material, supports, protection and maintenance of sides, dewatering, etc.

(b) concrete, reinforcement and formwork

(c) covers and frames and cable support

(d) forming holes for building in ducts

(e) forming rebates for and building in frames

(5) The rates and lump sums shall further include, if not itemized separately in the BOQ for the following Sections:

(a) Contractor’s design (where applicable)

(b) training for equipment and systems

(c) spare parts

(d) testing and commissioning

(e) maintenance tools and special tools

(f) protection

DIVISION 121 000: AIRFIELD LIGHTING

1.0 VISUAL ALIGNMENT GUIDANCE SYSTEM (VAGS)

1.1 Scope

This work includes the supply and installation of the Visual Alignment Guidance System (VAGS) for Runway 06.

1.2 Lighting System

(1) Visual Alignment Guidance System (VAGS) shall include of two Light Units (one Master and one Slave) placed symmetrically on both side of the Runway threshold supplying unidirectional rotating beam which gives a flashing effect..

(2) The Visual Alignment Guidance System (VAGS) shall consist of:

(a) One Master Unit and Optical Head.

(b) One Slave Unit and Optical Head

(c) Frangible Legs

(d) One Tool for Alignment and Horizontal adjustment

1.3 Technical Characteristics

(a) Each Optical Head fitting shall be of the unidirectional type. Elevated light fittings shall employ a halogen lamp 100 watt .

(b) Each fitting and supporting pole shall be of lightweight frangible construction suitable for concrete mounting base and shall be of sufficient strength to withstand aircraft engine blast.

(c) Exterior finished colour of elevated light fittings shall be yellow colour.

(d) Visual Range: not less than 10 KM

(e) Operating Angular Sector: 15 degree on both side of the approach axis

(f) Flashes Frequency: 1 Hz

(g) Provision of Heating resistors

1.4 Installation

(a) Exact position of light fittings to be installed shall be subject to the approval of the Engineer. Prior to erecting the concrete base the Contractor shall place temporary markings to identify the actual installation positions of the light fittings determined by him through detailed site survey, against the corresponding positions indicated on the Drawings, and shall notify the Engineer accordingly.

1.5 Concrete Base

The Contractor shall submit to the Engineer for approval structural calculation based on the Manufacturer recommendation and drawings of proposed concrete base.

1.6 Power Supply System

The VAGS shall be supplied with power from Low Voltage Panel in the Maintenance Room at the ground floor of Control Tower.

1.7 Remote Control of VAGS

The VAGS shall be controlled in three (3) brilliancy levels from the Control Tower. The remote control and brilliancy control (together with APAPI) Push Button switch shall be installed at the appropriate place in the existing Console at Control Tower. All necessary hardware including control cable, cable tray, ducting shall be provided by the Contractor and shall be inclusive of installation work and offer shall be inclusive of such cost.

1.8 Cabling Works

The power and control cables shall be laid in the prepared trench(in common trench with APAPI primary cable) running along the runway and up to the Maintenance Room and control cable up to Control Tower as shown in the drawing. Where available, the existing ducts shall be used for crossing. At the open drain crossing and other places appropriated duct shall be provided for running of cables.

The laying of power cable for other facilities shall be carried out either under the conduit, duct or buried direct in the trench. All the accessories for cable installation including conduit/duct shall be provided and shall be inclusive of installation work. The wiring shall be carried out by the Contractor with the approval of the Engineer.

2.0 ABBREVIATED PRECISION APPROACH PATH INDICATOR (APAPI)

2.1 Scope

This work includes the supply and installation of the Abbreviated Precision Approach Path Indicator System.

2.2 Lighting System

(a) Abbreviated Precision Approach Path Indicator System(APAPI) for Runway 06 shall comprise a total of two (2) light units placed at left side of the runway and right angles to the runway centre line.

(b) Each light beam angle of elevation setting for 3 degree (Setting angle will be finalized according to operational requirement) PAPI approach slope shall be 2º45’ and 3º15’.

(c) One Setting Tool set shall be provided

2.3 Light Units

(a) Each unit shall contain two (2) halogen lamps 6.6A 100W and shall comprise a glass

fibre or aluminium plate housing containing the optical projectors, filters, lamps, lead cables, etc., with an adjustable positioning frame and mounting legs to give an adjustment in lateral, transversal, horizontal and elevation angle.

(b) The colour transition from red to white in the vertical plane shall be such as to appear to an observer at a distance to occur up to a vertical angle of not more than 3 minutes.

(c) The light distribution of each unit shall be in accordance with the specification of Appendix 2, Figure 2-23 of ICAO Annex -14.

(d) The light unit housing shall be guaranteed against distortion due to sun or other climatic conditions prevailing on the Site.

(e) Each light unit and supporting pipe shall be of lightweight, frangible construction suitable for concrete mounting base and shall be of sufficient strength to withstand aircraft engine blast.

(f) Exterior finished colour of light units shall be Yellow in colour.

2.4 Installation

(a) Each light unit shall be installed on top of concrete mounting base using a breakable coupling or frangible pipe.

(b) Two (2 light units shall be in the level when checked by precision level meter and electronic survey equipment.

(c) The lower edges of all the slots of light units shall be within 150 mm of average level of the nearest point of both runway edge lines.

(d) Exact position of light units to be installed shall be subject to the approval of the Engineer .
Prior to erecting the concrete base, the Contractor shall place temporary markings to identify the actual installation positions of the light units determined by him through detailed site survey, against the corresponding positions indicated on the Drawings, and shall notify the Engineer accordingly.

(e) In azimuth the axis of the beams of all light units shall be parallel with the center line of the runway.

(f) Vertical beam angle checking foundation for the electronic survey equipment (theodolite) shall be installed on Runway 06 as instructed by the Engineer.

2.5 Concrete Mounting Base

Concrete base for the mounting of A-PAPI shall be as specified by the manufacturer of A-PAPI and cost shall be included in the installation cost.

2.6 Handhole

Handhole for Isolating Transformer shall be erected beside the concrete mounting base. Each Handhole shall be connected to the mounting base with 50 mm diameter PVC Elbow Tube

2.7 Isolating Transformer

An Isolating Transformer for the APAPI shall be installed in each Handhole.

2.8 Power Supply System

The Precision Approach Path Indicator System to be installed on Runway 06 shall be supplied with power from Low Voltage Panel in the Maintenance Room at the ground floor of Control Tower by means of constant current high voltage series loop circuit of 6.6 amperes at 100% brilliance.

2.9 Remote Control of APAPI

The APAPI shall be controlled in five (3) brilliancy steps of 100%, 30% and 10% of the full brilliance from the Control Tower. The remote control and brilliancy control (together with VAGS control) Push Button switch shall be installed at the appropriate place in the existing Console at Control Tower. All necessary hardware including control cable, cable tray, and ducting shall be provided by the Contractor and shall be inclusive of installation work and offer shall be inclusive of such cost.

DIVISION 122 000: CABLE DUCTS AND MANHOLES

1.0 SCOPE

This item shall consist of the installation of underground ducts and handholes in runway strip including where installed under paved road and shall also include cutting, trenching of any paved areas, installation of pull wires and capping and other necessary works.

2.0 MATERIALS

2.1 Cable Ducts

(1) For cable duct, the PVC pipe and accessories shall be used.

The PVC pipes shall be manufactured from high quality PVC (Polyvinyl Chloride) compound. It shall have corrosion and chemical resistance to most acidic and alkaline solution. It shall be of Heavy duty.

Outer Diameter:	50 mm
Pressure:	6 Kgf/cm^2
Ends:	one end flared

(Pipe to be manufactured according to relevant N.S)

2.2 Concrete, etc

(1) The concrete, mortar and reinforcement to be used shall meet the requirements as specified .

(2) The Contractor shall, before the work on cable ducts and handholes is started, secure the Engineer's approval on the materials to be used and on the method of the work execution.

2.3 Crushed Stone or Rubble

The size of the crushed stone or rubble shall not be less than 100mm but no more than 200mm, and the quality of the crushed stone shall be approved by the Engineer.

2.4 Granular Material for Backfill (Sand)

The granular material (sand) shall be free from any foreign substances and shall be approved by the Engineer..

3.0 CONSTRUCTION METHODS OF CABLE DUCT

3.1 General

(1) The Contractor shall place the electrical cable ducts at the locations approved by the Engineer.

(2) The Contractor shall provide each duct with a core-wire.

(3) All ducts installed shall be provided with draw wires of galvanized iron or steel of not less than 1.6 mm diameter for the drawing of the permanent cabling/wiring. A part of the draw wire shall be left in the manhole or handhole in the length enough to be bent so that the wire will not slide back in the duct.

(4) When a spare duct is provided as designated on the Drawings, the terminal end of duct opening shall be closed with the detachable taper plug designed by the pipe manufacturer or with hard wood plug which shall accurately fit to the duct in shape and having the plug end at least 6mm larger than the size of the duct.

(5) All ducts shall be firmly located and embedded throughout construction and shall be plugged to prevent grout, storm water or mud from entering. Any duct section with defective connection shall not be installed.

3.2 Excavation

(1) The excavation shall be performed true to the line, conforming to the width, depth and dimension shown on the Drawings. The Engineer is authorized to change the dimension and elevation involved in the excavations to ensure the stability of the ground.

(2) The trench bottoms shall be compacted to not less than 90% of the maximum dry density.

(3) Any surplus excavated material shall be removed or disposed of as directed by the Engineer.

3.3 Duct Signs

All terminating points of ducts shall be indicated with a stake (50mm x 50mm x 500mm) approximately 350mm above the ground. The signs shall be inscribed with the letter “DUCT” and placed at the terminating points or ends of all ducts except where the duct terminates at a handhole. The Contractor shall inscribe, on the sign slabs, the number and size of ducts buried under the signs.

3.4 Backfilling

(a) Backfilling of granular material (sand)

The backfilling of granular material (sand) shall be performed in accordance with the design. The backfilling shall be compacted to not less than 90% of the maximum dry density.

(b) Backfilling with excavated soil

After the backfilling of granular material (sand) is finished, the backfilling with the excavated soil shall be performed to the elevations shown on the Drawings. The backfilling shall be compacted to not less than 90% of the maximum dry density.

3.5 Clearing and Restoration of Site

After the backfilling is completed, the Contractor shall dispose of all surplus materials, dirt and rubbish from the site. The Contractor shall remove all tools and equipment from the site and restore all disturbed areas to their original conditions.

3.6 Quality Standards

The quality shall satisfy the standard values set for this type of work.

3.7 Tolerance Standards

The tolerance of the work shall be controlled in the manner shown on Table 1.

4.0 CONSTRUCTION METHODS OF HANDHOLE

4.1 Excavation

(1) The excavation for structures or for the foundation of structures shall be performed in conformity to the requirements of location, grade and elevation designated on the Drawings. The Engineer shall authorize change to the construction methods in the foundations including the elevation in consideration of the stability or the ground.

(2) The Contractor shall provide all safety and maintenance materials for excavations so as to meet the requirements of excavation as specified on the Drawings.

(3) Unless otherwise specified, the Contractor shall remove the timbers, covers, and supports upon completion of the structures. The removal operation shall be performed in a manner that neither will the ground surface be disturbed nor the completed structures be damaged.

(4) The foundation bed for structures shall be compacted properly with compaction equipment approved by the Engineer. After the excavation is completed, the Contractor shall inform its completion to the Engineer. Concreting operations may only commence after the Engineer has approved the depth of the excavation and the condition of the foundation.

4.2 Backfilling

(1) After the structures are completed, the spaces adjacent to the structures shall be backfilled with approved material, in a finished thickness of not exceeding 200mm in a layer, and compacted properly with compaction equipment approved by the Engineer. Each layer shall be compacted to the elevations designated on the Drawings.

(2) The backfilling shall not be made until 7 days after the concrete has been placed or the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfilling, or by vibrations of the compaction equipments.

4.3 Clearing and Restoration of Site

After the backfilling is completed, the Contractor shall dispose of all the remaining materials, dirt and rubbish from the Site. The Contractor shall remove all tools and equipment from the site and restore all disturbed areas to their original conditions.

4.4 Quality Standards

The quality shall satisfy the standard values set for this type of work.

4.5 Tolerance Standards

The tolerance of the work shall be controlled in the manner shown on Table 1.

Table 1 Tolerance

Work Item	Test Item	Test Method	Frequency	Standard Value
Handholes	Finish elevation	By surveying	At points designated by the Engineer	±10mm
	Width	By the Engineer's Instruction	- ditto -	±20mm
	Depth	- ditto -	- ditto -	±10mm
	Thickness	- ditto -	- ditto -	±20mm ±10mm

DIVISION 123 000 REMOTE CONTROL AND MONITORING SYSTEM

1.0 SCOPE OF WORK

This work includes the supply and the installation of the Remote Control and Monitoring System for the VAGS and APAPI

2.0 SYSTEM REQUIREMENTS

2.1 Remote operation of the VAGS and APAPI system shall be carried out from the Remote Control Panel at the VFR Tower Console and from the Local Control and Monitor Panel at the monitor room in the Maintenance Room for APAPI.

2.2 The control functions shall include ON-OFF switching, intensity control and monitoring .

2.3 In order to receive and the control and monitoring signal between Tower consoles and facilities, Relay Panel (Interface equipment) shall be installed in the Maintenance Room.

2.4 Control and Monitoring System of VAGS and A-PAPI shall comply with the following:

(a) ICAO Aerodrome Design Manual Part 4 – Visual Aids (Fourth Edition) Chapter 5, Light Intensity Settings.

(b) ICAO Aerodrome Design Manual Part 5 – Electrical Systems (First Edition), Chapter 3, 3.4 Control of aerodrome lighting systems and 3.7 Monitoring of aerodrome lighting circuits.

(c) ICAO Airport Services Manual Part 9 - Airport Maintenance Practices.

2.5 The Contractor shall submit to the Engineer for approval Equipment Layout plan and cable pit layout after review of the dimension size, weight and necessary cabling plan including control/communication cabling plan together with heat generation data of equipment.

3.0 DESIGN REQUIREMENTS

3.1 System Function

(1) For light operation system the following functions shall be provided.

(a) Switching On/Off of VAGS with (three) 3 step Brilliancy control by means of Push Button type switching at the existing Tower console.

(b) Switching On/Off of A-PAPI with (three) 3 step Brilliancy control by means of Push Button type switching at the existing Tower console.

(c) To indicate fault condition for power supply equipment such as CCR and so on at existing Tower console.

3.5 Remote Control Panel

This Panel shall be installed in the Blank space available in the existing two man console at VFR room.

(a) Operation Part for Light Operation

(i) Major Components shall be as follows:

- Self illuminated push-button switches for control
- Ditto but for "Reset"
- Three segment indicators for brightness tap for APAPI
- Three segment indicators for brightness tap for VAGS
- Push-button switch for lamp check
- Power Supply equipment for control and other

4.0 RELAY PANEL (INTERFACE EQUIPMENT)

The panel shall be constructed of steel plate and frame and shall majorly comprise as follows:

(a) Relays to be plug-in type voltage relay, coil rating of DC 24 V;

(b) Miniature circuit breakers (MCB's)

5.0 CONSTANT CURRENT REGULATORS (CCR)

5.1 General

The CCR's shall provide stepped brilliances with a stable current to the APAPI system under the specific conditions.

5.2 Design Requirements

The Constant Current Regulator shall maintain a constant and adjustable output current independent of load and input power supply frequency and voltage variations. It shall be full digitally controlled and regulated by microprocessors using thyristors with response time less than 0.5sec. It shall have USB connector in the front panel for parameter setting and diagnosis. It shall support the multiwire interface as well as latest serial communication network.

Standards:
ICAO Aerodrome Design Manual, Part 5, Electrical Systems, paragraph 3.2.1.4 to 3.2.1.6
FAA: AC150/5345-10G
IEC: 61822

Electrical features:

Rated output:	2.5 kVA
Output current:	From 2.8 to 6.6 A RMS
Supply voltage:	230 V (±10%), 1-Phase
Frequency:	50Hz (±2%)
Power factor:	>0.9 with optimum load.
Efficiency:	>90% at rated parameters.
Output Current Regulation:	within ±1% under either IEC or FAA standard

condition
Mode of operation: local and remote.
Remote control: 24V DC and serial communication network.
Brilliancy: three step
Back indication: static dry contacts.
Programmability: programmable accordance with security or password.

Mechanical features:
Use at normal temperature range: -20^0C to 45^0C
Natural air cooling
Protection Level: IP 21
Protections: Over current protection (programmable)
Open circuit protection.
Under/over voltage protection (programmable).
Lightening arrestor on input and output.
Input circuit breaker.

Other requirements:
Housing on rollers.
Local remote on /off operation.
Tapping on output transformer for load adaptation.
Safety device on CCR for maintenance Personnel

Interface:
Local Monitoring
It shall have digital display of supply voltage, load, output current, operating mode, brightness state, warnings and fault of any type on the front panel.
Remote monitoring
There shall be remote monitoring of CCR parameters, warnings and fault.

6.0 INSTALLATION

6.1 Cabling

The cable connecting between the Remote Control Panel in the VFR room and the local control and monitor panel in the Maintenance Room at Ground Floor of Control Tower Building shall be laid through the vertical cable rack or other appropriate means in the Control Tower.

6.2 Consoles and Relay Panel

(1) The remote control panel shall be installed in the VFR room of the Control Tower.

(2) Relay panel (interface equipment) shall be installed in the Control Tower Building Maintenance Room.

6.3 Constant Current Regulator (CCR)

Constant current regulator shall be installed in the Control Tower Building Maintenance Room.